Power Court Site
Luton
Bedfordshire

Written Scheme of Investigation for an Archaeological Watching Brief

CA PROJECT: 660816
SITE CODE: PCSL17
ENTRY NUMBER: LTNMG 1268
ACCESSION NO: TBC

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<th>APPROVED BY</th>
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<td>INTERNAL REVIEW</td>
<td>SCC</td>
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CONTENTS

1. INTRODUCTION........................................................................................................2
2. ARCHAEOLOGICAL BACKGROUND......................................................................3
3. AIMS AND OBJECTIVES..........................................................................................7
4. METHODOLOGY.......................................................................................................8
5. STAFF AND TIMETABLE..........................................................................................10
6. HEALTH AND SAFETY............................................................................................12
7. INSURANCES............................................................................................................12
8. MONITORING...........................................................................................................12
9. QUALITY ASSURANCE...........................................................................................12
10. PUBLIC ENGAGEMENT, PARTICIPATION AND BENEFIT.......................................13
11. STAFF TRAINING AND CPD..................................................................................13
12. REFERENCES...........................................................................................................14

APPENDIX A: ARCHAEOLOGICAL STANDARDS AND GUIDELINES.........................16
APPENDIX B: COTSWOLD ARCHAEOLOGY SPECIALISTS........................................19
1. **INTRODUCTION**

1.1 This document sets out details of a *Written Scheme of Investigation* (WSI) by Cotswold Archaeology (CA) for an archaeological watching brief at Power Court Site, Luton, Bedfordshire (centred at NGR: TL 09603 21263; Fig. 1). The fieldwork has been commissioned by 2020 Developments (Luton) Ltd.

1.2 The work is being conducted to inform a planning application to Luton Borough Council (LBC; the local planning authority) for the mixed use development of the site. The development will comprise a new football stadium with ancillary stadium related facilities, along with residential and community/commercial development, hotel and infrastructure (16/01400/OUTEIA).

1.3 The scope of the archaeological work, which will comprise the monitoring of geotechnical ground investigations, was established through discussions between CA and Martin Oake and Hannah Firth, Archaeologists for Central Bedfordshire Council’s Archaeological Service (CBCAS; the archaeological advisors to LBC). The discussion was informed by an archaeological desk-based assessment (DBA) prepared by CA (2016).

1.4 This WSI has been guided in its composition by *Standard and guidance: Archaeological watching brief* (CIfA 2014), the *Management of Research Projects in the Historic Environment (MORPHE): Project Manager’s Guide* (HE 2016) and any other relevant standards or guidance contained within Appendix A.

The Site

1.5 The proposed development site, which covers an area of approximately 7ha, is located in the centre of Luton, immediately to the south-east of the railway station (Fig. 1). The Site is bounded to the north by the Luton–Dunstable Busway, which traces the railway line, and the routes and interchange of Church Street/St. Mary’s Road (to the south-west) and Crawley Green Road (to the south-east). The Arndale Centre (a large shopping mall) and the Grade I Listed St. Mary’s Church are located on the opposite side of St. Mary’s Road, c. 20m to the south-west and c. 20m to the south respectively. The Site was formerly the location of an electricity power station that was in operation from 1901–1969; its two large cooling towers and other structures were demolished in 1972. The Site was subsequently used as an
industrial estate, but most of the late 20th-century warehouses and units have now been demolished. The Site lies at approximately 107m AOD, on roughly flat ground.

1.6 The underlying bedrock geology of the area is mapped as Holywell Nodular Chalk Formation and New Pit Chalk Formation of the Cretaceous Period, overlain by glaciofluvial sand and gravel deposits of the Mid Pleistocene (BGS 2016).

2. ARCHAEOLOGICAL BACKGROUND

2.1 The archaeological and historical background of the Site has been presented in an archaeological desk-based assessment (CA 2016). The following section is summarised from this source.

Pre-Holocene activity (c. 500,000 – 10,000BC)

2.2 The earliest evidence for hominin presence in the Luton area comprises flint implements, including a variety of Lower and Middle Palaeolithic tools discovered within brick-earth deposits of clay extraction pits during the 19th and early 20th centuries (Albion Archaeology 2005, 12). Findspots are located at Caddington (c. 3.5km to the south-west of the Site), Ramridge End (c. 2km to the north-east of the Site) and Leagrave (c. 4km to the north-west of the Site).

Later Prehistoric activity (10,000BC – AD43)

2.3 While there is no substantial evidence for Mesolithic activity in the area, Neolithic occupation is well-attested (Albion Archaeology 2005, 12) through a number of enclosure and monument sites within the wider landscape surrounding the Site. These include a large curvilinear ditched enclosure known as Wafuld’s Bank, adjacent to the source springs of the river Lea, c. 4.5km to the north-west of the Site; as well as Neolithic and Bronze Age ceremonial monuments c. 5.5km to the north of the Site at Warden Hill and Galley Hill.

2.4 A settlement established c. 3000BC is located north of Waulud’s Bank at Sundon Park (Albion Archaeology 2005, 12), with subsequent occupation focused on the alluvial terraces and chalk ridges overlooking the River Lea, c. 1-4km to the north-west of the Site (Carmichael et al. 2011, 27). The remains of a ‘log causeway’ associated with 2nd to1st-century BC pottery have been discovered at Leagrave, c. 4km to the north-west of the Site (BBC/CBC 2016a). It is likely that the Luton area
was ‘an extensive agricultural landscape’ during the Iron Age (Albion Archaeology 2005, 13).

2.5 **Roman activity (AD43 – 410)**

More substantial evidence of later occupation is recorded within (what is now) the modern town of Luton. At Limbury, slightly to the south of Leagrave and c. 3.7km north-west of the Site, excavations uncovered a timber-built settlement of 2nd–4th century date (Albion Archaeology 2005, 15). A section of a ‘service road’, which would have connected settlements to key routes such as Watling Street, has been identified at Leagrave Marsh, c. 3.3km to the north-west of the Site (HER Ref. 167).

A dense concentration of Roman period features and material has been recorded beneath the former Waller Street and at Vicarage Street, c. 50–250m from the Site (Carmichael *et al*. 2011, 27). In 1975–6, groundworks at Vicarage Street, c. 130m to the south of the Site, recovered Roman building debris that included box and flue tile fragments and pottery sherds.

2.7 There are no findspots of Roman date recorded within the Site and it is considered unlikely that there would have been a settlement here at this date as the River Lea (which is now culverted) once flowed in a south-easterly direction through the Site (CA 2016). It is probable, however, that the river and its floodplains were exploited for aquatic, floral and faunal resources during the prehistoric and Roman periods.

2.8 **Early Medieval Origins of Luton (AD410 – 1066)**

The establishment of a town at Luton is thought to have occurred in the 6th century, since the Anglo-Saxon Chronicle records an attack by a Saxon army on a place known as *Lygeanberc* (meaning a defended enclosure on the River Lea) in AD571 (Carmichael *et al*. 2011, 28). Archaeological evidence for activity during the first half of the first millennium is scarce, but suggests ongoing occupation at Leagrave, c. 4.5km to the north-west of the Site, from the Roman period (Albion Archaeology 2005, 16).

An extensive cemetery of 5th to 6th-century date has been excavated at Biscott, c. 2km to the north-west of the Site, but no traces of Saxon buildings have yet been found in Luton, where the settlement at this time is likely to have consisted of dispersed hamlets (Albion Archaeology 2005, 16). During the later first millennium, the River Lea formed the boundary of the Kingdom of Wessex, with a number of
territorial disputes centred on *Lygetune* (as it was re-named later) and its hinterland (CA 2016).

**Medieval development of Luton (AD1066 – 1539)**

2.10 By the time of the Domesday Survey (AD1086), Luton goes by the name of *Loitoine* and is described as a very large settlement with land for 82 ploughlands, woodland for 2000 pigs, six mills and a market (Open Domesday, accessed 16.12.16).

2.11 Following the ascension of King Stephen, the Manor of Luton was granted to Robert de Waudari, a foreign mercenary who built a substantial motte-and-bailey castle on high ground to the south of (but overlooking) the medieval town, c. 690m south-west of the Site. This castle was demolished in AD1154 under the terms of a truce (Carmichael *et al.* 2011, 29); archaeological investigations have located its 3–4m wide bailey ditch and it is thought that Castle Street follows the alignment of the inner ditch (Albion Archaeology 2005, 23). A new castle was established by Fulk de Breaute when he acquired the Manor of Luton in AD1221, on a Site adjacent to St. Mary’s Church and overlooking the River Lea. The castle appears to have been moated. It was partially destroyed in 1224–1225 following de Breaute’s exile, but the Site was re-used in the later 13th and 14th centuries (Carmichael *et al.* 2011, 29). Archaeological excavations at Park Square have unearthed buried remains of medieval structures, deposits and debris relating to the use, demolition and re-use of the castle complex.

**Fulk de Breaute’s castle**

2.12 The general location of Fulk de Breaute’s castle has been identified from both documentary sources and archaeological evidence. A 13th century account mentions flooding caused by a dam in the River Lea, intended to provide water for the castle’s moat (Keir 2011, 20). A map of Luton dating to 1855 notes the Site of the castle with a short description of visible surviving earthworks. It is labelled as ‘Site of Fulk de Brent’s [sic] Castle’ and the accompanying text notes: ‘This castle probably stood in the meadow at the east corner of the churchyard, where the site of a large square moated mansion is still very plainly to be seen; the meadow adjoining it is surrounded by a very high bank of earth, and a deep ditch’ (Davis 1855, 8, 144). Other more recent works have also repeated this mention of some surviving earthworks (Austin 1928).
The site of the castle has been the subject of several archaeological investigations, including excavation, since it was first evaluated in 1976 (CA 2016, 25-26). Most recently, investigations were carried out by Albion Archaeology in 2011 and Headland Archaeology in 2011 and 2013-2014. These provided some considerable evidence for the extent and location of the moat, as well as the layout and possible use of the castle buildings. Recovered assemblages of local and imported ceramic wares, decorative metalwork and imported coinage also demonstrated that the site remained a high-status site, perhaps even a political centre, before being abandoned in the mid-14th century (Headland Archaeology 2015, 60). Across the area of the 2013–2014 excavations, modern ground reduction and levelling had penetrated no deeper than c. 0.3m above the medieval horizon (Headland Archaeology 2015, 28), causing only localised disturbance to medieval deposits.

**Medieval settlement**

It seems that medieval Luton was a linear settlement comprising George Street and Park Street (on the same orientation as the River Lea), Bridge Street, Castle Street and Church Street (Albion Archaeology 2005, 51–52). Archaeological investigations have unearthed evidence of medieval occupation in these localities. Another medieval settlement was located on rising ground on the north side of the River Lea, c. 400m to the north-east of the Site at Crawley Green. Land here (and probably elsewhere in Luton) was owned by St. Albans Abbey prior to the Dissolution.

**Post-medieval (1540 – 1800) and Modern (1800 – present) Luton**

Brick-making was an important industry during the post-medieval period, although brewing and the sale of beer and spirits was the town's principal trade (CA 2016, 31).

The main growth of the town did not occur until the middle of the 18th century, when the near-doubling of Luton's population necessitated the creation of many new streets across former farmland and common along the river valley (Carmichael et al. 2011, 32). In the early 20th century, surrounding hamlets became absorbed into the town.
3. AIMS AND OBJECTIVES

3.1 The general aim of the archaeological investigation will be to provide information about the archaeological resource within the Site, including its presence/absence, character, extent, date, integrity, state of preservation and quality.

3.2 The specific objectives of the archaeological investigation are:

- to monitor ground investigations, and to identify, investigate and record all significant buried archaeological deposits revealed on the Site during the course of the ground investigations;

- To provide archaeological input and interpretation of geotechnical data derived from geotechnical ground investigations

- at the conclusion of the project, to produce an integrated archive for the project work and a report setting out the results of the project and the archaeological conclusions that can be drawn from the recorded data;

3.3 If significant archaeological remains are identified, reference will be made to the Bedfordshire Archaeology. Research and Archaeology: Resource Assessment, Research Agenda and Strategy (Oake et al. 2007), and Research and Archaeology Revisited: A Revised Framework for the East of England (Medlycott 2011) so that the remains can, if possible, be placed within their local and regional context.

3.4 The requirement for the archaeological investigation is in accordance with planning guidance stated in the National Planning Policy Framework (DCLG 2012).
4. METHODOLOGY

4.1 The watching brief will comprise the observation by an experienced archaeologist of the excavation of 25 geotechnical trial pits within the site (Figs 1 and 2). Each test pit will measure approximately 3m in length by 0.6m wide and will be excavated to a target depth of 4m (see Appendix C for detail of excavation methodology). Where mechanical excavators are used, these will be equipped with a toothless bucket. In addition to the trial pits, ten cable percussion boreholes, seven rotary boreholes and fifteen windowless sample boreholes will also be excavated, each preceded by a hand-dug inspection pit to a depth of 1.2m. Non-archaeologically significant deposits will be removed by the contractors under archaeological supervision. Sufficient time allowance should be made by site contractors for the investigation of any archaeological remains revealed during groundworks. The archaeologist will have the authority at any time to halt works to investigate potential archaeological deposits.

4.2 If archaeological deposits are encountered, they will be investigated by hand, characterised and excavated as necessary. They will then be planned and recorded in accordance with *Technical Manual 1: Fieldwork Recording Manual* (CA 2013). Each context will be recorded on a *pro-forma* context sheet by written and measured description. Principal deposits will be recorded by drawn plans (scale 1:20 or 1:50, or electronically using Leica GPS as appropriate) and drawn sections (scale 1:10 or 1:20 as appropriate). Should detailed feature planning be undertaken using GPS, then this will be carried out in accordance with *Technical Manual 4: Survey Manual* (CA 2012). A photographic record will be maintained in 35mm black & white negative film (Ilford HP5) and digital images (minimum 10 megapixels). Representative sections of all pits will be drawn and photographed, even if they contain no deposits of archaeological interest, drawn records including the full depth of the geotechnical intervention. All finds and samples will be bagged separately and related to the context record. All artefacts will be recovered and retained for processing and analysis in accordance with *Technical Manual 3: Treatment of Finds Immediately after Excavation* (CA 1995).

4.3 Due care will be taken to identify deposits which may have environmental potential, and where appropriate, a programme of environmental sampling will be initiated. Samples will be taken, processed and assessed for potential in accordance with *Technical Manual 2: The Taking and Processing of Environmental and Other*
Samples from Archaeological Sites (CA 2003) and Environmental Archaeology: a guide to the theory and practice of methods from sampling and recovery to post-excavation (EH 2011).

4.4 In the event of archaeological deposits being found for which the resources allocated are not sufficient to support treatment to a satisfactory and proper standard or which are of sufficient significance to merit an alternative approach such as contingency excavation or physical preservation, the client and Central Bedfordshire Council's Archaeological Service will be contacted immediately. Destructive work in that area will cease until agreement has been reached on an appropriate archaeological response.

4.5 In the event that human remains are encountered, a licence will be obtained from the Coroners Unit in the Ministry of Justice before the remains are excavated. Removal of the remains will be carried out to the requirements of the licence and will include notification to the local Environmental Health Officer.

4.6 CA will comply fully with the provisions of the Treasure Act 1996 and the Code of Practice referred to therein. A metal detector will be used to maximise the recovery of archaeologically significant metal objects and if any archaeologically significant finds are recovered the Portable Antiquities Scheme Finds Liaison Officer for Bedfordshire will be notified.

4.7 Artefacts from topsoil and subsoil and unstratified contexts will normally be noted but not retained unless they are of intrinsic interest (e.g. worked flint or flint debitage, pottery sherds, and other potential ‘registered artefacts’). All artefacts will be collected from stratified excavated contexts except for large assemblages of post-medieval or modern material. Such material may be noted and not retained, or, if appropriate, a representative sample may be collected and retained.
5. **STAFF AND TIMETABLE**

5.1 This project will be under the management of Michelle Collings ACIfA, Project Manager, CA.

5.2 The duration of the fieldwork will be dependent on the principal contractor’s ground investigation programme.

5.3 Specialists who will be invited to advise and report on specific aspects of the project as necessary are:

- Ed McSloy (CA) Ceramics, metalwork and worked flint
- Dan Stansbie (CA) Ceramics
- Jacky Somerville (CA) Ceramics and worked flint
- Andy Clarke (CA) Animal bone
- Sharon Clough (CA) Human bone
- Sarah Cobain (CA) Environmental remains

5.4 Depending upon the nature of the deposits and artefacts encountered it may be necessary to consult other specialists not listed here. A full list of specialists currently used by Cotswold Archaeology is contained within Appendix B.

6. **POST-EXCAVATION, ARCHIVING AND REPORTING**

6.1 Following completion of fieldwork, all artefacts and environmental samples will be processed, assessed, conserved and packaged in accordance with CA Technical Manuals and Luton Museum guidelines.

6.2 An illustrated report will be compiled on the results of the fieldwork. The report will include: a non-technical summary; an introduction to the project; an archaeological and historical background; an objective text account of the archaeological results, including a record of the full depth of all geotechnical interventions, supported by tabulated data that enables appropriate re-assessment of the results by other parties without recourse to the project archive; a quantification and assessment of the finds
and environmental materials; and an interpretative conclusion regarding the archaeological content of the Site. The report will include appropriate illustrations of the Site, its context and individual trenches, features and contexts where appropriate. A digital version of the report (either in .pdf or .doc format) will be distributed to the client for approval prior to submission to CBCAS.

6.3 A digital version of the report (either in .pdf or .doc format) will be submitted to CBCAS for approval. Following comment from CBCAS, the report will be finalised and a digital copy will be distributed to the client for submission to Luton Borough Council. A digital version of the approved report (in .pdf format) will be submitted to the Central Bedfordshire HER (her@centralbedfordshire.gov.uk) on the understanding that it will become a public document after an appropriate period of time (generally not exceeding six months).

6.4 The results may form part of ongoing work. If archaeology is found that will be reported on as a whole a short publication note or summary of the results of the evaluation will be produced for inclusion within an appropriate archaeological journal/publication (e.g. CBA South Midlands). If appropriate, the results will eventually be included in or will contribute towards a publication report in a local archaeological journal if the project proceeds to archaeological mitigation. A summary of information from the project will also be entered onto the OASIS online database of archaeological projects in Britain.

6.5 On completion of the watching brief, following approval of the report by CBCAS, an ordered, indexed, and internally consistent Site archive will be prepared and deposited in accordance with Archaeological Archives: A Guide to Best Practice in Creation, Compilation, Transfer and Curation (Archaeological Archives Forum 2007). The archive will be held at CA’s stores in Milton Keynes until they are transferred to Wardown Park Museum, Luton (Entry Number applied for). At present Wardown Park Museum is closed but is expected to re-open in Spring 2017 and an accession number will be obtained in due course. The guidelines of the museum will be adhered to in the archive’s preparation.

6.6 CA will make arrangements with Luton Culture for the deposition of the Site archive and, subject to agreement with the legal landowner(s), the artefact collection.
7. HEALTH AND SAFETY

7.1 CA will conduct all works in accordance with the Health and Safety at Work Act 1974 and all subsequent Health and Safety legislation, CA Health and Safety and Environmental policies and the CA Safety, Health and Environmental Management System (SHEMS). A site-specific Project Health and Safety Plan (form SHE 017) will be prepared prior to commencement of fieldwork.

8. INSURANCES

8.1 CA holds Public Liability Insurance to a limit of £10,000,000 and Professional Indemnity Insurance to a limit of £5,000,000. No claims have been made or are pending against these policies in the last three years.

9. MONITORING

9.1 CA will be responsible for notifying Central Bedfordshire Council’s Archaeological Service Archaeologist of the start of site works before the start of fieldwork so that there will be opportunities for them to visit the site and check on the quality and progress of the work. The exact date for the start of ground investigations has yet to be made available, but is anticipated that the work will start in January 2017.

10. QUALITY ASSURANCE

10.1 CA is a Registered Organisation (RO) with the Chartered Institute for Archaeologists (RO Ref. No. 8). As a RO, CA endorses the Code of Conduct (CIfA 2014) and the Code of Approved Practice for the Regulation of Contractual Arrangements in Field Archaeology (CIfA 2014). All CA Project Managers and Project Officers hold either full Member or Associate status within the CIfA.

10.2 CA operates an internal quality assurance system in the following manner. Projects are overseen by a Project Manager who is responsible for the quality of the project. The Project Manager reports to the Chief Executive who bears ultimate responsibility for the conduct of all CA operations. Matters of policy and corporate strategy are determined by the Board of Directors, and in cases of dispute recourse may be made to the Chairman of the Board.
11. PUBLIC ENGAGEMENT, PARTICIPATION AND BENEFIT

11.1 This project will not afford opportunities for public engagement or participation during the course of the fieldwork. However, the results will be made publicly available on the ADS (in full) and CA websites in due course.

12. STAFF TRAINING AND CPD

12.1 CA has a fully documented mandatory Performance Management system for all staff which reviews personal performance, identifies areas for improvement, sets targets and ensures the provision of appropriate training within CA’s adopted training policy. In addition, CA has developed an award-winning Career Development Programme for its staff, which ensures a consistent and high quality approach to the development of appropriate skills.

12.2 As part of the company’s requirement for Continuing Professional Development, all members of staff are also required to maintain a Personal Development Plan and an associated log which is reviewed within the Performance Management system. All staff are subject to probationary periods on appointment, with monthly review; for site-based staff additional monthly Employee Performance Evaluations measure and record skills and identify training needs.
13. REFERENCES


CA (Cotswold Archaeology) 2016 Power Court Site, Luton Town Football Club, Luton: Heritage Desk-Based Assessment, CA Report No. 16279


DCLG (Department of Communities and Local Government) 2012 National Planning Policy Framework

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APPENDIX A: ARCHAEOLOGICAL STANDARDS AND GUIDELINES

AAF 2007 Archaeological Archives. A guide to best practice in creation, compilation, transfer and curation. Archaeological Archives Forum


AAI&S nd Introduction to Drawing Archaeological Pottery. Association of Archaeological Illustrators and Surveyors, Graphic Archaeology Occasional Papers 1


AEA 1995 Environmental Archaeology and Archaeological Evaluations. Recommendations concerning the environmental archaeology component of archaeological evaluations in England. Working Papers of the Association for Environmental Archaeology No. 2

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

EH 2004a Twentieth-Century Military Sites. Current approaches to their recording and conservation English Heritage (Swindon)

EH 2004b Dendrochronology. Guidelines on producing and interpreting dendrochronological dates. English Heritage (Swindon)

EH 2004b Human Bones from Archaeological Sites: Guidelines for producing assessment documents and analytical report. English Heritage Centre for Archaeology Guidelines

EH 2006a Guidelines on the X-radiography of Archaeological Metalwork. English Heritage (Swindon)

EH 2006b Archaeomagnetic Dating. English Heritage (Swindon)

EH 2006c Science for Historic Industries: Guidelines for the investigation of 17th- to 19th-century industries. English Heritage (Swindon)

EH 2007a Understanding the Archaeology of Landscapes. A guide to good recording practice. English Heritage (Swindon)

EH 2007b Geoarchaeology. Using earth sciences to understand the archaeological record. (London)

EH 2008a Luminescence Dating. Guidelines on using luminescence dating in archaeology. English Heritage (Swindon)


EH 2008c Research and Conservation Framework for the British Palaeolithic. English Heritage/Prehistoric Society (Swindon)

EH 2008d Investigative Conservation. Guidelines on how the detailed examination of artefacts from archaeological sites can shed light on their manufacture and use. English Heritage (Swindon)


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Young C., 1980, *Guidelines for the Processing and Publication of Roman Pottery*. Department of the Environment
APPENDIX B: COTSWOLD ARCHAEOLOGY SPECIALISTS

Ceramics

Neolithic/Bronze Age
Ed McSloy (CA)
Emily Edwards (freelance)
Dr Ros Cleal (freelance)

Iron Age/Roman
Ed McSloy (CA)
(Samian) Gwladys Montell (freelance)
(Amphorae stamps) David Williams (freelance)

Anglo-Saxon
Paul Blinkhorn (freelance)
Dr Jane Timby (freelance)

Medieval/post-medieval
Ed McSloy (CA)
Duncan Brown (freelance)
Paul Blinkhorn (freelance)
(Clay pipe) Reg Jackson (freelance)

Ceramic Building Material
Ed McSloy (CA)
Phil Mills (freelance)

Other Finds

Small Finds
Ed McSloy (CA)

Metal Artefacts
Dr Jörn Schuster (freelance)
Dr Hilary Cool (freelance)

Lithics
Ed McSloy (CA)
Jackie Sommerville (CA)
(Palaeolithic) Francis Wenban-Smith (University of Southampton)

Worked Stone
Ruth Shaffrey (freelance)

Inscriptions
Dr Roger Tomlin (Oxford)

Glass
Ed McSloy (CA)
Dr Hilary Cool (freelance)
Dr David Dungworth (freelance; English Heritage)

Coins
Ed McSloy (CA)
Dr Peter Guest (Cardiff University)
Dr Richard Reece (freelance)

Leather
Quita Mould (freelance)

Textiles
Penelope Walton Rogers (freelance)

Iron slag/metal technology
Dr Tim Young (Cardiff University)
Dr David Dungworth (English Heritage)

Biological Remains

Animal bone
Philip Armitage (freelance)
Matilda Holmes (freelance)

Human Bone
Sharon Clough (CA)

Environmental sampling
Sarah Cobain (CA)
Dr Keith Wilkinson (ARCA)

Pollen
Rob Batchelor (QUEST, University of Reading)

Diatoms
Nigel Cameron (UCL)
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<td>Wood/Charcoal</td>
<td>Sarah Cobain (CA)</td>
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<td>Insects</td>
<td>David Smith (Birmingham University)</td>
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<td>Enid Allison (Canterbury Archaeological Trust)</td>
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<td>Dr Keith Wilkinson (ARCA)</td>
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<td>Philip Armitage (freelance)</td>
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<td>Dr Keith Wilkinson (ARCA)</td>
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<td>Robert Howard (NTRDL Nottingham)</td>
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<td>Neil Sutie (University of Liverpool)</td>
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<td>Cathy Batt (University of Bradford)</td>
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<td>TL/OSL Dating</td>
<td>Phil Toms (University of Gloucestershire)</td>
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<tr>
<td><strong>Conservation</strong></td>
<td>Karen Barker (freelance)</td>
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<td>Wiltshire Conservation Services</td>
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APPENDIX C: GEOTECHNICAL INVESTIGATION METHODOLOGIES
Defined Activity

This method statement has been developed in order to provide guidance on how Peter Brett Associates (PBA) supervise trial pits as well as the logging and sampling of soils associated with this procedure.

The defined activity is trial pitting by use of a mechanical excavator. Trial pitting is a method of intrusive investigation to provide an accurate assessment of the soil through visual inspection and sampling to depths of up to 4.5m.

Excavations are generally in the order of 0.6m wide and up to 3m long, depending on ground conditions encountered and depth of pit. The mechanical excavator is operated by an experienced operator, under the supervision of a PBA engineer.

Equipment

In most cases the mechanical excavator will be a backhoe loader JCB 3CX Site Master, or similar.

JCB 3CX Dimensions:

<p>| | |</p>
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<tr>
<td>Total Length</td>
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<td>Dig Depth</td>
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Hazard Identification

The following hazards have been identified in connection with trial pitting:

- Excavator coming into direct contact with buried services or overhead services.
- Noise and dust generated by excavator.
- Engineer coming into direct contact with contaminated soils/groundwater.
- Moving plant.
- Engineer or public falling into pit.
- Sudden collapse of excavations.
- Fall of soils from the excavator bucket.
- Trip hazard after backfilling of trial pitting, including depressions, and rutting of ground.
METHOD STATEMENT
TRIAL PITTING
Personal Protective Equipment (PPE)

The engineer will wear the following PPE during the on-site activities:

- Safety boots.
- Hi-visibility clothing.
- Gloves.
- Hard Hat.

If the excavator driver leaves the cab during site works they will be required to wear the above PPE.

At all times during the works, no persons will be allowed within 5m of the working area without the correct PPE.

Methodology

The location of trial pits should be determined in advance, and later confirmed on assessing the onsite conditions. Each location shall be scanned for the presence of underground services prior to excavation. Clearance of locations shall be undertaken by following the PBA Method Statement for Utilities Clearance. No trial pits are to be located directly beneath overhead services.

Trial pits will be fully supervised by the engineer during excavation, and will not be left unattended or out of sight of the engineer, unless appropriate fencing has been erected around the excavation.

Excavation is undertaken using a hydraulic backhoe-type excavator (e.g. JCB 3CX). Soils are excavated in layers and placed in separate stockpiles to prevent cross contamination.

A clear system of communication between the engineer and the machine operator should be agreed prior to starting the works. The engineer will ensure that they are clearly visible to the driver at all times. The engineer should stay at the opposite end of the trial pit to the excavator during excavation and should stop any excavation immediately upon the identification of any anomalous feature to ensure identification has been undertaken and the potential risk assessed.

Wherever possible the engineer should stay at the short end of trial pit. If instability is noted within the trial pit then the engineer should ensure nobody approaches within 1m of the unstable trial pit face.

At all times, the engineer will be required to inform the machine operator when he proposes to recover samples/undertake tests, be it in-situ, from stockpiles or from the bucket of the excavator. At no time will the engineer approach the working area of the excavator unless the machine operator has acknowledged to the engineer that it is safe to do so.

The bucket of the excavator shall be placed at the base of the pit or level on the ground surface prior to any personnel coming within 1m of the bucket.
METHOD STATEMENT
TRIAL PITTING

Logging and Sampling
The soil strata encountered during the excavation shall be logged in accordance with BS EN ISO 14688-1/2 (BS 5930:2015). The depth of each separate stratum shall be measured from the ground surface and its depth and thickness recorded. Areas of loose and unstable material shall be recorded together with the location and type (e.g. seepage, flow rate, etc) of groundwater influx.

Visual and olfactory evidence of encountered contamination shall be recorded.

The exposed strata within the excavation shall be photographed before the trial pit is backfilled.

Soil samples will be obtained from the excavator bucket or from the stockpiled arisings at known depths.

Reinstatement
Unless other arrangements for reinstatement have been agreed prior to PBA undertaking the trial pitting, reinstatement will comprise the following:

- Trial pits should be backfilled as soon as logging and sampling is completed.
- Soils are to be replaced in the order they were excavated.
- The final backfilled pit should be left slightly mounded and not compacted down to allow for subsequent settling.
- The backfilled pit should be photographed on completion.
defined activity

this method statement has been developed in order to provide guidance on how peter brett associates (pba) undertaken hand excavated trial pits as well as the logging and sampling of soils associated with this procedure.

trial pitting is a method of intrusive investigation to provide an accurate assessment of the soil through visual inspection and sampling. in most cases hand dug inspection pits are undertaken to either determine the presence of buried services to facilitate borehole construction, or undertaken adjacent to a structure to expose and record foundation details.

excavations, for the purposes of clearing borehole locations of services are generally no greater than 0.5m², whilst inspection pits to expose foundations will be as large as required.

in most cases, the pits will be excavated by a one or two man team.

equipment

in general hand excavation of inspection pits is undertaken by use of spades, scissor-shovels, and other equipment. forks, pick axes etc. should not be used in order to prevent the possibility of damage to unobserved buried services.

hazard identification

the following hazards have been identified in connection with trial pitting:

- coming into direct contact with buried services or overhead services.
- engineer coming into direct contact with contaminated soils/groundwater.
- sudden collapse of excavations.
- trip hazard after backfilling of trial pitting, including depressions, and rutting of ground.

personal protective equipment (ppe)

the engineer will wear the following ppe during the on-site activities:

- safety boots.
- hi-visibility clothing.
- gloves.
- ear defenders (if using hydraulic breaker)
METHOD STATEMENT
HAND DUG TRIAL PITS
Methodology

The location of trial pits should be determined in advance, and later confirmed on assessing the onsite conditions. Each location shall be scanned for the presence of underground services prior to excavation. Clearance of locations shall be undertaken by following the PBA Method Statement for Utilities Clearance.

Trial pits will be fully supervised by the engineer during excavation, and will not be left unattended or out of sight of the engineer, unless appropriate fencing has been erected around the excavation.

Excavation is undertaken using hand tools, such as spades, bars and posting shovels. Soils are excavated in layers and placed in separate stockpiles to prevent cross contamination.

Due to the small size of the excavation man entry to the pit is not permitted.

The engineer should stop any excavation immediately upon the identification of any anomalous feature to ensure identification has been undertaken and the potential risk assessed.

Logging and Sampling

The soil strata encountered during the excavation shall be logged in accordance with BS EN ISO 14688-1/2 (BS 5930:2015). The depth of each separate stratum shall be measured from the ground surface and its depth and thickness recorded. Areas of loose and unstable material shall be recorded together with the location and type (e.g. seepage, flow rate, etc) of groundwater influx.

Visual and olfactory evidence of encountered contamination shall be recorded.

The exposed strata within the excavation shall be photographed before the trial pit is backfilled.

Soil samples will be obtained from the excavation or from the stockpiled arisings at known depths.

Reinstatement

Unless other arrangements for reinstatement have been agreed prior to PBA undertaking the trial pitting, reinstatement will comprise the following:

- Trial pits should be backfilled as soon as logging and sampling is completed.
- Soils are to be replaced in the order they were excavated.
- The backfilled pit should be photographed on completion.
METHOD STATEMENT
WINDOW SAMPLER BOREHOLES

Defined Activity

This method statement has been developed in order to provide guidance on how Peter Brett Associates (PBA) supervise window sampler boreholes as well as the logging and sampling of soils associated with this procedure

The window sampling rig is designed to sink boreholes up to 130mm diameter through soils and weak rock, including clays, silts, sands, gravels and chalk. The rig is primarily used for shallow site investigations to a maximum depth of 10 metres, and for carrying out insitu tests to a maximum depth of 15 metres. In practice, the actual depth achieved is dependent on local ground conditions.

The rig is operated by a two man team under the supervision of the PBA engineer.

Equipment

The window sampling rig consists of the rig mounted on a self-propelled tracked undercarriage. The entire unit can be tracked easily between borehole locations, up gentle slopes and inside buildings. The rig and tracked undercarriage is powered by either a diesel or petrol engine.

The rig can pass through a domestic doorway and work inside a building with a minimum headroom of 2.75m.

- Overall length mast down: 2.7m
- Overall height mast down: 1.48m
- Overall height mast up: 2.22m to 2.85m
- Overall width: 0.8m
- Weight: 1050kg
- Trip hammer weight: 50kg or 63.5kg
- Trip hammer drop: 0.5m or 0.75m
- Borehole depth: up to 10m
- Borehole diameter: 50mm to 130mm

Hazard Identification

The following potential hazards have been identified to PBA staff in connection with window sampling:

- Drilling rig coming into direct contact with buried services
- Toppling of rig if not set up on even ground
- Noise fumes and dust generated by drilling rig
- Dermatitis – contact with oils/fuels/cements and other substances
- Explosion/fire hazard when refuelling rig
- Engineer coming into direct contact with contaminated soils/groundwater.
- Slip/trip hazards from drilling equipment and hand pitting equipment
Personal Protective Equipment (PPE)

The engineer will wear the following PPE during boring operations:

- Gloves
- Hard hats
- Safety boots
- Hi-Visibility clothing
- Ear defenders.

At all times during the works, no persons will be allowed within 5m of the working area without the correct PPE.

Other activities on site or clients site specific health and safety requirements may require additional PPE to be worn by the site personnel.

Methodology

The window sampling rig is a track mounted drilling rig that utilises a petrol or diesel engine operated winch which lifts a mechanized drop-weight (the ‘hammer’). The suspended weight is held in place by a steel frame and guide rods, which is then dropped onto an anvil, driving attached sample tubes (50–130mm diameter) or probe rods into the ground.

Before drilling can begin, a 1.2m deep hand dug pit must be completed as a precaution to any unidentified underground obstructions/services.

The rig is tracked into position and the mast erected by using a hydraulic ram. The rig needs a relatively flat working area free from obstructions including overhead obstructions. The rig pivots on the track to its upright position where two legs are attached to the rig to provide stability and to level the rig. The area required when on the tracked unit is approximately 4 x 2m. The hydraulic power unit is mounted on the tracked unit.

The lead driller must be at the controls of the rig at all times whilst drilling.

The rig has a free moving carriage which is positioned by a hydraulic cylinder mounted at the rear. The weight (adjustable from 50 - 63.5 kg) is lifted by a chain driven pick up device which has a variable speed enabling the blows per minute to be adjusted from 15 to 30 (to comply with BS1377). The stroke is also variable from 760mm (SPT testing) to 500mm (dynamic probing).

The weight when dropped drives a steel tube containing a 1 m PVC liner. A simultaneous casing system can also be used. Once casing is completed the diameter of the steel tube is reduced in stages to enable greater depths to be achieved. After each metre is driven it is hydraulically extracted and the PVC liner containing the sample is removed and replaced with a new liner.

After driving samplers to the required depth, they can be simply extracted using an integral hydraulic ram on the rig. No separate jacking system is required.
WINDOW SAMPLER BOREHOLES

Logging and Sampling

The soil strata encountered during the excavation shall be logged in accordance with BS EN ISO 14688-1/2 (BS 5930:2015).

Where required the PVC liner is split on site for sub sampling. This is achieved with the use of a hook blade knife which is used to cut the liner. Great care should be taken during this operation and the cut should always be made away from the body. The sample should not be held still by hand.

Lengths of core should be split open before logging to reveal the true colour and texture of the soils. Soil samples should be taken as to be representative of the overall soil mass at a specific depth and location, including all present grain sizes.

Visual and olfactory evidence of encountered contamination shall be recorded.

In Situ Testing

- The driller would be provided with instructions on testing to be completed and the relevant depths for each borehole in advance
- **Standard Penetration Tests (SPTs)** are dynamic tests and are described fully in BS1377: Part 9: 1990. They should be carried out in each borehole to measure the relative density of the underlying soils
- The SPT apparatus consists of a split spoon sampler attached by drill rods to the required sampling depth. The sampler will be driven into the soil by a 63.5kg hammer dropped from a height of 760mm onto an anvil at the top of the drill rods. The number of blows of the hammer will be counted over a length of 450mm, marked onto the drill rods at six 75mm increments.
- The first two increments are known as the ‘seating blows’ and will be recorded but not used when determining the in-situ soil density. The N-value, or number of blows, will be recorded for the remaining four increments. This is the measurement of the standard penetration soil resistance.
- Where possible the material from inside the split spoon should be retained as a small disturbed sample. For coarse granular material the split spoon is replaced with a 60° cone.

Installation

- Install pipe comprises plain HDPE pipe and slotted pipe 19mm or 50mm in diameter.
- Where the base of the borehole is deeper than that of the intended install, the borehole shall be backfilled with bentonite to the required depth.
- Slotted pipe is installed in the zone of interest (response zone), the area around the pipe is then backfilled with granular filter material of 1-5mm diameter.
- Plain pipe will be installed above this to the surface level and backfilled with bentonite.
- The well shall then be secured with a layer of cement/concrete approximately 0.2m thick, and the desired cover installed.
- The top of the plain standpipe shall either be plugged/capped if the well is to be used for groundwater monitoring only, or may be fitted with a gas tap if it to be used as a combined gas/groundwater well.

If an installation is not being constructed then the boreholes will be backfilled with arisings in the order of excavation, or with bentonite, as specified by the PBA engineer.
Technical Information - Noise

The operation of the drilling rig generates some noise, predominantly from the engine and falling drop hammer. If the supervising engineer is providing full time site supervision it is possible that the estimated daily personal noise exposure levels exceed the HSE limit of 85 decibels. Therefore all engineers will wear appropriate hearing protection whilst within 5m of the drilling rig.
METHOD STATEMENT FOR CABLE PERCUSSIVE BOREHOLES

Defined Activity

This Method Statement has been developed in order to provide guidance on how Peter Brett Associates (PBA) supervise drilling of cable percussive boreholes. Methods of soil logging and sampling are also included in this document. The PBA engineer should undertake the following as part of the supervision:

Discuss the work required with the drilling crew with particular regard to sample integrity, procedures to avoid cross contamination and work timescales.

Check the equipment that has been supplied against that which has been ordered and visually inspect equipment for any damage.

Brief the drilling crew on all health and safety requirements. Issue the drilling crew with the project Health and Safety plan and ensure that it is read and signed.

Check all proposed locations for adequate height clearance, working area and access with the driller.

Logs the soil arisings and take soil samples at the relevant depths as agreed with the project manager. The method of sampling will depend on the investigation requirements, the drilling technique used and the soil conditions.

Monitor the assembly and insertion of the instrument into the borehole to ensure that instructions are followed. Installations of wells in deep holes can be difficult and any problems should be discussed with the driller prior to installation. The anticipated well design will be dependent upon the requirements of each job and will be instructed by the Project Manager.

Equipment

Cable percussive rig (with all associated casing etc), four-wheel drive vehicle, water source, installation pipe, borehole cover, insulated shovel and scissor spade, camera, measuring tape, sample jars, transport containers.

The rig, which is mounted on two wheels, and usually towed by a 4-wheeled drive vehicle, comprises a winch that is driven by a diesel engine and a derrick of approximately 6.5m in height. The drill tools are worked by a wire rope using the clutch of the winch to provide the percussive action.

The legs to the rig of the derrick fold down to form a simple trailer that can be towed by a light vehicle. Vehicle and rig when towed are approximately 8.5m long.

This type of rig requires a large space to operate and will only be used in unconfined spaces (i.e. open fields, car parks, roads, large warehouses).
METHOD STATEMENT FOR CABLE PERCUSSIVE BOREHOLES

- Operating Height 5.20m - 6.65m
- Operating Width 2.10m
- Transport Length 8.50m
- Transport Height 1.380m
- Transport Width 1.80m
- Weight 2.10 ton
- Borehole Depth >60m
- Borehole Diameter 150mm - 300mm

Where access for a normal rig is not possible, a demountable rig can be used for difficult access and low headroom locations, gaining access through a normal domestic doorway or garden gate, and with a workable headroom as low as 2.6m.

Hazard Identification

The following potential hazards have been identified to PBA staff in connection with window sampling:

- Drilling rig coming into direct contact with buried services.
- Toppling of rig if not set up on even ground.
- Noise, fumes and dust generated by drilling rig.
- Dermatitis – contact with oils/fuels/cements and other substances.
- Explosion/fire hazard when refuelling rig.
- Engineer coming into direct contact with contaminated soils/groundwater.
- Slip/trip hazards from drilling equipment and hand pitting equipment.
- Impact with moving plant during set up and moving around site.

Personal Protective Equipment (PPE)

The supervising engineer will wear the following PPE during boring operations:

- Gloves
- Overalls
- Hard hats
- Safety boots
- Hi-Visibility clothing
- Ear defenders.

At all times during the works, no persons will be allowed within 5m of the working area without the correct PPE.

Other activities on site or clients site specific health and safety requirements may require additional PPE to be worn by the site personnel.
METHOD STATEMENT FOR CABLE PERCUSSIVE BOREHOLES

Methodology

- Boreholes are undertaken in order to investigate ground conditions at depth, and to enable installation of groundwater and ground gas monitoring wells.
- Boreholes are drilled using a tripod rig towed behind a four-wheel drive vehicle and are operated by a two man crew.
- Before drilling can begin each location shall be cleared for buried utilities as outlined in PBA method statement for utilities clearance.
- A 1.2m deep hand dug pit must be completed as a precaution to any unidentified underground obstructions/services.
- Borehole progression is driven by a free-fall winch.
- At intervals where the ground in difficult to bore, water may be added. This should be kept to a minimum and the approximate volume added should be recorded.
- When groundwater is struck, drilling is to stop and groundwater level recorded over a period of 20 minutes.
- Spoil is to be collected and set out in piles according to the depth it was recovered.
- Boreholes may be backfilled with arisings, bentonite pellets or installed for groundwater and gas monitoring.

Monitoring Well Installations

- Install pipe generally comprise plain HDPE pipe and slotted pipe 19mm or 50mm internal diameter.
- Where the base of the borehole is deeper than that of the intended install, the borehole shall be backfilled with bentonite to the required depth.
- Slotted pipe is installed in the zone of interest (response zone), which tends to be within the granular soils. The area around the pipe is then backfilled with granular filter material of 1-5mm diameter.
- Plain pipe will be installed above this to the surface level (if granular soils aren’t present from ground level), and backfilled with bentonite.
- The well shall then be secured with a layer of cement/concrete approximately 0.2m thick, and the desired cover installed.
- The top of the plain standpipe shall either be plugged/capped if the well is to be used for groundwater monitoring only, or may be fitted with a gas tap if it to be used as a combined gas/groundwater well.

In Situ Testing

- The driller will be provided with instructions from PBA engineer on testing to be completed and the relevant depths for each borehole in advance.
- **Standard Penetration Tests (SPTs)** are dynamic tests and are described fully in BS1377: Part 9: 1990. They should be carried out in each borehole to measure the relative density of the underlying soils.
- The SPT apparatus consists of a split spoon sampler attached by drill rods to the required sampling depth. The sampler will be driven into the soil by a 63.5kg hammer dropped from a height of 760mm onto an anvil at the top of the drill rods. The number of blows of the hammer will be counted over a length of 450mm, marked onto the drill rods at six 75mm increments.
- **UT100s** can be undertaken in the borehole and the samples used for geotechnical analysis. These are 100mm metals tubes 0.45m length which are driven into...
undisturbed ground and the blow count recorded by the driller.

Logging and Sampling

The soil strata encountered during the excavation shall be logged in accordance with BS EN ISO 14688-1/2 (BS 5930:2015). The depth of each separate stratum shall be measured from the ground surface and its depth and thickness recorded.

Visual and olfactory evidence of encountered contamination shall be recorded.

Soil samples for geotechnical and geoenvironmental laboratory testing can be taken from the soil arisings.

For geoenvironmental samples, each sample jar should be labelled with the appropriate job number, date, location and depth of the sample. Containers should be filled completely so to avoid headspace in the containers. Samples should be placed in a shipping container (cool box) with ice packs and surrounded with suitable packaging material (bubble wrap) to avoid damage. The samples are then sent by courier to the appropriate testing laboratory.

Technical Information - Noise

The operation of the cable percussive drilling rig generates some noise, predominantly from the engine. If the supervising engineer is providing full time site supervision it is possible that the estimated daily personal noise exposure levels exceed the HSE limit of 85decibles. Therefore all engineers will wear appropriate hearing protection whilst within 5m of the drilling rig.
Location of archaeological watching brief
PROPOSED EXPLORATORY HOLE LOCATION PLAN

LUTON TOWN FOOTBALL CLUB

FOR INFORMATION

NOTES

**KEY**

- Green line: Area With No Existing Ground Investigation Data
- Red star: 10 No. Cable Percussive Borehole locations
- Red diamond: 7 No. Rotary Borehole Locations
- Blue square: 25 No. Trial Pit Locations
- Purple cross: 15 No. Windowless Sampler Borehole Locations

**NOTE**

Final Locations subject to access and confirmation of existing monitoring wells

**UTILITIES NOTE:**
The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

**SCALING NOTE:**
Do not scale from this drawing. If in doubt, ask.

**File Location:**
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**Date of 1st Issue:**
05.04.16

**Designed:**

**Revision:**

**Drawn:**

**Mark:**

**Revision Chkd:**

**Approved:**

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Revision Chkd

Date

PW

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Update Exploratory Hole Locations
17.05.16

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