YORK ARCHAEOLOGICAL TRUST

ARCHAEOLOGICAL INVESTIGATIONS AT THE FORMER FIRE STATION, CLIFFORD STREET, YORK

By Ben Savine and Ian Milsted

UPDATED EVALUATION REPORT

Report Number 2017/28 March 2017

YORK ARCHAEOLOGICAL TRUST

York Archaeological Trust undertakes a wide range of urban and rural archaeological consultancies, surveys, evaluations, assessments and excavations for commercial, academic and charitable clients. We manage projects, provide professional advice and fieldwork to ensure a high quality, cost effective archaeological and heritage service. Our staff have a considerable depth and variety of professional experience and an international reputation for research, development and maximising the public, educational and commercial benefits of archaeology. Based in York, Sheffield, Nottingham and Glasgow the Trust's services are available throughout Britain and beyond.

York Archaeological Trust, Cuthbert Morrell House, 47 Aldwark, York YO1 7BX

Phone: +44 (0)1904 663000 Fax: +44 (0)1904 663024

Email: archaeology@yorkat.co.uk Website: http://www.yorkarchaeology.co.uk

CONTENTS

Plates

Tables

Figures

Abbreviations

AOD – Above Ordnance Datum

BGL – Below Ground Level

NON-TECHNICAL SUMMARY

An archaeological evaluation was undertaken at the former fire station, Clifford Street, York, between the 30th of June and the 24th of February 2016. Four trenches measuring approximately 3m^2 and 1.25m deep were excavated using a 6 ton mechanical excavator. The features and deposits excavated relate to 19th century buildings and post-medieval gardens predating those structures. Those features and deposits identified are of low archaeological importance.

A borehole survey consisting of 12 cored samples identified up to 2m of 19th and 20th century deposits followed by a further 1-2m of possible post-medieval garden soils and up to 2m of accumulated medieval deposits. Possible stone structures were identified on the interface between the garden soils and the medieval deposits. Below these, a further c.4-5m of banded re-worked and alluvial silts were identified. These contained preserved organic material, which could date from the Roman period onwards. These deposits have some potential for archaeological significance.

An additional borehole survey consisting of three cored samples was undertaken on the 26th and 27th of May 2016 and has been followed by a six month programme of water level monitoring. The intention of this borehole survey was to locate and sample potential waterlogged organic deposits and assess their condition. This was undertaken with a view to inform future consideration of the design of proposed below-ground structures and piling.

KEY PROJECT INFORMATION

Project Name	Former Fire Station, Clifford Street, York
YAT Project No.	5905
Report status	Updated Final
Type of Project	Evaluation
Client	David Chapman Associates
Planning Application No.	N/A
NGR	SE 6035 5148
Museum Accession No.	YORYM : 2015.501
OASIS Identifier	Yorkarch1-222966

REPORT INFORMATION

Version	Produced by		Edited by		Approved by	
	Initials	Date	Initials	Date	Initials	Date
1 (2015/43)	BS	14/07/15	IDM	18/08/15	DA	20/08/15
2 (2015/43)	BS/IDM	04/09/15	IDM	07/09/15	DA	08/09/15
3 (2016/19)	BS/IDM	11/03/16	IDM	11/03/16	IDM	11/03/16
4 (2016/77)	BS IP	29/09/16 19/10/16	IDM IP	20/10/16 19/10/16	DA	20/10/16

			IDM	31/10/16	DA	31/10/16
5 (2017/28)	IDM IP	02/03/17	IDM IP	02/03/17	IDM	02/03/17

1 INTRODUCTION

In advance of proposed development on the site of the Former Fire Station (Figure 1), Clifford Street, York (SE 6035 5148) an archaeological evaluation was undertaken. In the first instance trial trenching took place between 29th June and 3rd July 2015. This was followed a borehole survey carried out in three parts. Initially five cores were extracted between 27th and 31st July 2015, next a seven-core survey took place between 22nd and 24th February 2016, finally three cores were drilled on the 26th and 27th of May 2016. Dip wells were installed in the last three boreholes to facilitate a programme of water level monitoring.

2 METHODOLOGY

The work involved the excavation of four trenches 3m^2 and 1.25m deep (Figure 2). Limitations in the position, dimensions and excavated depth of the trenches were determined by the location of standing buildings, access, utilities and ground conditions.

Five 80mm diameter boreholes were drilled to a depth of c.8-9m Below Ground Level (BGL) using a self-propelled coring rig supplied and operated by Geoinvestigate Ltd in July 2015. One borehole was positioned in each excavated trench and a fifth (borehole 1) was located as close to the Clifford Street frontage as practicable to obtain a transect across the whole site (Figure 2). A further seven boreholes were drilled by Gordon Anderson Site Investigations Ltd in February 2016 to complete the initial survey (Figure 2) required by the WSI (Appendix 3). These were drilled to depth of c. 7-10m BGL.

It should be noted that compression of the deposits sampled is a factor in the accuracy of the borehole survey. The presence of loose solid materials such as stone, brick and concrete within the upper deposits will invariably have caused some compression. These materials were often observed to have dropped down on to the top of lower core sections. The weight of the drilling equipment can also cause compression particularly to soft, damp silt. This can be up to as much as 50% (pers. comm. G. Anderson). The potential of rubble slumping in from the tops of boreholes 6, 7 and12 was mitigated with the insertion of a 2m long sleeve in to the top of each of these boreholes.

The three additional boreholes (boreholes 13-15) were drilled by Gordon Anderson Site Investigations Ltd in May 2016. These were designed to meet concerns raised by Dr. Keith Emerick, Historic England Inspector of Ancient Monuments, in particular the potential 'halo' effect of proposed under-ground structures and intrusions into potentially waterlogged material. Acting on the concerns raised the City of York Archaeologist, John Oxley, imposed a condition whereby assessment of potentially waterlogged deposits was to be followed by a programme of water level monitoring (Appendix 7).

3 LOCATION, GEOLOGY & TOPOGRAPHY

The proposal site is at SE 6035 5148, fronting onto the south-west side of Clifford Street at the junction with Pickett Street, which lies to the south-east of the site. The riverside walkway along the north-east bank of the Ouse lies to the south-west, with the Magistrates Court buildings to the north-west. The site straddles a boundary in the drift geology between glaciolacustrine clays and silts to the north-east and post-glacial alluvial silts to the south-west.

The underlying solid geology consists of Sherwood group sandstone http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html. The site slopes down towards the River Ouse from north-east to south-west, from c.9.9m AOD to c.8.6m AOD.

4 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

4.1 Period by period background

Prehistory

Knowledge of prehistoric activity from this area is limited to the identification of alluvial deposits radiocarbon dated to the late Bronze Age (BC 1510 – BC 900) at the St George Fields pumping station some 250m to the SE of the Clifford Street site (Hunter-Mann, 1994, 7). These deposits were identified at c.-1 - 0m AOD, some 11-12m below the ground level at Clifford Street, suggesting that any prehistoric deposits surviving at this site will be at considerable depth.

Roman

The Clifford Street site is outside the fortress and in an area regarded as likely to have been marginal in the Roman period (Ottaway, 2011, 237). Fragmentary evidence for Roman settlement activity, along with a small number of burials, was identified cut into natural deposits at c.6m – 9.7m AOD during the Coppergate excavations, c.180m to the NE of Clifford Street (Ottaway, 2011, 201), but these were present on the banks of the River Foss, whereas the Clifford Street site overlies the slope into the much larger river valley of the Ouse. Roman material, if present, could be significantly deeper here as a result.

Clifford Street lies immediately south of a possible route for Roman Road 2 (RCHMY1; Brinklow, 1986, 85) but evidence for this was not identified during excavations in the York Castle car park, c.170m east of Clifford Street (Ottaway, 2011, 231-233) and it is suggested that a more accurate line for this road is in fact along the route of modern Fossgate, some 300m NE of the site (Ottaway, 2011, 196). Roman burials have been recorded at the Castle, but not in modern times.

Anglian

Anglian activity is very sparse in the Clifford Street area, being evidenced only by antiquarian records of burials at Castle Yard, which may have produced 7th century hanging bowls (Tweddle, 1999, 172). Anglian settlement was suggested by limited excavations at 5-13 Clifford Street but this was fragmentary and observed at c.3-4m below ground level (Hunter-Mann, 1990, 12), suggesting that if present material of this period is likely to occur at depth at this site.

Anglo-Scandinavian

Clifford Street lies c.180m SW of Coppergate, where the extensive and well-preserved remains of 9th-11th century settlement were identified as Jorvik, the Viking-period settlement of York (Hall, 2014). As with the Anglian remains, some limited evidence for Anglo-Scandinavian activity was encountered at 5-13 Clifford Street (Hunter-Mann, 1990a, 13); if present this evidence for this period may survive, and may be well-preserved by the inorganic conditions typically encountered in this area.

Medieval

Medieval archaeology on the Clifford Street site is likely to pertain to the Franciscan Friary that was present in this area. The friary was founded in c.1230 and was expanded in numerous stages up to 1314. The internal form of the friary has never been established, but significant buildings including the Kings Chamber, Chapter House and Kitchens all stood somewhere within the precinct. The friary was surrendered in 1538. (Tillott, 1961, 362).

Traces of the possible friary were identified immediately opposite the Clifford Street site at no. 23, in the form of robbed-out wall trenches and demolition rubble, suggested the clearance of the site after dissolution (Hunter-Mann, 1990b, 4). Any remains at the current site are likely to be similar, but structures could survive.

Post Medieval

Traces of the friary survived until the 19th century (Tillott, 1961, 362) and it is clear from historic mapping that the site in question was cleared by the 1850s. By this point the site is shown as a series of formal gardens on the first edition Ordnance Survey map; deposits of garden soil were encountered at 23 Clifford Street in 1990 (Hunter-Mann, 1990b, 4-5).

Modern

The site was occupied from 1856 by Trinity Chapel, which was founded by New Connexion Methodists and used by different Methodist groups until 1935 when it was sold and adapted for use as an extension to the neighbouring fire station, which had opened in 1892. (Tillott, 1961, 413). This work retained only the eastern wall of the chapel, which faces on to Peckitt Street.

4.2 Previous work

Investigations of any depth nearby are relatively limited, with recent works at the property of 23 Clifford Street producing the most indicative results. Work in 2011 found four phases of activity: 9th - 11th century dumping/levelling; 11th- 13th century pits hearths and possibly a ditch predating the friary; 13th- 15th structures such as a well, and a wall associated with the friary, beneath possible post Friary demolition activities. These were sealed by garden deposits.

Following the results of this previous work and other works referred to above, it is anticipated that there could be approximately 3.25m of archaeological deposits at the Clifford Street side of the site at least. Moving down towards the river it is anticipated that this will get considerably deeper.

5 RESULTS

5.1 Trench 1

Trench 1 was located towards the north-east end of the site on the Clifford Street frontage of the Former Fire Station. It measured 3m x 3m and was excavated to a depth of 1.25m BGL (Below Ground Level) or 9.86m AOD with the top of the trench at 11.06m AOD (Figures 2 and 3; Plates 1-2).

The cobble sets, context 1001, that form the existing forecourt on the Clifford Street frontage of the Former Fire Station were removed by hand before the commencement of machine excavation of Trench 1. Two underlying layers of concrete were broken out with a pneumatic

breaker. The resulting rubble was then removed with a 0.8m toothed bucket, below which a 1.4m wide flat bladed ditching bucket was used for the remaining excavation.

The earliest deposit encountered, context 1007, was located across the north-east half of the trench. It consisted of firm dark grey brown clayey silt and was interpreted as a garden or horticultural soil. This deposit had been truncated in the south-west half of the trench by the construction of a brick wall, contexts 1010, 1011, 1012 and 1013, and associated construction material, context 1009, on the south-west side of the wall (Plate 1). Orientated on a north-west to south-east axis, the wall extended along the entire length of the trench and was seen to continue beyond it in both sections. The base of the wall's foundations were observed to extend beyond the lower limit of excavation at approximately 9.9m AOD with the top of the wall surviving to a height of ten courses at 10.79m AOD.

Deposits situated on the south-west of the wall indicate extensive excavation, most likely in relation to the construction of the wall and the structure of which it was a part. Again this material extended below the limit of excavation. Butting up against the north-east side of the wall contexts 1005 and 1006 both contained a large element of brick rubble and are likely to relate to the construction of the wall or levelling up along the Clifford Street side of that structure.

Material most likely deriving from the demolition of the structure, context 1008, was seen to be infilling a space in the east corner of the trench extending to a point where it butted up against the south-west side of the wall.

Overlying the demolished structure were deposits relating to the existing cobble set hard standing. These included two distinct layer of concrete, contexts 1002 and 1003, of which the lower layer was reinforced with a steel mesh.

5.2 Trench 2

Trench 2 was located within the Fire Station building as close as was practicable to the neighbouring Magistrates Court (Figures 2 and 3; Plates 3-4). It measured 3m north-east to south-west and 2.8m north-west to south-east and was excavated to a depth of 1.25m. The foreshortened axis was due to available space being limited by a vehicle inspection pit, situated on the north-west side of the trench, and a surface drain running to the south-east of the trench. The top of the trench was at 11.00m AOD.

Following the breaking out of the current brick set floor and an underlying layer of reinforced concrete it became apparent that safe access would not be possible because of the instability of the trench sides (Plate 2). As a result only a limited record consisting of photographs, observation notes and a measured sketch could be produced.

The trench instability was caused by an approximately 1m thick layer of loose building debris, context 2007.

A north-west/south-east aligned wall, context 2006, was revealed in the south-east facing section of the trench (Plate3). The top of this wall survived to approximately 0.5m below ground level and with five courses visible in the trench section continued below the limit of excavation at the base of the trench. The lower three courses of the wall had air gaps roughly 50mm wide between each brick. This is indicative of a sprung floor with a space below it allowing the movement of air. The rubble deposits within the trench appear to have butted up

against the wall and the likelihood is that they derive from the demolition of a building and subsequent levelling.

5.3 Trench 3

Trench 3 was located in a car parking area on the south-west side of the main Fire Station building (Figures 2 and 4; Plates 5-7). It measured 4m north-east to south-west and 2.6m north-west to south-east. Time restrictions imposed on the use of the breaker led to alteration in the dimensions of the trench, the determining factor in the eventual dimensions being the trench location in relation to seams in the layer of concrete underlying the asphalt car park surface. The ground in this area slopes gently down towards the south-west and the river Ouse. At its highest point the top of the trench was at 10.05m AOD, falling to 9.84m AOD at its lowest. At its deepest point the trench was excavated to 8.61m AOD, giving a maximum depth of 1.39m, in its east corner.

A mechanical excavator employing a 0.6m wide toothed bucket was used to break out and remove the car park surface and an underlying layer of concrete, together with a thickness of approximately 0.2m. A further 0.4m – 0.5m of brick rubble, context 3003, was removed in the same way. Once structural remains were encountered further excavation was undertaken with a 1.4m wide flat bladed ditching bucket. This methodology was used for the remaining depth of the trench.

The earliest feature encountered was an oval pit, context 3015, situated at the depth limit of excavation at 8.67m AOD. This contained context 3014 a single backfill consisting of light brown clayey silt with inclusions of mortar. Overlying this feature was context 1012 a firm, mid brown grey clayey silt. Up to 0.28m thick this deposit sloped down to the south-west from a maximum height of 9.05m AOD to 8.71m AOD. Its density is considerably greater than the later soils above it and as such its character is broadly in line with local late medieval and early post-medieval soil accumulations. Overlying this material was a deposit of garden or horticultural type soil, contexts 3007 and 3019, which measured between 0.25m and 0.45m thick. The top of these deposits appear to have been levelled off by later structures, surfaces and demolition activity giving a relatively flat profile the top of which ranged between 9.15m to 9.33m AOD.

The structures consisted of three brick built walls. Wall 3005 ran along a north-west/south-east alignment, bonded into this and extending on a perpendicular line to the south-west was wall 3022. Both extend beyond the limits of excavation. Another brick wall, context 3016, was only identified in the north-east facing section of the trench. This feature had been extensively robbed out; only two courses remained in section and were not observed to extend further to the north-east during the course of excavation.

Abutting the north side of the junction of wall 3005 and 3022 was a drainage feature with a ceramic drain cover. This was cutting through or abutted by a thin concrete surface. Seen in section this appeared to continue to the north and west. The top of these features were at 9.21m AOD. Also extending from the south-east facing section of the trench was a brick set surface, context 3004. It was situated to the north-east of the walls at 9.39m AOD. These structures were sealed by context 3003 a layer of brick rubble approximately 0.5m thick.

5.4 Trench 4

Trench 4 was excavated inside the garage located at the south-west end of the site (Figures 2 and 5; Plates 8-9). Only a 1.2m wide slot along the north-west side of the trench could be excavated due to the restricted working space. The garage floor consisted of a 0.3m thick layer of concrete. After this material had been broken out excavation of the trench was carried out using a 0.8m wide toothed bucket enabling the south-east facing section of the trench to be recorded. The top of the trench was at 8.69m AOD, at its deepest point it was excavated to 7.49m AOD.

A sequence of dumps constituted the earliest deposits in this trench. The top of these deposits extended up to 8.01m AOD with a very slight downward trend to the south-west. No dateable material was retrieved. Above these deposits and extending up to 8.40m AOD was context 4009, a friable mid brown silty sand deposit interpreted as a garden or horticultural soil. The top of this material was disturbed by what may possibly be a cinder path, context 4006, and 19th century services.

6 BOREHOLES

6.1 Location

Fifteen boreholes were drilled across the site in three phases, forming a transect aligned NE-SW (Figure 2; Plate 10). Borehole 1 was drilled as close as possible to the Clifford Street frontage. Boreholes 2-5 were drilled through each of the four excavated trenches. Boreholes 6-12 were added at a later date in order to refine the deposit model. This was to be achieved by filling in at regular intervals, as far as was practicable, gaps between the initial five boreholes. Three further boreholes (13 – 15) were added with the aims of determining the extent, condition and character of deposits previously identified as potentially containing waterlogged organic material. In addition dip-wells were to be installed at the locations of these boreholes so that a programme of water-level monitoring could be undertaken (Figure 6 and 7).

It was intended that each borehole was to be drilled to a depth of 10m Below Ground Level (BGL). This depth of survey was only achieved in a few cases. Collapsing sides, soft and wet sediments as well as obstructions limited the depth of the majority of boreholes, however a minimum depth of 7m was achieved in all cases.

6.2 Results

All 15 borehole cores were assigned context numbers (see Appendix 2 and Figure 8). These contexts were then assigned into groups representing five broad phases of activity across the site (Figure 9). The results are necessarily crude given the relatively small number of boreholes but nevertheless are indicative of underlying strata to a depth of approximately 7-10m BGL.

Natural deposits

Natural clay was identified at c. 7.5.m BGL/3.5m AOD in Borehole 1 on the Clifford St frontage and at c. 9.5m BGL/0.5m AOD in Borehole 10, some 42m to the SW. Natural was also identified in boreholes 3, 6, 11, 13 and 14. In addition deposits at 7-9m BGL in the other boreholes were much cleaner and clayey that those above them, possibly suggesting that the interface with natural deposits may not have been much further down. The overlying strata and the modern

surface suggest that natural deposits are relatively high and fairly flat up to approximately 15-20m from the north-east end of the survey, after which point it drops down towards the SW. Measurements taken from boreholes 10 and 11 suggest the existence of a terrace before the natural deposits fall away towards the River Ouse in this area.

Alluvial silts

Overlying natural deposits was a group of banded clayey natural material and silty alluvial deposits that may relate to river activity (tidal and flooding). The upper surface of this group was identified at between c.3.75m BGL/7.25m AOD to the NE, sloping down to c.6.5m BGL/4.5m AOD at the SW. There was found to be a significant discrepancy between the heights of these deposits either side of borehole 3, approximately 15m from the Clifford St frontage and borehole 7, located *c.*5m further to the SW. To the SW of borehole 7 the alluvial deposits build up to c*.*4m BGL/7m AOD. Measurements taken from borehole 3 show them to be much lower, being at *c.*7m BGL/5m AOD before rising steadily to the NE.

These deposits become more organic from c.5m BGL down; unfortunately no dating evidence was retrieved from these depths but finds of animal bone fragments and charcoal confirm that these deposits are archaeological and suggest that conditions may be conducive for survival of organic remains at this depth.

Medieval build-up/reclamation and structures

The next group of deposits consisted of re-worked clayey natural material and possible dumps of sandy silt containing frequent flecks and small fragments of limestone. The upper surface of this group was observed between c.2.5m BGL/8.5m AOD at the NE, sloping down to c.4m BGL/7m AOD in the SW. It should be noted that there is some fluctuation across the extent of the survey area; however this is largely within the range of 7-8.5m AOD.

Mortared limestone walls were encountered in boreholes 2 and 12. In Borehole 2 the presumed wall was found at c. 3.5mBGL/7.5m AOD, extending to c. 5mBGL/6m AOD. In Borehole 12 the apparent wall was found at c. 4mBGL/7m AOD, extending to c.6.5mBGL/4.5m AOD.

The deposits probably relate to land reclamation in the medieval period associated with the friary, with the walls themselves potentially representing part of the friary buildings. In eight of the boreholes varying thicknesses of mortar, limestone and CBM rubble were observed at or around the interface with the generally darker siltier overlying deposits. The upper elements of this group may relate to the demolition of the friary structures although as noted in the excavation, relatively little definitive demolition material was identified.

Post-medieval garden soils

A layer of homogenous probable horticultural soils was identified, with its upper surface at c. 1.2m BGL/9.8m AOD at the NE end, sloping down to c. 2.5m BGL/7.5m AOD at the SW end. The considerable variation in the profile evident across boreholes 1-3 probably represents disturbance caused by 19th and 20th century building activity.

Modern activity

The upper c.1-2m of each borehole consisted of rubbly material derived from 19th and 20th century construction and subsequent demolition of structures in this area.

6.3 Deposit characterisation

An assessment of GBA (General Biological Analysis) samples retrieved from land reclamation and alluvial silts encountered in boreholes 13 – 15 was undertaken at the Dickson Laboratory by Sharon Carson. In each instance a single sample was taken from the bottom of deposits interpreted as land reclamation, in addition three samples were taken from the alluvial silts, broadly the top, middle and bottom.

Some variation in the character of the silts was evident. In the case of borehole 13 context 6004 was found to be characteristic of an organic soil. Unconsolidated and homogeneous there were no signs to suggest fluvial or alluvial deposition, the lowest sample, taken from around 6m AOD was however very wet. Although the top sample from borehole 14 (context 6009), positioned at approximately 5m AOD, was very similar in character to context 6004, the middle sample, situated at c.4m AOD, and the bottom sample were found to consist of multiple laminations and fine sand partings. This make-up is indicative of alluviation. The results from borehole 15 were poor. The silts were unconsolidated and wet with some suggestion that the homogenous and mixed character may have occurred during transit.

There was more consistency shown across the land reclamation deposits, (contexts 6003, 6008 and 6012). These were found to contain manganese and iron staining.

6.4 Results of Environmental Sample assessment

The results of processing the General Biological Analysis samples from boreholes 13-15 are presented in Appendices 8 (YAT laboratory assessment) and 9 (Geochemical assessment by Derwentside Environmental Testing Services). YAT's Principal Conservator, Ian Panter, has reviewed these results and provides the following summary.

The GBA assessment shows that whilst there is a very limited level of organic material present and that some of it is in wet conditions, the samples have very low potential for further information.

The geochemical assessment results show very low "loss on ignition" values, which indicate that the organic component of the sediments is very low, and therefore the sediments are primarily mineral-based.

Based on this evidence, the base-line conditions can be described as trending between "reducing" to "mildly-reducing". This means that conditions conducive to organic preservation are present but with an absence of significant organic components the significance of these deposits is low. It is felt that any fluctuations in site hydrology will have a minimal impact upon preservation conditions.

No material suitable for AMS or radiocarbon dating was recovered from the borehole samples.

6.5 Results of water monitoring

The ground water levels were monitored for a period of six months from the installation of the dipwells in June 2016 to November 2016. The results and report are presented in Appendix 10 (Groundwater monitoring). YAT's Principal Conservator, Ian Panter, has reviewed these results and provides the following summary.

Alluvial deposits that may contain organic archaeological and palaeoenvironmental evidence lie within the water table and are therefore remain waterlogged at all times, as indeed are the lower-most Medieval deposits.

The evidence suggests that the lowermost deposits beneath the fire-station building remain in connection with the river, however those furthest away (BH13, adjacent to Clifford Street) depend mainly on rainfall recharge, and general surface/groundwater flowing towards the river, whilst the river exerts a greater influence upon the deposits nearest to it (BH15).

The alluvial sediments have low hydraulic conductivity values indicating they are not freely draining. Hence the deposits are likely to remain saturated even when the river level drops to its base level of 5.0m AOD, or during periods of little or no rainfall.

The impact upon the water table from the redevelopment is likely to be minimal, if not negligible, assuming that nothing is done to isolate the alluvial sediments from the river - i.e. no secant pile wall, or coffer dam around the site. Single piles or mini-pile clusters should have no impact upon the site hydrology, as long as they do not form a barrier to the movement of groundwater through the sediments.

7 DISCUSSION

7.1 Trial trenching

Little in the way of dateable material was recovered from any of the deposits or features encountered, apart from bricks recovered from various 19th century walls and surfaces, and a probably residual medieval door jamb recovered from garden soil deposit 4009, in Trench 4.

The lack of cultural material makes it difficult to date the earliest deposits encountered. These relatively sterile deposits, such as contexts 3012 and 4014, may represent ground reclaimed from the tidal riverbank in preparation for the friary's construction, exposed and abandoned following the closure, demolition and probable clearance of the friary buildings. Equally they may date to well after the mid 16th century when Speed's 1610 map (Plate 11) shows a blank space in the area formerly occupied by the friary. The presence of a residual medieval door jamb from 4009 (Appendix 6) may support the latter interpretation. The pottery recovered from the interface of 3012 and overlying horticultural soil 3019 may suggest an 18th century date (Appendix 4) for some of these strata.

With the exception of Trench 2, an accumulation of soil typical of garden or horticultural activity was identified across the site. Map evidence, for example Drake 1736 (Plate 12), indicates that these deposits are likely to have been forming from at least the late 17th century onwards. This period of time is further reflected by the thickness of this material.

The 19th century wall observed in trench 1 is probably the aisle wall of Trinity Chapel, which was demolished when the building was converted for the fire station. 19th century pottery was recovered from the demolition deposit, 1008, but this is clearly residual as the demolition date is known to be 1935. The location of this wall can be inferred from historic photographs showing it being used for billboard posters prior to the expansion of the fire station (Plate 13).

The walls identified in Trench 3 are also of probable 19th century date and may represent structures relating to the chapel.

7.2 Borehole survey

The borehole assessment largely supports the results of the evaluation trenches within the upper 1.5m of deposits, with clear evidence for the 19th and 20th century activity within this range. These deposits overlie probable horticultural soils dating from the 17th century onwards, which are present to a depth of c.7m AOD. At the base of these deposits probable demolition material relating to the friary were observed. This sequence reflects the results of work at 23 Clifford Street (Hunter-Mann, 1990b, 5) and is supported by the historic maps referred to above.

The next group represents the probable build-up of this area as it was reclaimed from the River Ouse during the medieval period. These deposits range between c.8.5mAOD and c.6mAOD and may represent ground preparation for the construction of the friary; indeed the waterlogging identified at the bottom of this material may be an indication of the consolidation necessary to bring marginal land on the periphery of the Ouse into use. The friary buildings may be represented *in-situ* by the limestone walls encountered in boreholes 2 and 12. These walls are present from a depth of c.7.5m AOD, at approximately 3.5m BGL.

The next group consists of banded alluvial deposits which could be of any date from the Roman up to the medieval period. It is known that the activity on this part of the Ouse river bank took place on land re-claimed from the river from the medieval period onwards, but the extent of the Roman use and modification to the river in this area is unknown and could be present here. The marked difference in the height of this material to the NE and SW of the substantial wall encountered in borehole 12 could suggest that this material continued to accumulate during the later structural activity identified in the NE part of the site.

The presence of surviving organic material in the form of plant fibres and heavily stained animal bone suggests that deposits typical of York's Anglian and Viking periods could be present at this depth on the site but no dating evidence was obtained to support this interpretation, and the quantity of organic material present was relatively low.

The activity of tidal action must also be taken into account when assessing the alluviation, as the Ouse in York was tidal until the 1757 construction of the lock system at Naburn (Briden, 1997, 165) and the effect of the tides on earlier deposits has rarely been assessed. This may also have a bearing on the depth of natural deposits in the areas closest to the river, which has been observed at c.3-5m AOD further upstream (Ottaway, 2011, 115-8) and at c. 1m AOD further downstream (Hunter-Mann, 1994, 7) towards the proximity to the confluence with the Foss.

7.4 Conclusions

On the basis of the evaluation and borehole data assessed above, it is possible that surviving structures relating to the friary survive at a depth of c.7.5m AOD at the NE end of the site, with related activity present to the SW to a depth of c.6m AOD. Above these, the deposits identified during the evaluation trenching are likely to represent the demolition of the friary

remains and the establishment of post-medieval gardens, prior to the construction of the Methodist Chapel in 1856.

Below c.6m AOD, the deposits identified by borehole may represent alluvial action of the tidal River Ouse and could include evidence for activity from the Roman, Anglian and Anglo-Scandinavian periods. This material exhibits very limited organic preservation.

It should be noted that due to the potential compression of soft deposits during borehole drilling referred to in Section 2 above, these depths noted here are approximate.

7.5 Recommendations for further work (I Panter and I Milsted)

The base-line conditions at the former fire station site have been described and discussed above. No additional work is required to categorise the deposits.

A six-month monitoring programme has been completed. The deepest deposits lie below the water table, which is largely recharged from the river save from the Clifford Street end of the site, which is reliant on rainfall recharge. The development will have a minimal impact on these deposits provided the pile design does not isolate them from the river or impede the flow of groundwater through the sediments.

A post-construction monitoring programme has been agreed, although this will be dependent on survival of the current dipwells following the development.

Assessment of the GBA samples has demonstrated very low potential and no further work is proposed. It is recommended that the samples are discarded.

Based on the evidence presented here, besides the continued water monitoring programme, it is recommended that further work consist of a watching brief to monitor the impact of the development as is proceeds.

PLATES

Plate 1 Trench 1 general view looking NE

Plate 2 Trench 1 SE facing section

Plate 3 Trench 2 general view, looking east

Plate 4 Trench 2 SE facing section

Plate 5 Trench 3 general view looking SW

Plate 6 Trench 3 SW facing section

Plate 7 Trench 3 SE facing section

Plate 8 Trench 4 general view looking NE

Plate 9 Trench 4 SW facing section

Plate 10 Borehole 1 during drilling

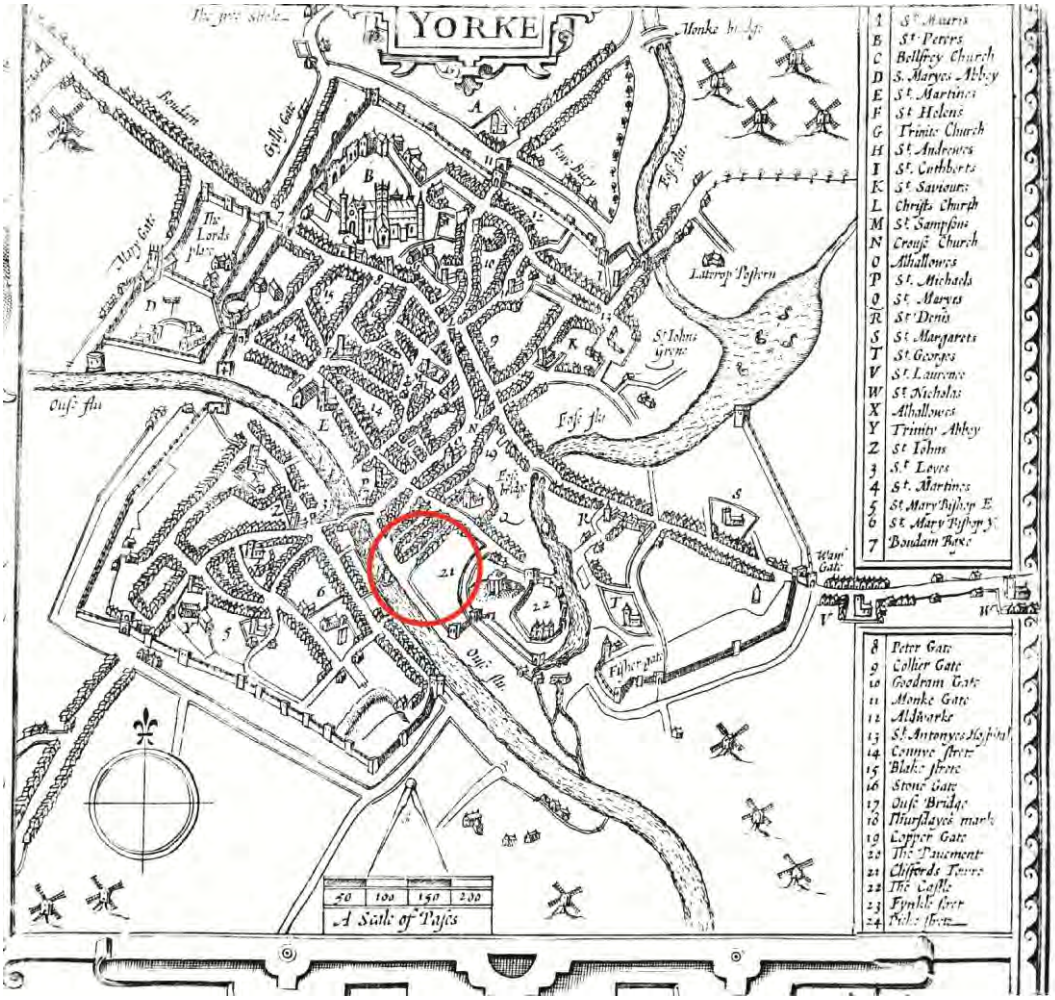


Plate 11 Speeds map of 1610 with approximate area of the site

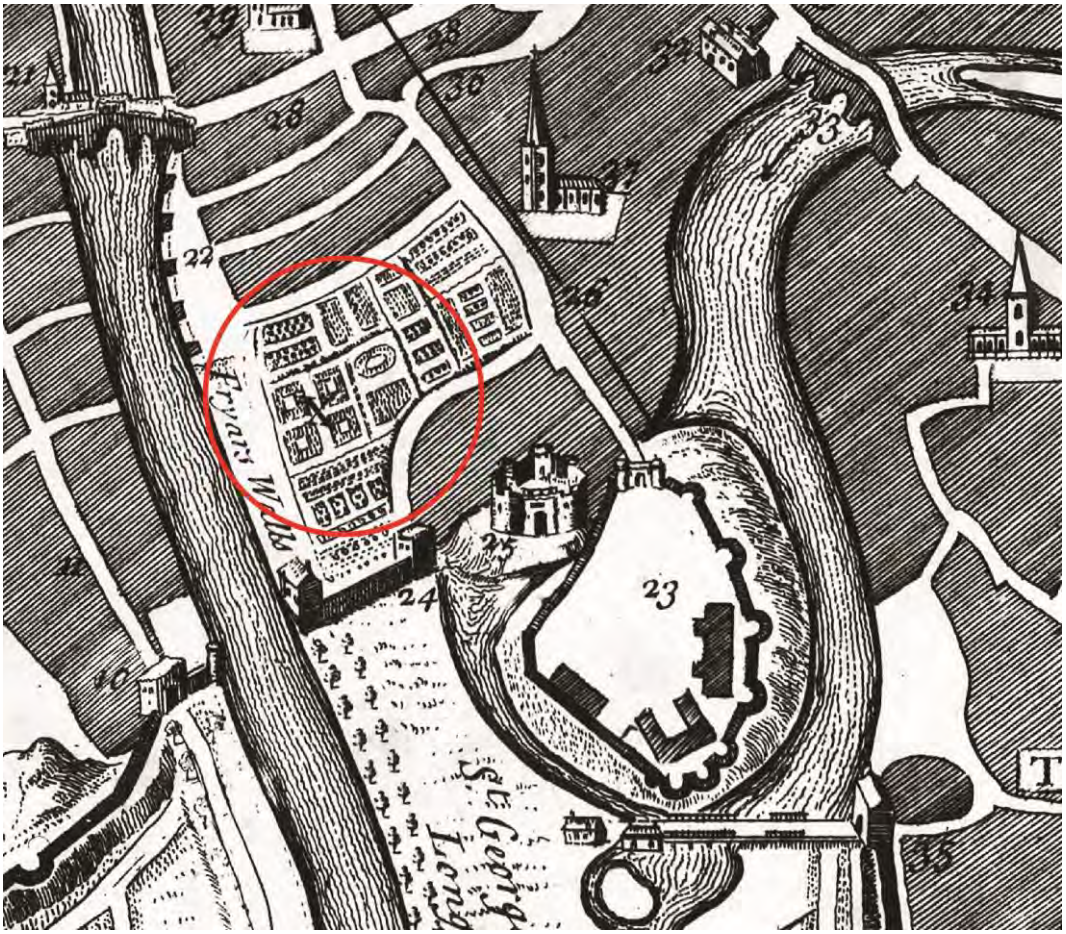


Plate 12 Drakes map of 1736 with approximate area of the site

Plate 13 View of advertising hoardings along the NE aisle of Trinity Chapel (photo from city archives)

LIST OF SOURCES

http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html

accessed 11/03/2016

REFERENCES

Briden, C., 1997, 'York as a tidal port', in *Yorkshire Archaeological Journal*, Volume 69, pp 165-171

Brinklow, D., 1986, *Coney Street, Aldwark and Clementhorpe, Minor Sites and Roman Roads*, Archaeology of York 6/1, York Archaeological Trust

Hall, R.A., 2014, *Anglo-Scandinavian Occupation at 16-22 Coppergate*, Archaeology of York 8/5, York Archaeological Trust

Hunter-Mann, K., 1990a, 'Excavations at Clifford Street', in *Archaeology in York*, Volume 15 Number 1, pp 11-16, York Archaeological Trust

Hunter-Mann, K., 1990b, 'Clifford Street Revisited', in *Archaeology in York*, Volume 15 Number 2, pp3-8, York Archaeological Trust

Hunter-Mann, K., 1994, 'Prehistoric York through the key-hole', in *Archaeology in York*, Volume 19 Number 3, pp4-8, York Archaeological Trust.

Ottaway, P., 2011, *Archaeology in the Environs of Roman York: Excavations 1976 – 2005*, Archaeology of York 6/2, York Archaeological Trust

RCHME, 1962, *An Inventory of the Historical Momuments in the City of York: Volume 1 Eboracum, Roman York*, HMSO.

Tillott, P.M. (Ed), 1961, *A History of Yorkshire: The City of York*, Victoria County History

ACKNOWLEDGEMENTS

YAT wish to acknowledge the assistance of the client, LondonEbor, and their agent, DC Architecture; the York Magistrates Court and their agents, Bilfinger GVA; and the North Yorkshire Fire and Rescue Service.

APPENDIX 1 – INDEX TO ARCHIVE

Item	Number of items
Context sheets	158
Context register	8
Borehole logs	20
Levels register	2
Drawings register	1
Original drawings	14
Addition drawings	6
Digital photographs	425
Written Scheme of Investigation	1
Report	2

Table 1 Index to archive

APPENDIX 2 – CONTEXT LIST

Table 2 Context list

Trenches		
Trench	**Context no.**	**Description**
1	1001	Granite set Floor
1	1002	Concrete
1	1003	Reinforced concrete
1	1004	Make up\Demolition layer
1	1005	Build up
1	1006	Demolition layer
1	1007	Build up
1	1008	Demolition layer
1	1009	Demolition layer
1	1010	Brick wall
1	1011	Foundation for wall 1010
1	1012	Construction cut backfill (Fill of 1013)
1	1013	Construction cut for brick wall 1010
1	1014	Clearance probably related to demolition of chapel and construction of fire station
2	2001	Brick floor internal to fire station
2	2002	Concrete
2	2003	Rubble levelling layer below 2002
2	2004	Demolition and level of chapel
2	2005	Rubble
2	2006	Brick wall
2	2007	Demolition and clearance of chapel
3	3001	Tarmac car park surface
3	3002	Concrete
3	3003	Brick rubble
3	3004	Brick surface

3	3005	Brick wall
3	3006	Brick wall (return of 3005)
3	3007	Loose dark brown silt build up
3	3008	Stone footing (below 3005)
3	3009	Loose dark brown silt (possibly same as 3007 and 3012)
3	3010	Brick footing for wall 3022
3	3011	Construction cut for 3010
3	3012	Mid brown grey clay silt at south west end of base of trench 3
3	3013	Sand bedding for 3004
3	3014	Light brown clay silt with frequent mortar and brick fragments upper fill of 3015 (not excavated)
3	3015	Pit at base of trench 3 (not excavated)
3	3016	Brick wall seen in north east facing section of trench 3 may have articulated with 3005
3	3017	In fill of robbing cut 2018
3	3018	Cut for robbing of 3016
3	3019	Dark brown clay silt garden\horticultural soil
3	3020	Construction cut for wall 3016
3	3021	Cut associated with demolition of chapel
3	3022	Brick wall, possible remains of Methodist chapel may relate to (3005)
3	3023	Cut for drain seen in section associated with 3005 and 3022 (not excavated)
3	3024	Drain seen in section associated with 3005 and 3022 (not excavated)
3	3025	Fill of construction cut 3023 seen in section (not excavated)
3	3026	Stone footing for 3005 same as 3008
3	3027	Construction cut for stone footing 3026 and 3005
4	4001	Concrete floor surface
4	4002	Fill of 4003 very dark grey silt sand with occasional sandstone and chalk fragments
4	4003	Cut for small U shaped pit visible in section of trench
4	4004	Mid orange brown sandy clay with occasional shell flecks part of a

		levelling deposit
4	4005	Mid orange brown sandy clay with occasional charcoal flecks and small pebbles part of a levelling deposit
4	4006	Cinder and clinker possibly representing a yard surface or path
4	4007	mid brown sandy silt
4	4008	U shaped pit
4	4009	Mid brown silt sand build up deposit broadly similar to 3007 and 1007
4	4010	Multiple thin lenses of sand silt, silt clay and chalk and gravel probably levelling and build up for the 19th century gardens that lay at the site
4	4011	Dark grey clay silt garden\horticultural soil similar to 4009
4	4012	Loose light grey brown sand and mortar with moderate cbm fragments
4	4013	Firm light brown silt sand with moderate stone and mortar fragments
4	4014	Light brown sand silt with moderate small cbm and mortar fragments similar to 4013
4	4015	Salt glazed earthen ware drainage pipe
4	4016	19th or early 20th century cast iron pipe
Boreholes		
Borehole number	**Context No.**	**Description**
1	5001	Granite sets
1	5002	Concrete
1	5003	Rubble
1	5004	Sand silt loam with occasional CBM (garden\horticultural soil)
1	5005	Silt loam with frequent mortar and CBM (garden\horticultural soil)
1	5006	Silt clay with CBM, mortar, oyster shell and limestone (build up)
1	5007	Very clean clay (build up)
1	5008	Silts occasional charcoal, limestone, shell and bone (allluvium)
1	5009	Sand and clay (natural)
2	5010	Dark brown sandy silt with frequent mortar and occasional small stones, bone, charcoal, CBM and limestone fragments

		(garden\horticultural soil)
2	5011	Loose light grey mortar with occasional charcoal and small stones (demolition)
2	5012	Layers of mortared limestone (possible wall)
2	5013	Soil build up or possibly upper drier alluvial silts with occasional charcoal, daub, bone and shell
2	5014	Alluvial silts with frequent sand and limestone fragments at between 4m and 4.2m aOD
3	5015	Demolition rubble
3	5016	Loose dark brown sandy silt with moderate limestone and cbm fragments, occasional charcoal and animal bone (garden\horticultural soil)
3	5017	Very soft mid yellow brown silty sand damp and clean (build up)
3	5018	Loose sand with lime mortar and tile fragments (possible demolition debris)
3	5019	Soft mid yellow brown sandy silt with occasional small stones and CBM (build-up)
3	5020	Dark grey silt sand (alluvial silt)
3	5021	Mid yellow brown sand (natural)
4	5022	Soft mid yellow brown silt sand with frequent lime mortar and limestone fragments (possible demolition debris)
4	5023	Firm dark grey silt sand (build up)
4	5024	Multiple fine layers of firm grey slightly sandy clay silts varying in hue very frequent inclusions of cbm, stone, charcoal, plant fibres and animal bone (build-up)
4	5025	Layers of soft and very soft mid and dark grey silt clays and clay silts with moderate organic content, occasional stones, shell, charcoal and animal bone (alluvial silts)
5	5026	Loose dark brown sandy silt with mortar flecks, cbm, limestone fragments and charcoal (garden\horticultural soil)
5	5027	Rubble layer comprising thick limestone fragments, moderate mortar and cbm inclusions (possible demolition)
5	5028	Firm mid brown sand silt with occasional charcoal, sand and animal bone (build up)
5	5029	Multiple layers of firm light brown to mid brown sand clay with grey streaking, occasional charcoal, shell, stone and limestone

		fragments (build up)
5	5030	Multiple layers of mid and dark grey or brown sand silt and clay sand, fairly organic with some small stones and animal bone (alluvial silts)
8	5031	Tarmac
8	5032	Concrete and rubble hardcore
8	5033	Demolition rubble
8	5034	Friable dark brown sandy silt with moderate limestone and CBM fragments, occasional charcoal and animal bone (garden\horticultural soil)
8	5035	Firm, mid brown, slightly sandy silt with occasional charcoal, CBM and limestone flecks (build-up)
-	5036	Context number not assigned
9	5037	Tarmac
9	5038	Concrete
9	5039	Loose dark brown silt and building debris/rubble
9	5040	Friable dark brown sandy silt with moderate limestone and CBM fragments, occasional charcoal and animal bone (garden\horticultural soil)
9	5041	Firm, mid brown, sandy silt with frequent charcoal flecks and small pebbles, moderate CBM and limestone fragments (build-up)
9	5042	Limestone fragment, 0.1m thick
9	5043	Firm mid to dark grey slightly sandy silt, occasional charcoal, small bone fragments and wood flecks (alluvial silts)
11	5044	Tarmac
11	5045	Concrete and rubble hardcore
11	5046	Friable dark brown sandy silt with moderate limestone and CBM fragments, occasional charcoal and animal bone (garden\horticultural soil)
11	5047	CBM and mortar rubble with lenses of silty and sandy clay (possible demolition debris)
11	5048	Limestone and mortar rubble (possible demolition debris)
11	5049	Friable, light brown, slightly silty sand (build-up)
11	5050	Firm, mid brown, slightly sandy silt with occasional charcoal, CBM and limestone flecks (build-up)

11	5051	Firm mid to dark grey slightly sandy silt, occasional charcoal, small bone fragments and wood flecks (alluvial silts)
11	5052	Firm, dark orange brown and yellow grey clay with lenses of sand and gravel (natural)
10	5053	Tarmac
10	5054	Loose, coarse brick fragments and mortar rubble(building debris)
10	5055	Friable dark brown sandy silt with moderate limestone and CBM fragments, occasional charcoal and animal bone (garden\horticultural soil)
10	5056	Loose limestone and mortar fragments (possible demolition layer)
10	5057	Firm, light brown slightly sandy clay with occasional sandier lenses. Occasional charcoal flecks (build-up)
10	5058	Firm mid to dark grey slightly sandy silt, occasional charcoal, small bone fragments and wood flecks (alluvial silts)
10	5059	Limestone fragments, 80mm thick
10	5060	Firm mid to dark grey slightly sandy silt, occasional charcoal, small bone fragments and wood flecks (alluvial silts)
10	5061	Firm, light orange brown sandy clay (natural)
12	5062	Brick set floor
12	5063	Concrete
12	5064	Loose, coarse brick fragments and mortar rubble(building debris)
12	5065	Friable dark brown sandy silt with moderate limestone and CBM fragments, occasional charcoal and animal bone (garden\horticultural soil)
12	5066	Friable mid brown sandy silt with CBM, limestone and mortar fragments (possible building debris/demolition rubble)
12	5067	Friable light grey brown sand and mortar fragments (possible building debris/demolition rubble)
12	5068	Friable light brown sandy silt with occasional mortar limestone and charcoal fragments (build-up)
12	5069	Layers of small, medium and large limestone fragments often with lenses of mortar between (mortared limestone wall)
7	5070	Brick set floor
7	5071	Concrete
7	5072	Loose dark grey silt sand and CBM rubble (building debris)

7	5073	Friable dark brown sandy silt with moderate limestone and CBM fragments, occasional charcoal and animal bone (garden\horticultural soil)
7	5074	CBM and limestone rubble (possible building debris)
7	5075	Firm light brown sandy clay, occasional charcoal flecks (build-up)
7	5076	Firm mid to dark grey slightly sandy silt, occasional charcoal, small bone fragments and wood flecks (alluvial silts)
6	5077	Granite sets
6	5078	Concrete
6	5079	Loose sand, CBM, mortar and limestone rubble (demolition debris)
6	5080	Friable dark brown sandy silt with moderate limestone and CBM fragments, occasional charcoal and animal bone (garden\horticultural soil)
6	5081	Firm light brown sandy clay with sandy lenses and occasional charcoal and shell flecks (build-up)
6	5082	Soft, damp mottled light, mid and dark grey silts. Occasional light grey clay lenses and orange sand flecks. (alluvial silts)
6	5083	Firm light reddish brown slightly sandy clay with occasional small pebbles (natural)
8	5084	Loose CBM and limestone fragments, 0.12m thick (possible demolition debris)
8	5085	Firm light brown sandy clay, occasional charcoal flecks (build-up)
8	5086	Varies between firm and soft, mottled light, mid and dark grey silts. Occasional small bones and wood fragments (alluvial silts)
12	5087	Loose mid brown coarse sand with moderate small limestone fragments
12	5088	Soft dark grey silt (alluvial silt)
13	6000	19th and 20th century activity. Cobble set surface overlying concrete and rubble grading through to a mortar rich layer containing CBM fragments.
13	6001	Firm dark brown clayey silt garden soil.
13	6002	Firm dark brown clayey silt garden soil with limestone fragments.
13	6003	Land reclamation material. Firm mid brown sandy clay with moderate mortar and CBM fragments, Increasingly damp towards base of deposit.
13	6004	Alluvial silts.

13	6005	Natural sand.
14	6006	19th and 20th century activity. Loose dark brown sand with mortar and CBM fragments
14	6007	Post-medieval garden soil. Friable dark brown sandy silt grading through to mid brown silty sand with mortar and limestone fragments.
14	6008	Land reclamation. Clean firm light brown sandy clay.
14	6009	Alluvial silts. Dense mid to light grey silt with some sandy lenses, charcoal and occasional cobbles.
14	6010	Natural clays.
15	6011	Current ground surface. Tarmac and hardcore.
15	6012	Post-medieval garden soil. Loose dark brown gritty silt with mortar and CBM fragments.
15	6013	Land reclamation. Light brown sandy clay with occasional silt lenses, mortar, CBM and limestone fragments.
15	6014	Mortar, limestone and CBM fragments. Demolition material.
15	6015	Land reclamation. Soft mid brown sandy silt with frequent limestone and occasional mortar fragments.
15	6016	Firm mid grey silt with an organic content. Inclusions of limestone, mortar and charcoal.
15	6017	Firm mid orange/brown clay.
15	6018	Alluvial silt. Mid to light grey/brown silt with clay patches. Moderate inclusions of charcoal and limestone.
15	6019	Mid orange/brown sandy clay.
15	6020	Soft mid grey wet silt.
15	6021	Mid orange/brown sandy clay with occasional wood flecks

APPENDIX 3 – WRITTEN SCHEME OF INVESTIGATION

Site Location: Former Fire Station, Clifford Street, York.
NGR: SE 6035 5148
Proposal: Archaeological Evaluation
Planning ref: NA (HER Consultation CY0410)
Prepared for: David Chapman Associates
Status of WSI: draft, for approval 28/05/15

1 SUMMARY

1.1 David Chapman Associates are to submit a planning application for the redevelopment of the Former Fire Station, Clifford Street, York. The site has the potential for archaeological deposits to be present that may be impact by development proposals.

1.2 In order to further assess the archaeological potential of the fire station site and inform any future planning application John Oxley the City of York Archaeologist has requested an Archaeological Evaluation. This evaluation will provide information to allow a reasoned decision regarding the impact of the redevelopment of the site on any archaeological assets that may be present.

1.3 This Written Scheme of Investigation (WSI) has been prepared in response to a specification supplied by the City of York Archaeologists. The work will be carried out in accordance with the Brief and this WSI, and according to the principles of the Institute for Archaeology (IfA) Code of Conduct and all relevant standards and guidance.

2 SITE LOCATION & DESCRIPTION

2.1 The proposal site is located fronted onto Clifford street and runs the full extent of the northern side of Peckitt Street (Figure 1).
The Clifford Street frontage is made up of a stone sett entrance bay which has the main station building to the rear. This continues back for a little over 50% of the site, until a road which is the Peckitt Street vehicular access for this complex and the Magistrates Court. The rear of the complex is a smaller building and garage which overlooks the River Ouse & South Esplanade.

The ground level slopes downwards towards the River Ouse from a high point on Clifford Street of c.11m OD.

3 DESIGNATIONS & CONSTRAINTS

3.1 The client is responsible for investigating designations of the site regarding listed building, conservation areas etc. York Archaeological Trust (YAT) are appointed purely to deliver the Archaeological Evaluation as outlined in this document. The site lies within York's Area of Archaeological Importance as defined by the Scheduled Monuments and Archaeological Areas Act 1979.

3.2 Evaluation trenches, specifically their location, are constrained by two separate factors;

A) Standing buildings on the site which will limit machine access for opening and backfilling trenches. There may also be further limitations from underground obstructions and utilities linked with the previous use of the building as a Fire Station.

B) The presence of a right of way from Peckitt Street to the Magistrates Court, running between the two separate ranges of buildings linked with the Former Fire Station.

4 ARCHAEOLOGICAL INTEREST

4.1 The site has not previously been archaeologically investigated and it is unclear what the archaeological sequence will present.

Prehistory – It is unclear if there will be any remains of this date on the site. If they do survive it is likely that they will only be encountered during the borehole phase of investigation

Roman – The site is outside the Roman Fortress and away from the known principal routes associated with it. If any archaeology of this date were to survive it may be encountered during the borehole phase of investigation.

Anglian – This area of the City was used during the Anglian period, however this is largely hidden by activities linked with the Castle to the east. Previous investigations have encountered Anglian burials and occupation spreading from the line of the Roman Road. Again if this archaeology survives it is likely to beyond the depth of the evaluation trenches and will be picked up during the borehole investigations

Anglo-Scandinavian – As with the Anglian remains this will most probably be encountered at depths beyond the limits of the evaluation trenches. Nearby investigations at 23 Clifford Street had this period being represented by a sequence of spreads of material, which may be linked with site levelling. The proximity of the site to the River Ouse and sloping nature in that direction may lead to similar material being revealed.

Medieval – Any archaeology on the site that may be encountered within the evaluation trenching is likely to be dominated by the medieval period and the Franciscan Friary that was present in this area. The friary was founded in c.1230 and was expanded in numerous stages up to 1314.

The internal form of the friary has never been established. A number of significant buildings such as the Kings Chamber, Chapter House and Kitchens will have all stood somewhere within the precinct.

The friary was surrendered in 1538 and very little is known of what happened across the site beyond that date.

Post Medieval – Traces of the friary survived until the 19th century and it is clear from historic mapping that the site in question was cleared by the 1850s. By this point the site is shown as a series of formal gardens on the first edition Ordnance Survey map .

Trinity Chapel which is incorporated into the front range of buildings was constructed in 1856, though had fallen out of use little more than half a century later.

Modern – The earlier fire station which was positioned on Clifford Street was opened in 1892 and it moved sideways into the buildings which are the subject of this investigation in 1938. This included taking over the former Trinity Chapel positioned on this site.

4.2 Investigations nearby which have been of any depth are relatively limited, with the nearby property of 23 Clifford Street producing the most indicative results.

Excavations in 1991 showed a burial and robbing which was most probably associated with the friary and just afterwards. This was sealed by 18th century garden soils.

Work in 2011 found four phases of activity; 9th - 11th century dumping/levelling, 11th-13th century pits hearths and possibly a ditch predating the friary, 13th- 15th structures such as a well and wall associated with the friary as well as possibly post Friary demolition activities. Again this was sealed by garden deposits.

Following the results of this previous work it is anticipated that there could be approximately 3.25m of archaeological deposits at the Clifford Street side of the site. Moving down towards the river it is anticipated that this will get considerably deeper.

5 AIMS

5.1 The aims of the evaluation are:

- to determine the extent, condition, character, importance and date of any archaeological remains present
- to provide information that will enable the remains to be placed within their local, regional, and national context and for an assessment of the significance of the archaeology of the proposal area to be made
- to provide information to enable the local authority to decide any requirements for further archaeological mitigation for the site

More specifically the work will investigate:

- The potential for Roman deposits on the site;
- The potential for burials to be present on the site;
- The nature of the use of the site in the post-Roman period; and
- What evidence survives which relates to the a) construction of York Castle, and b) the establishment, development and abandonment of the friary.

In addition the following will be investigated:

- Are there anoxically preserved deposits, wet deposits, and dry deposits preserved across the site in areas proposed for level reduction?
- Can a deposit prediction for the site as a whole, indicating the nature and preservation of prehistoric, Roman, Anglian, Anglo-Scandinavian, medieval and post-medieval strata be made?
-

6 EXCAVATION METHODOLOGY

6.1 The evaluation will comprise the following elements:

- Trial trenching
- Borehole survey

Please note that further stages of work or other mitigation measures could be required by the local authority, depending upon the results of the evaluation.

6.2 A series of 4 trenches 3mx3m wide and up to 1.25m deep will be excavated. The proposed location of the trenches is shown on Figure 2. It is highly likely that below ground constraints (see 3.2 above) will result in the final location of trenches varying from the proposed. In this case the trenches will be placed where they can offer the maximum amount of information to complete the aims of the project.

No.	Size (m)	Rationale
1	3x3 1.25deep	Site coverage and access available
2	3x3 1.25deep	Site coverage and access available
3	3x3 1.25deep	Site coverage and access available
4	3x3 1.25deep	Site coverage and access available

Trenches will be stepped if necessary, to ensure their stated size at the base of the trench, though this is unlikely to be required due to their 1.25m depth limit.

6.3 Where possible trenches will be located using GPS survey equipment, all measurements will be accurate to +/-25mm. If this is not possible trench locations will be accurately plotted using an EDM Total station, by measurement to local permanent features shown on published Ordnance Survey maps. All measurements will be accurate to +/-10cm, and the trenches locatable on a 1:2500 Ordnance Survey map. This is to ensure that the trenches can be independently relocated in the event of future work.

6.4 Overburden such as concrete, setts, tarmac and other superficial fill materials will be removed by a machine. Mechanical excavation equipment, using a toothless bucket, will be used judiciously, under archaeological supervision down to the top of archaeological deposits, or the natural subsoil, whichever appears first. If archaeology is present machining will cease and excavation will normally proceed by hand. Where deep homogenous deposits, or deposits such as rubble infills, are encountered, these may be carefully removed by machine, after consultation with the City of York Archaeologist.

6.5 The use of mechanical, air-powered, or electrical excavation equipment may also be appropriate for removing deep intrusions (e.g. modern brick and concrete floors or footings) or through deposits to check that they are of natural origin, after consultation with the City of York Archaeologist. The machine will not be used to cut arbitrary sondages down to natural deposits.

6.6 All trenches will be sufficiently cleaned by hand to enable potential archaeological features to be identified and recorded; areas without archaeological features will be recorded as sterile and no further work will take place in these areas. The stratigraphy of all trenches will be recorded on trench record sheets even where no archaeological features are identified.

6.7 A sufficient sample of any archaeological features and deposits revealed will be excavated in an archaeologically controlled and stratigraphic manner in order to establish the aims of the evaluation.

- Structures will be sample excavated to a degree whereby their extent nature, form, date, function and relationships to other features and deposits can be established.

7 RECORDING METHODOLOGY FOR EXCAVATION & BOREHOLE SURVEY

7.1 All archaeological features will be recorded using standardised pro forma record sheets. Plans, sections and elevations will be drawn as appropriate and a comprehensive photographic record will be made where archaeological features are encountered.

7.2 Archaeological deposits will be planned at a basic scale of 1:20 & sections/elevations will be drawn to a basic scale of 1:10 or 1:20 depending on detail required. All drawings will be related to Ordnance Datum. Where it aids interpretation, structural remains will also be recorded in elevation.

7.3 Each context will be described in full on a pro forma context record sheet in accordance with the accepted context record conventions. Each context will be given a unique number. These field records will be checked and indexes compiled.

7.4 Photographs of work in progress and post-excavation of individual and groups of features will be taken. This will include general views of entire features and of details such as

sections as considered necessary. The photographic record will comprise of digital photographs of not less than 10 mega-pixels. All site photography will adhere to accepted photographic record guidelines.

7.5 Areas which do not contain any archaeological deposits will be photographed and recorded as being archaeologically sterile. The natural stratigraphic sequence within these areas will be recorded.

7.6 All finds will be collected and handled following the guidance set out in the IfA guidance for archaeological materials. Unstratified material will not be kept unless it is of exceptional intrinsic interest. Material discarded as a consequence of this policy will be described and quantified in the field. Finds of particular interest or fragility will be retrieved as Small Finds, and located on plans. Other finds, finds within the topsoil, and dense/discrete deposits of finds will be collected as Bulk Finds, from discrete contexts, bagged by material type. Any dense/discrete deposits will have their limits defined on the appropriate plan.

7.7 All artefacts and ecofacts will be appropriately packaged and stored under optimum conditions, as detailed in the RESCUE/UKIC publication *First Aid for Finds,* and recording systems must be compatible with the recipient museum. All finds that fall within the purview of the Treasure Act (1996) will be reported to HM Coroner according to the procedures outlined in the Act, after discussion with the client and the local authority.

7.8 Other samples will be taken, as appropriate, in consultation with York Archaeological Trust specialists and the English Heritage Regional Science Advisor, as appropriate (e.g. dendrochronology, soil micromorphology, monolith samples, C14, etc.). Samples will be taken for scientific dating where necessary for the development of subsequent mitigation strategies. Material removed from site will be stored in appropriate controlled environments.

7.9 In the event of human remains being discovered during the evaluation these will be left *in-situ*, covered and protected, in the first instance. The removal of human remains will only take place in compliance with environmental health regulations and following discussions with, and with the approval of, the Ministry of Justice. If human remains are identified, the Ministry of Justice and City Archaeologist will be informed immediately. An osteoarchaeologist will be available to give advice on site.

- If **disarticulated** remains are encountered, these will be identified and quantified on site. If trenches are being immediately backfilled, the remains will be left in the ground. If the excavations will remain open for any length of time, disarticulated remains will be removed and boxed, for immediate reburial by the Church.
- If **articulated** remains are encountered, these will be excavated in accordance with recognised guidelines (see 6.12) and retained for assessment.
- Any grave goods or coffin furniture will be retained for further assessment.
-

7.10 Where a licence is issued, all human skeletal remains must be properly removed in accordance with the terms of that licence. Where a licence is not issued, the treatment of human remains will be in accordance with the requirements of Civil Law, IfA Technical Paper 13 (1993) and English Heritage guidance (2005).

7.11 The borehole survey will take place at 5m intervals across the site, the intention being to provide a profile running from Clifford Street to adjacent to South Esplanade. A compact, tracked, borehole rig will be used to complete this process.

7.12 Borehole cores will be examined in the field by an archaeologist suitably experienced in the deep stratigraphic nature of York's archaeological deposits. Observations will be recorded in note form, to enable rapid progress during the survey. The results will then be presented as part of the excavation results, cross referencing to excavated deposits where possible.

8 SPECIALIST ASSESSMENT

8.1 The stratigraphic information, artefacts, soil samples, and residues will be assessed as to their potential and significance for further analysis and study. The material will be quantified (counted and weighted). Specialists will undertake a rapid scan of all excavated material. Ceramic spot dates will be given. Appropriately detailed specialist reports will be included in the report.

8.2 Materials considered vulnerable should be selected for stabilisation after specialist recording. Where intervention is necessary, consideration must be given to possible investigative procedures (e.g. glass composition studies, residues on or in pottery, and mineral-preserved organic material). Allowance will be made for preliminary conservation and stabilization of all objects and a written assessment of long-term conservation and storage needs will be produced. Once assessed, all material will be packed and stored in optimum conditions, in accordance with Watkinson and Neal (1998), IfA (2007) and Museums and Galleries (1992).

8.3 All finds will be cleaned, marked and labelled as appropriate, prior to assessment. For ceramic assemblages, any recognised local pottery reference collections and relevant fabric Codes will be used.

8.4 Allowance will be made for the recovery of material suitable for scientific dating and contingency sums will be made available to undertake such dating, if necessary. This will be decided in consultation with the City Archaeologist.

9 REPORT & ARCHIVE PREPARATION

9.1 Upon completion of the site work, a report will be prepared to include the following:

a) A non-technical summary of the results of the work.

b) An introduction which will include where possible the planning reference number, grid reference and dates when the fieldwork took place.

c) An account of the methodology and detailed results of the operation, describing structural data, archaeological features, associated finds and environmental data, and a conclusion and discussion.

d) A selection of photographs and drawings, including a detailed plan of the site accurately identifying the areas monitored, trench locations, selected feature drawings, and selected artefacts, and phased feature plans where appropriate.

e) Specialist artefact and environmental reports where undertaken, and a context list/index.

f) Details of archive location and destination (with accession number, where known), together with a context list and catalogue of what is contained in that archive.

g) A copy of the key OASIS form details

h) Copies of the Brief and WSI

i) Additional photographic images may be supplied on a CDROM appended to the report

9.2 Copies of the report will be submitted to the commissioning body. A bound and digital copy of the report will be submitted direct to the City Archaeologist for planning purposes, and subsequently for inclusion into the SMR/HER.

9.3 A field archive will be compiled consisting of all primary written documents, plans, sections and photographs. Catalogues of contexts, finds, soil samples, plans, sections and photographs will be produced.

9.4 The owner of the Intellectual Property Rights (IPR) in the information and documentation arising from the work, would grant a licence to the Local Authority and the museum accepting the archive to use such documentation for their statutory functions and provide copies to third parties as an incidental to such functions. Under the Environmental Information Regulations (EIR), such documentation is required to be made available to enquirers if it meets the test of public interest. Any information disclosure issues would be resolved between the client and the archaeological contractor before completion of the work. EIR requirements do not affect IPR.

9.5 Upon completion of the project an OASIS form will be completed at http://ads.ahds.ac.uk/project/oasis/.

10 POST EXCAVATION ANALYSIS & PUBLICATION

10.1 The information contained in the evaluation report will enable decisions to be taken regarding the future treatment of the archaeology of the development site and any material recovered during the evaluation.

10.2 If further archaeological investigations (mitigation) take place, any further analyses (as recommended by the specialists, and following agreement with City Archaeologist) may be incorporated into the post-excavation stage of the mitigation programme unless such analysis are required to provide information to enable a suitable mitigation strategy to be devised. Such analysis will form a new piece of work to be commissioned.

10.3 In the event that no further fieldwork takes place on the site, a full programme of post excavation analysis and publication of artefactual and scientific material from the evaluation may be required by City Archaeologist. Where this is required, this work will be a new piece of work to be commissioned.

10.4 If further site works do not take place, allowance will be made for the preparation and publication in a local and/or national journal of a short summary on the results of the evaluation and of the location and material held within the site archive.

11 HEALTH AND SAFETY

11.1 Health and safety issues will take priority over archaeological matters and all archaeologists will comply with relevant Health and Safety Legislation.

11.2 A Risk Assessment will be prepared prior to the start of site works.

12 PUBLIC ENGAGEMENT

12.1 The City of York recognises the importance of engaging the public in archaeological issues. Excavations within the City generate significant levels of public interest as well as affording the opportunity for people to see the process as it happens.

12.2 YAT is a leader in the field public engagement with archaeology and has a proven track record of integrating public access and presentation into active archaeological projects. The positive responses to this work have created positive press, goodwill towards redevelopment as well as enabling new developments to be 'placed' within the history of their surrounds.

12.3 In this project the relatively short duration and sensitivity regarding access to the Magistrates Courts means that the trench or trenches at the front of the site would offer the best point of contact for the public and the archaeology if the site.

12.4 It is proposed that the Heras fencing or similar barriers along the front of the site can be used by the client to display any details they wish to regarding the future of the site.

12.5 If the front trench contain archaeology that is visible and contains a 'story' which can be explained to the public that a formal 'open afternoon' at the end of the project be set aside to do so.

12.5 YAT can issue a press release detailing the work and discoveries as well as use its multiple social media platforms to inform on the work as it is underway.

12.6 This is all ultimately down to enabling safe site access and the discretion of the client and what they wish to publicise.

12.7 Public engagement will only take place with the permission of the client.

13 PRE-START REQUIREMENTS

13.1 The client will be responsible for ensuring site access has been secured prior to the commencement of site works, and that the perimeter of the site is secure.

13.2 The client will provide York Archaeological Trust with up to date service plans and will be responsible for ensuring services have been disconnected, where appropriate.

13.3 The client will be responsible for ensuring that any existing reports (e.g. ground investigation, borehole logs, contamination reports) are made available to York Archaeological Trust prior to the commencement of work on site.

14 REINSTATEMENT

14.1 Following excavation and recording the spoil from the trenches will be backfilled unless requested otherwise. The backfill material will be levelled and compressed as far as possible with the mechanical excavator bucket, but will not be compressed to a specification. York Archaeological Trust are not responsible for reinstating any surfaces unless specifically commissioned by the client who will provide a suitable specification for the work.

14.2 YAT are not responsible for ensuring that trench or trenches fronting onto Clifford Street are resurfaced in a suitable manner once any temporary barrier fencing is removed.

15 TIMETABLE & STAFFING

15.1 The timetable suggested is that all works on site during the first 3 weeks of June 2015.

15.2 Specialist staff available for this work are as follows:

- Human Remains – Ruth Whyte (Dickinson Laboratory for Bio-archaeology)

- Palaeoenvironmental remains – Dr Jennifer Miller (Dickinson Laboratory for Bio-archaeology
- Head of Curatorial Services - Christine McDonnell
- Finds Researcher - Nicky Rogers
- Pottery Researcher - Anne Jenner
- Finds Officers – Nienke Van Doorn & Rachel Cubitt
- Archaeometallurgy & Industrial Residues – Rachel Cubitt and Dr Rod Mackenzie
- Conservation - Ian Panter

16 MONITORING OF ARCHAEOLOGICAL FIELDWORK

16.1 As a minimum requirement, the City of York Archaeologist will be given a minimum of one week's notice of work commencing on site, and will be afforded the opportunity to visit the site during and prior to completion of the on-site works so that the general stratigraphy of the site can be assessed and to discuss the requirement any further phases of archaeological work. York Archaeological Trust will notify City of York Archaeologist of any discoveries of archaeological significance so that site visits can be made, as necessary. Any changes to this agreed WSI will only be made in consultation with City of York Archaeologist.

17 COPYRIGHT

17.1 York Archaeological Trust retain the copyright on this document. It has been prepared expressly for the named client, and may not be passed to third parties for use or for the purpose of gathering quotations.

18 KEY REFERENCES

Brown, D. H. 2007. Archaeological Archives: a guide to best practice in creation, compilation, transfer and curation. IfA/AAA

Department for Communities and Local Government 2010 Planning Policy Statement 5: planning for the Historic Environment.

English Heritage. 2001. *Archaeometallurgy*. Centre for Archaeology Guidelines.

English Heritage. 2002. Environmental Archaeology. A guide to the theory and practice of methods from sampling and recovery to post-excavation.

English Heritage. 2002. With Alidade and Tape – graphical and plane table survey or archaeological earthworks.

English Heritage. 2003. Where on Earth are We? The Global Positioning System (GPS) in archaeological field survey.

English Heritage. 2004. Geoarchaeology: using earth sciences to understand the archaeological record.

English Heritage. 2005 Guidance for Best Practice for Treatment of Human Remains Excavated from Christian Burial Grounds in England.

English Heritage. 2006. Guidelines on the x-radiography of archaeological metalwork.

English Heritage. 2006b. Management of Research Projects in the Historic Environment: The MoRPHE Project Managers' Guide.

English Heritage. 2007. Understanding the Archaeology of Landscape – a guide to good recording practice

English Heritage. 2008. Investigative Conservation.

Institute for Archaeologists. 1993. Technical paper No 13 by McKinley, J. I., and C. Roberts. *Excavation and post-excavation treatment of cremated and inhumed human remains*.

Institute for Archaeologists. 2007. Archaeological Archives: A guide to best practice in creation, compilation, transfer and curation by D.H. Brown.

Institute for Archaeologists. 2008. Standard and Guidance for the Collection, Documentation, Conservation and Research of Archaeological Materials.
Institute for Archaeologists. 2008. Standard and Guidance for Archaeological Field Evaluation
Museum and Galleries Commission. 1992. Standards in the museum care of archaeological collections.
RCHMS. 1999. 'Recording Archaeological Field Monuments – a descriptive specification.
Standing Conference of Archaeological Unit Managers (SCAUM). 2007. *Health and Safety in Field Archaeology*
Neal, V., and D. Watkinson (eds). 1998. *First Aid for Finds: practical guide for archaeologists.* United Kingdom Institute for Conservation of Historic & Artistic Works, Archaeology Section; 3rd Revised Edition.

See also the **HELM** website for a full list of English Heritage Guidance documents.

APPENDIX 4 – POTTERY BY ANNE JENNER

INTRODUCTION AND DISCUSSION

11 sherds of pottery were retrieved from 4 Contexts. They range in date from the 18th to the 19th century (see Table 1 below). Despite this, there are no black glazed earthen wares or slip wares typical of the 18th century, suggesting that these are 19th century Contexts. All wares would have been used in a domestic environment. Most are 'fine wares' but one Tortoiseshell earthen ware and two sherds from a stone ware bowl may be more functional. All, apart from the stone ware would have been used for eating and drinking. The stone ware bowl may have been used in the kitchen. The fine wares may have been used in the parlour and on the table.

There is little to denote any great wealth, as transfer printed and flow blue wares were mass produced in the 19thcentury. Flow blue wares are known to be in production by the 1820's as, although transfer printed, this new technique caused the glaze to flow and blur the often transfer printed pattern.

All sherds are small, mostly less than 5cms at their widest girth, though the white ware and brown stone ware sherds are slightly larger. Although they are not particularly abraded, their size suggests that they may not be in a primary deposit.

FURTHER RECOMMENDATIONS

There are no recommendations for further analysis of this assemblage.

Context	Quantity	Dating	Details
1008	5	19TH CENTURY	2 cut sponged blue and white 1 transfer printed 'fibre' pattern Yorkshire 1 banded slip plain 1 buff stone ware
3012	3	LATE 18TH/19TH CENTURY	1 tin glazed with blue foliste motif 1 Tortoiseshell with pink staining on broken edges 1 porcelain with fine gold band
3014	2	18TH CENTURY	2 English brown stone ware with small lug horizontal handle and bands of incised decoration
4014	1	19TH CENTURY	1 Flow blue

Table 3 Pottery quantification

APPENDIX 5 – CERAMIC BUILDING MATERIAL BY J.M. MCCOMISH

Six sherds of ceramic building material were recovered from the site and these collectively weighed 23.925kg. The CBM was recorded to a standard YAT methodology, whereby each sherd is recorded in full, with only a representative sample being retained for long-term curation. All the sherds were of modern date and they are summarised in Table 3 below.

A slop moulded brick dating from 1750 or later was present in Context 3005.

An elaborately moulded machine made cornice brick dating to 1850 or later was present in Context 1000.

A machine-made ridge or coping tile with a roll-moulding along the apex was present in Context 2004. This dates to 1850 or later.

A machine made floor tile was present in Context 3016. This was stamped with the makers mark JC indicating that it was made by John Chambers of Littlethorpe, Ripon, or by his successor Mrs J Chambers and Sons who were listed in trade directories from 1867-1881 (http://www.penmorfa.com/bricks/england12.html).

Two machine made firebricks were present in Context 3004, both bearing the makers stamp PEASE. These bricks probably originated from the Thorne Colliery near Doncaster, which was owned by Pease & Partners of Darlington, and was in operation from 1925-1956 (http://www.penmorfa.com/bricks/england18.html; http://www.memories-of-bygone-moorends.com/the-sinking-of-the-pit.php). It should be noted that fireclay is often found in association with coal deposits, and many collieries had associated brickworks.

Context	Date range	Forms present
1000	1850+	Cornice brick
2004	1850+	Ridge or coping tile
3004	1925-1956	Firebrick
3005	1750+	Brick
3016	1867-1881	Floor

Table 4 CBM summary by context

This material is mainly of use in terms of dating individual contexts from the site, and does not merit any further research. Four of the sherds have been retained in the YAT teaching collection, while the remaining two sherds were discarded.

Web Sources

Memories of Bygone Moorends online *at*http://www.memories-of-bygone-moorends.com/the-sinking-of-the-pit.php. Accessed on 30 July 2015

Old Bricks – History at your feet online *at* http://www.penmorfa.com/. Accessed on 30 July 2015

APPENDIX 6 – ARCHITECTURAL FRAGMENTS BY J.M. MCCOMISH

A single architectural fragment (AF1) was recovered from the excavations. This comprised a large magnesian limestone block with six original faces present (F1-F6). F1 and F2 are the top and base, F3 and F4 opposing plain sides, F5 the moulded front of the block and F6 the back of the block which would have been within the walling originally. F5 is decorated with a chamfer, double roll with central fillet (badly damaged) and two hollow rolls. F6 is slightly rebated. F1 and F5 damaged. Striated tooling on F1. This block is from a jamb and dates to *c.* 1350-1540.

The fragment would have originated from an ecclesiastical building, probably from the Franciscan friary. This fragment has been retained, and is currently stored at YATs warehouse in Huntington. No further research is recommended for this AF.

APPENDIX 7 –WRITTEN SCHEME OF INVESTIGATION FOR EVALUATION OF IMPACT ON ORGANIC ARCHAEOLOGICAL DEPOSITS AT THE FORMER FIRE ATATION, CLIFFORD STREET, YORK

Site Location:	Former Fire Station, Clifford Street, York.
NGR:	SE 6035 5148
Proposal:	Archaeological Evaluation
Planning ref:	NA (HER Consultation CY0410)
Prepared for:	David Chapman Architecture
Document reference:	YAT 2016/34
Status of WSI:	Draft for comment 06/05/16

1 INTRODUCTION

1.1 David Chapman Architecture are to submit a planning application for the redevelopment of the Former Fire Station, Clifford Street, York. The site contains archaeological deposits that will be impacted by the development proposals.

1.2 Dr Keith Emerick, Historic England Inspector of Ancient Monuments, has commented on the proposal, raising concerns about its impact on archaeological deposits, and in particular on the potential 'halo' effect of below-ground structures and intrusions into potentially water-logged material.

1.3 To meet these concerns, the City of York Archaeologist, John Oxley, has requested a description of the proposed foundations and an assessment of the impact of the piling, and proposed sub-basement carpark and flood water attenuation tank, on the archaeological sequence as currently understood following a recent archaeological trench and borehole evaluation (YAT 2016/19).

1.4 The City of York Archaeologist has also requested that a proposal for further archaeological borehole evaluation, including a condition assessment of the waterlogged deposits, and a subsequent programme of water monitoring be prepared, to further assess the condition of deeply buried and potentially organic waterlogged deposits identified during the evaluation.

1.5 The client has committed to a proposed mitigation strategy for the potentially organic waterlogged deposits, devised in consultation with the City of York Archaeologist, irrespective of the results of the borehole evaluation.

1.6 This Written Scheme of Investigation (WSI) has been prepared in response to a specification supplied by the City of York Archaeologist. The work will be carried out in accordance with the Brief and this WSI, and according to the principles of the Institute for Archaeology (IfA) Code of Conduct and all relevant standards and guidance.

2 SITE LOCATION & DESCRIPTION

2.1 The proposal site is located fronted onto Clifford street and runs the full extent of the northern side of Peckitt Street (Figure 1).

The Clifford Street frontage is made up of a stone sett entrance bay which has the main station building to the rear. This continues back for a little over 50% of the site, until a road which is the Peckitt Street vehicular access for this complex and the Magistrates Court. The rear of the complex is a smaller building and garage which overlooks the River Ouse & South Esplanade.

The ground level slopes downwards towards the River Ouse from a high point on Clifford Street of c.11m OD.

3 DESIGNATIONS & CONSTRAINTS

3.1 The client is responsible for investigating designations of the site regarding listed building, conservation areas etc. York Archaeological Trust (YAT) are appointed purely to deliver the Archaeological Evaluation as outlined in this document. The site lies within York's Area of Archaeological Importance as defined by the Scheduled Monuments and Archaeological Areas Act 1979.

3.2 Evaluation boreholes, specifically their location, are constrained by two separate factors;

A) Standing buildings on the site which will limit machine access for opening and backfilling trenches. There may also be further limitations from underground obstructions and utilities linked with the previous use of the building as a Fire Station.

B) The presence of a right of way from Peckitt Street to the Magistrates Court, running between the two separate ranges of buildings linked with the Former Fire Station.

3.3 There may also be constraints on noise and vibration during hours of session in the Court that limit the working day.

4 ARCHAEOLOGICAL INTEREST

4.1 Period-by-period summary

This was prepared for the recent archaeological evaluation of the site (YAT2016/19)

4.1.1 Prehistory

Knowledge of prehistoric activity from this area is limited to the identification of alluvial deposits radiocarbon dated to the late Bronze Age (BC 1510 – BC 900) at the St George Fields pumping station some 250m to the SE of the Clifford Street site (Hunter-Mann, 1994, 7). These deposits were identified at c.-1 - 0m AOD, some 11-12m below the ground level at Clifford Street, suggesting that any prehistoric deposits surviving at this site will be at considerable depth.

4.1.2 Roman

he Clifford Street site is outside the fortress and in an area regarded as likely to have been marginal in the Roman period (Ottaway, 2011, 237). Fragmentary evidence for Roman settlement activity, along with a small number of burials, was identified cut into natural deposits at c.6m – 9.7m AOD during the Coppergate excavations, c.180m to the NE of Clifford Street (Ottaway, 2011, 201), but these were present on the banks of the River Foss, whereas the Clifford Street site overlies the slope into the much larger river valley of the Ouse. Roman material, if present, could be significantly deeper here as a result.

Clifford Street lies immediately south of a possible route for Roman Road 2 (RCHMY1; Brinklow, 1986, 85) but evidence for this was not identified during excavations in the York Castle car park, c.170m east of Clifford Street (Ottaway, 2011, 231-233) and it is suggested that a more accurate line for this road is in fact along the route of modern Fossgate, some 300m NE of the site (Ottaway, 2011, 196). Roman burials have been recorded at the Castle, but not in modern times.

4.1.3 Anglian

Anglian activity is very sparse in the Clifford Street area, being evidenced only by antiquarian records of burials at Castle Yard, which may have produced 7th century hanging bowls (Tweddle, 1999, 172). Anglian settlement was suggested by limited excavations at 5-13 Clifford Street but this was fragmentary and observed at c.3-4m below ground level (Hunter-Mann, 1990, 12), suggesting that if present material of this period is likely to occur at depth at this site.

4.1.4 Anglo-Scandinavian

Clifford Street lies c.180m SW of Coppergate, where the extensive and well-preserved remains of 9th-11th century settlement were identified as Jorvik, the Viking-period settlement of York (Hall, 2014). As with the Anglian remains, some limited evidence for Anglo-Scandinavian activity was encountered at 5-13 Clifford Street (Hunter-Mann, 1990a, 13); if present this evidence for this period may survive, and may be well-preserved by the inorganic conditions typically encountered in this area.

4.1.5 Medieval

Medieval archaeology on the Clifford Street site is likely to pertain to the Franciscan Friary that was present in this area. The friary was founded in c.1230 and was expanded in numerous stages up to 1314. The internal form of the friary has never been established, but significant buildings including the Kings Chamber, Chapter House and Kitchens all stood somewhere within the precinct. The friary was surrendered in 1538. (Tillott, 1961, 362).

Traces of the possible friary were identified immediately opposite the Clifford Street site at no. 23, in the form of robbed-out wall trenches and demolition rubble, suggested the clearance of the site after dissolution (Hunter-Mann, 1990b, 4). Any remains at the current site are likely to be similar, but structures could survive.

4.1.6 Post Medieval

Traces of the friary survived until the 19th century (Tillott, 1961, 362) and it is clear from historic mapping that the site in question was cleared by the 1850s. By this point the site is

shown as a series of formal gardens on the first edition Ordnance Survey map; deposits of garden soil were encountered at 23 Clifford Street in 1990 (Hunter-Mann, 1990b, 4-5).

4.1.7 Modern

The site was occupied from 1856 by Trinity Chapel, which was founded by New Connexion Methodists and used by different Methodist groups until 1935 when it was sold and adapted for use as an extension to the neighbouring fire station, which had opened in 1892. (Tillott, 1961, 413). This work retained only the eastern wall of the chapel, which faces on to Peckitt Street.

4.2 Previous archaeological work

4.2.1 Prior to current application

Investigations nearby which have been of any depth are relatively limited, with the nearby property of 23 Clifford Street producing the most indicative results.

Excavations in 1991 showed a burial and robbing which was most probably associated with the friary and just afterwards. This was sealed by 18th century garden soils.

Work in 2011 found four phases of activity; 9th - 11th century dumping/levelling, 11th-13th century pits hearths and possibly a ditch predating the friary, 13th- 15th structures such as a well and wall associated with the friary as well as possibly post Friary demolition activities. Again this was sealed by garden deposits.

Following the results of this previous work it is anticipated that there could be approximately 3.25m of archaeological deposits at the Clifford Street side of the site. Moving down towards the river it was anticipated that this would get considerably deeper.

4.2.2 Evaluation YAT 2016/19

4 trial trenches were excavated to a maximum depth of 1.25m BGL, and a series of 12 window sample boreholes was undertaken (Figures 1 and 2). The following sequence has been adapted from report YAT 2016/19.

- *Natural deposits*

  Natural clay was identified at c. 7.5.m BGL/3.5m AOD in Borehole 1 on the Clifford St frontage and at c. 9.5m BGL/0.5m AOD in Borehole 10, some 42m to the SW. Natural was also identified in boreholes 3, 6 and 11. In addition deposits at 7-9m BGL in the other boreholes were much cleaner and clayey that those above them, possibly suggesting that the interface with natural deposits may not have been much further down. The overlying strata and the modern surface suggest that natural deposits are relatively high and fairly flat up to approximately 15-20m from the north-east end of the survey, after which point it drops down towards the SW. Measurements taken from boreholes 10 and 11 suggest the existence of a plateau before the natural deposits slope fairly sharply down towards the River Ouse in this area.

- *Alluvial silts*

  Overlying natural deposits was a group of banded clayey natural material and silty alluvial deposits that may relate to river activity (tidal and flooding). The upper

surface of this group was identified at between c. 4.5m BGL/6.5m AOD to the NE, sloping down to c.6.5m BGL/4.5m AOD at the SW. There was found to be a significant discrepancy between the heights of these deposits either side of borehole 3, approximately 15m from the Clifford St frontage and borehole 7, located *c.*5m further to the SW. To the SW of borehole 7 the alluvial deposits build up to *c.*4m BGL/7m AOD. Measurements taken from borehole 3 show them to be much lower, being at *c.*7m BGL/5m AOD before rising steadily to the NE.

These deposits become more organic from c.5m BGL down; unfortunately no dating evidence was retrieved from these depths but finds of animal bone fragments and charcoal confirm that these deposits are archaeological and suggest that conditions may be conducive for survival of organic remains at this depth.

- *Medieval build-up/reclamation and structures*

The next group of deposits consisted of re-worked clayey natural material and possible dumps of sandy silt containing frequent flecks and small fragments of limestone. The upper surface of this group was observed between c.3m BGL/8m AOD at the NE, sloping down to c.4m BGL/7m AOD in the SW. It should be noted that there is some fluctuation across the extent of the survey area; however this is largely within the range of 7-8m AOD.

Mortared limestone walls were encountered in boreholes 2 and 12. In Borehole 2 the presumed wall was found at c. 3.5mBGL/7.5m AOD, extending to c. 5mBGL/6m AOD. In Borehole 12 the apparent wall was found at c. 4mBGL/7m AOD, extending to c.6.5mBGL/4.5m AOD.

The deposits probably relate to land reclamation in the medieval period associated with the friary, with the walls themselves potentially representing part of the friary buildings. In seven of the boreholes varying thicknesses of mortar, limestone and CBM rubble were observed at or around the interface with the generally darker siltier overlying deposits. The upper elements of this group may relate to the demolition of the friary structures although relatively little definitive demolition material was identified.

- *Post-medieval garden soils*

A layer of homogenous probable horticultural soils was identified, with its upper surface at c. 1.2m BGL/9.8m AOD at the NE end, sloping down to c. 2.5m BGL/7.5m AOD at the SW end. The considerable variation in the profile evident across boreholes 1-3 probably represents disturbance caused by 19th and 20th century building activity. In trench 4, the garden soil was represented by context 4009, which produced a residual medieval limestone door jamb, interpreted as originally deriving from the friary.

- *Modern activity*

The upper c.1-2m of each borehole consisted of rubbly material derived from 19th and 20th century construction and subsequent demolition of structures in this

area. In evaluation trench 1 a probable aisle wall of the 1856 Trinity Chapel was identified, and additional 19th century walls were identified in trench 3.

The recent evaluation concluded that, on the basis of the recovered data, it is possible that surviving structures relating to the friary survive at a depth of c.7.5m AOD at the NE end of the site, with related activity present to the SW to a depth of c.6m AOD. Above these, the deposits identified during the evaluation trenching are likely to represent the demolition of the friary remains and the establishment of post-medieval gardens, prior to the construction of the Methodist Chapel in 1856.

Below c.6m AOD, the deposits identified by borehole may represent alluvial action of the tidal River Ouse and could include evidence for activity from the Roman, Anglian and Anglo-Scandinavian periods. This material exhibits a degree of organic preservation and could potentially be of national importance.

5 PROPOSED DESIGN AND IMPACT ON ARCHAEOLOGICAL SEQUENCE

5.1 Foundation design

5.1.1 The proposed design comprises two buildings, a restaurant/residential building at the front of the site and a residential block at the rear of the site (Figures 3-6).

5.1.2 The development site is c.1435m² in area. Current ground level slopes from NE to SW from c.10.9m AOD to c.8.6m AOD.

5.1.3 The proposed restaurant/residential block includes a sub-basement carpark and access ramp (Figures 4 and 5). The formation depth of this structure (including beams and blinding) is 7.85m AOD.

5.1.4 The proposed rear residential block includes a basement flood water holding tank (Figure 5). The formation depth of this structure (including beams and blinding) is 8.4m AOD.

5.1.5 The development will be founded on piles (Figures 4-6 for layout and section). The current proposal is for a total of 148 continuous flight auger (CFA) piles of 450mm diameter. The pile caps are located at the formation depths specified above.

5.2 Impact of restaurant/residential building on archaeological deposits

5.2.1 The archaeological sequence as currently understood has been presented as a profile drawing with the indicative location, extent and formation depth of below-ground structures shown (Figure 2).

5.2.2 The restaurant/residential building is 749m² in area, of which the basement amounts to 493m² and the remainder 256m² (Figures 4 and 5). Within the footprint of the basement, current ground level is between c.10.8m and c.10m AOD; the formation depth is 7.85m AOD. The excavation for the basement will be between 2.15 and 2.95m deep, removing a volume of between c.1060 and c.1454m³.

5.2.3 The basement carpark excavation will impact on the following deposit groups identified in the recent evaluation:

- 19th/20th century activity: demolition and levelling material and foundation

structures
- Post-medieval garden soils
- Medieval build-up and land reclamation

5.2.4 Within these deposits may survive the following archaeological remains:

- structural elements of the 19th century Methodist chapel and associated structures
- residual fragments of demolition material from the Franciscan Friary within the later garden soils
- *in-situ* remains of Friary structure and associated deposits.

5.2.5 By area, the basement car park will remove c.34% of the 19th and 20th century activity, and c.34% of the post-medieval garden soils of the total site area. Very little of the potential Friary remains and medieval build-up / land reclamation deposits will be removed as these deposits lie at the formation depth of the structure. There is an opportunity to expose and record these potential Friary deposits as a result of this proposal, without significantly impacting upon them.

5.2.6 The potential waterlogged organic deposits identified in the evaluation lie c.3m below the formation depth of the basement carpark and therefore none of these deposits will be removed by the carpark excavation.

5.2.7 114 CFA piles are proposed for the restaurant/residential building (Figure 4), which will impact on the medieval and earlier deposits, some of which may contain water logged organic material. The pile proposal for this building measures 18.2m² and will remove approximately 1.3% of these deposits.

5.2.8 The remaining c.256m² area of the restaurant/residential building outwith the basement will remove up to 0.4m of the 19th and 20th century deposits, representing 18% of this deposit group.

5.3 Impact of flood water tank and associated building on archaeological deposits

5.3.1 The archaeological sequence as currently understood has been presented as a profile drawing with the indicative location, extent and formation depth of below-ground structures shown (Figure 2).

5.3.2 The proposed flood water tank is 291m² in area, representing the entire footprint of the rear residential structure (Figure 6). Current ground level here is between c.9.4m and c.8.6m AOD; the formation depth is 8.4m AOD. The excavation for this structure will therefore be between 0.2 and 1m deep, removing a volume of up to 291m³.

5.3.3 The rear residential flood tank excavation will impact on the following deposit groups identified in the recent evaluation:

- 19th/20th century activity: demolition and levelling material and foundation structures
- Post-medieval garden soils

5.3.4 Within these deposits may survive the following archaeological remains:

- structural elements of the 19th century Methodist chapel and associated structures

- residual fragments of demolition material from the Franciscan Friary within the later garden soils

5.3.5 By area, the basement carpark will remove c.20% of the 19th and 20th century activity, and c.20% of the post-medieval garden soils over the total site area.

5.3.6 The potential waterlogged organic deposits identified in the evaluation lie c.3.4m below the formation depth of the rear residential building and therefore none of these deposits will be removed by the flood tank excavation.

5.3.7 34 CFA piles are proposed for the rear residential building, which will impact on the deeper deposits. The pile proposal for this building (Figure 6) will remove approximately 0.4% of these deposits.

5.4 Total impact of development on archaeology

5.4.1 The impact of the proposed development amounts to (by total area of the site):

- c.72% of the 19th and 20th century activity
- c.54% of the post-medieval garden soils
- c.1.7% of the medieval and earlier deposits, including those potentially containing waterlogged organic material

5.4.2 Based on the archaeological sequence as currently understood, the impact of the below-ground structures and piling on the deeply buried potentially waterlogged organic deposits is considered to be minimal. Up to 1.7% of the potentially waterlogged organic deposits will be directly affected by piling, and the potential waterlogged deposits lie well below the formation depth of the below-ground structures.

5.4.3 As the limited amount of piling is anticipated to provide little or no impediment to water movement through the potentially waterlogged organic deposits the potential for any resultant 'halo' effect is considered to be minimal. This hypothesis will be tested by a further borehole evaluation to locate and sample the potential waterlogged organic deposits and assess their condition, and by a subsequent programme of water-level monitoring (Figure 3).

5.4.4 This further borehole evaluation and re-assessment of impact can then inform future consideration of the design of the proposed below-ground structures and piling.

5.5 Mitigation of waterlogged organic deposits

5.5.1 In discussion with the City of York Archaeologist, John Oxley, and the YAT Principal Conservator, Ian Panter, it is proposed that an appropriate mitigation strategy for the impact of the development on any waterlogged, organic deposits would consist of incorporating a system of collecting and distributing rainwater into these deposits through the design of the buildings' foundations.

5.5.2 A model for this approach would be the Guy's Hospital development, where a water-logged Roman river craft, a Scheduled Ancient Monument, has been protected by a similar scheme.

5.5.3 The client has committed to designing, installing and, on the recommendation of the City of York Archaeologist, activating this mitigation strategy irrespective of the condition of any significant waterlogged organic deposits identified in the evaluation boreholes.

5.5.4 The client has committed to a programme of on-going water monitoring post-development to assess the impact of the development and of the proposed mitigation strategy.

6 AIMS OF FURTHER BOREHOLE EVALUATION

6.1 The aims of further borehole evaluation would be:

- to determine the extent, condition and character of the deposits identified in the recent archaeological evaluation as potentially containing waterlogged organic material

- to install dip-wells and undertake a programme of water-level monitoring to determine the impact of the development on these deposits

7 EVALUATION METHODOLOGY

7.1 The evaluation will comprise the following elements:

- 3 point borehole survey
- AMS dating of waterlogged deposits if suitable material is recovered (SUERC)
- Specialist assessment for environmental potential (YAT)
- Specialist assessment for environmental condition (GEOLABS)
- Monitoring of water levels

Please note that further stages of work or other mitigation measures could be required by the local authority, depending upon the results of the evaluation.

7.2 Three window sample boreholes will be drilled using a compact tracked rig in locations where the proposed development will not prevent on-going water monitoring post-construction. The proposed location of these boreholes is shown on Figure 3. Two possible locations are shown for #2; the one within the existing building is the preferred location. It is highly likely that below ground constraints (see 3.2 above) will result in the final location of boreholes varying from those proposed. In this case the boreholes will be placed where they can offer the maximum amount of information to complete the aims of the project.

7.3 Where boreholes will be located using GPS survey equipment, all measurements will be accurate to +/-25mm. If this is not possible trench locations will be accurately plotted using an EDM Total station, by measurement to local permanent features shown on published Ordnance Survey maps. All measurements will be accurate to +/-10cm, and locatable on a 1:2500 Ordnance Survey map. This is to ensure that the boreholes can be independently relocated in the event of future work.

7.4 The boreholes will use window sample cores to identify and refine the sequence already ascertained on the site by the previous borehole evaluation. The recording methodology is set out in section 8. The aim is to locate the deposits already identified as being of organic potential and target the sample strategy on them.

7.5 When the potential organic deposits identified during the recent evaluation are reached, environmental samples will be taken for General Biological Analysis from the core and if present, suitable material will be sent for AMS dating (see section 9 for Specialist Assessment).

7.6 When organic deposits are reached, a 100mm diameter Shelby Tube will be inserted to recover 2no 300mm long Class 1 undisturbed samples per borehole for further specialist assessment (section 9).

8 RECORDING METHODOLOGY FOR BOREHOLE SURVEY

8.1 All boreholes will be recorded using standardised pro forma record sheets and related to Ordnance Datum. Borehole cores will be examined in the field by an archaeologist suitably experienced in the deep stratigraphic nature of York's archaeological deposits. The results will then be cross referenced to deposits identified in the recent evaluation (YAT 2016/19) where possible.

8.2 Each context will be described in full on the pro forma borehole record sheet in accordance with the accepted context record conventions. Each context will be given a unique number. These field records will be checked and indexes compiled.

8.3 Photographs of work in progress and recovered cores will be taken. The photographic record will comprise of digital photographs of not less than 10 mega-pixels. All site photography will adhere to accepted photographic record guidelines.

8.4 All finds will be collected and handled following the guidance set out in the IfA guidance for archaeological materials. Unstratified material will not be kept unless it is of exceptional intrinsic interest. Material discarded as a consequence of this policy will be described and quantified in the field. Finds of particular interest or fragility will be retrieved as Small Finds, and located on plans. Other finds, finds within the topsoil, and dense/discrete deposits of finds will be collected as Bulk Finds, from discrete contexts, bagged by material type.

8.5 All artefacts and ecofacts will be appropriately packaged and stored under optimum conditions, as detailed in the RESCUE/UKIC publication *First Aid for Finds,* and recording systems must be compatible with the recipient museum. All finds that fall within the purview of the Treasure Act (1996) will be reported to HM Coroner according to the procedures outlined in the Act, after discussion with the client and the local authority.

9 SPECIALIST ASSESSMENT

9.1 The stratigraphic information, artefacts, soil samples, and residues will be assessed as to their potential and significance for further analysis and study. The material will be quantified (counted and weighted). Specialists will undertake a rapid scan of all excavated material. Ceramic spot dates will be given. Appropriately detailed specialist reports will be included in the report.

9.2 Materials considered vulnerable should be selected for stabilisation after specialist recording. Where intervention is necessary, consideration must be given to possible

investigative procedures (e.g. glass composition studies, residues on or in pottery, and mineral-preserved organic material). Allowance will be made for preliminary conservation and stabilization of all objects and a written assessment of long-term conservation and storage needs will be produced. Once assessed, all material will be packed and stored in optimum conditions, in accordance with Watkinson and Neal (1998), IfA (2007) and Museums and Galleries (1992).

9.3 All finds will be cleaned, marked and labelled as appropriate, prior to assessment. For ceramic assemblages, any recognised local pottery reference collections and relevant fabric Codes will be used.

9.4 Sampling will be carried out in consultation with the City of York Archaeologist, YAT specialists and the English Heritage Regional Science Advisor, as appropriate.

9.5 All sampling for environmental and biological material will take place in accordance with the recommendations contained in the papers Environmental Archaeology and Archaeological Evaluations, Association for Environmental Archaeology (1995) and Environmental Archaeology: A Guide to the Theory and Practice of Methods from Sampling and Recovery to Post -Excavation 2nd Edition (English Heritage 2011).

9.6 General Biological Analysis (GBA) samples from the potential waterlogged organic deposits will be processed and assessed by specialist staff at the YAT Dickson Laboratory for Bio-Archaeology. The purpose of these samples is to establish baseline conditions regarding preservation of organic remains, by characterising the potential organic deposits via the recovery of charcoal, burnt seeds, bone, artefacts, macrofossils and microscopic remains such as pollen and insects.

9.7 If suitable material is identified within the GBA samples then it will assessed and submitted for AMS dating. This will be conducted by SUERC and will aim to date samples from the top and bottom of the sequence of potential waterlogged organic deposits, with at least one intermediate point, to contribute to the understanding of the archaeology.

9.8 2no undisturbed samples of the organic deposits will be collected per borehole for further specialist assessment at Geolabs. These will be tested to ascertain the quality and condition of the waterlogged organic deposits using the following techniques:

- Triaxial permeability testing
- Porosity/bulk density/moisture content testing
- Particle size distribution analysis
- Chemical redox potential testing

9.9 60mm diameter standpipes will be inserted into each borehole, surrounded by gravel and Bentonite surrounds and capped with a lockable cover.

9.10 Weekly monitoring of the water levels will be undertaken by YAT staff for a period of 6 months, when there will be an assessment of the results and a report will be made to the client and the City of York Archaeologist, John Oxley.

10 REPORT & ARCHIVE PREPARATION

10.1 Upon completion of the site work, a report will be prepared to include the following:

a) A non-technical summary of the results of the work.

b) An introduction which will include where possible the planning reference number, grid reference and dates when the fieldwork took place.

c) An account of the methodology and detailed results of the operation, describing structural data, archaeological features, associated finds and environmental data, and a conclusion and discussion.

d) A selection of photographs and drawings, including a detailed plan of the site accurately identifying the areas monitored and selected drawings where appropriate.

e) Specialist artefact and environmental reports where undertaken, and a context list/index.

f) Details of archive location and destination (with accession number, where known), together with a context list and catalogue of what is contained in that archive.

g) A copy of the key OASIS form details

h) Copies of the Brief and WSI

i) Additional photographic images may be supplied on a CDROM appended to the report

10.2 Copies of the report will be submitted to the commissioning body. A bound and digital copy of the report will be submitted direct to the City Archaeologist for planning purposes, and subsequently for inclusion into the HER.

10.3 A field archive will be compiled consisting of all primary written documents, drawings and photographs. Catalogues of contexts, finds, soil samples, drawings and photographs will be produced.

10.4 The owner of the Intellectual Property Rights (IPR) in the information and documentation arising from the work, would grant a licence to the Local Authority and the museum accepting the archive to use such documentation for their statutory functions and provide copies to third parties as an incidental to such functions. Under the Environmental Information Regulations (EIR), such documentation is required to be made available to enquirers if it meets the test of public interest. Any information disclosure issues would be resolved between the client and the archaeological contractor before completion of the work. EIR requirements do not affect IPR.

10.5 Upon completion of the project an OASIS form will be completed at http://ads.ahds.ac.uk/project/oasis/.

11 POST EXCAVATION ANALYSIS & PUBLICATION

11.1 The information contained in the evaluation report will enable decisions to be taken regarding the future treatment of the archaeology of the development site and any material recovered during the evaluation.

11.2 If further archaeological investigations (mitigation) take place, any further analyses (as recommended by the specialists, and following agreement with City of York Archaeologist) may be incorporated into the post-excavation stage of the mitigation programme unless such analysis are required to provide information to enable a suitable mitigation strategy to be devised. Such analysis will form a new piece of work to be commissioned.

11.3 In the event that no further fieldwork takes place on the site, a full programme of post excavation analysis and publication of artefactual and scientific material from the evaluation may be required by City of York Archaeologist. Where this is required, this work will be a new piece of work to be commissioned.

11.4 If further site works do not take place, allowance will be made for the preparation and publication in a local and/or national journal of a short summary on the results of the evaluation and of the location and material held within the site archive.

12 HEALTH AND SAFETY

12.1 Health and safety issues will take priority over archaeological matters and all archaeologists will comply with relevant Health and Safety Legislation.

12.2 A Risk Assessment will be prepared prior to the start of site works.

13 PUBLIC ENGAGEMENT

13.1 The City of York recognises the importance of engaging the public in archaeological issues. Excavations within the City generate significant levels of public interest as well as affording the opportunity for people to see the process as it happens.

13.2 YAT is a leader in the field public engagement with archaeology and has a proven track record of integrating public access and presentation into active archaeological projects. The positive responses to this work have created positive press, goodwill towards redevelopment as well as enabling new developments to be ‘placed’ within the history of their surrounds.

13.3 Public engagement will only take place with the permission of the client.

14 PRE-START REQUIREMENTS

14.1 The client will be responsible for ensuring site access has been secured prior to the commencement of site works, and that the perimeter of the site is secure.

14.2 The client will provide York Archaeological Trust with up to date service plans and will be responsible for ensuring services have been disconnected, where appropriate.

14.3 The client will be responsible for ensuring that any existing reports (e.g. ground investigation, borehole logs, contamination reports) are made available to York Archaeological Trust prior to the commencement of work on site.

15 REINSTATEMENT

15.1 Dip-wells will be installed in each borehole and surrounded with gravel and Bentonite. A lockable cover will be fitted.

16 TIMETABLE & STAFFING

16.1 The survey is proposed to commence post-determination of the application at a time to be agreed with the client.

16.2 Specialist staff available for this work are as follows:

- Palaeoenvironmental remains – Dr Jennifer Miller (Dickinson Laboratory for Bio-archaeology
- Conservation and assessment of organic deposits – Ian Panter
- Head of Curatorial Services - Christine McDonnell
- Finds Researcher - Nicky Rogers
- Pottery Researcher - Anne Jenner
- Finds Officers – Nienke Van Doorn

17 MONITORING OF ARCHAEOLOGICAL FIELDWORK

17.1 As a minimum requirement, the City of York Archaeologist will be given a minimum of one week's notice of work commencing on site, and will be afforded the opportunity to visit the site during and prior to completion of the on-site works so that the general stratigraphy of the site can be assessed and to discuss the requirement any further phases of archaeological work. York Archaeological Trust will notify City of York Archaeologist of any discoveries of archaeological significance so that site visits can be made, as necessary. Any changes to this agreed WSI will only be made in consultation with City of York Archaeologist.

18 COPYRIGHT

KEY REFERENCES

Briden, C., 1997, 'York as a tidal port', in *Yorkshire Archaeological Journal*, Volume 69, pp 165-171

Brinklow, D., 1986, *Coney Street, Aldwark and Clementhorpe, Minor Sites and Roman Roads*, Archaeology of York 6/1, York Archaeological Trust

Brown, D. H. 2007. Archaeological Archives: a guide to best practice in creation, compilation, transfer and curation. IfA/AAA

Department for Communities and Local Government 2010 Planning Policy Statement 5: planning for the Historic Environment.

English Heritage. 2001. *Archaeometallurgy*. Centre for Archaeology Guidelines.

English Heritage. 2002. Environmental Archaeology. A guide to the theory and practice of methods from sampling and recovery to post-excavation.

English Heritage. 2002. With Alidade and Tape – graphical and plane table survey or archaeological earthworks.

English Heritage. 2003. Where on Earth are We? The Global Positioning System (GPS) in archaeological field survey.

English Heritage. 2004. Geoarchaeology: using earth sciences to understand the archaeological record.

English Heritage. 2005 Guidance for Best Practice for Treatment of Human Remains Excavated from Christian Burial Grounds in England.

English Heritage. 2006. Guidelines on the x-radiography of archaeological metalwork.

English Heritage. 2006b. Management of Research Projects in the Historic Environment: The MoRPHE Project Managers' Guide.

English Heritage. 2007. Understanding the Archaeology of Landscape – a guide to good recording practice

English Heritage. 2008. Investigative Conservation.

Hall, R.A., 2014, *Anglo-Scandinavian Occupation at 16-22 Coppergate*, Archaeology of York 8/5, York Archaeological Trust

Hunter-Mann, K., 1990a, 'Excavations at Clifford Street', in *Archaeology in York*, Volume 15 Number 1, pp 11-16, York Archaeological Trust

Hunter-Mann, K., 1990b, 'Clifford Street Revisited', in *Archaeology in York*, Volume 15 Number 2, pp3-8, York Archaeological Trust

Hunter-Mann, K., 1994, 'Prehistoric York through the key-hole', in *Archaeology in York*, Volume 19 Number 3, pp4-8, York Archaeological Trust.

Institute for Archaeologists. 1993. Technical paper No 13 by McKinley, J. I., and C. Roberts. *Excavation and post-excavation treatment of cremated and inhumed human remains*.

Institute for Archaeologists. 2007. Archaeological Archives: A guide to best practice in creation, compilation, transfer and curation by D.H. Brown.

Institute for Archaeologists. 2008. Standard and Guidance for the Collection, Documentation, Conservation and Research of Archaeological Materials.

Institute for Archaeologists. 2008. Standard and Guidance for Archaeological Field Evaluation

Museum and Galleries Commission. 1992. Standards in the museum care of archaeological collections.

Ottaway, P., 2011, *Archaeology in the Environs of Roman York: Excavations 1976 – 2005*, Archaeology of York 6/2, York Archaeological Trust

RCHME, 1962, *An Inventory of the Historical Monuments in the City of York: Volume 1 Eboracum, Roman York*, HMSO.

RCHMS. 1999. 'Recording Archaeological Field Monuments – a descriptive specification.

Standing Conference of Archaeological Unit Managers (SCAUM). 2007. *Health and Safety in Field Archaeology*

Tillott, P.M. (Ed), 1961, *A History of Yorkshire: The City of York*, Victoria County History

Neal, V., and D. Watkinson (eds). 1998. *First Aid for Finds: practical guide for archaeologists.* United Kingdom Institute for Conservation of Historic & Artistic Works, Archaeology Section; 3rd Revised Edition.

See also the Historic England website for a full list of Historic England Guidance documents.

http://historicengland.org.uk/advice/

APPENDIX 8 – DEPOSIT CHARACTERISATION BY S. CARSON

1. Introduction

A borehole survey conducted in 2016 at the site of the former fire station, Clifford Street, York identified up to 2m of 19th and 20th century deposits followed by a further 1-2m of possible post-medieval garden soils and up to 2m of accumulated medieval deposits. Below these, a further c.4-5m of banded re-worked and alluvial silts were identified. Specific areas within the borehole samples were selected for sub sampling to establish if the individual deposits were in any way mixed and altered.

2. Methodology

Boreholes were sub sampled in the field, bagged and sent for specialist assessment. Individual samples were visually assessed, identified and characterised in the laboratory. This was achieved by determining texture following Avery (1973) with reference to McMillan & Powell (1999) and colour following Munsell (2009). All descriptions and processes undertaken conform to guidelines set out by English Heritage (Ayala et al 2007).

3. Results

Borehole 13

(6004) <1> top of alluvium

Black (10YR 2/1) sandy silt. The material was a homogenous soil with a loose crumb structure. No laminations or other characteristics indicative of fluvial or alluvial deposition were observed. The soil contained a range of inclusions with occasional fragments of oyster shell, CBM/pottery, charcoal, flint and bone, some of which was calcined. The overall characteristic of the deposit was that of an organic soil.

(6004) <2> middle of alluvium

Very dark greyish brown (10YR 3/2) sandy silt. The deposit was characterised as a homogenous organic soil with a loose crumb structure. No laminations or other characteristics indicative of fluvial or alluvial deposition were observed. The soil contained a range of inclusions with occasional fragments of oyster shell, CBM/pottery, charcoal and uncarbonised plant tissue, likely derived from modern roots. The overall characteristic of the deposit was that of an organic soil.

(6004) <3> bottom of alluvium

Black (5Y 2.5/1) sandy clay with occasional charcoal, CBM and stone inclusions of variable size and shape. The deposit was very wet unconsolidated and homogenous with no visible laminations or other characteristics commonly associated with alluvial deposition.

(6003) <4> bottom of land reclamation

The sample was very wet unconsolidated and homogenous in nature, described as a brown (7.5YR 4/4) sandy clay. Frequent stone inclusions of variable size and shape were observed with occasional degraded plant remains, possibly roots. Areas of manganese and iron staining were observed.

Borehole 14

(6009) <5> top of alluvium

Black (2.5Y 2.5/1) fine sandy silt with no laminations, partings or other characteristics indicative of fluvial or alluvial deposition. A general marled appearance was observed with extensive fissures, indicative of some degree of post depositional alteration and mixing. The deposit contained a range of inclusions with occasional fragments of charcoal, uncarbonised plant tissue and possibly modern roots. The sample had become unconsolidated and altered during transit.

(6009) <6> middle of alluvium

The deposit was a very dark grey (2.5Y 3/1) silty clay with multiple fine laminations and fine sand partings, typical of alluvial deposition. Evidence of fissuring was observed caused by post depositional alteration and mixing by modern roots. No other inclusions were observed.

(6009) <7> bottom of alluvium

The deposit was a very dark grey (2.5Y 3/1) silty clay with multiple fine laminations and fine sand partings, indicative of alluvial deposition. Occasional organic inclusions of charcoal, plant tissue and calcined bone were observed, with frequent small angular pebble inclusions.

(6008) <8> bottom of land reclamation

The sample was very wet unconsolidated and homogenous in nature described as a dark brown (7.5YR 3/3) sandy clay. Frequent stone inclusions of variable size and shape were observed with occasional degraded plant remains, possibly roots and possible charcoal. Areas of manganese and iron staining were observed.

Borehole 15

(6016) <9> top of alluvium

The deposit was described as a very dark grey (5Y 3/1) sandy silt with occasional inclusions of sub angular stones, charcoal and mortar material. The sample appeared to be somewhat homogenous in nature and very mixed, likely to have occurred during transit. The deposit was very wet, loose and unconsolidated.

(6018) <10> middle of alluvium

The deposit was described as a black (5Y 2.5/1) silty clay with occasional inclusions of charcoal and bone and frequent large stones. The sample appeared to be homogenous in nature and very mixed which may or may not have occurred during transit. The deposit was wet, very loose and unconsolidated.

(6020) <11> bottom of alluvium

Described as very dark greyish brown (5Y 3/2) sandy silt with occasional inclusions of angular flint stones. The sample was homogenous and displayed a very mixed appearance which may or may not have occurred during transit. The deposit was very unconsolidated and wet, with a very soft loose structure.

(6013) <12> bottom of land reclamation

The deposit was a very dark greyish brown (10YR 3/2) coarse sandy silt, primarily composed of sub rounded gravel and stone inclusions. Other inclusions observed were occasional fragments of bone, CBM and mortar. No evidence for post depositional alteration was observed.

4. Discussion

The primary objective of this investigation was to determine if the deposits were mixed or contained components from the overlying or underlying deposits. It was not possible to definitively establish this because the horizon or boundary between the individual deposits were not recorded *in situ* and sub samples were extracted in the field before such salient observations were conducted as part of the deposit characterisation. Observations of the boundary between deposits allude to the occurrence and extent of post depositional alteration within and between the individual deposits.

Many of the deposits contained a number of visible inclusions including bone, CBM/pottery and charcoal. It is not possible to determine the extent of post depositional alteration of the deposits and the degree of any possible mixing between deposits other than fissuring and possible root bioturbation described previously therefore such inclusions may or may not be in a primary context.

5. Bibliography

Avery, B.W. 1973. Soil Classification in the Soil Survey of England and Wales. *Journal of Soil Science 24, 324-38.*

Ayala, G., Canti, M., Heathcote, J., Sidell, J. and Usai, R. 2007. *Geoarchaeology: Using Earth Sciences to Understand the Archaeological Record*. Swindon: English Heritage.

McMillan, A.A. & Powell. J.H. 1999 BGS Rock Classification Scheme 4. Classification of artificial (man-made) ground and natural superficial deposits – applications to geological maps and datasets in the UK. British Geological Survey Research Report RR 99-04

Munsell Color Company 2009 Munsell Soil Color Charts. Revised ed. Munsell Color Company, X - Rite America, Grand Rapids, Michigan.

Former Fire Station 5905				Flot Constituents Abundance Scale 1-5									
Sample	Context	BH	Charcoal	Cereal	Nutshell	Shell/Mollusc	Bone	Antler	Pottery	CBM	Mortar	Worked Stone	Metal
1	6004	13	+++	-	-	++	++++	-	++	+++	++	-	+
2	6004	13	+++	+	-	++++	++++	-	++	+++	+	+	-
3	6004	13	++	-	+	++	+++	-	-	+	+	-	-
4	6003	13	+	-	-	+	+	-	-	+++	+	-	-
5	6009	14	++	-	-	-	++	-	-	++	-	-	-
6	6009	14	+	-	-	-	-	-	-	-	-	-	-
7	6009	14	+++	-	-	++	++	-	+	++	-	-	-
8	6008	14	+	-	-	-	+	-	-	+	-	-	-
9	6016	15	++	-	-	-	+++	-	-	++	+	-	-
10	6018	15	+	-	-	++	+++	-	+	++	++	-	-
11	6020	15	+++	-	-	++	++	-	-	-	-	-	-
12	6013	15	+++	-	-	+	+++	++	-	++++	+	-	-

Table 5 Retent assessment table

1	6004	13	+++	++	++	-	++	++	-	-
2	6004	13	++++	++	-	+	++	-	-	++
3	6004	13	+++	++	+	-	-	++	-	-
4	6003	13	-	-	-	-	-	-	-	-
5	6009	14	++	+	-	-	-	-	-	-
6	6009	14	++	+	+	-	-	-	+	-
7	6009	14	++	++	-	++	-	-	-	-
8	6008	14	++	+	-	-	-	++	-	-
9	6016	15	+++	+++	-	-	-	-	-	-
10	6018	15	-	++	-	-	++	-	-	-
11	6020	15	+++	+	-	-	-	-	-	-
12	6013	15	+++	-	-	-	++	-	-	++
	Wet									

Table 6 Flot assessment table

APPENDIX 9 - ASSESSING BASELINE CONDITIONS AT THE SITE OF THE FORMER FIRE STATION, CLIFFORD STREET, YORK

Methodology

To characterise the sub-surface environment, three additional boreholes were drilled between the 26th and 27th May 2016, using a lightweight windowless dynamic rig, with the capability of collecting 1.0m long continuous undisturbed soil columns extracted in Perspex tubes. Each borehole was completed by the insertion of a 60mm diameter slotted dipwell, capped and sealed with bentonite clay from the surface to a depth of 1.0m to prevent surface water ingress. The borehole locations provide a transect across the site from the Clifford Street forecourt (designated BH13, sunk to a depth of 9.0m below ground surface), inside the building (BH14, sunk to 8.5m below ground surface) and adjacent to the river Ouse waterfront, to the rear of the complex (BH15, completed at c. 7.0m below ground surface). The locations were carefully selected to enable post-construction monitoring, assuming the well-heads survive.

Baseline characterisation of the deposits involved collecting sediment sub-samples to assess key geochemical and physical parameters, as well as the presence and abundance of palaeoenvironmental evidence.

Geochemical assay: certain chemical species can only exist under specific conditions and hence their presence or absence can be used to help define soils and sediments as to whether they are oxidising or reducing environments. The standard suite of "redox sensitive parameters", (as they are often referred to) are listed in the table below, along with the class of microbes associated with the type of burial environment. Furthermore, as these chemicals species react with others, the redox reaction that follows (redox is shorthand for reduction/oxidation) generates a transfer of electrons from one chemical species to another, and this transfer can be measured in the field using a specific electrode and mVolt meter.

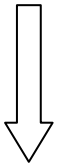
Description	Species present/absent	Redox value mV	Microbes present	Decreasing rate of decay
Oxidising	Oxygen	400 and above	Aerobes	
Mildly reducing	Nitrate, Manganese (Mn^{4+}) decline,	100 to 400	Facultative anaerobes	
Reducing	Sulphate, ferric Iron (Fe^{3+}) present	-100 to 100	Facultative anaerobes and obligate anaerobes	
Highly reducing	Sulphate and ferric Iron (Fe^{3+}) disappear Sulphur (S^{2-}), ammonium (NH_4^{+}), ferrous Fe^{2+} and methane present	-400 to -100	Obligate anaerobes	

Table 7 Redox Sensitive Parameters

Facultative anaerobes can survive when oxygen is present or absent, and obligate anaerobes die in the presence of oxygen. The energy produced by obligate anaerobes is much lower than that of aerobes hence decay rates are much slower, almost imperceptible, but it is worth repeating that decay continues in highly reducing deposits.

The detection and measurement of these redox sensitive parameters is now a standard procedure for in situ preservation research, including commercially funded developments, where geochemical assays are widely used to supplement a ground water monitoring programme.

To classify the below-ground deposits at the Fire station site, samples were analysed for iron, nitrogen and sulphur content, as well as moisture content and pH (a measure of the acidity/alkalinity of the sediment). Samples, each approximately 200g, were stored in airtight screw-lid plastic containers and kept at 5°C in a cold box until analysis by Derwentside Environmental Testing Services, based in Consett, Co. Durham.

Physical testing: the flow of groundwater through the sub-surface deposits will be influenced by several factors including the composition of the sediments (i.e. proportions of clay, silt and sand), the permeability (hydraulic conductivity) of the sediments as well as their porosity (the portion of the soil occupied by pore spaces). Composition and permeability are measured directly from intact column samples, whilst porosity can be calculated from bulk density and particle density, using a standard density of 2.65g/cm3 for inorganic material. Moisture content and the organic content calculated by Loss on Ignition (weight loss after igniting a sample at 450° C) were also measured. Intact and continuous column samples were sealed into the Perspex tubes, taken directly from the drilling rig, and sent to Geolabs, Watford, for analyses. Sample retrieval from BH15 proved impossible, despite repeated attempts, and hence only four samples could be analysed - two each from BH13 and BH14.

Water level monitoring: a six-month programme of water level monitoring (June to December 2016) has now been initiated to clarify the hydrology regime for the sub-surface deposits, and identify any potential risk or opportunity that may come about resulting from the proposed redevelopment. Water levels are measured on a weekly basis using an audible dip-meter, and the results will be presented in a separate report early in 2017.

Palaeoenvironmental assessment: the degree of preservation of organic biological remains is often a good indicator of the nature of the burial environmental, with best preservation found where deposits are stagnant, waterlogged and highly reducing. To assess the degree of survival spot GBA (General Biological Assessment) samples were collected from each borehole and processed at the in-house environmental laboratory in Glasgow. Samples were washed over a succession of fine sieves and the various categories of materials, and their abundance noted, and quantified.

Results

Geochemical tests:

	Sample ID	BH13.S13	BH13.S14	BH14.S16	BH14.S18	BH15.S19	BH15.S20
	Depth	4.30-4.45	6.50-7.00	2.00-2.90	7.40-7.50	4.70-4.85	6.00-6.20
Preparation							
Moisture Content	%	43	20	22	22	22	31
Metals							
Iron	mg/kg	15000	23000	14000	21000	26000	25000
Manganese	mg/kg	590	210	210	2000	470	790
Inorganics							
pH		8.0	8.0	7.2	7.7	8.2	8.0
Ammoniacal Nitrogen as N	mg/kg	28	76	29	180	24	25
Nitrate as NO^3	mg/kg	3.3	5.9	5.7	9.2	9.7	5.4
Sulphide	mg/kg	< 10	<10	<10	<10	<10	<10
Sulphur as S, Total	mg/kg	300	<100	600	1300	200	1700
Sulphate as SO^4, Total	mg/kg	600	100	400	800	300	500

Table 8 Geochemical test results

The results present a complex picture, where all the major redox sensitive chemical species are present in all samples. However Sulphur and Sulphate are present in higher concentrations than nitrogen containing species, with a high of 1700 mg/kg of Sulphur recorded from c. 6.00 m below the ground surface in BH15 - adjacent to the river Ouse. Sulphate concentrations ranged from a low of 100mg/kg (c. 6.5-7.0 m below ground surface, BH13) to a high of 800mg/kg (BH14, c. 7.40 to 7.50 m below ground surface). Sulphides (the reduced from of sulphur) were below test detection limits in all samples. Nitrate concentrations were much lower than both sulphates and sulphur by a factor of 100 and by a factor of 10 for ammoniacal nitrogen.

Based on these data, the dominant redox sensitive reaction is oxidation of sulphur to sulphate, and reduction of nitrogen to ammoniacal nitrogen, which implies reducing conditions. The presence of manganese, in association with relatively high concentrations of iron would also suggest reducing conditions.

The pH value indicates whether deposits are acidic or alkaline, which can influence the degree of preservation of archaeological materials, Boreholes 13 and 15 are alkaline (pH values of between 8.0 and 8.2) whilst conditions in borehole 14 are neutral (between 7.2 and 7.7).

Overall moisture contents are moderate, ranging between 20 - 22%, although higher values were recorded from the uppermost sample from BH13 (43% at between 4.30 to 4.45 m below ground surface) and 31% from the deeper samples from BH15 (31% at between 6.0 and 6.20 m below ground surface).

Physical tests:

Sample	Depth mgs	Description	Loss on Ignition %	Moisture Content %	Coefficient of Permeability m/s	Porosity %
BH13 S21	5.50-6.00	Brownish grey slightly clayey silty sand	3.4	35	4.3×10^{-9}	25
BH13 S22	6.00-6.50	Brownish grey slightly clayey silty sand with rare sandstone	1.9	27	2.4×10^{-9}	25
BH14 S23	2.50-3.00	Dark grey silty sand	3.6	28	4.0×10^{-9}	29
BH14 S24	5.50-6.00	Brownish grey clayey very fine sandy silt	5.3	44	4.7×10^{-9}	36

Table 9 Physical test results

Based on these results the alluvial deposits comprise mainly silty sands, occasionally with a small clay component, and all having low amounts of organic materials (as determined by the Loss on Ignition values, which range from 1.9% to 5.3%). Moisture contents are low to moderate, ranging from 27% (in BH13) to 44% (from BH14). Both the coefficient of permeability and porosity values are as expected for sediments of this nature (Lewis et al, 2006), and the low values infer slow water movement through the deposits.

Palaeoenvironmental assessment: please refer to table 5

Overall, the level of recovery of biological remains is low, with charcoal, bone and shell dominating the assemblage and smaller quantities of seed and cereal also recovered. Five samples are described as “waterlogged” (contexts 6003 and 6004 from BH 13 and contexts 6013 and 60018 from BH15) however the abundance of organic material was extremely low from these contexts.

No material suitable for AMS or radiocarbon dating was retrieved from any sample.

Conclusions

The evidence assessed to date suggests that the below-ground deposits at the site of the former Fire station in Clifford Street, York, can be considered conducive to the preservation of organic remains, as all indicators point towards “reducing” conditions. The optimum conditions for preservation of organic remains are where the burial environment can be defined as “highly-reducing”, characterised by appreciable concentrations of sulphide, the reduced form of sulphur. Whilst very little sulphide was detected from the fire station samples, this does not imply that conditions are not highly reducing though. Recent work in Nantwich (Malim et al, 2016) has demonstrated excellent levels of preservation of organic archaeological and palaeoenvironmental materials from deposits exhibiting similar geochemical characteristics. Sulphides will oxidise rapidly, especially in the interval between sampling and laboratory processing, and this will contribute to an artificial reduction in the

concentration of sulphides and a commensurate increase in concentration of sulphates from the samples.

Results from the processing of the GBA samples, coupled with the low "loss on ignition" values indicate that the organic component of the sediments is very low, and therefore the sediments are primarily mineral-based.

Based on this evidence, the base-line conditions can be described as trending between "reducing" to "mildly-reducing" but with an absence of significant organic components and therefore any fluctuations will have minimal impact upon preservation conditions.

Recommendations

The base-line conditions at the former fire station site have been described and no additional work is required to categorise the deposits.

A six-month monitoring programme is underway to record ground water levels in the three dipwells. This will provide sufficient detail about the hydrology regime required before construction can commence. A report will be prepared once the monitoring has concluded, discussing the site hydrology and implications for the proposed development. A post-construction monitoring programme has been agreed, although this will be dependent on survival of the current dipwells following the development.

Assessment of the GBA samples has demonstrated very low potential and no further work is proposed. It is recommended that the samples are discarded.

References

Lewis, MA, Cheney, CS, ÓDochartaigh, BÉ, 2006, Guide to Permeability Indices, Information Products Programme, Open Report CR/06/160N. British Geological Survey, Keyworth, Nottingham.

Malim, TJP, Panter, I, Swain, M, Carrott, J. 2009, Nantwich Waterlogged Deposits Report No 2. The Character and Extent of Archaeological Preservation. Cheshire County Council and English Heritage 3839 MAIN. Unpublished project report.

APPENDIX 10: GROUNDWATER MONITORING AT THE SITE OF THE FORMER FIRE STATION, CLIFFORD STREET, YORK

The following report considers the results of six months of groundwater monitoring between June and November 2016, with the aim of assessing potential impacts upon the site hydrology from the proposed redevelopment, including piling and other ground disturbances. Groundwater levels were collected on a weekly basis, using an audible dipmeter, measuring the height of the water level to the top of the well head cover. These readings have subsequently been converted to a height above Ordnance Datum (m AOD) and compared with river levels measured by the Viking Recorder on the Ouse (the closest Environment Agency recording station), along with weekly rainfall levels recorded at the University's Heslington Campus and hosted by the Electronics Department, University of York. Please refer to figure xx for a plot of all the results.

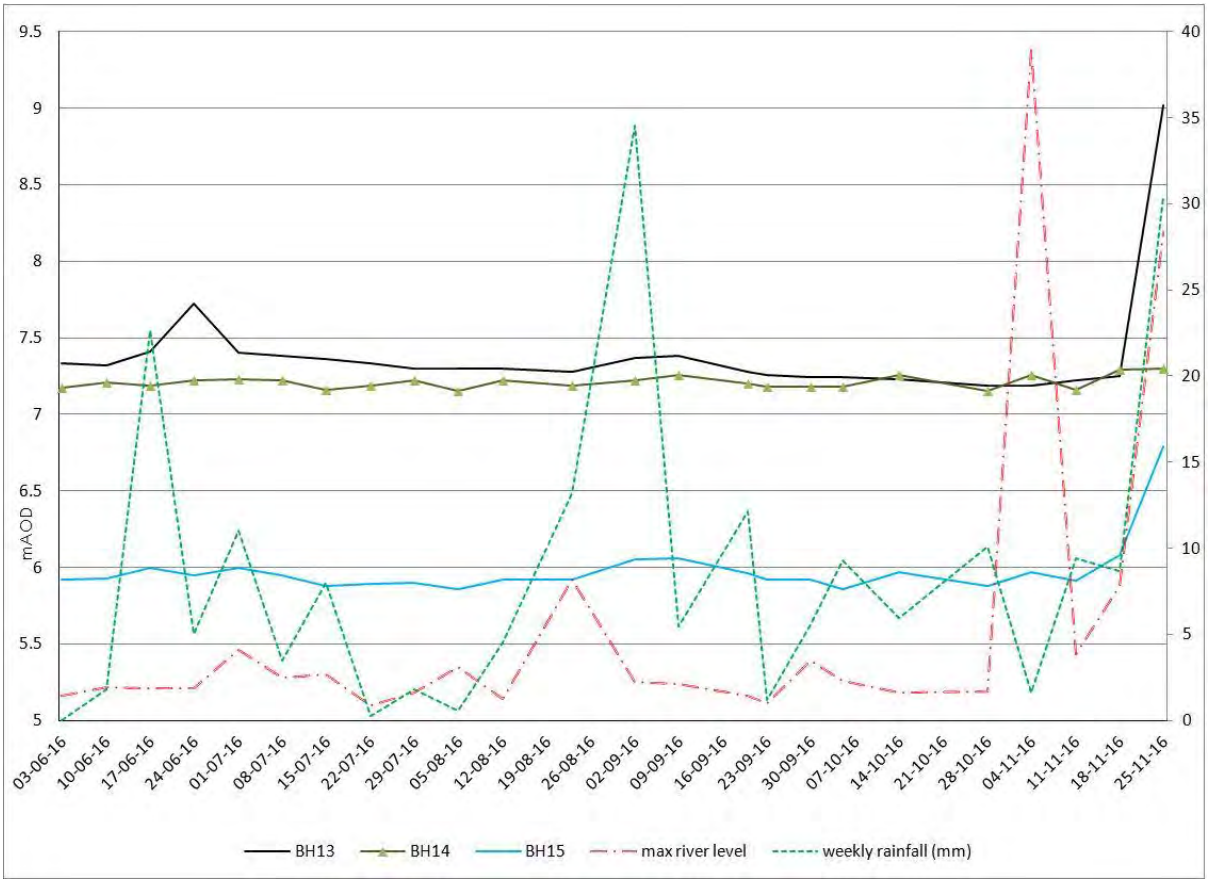


Figure: Water Monitoring results

BH13

Located to the front of the building, adjacent to Clifford Street, and hence farthest away from the River Ouse.

The dipwell was inserted to 9.0m below ground surface (2.12 mAOD), to monitor the alluvial deposits which comprise slightly clayey silty sands with low organic content, moisture contents of between 27% and 35%, low coefficient of permeability values of between 2.4 x 10^{-9} m/s and 4.3 x10^{-9} m/s, and porosity values of 25%.

Groundwater levels have fluctuated from a low of 7.19m AOD to a maximum of 7.72m AOD, a variation of 0.53m over the course of the six month period. A higher water table height of

9.02m AOD was recorded on the 25th November, but this is an erroneous value, caused by flooding in the well head due to excessive rainfall.
Increased weekly rainfall produces a subsequent rise in ground water levels in BH13, as evidenced by the high rainfall events in mid June and early September, although there is a time delay before elevated water levels are detected at this location.

In broad terms, the water levels in BH13 have dropped marginally over the course of the six month period, whilst the river Ouse levels have fluctuated between a minimum height of 5.06m AOD to a peak of 9.38m AOD after prolonged heavy rainfall in the Ouse catchment area during November (and not necessarily heavy rainfall in York).

BH14
Located inside the building, the dipwell was inserted to c. 8.5m below ground surface (1.11m AOD) to monitor water levels in the alluvial deposits which are comprised of mainly clayey silty sands, with low organic content, moisture contents between 28% and 44% (at depth), low coefficient of permeability values between 4.0 x 10^{-9} m/s to 4.7x10^{-9} m/s, and porosity values ranging from 29% to 36%.

Groundwater levels ranged from 7.3m AOD to 7.15m AOD, representing a variation of 0.15m during the monitoring period.

There is little fluctuation in the height of the water table at this location, and the results imply marginal influence from both river and rainfall levels. High rainfall events, or a high peak in the river level appears to produce a slight elevation in the water table.

BH15
Located to the rear of the building adjacent to the river, the dipwell was inserted to a depth of c. 7.0m below ground surface (c. 2.47 mAOD). Intact sample recovery proved impossible due to the very wet conditions encountered from c. 4 m below ground surface, and therefore no physical data could be determined about the nature of the alluvial deposits at this location.

Groundwater levels ranged from 5.86m AOD to a peak of 6.79m AOD which coincided with the November flooding of the river Ouse. This represents a variation in height of 0.93m, the highest variation recorded across the site, which probably reflects the fact that at this location the height of the water table will be influenced more by the river level than by precipitation. Subsequent falls in the river levels do not always lead to drops in the water table height due to the low hydraulic conductivity of the alluvial sediments.

Conclusions

Based on the results of a six month groundwater monitoring programme, the following conclusions can be drawn:

1. Alluvial deposits that may contain organic archaeological and palaeoenvironmental evidence lie within the water table and are therefore remain waterlogged at all times, as indeed are the lower-most Medieval deposits.

2. The evidence suggests that the lowermost deposits beneath the fire-station building remain in connection with the river, however those furthest away (BH13, adjacent to Clifford Street) depend mainly on rainfall recharge, and general surface/groundwater flowing towards the river, whilst the river exerts a greater influence upon the deposits nearest to it (BH15).

3. The alluvial sediments have low hydraulic conductivity values indicating they are not freely draining. Hence the deposits are likely to remain saturated even when the river level drops to its base level of 5.0m AOD, or during periods of little or no rainfall.

4. The impact upon the water table from the redevelopment is likely to be minimal, if not negligible, assuming that nothing is done to isolate the alluvial sediments from the river - i.e. no secant pile wall, or coffer dam around the site. Single piles or mini-pile clusters should have no impact upon the site hydrology, as long as they do not form a barrier to the movement of groundwater through the sediments.

Ian Panter
February 2017

Appendix: water level data.

Date	BH13		BH14		BH15		Weekly rainfall	River Ouse, Viking Recorder	
	m bgs	m AOD	m bgs	m AOD	m bgs	m AOD	mm	Min level, m AOD	Max level m AOD
03-06-16	3.79	7.33	2.44	7.17	3.55	5.92	0.01	5.16	5.16
10-06-16	3.8	7.32	2.4	7.21	3.54	5.93	1.81	5.22	5.22
17-06-16	3.71	7.41	2.42	7.19	3.47	6	22.63	5.19	5.21
24-06-16	3.7	7.72	2.39	7.22	3.52	5.95	5	5.17	5.21
01-07-16	3.72	7.4	2.38	7.23	3.47	6	11.03	5.26	5.46
08-07-16	3.74	7.38	2.39	7.22	3.52	5.95	3.46	5.23	5.28
15-07-16	3.76	7.36	2.45	7.16	3.59	5.88	8.01	5.25	5.3
22-07-16	3.79	7.33	2.42	7.19	3.58	5.89	0.23	5.09	5.1
29-07-16	3.82	7.3	2.39	7.22	3.57	5.9	1.82	5.07	5.18
05-08-16	3.82	7.3	2.46	7.15	3.61	5.86	0.54	5.09	5.35
12-08-16	3.82	7.3	2.39	7.22	3.55	5.92	4.53	5.13	5.14
23-08-16	3.84	7.28	2.42	7.19	3.55	5.92	13.2	5.61	5.92
02-09-16	3.75	7.37	2.39	7.22	3.42	6.05	34.55	5.24	5.25
09-09-16	3.74	7.38	2.35	7.26	3.41	6.06	5.44	5.23	5.24
20-09-16	3.84	7.28	2.41	7.2	3.51	5.96	12.17	5.15	5.16
23-09-16	3.86	7.26	2.43	7.18	3.55	5.92	1.17	5.11	5.11
30-09-16	3.88	7.24	*	*	*	*	5.57	5.3	5.39
05-10-16	3.88	7.24	^	^	3.61	5.86	9.28	5.22	5.26
14-10-16	3.89	7.23	2.35	7.26	3.5	5.97	5.95	5.12	5.18
28-10-16	3.93	7.19	2.46	7.15	3.59	5.88	10.1	5.19	5.19
04-11-16	3.93	7.19	2.35	7.26	3.5	5.97	1.64	5.17	9.38
11-11-16	3.9	7.22	2.45	7.16	3.56	5.91	9.43	5.41	5.43
18-11-16	3.87	7.25	2.32	7.29	3.39	6.08	8.67	5.52	5.88
25-11-16	2.1	9.02	2.31	7.3	2.68	6.79	30.43	7.25	8.19

Key:

Levels:
mbgs - metre below ground surface, taken to be the top of the well head cover.
Levels corrected to mAOD (above Ordnance Datum) using the following levels:

BH13: 11.12 m AOD
BH14: 9.61 m AOD
BH15: 9.47 m AOD

River levels were downloaded as a csv file from the website below on 13/12/16:

https://www.riverlevels.uk/river-ouse-york-viking-recorder#.WFEsIvmLSUk

Rainfall data provided by the Electronics Department web site: http://weather.elec.york.ac.uk/index.html,
last accessed on 17th February 2017.

* - the audible dipmeter broke during the site visit on 30/09/16, therefore it was only possible to take a reading at BH13.

^ - an asbestos survey was being conducted in the building on 5/10/16 and therefore access was prohibited. Readings could only be taken from the two external boreholes.

PHYSICAL TEST RESULTS FROM GEOLABS

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression			Chemical Tests			Other tests and comments
Borehole / Trial Pit	Sample Ref	Depth (m)	Type	Description	MC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH13	S21	5.50-6.00	C	Soft greyish brown sandy CLAY. Occasional fine gravel.														Particle Size Distribution Permeability, Loss on Ignition
BH13	S22	6.00-6.50	C	Soft brownish grey with dark grey streaks, sandy CLAY. Sand is fine to medium.														Particle Size Distribution Permeability, Loss on Ignition
BH14	S23	2.50-3.00	C	Soft brownish grey sandy CLAY. Sand is fine to medium.														Particle Size Distribution Permeability, Loss on Ignition
BH14	S24	5.50-6.00	C	Brownish grey clayey very fine sandy SILT.														Particle Size Distribution Permeability, Loss on Ignition

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke

S Burke - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS®

1131 - BS1377 Chemical Suite - 24132.XLSM

SUMMARY OF CHEMICAL TESTS ON SOIL

Borehole / Trial Pit	Depth m	Sample Ref	Sample Type	pH Value	Total Acid Soluble Sulphate as SO4 %	Water Soluble Sulphate as SO4 2:1 Water:Soil Extract g/L	Total Sulphur %	Water Soluble Chloride mg/L	Water Soluble Nitrate mg/L	Magnesium mg/L	Organic Content %	Mass Loss on Ignition %	Carbonate Content %
BH13	5.50-6.00	S21	C									3.4	
BH13	6.00-6.50	S22	C									1.9	
BH14	2.50-3.00	S23	C									3.6	
BH14	5.50-6.00	S24	C									5.3	

Checked and Approved by:

S Burke

S Burke - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK

5905

GEOLABS®

BS1377 : Part 2 : Clause 9 : 1990

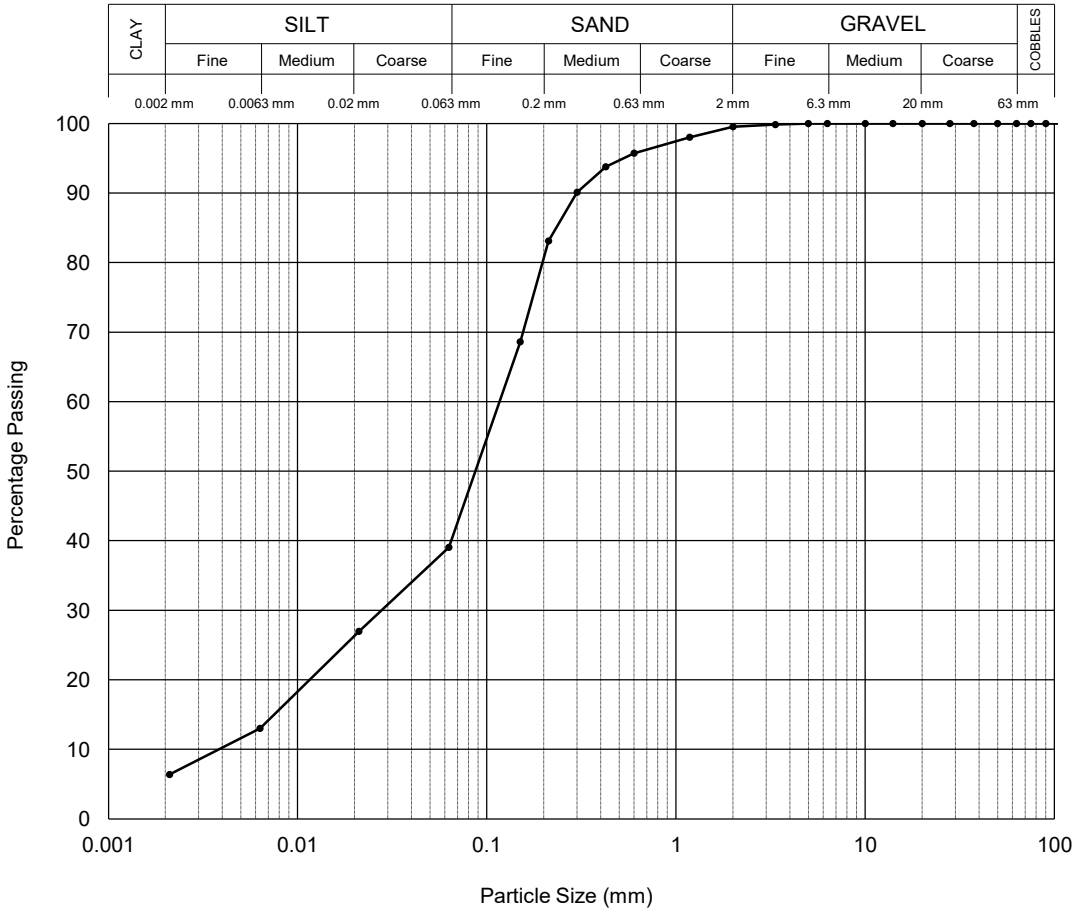
PARTICLE SIZE DISTRIBUTION

BH/TP No:	BH13
Sample Ref.	S21
Depth (m):	5.50-6.00
Sample Type	C

Description:
Brownish grey slightly clayey silty SAND.

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method
BS1377 : Part 2 : Clause 9.4 : 1990 Sedimentation by the Pipette Method

Sieve	
Sieve (mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	100
3.35	100
2	100
1.18	98
0.6	96
0.425	94
0.3	90
0.212	83
0.15	69
0.063	39



Pipette	
P. Size (µm)	% pass
21.1	27
6.3	13
2.1	6
Preparation:	
No Pre-treatment used	

Temp (ºC)	20

Particle Proportions	
Cobbles	0.0 %
Gravel	0.5 %
Sand	60.5 %
Silt	32.7 %
Clay	6.4 %

Checked and Approved by

S Burke

S Burke - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS®
UKAS TESTING 1982

BS1377 : Part 2 : Clause 9 : 1990

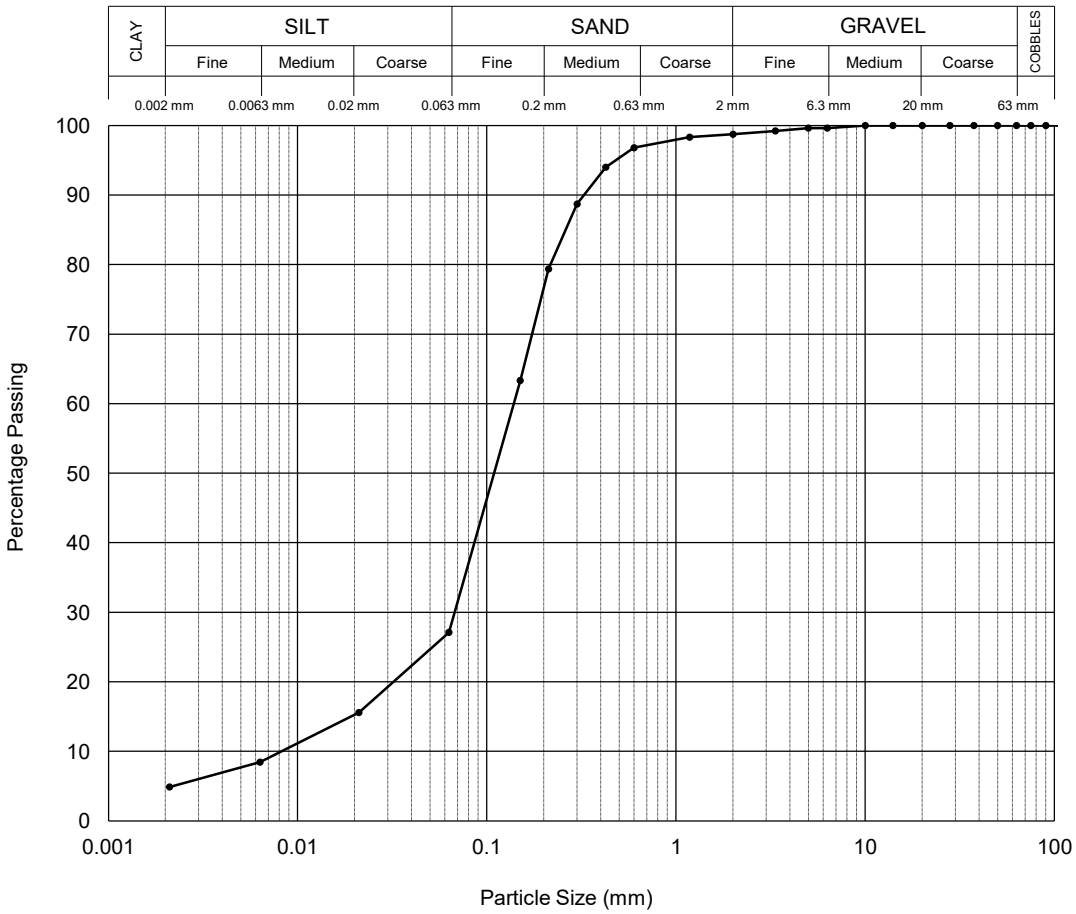
PARTICLE SIZE DISTRIBUTION

BH/TP No:	BH13
Sample Ref.	S22
Depth (m):	6.00-6.50
Sample Type	C

Description:
Brownish grey slightly clayey silty SAND with rare sandstone.

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method
BS1377 : Part 2 : Clause 9.4 : 1990 Sedimentation by the Pipette Method

Sieve	
Sieve (mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	100
3.35	99
2	99
1.18	98
0.6	97
0.425	94
0.3	89
0.212	79
0.15	63
0.063	27



Pipette	
P. Size (µm)	% pass
21.1	16
6.3	8
2.1	5
Preparation:	
No Pre-treatment used	

Temp (ºC)	20

Particle Proportions	
Cobbles	0.0 %
Gravel	1.3 %
Sand	71.6 %
Silt	22.2 %
Clay	4.9 %

Checked and Approved by

S Burke

S Burke - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS®

UKAS TESTING 1982

BS1377 : Part 2 : Clause 9 : 1990

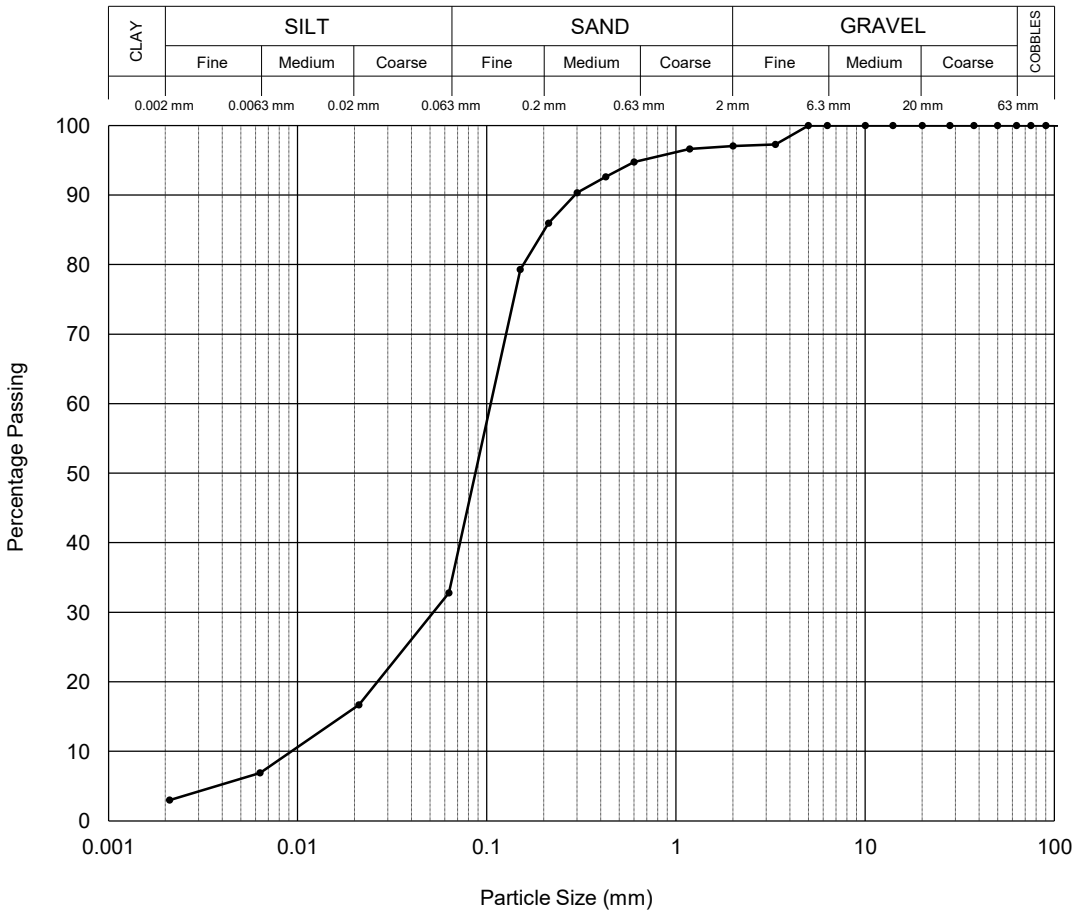
PARTICLE SIZE DISTRIBUTION

BH/TP No:	BH14
Sample Ref.	S23
Depth (m):	2.50-3.00
Sample Type	C

Description:
Dark grey silty SAND.

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method
BS1377 : Part 2 : Clause 9.4 : 1990 Sedimentation by the Pipette Method

Sieve	
Sieve (mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	100
3.35	97
2	97
1.18	97
0.6	95
0.425	93
0.3	90
0.212	86
0.15	79
0.063	33



Pipette	
P. Size (µm)	% pass
21.1	17
6.3	7
2.1	3
Preparation:	
No Pre-treatment used	

Temp (ºC)	20

Particle Proportions	
Cobbles	0.0 %
Gravel	2.9 %
Sand	64.3 %
Silt	29.8 %
Clay	3.0 %

Checked and Approved by

S Burke

S Burke - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS®
UKAS TESTING 1982

BS1377 : Part 2 : Clause 9 : 1990

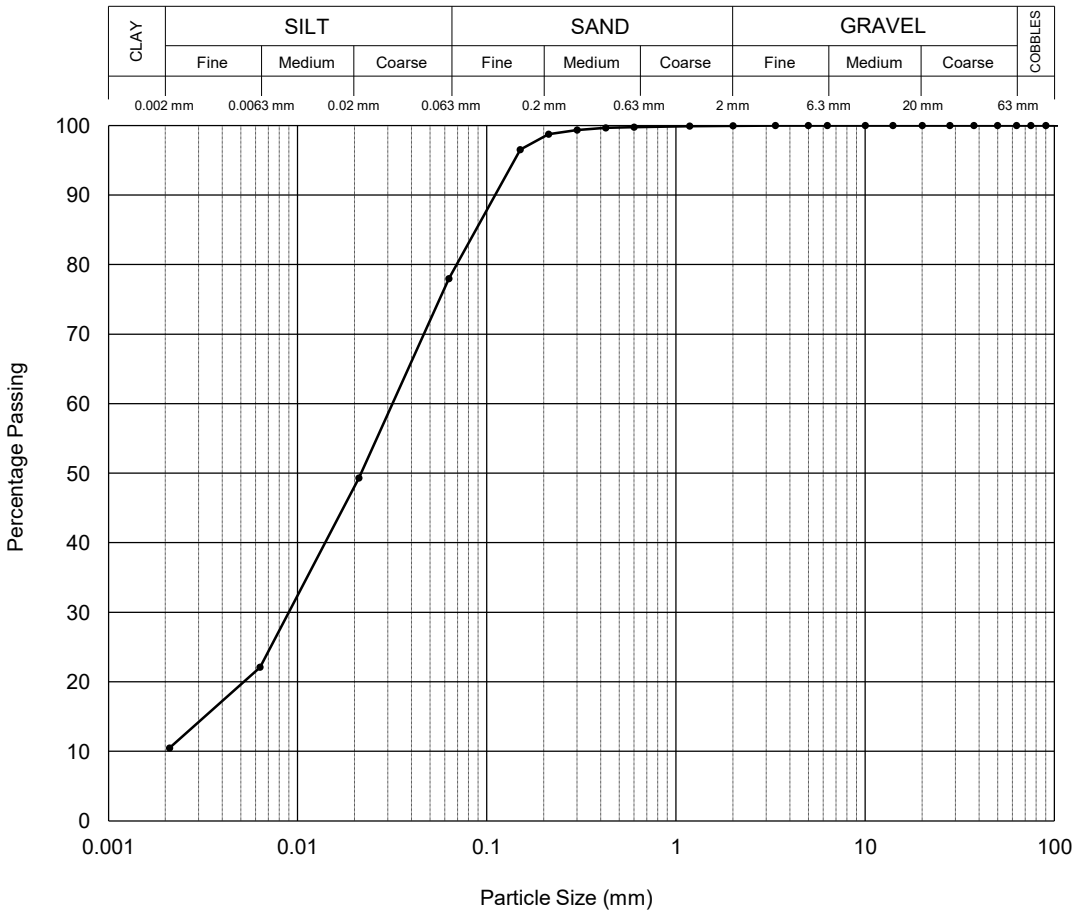
PARTICLE SIZE DISTRIBUTION

BH/TP No:	BH14
Sample Ref.	S24
Depth (m):	5.50-6.00
Sample Type	C

Description:
Brownish grey clayey very fine sandy SILT.

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method
BS1377 : Part 2 : Clause 9.4 : 1990 Sedimentation by the Pipette Method

Sieve	
Sieve (mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	100
3.35	100
2	100
1.18	100
0.6	100
0.425	100
0.3	99
0.212	99
0.15	97
0.063	78



Pipette	
P. Size (µm)	% pass
21.1	49
6.3	22
2.1	10
Preparation:	
No Pre-treatment used	

Temp (ºC)	20

Particle Proportions	
Cobbles	0.0 %
Gravel	0.0 %
Sand	22.0 %
Silt	67.5 %
Clay	10.5 %

Checked and Approved by

S Burke

S Burke - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS®
UKAS TESTING 1982

BS1377 : Part 6 : Clause 6 :1990

Determination of Permeability in a Triaxial Cell

Borehole Ref.:	BH13
Sample Ref.:	S21
Depth (m):	5.50-6.00
Sample Type:	C

Description:
Soft grey brown sandy CLAY with rare fine gravel.

SPECIMEN DETAILS

Depth within original sample	45mm from top
Orientation within original	Vertical
Specimen preparation	Undisturbed

TEST DETAILS

Cell Preparation: Performed in accordance with Clause 3.5

		INITIAL	FINAL
Diameter	*mm*	69.66	68.07
Height	*mm*	73.15	71.49
Moisture Content	*%*	35	30
Bulk Density	*Mg/m³*	1.99	2.05
Dry Density	*Mg/m³*	1.47	1.58

SATURATION STAGE

Saturation initially by constant moisture content, followed by back-pressure assistance.

Pore pressure coefficient ('B' value)		0.99	0.99

CONSOLIDATION STAGE

Effective pressure	*kPa*	60
Volume change	*mL*	19.1

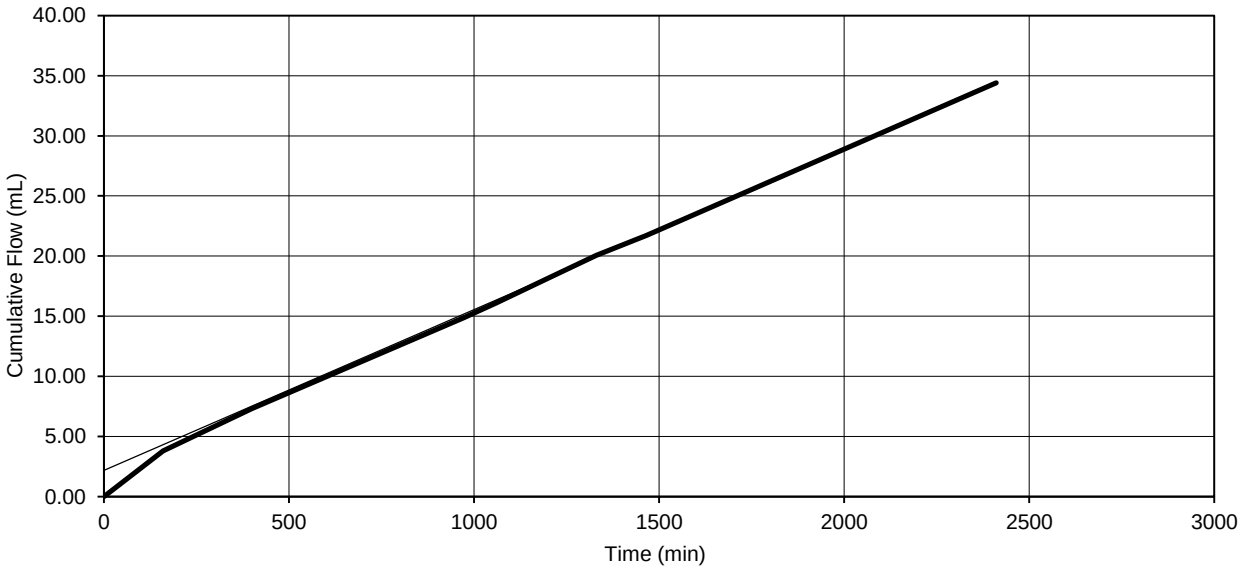
PERMEABILITY STAGE

Pressure difference across specimen	*kPa*	10
Hydraulic gradient		14.3
Mean effective stress	*kPa*	55

TEST DURATIONS

Saturation	*days*	2
Consolidation	*days*	1
Flow	*days*	1

Coefficient of Permeability
k_v at 20 °C = 4.3×10^{-9} m/s



Checked and Approved by

D Searing - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS

UKAS TESTING 1982

BS1377 : Part 6 : Clause 6 :1990

Determination of Permeability in a Triaxial Cell

Borehole Ref.:	BH13
Sample Ref.:	S22
Depth (m):	6.00-6.50
Sample Type:	C

Description:
Soft brownish grey sandy CLAY with dark grey streaks. Sand is fine to medium.

SPECIMEN DETAILS

Depth within original sample	40mm from top
Orientation within original	Vertical
Specimen preparation	Undisturbed

TEST DETAILS

Cell Preparation: Performed in accordance with Clause 3.5

		INITIAL	FINAL
Diameter	*mm*	72.60	71.46
Height	*mm*	67.41	66.35
Moisture Content	*%*	27	23
Bulk Density	*Mg/m³*	1.98	2.01
Dry Density	*Mg/m³*	1.56	1.64

SATURATION STAGE

Saturation initially by constant moisture content, followed by back-pressure assistance.

Pore pressure coefficient ('B' value)		0.99	0.98

CONSOLIDATION STAGE

Effective pressure	*kPa*	65
Volume change	*mL*	13.2

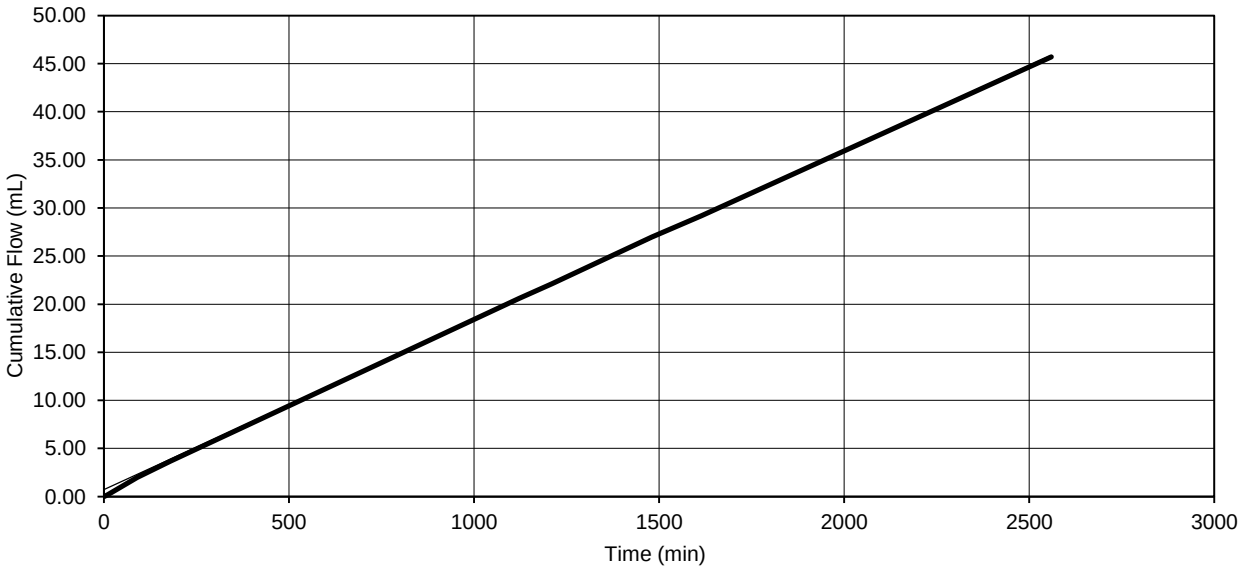
PERMEABILITY STAGE

Pressure difference across specimen	*kPa*	20
Hydraulic gradient		30.7
Mean effective stress	*kPa*	55

TEST DURATIONS

Saturation	*days*	2
Consolidation	*days*	1
Flow	*days*	1

Coefficient of Permeability
k_v at 20 °C = 2.4×10^{-9} m/s



Checked and Approved by

D Searing - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS®

UKAS TESTING 1982

BS1377 : Part 6 : Clause 6 :1990

Determination of Permeability in a Triaxial Cell

Borehole Ref.:	BH14
Sample Ref.:	S23
Depth (m):	2.50-3.00
Sample Type:	C

Description:
Soft brownish grey sandy CLAY. Sand is fine to medium.

SPECIMEN DETAILS

Depth within original sample	30mm from top
Orientation within original	Vertical
Specimen preparation	Undisturbed

TEST DETAILS

Cell Preparation — Performed in accordance with Clause 3.5

		INITIAL	FINAL
Diameter	*mm*	104.46	101.63
Height	*mm*	101.32	98.58
Moisture Content	*%*	28	25
Bulk Density	*Mg/m³*	1.88	1.99
Dry Density	*Mg/m³*	1.46	1.59

SATURATION STAGE

Saturation initially by constant moisture content, followed by back-pressure assistance.

Pore pressure coefficient ('B' value)		0.99	0.99

CONSOLIDATION STAGE

Effective pressure	*kPa*	30
Volume change	*mL*	70.6

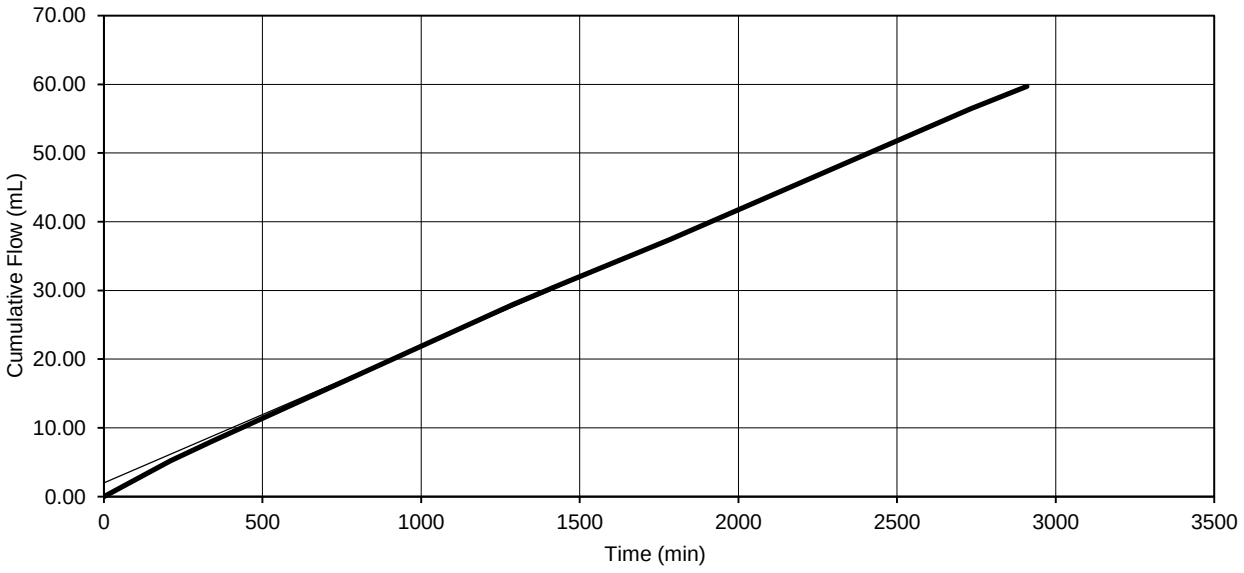
PERMEABILITY STAGE

Pressure difference across specimen	*kPa*	10
Hydraulic gradient		10.3
Mean effective stress	*kPa*	25

TEST DURATIONS

Saturation	*days*	2
Consolidation	*days*	1
Flow	*days*	1

Coefficient of Permeability
k_v at 20 °C = 4.0×10^{-9} m/s



Checked and Approved by

D Searing - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS

UKAS TESTING 1982

BS1377 : Part 6 : Clause 6 :1990

Determination of Permeability in a Triaxial Cell

Borehole Ref.:	BH14
Sample Ref.:	S24
Depth (m):	5.50-6.00
Sample Type:	C

Description:
Firm brownish grey slightly sandy SILT.

SPECIMEN DETAILS

Depth within original sample	50mm from top
Orientation within original	Vertical
Specimen preparation	Undisturbed

TEST DETAILS

Cell Preparation — Performed in accordance with Clause 3.5

		INITIAL	FINAL
Diameter	*mm*	100.95	100.29
Height	*mm*	85.80	85.25
Moisture Content	*%*	44	43
Bulk Density	*Mg/m³*	1.70	1.71
Dry Density	*Mg/m³*	1.18	1.20

SATURATION STAGE

Saturation initially by constant moisture content, followed by back-pressure assistance.

Pore pressure coefficient ('B' value)		0.97	0.98

CONSOLIDATION STAGE

Effective pressure	*kPa*	60
Volume change	*mL*	13.4

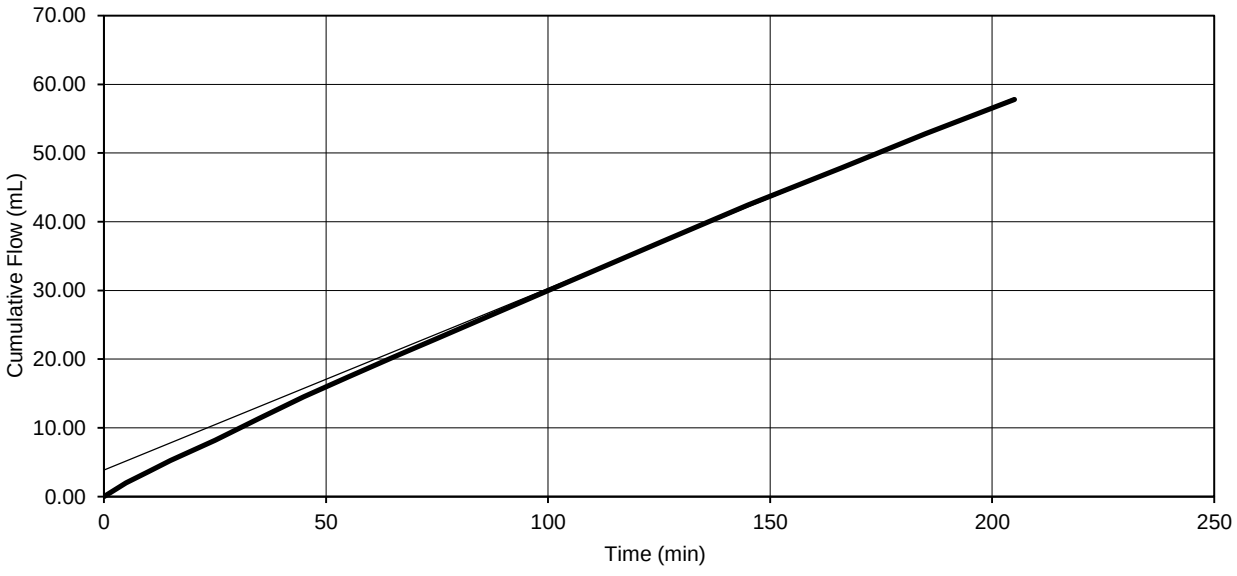
PERMEABILITY STAGE

Pressure difference across specimen	*kPa*	10
Hydraulic gradient		12.0
Mean effective stress	*kPa*	55

TEST DURATIONS

Saturation	*days*	2
Consolidation	*days*	1
Flow	*days*	1

Coefficient of Permeability
k_v at 20 °C = 4.7×10^{-8} m/s



Checked and Approved by

D Searing - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS

UKAS TESTING 1982

BS1377 : Part 6 : Clause 6 :1990

Determination of Permeability in a Triaxial Cell

Borehole Ref.:	BH13
Sample Ref.:	S21
Depth (m):	5.50-6.00
Sample Type:	C

Description:
Soft grey brown sandy CLAY with rare fine gravel.

SPECIMEN DETAILS

Depth within original sample	45mm from top
Orientation within original	Vertical
Specimen preparation	Undisturbed

TEST DETAILS

Cell Preparation: Performed in accordance with Clause 3.5

		INITIAL	FINAL
Diameter	*mm*	69.66	68.07
Height	*mm*	73.15	71.49
Moisture Content	*%*	35	30
Bulk Density	*Mg/m³*	1.99	2.05
Dry Density	*Mg/m³*	1.47	1.58

SATURATION STAGE

Saturation initially by constant moisture content, followed by back-pressure assistance.

Pore pressure coefficient ('B' value)		0.99	0.99

CONSOLIDATION STAGE

Effective pressure	*kPa*	60
Volume change	*mL*	19.1

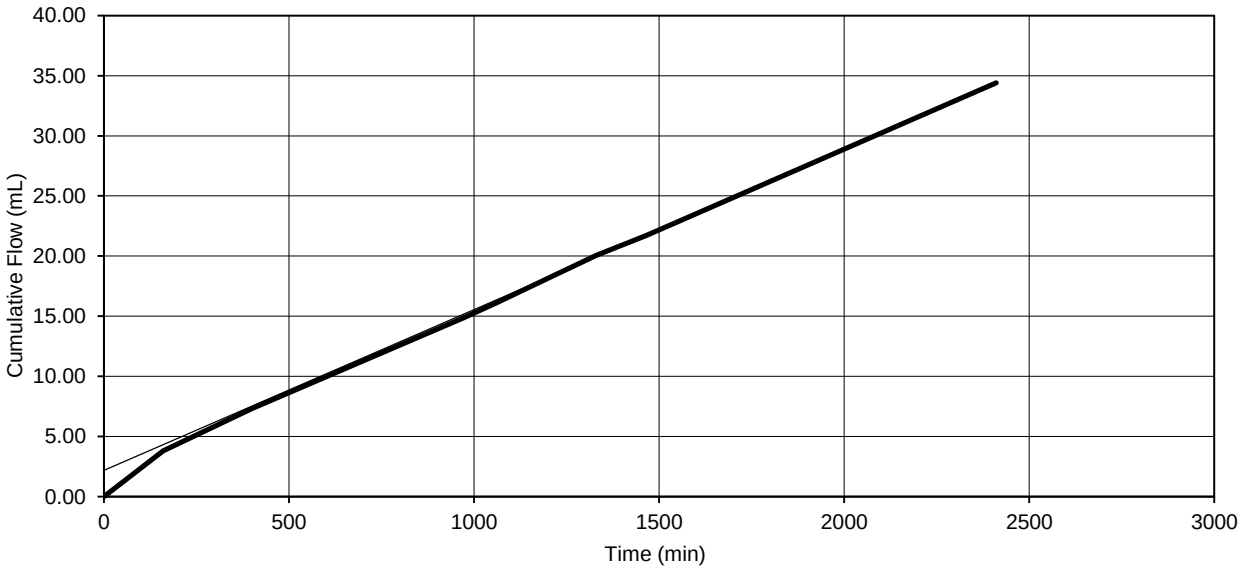
PERMEABILITY STAGE

Pressure difference across specimen	*kPa*	10
Hydraulic gradient		14.3
Mean effective stress	*kPa*	55

TEST DURATIONS

Saturation	*days*	2
Consolidation	*days*	1
Flow	*days*	1

Coefficient of Permeability
k_v at 20 °C = 4.3×10^{-9} m/s



Checked and Approved by

D Searing - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS

UKAS TESTING 1982

BS1377 : Part 6 : Clause 6 :1990

Determination of Permeability in a Triaxial Cell

Borehole Ref.:	BH13
Sample Ref.:	S22
Depth (m):	6.00-6.50
Sample Type:	C

Description:
Soft brownish grey sandy CLAY with dark grey streaks. Sand is fine to medium.

SPECIMEN DETAILS

Depth within original sample	40mm from top
Orientation within original	Vertical
Specimen preparation	Undisturbed

TEST DETAILS

Cell Preparation: Performed in accordance with Clause 3.5

		INITIAL	FINAL
Diameter	*mm*	72.60	71.46
Height	*mm*	67.41	66.35
Moisture Content	*%*	27	23
Bulk Density	*Mg/m³*	1.98	2.01
Dry Density	*Mg/m³*	1.56	1.64

SATURATION STAGE

Saturation initially by constant moisture content, followed by back-pressure assistance.

Pore pressure coefficient ('B' value)		0.99	0.98

CONSOLIDATION STAGE

Effective pressure	*kPa*	65
Volume change	*mL*	13.2

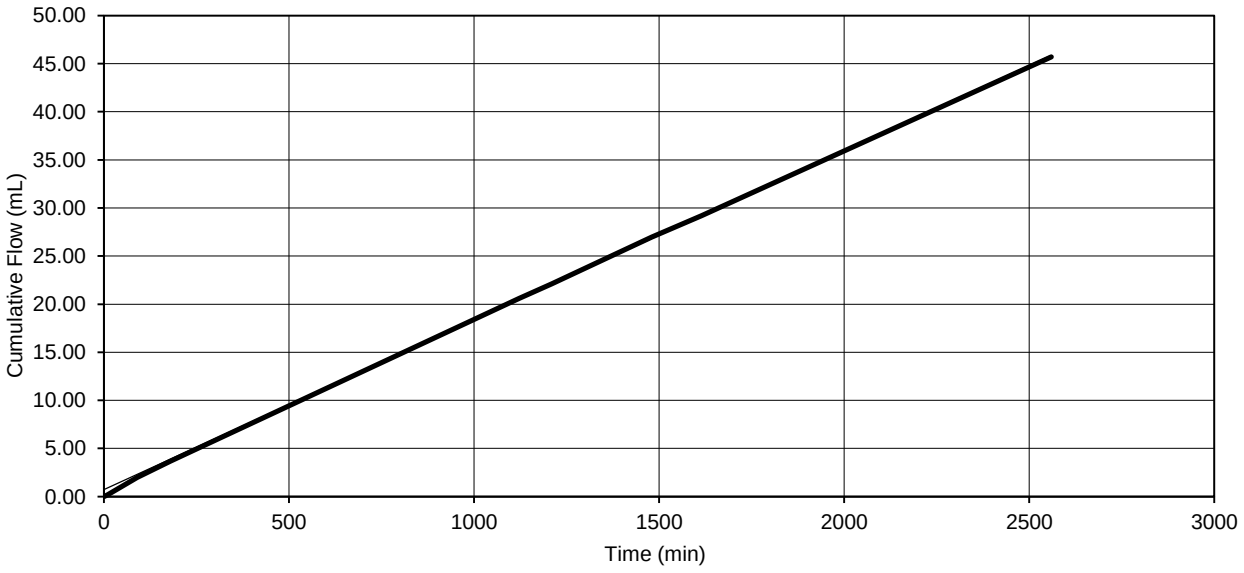
PERMEABILITY STAGE

Pressure difference across specimen	*kPa*	20
Hydraulic gradient		30.7
Mean effective stress	*kPa*	55

TEST DURATIONS

Saturation	*days*	2
Consolidation	*days*	1
Flow	*days*	1

Coefficient of Permeability
k_v at 20 °C = 2.4×10^{-9} m/s



Checked and Approved by

D Searing - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS®

UKAS TESTING 1982

BS1377 : Part 6 : Clause 6 :1990

Determination of Permeability in a Triaxial Cell

Borehole Ref.:	BH14
Sample Ref.:	S23
Depth (m):	2.50-3.00
Sample Type:	C

Description:
Soft brownish grey sandy CLAY. Sand is fine to medium.

SPECIMEN DETAILS

Depth within original sample	30mm from top
Orientation within original	Vertical
Specimen preparation	Undisturbed

TEST DETAILS

Cell Preparation — Performed in accordance with Clause 3.5

		INITIAL	FINAL
Diameter	*mm*	104.46	101.63
Height	*mm*	101.32	98.58
Moisture Content	*%*	28	25
Bulk Density	*Mg/m³*	1.88	1.99
Dry Density	*Mg/m³*	1.46	1.59

SATURATION STAGE

Saturation initially by constant moisture content, followed by back-pressure assistance.

Pore pressure coefficient ('B' value)		0.99	0.99

CONSOLIDATION STAGE

Effective pressure	*kPa*	30
Volume change	*mL*	70.6

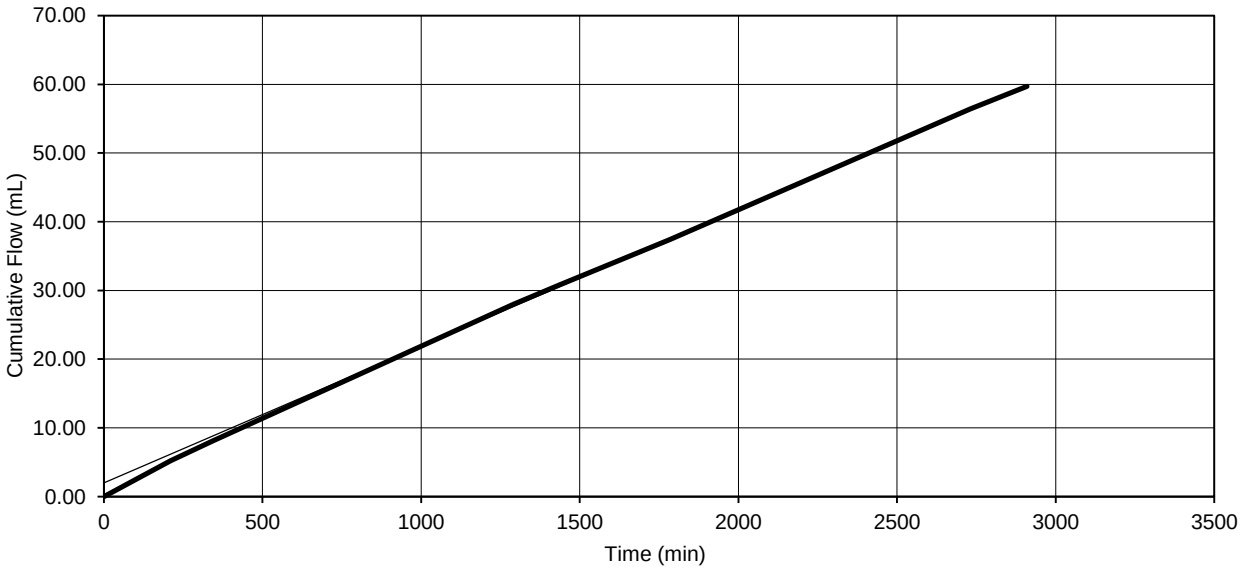
PERMEABILITY STAGE

Pressure difference across specimen	*kPa*	10
Hydraulic gradient		10.3
Mean effective stress	*kPa*	25

TEST DURATIONS

Saturation	*days*	2
Consolidation	*days*	1
Flow	*days*	1

Coefficient of Permeability
k_v at 20 °C = 4.0×10^{-9} m/s



Checked and Approved by

D Searing - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS

UKAS TESTING 1982

BS1377 : Part 6 : Clause 6 :1990

Determination of Permeability in a Triaxial Cell

Borehole Ref.:	BH14
Sample Ref.:	S24
Depth (m):	5.50-6.00
Sample Type:	C

Description:
Firm brownish grey slightly sandy SILT.

SPECIMEN DETAILS

Depth within original sample	50mm from top
Orientation within original	Vertical
Specimen preparation	Undisturbed

TEST DETAILS

Cell Preparation — Performed in accordance with Clause 3.5

		INITIAL	FINAL
Diameter	*mm*	100.95	100.29
Height	*mm*	85.80	85.25
Moisture Content	*%*	44	43
Bulk Density	*Mg/m³*	1.70	1.71
Dry Density	*Mg/m³*	1.18	1.20

SATURATION STAGE

Saturation initially by constant moisture content, followed by back-pressure assistance.

Pore pressure coefficient ('B' value)		0.97	0.98

CONSOLIDATION STAGE

Effective pressure	*kPa*	60
Volume change	*mL*	13.4

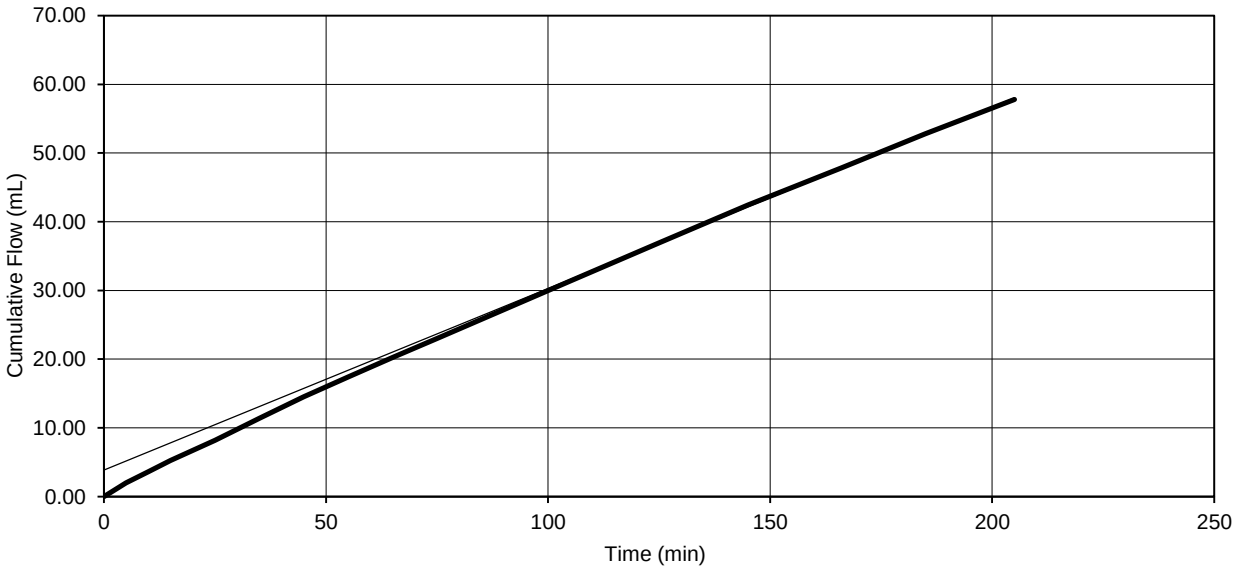
PERMEABILITY STAGE

Pressure difference across specimen	*kPa*	10
Hydraulic gradient		12.0
Mean effective stress	*kPa*	55

TEST DURATIONS

Saturation	*days*	2
Consolidation	*days*	1
Flow	*days*	1

Coefficient of Permeability
k_v at 20 °C = 4.7×10^{-8} m/s



Checked and Approved by

D Searing - Senior Technician
20/06/2016

Project Number:

GEO / 24132

Project Name:

FORMER FIRESTATION, YORK
5905

GEOLABS

UKAS TESTING 1982

Derwentside Environmental Testing Services

Certificate of Analysis

Certificate Number 16-68371

07-Jun-16

Client York Archaeological Trust
47 Aldwark
York
Y01 7BX

Our Reference	16-68371
Client Reference	(not supplied)
Order No	3184
Contract Title	Fire Station
Description	6 Soil samples.
Date Received	02-Jun-16
Date Started	02-Jun-16
Date Completed	07-Jun-16
Test Procedures	Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the scope of UKAS accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Rob Brown
Business Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 16-68371
Client Ref
Contract Title Fire Station

	Lab No	998055	998056	998057	998058	998059	998060
	Sample ID	BH13.S.1 3	BH13.S.1 4	BH14.S.1 6	BH14.S.1 8	BH15.S.1 9	BH15.S.2 0
	Depth	4.30-4.45	6.50-7.00	2.00-2.90	7.40	4.70	6.00
	Other ID						
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date	26/05/16	26/05/16	26/05/16	26/05/16	27/05/16	27/05/16
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Preparation							
Moisture Content	DETSC 1004*	0.1	%	43	20	22	22	22	31
Metals							
Iron	DETSC 2301	25	mg/kg	15000	23000	14000	21000	26000	25000
Manganese	DETSC 2301#	20	mg/kg	590	210	210	2000	470	790
Inorganics							
pH	DETSC 2008#			8.0	8.0	7.2	7.7	8.2	8.0
Ammoniacal Nitrogen as N	DETSC 2119#	0.5	mg/kg	28	76	29	180	24	25
Nitrate as NO3	DETSC 2055	1	mg/kg	3.3	5.9	5.7	9.2	9.7	5.4
Sulphide	DETSC 2024#	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
Sulphur as S, Total	DETSC 2320	0.01	%	0.03	< 0.01	0.06	0.13	0.02	0.17
Sulphate as SO4, Total	DETSC 2321#	0.01	%	0.06	0.01	0.04	0.08	0.03	0.05

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 16-68371
Client Ref
Contract Fire Station

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
998055	BH13.S.13 4.30-4.45 SOIL	26/05/16	PT 1L		
998056	BH13.S.14 6.50-7.00 SOIL	26/05/16	PT 1L		
998057	BH14.S.16 2.00-2.90 SOIL	26/05/16	PT 1L		
998058	BH14.S.18 7.40 SOIL	26/05/16	PT 1L		
998059	BH15.S.19 4.70 SOIL	27/05/16	PT 1L		
998060	BH15.S.20 6.00 SOIL	27/05/16	PT 1L		

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

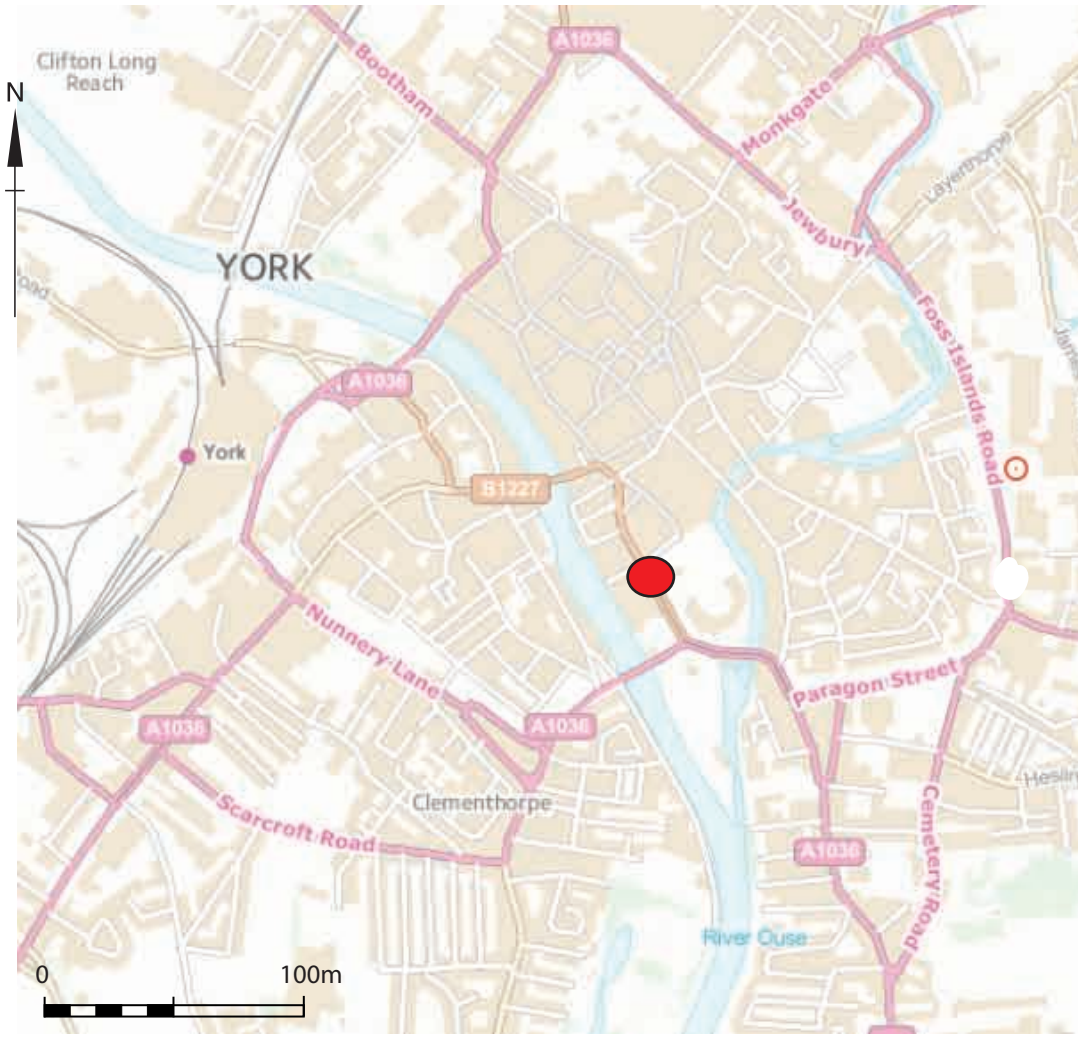
The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

FIGURES



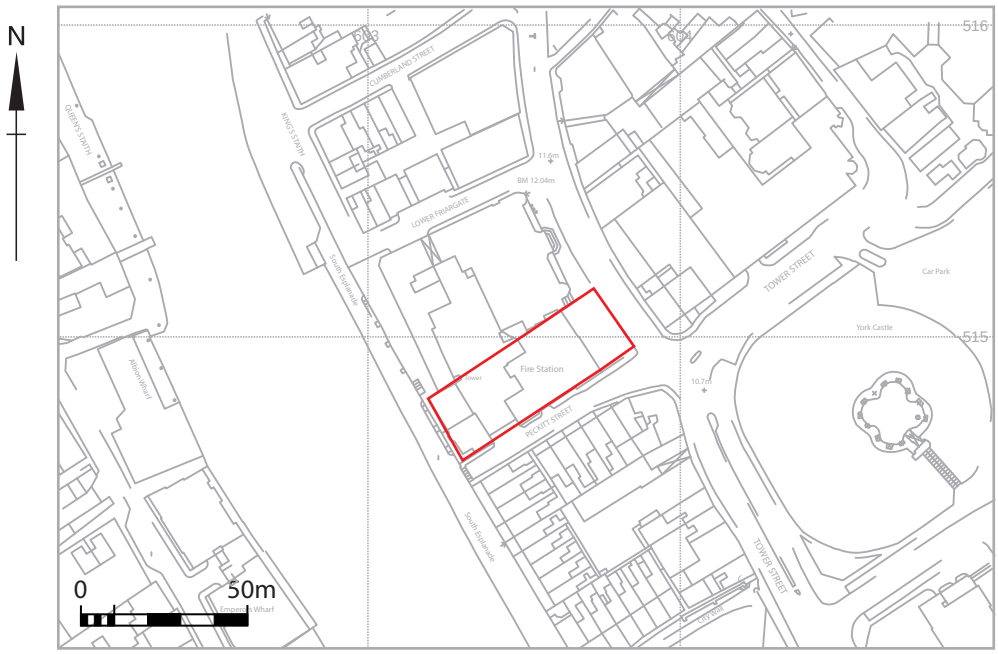


Figure 1: Site location

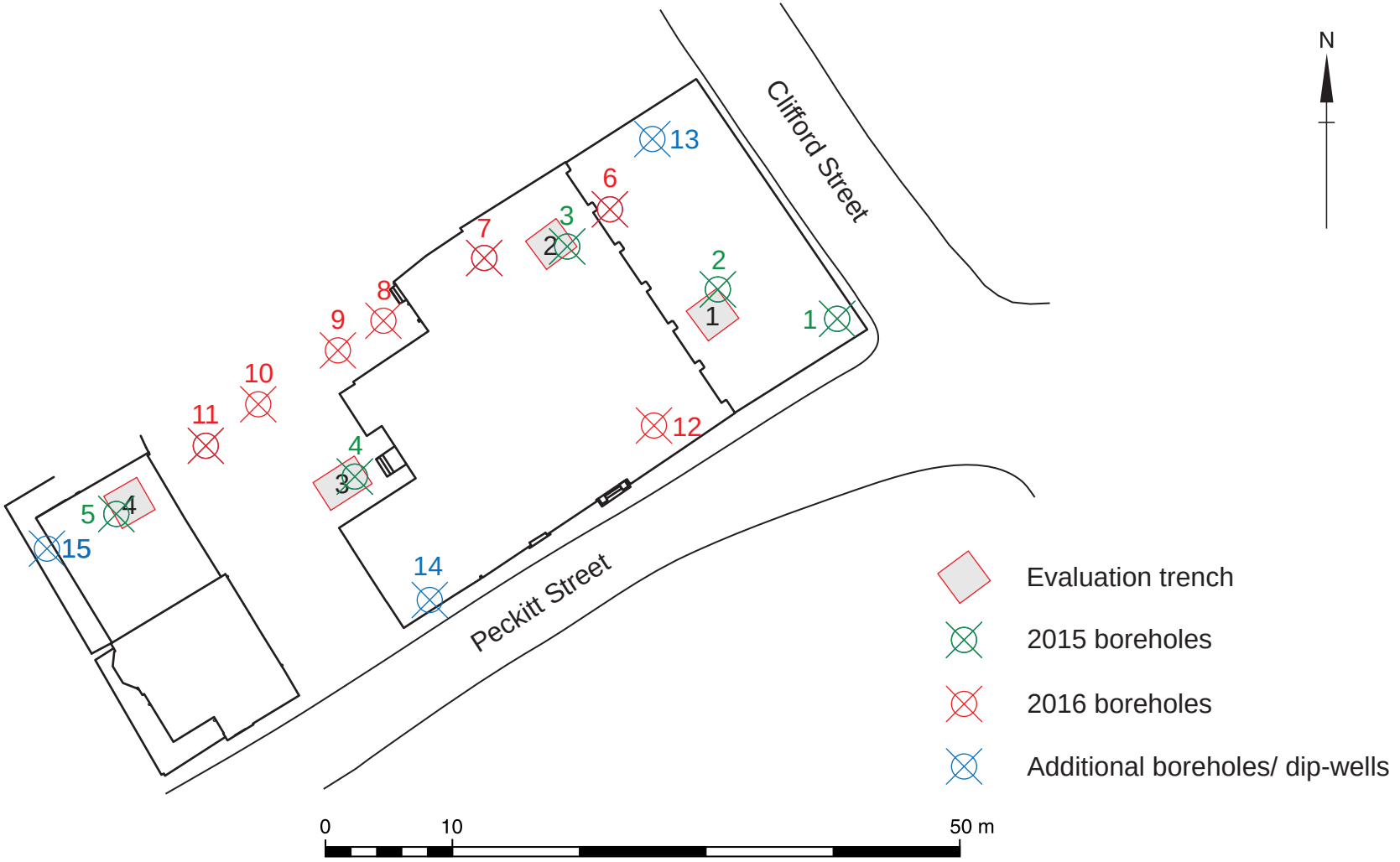
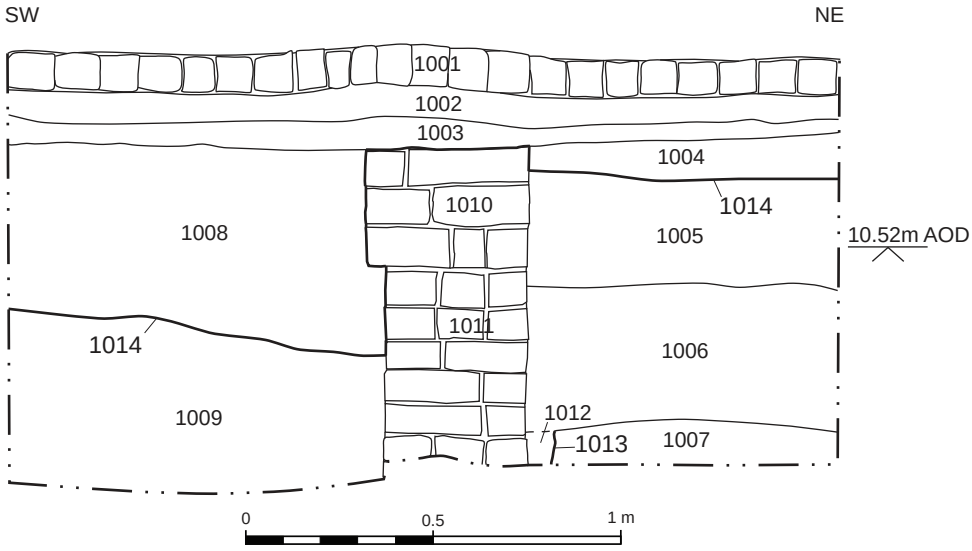
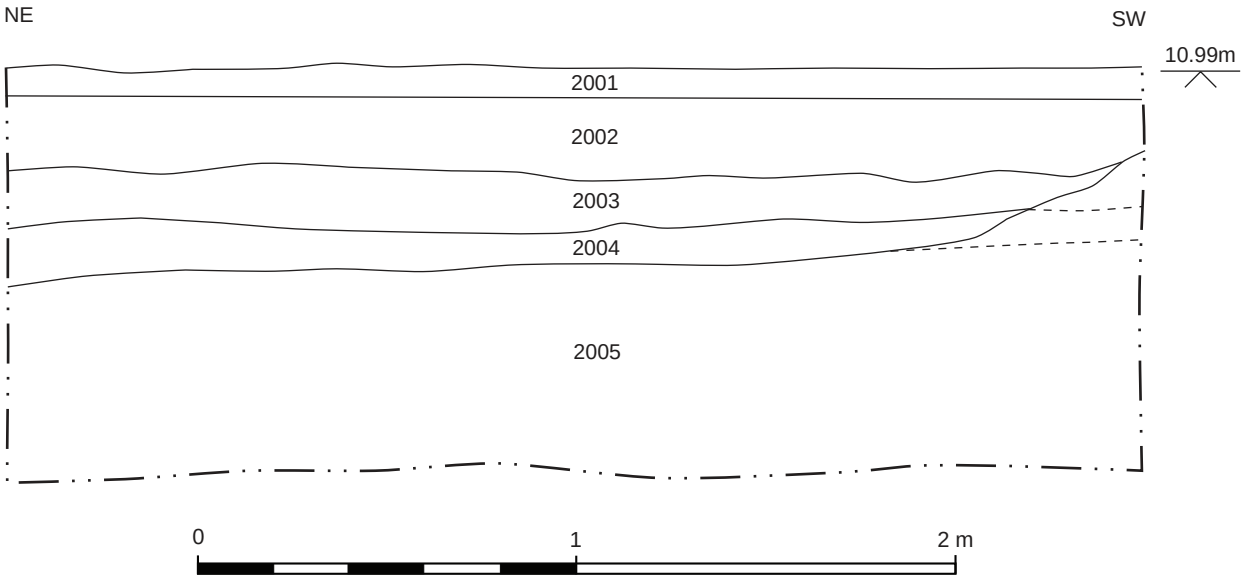


Fig. 2 Intervention locations

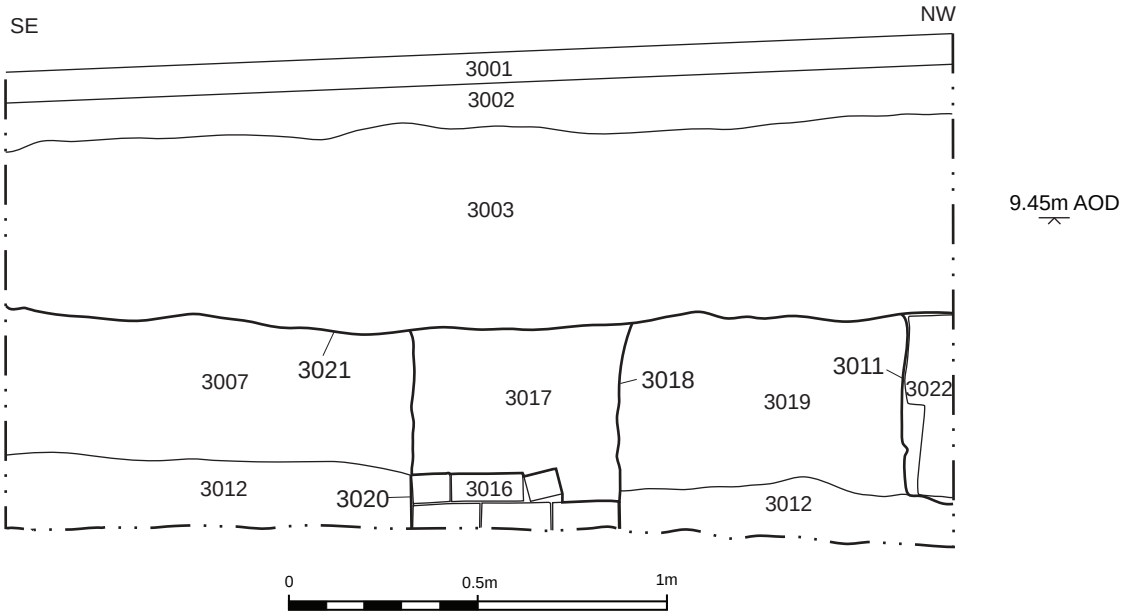


Trench 1: SE facing section

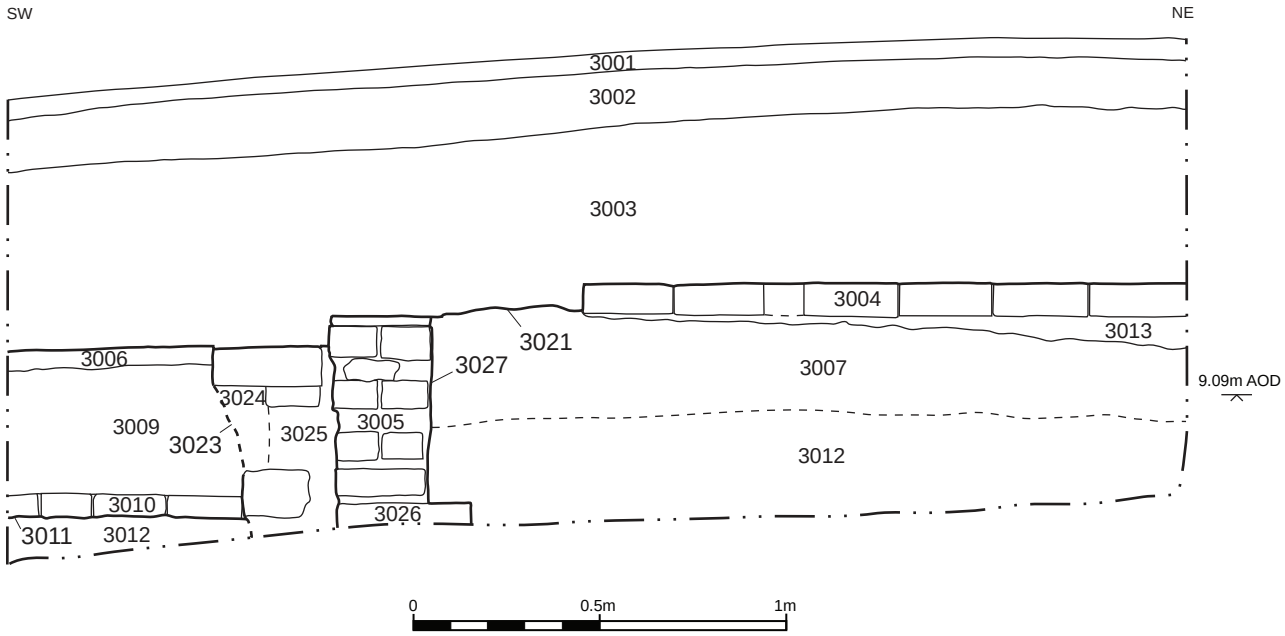


Trench 2: NW facing section

Fig. 3 Trench 1 and 2 sections
(Scale 1:20 at A4)

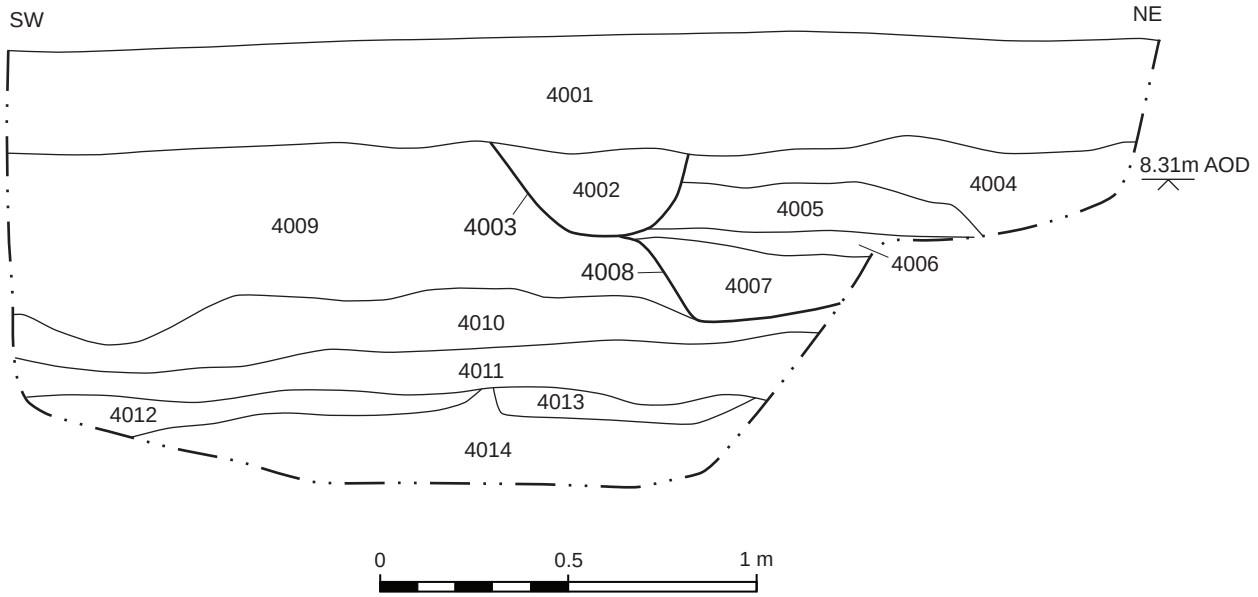


Trench 3 Section 1: NE facing section



Trench 3 Section 2: SE facing section

Fig. 4 Trench 3 sections 1 and 2
(Scale 1:20 at A4)



Trench 4: SE facing section

Fig. 5 Trench 4 section
(Scale 1:20 at A4)

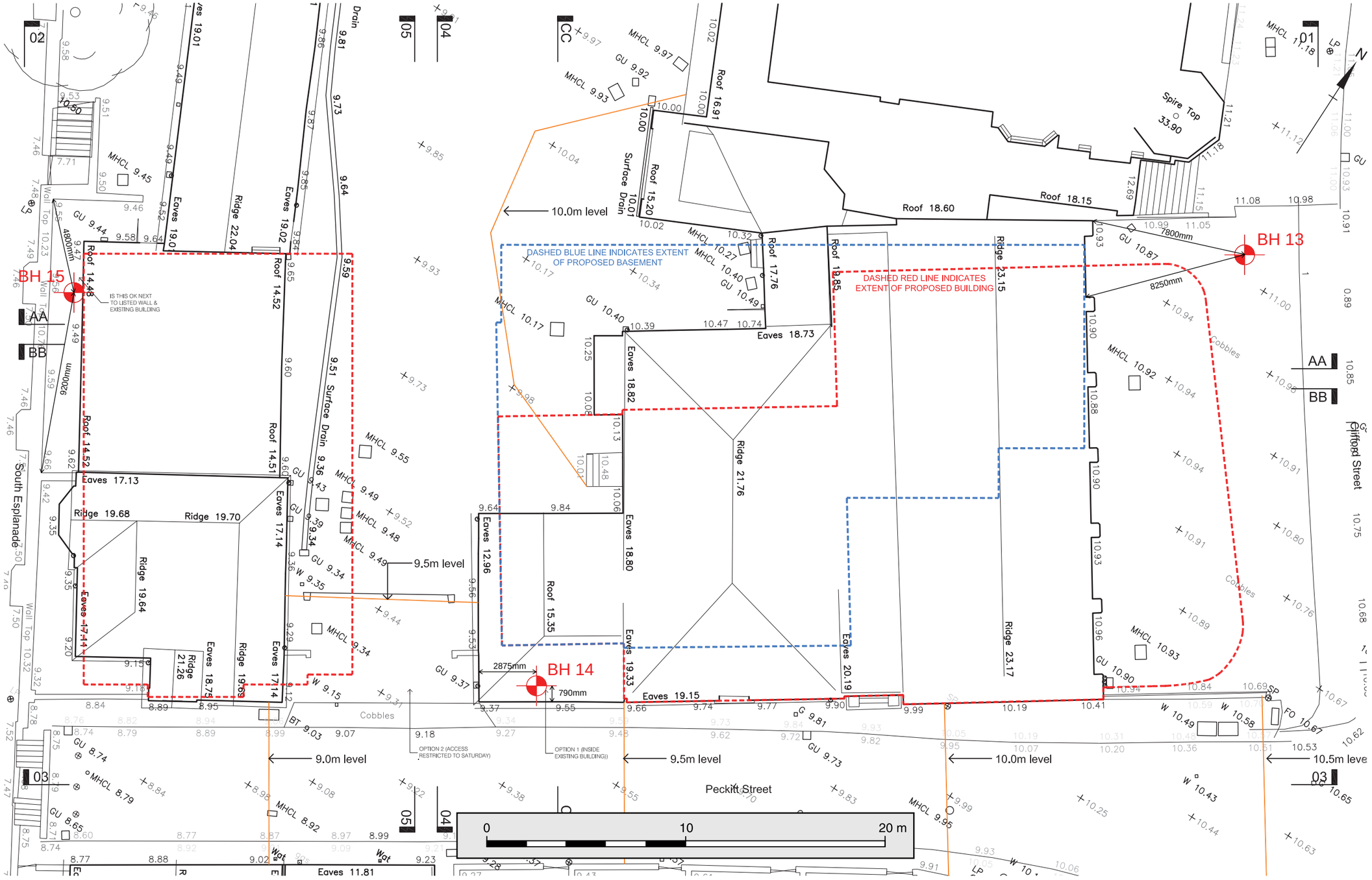
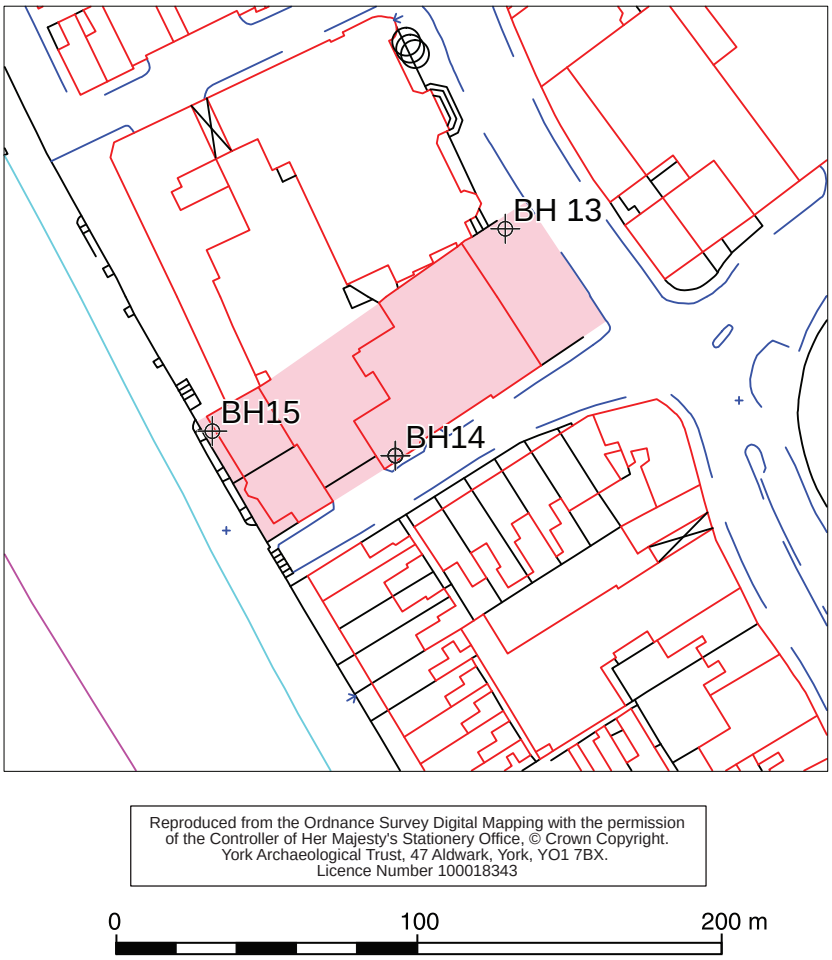


Fig. 6 Dip-well location plan
(based on drawing number 010, revision P02, dc-architecture)



0 100 200 m

Dip-well co-ordinates

BH13 x 460368.8, y 451511.2
BH14 x 460350.6, y 451473.7
BH15 x 460320.4, y 451477.8

Fig. 7 Dip-well locations on 1:2500 OS map base

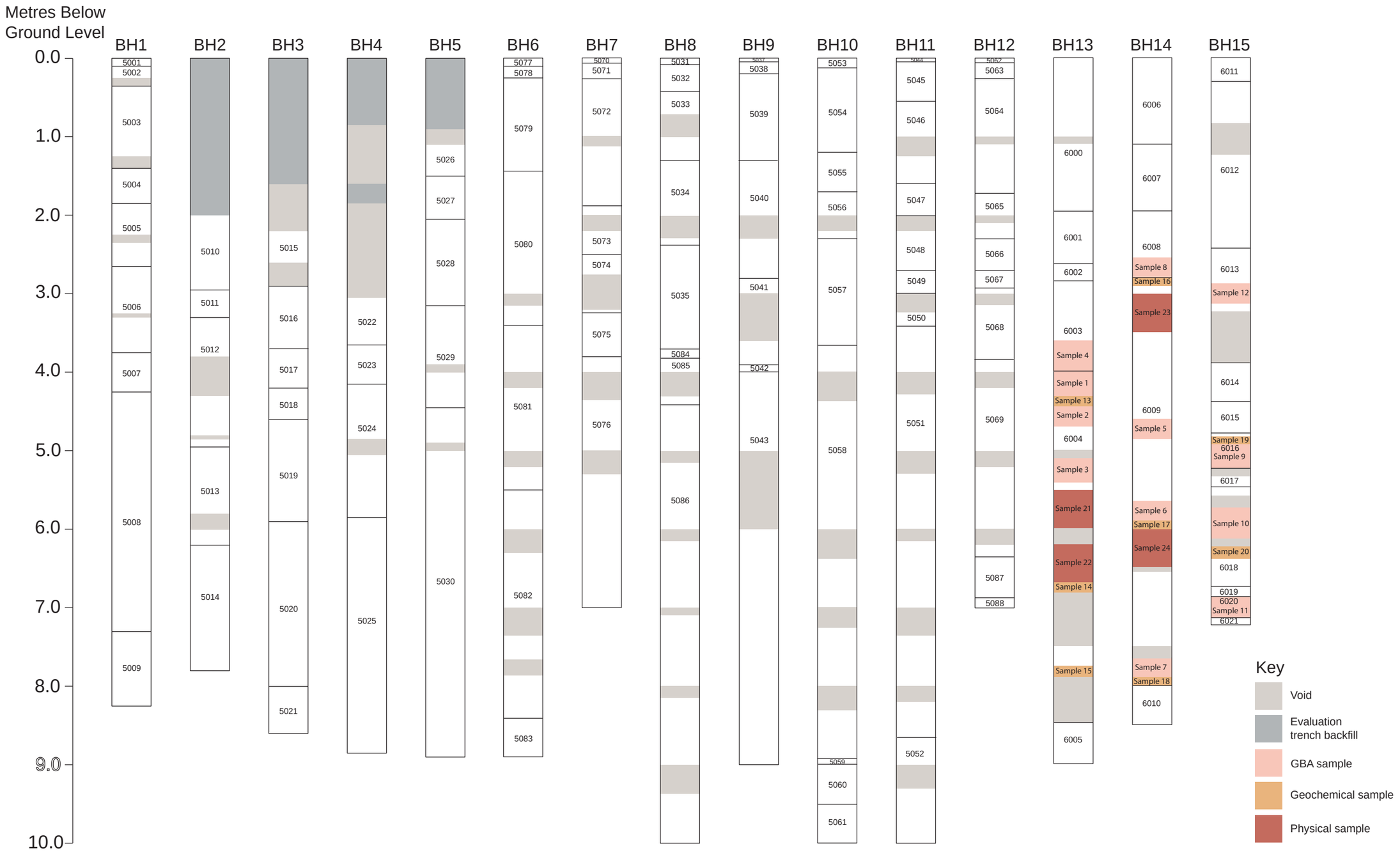


Fig. 8 Borehole profiles, context numbers and sample locations

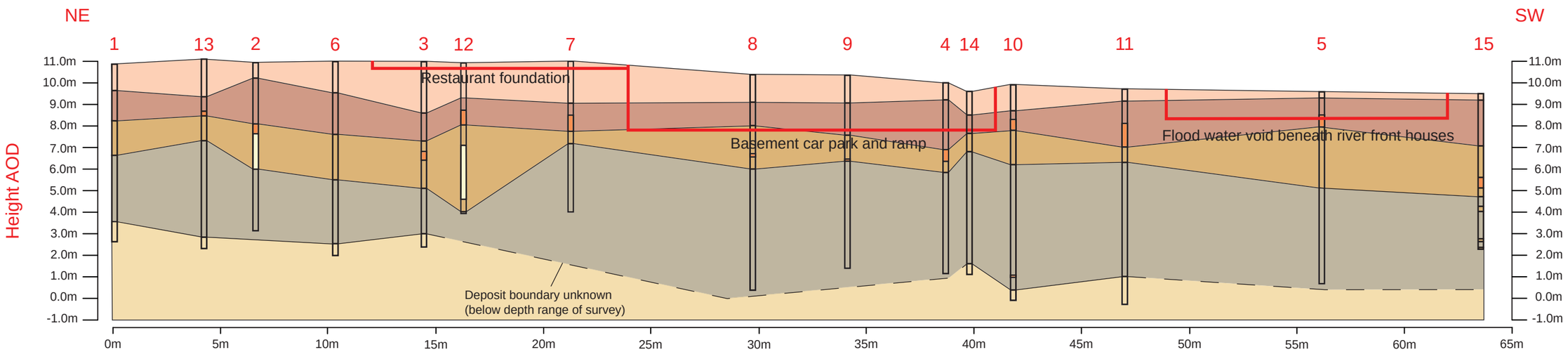


Figure 9 Schematic deposit and impact model
(Scale 1:200 at A3)