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IBIS BUDGET, LONDON CITY AIRPORT, NORTH WOOLWICH ROAD, LONDON BOROUGH OF NEWHAM

Geoarchaeological Deposit Model Report

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1. NON-TECHNICAL SUMMARY

A programme of geoarchaeological fieldwork and deposit modelling was undertaken at the Ibis Budget site in order to (1) clarify the nature of the sub-surface stratigraphy, including the depth, thickness and extent of the major stratigraphic units; and (2) to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs. In order to address these aims, two geotechnical boreholes were monitored and described by a geoarchaeologist, and the new and existing stratigraphic data used to produce a deposit model of the major depositional units.

The results of the deposit modelling indicate that the sediments recorded at the site are similar to those recorded elsewhere in this area of the Lower Thames Valley, with Late Devensian Shepperton Gravel overlain by a sequence of Holocene alluvial sediments, including peat, and buried beneath modern Made Ground. In contradiction to the MoLAS (2002) investigations, no Gravel 'highs' were identified underlying the site; the highest Gravel surface identified here was -3.9m OD. As a result, the prehistoric archaeological potential of the Gravel surface is considered to be very low, and no soil horizons associated with a higher Gravel surface can be expected at the site (and were not identified during the monitoring of two new geotechnical boreholes).

The palaeoenvironmental potential of the alluvial sequence is considered to be high, since a thick peat horizon was identified at levels between *ca.* -0.5 and -3.5m OD. However, this peat horizon was investigated during the previous work undertaken by MoLAS (2002). Although the levels in the MoLAS (2002) report are considered here to be incorrect, the peat was radiocarbon dated to the early Neolithic (4370 to 3960 cal BC) to middle Bronze Age (1520 to 1200 cal BC). On the basis of existing palaeoenvironmental data from sites nearby and where the peat is of a similar age, including at London City Airport (Young *et al.*, 2018), and those forthcoming from the Former Camel Works site (in prep.), no further palaeoenvironmental assessment of the sequence at the Ibis Budget site is recommended.

2. INTRODUCTION

2.1 Site context

This report summarises the findings arising out of the geoarchaeological fieldwork and deposit modelling undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development of land at Ibis Budget, London City Airport, North Woolwich Road, London Borough of Newham (National Grid Reference (NGR): *centred on* TQ 4180 8013; Figure 1). The lies on the floodplain of the River Thames, around 300m to the north of the modern waterfront (see Figures 1 and 2). The site is 0.43 hectares in size, its present surface at a level of approximately 2.0m OD, although MoLAS (2002) show the site lying at 5m OD at the time of their investigation. British Geological Survey (BGS) mapping shows the site lying at the interface between Palaeogene Thanet Sand and Lambeth Group bedrock, both described as 'Clay, Silt and Sand'. The superficial geology is shown at the site as Alluvium, described as 'Clay, Silty, Peaty, Sandy' (http://mapapps.bgs.ac.uk/geologyofbritain/home.html). In fact, the alluvial deposits of the Lower Thames and its tributaries are almost everywhere underlain by Late Devensian Late Glacial Gravels (in the Thames valley, the Shepperton Gravel of Gibbard, 1985, 1994), and this gravel is widely recorded in BGS archive boreholes in the area of the site.

Previous geotechnical and geoarchaeological investigations have been undertaken at the site, incorporating five geotechnical window sample boreholes (TRC, 2018) and a south west-north east transect of four geoarchaeological boreholes put down by MoLAS (2002) across the northern area of the site. The recent geotechnical boreholes did not record the entire Holocene alluvial sequence, although all but one terminated within peat at 5m below ground level (bgl). During the geoarchaeological investigations undertaken by MoLAS (2002), the underlying Shepperton Gravel surface was recorded at between *ca*. -3 and 0m OD, the Gravel surface rising in the eastern area of the site to 0m OD in the area of GBH1. The alluvial sequence overlying the Gravel included a peat horizon, recorded at levels of between *ca*. 2.2 and -0.5m OD; this horizon was subsequently radiocarbon dated, revealing on onset of peat accumulation during the early Neolithic, and peat cessation during the middle Bronze Age (MoLAS, 2002). Geoarchaeological deposit modelling carried out by Crossrail (2011), based on a transect of boreholes across the area of the North Woolwich Portal (to the south of London City Airport and King George V Dock) shows the present site as lying within Landscape Zone (LZ) 2, described (on the basis of work undertaken at the present site by MoLAS (2002)), as an area of higher, drier ground to the west of their study area, rising to 0m OD (Crossrail, 2011). This area of higher ground is considered to have been a significant component of the prehistoric floodplain landscape that would have remained as high, dry ground above the surrounding floodplain during much of prehistory (Crossrail, 2011).

However, it should be noted at this point that there is a discrepancy between the level of the site shown during the MoLAS (2002) investigations (5m OD) and those of the more recent topographic survey (*ca*. 2m OD). It is not known if the level of the site has reduced significantly since 2002, although this seems unlikely on the basis of a map regression exercise undertaken by CgMs (2018). Such a discrepancy in the level of the site clearly has implications for the surface height of the underlying stratigraphy, including the gravel and peat surfaces; the new geotechnical investigations

(TRC, 2018) show the surface of the peat at between *ca*. 0 and -1m OD, more consistent with other geoarchaeological investigations in this area (see below).

At the Former Royal Docks Service Station (Border Archaeology, 2018) immediately to the west, a total of seven archaeological trial trenches were excavated to a maximum depth of *ca*. 4m below ground level (bgl). The Gravel surface was reached within two of these trenches (001 and 002), with a peat horizon recorded in all seven. No levels are given within the Border Archaeology report, although they do state that the Gravel surface lies below -1.5m OD, and that no gravel highs were identified within the area of the site. Wood was identified within the peat in Trench 002, 'laid in a manner which may be suggestive of pathways, although it is more likely due to natural alluvial and fluvial processes.' (Border Archaeology, 2018).

The deposits of Crossrail's (2011) LZ3 lie just to the east of the site, and are described as follows:

> *'LZ3 characterises the intermediary zone between the higher dry islands of LZ2, and the low lying channel braidplain (LZ1). Well–developed woody peats indicating long term wetland vegetation at the margins of the main channel network dominate this landscape zone. LZ3 has reasonable to good potential for the recovery of prehistoric wetland archaeological remains in particular timber structures (e.g. Bronze Age timber trackways or platforms), and high potential for the recovery of well preserved palaeoenvironmental remains.'*

Within LZ3, at the London City Airport site *ca*. 500m to the northeast (Young *et al*., 2018; see Figure 1) the relief features of the Shepperton Gravel surface were indicative of a possible Late Devensian/Early Holocene channel, the main axis of which is probably located towards the western area of the site, and which may have been aligned broadly north-south. Within this palaeochannel the Gravel surface fell to -5.2m OD, falling from *ca*. -2.9 to -3.5m OD towards the east of the site and beyond the margins of this feature. Further to the west and *ca*. 200m to the northeast of the Ibis Budget site at the Former Camel Works site (Young, 2018a), the surface of the Shepperton Gravel was identified at between *ca*. -3 and -3.5m OD, indicating that the palaeochannel identified at the London City Airport site does not extend as far as the Camel Works site.

Similar but in places slightly higher Gravel surfaces of between -1.59 and -5.16m OD were recorded at the Plot 2.3, Royals Business Park site (Young & Batchelor, 2013) *ca*. 800m to the northwest. Elsewhere, surfaces of between -1.6 and -3.0m OD were recorded at Royal Albert Dock *ca*. 1.2km to the northeast (Batchelor, 2009), with similar elevations at Ferndale Street *ca*. 1.5km to the northeast (*ca*. -3m OD; Divers, 1995), and to the southeast at Albert Road (-4.5m OD; Spurr *et al*., 2001), and North Woolwich Pumping Station (*ca*. -5m OD; Sidell, 2003), Barge House Road (Corcoran et al., 2001) and Gallions Point (Branch *et al*., 1999). The highest Gravel surfaces identified at the present site (*ca*. -2.9m OD) are significantly lower than the elevation of the Gravel at the Royal Docks Community School *ca*. 500m to the northwest (*ca*. 0.5m OD), at which a soil horizon containing Mesolithic flint flakes was recorded, overlain by a Neolithic and Bronze Age soil containing over 1300 fragments of flint tools, debris and pottery (Holder, 1998). At the London City Airport site

(Young *et al.*, 2018) a sequence of Holocene alluvial deposits was recorded overlying the Gravel, comprised (in stratigraphic order) of the Lower Alluvium, Peat and Upper Alluvium. The peat recorded across the London city Airport site was between 0.6 and 2.8m thick, its surface lying at between -3.5 and -1.5m OD; in general, greater thicknesses of both peat and the combined Holocene alluvial deposits are recorded towards the west, in the area of a possible former channel. The results of radiocarbon dating of the peat at the London City Airport site indicated that peat accumulation began during the Late Mesolithic (6640-6450 cal BP), and continued until the Bronze Age (3640-3470 cal BP) (Young *et al.*, 2018).

Generally thinner deposits of up to 1.1m of Peat were recorded at the Plot 2.3, Royals Business Park site (Young & Batchelor, 2013), where it was present at elevations of between *ca.* -2 and -1m OD and radiocarbon dated to the Bronze Age (3390-3270 to 3640-3470 cal BP). Accumulation of the Peat at this site occurred during the Bronze Age, slightly later than that recorded at other sites to the east, despite their similar elevation. At Ferndale Street, the base of the Peat was recorded at -1.89m OD, and was radiocarbon dated to 5314-4870 cal BP (Divers, 1995), similar to that recorded at East Ham Football Club (-1.47m OD; 5600-5050 cal. BP; Scaife, 2001). At the Royal Albert Dock site, Peat was recorded between -1.63 and -1.00m OD. Radiocarbon dating indicated that this horizon accumulated between 4410-4080 and 3630-3360 cal BP (during the Late Neolithic). To the southeast of the present site at Albert Road (Spurr et al., 2001) the base of the Peat was recorded at -4.40m OD, and was radiocarbon dated to 7150-6670 cal BP (Late Mesolithic). To the east of here at the North Woolwich Pumping Station (Sidell, 2003) it was recorded at ca. -4.50m OD (7640-6340 cal. BP); at Barge House Road (Corcoran et al., 2001) at -4.80m OD (ca. 6760-6450 cal. BP); and at Gallions Point (Branch *et al.*, 1999) at ca. -5.10m OD (prior to 6170-5650 cal. BP).

2.2 Palaeoenvironmental and archaeological significance

The existing geotechnical borehole records in the area of the site thus indicate considerable variation in the height of the Gravel surface, and the type, thickness and age of the subsequent Holocene alluvial deposits. Such variations in the alluvial sequence are significant as they represent different environmental conditions that would have existed in a given location. For example: (1) the varying surface of the Gravel may represent the location of former channels and bars; (2) the presence of soil and peat represents former terrestrial or semi-terrestrial land-surfaces, and (3) the various alluvial units represent periods of changing hydrological conditions. Thus by studying the sub-surface stratigraphy across the site in greater detail, it will be possible to build an understanding of the former landscapes and environmental changes that took place across space and time.

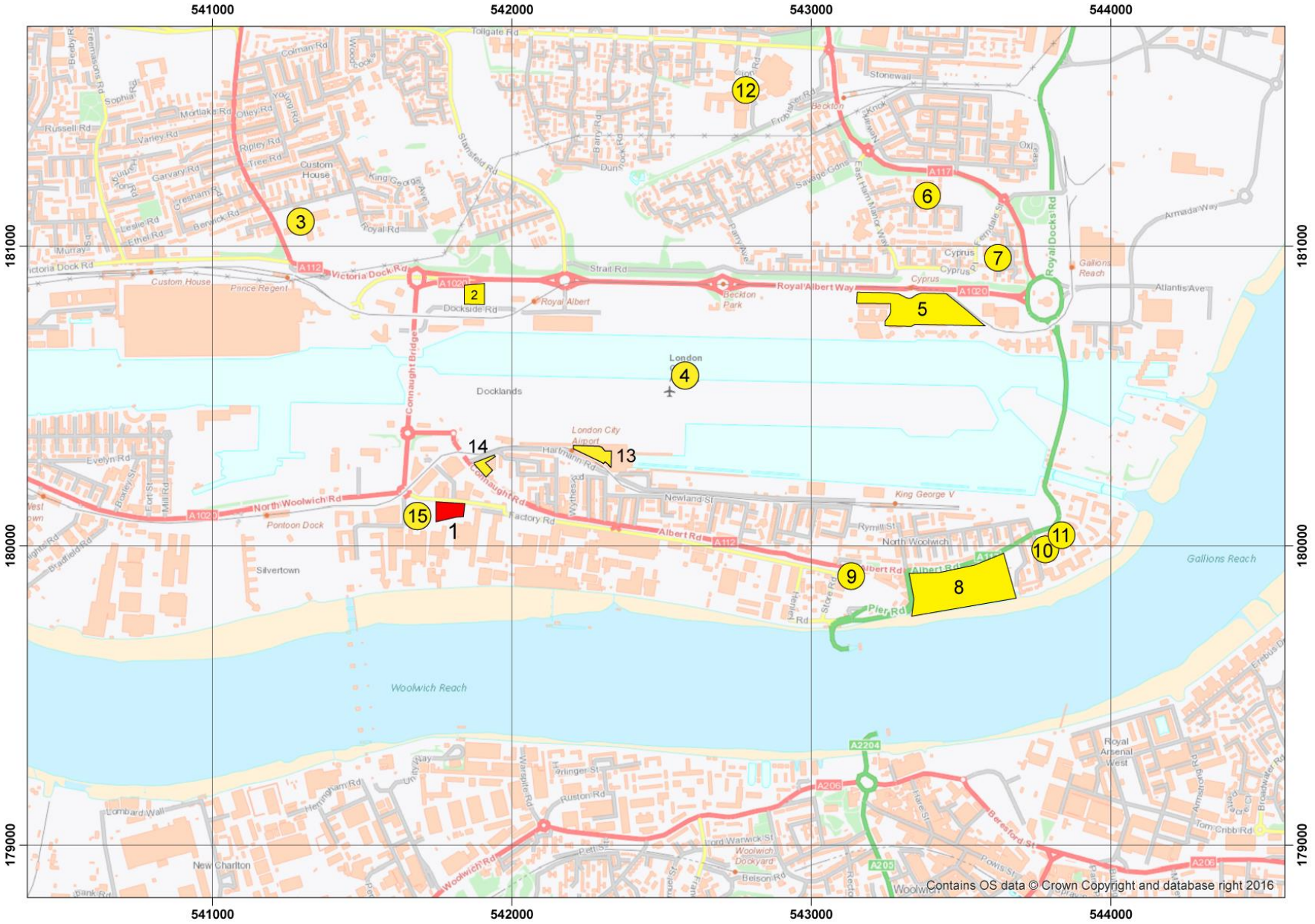
The alluvial and organic-rich sediments (in particular peat) also have high potential to provide a detailed reconstruction of past environments on both the wetland and dryland. In particular, they provide the potential to increase knowledge and understanding of the interactions between hydrology, human activity, vegetation succession and climate. Significant vegetation changes include the Mesolithic/Neolithic decline of elm woodland, the Neolithic colonisation and decline of yew woodland; the Late Neolithic/Early Bronze Age growth of elm on Peat, and the general decline of wetland and dryland woodland during the Bronze Age. As outlined above, investigations of this

nature have been undertaken in the general area of the site at the London City Airport site (Young *et al.*, 2018), Plot 2.3, Royals Business Park (Young & Batchelor, 2013), Ferndale Street (Divers, 1995), Royal Albert Dock (Batchelor, 2009), Albert Road (Spurr *et a*l., 2001), North Woolwich Pumping Station (Sidell, 2003), Barge House Road (Corcoran et al., 2001) and Gallions Point (Branch *et al.*, 1999).

Finally, areas of high gravel topography, soils and peat represent potential areas that might have been utilised or even occupied by prehistoric people, evidence of which may be preserved in the archaeological (e.g. features and structures) and palaeoenvironmental record (e.g. changes in vegetation composition). This is particularly true of the present site, where a gravel high was identified during previous work at the site (MoLAS, 2002) and in subsequent deposit modelling for Crossrail (2011) (using the same borehole data). However, as noted above, there is some uncertainty as to the actual level of the Gravel surface underlying the site. Such prehistoric archaeological activity has been recorded on higher gravel topography at Royal Docks Community School *ca*. 1.2km to the northwest, where a soil horizon containing Mesolithic flint flakes was recorded, overlain by a Neolithic and Bronze Age soil containing over 1300 fragments of flint tools, debris and pottery (Holder, 1998; number 3 on Figure 1).

2.3 Aims and objectives

As recommended within the Written Scheme of Investigation for the site (Young, 2018b) a programme of geoarchaeological fieldwork was carried out, incorporating the monitoring of two new geotechnical boreholes at the site. A programme of geoarchaeological deposit modelling was subsequently undertaken, incorporating the results of the monitoring and previous geotechnical and geoarchaeological records from the site and the wider area, in order to: (1) clarify the nature of the sub-surface stratigraphy across the site, including the depth, thickness and extent of the major stratigraphic units; and (2) to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs.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Albert Rd
Factory Rd
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Gallions Reach
North Woolwich
Royal Docks Rd
Custom House
Royal Albert
Beckton Park
Cyprus
Atlantis Ave
Armada Way
Newland St
King George V
Pier Rd
Woolwich Rd
New Charlton
Lombard Wall
Royal Arsenal West
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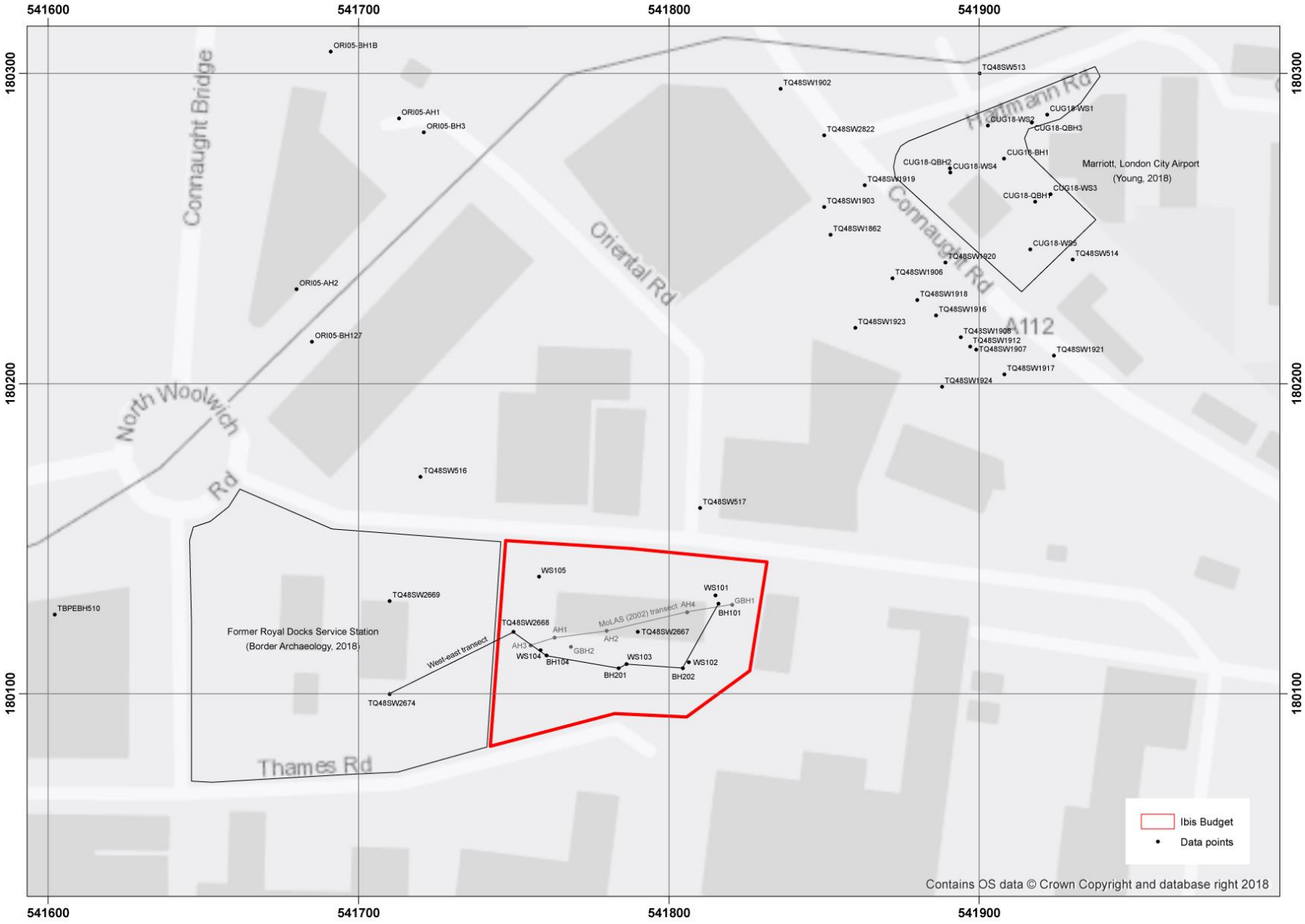
Figure 1: Location of the present site (1) (incorporating the MoLAS, 2002 investigation) and selected sites of geoarchaeological/archaeological investigation: (2) Plot 2.3, Royals Business Park (Young & Batchelor, 2013); (3) Royal Docks Community School (Holder, 1998); (4) Albert Dock (Spurrell, 1889); (5) Royal Albert Dock (Batchelor, 2009); (6) East Ham Football Club (PYR00; Scaife, 2001); (7) Ferndale Street (Divers, 1995); (8) North Woolwich Pumping Station (Sidell, 2003); (9) Albert Road (Spurr *et al*., 2001); (10) Barge House Road (Corcoran *et al*., 2001); (11) Gallions Point (Branch *et al.,* 1999); (12) Beckton Tollgate (Tamblyn, 1994); (13) London City Airport, Hartmann Road (Young & Batchelor, 2017); (14) Former Camel Works (Young, 2018); (15) Former Royal Docks Service Station (Border Archaeology, 2018).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ORI05-BH3
ORI05-AH2
ORI05-BH127
TQ48SW513
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CUG18-WS4
CUG18-QBH1
CUG18-WS3
CUG18-WS5
Marriott, London City Airport
(Young, 2018)
TQ48SW516
TQ48SW517
TBPEBH510
TQ48SW2669
Former Royal Docks Service Station
(Border Archaeology, 2018)
TQ48SW2674
WS105
TQ48SW2668
AH1
AH2
AH3
GBH2
WS104
BH104
WS103
BH201
WS102
BH202
MoLAS (2002) transect
AH4
GBH1
WS101
BH101
TQ48SW2667
West-east transect
Ibis Budget
Data points
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Figure 2: Location of the geoarchaeological/geotechnical and BGS archive boreholes (http://mapapps.bgs.ac.uk/geologyofbritain/home.html) used in the deposit model at Ibis Budget, London City Airport, North Woolwich Road, London Borough of Newham.

3. METHODS

3.1 Field investigations

Two new geotechnical boreholes put down at the site by TRC in October 2018 were monitored in the field by a geoarchaeologist, following a review of the existing geotechnical records for the site (see Table 1). The lithostratigraphy of the boreholes was described using standard procedures for recording unconsolidated/organic sediments, noting the physical properties (colour), composition (gravel, sand, clay, silt and organic matter) and inclusions (e.g. artefacts) (Tröels-Smith, 1955). The procedure involved: (1) cleaning the samples with a spatula or scalpel blade and distilled water to remove surface contaminants; (2) recording the physical properties, most notably colour using a Munsell Soil Colour Chart; (3) recording the composition; gravel (Grana glareosa; Gg), fine sand (Grana arenosa; Ga), silt (Argilla granosa; Ag) and clay (Argilla steatoides); (4) recording the degree of peat humification and (5) recording the unit boundaries e.g. sharp or diffuse. The results of the lithostratigraphic descriptions are displayed in Tables 2 and 3.

3.2 Deposit modelling

The deposit model for the site was based on a review of 15 borehole records for the site itself and the immediate surrounding area, incorporating the two new monitored geotechnical boreholes (BH201 and BH202), seven existing geotechnical records (TRC, 2018) and six British Geological Survey (BGS) archive boreholes (http://mapapps.bgs.ac.uk/geologyofbritain/home.html). In the wider area of the site, stratigraphic records from the Quaternary Scientific Lower Thames Valley Geoarchaeological Database, combining records from various geoarchaeological and geotechnical investigations in the wider area (see Figure 1) and the British Geological Survey (BGS) borehole archive (https://www.bgs.ac.uk/geoindex/). The total number of records used in the wider deposit model was 646, including 403 BGS archive boreholes (see Figure 11). Importantly, it should be noted that the stratigraphic data from the MoLAS (2002) investigation at the site was not included in the deposit models, since as described above, the accuracy of the elevation data for these boreholes is unclear (see 2.1).

Sedimentary units from the boreholes were classified into five main groups: (1) Gravel, (2) Lower Alluvium. (3) Peat, (4) Upper Alluvium and (5) Made Ground. The classified data for groups 1-5 were then input into a database with the RockWorks 16 geological utilities software. Models of surface height were generated for the Gravel (Figure 4), Lower Alluvium (Figure 5), Peat (Figure 6) and the Upper Alluvium (Figure 8). Thickness of the Peat (Figure 7), the combined Holocene alluvial sequence (Figure 9), and the Made Ground (Figure 10) were also modelled (also using a nearest neighbour routine). A deposit model for the surface of the Gravel in the wider area, utilising the Quaternary Scientific Lower Thames Valley Geoarchaeological Database, is shown in Figure 11. Because the boreholes are not uniformly distributed over the area of investigation, the reliability of the models generated using RockWorks is variable. In general, reliability improves from outlying areas where the models are largely supported by scattered archival records towards the core area of commissioned boreholes; within the Ibis Budget site itself, borehole coverage is sufficient to model the sub-surface stratigraphy with a reasonable level of confidence.

Because of the 'smoothing' effect of the modelling procedure, it should be noted that the modelled levels of stratigraphic contacts may differ slightly from the levels recorded in borehole logs and section drawings. As a consequence of this, the modelling procedure has been manually adjusted so that only those areas for which sufficient stratigraphic data is present will be modelled. In order to achieve this, a maximum distance cut-off filter equivalent to a 50m radius around each record is applied to all deposit models, with the exception of the wider model of the Gravel surface, to which a 100m radius is applied in order to aid interpretation of the major topographic features. Finally, it is important to recognise that multiple sets of boreholes are represented, put down at different times and recorded using different descriptive terms and subject to differing technical constraints in terms of recorded detail including the exact levels of the stratigraphic boundaries.

Table 1: Spatial data for the borehole logs used in the deposit model at Ibis Budget, London City Airport, North Woolwich Road, London Borough of Newham.

Name	Easting	Northing	Elevation (m OD)	Total depth (m)
New geotechnical boreholes (monitored)				
BH201	541783.83	180108.27	2.00	10.00
BH202	541804.54	180108.27	1.80	25.00
Existing geotechnical boreholes (TRC, 2018)				
BH101	541813.38	180128.15	1.80	14.30
BH104	541760.63	180112.41	2.00	25.00
WS101	541815.04	180131.74	1.80	5.00
WS102	541806.47	180110.20	1.80	5.00
WS103	541786.32	180109.65	2.00	5.00
WS104	541758.70	180114.07	2.00	4.60
WS105	541758.15	180137.82	1.70	5.00
BGS archive boreholes (https://www.bgs.ac.uk/geoindex/)				
TQ48SW2674	541710.00	180100.00	2.41	3.00
TQ48SW2668	541750.00	180120.00	2.33	3.00
TQ48SW2667	541790.00	180120.00	2.10	3.00
TQ48SW2669	541710.00	180130.00	2.56	3.00
TQ48SW517	541810.00	180160.00	1.53	25.00
TQ48SW516	541720.00	180170.00	1.60	25.00

4. RESULTS AND INTERPRETATION OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS & DEPOSIT MODELLING

A summary of the borehole data included in the deposit model for the site is shown in Table 1, with the results of the lithostratigraphic description of boreholes BH201 and BH202 shown in Tables 2 and 3 respectively. The results of the deposit modelling are shown in Figures 3 to 11; Figure 3 is a two-dimensional west-east transect of selected boreholes across the site and the wider area, whilst Figures 4 to 10 are surface elevation and thickness models for each of the main stratigraphic units. A deposit model for the Gravel surface in the wider area is shown in Figure 11, incorporating data from the Quaternary Scientific Lower Thames Valley Geoarchaeological Database,

The results of the deposit modelling indicate that the number and spread of the logs is sufficient to permit modelling with a high level of certainty across the Ibis Budget site. Overlying the bedrock, the full sequence of sediments recorded in the boreholes comprises:

Made Ground
Upper Alluvium – widely present
Peat – widely present
Lower Alluvium – not reached in all boreholes
Gravel (Shepperton Gravel) – not reached in all boreholes

4.1 Shepperton Gravel

The Shepperton Gravel was recorded in all four of the new geotechnical boreholes that reached the base of the Holocene alluvial sequence (BH101, BH104, BH201 and BH202). The Gravel was deposited during the Devensian Late Glacial (MIS2; 15,000 to 11,500 years before present) and comprises the sands and gravels of a high-energy braided river system which, while it was active, would have been characterised by longitudinal gravel bars and intervening low-water channels in which finer-grained sediments might have been deposited. Such a relief pattern would have been present on the valley floor at the beginning of the Holocene when a lower-energy fluvial regime was being established.

In these boreholes, the surface of the Gravel was relatively even (Figure 4), recorded at between -3.9 (BH101) and -4.1m OD (BH202). To the north, the model indicates that it rises to -2.17m OD in borehole TQ48SW517, and to the northwest to -2.65m OD in TQ48SW516. As noted above, the previous geoarchaeological and geotechnical boreholes included in the MoLAS (2002) investigations were not included in this deposit model due to the uncertainty over the accuracy of the elevation data for these boreholes, although their distribution is shown in Figure 2. During the geoarchaeological investigations undertaken by MoLAS (2002), the underlying Shepperton Gravel surface was recorded at between -2.9 (AH1) and rising to 0.1m OD in the eastern area of the site in the area of GBH1. In borehole BH101 from the present investigation and within *ca.* 5m of GBH1, the Gravel surface is recorded at -3.90m OD. The surface elevation for the boreholes at the MoLAS

(2002) investigations (5m OD) is therefore considered to be incorrect, and the new deposit model indicates that no Gravel 'highs' underly the site.

As described in 2.1, at the Former Royal Docks Service Station (Border Archaeology, 2018) immediately to the west, the Gravel surface was reached within two trenches; although no levels are given within the Border Archaeology report (and hence this data is not used in the deposit model), they do state that the Gravel surface lies below -1.5m OD, and that no gravel highs were identified within the area of the site. At the London City Airport site *ca.* 500m to the northeast (Young *et al.*, 2018; see Figure 1) the relief features of the Shepperton Gravel surface were indicative of a possible Late Devensian/Early Holocene channel, perhaps aligned broadly north-south, within which the Gravel surface fell to -5.2m OD, falling from *ca.* -2.9 to -3.5m OD towards the east of the site and beyond the margins of this feature. Further to the west of the London City Airport site and *ca.* 200m to the northeast of the present investigations at the Former Camel Works site (Young, 2018a), the surface of the Shepperton Gravel was identified at between *ca.* -3 and -3.5m OD, indicating that the palaeochannel identified at the London City Airport site does not extend as far as the Camel Works site. The new data from the present deposit modelling exercise (Figure 11) indicates that the general Gravel topography in the wider area of the Ibis Budget site is typical of that on the valley floor during the Late Devensian/Early Holocene.

4.2 Lower Alluvium

The Lower Alluvium rests directly on the Shepperton Gravel across the area of the site, and was again recorded in only those boreholes that reached the base of the Holocene alluvial sequence (BH101, BH104, BH201 and BH202). The deposits of the Lower Alluvium are described as predominantly silty or clayey, and tending to become increasingly sandy downward. The Lower Alluvium frequently contains detrital wood or plant remains, and in many cases is described as organic and with occasional Mollusca remains. The surface of the Lower Alluvium (Figure 5) is relatively uneven within the area of the site, lying at between -2.2 (BH201) and -3.7m OD (BH202), and it rises to the north/northwest to between -1.27 and -1.70 in boreholes TQ48SW517 and TQ48SW516 respectively.

The sediments of the Lower Alluvium are indicative of deposition during the Early to Mid-Holocene, when the main course of the Thames was probably confined to a single meandering channel. During this period, the surface of the Shepperton Gravel was progressively buried beneath the sandy and silty flood deposits of the river. The richly-organic nature of the Lower Alluvium suggests that this was a period during which the valley floor was occupied by a network of actively shifting channels, with a drainage pattern on the floodplain that was still largely determined by the relief on the surface of the underlying Shepperton Gravel.

4.3 Peat

A horizon of peat, usually described as woody and silty, was recorded directly overlying the Lower Alluvium in boreholes BH101, BH201 and BH202 and forming the basal unit in the shallow window sample boreholes WS101 and WS103-105. The peat was not reached in WS102. The surface of the

peat (Figure 6) was recorded at between -0.50 (BH101) and -2.0m OD (WS103) within the area of the site. To the north of the site the peat surface rises to between -0.37 and -0.40 in boreholes TQ48SW517 and TQ48SW516 respectively. MoLAS (2002) show the surface of the peat within the area of the site at between 0.5 and 2.8m OD, significantly higher than the levels identified here. Again, this discrepancy is considered to be a result of the incorrect elevation data for the geoarchaeological/geotechnical boreholes in the MoLAS (2002) investigation.

The full thickness of the peat was recorded in only three boreholes within the site (BH101, BH201 and BH202), where it was recorded at between 0.9 (BH201) and 2.7m (BH101) thick. Between 0.9 and 1.3m of peat was recorded to the north in boreholes TQ48SW517 and TQ48SW516. At the Former Camel Works site (Young, 2018a) *ca.* 200m to the northeast (see Figure 7) between 0.25 and 2.6m of peat was recorded, whilst at the London City Airport site *ca.* 500m to the northeast (Young & Batchelor, 2017), up to 2.8m of peat was recorded, with greater thicknesses recorded towards the west of the site, particularly in the area of the palaeochannel identified here.

Significantly, the peat recorded at the site is indicative of a transition towards semi-terrestrial (marshy) conditions, supporting the growth of either saltmarsh, sedge fen/reed swamp and/or woodland communities. Such semi-terrestrial conditions may have represented former land surfaces that might have been utilised by prehistoric communities. During the MoLAS (2002) investigations, the peat was radiocarbon dated in borehole AH3 to the early Neolithic (4370 to 3960 cal BC) to middle Bronze Age (1520 to 1200 cal BC).

4.4 Upper Alluvium

The Upper Alluvium overlies the peat across the site, the deposits of which are described as predominantly silty or clayey and occasionally organic-rich. The surface of the Upper Alluvium (Figure 8) is relatively even across the site, generally lying at between *ca.* 0.5 and 1.0m OD (although in WS102 it was recorded at -0.4m OD, and here it is possible that the natural surface is truncated by the overlying Made Ground. The sediments of the Upper Alluvium are indicative of deposition within low energy fluvial and/or semi-aquatic conditions during the Holocene. The high mineral content of the sediments may reflect increased sediment loads resulting from intensification of agricultural land use from the later prehistoric period onward, combined with the effects of rising sea level.

The combined Holocene alluvial sequence at the site (incorporating the Lower Alluvium, Peat and Upper Alluvium) is recorded in thicknesses of between 4.2 (BH201) and 4.7m (BH202) within the site (Figure 9). To the north where the Gravel surfaces rises, it thins slightly to between 2.75 and 3.25m in boreholes TQ48SW517 and TQ48SW516 respectively. At the Former Camel Works site (Young, 2018a) *ca.* 200m to the northeast (see Figure 9) similar thicknesses of between 4.2 and 4.6m were recorded, whilst at the London City Airport site (Young & Batchelor, 2017) up to 6.0m of alluvium was recorded within the area of a Late Glacial/Early Holocene palaeochannel.

4.5 Made Ground

Between 0.8 (WS101) and 2.2m (WS102) of Made Ground caps the Holocene alluvial sequence across the site (Figure 10). As discussed above, the variable thickness of the Made Ground across the site is generally reflected in the extent of truncation/lowering of the natural sequence in some areas of the site, particularly in the area of WS102.

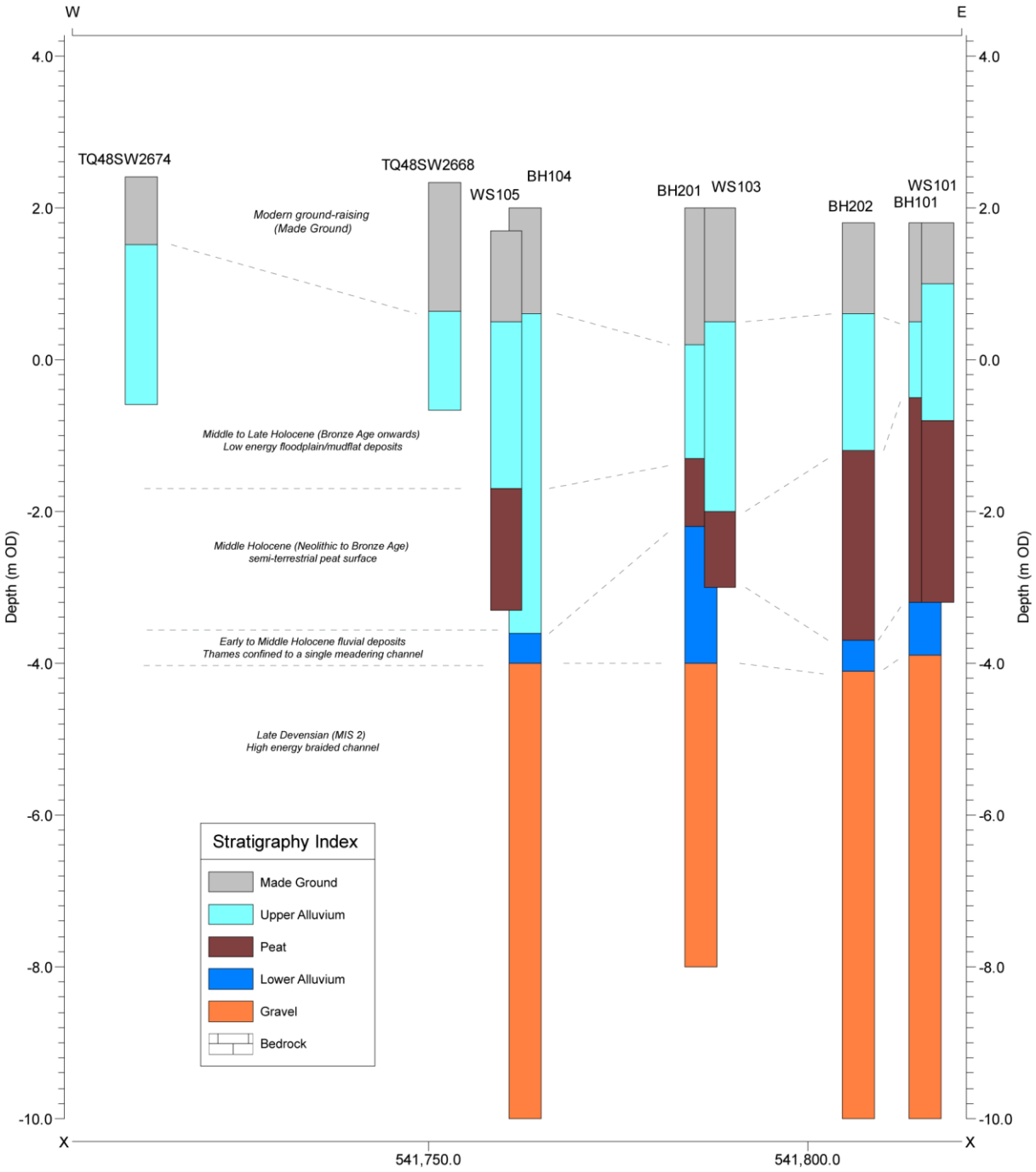

Figure 3: West-east transect of selected boreholes across the Ibis Budget site and the wider area (see Figure 2 for location).

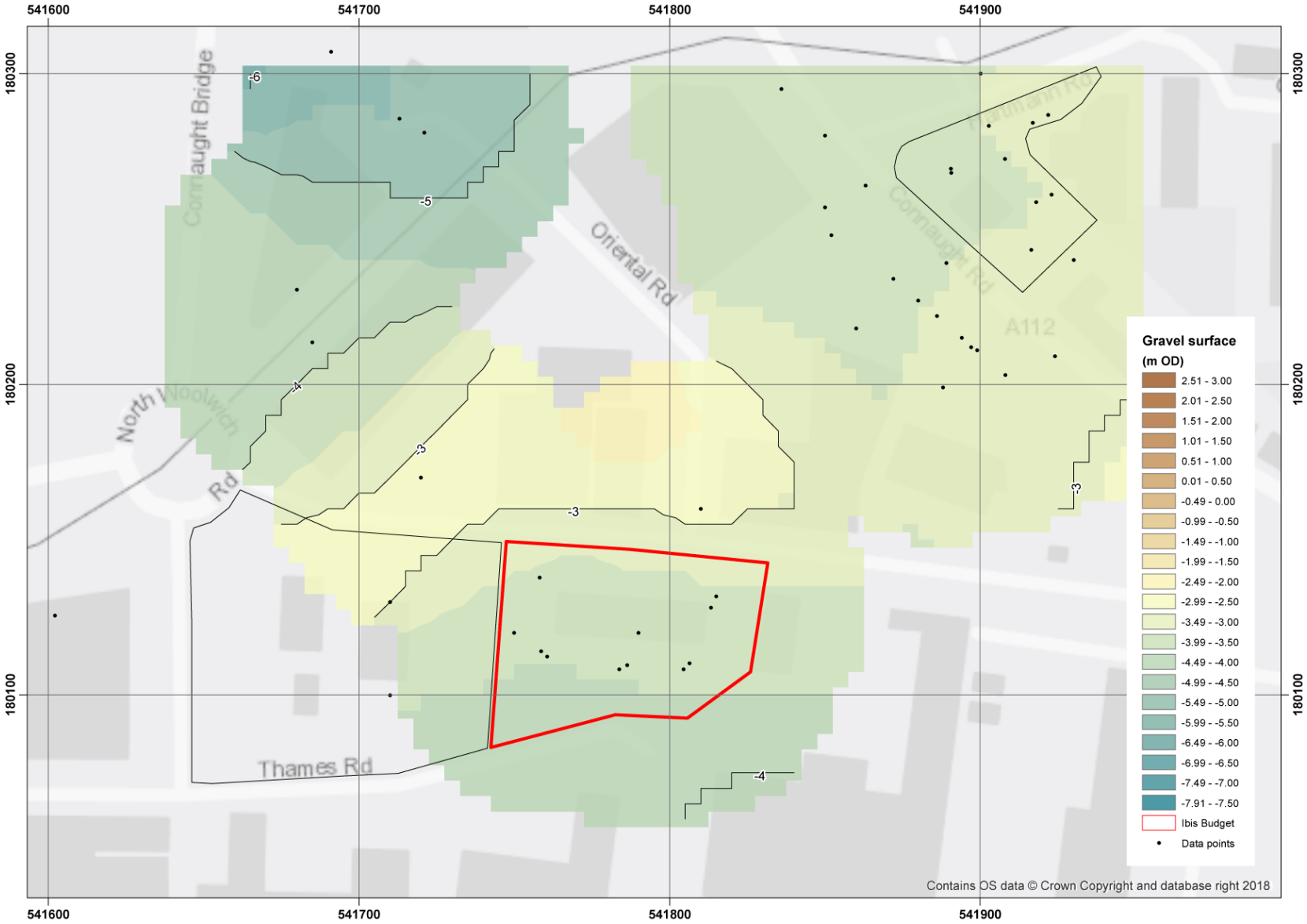

Figure 4: Top of the Shepperton Gravel (m OD) (site outline in red).

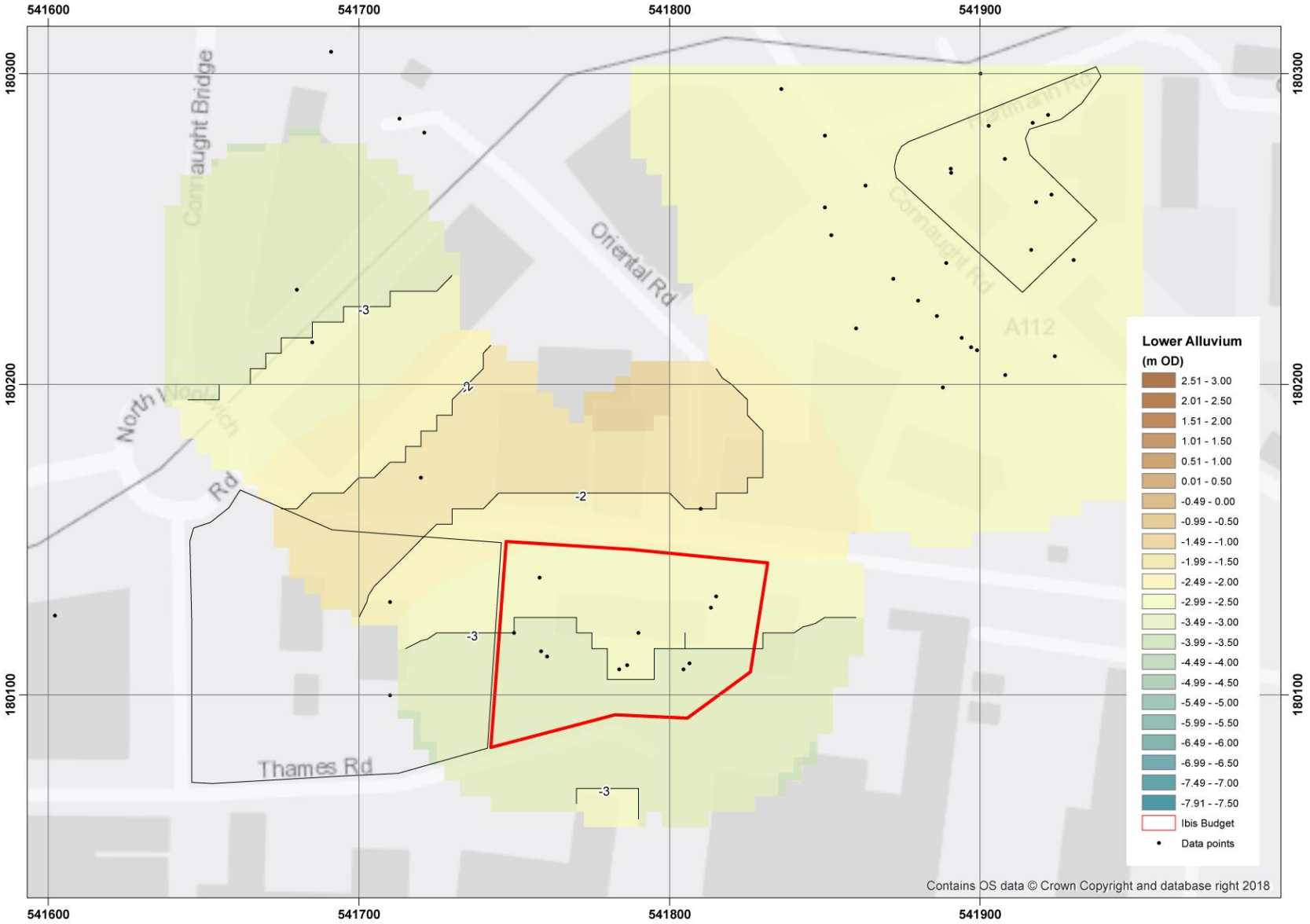

Figure 5: Top of the Lower Alluvium (m OD) (site outline in red).

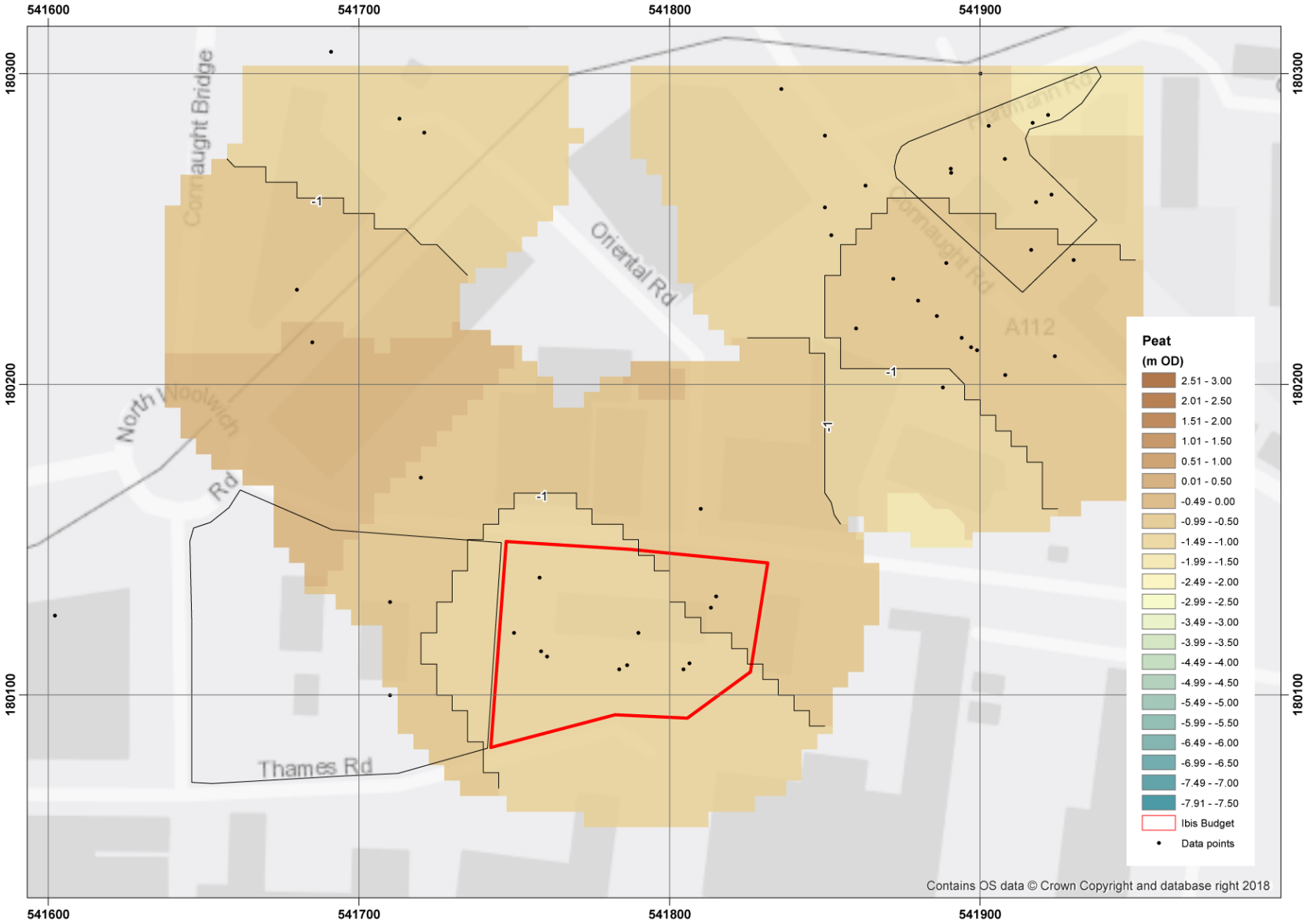

Figure 6: Top of the Peat (m OD) (site outline in red).

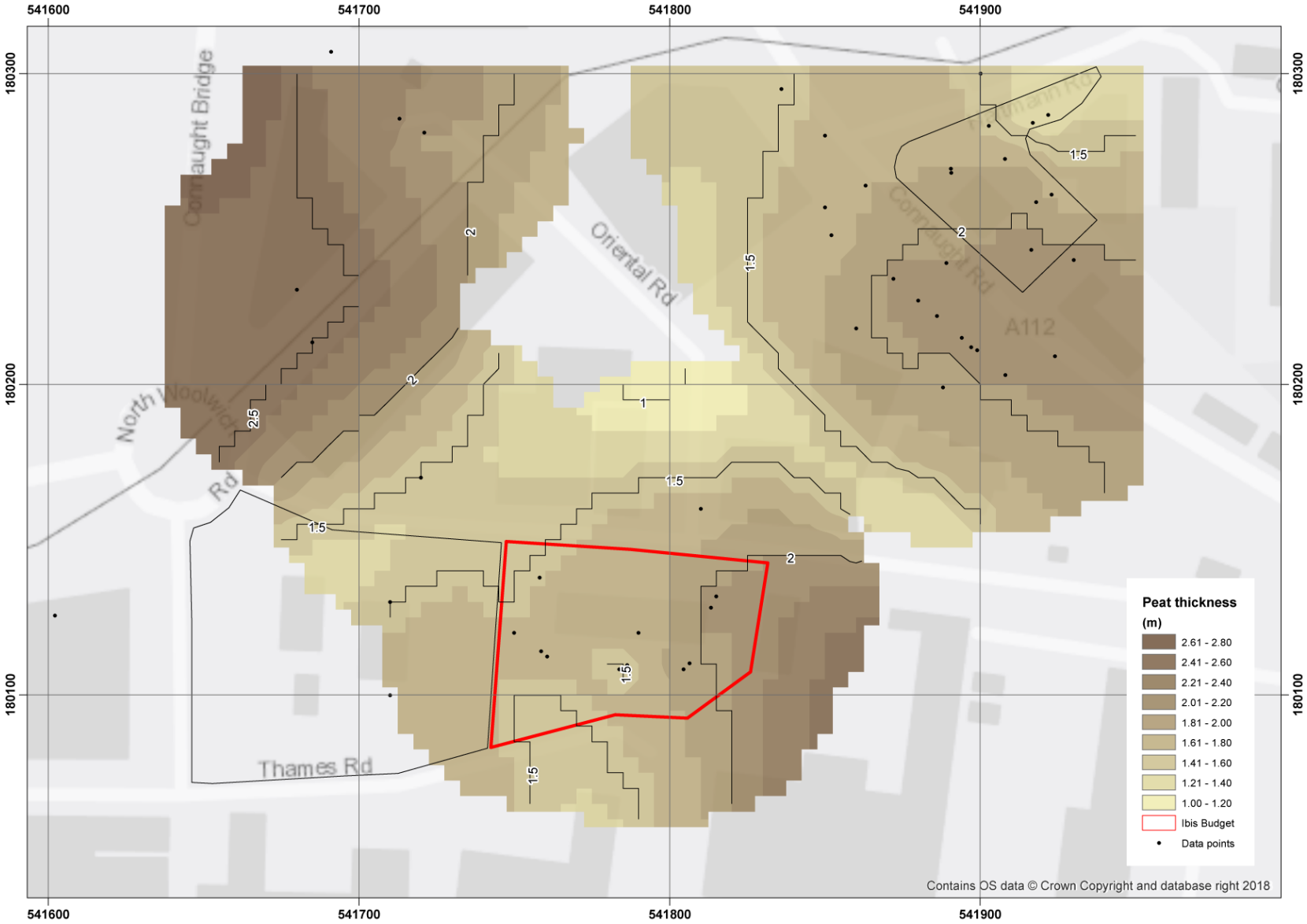

Figure 7: Thickness of the Peat (m) (site outline in red).

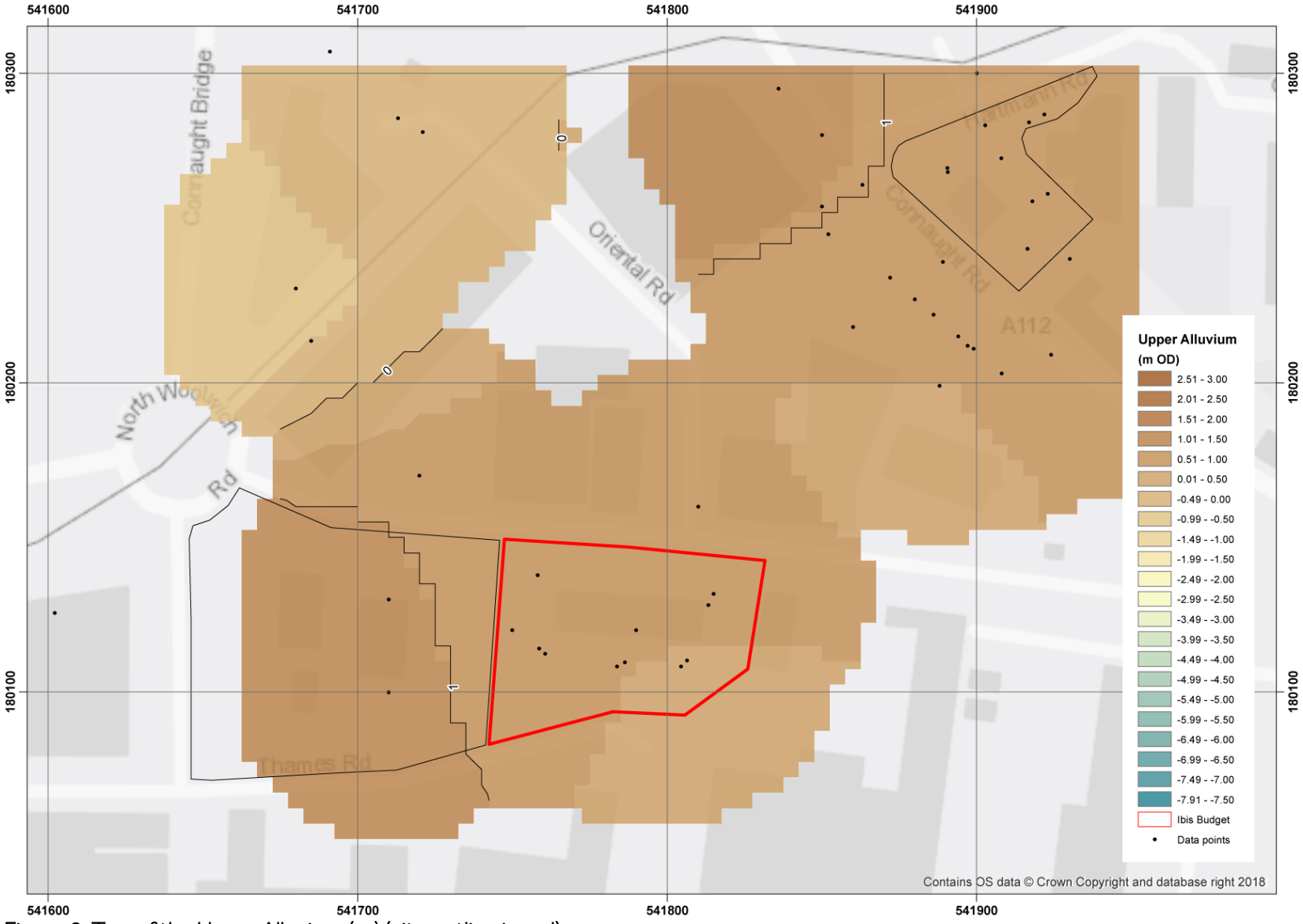

Figure 8: Top of the Upper Alluvium (m) (site outline in red).

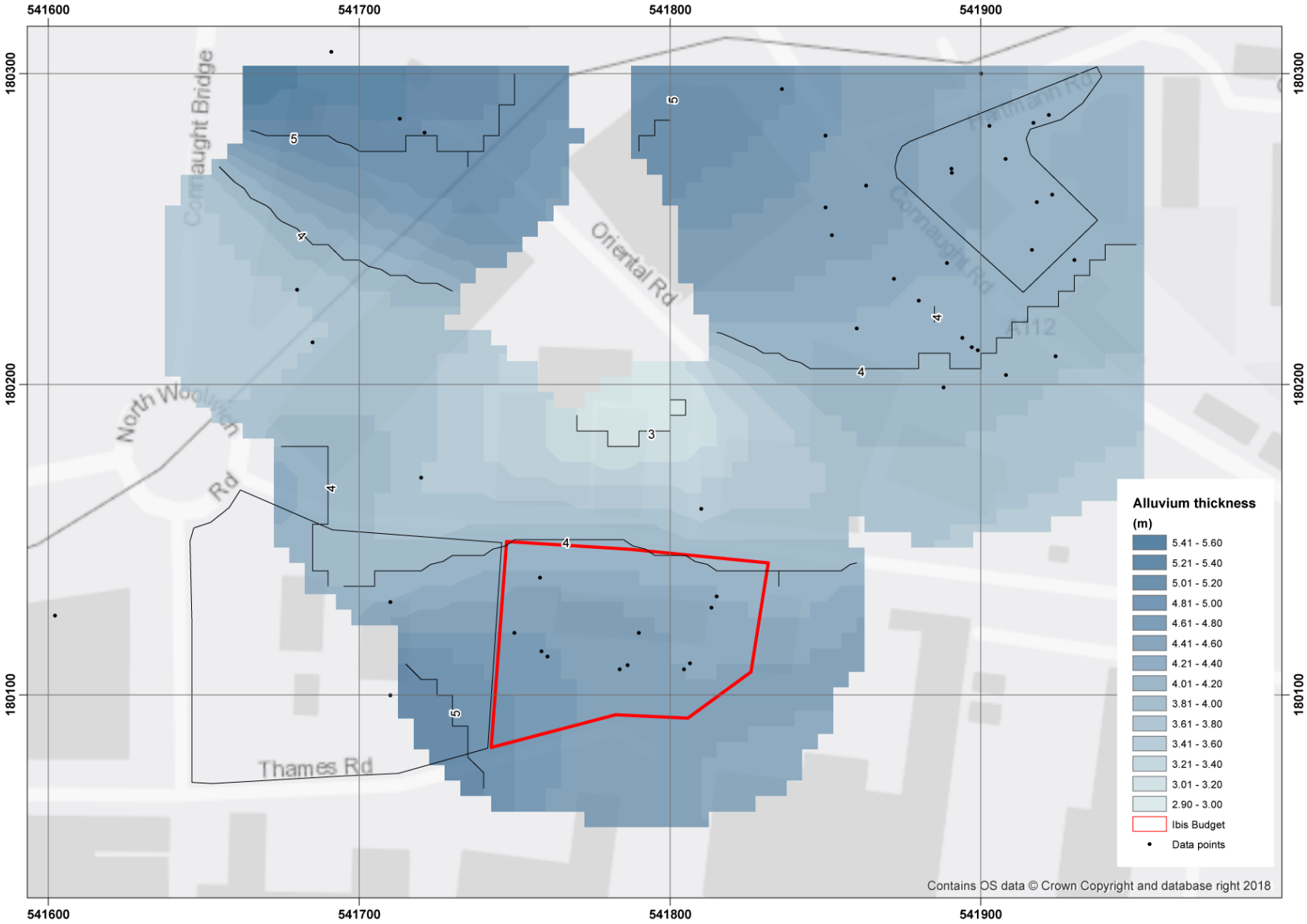

Figure 9: Thickness of the Holocene alluvial sequence (Lower Alluvium, Peat and Upper Alluvium) (m) (site outline in red).

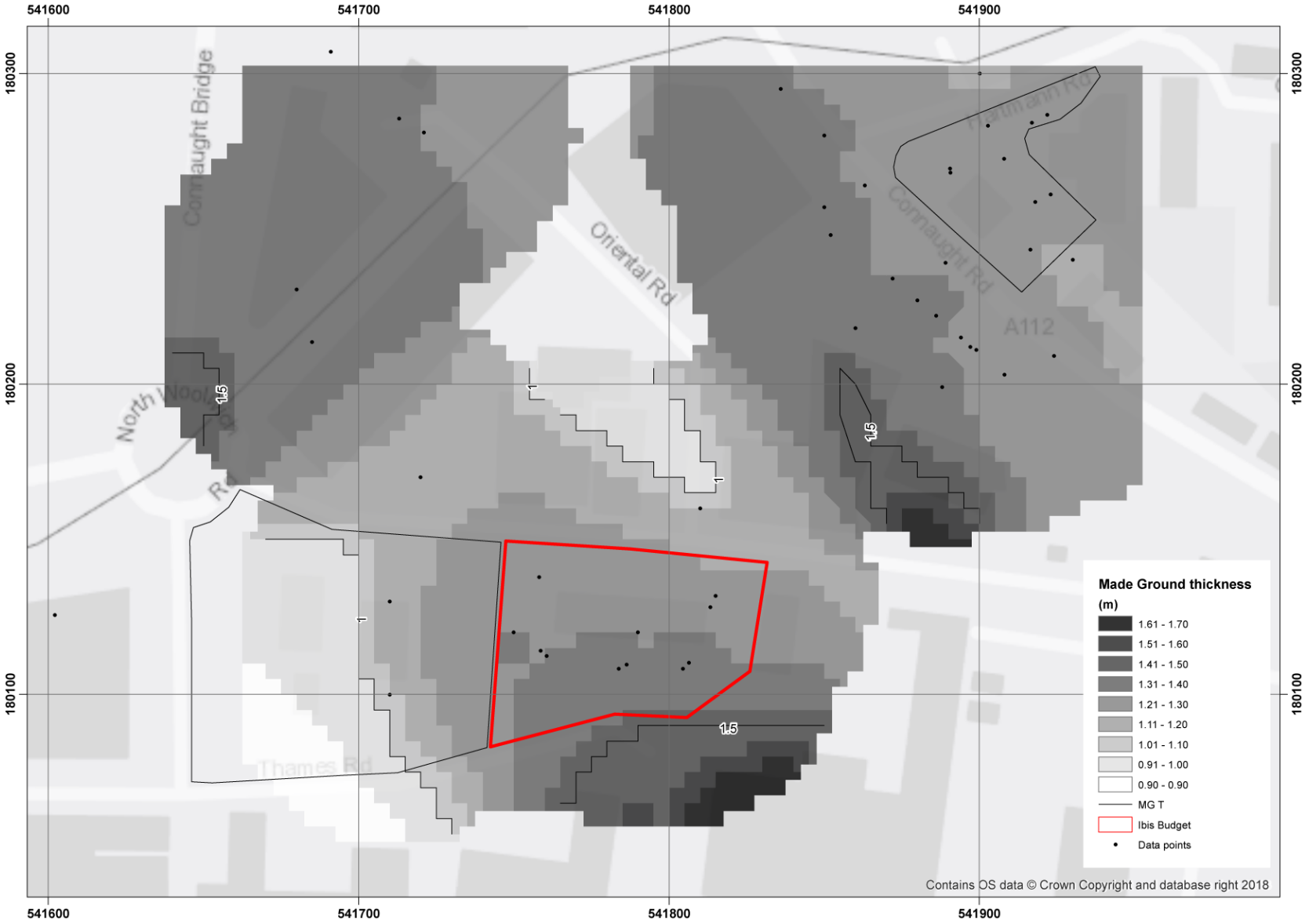

Figure 10: Thickness of Made Ground (m) (site outline in red).

Table 2: Lithostratigraphic description of borehole BH201,

Depth (m bgl)	Depth (m OD)	Description	Interpretation
0.00 to 0.10	2.00 to 1.90	Tarmac hardstanding.	MADE GROUND
0.10 to 1.10	1.90 to 0.90	Concrete and brick rubble in a dark grey sandy clay matrix.	
1.10 to 1.80	0.90 to 0.20	Grey sandy, silty clay with frequent brick.	
1.80 to 3.30	0.20 to -1.30	As3 Ag1; olive grey silty clay. Sharp contact in to:	UPPER ALLUVIUM
3.30 to 4.20	-1.30 to -2.20	Sh2 Tl^{2}1 Ag1 Th+; humo. 2/3; black moderately to well humified black woody, silty peat with a trace of herbaceous material. Diffuse contact in to:	PEAT
4.20 to 5.50	-2.20 to -3.20	Ag2 As1 Sh1; greenish grey clayey silt with traces of organic matter and organic lenses throughout. Diffuse contact in to:	LOWER ALLUVIUM
5.50 to 6.00	-3.20 to -4.00	Ga2 Ag2; grey silt and sand. Sharp contact in to:	
6.00 to 8.00	-4.00 to -6.00	Gg3 Ga1; olive greenish grey sandy gravel. Clasts are mainly flint, average diameter 30mm, sub-angular to well-rounded. Some sandier (Ga3 Gg1) sub-units.	SHEPPERTON GRAVEL

Table 3: Lithostratigraphic description of borehole BH202,

Depth (m bgl)	Depth (m OD)	Description	Interpretation
0.00 to 0.10	1.80 to 1.70	Tarmac hardstanding.	MADE GROUND
0.10 to 1.20	1.70 to 0.60	Concrete and brick in brown sandy clay matrix.	
1.20 to 2.40	0.60 to -0.60	As3 Ag1; grey silty clay. Diffuse contact in to:	UPPER ALLUVIUM
2.40 to 3.00	-0.60 to -1.20	As2 Ag2 Dl+; dark grey silt and clay with a trace of detrital wood.	
3.00 to 4.00	-1.20 to -2.20	Sh2 Tl^{2}1 Ag1 Th+; humo. 2/3; brown moderately to well-humified silty, woody peat with a trace of herbaceous material. Diffuse contact in to:	PEAT
4.00 to 4.50	-2.20 to -2.70	Sh2 Ag1 Ga1 Th+ Tl+; humo. 3; dark greyish brown well humified silty, sandy peat with traces of wood and herbaceous material. Diffuse contact in to:	
4.50 to 5.50	-2.70 to -3.70	Sh3 Tl^{2}1 Th+; humo. 2; dark brown moderately humified woody peat with a trace of herbaceous material. Sharp contact in to:	
5.50 to 5.90	-3.70 to -4.10	Ag2 Ga2 Dh+ Dl+; grey silt and sand with traces of detrital wood and detrital herbaceous material. Sharp contact in to:	LOWER ALLUVIUM
5.90 to 7.50	-4.10 to -5.70	Gg3 Ga1; grey sandy gravel. Clasts are mainly flint, average diameter 30mm, sub-angular to well-rounded.	SHEPPERTON GRAVEL

5. DISCUSSION

A programme of geoarchaeological fieldwork and deposit modelling was undertaken at the Ibis Budget site in order to (1) clarify the nature of the sub-surface stratigraphy across the site, including the depth, thickness and extent of the major stratigraphic units; and (2) to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs. In order to address these aims, two geotechnical boreholes were monitored and described by a geoarchaeologist, and the new and existing stratigraphic data used to produce a deposit model of the major depositional units.

The results of the deposit modelling indicate that the sediments recorded at the site are similar to those recorded elsewhere in this general area of the Lower Thames Valley, with Late Devensian Shepperton Gravel overlain by a sequence of Holocene alluvial sediments, including peat, and buried beneath modern Made Ground. Elsewhere in the Lower Thames Valley, the surface of the Late Devensian Shepperton Gravel is often uneven (Gibbard, 1985; 1994) with relief features that can be identified as longitudinal gravel bars and palaeochannels with a relief amplitude commonly of 3-4m and in some places up to 6m. At the present site and across the modelled area, the relief features of the Shepperton Gravel surface are typical of those on the floor of the valley during the Late Devensian/Early Holocene, the surface within the site relatively even at between *ca*. -3.9 and -4.1m OD. No Gravel highs appear to be present; Gravel surfaces of up to 0.1m OD indicated during the MoLAS (2002) investigations are considered to be incorrect, the result of an erroneous surface elevation for the geoarchaeological and geotechnical boreholes used in that investigation (5m OD compared to *ca*. 2m OD shown in current topographic surveys of the site).

The Gravel topography in the wider area is shown in Figure 11. Similar Gravel surfaces were recorded at the Former Camel Works (Young, 2018a) and London City Airport sites (Young & Batchelor, 2017) *ca*. 200 and 500m to the northeast respectively. At the London City Airport site the relief features of the Shepperton Gravel surface were indicative of a possible Late Devensian/Early Holocene channel, perhaps aligned broadly north-south, within which the Gravel surface fell to -5.2m OD, from *ca*. -2.9 towards the east of the site. At the Former Camel Works site (Young, 2018a), the surface of the Shepperton Gravel was identified at between *ca*. -3 and -3.5m OD. Similar but in places slightly higher Gravel surfaces of between -1.59 and -5.16m OD were recorded at the Plot 2.3, Royals Business Park site (Young & Batchelor, 2013) *ca*. 800m to the northwest. Elsewhere, surfaces of between -1.6 and -3.0m OD were recorded at Royal Albert Dock *ca*. 1.2km to the northeast (Batchelor, 2009), with similar elevations at Ferndale Street *ca*. 1.5km to the northeast (*ca*. -3m OD; Divers, 1995), and to the southeast at Albert Road (-4.5m OD; Spurr *et al*., 2001), and North Woolwich Pumping Station (*ca*. -5m OD; Sidell, 2003), Barge House Road (Corcoran et al., 2001) and Gallions Point (Branch *et al*., 1999). The highest Gravel surfaces identified at the present site (*ca*. -3.9m OD) are significantly lower than the elevation of the Gravel at the Royal Docks Community School *ca*. 500m to the northwest (*ca*. 0.5m OD), at which a soil horizon containing Mesolithic flint flakes was recorded, overlain by a Neolithic and Bronze Age soil containing over 1300 fragments of flint tools, debris and pottery (Holder, 1998). On this basis, it is considered very unlikely that the site will contain *in situ* evidence of prehistoric activity on the surface of the Gravel.

At the present site, the Holocene alluvial sequence overlying the Gravel is comprised (in stratigraphic order) of the Lower Alluvium, Peat and Upper Alluvium, the alluvial sequence between 4.2 and 4.7m thick in those boreholes that recorded the entire alluvial sequence. The peat horizon recorded within the site is generally present at elevations of between *ca.* -0.5 and -3.5m OD, and in thicknesses of between 0.9 and 2.7m. At the Former Camel Works (Young, 2018a) the peat was present at similar elevations of between *ca.* -1 and -3m OD, and thicknesses of between 0.25 and 2.6m. At the London City Airport site (Young & Batchelor, 2017), up to 2.8m of peat was recorded, with greater thicknesses recorded towards the west of this site.

During the MoLAS (2002) investigations, the peat at the present site was radiocarbon dated to the early Neolithic (4370 to 3960 cal BC) to middle Bronze Age (1520 to 1200 cal BC). The results of radiocarbon dating of the peat at the London City Airport site indicated that peat accumulation began during the Late Mesolithic (6640-6450 cal BP), and continued until the Bronze Age (3640-3470 cal BP) (Young *et al.*, 2018). Elsewhere, generally thinner deposits of up to 1.1m of peat was recorded at the Plot 2.3, Royals Business Park site (Young & Batchelor, 2013), where it was present at elevations of between *ca.* -2 and -1m OD and radiocarbon dated to the Bronze Age (3390-3270 to 3640-3470 cal BP). Accumulation of the peat at this site occurred during the Bronze Age, slightly later than that recorded at other sites to the east, despite their similar elevation. At Ferndale Street, the base of the Peat was recorded at -1.89m OD, radiocarbon dated to 5314-4870 cal BP (Divers, 1995), similar to that recorded at East Ham Football Club (-1.47m OD; 5600-5050 cal. BP; Scaife, 2001). At the Royal Albert Dock site, peat was recorded at between -1.63 and -1.00m OD. Radiocarbon dating indicated that this horizon accumulated between 4410-4080 and 3630-3360 cal BP (during the Late Neolithic). To the southeast of the present site at Albert Road (Spurr et al., 2001) the base of the Peat was recorded at -4.40m OD, here radiocarbon dated to 7150-6670 cal BP (Late Mesolithic). To the east of here at the North Woolwich Pumping Station (Sidell, 2003) it was recorded at ca. -4.50m OD (7640-6340 cal. BP); at Barge House Road (Corcoran et al., 2001) at -4.80m OD (ca. 6760-6450 cal. BP); and at Gallions Point (Branch et al., 1999) at ca. -5.10m OD (prior to 6170-5650 cal. BP).

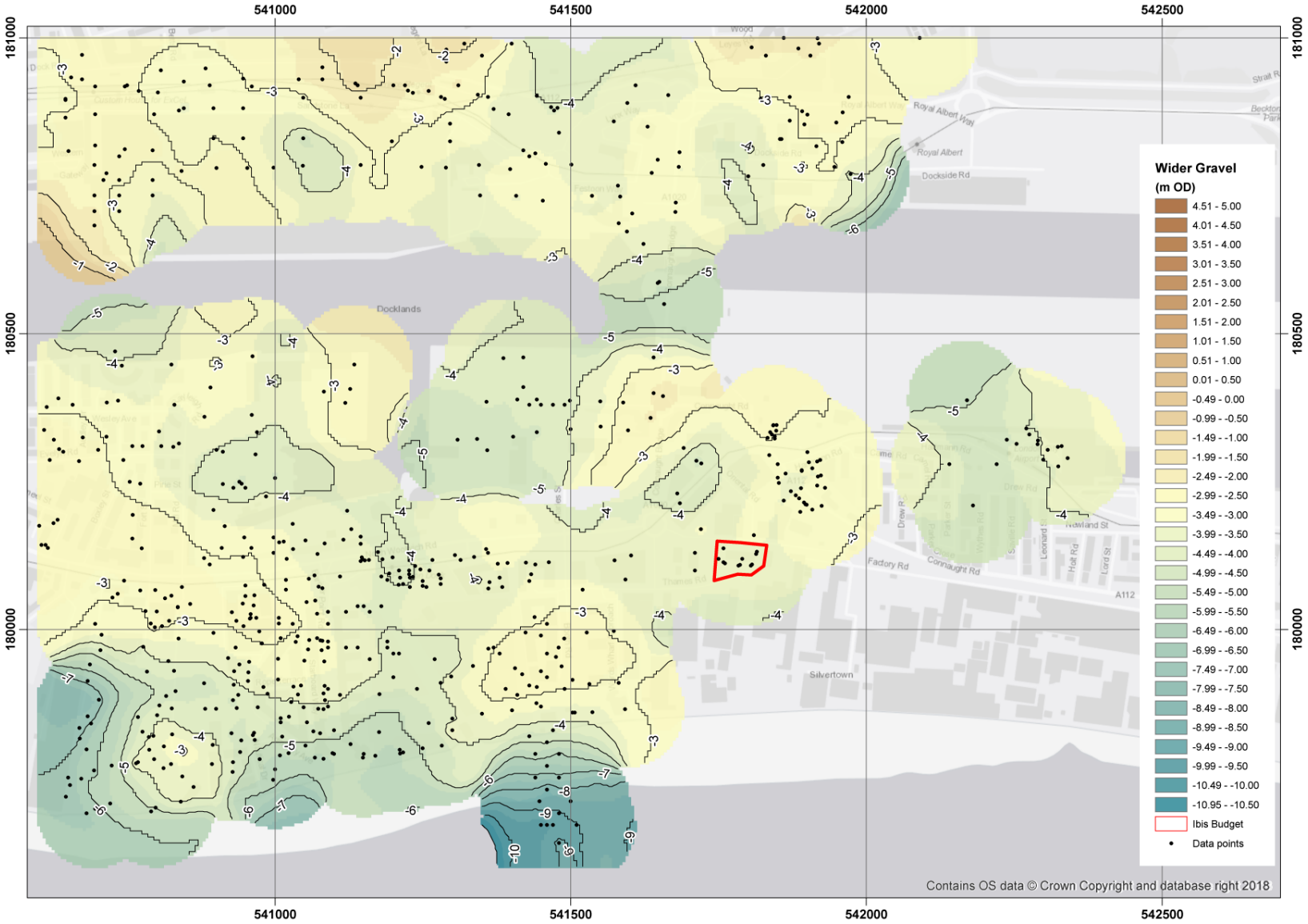

Figure 11: Surface of the Gravel (m OD) in the wider area of the site, utilising data from the Quaternary Scientific Lower Thames Valley Geoarchaeological Database. See Figure 1 for selected site locations.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the new geoarchaeological investigations at the Ibis Budget site have contributed to our understanding of the sub-surface stratigraphy underlying the site, and in particular the level of the Shepperton Gravel surface. In contradiction to the MoLAS (2002) investigations, no Gravel 'highs' were identified underlying the site; the highest Gravel surface identified here was -3.9m OD. As a result, the prehistoric archaeological potential of the Gravel surface is considered to be very low, and no soil horizons associated with a higher Gravel surface can be expected at the site (and were not identified during the monitoring of two new geotechnical boreholes).

The palaeoenvironmental potential of the alluvial sequence is considered to be high, since a thick peat horizon was identified at levels between *ca*. -0.5 and -3.5m OD. However, this peat horizon was investigated during the previous work undertaken by MoLAS (2002). Although the levels in the MoLAS (2002) report are considered here to be incorrect, the peat was radiocarbon dated to the early Neolithic (4370 to 3960 cal BC) to middle Bronze Age (1520 to 1200 cal BC). On the basis of existing palaeoenvironmental data from sites nearby and where the peat is of a similar age, including at London City Airport (Young *et al*., 2018), and those forthcoming from the Former Camel Works site (in prep.), no further palaeoenvironmental assessment of the sequence at the Ibis Budget site is recommended.

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8. OASIS FORM

OASIS ID: quaterna1-332300

Project details

Project name	Ibis Budget, North Woolwich Road
Short description of the project	A programme of geoarchaeological fieldwork and deposit modelling was undertaken at the Ibis Budget site in order to (1) clarify the nature of the sub-surface stratigraphy across the site, including the depth, thickness and extent of the major stratigraphic units; and (2) to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs. The results of the deposit modelling indicate that the sediments recorded at the site are similar to those recorded elsewhere in this area of the Lower Thames Valley, with Late Devensian Shepperton Gravel overlain by a sequence of Holocene alluvial sediments, including peat, and buried beneath modern Made Ground. In contradiction to the MoLAS (2002) investigations, no Gravel 'highs' were identified underlying the site; the highest Gravel surface identified here was -3.9m OD. As a result, the prehistoric archaeological potential of the Gravel surface is considered to be very low, and no soil horizons associated with a higher Gravel surface can be expected at the site (and were not identified during the monitoring of two new geotechnical boreholes). The palaeoenvironmental potential of the alluvial sequence is considered to be high, since a thick peat horizon was identified at levels between ca. -0.5 and -3.5m OD. However, this peat horizon was investigated during the previous work undertaken by MoLAS (2002). Although the levels in the MoLAS (2002) report are considered here to be incorrect, the peat was radiocarbon dated to the early Neolithic (4370 to 3960 cal BC) to middle Bronze Age (1520 to 1200 cal BC). On the basis of existing palaeoenvironmental data from sites nearby, including at London City Airport (Young et al., 2018), and those forthcoming from the Former Camel Works site (in prep.), no further palaeoenvironmental assessment of the sequence at the Ibis Budget site is recommended.
Project dates	Start: 01-03-2018 End: 31-10-2018
Previous/future work	Yes / Not known
Any associated project reference codes	NWH01 - Sitecode

Any associated project reference codes	IBS18 - Sitecode
Type of project	Environmental assessment
Survey techniques	Landscape

Project location

Country	England
Site location	GREATER LONDON NEWHAM NEWHAM Ibis Budget, North Woolwich Road
Postcode	E16 2EE
Study area	0.43 Hectares
Site coordinates	TQ 4180 8013 51.501789788465 0.043227495109 51 30 06 N 000 02 35 E Point

Project creators

Name of Organisation	Quaternary Scientific (QUEST)
Project brief originator	RPS
Project design originator	D.S. Young
Project director/manager	D.S. Young
Project supervisor	D.S. Young
Type of sponsor/funding body	Developer

Project archives

Physical Archive Exists?	No
Digital Archive Exists?	No

Paper Archive recipient	LAARC
Paper Contents	''Environmental'',''Stratigraphic''
Paper Media available	''Report''
Entered by	Daniel Young (d.s.young@reading.ac.uk)
Entered on	31 October 2018