London Gateway:
Northern Triangle East
Habitat Creation and Enhancements

Archaeological Investigation Report

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LONDON GATEWAY

ARCHAEOLOGICAL INVESTIGATION REPORT:

NORTHERN TRIANGLE EAST

HABITAT CREATION AND ENHANCEMENTS

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NON-TECHNICAL SUMMARY

During July 2008, Oxford Archaeology (OA) carried out a series of trench excavations at the Northern Triangle East site, Corringham, Essex, in relation to an ecological mitigation and habitat creation project, being undertaken as part of the London Gateway port development. The aim was to assess the archaeological potential of the area, and to mitigate the effects of constructing 24 ponds and other landscaping and planting work. The site is located to the north of the former oil refinery at Shell Haven, Essex, and the work was carried out on behalf of DP World.

The trenching revealed no below ground archaeological remains in any of the twenty trenches although two modern ditches, both extant features in the current landscape, were present in Trenches 16 and 24. In addition, Trench 21 contained two intercutting palaeochannels in the top 1.25m of the trench, immediately under the topsoil; they are likely to be of recent origin, although their date is currently unknown.

The trenches presented an opportunity to assess the geostratigraphy of the upper alluvium within this part of the development area. This proved to be a relatively homogeneous and simple sequence throughout the Northern Triangle East area, with generally low archaeological potential.

Limited further analysis is recommended to date the upper alluvial stratigraphy using radiocarbon dating. This will assist in predicting the likely significance of archaeological deposits in the upper alluvium, across the wider development area.

1 INTRODUCTION

1.1 Location and scope of work

1.1.1 In July 2008, OA carried out a series of trench excavations at Corringham, Essex on behalf of DP World (Fig. 1). The fieldwork took place at the Northern Triangle East site, an ecological habitat creation and enhancement area, forming part of the London Gateway Port and Park development. The work was conducted in accordance with the London Gateway Archaeological Mitigation Framework (AMF, see 1.2 below).

1.1.2 The Northern Triangle East site, comprising *c.* 27 hectares, is located within the ancient parish of Corringham, Essex (TQ 733 831) and is immediately to the north of the A1014 Manorway and the main London Gateway development area (Fig. 2). The work was carried out in accordance with a project design for the archaeological trenching, which was approved by Essex County Council Historic Environment Branch on behalf of the Planning Authority (Oxford Archaeology, 2008, London Gateway: Northern Triangle East; Habitat Creation and Enhancements. Written Scheme of Investigation for Archaeological Monitoring).

1.2 Project planning background

1.2.1 London Gateway Port and Park received planning permission from Government on the 30th May 2007. The applications were in the form of an Outline Planning Application (OPA) for the Park and a Harbour Empowerment Order (HEO) for the Port. The proposed development area is extensive, including works on the gravel terrace, historic marshland, and the inter-tidal and sub-tidal zones, which are likely to encompass a diverse archaeological resource. Desk-based studies and non-intrusive surveys undertaken to support the London Gateway Environmental Statement suggest that the development has the potential to impact on important archaeological remains.

1.2.2 In recognition of this, a condition of both permissions is the implementation of the London Gateway Archaeological Mitigation Framework (AMF). Originally included as a Technical Report to the Environmental Statement, the purpose of this document was to establish a strategic framework, applicable to the entirety of the archaeological resource, within which the London Gateway archaeological programme would operate. Following consultation with Thurrock Council, an updated version of the AMF was included as Appendix 2 of the 'Statement of Common Ground' agreed between the developer (P&O, now DP World), and Thurrock Council, in July 2003a (OA 2003).

1.3 Geology and topography

1.3.1 The site lies at the boundary between the inner and outer parts of the Thames estuary within an area known as the London Basin, which is bounded to the north by the chalk escarpment of the Chiltern Hills and to the south by the chalk of the North Downs. The Northern Triangle lies between 2.20m and 1.31mOD sloping imperceptibly from north to south. The land is currently under pasture.

1.4 Archaeological and historical background

1.4.1 The archaeological background to the trenching has been the subject of a separate desk based assessment (OA 2002), the results of which are summarised below.

1.4.2 The Thames estuary has been a focus for human inhabitation from the Palaeolithic through to the 20th century and throughout that period, changes in the environment and sea levels have profoundly affected patterns of settlement, exploitation of natural resources and the use of the river for transport and trade.

1.4.3 The original desk-based assessment and geoarchaeological deposit model characterised the London Gateway study area as divided between four archaeological zones. The Northern Triangle lies entirely within one of these zones, the alluvial floodplain. The site is located in the angle between the main Thames channel to the south and Vange Creek to the east. Prior to the 18th century, the entire area was coastal salt marsh, cut by sinuous creeks. It is clear from borehole records immediately to the south of the Manorway (e.g. ARC BH7) that the Holocene alluvial sequence within this general area is *c.* 12m thick.

1.4.4 The surface of the Pleistocene gravels rises to form the present land surface *c.* 2km to the northwest. The main medieval and later settlements of Fobbing, Corringham and Stanford-le-Hope lie on this higher, drier ground. The desk-based assessment has identified a number of sites that confirm the potential for prehistoric and later settlement, also concentrated on the gravel terrace. The Northern Triangle lies in an area historically exploited by these communities as salt marsh, summer pasture and potentially a range of other economic activities such as salt making, fishing or hunting.

1.4.5 The Northern Triangle contains evidence for medieval and later sea defences, land reclamation and agricultural improvement, but the site was not included in the late 19th and 20th century industrial development that occurred at the main Shell Haven site. The area now forms part of a rural, agricultural buffer zone, lying between the historic settlements on the gravel terrace and the late 19th and 20th century industrial developments at Shell Haven to the south. The marshland character of the area has been substantially eroded during the last 200 years, although some elements survive, particularly along the fringes of the Manorway Fleet, in the flat, largely treeless aspect and in the presence of old sea walls.

1.4.6 The desk-based assessment identified two surviving historic landscape features of local interest within the site boundaries. WWII anti-glider ditches (OAU 55) were placed across the site, but have subsequently been infilled and are only evident as crop-marks. The SMR records earthworks of WWII bomb craters on the eastern side of Manorway Fleet (OAU 94). The Shell Haven oil storage facilities were a strategic target during World War II, and this is reflected in defensive features and bomb craters of this period within the site and adjacent areas.

1.4.7 In 2006, a walkover survey commissioned by the Royal Society for the Protection of Birds (RSPB) was undertaken, covering an extensive area to the north of the Port development. Identified landscape features within the Northern Triangle (East) include an old sea wall (along the edge of Manorway Creek) and traces of post-medieval 'stetch' cultivation. Further details of the bomb craters identified on the County SMR and London Gateway Environmental Statement Gazetteer are also noted.

1.4.8 The distribution of archaeological activity has been assessed from air photographs, cartographic sources and site visits, including the walkover survey conducted by the

RSPB. Other than this the site has seen no intensive and systematic archaeological fieldwork in the past. It is therefore probable that the present distribution of known archaeological sites and finds, as recorded by the SMR and NMR, does not accurately reflect the true distribution of previous human activity. This is due to substantial depths of alluvium burying, and hence masking, components of the archaeological resource from conventional forms of shallow archaeological prospection, e.g. aerial photography. The area of the development has a range of different geomorphic units, such as palaeochannels, terraces and inter-tidal floodplain, each having a different archaeological potential. In broad terms, the site has the potential to contain archaeological remains dating from the prehistoric to post-medieval periods, buried at various depths, dependant on the geomorphic unit. Economic utilisation of the inter-tidal floodplain is unlikely to have involved permanent settlement, but may include evidence of salt-workings, trackways, fishing and hunting and maritime transport. There is potential for wrecks and wharf structures of prehistoric or later date to have been preserved in and around the inter-tidal palaeochannels, if they had a navigable capacity.

1.4.9 In the post-medieval period, the marshland was extensively drained and reclaimed. The Northern Triangle was apparently used for agricultural purposes, as no settlements are shown in the area on historic maps in this location. Farming practices over time, might have involved cleaning out the existing ditches and creeks in order to improve drainage. This may have had an impact upon any later medieval or post-medieval archaeological remains contained within such features, such as boats, wharf structures or water management features.

1.4.10 The area is currently under pasture and in the past, the land has been subject to agricultural improvement and used for arable cultivation. Ploughing will have had an impact in the upper *c*. 0.30m of the ground and this may have damaged any archaeological remains present at the very top of the alluvium. The survival of the bomb craters, 'stetch' cultivation ridges and the old sea wall, suggest that the level of erosion from mechanised farming since WWII has not been significant.

1.4.11 The lack of modern development within the area, other than the construction of WWII anti-glider ditches (now infilled) suggests that any archaeological deposits that may be present within this area would have survived intact and are likely to be well preserved in waterlogged conditions.

1.5 Geoarchaeological deposit model

1.5.1 The London Gateway development site lies within a floodplain/inter-tidal zone, where archaeological deposits are likely to be deeply stratified. In order to address this the AMF proposed that all work undertaken in these areas should be supported by the development of a detailed geoarchaeological deposit model. The principal objective of the deposit modelling is to identify areas of higher archaeological potential likely to be affected by development impacts and to place those areas within an overall understanding of the archaeological remains, palaeo-topography and palaeo-environment of the site.

1.5.2 The archaeological mitigation strategy for the London Gateway development has adopted an innovative approach, designed to assess and mitigate impacts on the geoarchaeological resources contained within the extensive, deep Holocene alluvial sequences at the site. The investigation comprises a combination of deep geoprospection survey, undertaken through electrical resistivity imaging, complemented by palaeo-landsurface modelling using geotechnical and geoarchaeological borehole data, integrated with a site-wide palaeo-environmental

study. This combined dataset will provide a platform through which the depth and potential location of archaeological sites can be predictively modelled. It will also provide a framework into which excavated cultural remains can be placed (OA July 2008a, July 2008b & August 2008)).

2 PROJECT AIMS

The aims of this trenching are summarised as follows:

- Clarification of areas of archaeological potential within the Northern Triangle, in order to
  - understand the likely impact, if any, of the habitat creation on archaeological resources within the Northern Triangle.
  - mitigate any impacts to the archaeological resource through archaeological monitoring and recording.
  - provide a chronology and assessment of archaeological potential in the upper alluvium (<3m) that can be extrapolated on a development wide basis.

3 METHODOLOGY

3.1 Scope of fieldwork

3.1.1 The fiedwork comprised a series of twenty trenches cut transversely across each pond location. With the prior agreement of ECC, four of the shallower ponds were not subject to archaeological trenching. The top of the alluvial sequence was removed under close archaeological supervision by a 360° mechanical excavator fitted with a toothless bucket, to a maximum depth of 3.25m. Prior to trenching, a rapid earthworks survey was conducted to record a representative sample of 'stetch' cultivation ridges, which is present throughout the Northern Triangle. Further ridges were surveyed in areas affected by the pond construction, after topsoil stripping, as the strips were then clearly visible in plan (Fig. 3).

3.1.2 All fieldwork records were entered into the London Gateway Archaeological GIS (ArcGIS ver. 9.2). Within this GIS there are a number of data sources that facilitate contextualisation of the archaeological data retrieved from the Northern Triangle. These include:

- Ordnance Survey maps at 1:10000, and 1:50,000
- Lidar topographic models at a 2m data posting
- The known Historic Environmental Record (HER) for the development area
- The London Gateway deposit model with a surface of the Holocene/Devensian interface
- The borehole database for the development area
- Historic maps

3.1.3 Of particular relevance to the Northern Triangle is the lidar data, that has produced a digital surface model (DSM) and a digital terrain model (DTM) of the development

area at a 2m data posting. Lidar is an aircraft mounted topographic survey system that uses a light beam at 1047nm to produce high resolution topographic models. The lidar product consists of two components: A first pulse return (FP) is reflected back from the top of vegetation and buildings to produce a DSM. Secondly, a last pulse return (LP) return penetrates through vegetation canopies, to produce a model of the 'bare ground' DTM, independant of vegetation canopies, etc. These topographic models are particularly important within the Northern Triangle, as they have allowed the surface mapping of geomorphic features such as palaeochannels, which has informed interpretation of excavated features.

3.2 Fieldwork methods and recording

3.2.1 The twenty trenches were located within each pond location, as set out by Thomson Ecology surveyors on the ground. Each trench was excavated across the width of the pond and to the full proposed depth, following the proposed profile. The trenches were of variable length and depth following the four pond template designs:

- 6 trenches were excavated of pond type 1: 17m x 2.25m
- 2 trenches were excavated of pond type 2: 13m x 1.5m
- 6 trenches were excavated of pond type 3: 23m x 3.25m
- 6 trenches were excavated of pond type 4: 16m x 2.75m.
- Four shallow (type 2) ponds were not subject to investigation, as agreed in advance with Essex County Council Heritage Conservation.

3.2.2 An OA surveyor recorded trench locations on completion using a differential GPS. Trench sections were cleaned by hand where necessary and where access was possible the revealed alluvial sequences were recorded on geoarchaeological log sheets. Features were planned at an appropriate scale and their sections drawn at scales of 1:20 or 1:50. All trenches and features were photographed using colour digital photography and black and white print film. Recording followed procedures laid down in the *OAU Fieldwork Manual* (Ed. D Wilkinson, 1992).

3.2.3 The field-based recording adopted a dual approach, whereby any cultural features were recorded using standard OA conventions as archaeological contexts, cuts, fills, etc. In addition the sedimentology of the upper alluvial sequence was also recorded, due to its relevance in understanding the evolution of the Holocene landscape and allowing inferences to be made of archaeological potential, both within the Northern Triangle and, by extrapolation, across the wider development area. Therefore, two sets of records were made, one defining archaeological contexts and a second detailing geoarchaeological units (see Appendices A and B).

3.3 Finds

3.3.1 Finds were to be recovered by hand during the course of the excavation and bagged by context. In the event only a single fragment of CBM was recovered at the base of the topsoil sequence in Trench 24.

3.4 Palaeoenvironmental evidence

3.4.1 A number of samples were taken for palaeoenvironmental evaluation, in order to address specific questions relating to the mechanism of formation of the upper alluvial stratigraphy (see Appendix C). Extensive palaeoenvironmental sampling

was not conducted, as no significant archaeological deposits were present. Larger scale environmental questions will be addressed through the London Gateway Site-wide Palaeoenvironmental Study (OA August 2008).

4 RESULTS: GENERAL

4.1 Soils and ground conditions

4.1.1 The site is located on an area of inter-tidal floodplain, extending to a depth of c.12m, where the interface between the Holocene alluvium and Pleistocene gravels occurs. Despite the depth of the trenches, the water table was usually only encountered at the base of the deeper trenches. Trench 10, however, was an exception with ground water present at 1.5m. Although the water table did not present problems with visibility, the soil structure of the deeper sediments sometime did. In trenches where either sand or silt was the dominant component of the alluvial unit at depths over 1.8m, the weakened soil structure often caused the sides of the trench to collapse. Stepping the trench sides did not resolve the problem.

5 RESULTS: DESCRIPTIONS

5.1 Cultural features

5.1.1 No below ground archaeological deposits were observed in any of the trenches. Modern ditches, still present within the current landscape, were recorded in Trenches 16 and 24. No evidence of WWII anti-glider ditches was observed in any of the trenches.

5.1.2 'Stetch' cultivation ridges were evident across the site. A rapid earthworks survey was conducted prior to trenching and the regular pattern could be observed in plan at most pond locations once the topsoil had been removed. A sample of these were surveyed in detail to record the alignment and dimensions of the ridges. The ridges were difficult to see in the trench sections, primarily due to the prismatic structure of the dry topsoil with its high clay content. A representative section was recorded in Trench 24 and here the ridges apparently only survive to a depth of 0.10m.

5.2 Geoarchaeological features

5.2.1 Whilst the archaeological remains across the excavations in the Northern Triangle area were scant, the pond excavations allowed the upper 3m of the alluvial sequence to be investigated. The examination of these exposures has provided geoarchaeological information on the upper alluvial sediment sequence relating to its archaeological potential, which can be extrapolated across the wider development area. The data that has been collected can be used to:

- Characterise the sequence of natural sediments and patterns of accumulation across the site within the upper alluvium sequence (<3m), including the depth and lateral extent of major stratigraphic units.
- Identify significant variations in the deposit sequence, which may indicate localised features such as islands or palaeochannels, which may have been the focus of previous human activity.

- Identify the location and extent of any waterlogged organic deposits and establish the potential for preservation of archaeological and palaeoenvironmental remains.

- Assist in correlating the Holocene deposit sequence and archaeological potential to local and regional models.

5.2.2 The upper alluvial stratigraphy was largely homogeneous across the Northern Triangle East. As a generalisation, the top 0.5m of the soil profile (A horizon) consisted of a stiff brown silty clay, with a clear prismatic structure. Below this to a depth of c. 0.9-1.0m was a stiff brown grey clay silt. Variation was seen in the clay/silt ratio across the site, with either the clay or silt being the dominant component in different trenches. This unit occasionally had light sand or silt dominated bands within it and always had visible Fe mottling. Below this, to the base of all machine trenches, was a blue grey silt clay, with a trace of sand (again the ratio of silt and clay varying between trenches). This relatively homogeneous sequence was observed in all twenty trenches (Appendix B, Fig. 4). Some areas of higher organic content were visible in the lower blue grey clay silt.

5.2.3 Although some localised variations were seen in the pattern of alluvial stratigraphy, this sequence was witnessed across the investigation area. The stratigraphy was always horizontally bedded, with no dipping stratigraphic boundaries witnessed, except for trench 21 (section 5.2.5). Some lamina structures were witnessed in the grey brown clay silt and the blue grey clay silt, which were either sand or silt dominated. These lamina structures were usually thin (c. 1cm thick) and horizontally bedded. In addition the grey brown clay silt and the blue grey clay silt had occasional finds of bivalve mollusc shell.

5.2.4 In a number of trenches some localised variations were seen in this general alluvial sequence. These are discussed below. Some limited sampling was undertaken to address specific questions relation to site formation processes and resulting archaeological potential.

5.2.5 In trenches 21 and 22 a palaeochannel exposure was witnessed. The upper sequence of deposition in these trenches differed considerably from the other excavations in the Northern triangle. Sand and silt dominated lamina structures were visible in unit 2, to a depth of c. 1.6m (Fig. 5). These clear lamina structures represent a different hydrological system within the vicinity of the trenches, potentially representing a higher energy regime, such as an intertidal creek. Within trench 21, two intercutting palaeochannels were recorded (Fig. 6). Both features extend beyond the southern limit of the trench. Channel 2106 is present immediately below the topsoil, survives to a depth of 0.85m and contains two deposits (2111 and 2112). The lower deposit (2111) contained frequent marine shells. Channel 2106 cuts channel 2107. The full depth of 2107 was not revealed within the trench and it extends beyond the southern limit of the trench. The location of these channels towards the top of the sediment sequence suggests that they are of recent origin, although dating of the top of the alluvial sequence is uncertain and needs to be addressed. Both palaeochannel fills had a low palaeoenvironmental potential and neither contained evidence of cultural activity.

5.2.6 The palaeochannel exposure in trench 21 is visible in the remote sensed lidar data (Fig. 7). This demonstrates that some of the surface features revealed by the lidar model represent palaeochannels, such as that exposed in trench 21. Dating of these palaeochannels and upper alluvial stratigraphy should now be a priority, following on from this investigation, in order to elucidate the archaeological potential of the

palaeochannels mapped from the lidar data across the whole development area.

5.2.7 Within two of the trenches (3 and 16) a discontinuous black band was revealed in section and in plan. This surface was extremely thin <1cm, but at some points several discrete bands of it would occur over a depth of c. 10cm (Fig. 8). This layer was visible in trenches 3 (context 307, 0.55 – 0.65cm below ground surface) and 16 (context 1607, 50cm below ground surface). The layer appeared to be dominated by Manganese precipitates, but also contained fibrous organic material and occasional flecks of possible heavily degraded ceramic material, perhaps brick. The layer also had a distinct red component to its colouring, probably a result of Manganese and Iron deposition. This layer does not represent *in situ* archaeological remains, but rather a discontinuous surface within the upper alluvial stratigraphy, possibly related to high magnitude flood events. Both exposures in trenches 3 and 16 were bulk sampled for characterisation.

5.3 Palaeoenvironmental remains

5.3.1 The London Gateway development area is subject to a site wide palaeoenvironmental study that will provide a framework for integrating subsequent archaeological data. Consequently the palaeoenvironmental sampling during the Northern Triangle investigation was extremely limited, with samples only being taken to address specific issues that arose during trenching. The palaeoenvironmental samples are described in Appendix C. The samples were collected to address these specific points:

1. To sample bi-valve mollusca remains to ascertain whether the environment they lived in was fresh water, saline or inter-tidal.
2. To sample the discontinuous land surface evident in trenches 3 and 16, to characterise the deposit and provide a chronology for it.
3. To remove organic material suitable for radiocarbon dating, in order to date the upper alluvial stratigraphy (up to 3m below current ground surface).

5.4 Carbonised plant remains and charcoal

5.4.1 Trenches 3 and 16 provided a potential landsurface with some fibrous organic matter, with a characteristic black colour, caused by Manganese precipitates, both exposures of which were bulk sampled. Superficially this deposit looks similar to *in situ* burning features, although the current interpretation is that they are natural deposits. In order to characterise this deposit and remove any ambiguity in its interpretation, the bulk samples from both trenches should be subject to an evaluation of carbonised organic material. This will define whether the deposit has any charcoal within it and is likely to be of anthropogenic origin.

5.5 Bivalve mollusca

5.5.1 Several of the trenches contained bi-valve mollusc shells, normally contained within in the grey brown clay silt, although occasionally witnessed in the lower blue grey clay silt deposit. These remains were sampled in trenches 14, 11 and 17. These samples should all be assessed to ascertain whether the species were marine, freshwater or inter-tidal. Full species counts are not necessary and only a brief evaluation is required. This will provide valuable information on the evolution of the inter-tidal zone in the upper alluvial stratigraphy.

5.6 Soils and Sediments

5.6.1 Several monolith tin samples were taken from trench sections (trenches 6, 8 and 11). These samples were taken to provide material suitable for radiocarbon dating and there is no requirement to undertake any further sediment characterisation on them. Further to this a large piece of driftwood was recovered from trench 11 (context 1104) and is recommended for radiocarbon dating in order to date deposition of the blue grey clay silt.

6 DISCUSSION AND INTERPRETATION

6.1 Reliability of field investigation

6.1.1 The trenching assessed the archaeological potential at 20 pond locations across the site. Weather conditions were excellent and although trench collapse occurred at a number of trenches, this has not influenced the findings.

6.2 Overall summary

6.2.1 Twenty trenches were excavated across the Northern Triangle (East) site. No below ground archaeological remains were encountered in any of the trenches, although surface features were recorded. Two inter-cutting palaeochannels were observed in trench 21 and these are likely to be of recent date, as they appear high within the sediment sequence. Information on the upper alluvial stratigraphy was collected, which needs to be followed with some limited dating and palaeoenvironmental evaluation work, to help inform future mitigation strategy across the development area.

7 RECOMMENDATIONS FOR FURTHER WORK

7.1 Interim review of research issues

7.1.1 The Northern Triangle archaeological investigation has provided an opportunity to assess the upper 3m of the alluvial stratigraphy in the London Gateway port development. The overall alluvial stratigraphy across the Northern Triangle East is relatively homogeneous, and appears to contain a low potential for cultural archaeological features. However, the chronology of the upper alluvial stratigraphy is unresolved. This can be addressed through the application of radiocarbon dating to samples collected during the trenching works. A full list of samples is given (Appendix C) with recommendations for future work. In total it is envisaged that a maximum of eight radiocarbon dates will be required to provide a secure alluvial chronology for this part of the development.

7.1.2 Further to this several palaeoenvironmental samples were taken to assess the bivalve molluscan remains. These samples require an evaluation to ascertain the salinity of the environment that they inhabited. This will provide information as to whether the upper alluvial stratigraphy is a freshwater, marine or inter-tidal system, which, combined with the chronology derived from the dating of the samples from the Northern Triangle, will provide a framework for mitigating the impact to the upper alluvial stratigraphy across the development area.

7.1.3 It is apparent that the lidar surface model will be a useful tool for locating palaeochannels. This will be combined with historic map data and the chronological sequence derived from this investigation, to provide a sound chronostratigraphic model of the upper alluvial sequence (<3.25m) across the development area.

7.2 Review and updating of mitigation strategy

7.2.1 Following the Northern Triangle archaeological investigation there is currently no need to review the archaeological mitigation strategy devised for the London Gateway Development.

APPENDIX A ARCHAEOLOGICAL CONTEXT INVENTORY

Trench	Orientation	Trench length (m)	Arch. features?	Trench depth mAOD	Context No.	Type	Comments	Finds
1	NW-SE	23	No	-0.12			No archaeology present	
2	NNE-SSW	17	No	-1.44			No archaeology present	
3	NNW-SSE	32	No	-1.08			No archaeology present	
4	NNW-SSE	32	No	-0.57			No archaeology present	
5	E-W	23	No	-1.51			No archaeology present	
6	N-S	17	No	-0.81			No archaeology present	
7	NE-SW	23	No	-1.79			No archaeology present	
8	E-W	16	No	-127			No archaeology present	
9	Not excavated							
10	ENE-WSW	13	No	-0.35			No archaeology present	
11	E-W	16	No	-0.65			No archaeology present	
12	ESE-WNW	17	No	-0.53			No archaeology present	
13	NNE-SSW	23	No	-1.03			No archaeology present	
14	ENE-WSW	16	No	-0.87			No archaeology present	
15	NE-SW	23	No	-1.15			No archaeology present	
17	NW-SE	23	No	-1.72			No archaeology present	
18	Not excavated							
19	NE-SW	17	No	-0.72			No archaeology present	
20	Not excavated							
21	N-S	17	No	-0.10			No archaeology present	
22	N-S	17	No	0.07			No archaeology present	
23	Not excavated							
24	NE-SW	13	Yes	0.47	2405	Cut	Modern ditch, still in use. Max width 2.80m. Max depth 0.51m.	
					2406	Fill	Fill of (2405). Friable mid grey brown silty sand with occasional orange mottling. Max thickness 0.51m.	
					2407	Cut	Stetch cultivation furrow. Max width 0.60m. Max depth 0.10m.	
					2408	Fill	Fill of (2407). Diffuse stiff brown grey clay silt. Max thickness 0.10m.	

APPENDIX B GEOARCHAEOLOGICAL INVENTORY

Trench	Depth (below ground surface)	Sediment unit	Notes
1	0 – 0.5m	Stiff brown grey silty clay. Prismatic structure, rootlets. Context 101. Layer.	
	0.5 – 0.76m	Stiff brown grey silty clay, partially gleyed, Fe mottling, no prismatic structure. Context 102. Layer.	
	0.76 – 1.85m	Grey brown clayey silt, with fine sand. Fe mottling and some limited organic remains. Very occasional and heavily degraded shell fragments. Context 103. Layer.	
	1.85m onwards	Dark grey silty clay. Horizontal sand bedding units interspersing the dark grey silty clay. Context 104. Layer.	
2	0 – 0.48m.	Grey brown silty clay, A horizon, prismatic structure. Context 200. Layer.	
	0.48 – 1.85m	Light grey silty clay with Fe mottling and occasional manganese flecks. Context 201. Layer.	
	1.85 onwards	Dark grey blue sandy silt. Context 202. Layer.	
3	0 – 0.5m.	Stiff brown grey silty clay, prismatic soil structure. Context 301. Layer.	Context 307 was revealed in unit 302 as a discontinuous black band, between 0.55 and 0.65m, <1cm deep. It contained fibrous remains, Mn precipitates and some potential fragments of unidentifiable ceramic material (possibly weathered brick, <0.3cm). Context 307 could represent a palaeo-landsurface in the inter-tidal floodplain. Bulk sample 1.
	0.5 – 0.7m.	Blue grey silty clay, trace of sand, Fe mottling. Contained context 307. Context 302. Layer.	
	0.7 – 0.85m.	Orange brown grey silty clay, mottled appearance, Fe mottling. Context 303. Layer.	
	0.85 – 0.92m.	Blue grey silty clay, Fe mottling. Context 304. Layer.	
	0.92 – 1.96m.	Orange brown grey silty clay. Context 305. Layer.	
	1.96 onwards.	Dark grey silt clay, trace of sand, with some lamina structure, bedding horizontally. Some limited organic matter. Context 306. Layer.	
		Black discontinuous lens of silty clay within (302) probably representing a hiatus layer in sediment accumulation. Mn rich, with fibrous material. Max thickness 0.10m. Sample number 1.	
4	0 – 0.5m	Grey brown silty clay, trace of sand. Prismatic structure, A horizon, rootlets. Context 401. Layer.	

Trench	Depth (below ground surface)	Sediment unit	Notes
	0.5 – 1.6m	Brown grey silty clay, Fe mottling, some limited and degraded shell fragments between 0.5 and 1m. Context 402. Layer.	
	1.6m onwards	Blue grey silt clay, trace of sand, some ltd organic matter. Context 403. Layer.	
5	0 – 0.57m	Stiff brown grey silty clay, trace of sand. A horizon, rootlets, prismatic structure. Context 501. Layer.	
	0.57 – 1.86m	Grey clay, trace of silty. Fe mottled, some fibrous material. Context 502. Layer.	
	1.86m onwards	Dark grey sandy silt, trace of clay. Limited organic matter. Lamina horizontal bedding planes. Context 503. Layer.	
6	0 – 0.6m	Stiff brown grey silty clay. A horizon, rootlets, prismatic structure. Context 601. Layer.	Context 603, and part of context 602 was sample to obtain organic matter suitable for radiocarbon dating, in order to date the lower context 603.
	0.6 – 1.0m	Brown grey clay, trace of silt. Fe mottling. Frequent shell fragments. Context 602. Layer.	
	1.6m onwards	Dark grey blue clay, trace of silt and sand. Frequent organic material. Context 603. Layer.	
7	0 – 0.4m	Dark brown clayey silt. A horizon, rootlets. Context 700. Layer.	
	0.4 – 0.8m	Mid grey, orange mottled clay. Context 701. Layer.	
	0.8 – 1.9m	Firm mid brown clay with occasional orange mottling. Layer.	
	1.9 – 3.25m	Dark blue grey clayey silt, with sand. Layer.	
8	0 – 0.7m	Stiff mid brown grey silty clay with traces of sand. A horizon, prismatic structure, rootlets. Context 801. Layer.	
	0.7 – 1.54m	Stiff brown grey silty clay with traces of sand and occasional Fe mottling. Context 802. Layer.	
	1.56 – 2.4m	Dark blue grey silty clay with inclusions of organic material. Context 803. Layer.	
	2.4m onwards	Dark blue grey clayey silt with inclusions of organic material. Horizontal bedding observed. The deposit contained a higher sand content than (803). Context 804. Layer.	
9	Not excavated		

Trench	Depth (below ground surface)	Sediment unit	Notes
10	0 – 0.4m	Firm dark grey brown clayey silt. A horizon. Context 1000. Layer.	
	0.4 – 0.65m	Firm mid grey blue silty clay with frequent orange mottling and occasional manganese. The deposit had a diffuse lower boundary. Context 1001. Layer.	
	0.65 – 1.5m	Firm mid brown silty clay with frequent orange mottling. Context 1002. Layer.	
11	0 – 0.6m.	Brown grey silty clay. A horizon, rootlets, prismatic structure. Context 1101. Layer.	Context 1104 represents a piece of driftwood that was recovered for radiocarbon dating. A further sample was taken from contexts 1103/1104 for bulk radiocarbon dating of the sediment, around context 1104.
	0.6 – 1.84m	Brown grey silty clay, trace of sand, Fe mottling. Context 1102. Layer.	
	1.84 onwards	Blue grey silty clay, trace of sand. Contained a large wood fragment. Context 1103. Layer.	
	1.12m	Piece of driftwood. Context 1104. No signs of anthropogenic working. Find	
12	0 – 0.4m.	Firm dark grey brown clayey silt. A horizon rootlets. Context 1201.	
	0.4 – 0.8m	Firm mid brown clay with occasional orange mottling. Context 1202.	
	0.8- 1.0m	Firm light grey clay with rare orange mottling and mica. Context 1203 layer.	
	1.0 – 1.3m	Soft mid brown silty clay with orange mottling at the lower boundary. Context 1204. Layer	
	1.3 – 2.1m	Soft mid grey blue silty clay with sand laminations. Context 1205 layer.	
13	0 – 0.55m	Stiff brown grey silty clay. Context 1301. Layer.	
	0.55 – 1.55m	Stiff brown grey silty clay, with occasional marine shell fragments and Fe mottling. Context 1302. Layer.	
	1.55 – 2.0m	Light blue grey clay silt. Context 1303. Layer.	
	2.0m onwards	Dark grey silty clay. Context 1304. Layer.	
14	0 – 0.48m	Brown grey stiff silty clay, trace of sand. A horizon, prismatic structure. Context 1401. Layer.	Context 1403 had a small bucket sample taken to assess the shell fragments, as to whether they represent marine, freshwater or intertidal species. Sample 1403.
	0.48 – 0.96m	Brown grey silty clay, trace of sand, Fe mottling. Context 1402. Layer.	
	0.96 – 1.04m	Brown grey silty clay, containing degraded shell fragments. Context 1403. Layer.	
	1.04 – 1.72m	Brown grey silty clay, trace of sand. Fe mottling and some limited organic matter. Frequent horizontally bedded light grey silty sand layers. Context 1404.	
	1.72 – 2.0m	Light blue grey silty clay, trace of sand, Fe mottling. Context 1405. Layer.	
	2.0m onwards	Dark blue grey clay, trace of sand, containing organic matter. Context 1406 layer.	
15	0 – 0.55m	Dark grey brown silty clay. A horizon, prismatic structure, rootlets. Context 1501 layer.	
	0.55 – 0.75m	Mid brown grey clay with frequent orange mottling. Context 1502 Layer.	
	0.75 – 1.1m	Mid brown clay with light grey mottling at interface with (1502). Context 1503 Layer.	

Trench	Depth (below ground surface)	Sediment unit	Notes
	1.1 – 1.6m	Soft mid brown clay with sandy laminations. Context 1504 Layer.	
	1.6 – 2.1m	Mid brown clay with sandy layers. Context 1504 Layer.	
	2.1m onwards	Soft dark grey clayey silt with occasional sand. Context 1505 Layer.	
16	0 – 0.45m	Dark grey brown clayey silt. A horizon, prismatic structure, rootlets. Context 1601 layer.	
	0.45 – 0.65m	Mid grey brown silty clay with frequent orange mottling. Context 1602 layer.	
	0.65 – 0.85m	Firm light blue grey clay. Context 1603 layer.	
	0.85 – 1.1m	Soft mid brown clay with rare orange mottling. Context 1604 layer.	
	1.1 – 1.3m	Mid brown grey clay with sand laminations. Context 1605 layer.	
	1.3 – 2.4m	Soft dark grey silty clay with increasing sand content towards the excavated base. Context 1606 layer.	
	2.4m onwards	Firm orange grey clay with occasional flecks of sandstone and organic matter. Context 1607 layer. Sample number 7.	
17	0 – 0.52m	Stiff brown, blue, grey clay, trace of silt/sand. A horizon, prismatic structure. Context 1701.	
	0.52 – 0.64m	Blue grey gleyed stiff clay, trace of silt and sand. Fe mottling. Context 1702. Layer.	
	0.64 – 1.20m	Brown grey clay, trace of sand and silt, Fe mottling. Context 1703. Layer.	
	1.20 – 1.46m	Brown grey silty clay, trace of sand, Fe mottling and occasional marine shell fragments. Context 1704. Layer.	
	1.46 – 1.86m	Dark grey silty clay, with occasional marine shell. Some horizontally bedded dark grey silt dominated layers interspersed in the dark grey silty clay. Context 1705 layer.	
	1.86m onwards	Dark grey silty clay with occasional horizontal sand lamina and occasional inclusions of marine shell. Max thickness. Context 1706 layer.	
18	Not excavated		
19	0 – 0.5m	Firm dark grey brown silty clay. A horizon, prismatic structure, rootlets. Context 1901 layer.	
	0.5 – 0.65m	Mid brown grey silty clay with frequent orange mottling. Context 1902 layer.	
	0.65 – 0.9m	Mid brown grey silty clay with occasional blue grey mottling. Context 1903 layer.	
	0.9 – 1.8m	Light grey silty clay with occasional orange mottling. Context 1904 layer.	
	1.8m onwards	Dark blue grey sandy clay. Context 1905 layer.	
20	Not excavated		
21	0 – 0.55m	Firm dark grey brown clayey silt. A horizon, prismatic structure, rootlets. Topsoil. Context 2101 Layer.	

Trench	Depth (below ground surface)	Sediment unit	Notes
	0.55 – 1.1m	Red brown weakly laminated sandy clay. Context 2102 layer.	
	1.1 – 1.75m	Light brown sands, finely laminated. Context 2103 layer.	
		Mid brown silty sand with occasional orange mottling. Context 2104 layer.	
		Mid grey silty sand. Context 2105 layer.	
		Palaeochannel. Max width (as exposed) 5.20m+. Max depth 0.85m. Context 2106 Cut.	
		Palaeochannel. Max width (as exposed) 2.50m. Max depth (as exposed) 0.80m+. Context 2107 Cut.	
		2108 Not used	
		Firm mid brown silty clay with occasional orange mottling. Max thickness 0.40m+. Extends beyond the southern limit of the trench. Context 2109 Fill. Fill of (2107).	
		Firm mid blue clay. Max thickness 0.40m. Extends beyond the southern limit of the trench. Context 2110 Fill. Fill of (2107).	
		Firm mid brown red clay with occasional well preserved marine shells. Max thickness 0.25m. Extends beyond the southern limit of the trench. Context 2111 Fill. Fill of (2106).	
		Firm mid grey brown clay. Max thickness 0.70m. Extends beyond the southern limit of the trench. Context 2112 Fill. Fill of (2106).	
22	0-0.5m	Dark grey brown clay. A horizon, prismatic structure, rootlets. Context 2201 layer.	
	0.5 – 0.7m	Mid red brown sandy clay with fine light brown sandy laminations. Context 2202 layer.	
	0.7 – 1.45m	Mid grey brown silty and sandy clay. Laminated. Context 2203 layer.	
	1.45 – 1.68m	Mid grey silty clay with frequent orange mottling. Context 2203 layer.	
	1.68m onwards	Soft dark grey silty sand with sandy clay laminations. Mica present. Context 2204 layer.	
23	Not excavated		
24	0 - 0.6m:	Stiff brown grey clayey silt, A horizon, rootlets. Context 2401 layer.	
	0.60 – 0.88m:	Stiff brown grey clay silt, interspersed by light buff sand/silt horizontal bands, Fe mottling. Context 2402 layer.	
	0.88 – 1.16m:	Mid blue stiff silty clay, Fe mottling. Context 2403 layer.	
	1.16m onwards:	Mid blue grey clay silt, trace of sand Fe mottling. Context 2404 layer.	

APPENDIX C PALAEOENVIRONMENTAL SAMPLE INVENTORY

Sample	Trench	Context/s	Reason for taking sample	Recommended further work
1	3	307	Possible discontinuous land surface, visible as a thin black band in section. Manganese rich.	Initial microscopic examination and wet sieving to define whether this is a natural or anthropogenic deposit. If suitable material is found then apply radiocarbon date.
2	6	602/603	Organic material housed within the blue grey clay silt towards the base of the excavated sequence.	Apply two radiocarbon dates to organic material retrieved from this unit to date the top of the lower blue grey clay silt.
3	11	1103	Sample taken in the across a dense bivalve shell concentration.	Evaluation of the bivalve mollusc species to ascertain whether the environment they lived in was marine, freshwater or inter-tidal.
4	14	1403	Bulk sample taken in bivalve mollusc spread	Evaluation of the bivalve mollusc species to ascertain whether the environment they lived in was marine, freshwater or inter-tidal.
5	11	1103/1104	Monolith tin across sediment boundary containing driftwood.	To apply one bulk sediment radiocarbon date to provide a chronology on the blue grey clay silt and provide an independent control on dating piece of driftwood context 1104.
6	17	1706	Bivalve mollusc remains were visible in the blue grey clay silt alluvial unit. They appeared to be a different species to that in samples 5 and 3.	Evaluation of the bivalve mollusc species to ascertain whether the environment they lived in was marine, freshwater or inter-tidal.
7	16	1607	Possible discontinuous land surface, visible as a thin black band in section. Manganese rich.	Initial microscopic examination and wet sieving to define whether this is a natural or anthropogenic deposit. If suitable material is found then apply radiocarbon date.
8	21		To be able to date the blue grey clay silt and provide a chronology for the palaeochannel.	Investigate the sample for organic remains and radiocarbon date if suitable fragments survive. If no definable organic material survives apply a bulk sediment radiocarbon date.
9	11	1104	Piece of driftwood excavated in trench 11, within context 1103.	Radiocarbon dating of the driftwood.

APPENDIX D REFERENCES

Oxford Archaeology (June 2008) London Gateway: Northern Triangle (East); Habitat Creation and Enhancements. Written Scheme of Investigation for Archaeological Monitoring.

Oxford Archaeology (July 2008a) London Gateway: Geoarchaeological deposit model interim report; Prepared by OA for DP World

Oxford Archaeology (July 2008b) London Gateway: Archaeological mitigation proposal for geophysical survey in the alluvial floodplain; Prepared by OA for DP World

Oxford Archaeology (August 2008) London Gateway: Project design for site-wide palaeoenvironmental study; Prepared by OA for DP World

Oxford Archaeology (2003) *London Gateway Archaeological Mitigation Framework* prepared by OA for P&O

Oxford Archaeology (2002) *Cultural Heritage Assessment Report.* Environmental Statement chapter and technical appendices, prepared by OA for P&O

APPENDIX E SUMMARY OF SITE DETAILS

Site name: London Gateway: Northern Triangle East; Habitat Creation and Enhancements, Archaeological monitoring and recording.
Site code: CONTE 08
NGR: TQ 733 831
Type of investigation: 20 trenches placed through newt pond locations. Trenches varied in length and depth reflecting the width and depth of the four different proposed pond types - pond type 1: 17m x 2.25m, pond type 2: 13m x 1.5m, pond type 3: 23m x 3.25m, pond type 4: 16m x 2.75m.
Date and duration of project: 16th-23rd July 2008
Area of site: *c.* 27 hectares.
Summary of results: The trenches contained no archaeological remains. Trench 21 revealed two intercutting palaeochannels, believed to be of relatively recent origin within the top 1.25m.
Location of archive: The archive is currently held at OA, Janus House, Osney Mead, Oxford, OX2 0ES, and will be deposited Thurrock museum, Essex in due course.

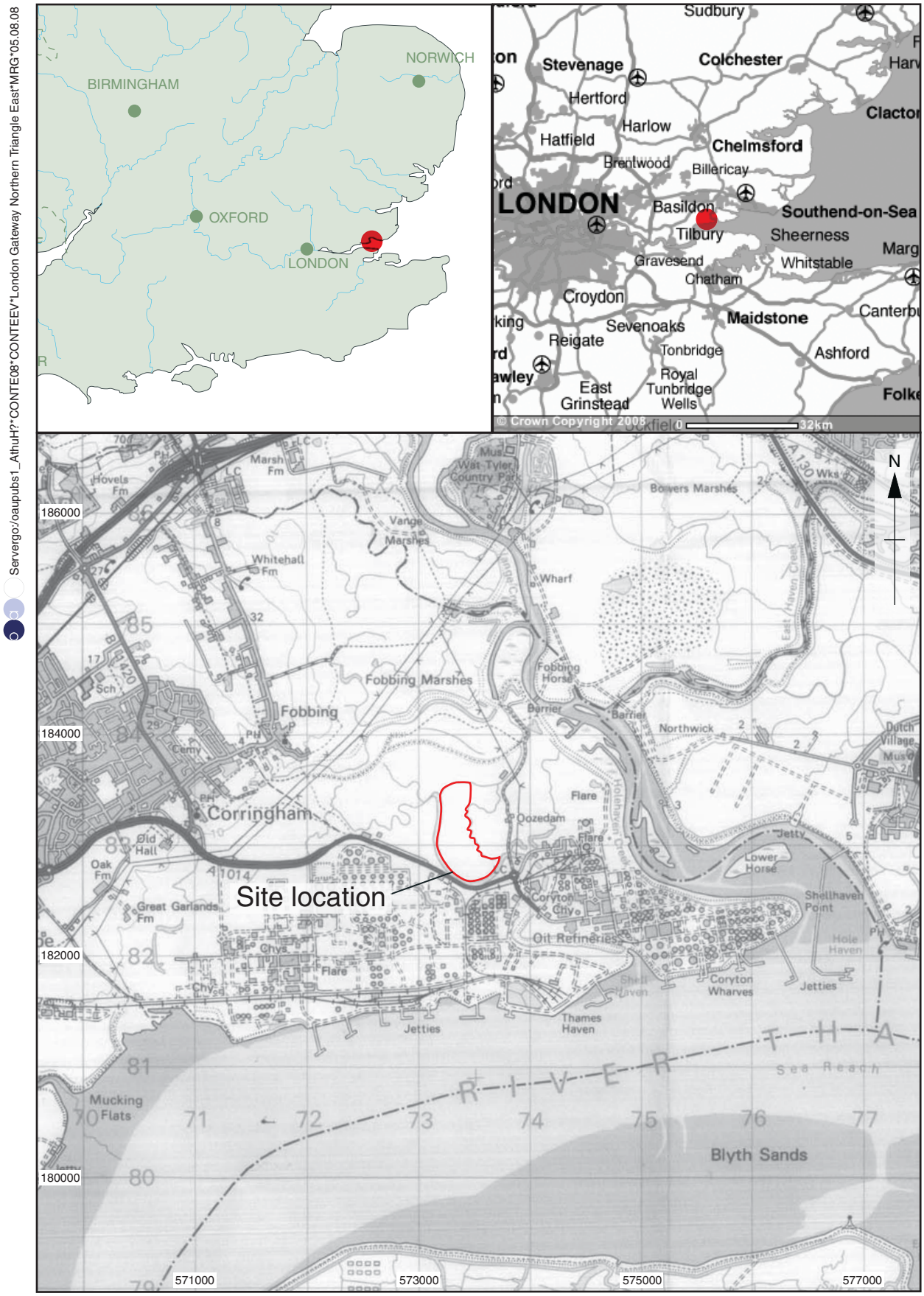

Figure 1: Site location

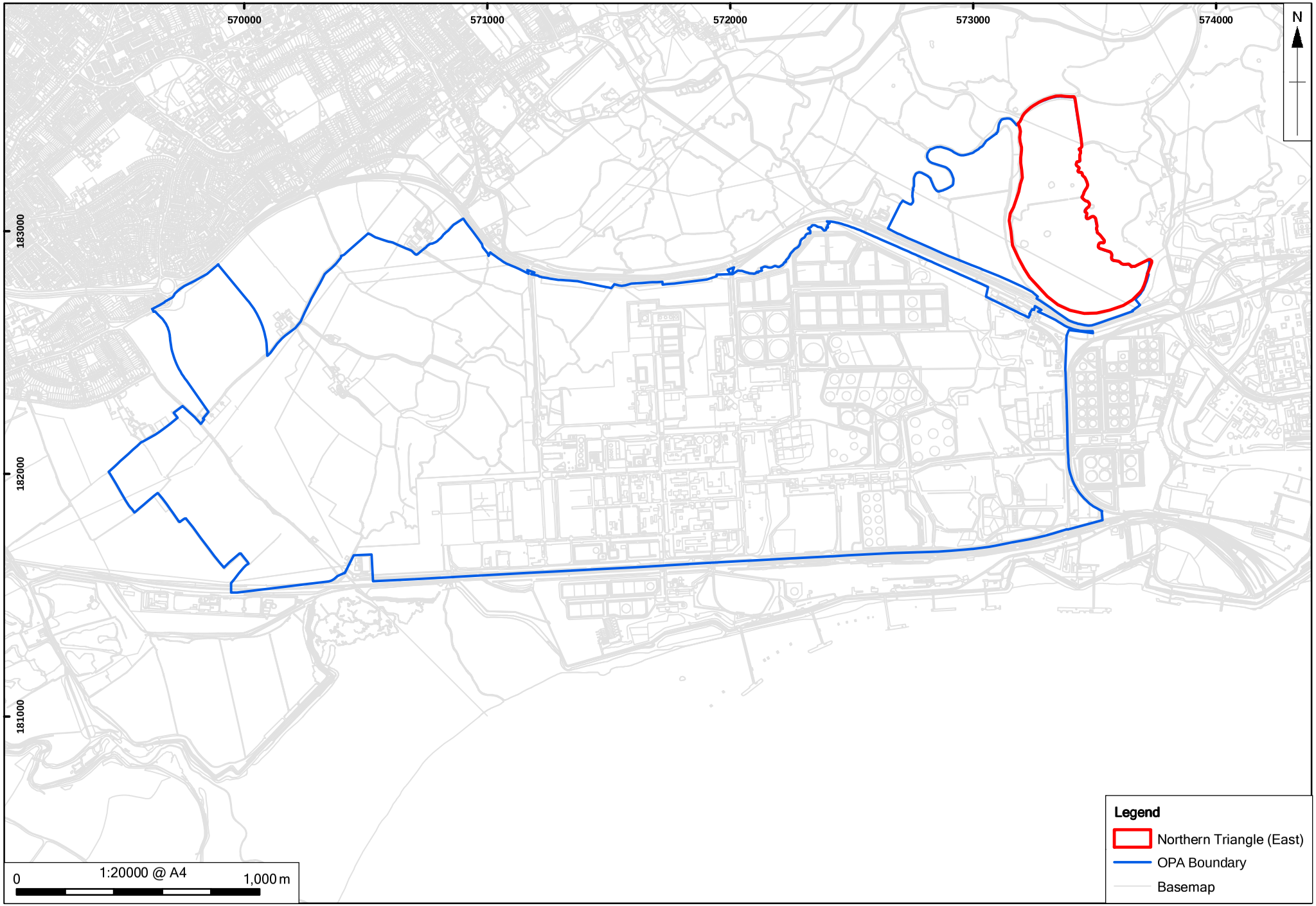

Figure 2: Location of Northern Triangle (East)

X:\LONDON GATEWAY 2007\03_Geomatics\CAD\001Current\London_Gateway_Northern_triangle_earthwork_survey_230708.dwg(A3 Figure 3 - Trench Location Plan)***London Gateway*conan.parsons* 06 Aug 2008

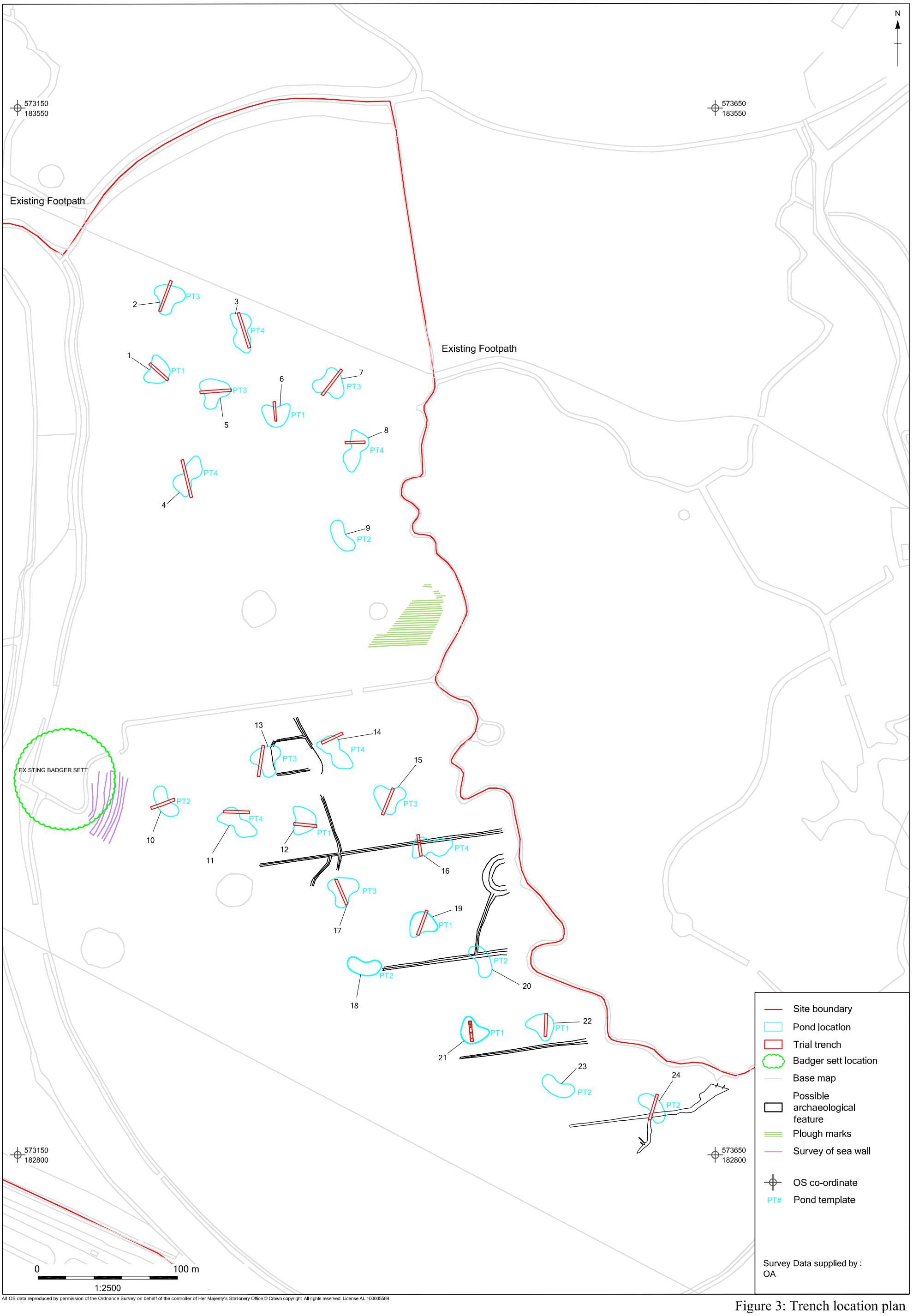

Figure 3: Trench location plan

Figure 4: Trench 7, illustrating the relatively homogeneous upper alluvial stratigraphy in the Northern Triangle: In general the sequence comprised a grey brown silty A horizon with prismatic structure, under which was a grey brown clay silt with Fe mottling, underlain by a blue grey silt clay to the base of excavation.

Figure 5: Trench 21, showing localised variation in the sequence of alluvial deposition. Trenches 21 and 22 differed considerably in the upper sequence of deposition, compared to the other excavations in the Northern Triangle. Sand and silt dominated lamina structures were visible to a depth of c. 1.6m. This is suggestive of a higher energy hydrological regime in the immediate vicinity, such as saltmarsh creek or alluvial palaeo-channel

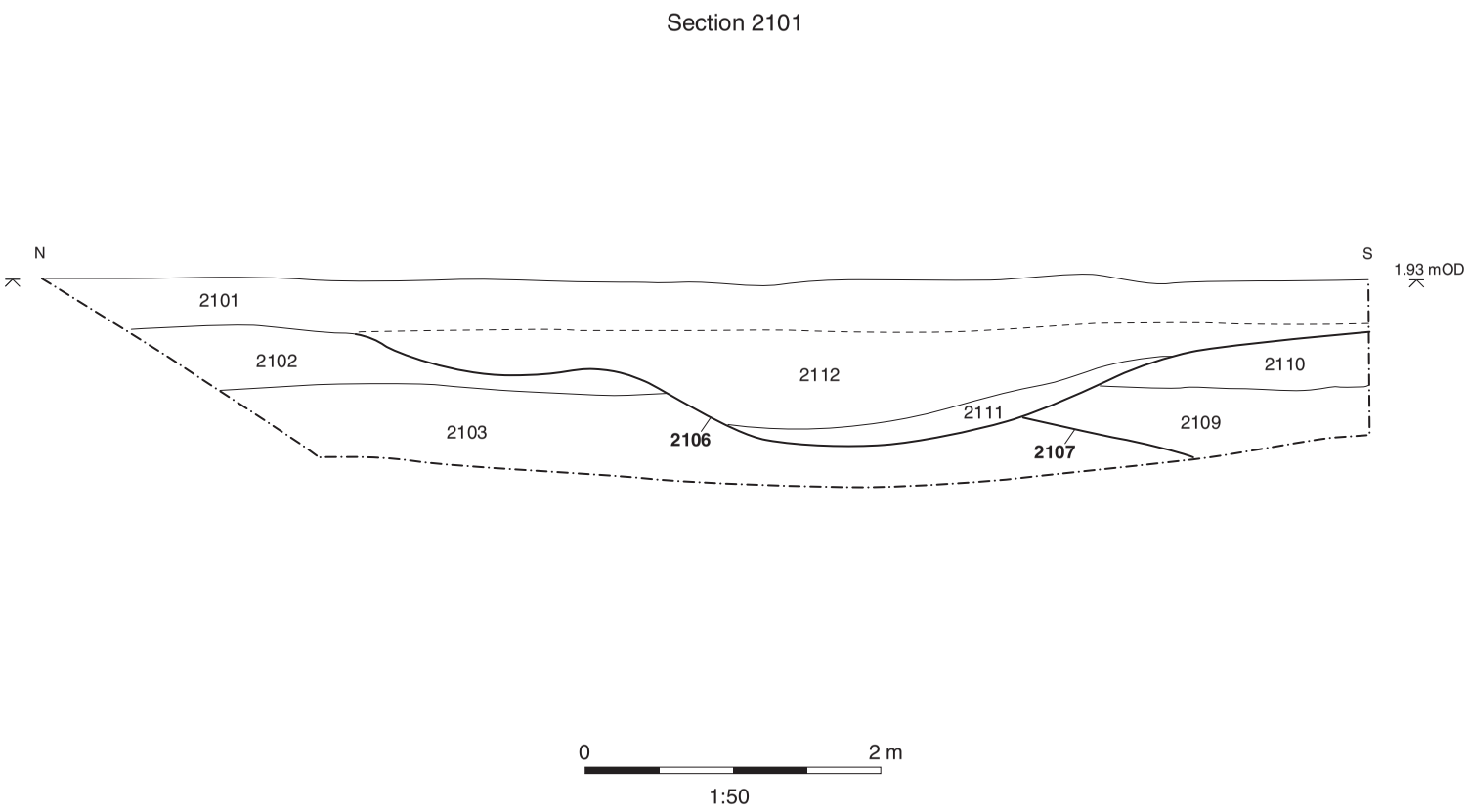

Figure 6: Trench 21, section 2101, showing two inter-cutting palaeo-channels.

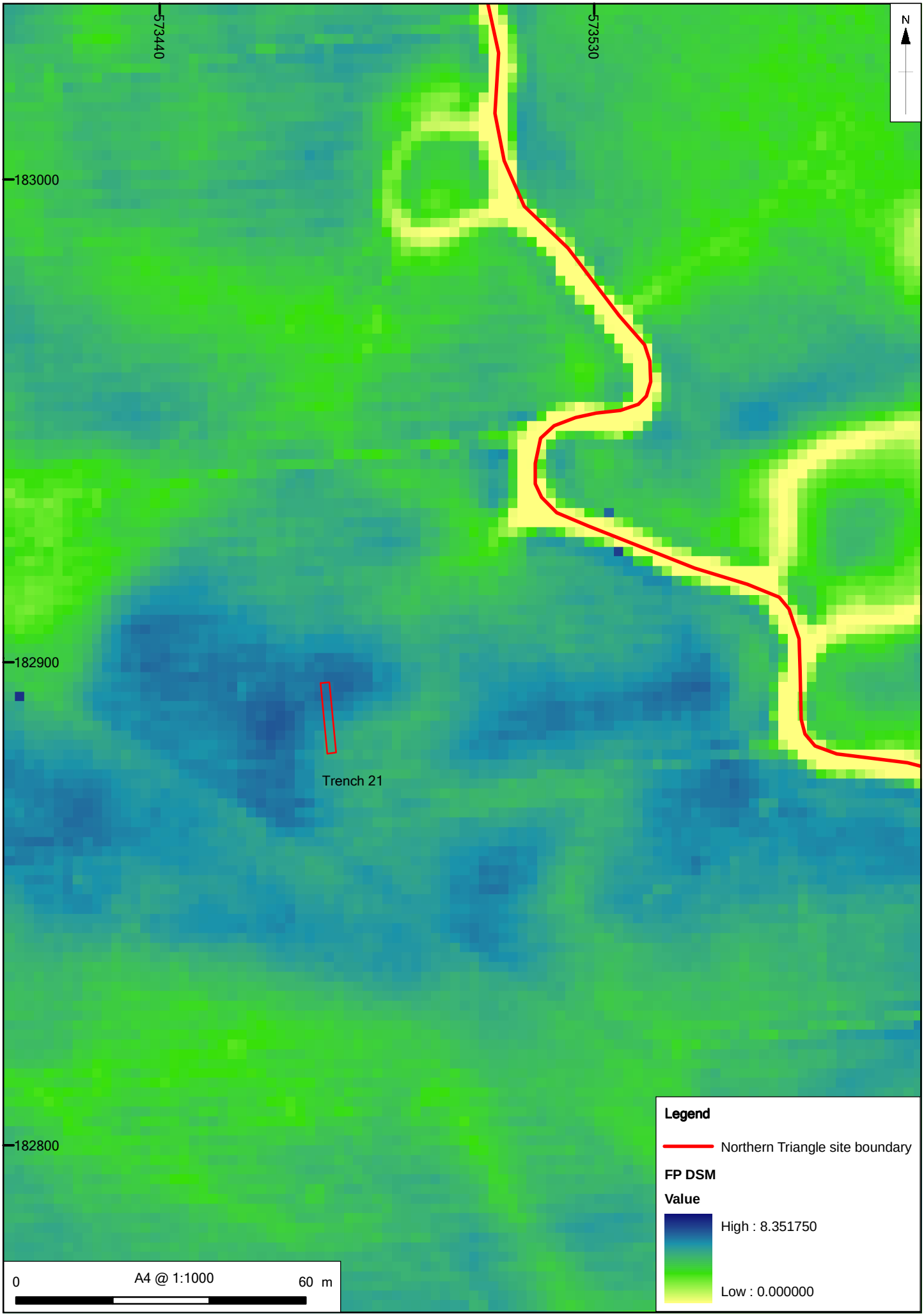

Figure 7: The palaeochannel in trench 21 depicted in Lidar topographic data