Morden Bog
NNR Decoy Pond

Palaeoenvironmental Assessment Report

Document Ref.: 273310.04
August 2023

wessexarchaeology

Portway House
Old Sarum Park
Salisbury
SP4 6EB

www.wessexarch.co.uk

Wessex Archaeology Ltd is a company limited by guarantee registered in England, company number 1712772. It is also a Charity registered in England and Wales number 287786, and in Scotland, Scottish Charity number SC042630. Our registered office is at Portway House, Old Sarum Park, Salisbury, Wiltshire, SP4 6EB

Document Information

Document title	Morden Bog National Nature Reserve (NNR) Decoy Pond, Decoy Heath, Wareham, Dorset
Document subtitle	Palaeoenvironmental Assessment Report
Document reference	273310.04
Client name	Natural England
Address	Horizon House Deanery Road Bristol BS1 5AH
Site location	Morden Bog Bere Road Wareham Dorset BH20 7PA
County	Dorset
National grid reference	391322 091340 (SY 913 913)
Statutory designations	Scheduled Monument No. SM 33168, HA 1016916 Dorset Heath Ramsar Morden Bog and Hyde Heath SSSI Dorset Heaths (Purbeck and Wareham) Special Area of Conservation Dorset Heathlands Special Protection Area
Planning authority	Dorset Council
WA project name	Morden Bog NNR Decoy Pond
WA project code	273310
Dates of fieldwork	28/04/23 – 20/04/23
Fieldwork directed by	Jon Badger
Project management by	Dr Daniel Young
Document compiled by	Dr Daniel Young
Contributions from	Dr Inés López-Dóriga, Dr Ed Treasure, Dr Tom Hill, Dr Nigel Cameron, Professor Neil Rose and Jon Badger
Graphics by	Nancy Dixon

Quality Assurance

Issue number & date		Status	Author	Approved by
1	11/08/2023	First draft	DSY	ADB

Contents

List of Figures

List of Tables

Summary

A targeted geoarchaeological borehole survey was undertaken in and around the Decoy Pond at Morden Bog National Nature Reserve (NNR), Decoy Heath, Wareham. The geoarchaeological borehole survey and palaeoenvironmental assessment were undertaken to provide further information on the archaeological and palaeoenvironmental potential of the deposits in the area of the pond that may be impacted by the proposed restoration, and to provide recommendations for further work, where appropriate. A total of 28 hand auger boreholes were undertaken using a Russian corer. Borehole WA-25a was selected as the master sequence for palaeoenvironmental assessment. A second borehole, WA-10a, was also radiocarbon dated for chronological comparison against the deposits in WA-25a.

The sequence of deposits at the Site comprised well preserved plant remains in a peaty matrix, overlying humified peat, in turn overlying coarse Sands. These Sands are considered likely to represent fluvial deposits of either Upper Pleistocene or early Holocene date, and form the topographic template upon which the organic deposits of Holocene age accumulated. The organic deposits are widespread both within and outside of the pond, and form part of the sequence that has accumulated during the Holocene in a stream valley draining south towards the River Piddle. No basal (e.g. clay) lining to the pond was identified during the borehole survey, and on the basis of the expected age of the underlying Sands, it is considered unlikely that a lining was used in the construction of the pond.

There is a general decline in the surface elevation of the Sands from a level of c. 8.3 m OD in the west to c. 7.4 m OD in the east; in the area of the pond, a depression in the surface of these Sands is evident to a level of c. 7.8 m OD. How the surface of these Sands relates to the pond is currently unclear; it may relate to a natural feature, perhaps associated with a broadly north-south aligned early Holocene palaeochannel, the surviving topography of which may have been exploited during the construction of the pond; alternatively, construction of the pond may have resulted in a cut in to these Sands to a level of c. 7.8 m OD, the overlying material having accumulated within this feature. The combined results of the palaeoenvironmental assessment and scientific dating, including radiocarbon dating and the analysis of Spheroidal Carbonaceous Particles (SCPs) and provisional age modelling for the deposits, have helped to test these hypotheses.

SCPs were observed in every analysed sample (at levels between 0.40 and 0.68 m bgl) suggesting that this part of the sequence post-dates the mid-19th century. A marked increase in SCP concentration observed at 0.48 m represents a date at, or close to, 1950 AD. However, on the basis of the radiocarbon dating, there is significant uncertainty as to the age of the deposits in the lower part of the sequence. The basal samples, derived from the lower peat unit and overlying silty peat, are typified by the presence of pine and birch, in addition to heathland shrubs and aquatic taxa, likely forming in wet heath or valley bog, adjacent to dry heath.

Borehole WA-25a recorded a stratigraphic boundary at 0.98m, where a silty peat is overlain by a peat rich in organic remains. The palynological assessment has also identified a shift in the pollen signal at this boundary. Those samples derived from *above* 0.98 m bgl contain a more diverse arboreal signal, along with an abundance of charcoal within the upper sample from the silty peat, to infer the potential for allochthonous input (e.g. fires) prior to the onset of peat development above this unit. Isolated grains of beech are also recorded above 0.59m bgl, and the presence of likely cereal pollen above 0.52m bgl. The presence of beech provides a *maximum* age of c. 3000 BP for the uppermost samples. Diatoms were absent from the bottom three samples of core WA-25a (below c. 0.98 m bgl). Above this level, the diatom assemblage is indicative of acid, oligotrophic, shallow water habitats; the diversity of acidophilous, acidobiontic and other non-planktonic taxa in the top samples suggest that the sediments are derived from pond sediments rather than diatoms from the mire surface preserved in the peat.

On the basis of these results, the pollen and diatom assessments are indicative of a transition in the sediments at 0.98 m bgl, at the interface between the humified peats and the poorly humified plant remains that may relate to a transition from peat associated with the naturally forming valley bog/wet heath to deposits forming within the decoy pond. Further refinement to the age model for WA-25a, in the form of additional SCP analysis below 0.70 m bgl and additional radiocarbon dating in the lower part of the sequence (below 0.98 m bgl) may help to refine our understanding of the chronology of the sequence and to test these biostratigraphic boundaries. Recommendations for any further palaeoenvironmental analysis should be made on the basis of these results.

Acknowledgements

Wessex Archaeology thanks Steve Hall of Natural England for commissioning the work detailed in this report. We are grateful to both Steve Hall and Nate Evans for their support with arranging the fieldwork and for assistance at the site. The fieldwork was managed on site by Jon Badger. Deposit modelling was undertaken by Dr Daniel Young. The report was compiled by Dr Daniel Young and reviewed by Dr Alex Brown. Figures were produced by Nancy Dixon. The project was managed on behalf of Wessex Archaeology by Dr Daniel Young.

Morden Bog National Nature Reserve (NNR) Decoy Pond, Decoy Heath, Wareham, Dorset

Palaeoenvironmental Assessment Report

1 INTRODUCTION

1.1 Project and planning background

1.1.1 Wessex Archaeology has been commissioned by Natural England ('the client') to undertake a geoarchaeological borehole survey and palaeoenvironmental assessment at the Morden Bog National Nature Reserve (NNR) Decoy Pond, Decoy Heath, Wareham, Dorset (the 'Site'). The Site is centred on National Grid Reference (NGR) 391322 091335 (SY 91322 91335) (**Figure 1**).

1.1.2 The proposed development works comprise the restoration of the decoy pond and associated overnight shelter on Decoy Heath, part of Morden Bog NNR. The decoy pond and associated overnight shelter is a designated Scheduled Monument (SM 33168, HA 1016916). The aim of the restoration is to prevent further deterioration and to ensure suitable future management, and to have them both removed from the Historic England At Risk Register (Natural England 2022). The borehole survey was undertaken under Scheduled Monument Consent (S00243850).

1.1.3 Natural England requires an assessment of the geoarchaeological potential of any surviving waterlogged deposits formed in the decoy pond after its construction in 1724 (Natural England 2022). Geoarchaeological potential is defined as the possibility for deposits that preserve paleoenvironmental evidence and/or dating evidence relevant for contextualising historical and archaeological significance.

1.2 Scope of works

1.2.1 This borehole survey follows on from an Archaeological Survey and Condition Assessment produced by Oxford Archaeology in 2022 (Oxford Archaeology 2022). The Condition Assessment and Archaeological Assessment produced by Oxford Archaeology (Oxford Archaeology 2022) identified specific research questions for further investigation of the decoy pond:

1.2.2 The geoarchaeological borehole survey and palaeoenvironmental assessment will provide further information on the archaeological and palaeoenvironmental potential of the deposits in the area of the pond that may be impacted by the proposed restoration, and facilitate an informed decision with regard to the requirement for, and methods of, any further archaeological and geoarchaeological work that may be required, including palaeoenvironmental analysis.

1.2.3 Following the scope outlined within the Written Scheme of Investigation (WSI; Wessex Archaeology 2023), the works reported on here comprised:

- An initial survey comprising a total of 28 no. hand auger holes using a Russian (J-section) corer to assess the character and depth of deposits across the decoy pond; and

- Recovery of targeted cores using a Russian (J-section) corer for detailed sediment description and subsequent laboratory assessment, informed by the results of the hand auger survey;
- Geoarchaeological deposit modelling, illustrating the character of the sedimentary sequence across the decoy pond;
- Palaeoenvironmental assessment and scientific dating of the deposits; and
- Reporting on the results, with recommendations for any further work.

1.3 Location, topography and geology

1.3.1 The Site covers an area of 0.45 ha and is located at Morden Bog National Nature Reserve (NNR), one of the largest valley mire habitats in England comprised of dry and wet heathland. Located to the west of Poole Harbour, the Site is bounded by the River Sherford to the north, Morden Road to the west and is located close to the route of the Sika trail cycling route.

1.3.2 The Site comprises open heathland and bogs, supporting rare and unique English wildlife and some of the oldest heather plants in Dorset (Oxford Archaeology 2022). The modern topography of the Site reflects its position on the western edge of a north-south lowland valley located between the rivers Sherford to the north and Piddle to the south. The pond itself lies at an elevation of approximately 38m OD (Ordnance Datum). In comparison, the valley floor forming the main wetland area of Morden Bog lies at a level of around 9m OD.

1.3.3 The underlying bedrock geology across the Site is mapped by the British Geological Survey (BGS) as sand of the Poole Formation (**Figure 1**), a sedimentary unit formed during the Palaeogene Period (56.0 to 41.2 million years ago (Mya)). Deposits of the younger Oakdale Clay Member are mapped immediately to the west of the pond, also formed during the Palaeogene (23.03 to 28.1 Mya).

1.3.4 Superficial deposits of Alluvium are mapped by the BGS in the area of the pond (**Figure 2**), comprising Holocene clays, silts and sands formed within a stream valley draining south towards the River Piddle. Deposits of Head, described as clay, silt, sand and gravel, are mapped to the west of the Site, likely comprising sediments of Pleistocene and/or Holocene date and formed by slope-wash or downslope creep on the side of the valley.

1.3.5 These superficial geological deposits likely form the sediments into which the decoy pond was cut, and will likely be visible in the sedimentary sequences underlying the deposits of the decoy pond itself.

1.3.6 Within the pond, deposits likely comprising silts and clays formed under stagnant or slow-moving water may have accumulated, along with organic detritus or organic muds associated with the decay of aquatic and riparian plants growing within or adjacent to the pond. The sediments within the pond may also comprise colluvial and alluvial deposits associated with the wider catchment in which the Site is located, potentially comprising a range of deposits of variable texture (clays, silts, sands and gravels) and of variable source area.

1.3.7 Where continuously waterlogged deposits (including peaty or organic-rich sediments) have accumulated in-situ, these will be of high palaeoenvironmental potential and may preserve archaeological and environmental evidence relating to the use of the pond and the wider landscape. As outlined by Natural England (2022), the sediments that have accumulated

within the decoy pond may date from its construction in 1724, with a continuous build-up of sediment thereafter, unless the pond management strategy included any drainage or dredging in the years between construction and when it ceased to be used as a decoy pond in 1856.

2 AIMS AND OBJECTIVES

2.1.1 The aims and objectives of the borehole survey and palaeoenvironmental assessment follow those outlined within the WSI (Wessex Archaeology 2023) and are presented below.

2.2 Overarching aims

2.2.1 The general aims (or purpose) of the borehole survey, in compliance with the CIfA *Standard and guidance for archaeological field evaluation* (CIfA 2020), were:

- to provide information about the archaeological and geoarchaeological potential of the deposits at the Site;
- to consider the possible significance of any archaeological and geoarchaeological evidence present, or potentially present, in the context of national and regional research priorities and agendas (e.g. South West Archaeological Research Framework (SWARF; Webster 2008), and
- inform the scope and nature of any further archaeological and geoarchaeological work that may be required, including palaeoenvironmental analysis.

2.3 Overarching objectives

2.3.1 The specific objectives of the geoarchaeological borehole survey and palaeoenvironmental assessment were as follows:

- To record the sequence of superficial deposits across the decoy pond, and obtain core samples of deposits suitable for paleoenvironmental assessment (where appropriate);
- To undertake deposit modelling of the data arising from the borehole survey, in order to map the extent, thickness and depth of deposits within the pond;
- Determine the importance of the deposits with regard to their archaeological and geoarchaeological (including palaeoenvironmental) potential and devise a strategy for their assessment and scientific dating;
- To assess the potential of the deposits to address the specific objectives outlined in Oxford Archaeology (2022) (see **Section 1.1**);
- To undertake targeted palaeoenvironmental assessment and scientific dating of those deposits; and
- Make specific recommendations for further work, where appropriate, which may include additional palaeoenvironmental analysis and/or scientific dating.

2.4 Site-specific objectives

2.4.1 Following consideration of the archaeological and geoarchaeological background to the Site and a review of the Request for Quotation produced by Natural England (2022), the following site-specific objectives of the evaluation have been identified:

- To consider how the recovered data can add to the history of the decoy pond and the surrounding landscape during its period of use;
- To consider what the sediment sequence can tell us about the management of the pond during its period of use;
- To clarify the types of vegetation surrounding the pond, with reference to those documented during the time of construction;
- To determine the importance of the deposits, and how they relate to whether water flow within the pond was maintained;
- To understand the extent of the pipes and their sedimentary sequence and palaeoenvironmental potential, particularly from the perspective of historic management of the decoy pond;
- To understand the form and break of slope of the decoy pond, as well as depth; and
- To determine how the evidence can inform questions about the future water management of the pond for and following its restoration.

3 METHODS

3.1 Introduction

3.1.1 Health and safety override archaeological considerations in all works since, as stated in CIfA guidance, *Health and Safety regulations and requirements cannot be ignored no matter how imperative the need to record archaeological information; hence Health and Safety will take priority over archaeological matters* (CIfA 2020, 11). All works were undertaken in accordance with the detailed methods set out within this WSI (Wessex Archaeology 2023).

3.2 Geoarchaeological borehole survey

3.2.1 All boreholes were set out using GNSS in the positions shown in **Figure 3**. The borehole locations were tied in to the Ordnance Survey (OS) National Grid and Ordnance Datum (OD) (Newlyn), as defined by OSGM15 and OSTN15. The borehole survey was undertaken in two stages:

- An initial survey comprising a total of 28 no. hand auger holes using a using a Russian (J-section) corer to assess the character and depth of deposits across the decoy pond and pipes (**Figure 3**);
- Recovery of targeted cores using a Russian (J-section) corer for detailed sediment description and subsequent laboratory assessment, with locations for sampling informed by the results of the hand auger survey.

3.2.2 The fieldwork was carried out under the supervision of an experienced geoarchaeological specialist. A total of 28 boreholes (WA01-WA-29; WA15 descoped) were put down at the locations shown in **Figure 3**. The final locations of the boreholes were adjusted based on accessibility and safety precautions associated with deep water and very soft sediment in some areas of the pond (particularly in the centre and at drain locations).

3.2.3 At each borehole location 0.5m lengths of core sample were extracted using a Russian corer. Selected samples (BH3a, BH10a, BH20a, BH24a and BH25a) were retained in sleeved plastic liners and were sealed and marked with the project number, site number, borehole number and sample depth and returned to the Wessex Archaeology laboratory for later description.

3.2.4 Sampled sequences were excavated using the Russian corer, with a 10cm overlap between samples in order to better capture unit boundaries. The boreholes were excavated to maximum depths of between 0.79 and 2.00 m bgl.

3.2.5 The geoarchaeologists recorded and interpreted the sequence of deposits encountered in the boreholes order to allow assessment of likely palaeoenvironmental potential.

3.3 Sediment description

3.3.1 The boreholes were recorded using Wessex Archaeology's pro-forma digital recording system. For each stratigraphic unit descriptions and interpretations of the deposits are provided. Descriptions of deposits included information such as:

- *Depth*
- *Texture*
- *Composition*
- *Colour*
- *Inclusions*
- *Structure*
- *Shape and nature of contacts between deposits*

3.3.2 Interpretations included, where possible, probable depositional environments and formation processes.

3.3.3 A full photographic record was made using a digital camera equipped with an image sensor of not less than 10 megapixels. This recorded both the detail and the general context of the principal lithological and stratigraphic features, and the evaluation area as a whole.

3.3.4 Digital images were subject to managed quality control and curation processes which will embed appropriate metadata within the image and ensure long term accessibility of the image set. Photographs were taken of all areas, including access routes, to provide a record of conditions prior to and on completion of the borehole survey.

3.4 Survey

3.4.1 The real time kinematic (RTK) survey of all boreholes was carried out using a Leica GNSS connected to Leica's SmartNet service. All survey data was recorded in OS National Grid coordinates and heights above OD (Newlyn), as defined by OSGM15 and OSTN15, with a three-dimensional accuracy of at least 50 mm.

3.5 Deposit modelling

3.5.1 A series of geoarchaeological deposit models were constructed for the site using a total of 28 stratigraphic records arising from the borehole survey. The deposit modelling was undertaken following the guidelines in Historic England (2020).

3.5.2 All available data points were entered into industry standard geological utilities software (RockWorks™ 23). Each stratigraphic unit was given a colour and pattern allowing cross correlation and grouping of the different sedimentary units. The grouping of these deposits is based on lithological descriptions, which define distinct depositional environments referred to as 'stratigraphic units'. To aid interpretation of the deposits present at the Site,

a combination of both stratigraphic unit (e.g. 'Sand') and lithostratigraphic unit (e.g. 'sandy peat') was used in the deposit modelling.

3.5.3 Sedimentary units from the boreholes were classified into six main units: (1) Sand, (2) Sandy silt, (3) Peaty sand, (4) Sandy peat, (5) Clayey peat and (6) Plant material in peat matrix. The classified data for groups 1 to 6 were then input into a database within the RockWorks 23™ program.

3.5.4 Two-dimensional stratigraphic profiles ('transects') of selected interventions across the Site were generated showing the main stratigraphic units and their lateral and vertical variability across the Site. These include one east-west transect (**Figure 4**) and two north-south transects (**Figures 5** and **6**). The location of these transects is shown in **Figure 3**. A model of the surface height of the Sand was also generated using an inverse-distance weighted (IDW) algorithm (**Figure 7**).

3.5.5 Where data points are not uniformly distributed over the area of investigation the reliability of the models is variable. To account for this, the modelling algorithm has been adjusted to include a maximum distance cut-off filter, so that only those areas for which sufficient stratigraphic data is present will be included in the model. A maximum distance cut-off filter equivalent to a 25 m radius around each data point is applied to the models from the present Site.

3.5.6 The key aims of the modelling were to interpret the data, identify the probable depositional environments represented, and determine areas of higher and/or lower geoarchaeological potential where further work may be required (e.g. deposits with potential for the recovery of significant archaeological and palaeoenvironmental remains).

3.6 Macrofossil assessment

3.6.1 Nine subsamples from two boreholes (WA-10a and WA-25a) were processed for the recovery and assessment of palaeoenvironmental evidence. The aim of the assessment was to undertake a plant macrofossil assessment, and to provide material for radiocarbon dating.

3.6.2 The subsamples were around 20 ml in volume and they were processed by wet sieving using a 0.125 mm mesh. After processing, the samples were kept wet and stored in a refrigerated unit prior to assessment. All remains extracted for radiocarbon dating were stored in sealed glass containers with a small volume of de-ionised water and refrigerated to limit any fungal growth or degradation of the material.

3.6.3 The samples were rapidly scanned using a stereomicroscope at up to 40x magnification for uncharred and charred botanical remains, including organic/vegetative material, herbaceous epidermal tissues, wood remains, mosses, and plant macroremains ('seeds'), as well as other material (e.g., insects/invertebrates, molluscs, etc.). Plant macroremains were identified through comparison with modern reference material held by Wessex Archaeology and relevant literature (Cappers *et al.* 2006). Selected wood fragments were identified through examination of the transverse, tangential longitudinal, and radial longitudinal sections at up to 400x magnification. Wood identifications were undertaken through comparison with Wessex Archaeology's reference collection and relevant literature (Gale and Cutler 2000; Hather 2000; Schweingruber 1990). Nomenclature follows Stace (1997), with additional habitat information taken from Preston *et al.* (2002). For simplicity, the term 'seed' is used to refer to different types of plant macroremain (e.g., achene, fruit etc.)

3.6.4 Remains were recorded semi-quantitatively on an abundance scale: C = <5 ('Trace'), B = 5-10 ('Rare'), A = 10-30 ('Occasional'), A* = 30-100 ('Common'), A** = 100-500 ('Abundant'), A*** = >500 ('Very abundant/Exceptional').

3.7 Radiocarbon dating

1.1.1 Following the macrofossil assessment, suitable samples for radiocarbon dating were selected. Two samples for radiocarbon dating were submitted to assess the age of the deposits, and to examine how they relate to the construction and infilling of the pond.

3.7.1 A list of suitable material for radiocarbon dating was provided for each sample assessed, with all extracted material stored in sealed glass containers with de-ionised water in a refrigerator.

3.7.2 The radiocarbon dating samples were selected following Historic England's guidance outlined in *Radiocarbon Dating and Chronological Modelling: Guidelines and Best Practice* (Bayliss and Marshall 2022). This took into account stratigraphic and technical criteria, such as the nature of the available material for radiocarbon dating, and any potential for age-offsets (e.g., freshwater reservoir effect). The association between the samples and the event aimed to be dated, following was assessed following Waterbolk (1971). Stems and rhizomes of *Phragmites australis* (Common reed) were avoided for radiocarbon dating since these can be significantly younger that the associated sediment. Single-entity samples from short-lived terrestrial species were selected as the first choice for radiocarbon dating.

3.7.3 The samples were submitted to the 14CHRONO Centre, Queen's University, Belfast (UBA), where they were treated with Acid/AAA (Acid-Alkali-Acid) and the measurements were corrected using AMS $\delta^{13}C$ values. Further detail is given in 14Chrono (2019).

3.7.4 All radiocarbon measurements are given following international conventions (Bayliss and Marshall 2022; Millard 2014) as radiocarbon ages - uncalibrated years before present (BP) or $F^{14}C$ – together with the laboratory code, and the calibrated and modelled date-ranges (in calendar years cal. AD). The age ranges were calculated with OxCal 4.4 (Bronk-Ramsey 2009) using the IntCal20 curve (Reimer *et al*. 2020) or the Bomb21NH1 (Hua *et al*. 2022). Calibrated dates are given at 95% confidence, with the end points rounded out to the nearest 10 years; modelled date ranges (posterior density estimates) given in italics at 68% confidence, with the end points rounded out to the nearest 5 years. These are taken from the Poisson deposition models (Bronk Ramsey 2008, Bronk Ramsey and Lee 2013) given in **Figures 9** and **11**. Calibrated dates are given in grey outline in the figures, modelled dates in black.

3.8 Spheroidal Carbonaceous Particles (SCPs)

3.8.1 Spheroidal carbonaceous particles (SCPs) are a component of fly-ash, the particulate by-product of industrial high temperature combustion of fuel-oil and coal series fuels. SCPs are composed of elemental carbon making them resistant to chemical attack and they are morphologically distinct under the light microscope (Rose 2008). These properties allow SCPs to be stored within and extracted from natural archives such as lake and marine sediments, peat sequences etc., and make them unambiguous environmental indicators of emissions to, and deposition from, the atmosphere after transport from these industrial sources.

3.8.2 Furthermore, the scale of SCP emission makes these particulates a clear signal of great stratigraphic utility representing a primary driving force (fossil-fuel combustion) for global anthropogenic change. As a consequence, the stratigraphic records of SCPs in natural

archives have been widely used to provide chronological information (e.g., Rose et al. 1995; Yang et al., 2001; Rose & Appleby 2005; Swindles 2010) and it has been suggested that SCPs may provide a useful marker for a mid-20th century Global Stratigraphic Section and Point (GSSP) for the proposed Anthropocene Epoch (Rose 2015; Swindles et al. 2015).

3.8.3 Sediment material from 15 levels between 0.40 m and 0.68 m bgl in borehole WA-25a were submitted for SCP analysis. Samples were supplied at 0.02 m intervals throughout this sediment sequence.

3.8.4 Sediment samples were analysed for SCPs following the method described in Rose (1994). Dried sediment was subjected to sequential chemical attack by mineral acids to remove unwanted fractions leaving a suspension of mainly carbonaceous material and a few persistent minerals in water. SCPs are composed mostly of elemental carbon and are chemically robust. The use of concentrated nitric acid (to remove organic material), hydrofluoric acid (siliceous material) and hydrochloric acid (carbonates and bicarbonates) therefore does them no damage. As the samples from Morden Bog were particularly organic-rich, the nitric acid stage was repeated. A known fraction of the final suspension was evaporated onto a coverslip and mounted onto a microscope slide. The number of SCPs on each coverslip was counted using a light microscope at x450 magnification and the sediment concentration calculated in units of 'number of particles per gram dry mass of sediment' (gDM^{-1}).

3.8.5 The criteria for SCP identification under the light microscope followed Rose (2008). The detection limit for the technique is typically c. 100 gDM^{-1} although detection limits were slightly higher in this Morden Bog core (typically 100 - 300 gDM^{-1}). SCP counts were sub-divided into size classes whilst counting. Analytical blanks and SCP reference material (Rose 2008) were also included in the analysis. The SCP concentration in the reference sample (6097 gDM^{-1}) agreed closely with expected values (6005 ± 70 gDM^{-1}) while no SCPs were observed in the blank. SCP concentrations calculated from this procedure typically have an accuracy of c. ± 45 gDM^{-1} (Rose 2008).

3.9 Pollen assessment

3.9.1 A total of 12 samples were submitted for pollen assessment from borehole WA-25a. Pollen preparation will vary depending on the organic/minerogenic content of each sample. Preparations were undertaken at The Department of Geography, University of Liverpool, broadly following the methodology outlined by Campbell et al (2016), to include (1) sampling a standard volume of sediment; (2) adding one tablet of the exotic clubmoss Lycopodium clavatum to provide a measure of pollen concentration in each sample; (3) treatment with hydrochloric acid and potassium hydroxide to remove carbonates and humic acids respectively (4) sieving of the sample to remove coarse mineral and organic fractions (>180µm); (5) removal of finer minerogenic fraction (using sodium pyrophosphate); (6) density separation (sodium polytungstate); (7) acetolysis and (8) mounting of the sample in glycerol jelly and onto microscope slide.

3.9.2 Upon completion of preparation, a standard assessment of potential requires either a total of 10 microscope slide traverses to be undertaken, or a count of at least 100 total land pollen grains (TLP), excluding aquatics and spores (whichever comes first). During assessment, comments of other visible microfossil features (charcoal, pre-Quaternary pollen and spores, other identifiable non-pollen palynomorphs such as dinoflagellate cysts, testate amoebae etc) are also provided, if encountered.

3.10 Diatom assessment

3.10.1 A total of seven samples through the sequence of silty peats in borehole WA-25a were selected for diatom assessment. The diatom assessment considers the numbers of diatoms, the state of preservation of the diatom assemblages, species diversity, diatom species environmental preferences and the potential of the sediments for further diatom analysis.

3.10.2 Diatom preparation and assessment followed standard techniques (Battarbee et al. 2001). Diatom reports, floras and taxonomic publications were consulted to assist with diatom identification and to provide supporting data on diatom environmental preferences, these publications include Krammer & Lange-Bertalot (1986-1991), Camburn & Charles (2000), Stevenson et al. 1991 and ECRC internal documents.

4 RESULTS

4.1 Borehole survey and deposit modelling

4.1.1 This section summarises the results of the geoarchaeological borehole survey and deposit modelling. A total of 28 geoarchaeological boreholes were undertaken as outlined in **Section 3.3** and as shown in **Figure 3**. The results of the sediment descriptions of these boreholes are shown in **Appendix 1** and **2**, with the results of the deposit modelling presented in **Figures 4** to **7**.

4.1.2 The full sequence of sediments recorded during the borehole survey comprises:

- Upper peat (loose plant material within a peat matrix);
- Peat (including sandy and silty sub-units);
- Sand

4.1.3 More detail on the variability and composition of these deposits is described below.

Sand

4.1.4 Coarse sands were encountered as the basal unit in the majority of boreholes across the Site. In cases where boreholes refused without recording these deposits, the basal unit was considered likely to be coarse sands.

4.1.5 Retained samples and those described on-site describe the sand as clean, varying between grey, light grey and white. The grain size was coarse and contained little organic material with occasional rootlets. Traces of fine well-rounded gravel were present within the sand.

4.1.6 The surface of the Sand was higher in the west of the Site (see **Figure 7**), at around 8.26 m OD in WA-07, and falling to 7.90 m OD (WA-25) and 7.92 m OD (WA-01) in the centre of the site (towards the main body of the pond). The surface of the Sand falls below 7.5 m OD to the east of the pond. The depths at which sand was present within the boreholes varied between 0.75m bgl to 2.00m bgl.

4.1.7 The Sand underlying the organic deposits in the area of the pond are interpreted as fluvial deposits of a channel draining southwards towards the River Piddle, associated with the valley that drains Morden Heath and Decoy Heath reaching the Piddle c. 3 km to the southeast. These deposits are of unknown date, but may have accumulated during the Late Pleistocene or Early Holocene.

4.1.8 The palaeoenvironmental potential of the sand is considered to be low, although its surface has broad potential for the presence of earlier prehistoric or Upper Palaeolithic archaeology.

Peat

4.1.9 Peat was recorded in all boreholes across the Site, generally between 0.5 and 1.5 m thick and varying from firm to very soft, and including units of variably sandy, silty or clayey peat. Peat colouration also varied from black to brown depending on the degree of humification. Traces of modern plant material and preserved organic matter were identifiable within the peat and comprised rooting, bark and leaves, although in general the peat was soft, fine and relatively well humified.

4.1.10 Boreholes WA-24 and WA-28 contained a dark brown/black layer of peat with abundant, fine black wood or possibly charcoal fragments between 8.12 and 7.84 m OD.

4.1.11 The geoarchaeological potential of the peat is considered to be high due to the likely preservation of biological remains that are of high palaeoenvironmental and dating potential.

Upper peat

4.1.12 Plant material, consisting primarily of *Phragmites* stems and roots, as well as other plant remains including wood, leaves, stems and roots, dominated the upper part of the sequence in all boreholes, either beginning from the ground surface or below the water body. These deposits may represent modern and post-construction sediments infilling the pond; however, their relationship to the underlying peat is currently unclear.

4.1.13 Given the good preservation of these remains, which demonstrate a low level of decay, it is possible that they represent the upper, actively forming and decaying part of the peat body (the acrotelm).

4.2 Macrofossil assessment

4.2.1 The results of the palaeoenvironmental assessment of boreholes WA-10a and Wa-25a are summarised in **Table 1**. Varying quantities of waterlogged plant macroremains and wood fragments are present in the samples, together with occasional remains of invertebrates, notably *Daphnia* sp. (water-fleas) egg cases. Charred plant material, mainly <2 mm, is present in most of the samples.

WA-10a

4.2.2 All of the samples are primarily composed of *Sphagnum* sp. moss leaflets and stems. A near-complete leaf of *Myrica gale* (Bog myrtle) is recorded at 0.64–0.66 m bgl. A wider range of plant macroremains are present in the samples from 0.62–0.64m and 0.60–0.62 m bgl, including *Phragmites australis*-sized (Common reed) stems, deciduous tree leaf fragments, *Betula* sp. (Birch) fruits, and an *Erica* sp. (Heath) leaf fragment, as well as 'seeds' of *Potamogeton* sp. (Pondweeds), *Carex* sp. (Sedges) and *Juncus* sp. (Rushes). The fresh condition of many of the *Juncus* sp. seeds perhaps indicates that they are intrusive contaminants.

WA-25a

4.2.3 The samples taken between 0.98–1.00 m and 1.02–1.04 m bgl are mainly composed of fine rootlets and monocotyledon/herbaceous stems. Again, there are *Juncus* sp. (Rush) seeds although some of these could be intrusive contaminants.

4.2.4 Between 1.10–1.12 m and 1.12–1.14 m bgl there are a few seeds of aquatic species including *Potamogeton* sp. (Pondweeds) and *Menyanthes trifoliata* (Bogbean), as well as

Sphagnum sp. moss leaves and *Phragmites australis*-sized (Common reed) stems in the sample from 1.12–1.14 m bgl. The lowest sample assessed from 1.14–1.16m bgl contains a few twigs of Betulaceae (Birch family), which are probably from cf. *Betula* sp. (Birch).

Table 1 Results of the plant macrofossil assessment

Borehole	Sample depth (m bgl)	Sample vol. (ml)	Flot vol. (ml)	Sample composition
WA - 10a	0.60 - 0.62	20	15	Mainly *Sphagnum* leaflets/stems, occasional fine rootlets, rare deciduous tree leaf frags; Plant macroremains C - *Betula* sp. fruit (wings present), *Potamogeton* sp.; Charred material C, <2mm
	0.62 - 0.64	20	10	Mainly *Sphagnum* leaflets/stems and herbaceous/monocotyledon stems/rhizomes (inc. *Phragmites*-sized stems), some deciduous tree leaf frags and budscales; Plant macroremains A - *Betula* sp. seed, cf. *Acer* fruit/wing frag, Characeae oospores, *Carex* sp. seed, *Erica* sp. leaf frag, *Juncus* sp. seeds (fresh condition - modern?); Charred material A*, mainly <2 mm; Insects/invertebrates - *Daphnia* egg cases C
	0.64 - 0.66	20	5	Mainly *Sphagnum* leaflets/stems, some deciduous leaf frags (inc. near complete *Myrica gale* leaf)
WA - 25a	0.98 - 1.00	20	<5	Mainly fine rootlets, rare fragments of herbaceous/monocotyledon stems
	1.00 - 1.02	20	10	Mainly fine rootlets, rare fragments of herbaceous/monocotyledon stems; Plant macroremains A - *Juncus* sp. seeds (fresh condition - modern?); Charred material C, <2mm
	1.02 - 1.04	20	10	Mainly fine rootlets, rare fragments of herbaceous/monocotyledon stems; Charred material C, <2mm
	1.10 - 1.12	10	10	Mainly fine rootlets, rare fragments of herbaceous/monocotyledon stems and moss stems; Plant macroremains A - *Potamogeton* sp., *Menyanthes trifoliata*
	1.12 - 1.14	20	15	Mainly fine rootlets and herbaceous/monocotyledon stems (inc. *Phragmites*-sized stems and other species), rare *Sphagnum* leaves Plant macroremains B - *Potamogeton* sp.
	1.14 - 1.16	20	15	Mainly fine rootlets and herbaceous/monocotyledon stems; wood - twigs (cf. *Betula* sp.) pith to bark 3-4 mm diameter

4.3 Radiocarbon dating

4.3.1 The samples submitted for radiocarbon dating were successfully measured, providing modern results (**Table 2**).

Table 2 Radiocarbon dating results

Lab. ref	Sample details	Radiocarbon age	Calibrated date (95% probability)	Modelled date (68% probability)
UBA-50891	WA-10a 0.64–0.66 m bgl Waterlogged plant remain – *Myrica gale* (Bog myrtle) leaf x1	1.2845 ± 0.0038 $F^{14}C$	cal. AD 1959–1980 (1979–1980 56% probability)	-
UBA-50892	WA-25a, 1.14–1.16 m bgl Waterlogged wood – Betulaceae (cf. *Betula* sp.) twig, 3-4mm diameter, pith and bark present	77 ± 28 BP	cal. AD 1690–1920 (1810–1920 69% probability)	*cal. AD 1690–1835 (1690–1725 55% probability)*

4.3.2 The measurement from WA-10a (UBA-50891) from a subsample at depth of 0.64–0.65 m bgl suggests a relatively modern chronology (probably the 1960s and 1970s) for the upper part of the peat deposit in this borehole. However, it is also possible that the dated plant material is intrusive and has been introduced through bioturbation (e.g. *Phragmites australis* roots).

4.3.3 A slightly older measurement was obtained for WA-25a (UBA-50892). Peat deposits were recorded between 0.98–1.40 m bgl, with the measurement obtained from near the base of the deposit, at approximately 1.15 m bgl depth (UBA-50892: cal. AD 1690–1920). This result is relatively consistent with other chronological indicators, particularly the carbonaceous fly-ash particle (SCP) analysis results (see **Section 4.4**), which suggest at least the top 0.70m in core WA-25a is post-19th century, and 1950 likely at or near 0.48 m bgl.

4.3.4 The chronology of the sequence is discussed in more detail in **Section 5**, with age-depth models presented in **Figures 8** to **11**.

4.4 Spheroidal Carbonaceous Particles (SCPs)

4.4.1 SCP concentrations with 90% confidence intervals are presented in **Table 3**. **Figure 12** shows these SCP concentrations plotted against sediment depth (bgl) and the lithostratigraphy of WA-25a.

4.4.2 SCPs were found in all samples. SCP concentrations are low in the deepest samples and increase slowly from 0.58 m to 0.48 m bgl where there is a rapid increase through to the maximum observed concentration of almost 20,000 gDM^{-1} at 0.46 m bgl. Above this depth, concentrations are variable with a second peak of a similar concentration (c. 19,000 gDM^{-1}) at 0.42 m depth. This profile (at least up to the concentration peak) is typical of many SCP concentration profiles across the UK and Europe (e.g. Rose & Appleby 2005).

4.4.3 Data for the allocation of SCPs to size classes through the Morden Bog core are shown in **Appendix 3**. Most SCPs lie within the 10 – 50 µm size range which is again typical for UK sediment cores. The largest size class (50 – 75 µm) is found in every sample above 0.48 m inclusive, while a single SCP of this size range (representing 50% of the total at this depth) is also found at 0.58 m. Larger particles emitted to the atmosphere tend to travel shorter distances so these data may indicate 'new' SCP sources closer to the site above 0.58 m and especially above 0.48 m bgl.

Table 3 SCP concentration data with 90% confidence limits

Sediment depth (m bgl)	SCP conc. (gDM-1)	Upper 90% C.L. (gDM-1)	Lower 90% C.L. (gDM-1)
0.40	12014	13298	10729
0.42	18991	20598	17383
0.44	11453	12834	10071
0.46	19357	21325	17390
0.48	3804	4709	2900
0.5	2706	3590	1822
0.52	4250	5824	2676
0.54	1639	2246	1032
0.56	1073	1599	547
0.58	762	1291	234
0.60	446	754	137

0.62	415	702	127
0.64	308	610	6
0.66	330	653	7
0.68	1175	1840	510

Interpretation

4.4.4 SCPs were observed in every analysed sample suggesting that the whole sequence post-dates the mid-19th century as SCPs were only produced from this time. The marked increase in SCP concentration, observed here at 0.48 m, is common in natural archives across the UK (Rose & Appleby 2005), Europe and elsewhere around the world (Rose 2015) and represents a date at, or close to, 1950 AD. Following the Second World War there was a dramatic increase in the demand for electricity which, in the UK, was met by an increase in power station coal combustion as well as the introduction of oil-fired power stations for the first time. This increase seems to be unequivocal in this core.

4.4.5 Assuming that the whole sediment sequence is present and therefore that 0.4 m represents 2023 AD, when the core was taken, then a date of 1950 AD at 0.48 m gives an average sedimentation rate of 0.11 cm yr^{-1} over the uppermost 73 years. Although sedimentation rates may vary, sometimes considerably, this accumulation rate would place the SCP concentration peak (0.46 m) at c. 1970 AD which is in excellent agreement with the date ascribed for this part of the UK (Rose & Appleby 2005). However, extrapolating this sedimentation rate to the base of the sequence gives an age of around 250 years for 0.68 m which would be prior to start of SCP formation in the mid-19th century. The presence of SCPs at the base of this sequence could therefore imply a more rapid sedimentation rate between 0.48 m and 0.68 m. If the SCP record were to fall to 0 just below the sequence (i.e. at 0.70 m) then the mean sedimentation rate for this lower section of the core would need to be approximately 0.2 cm yr^{-1}. This interpretation assumes that no SCPs have been transferred from the upper higher concentration levels to the lower samples by natural movement (e.g., via the action of plant roots or bioturbation) or during the sampling process. The uncertainty around the completeness of the SCP record precludes the use of the cumulative percentile approach for providing additional dates (Rose & Appleby 2005).

4.4.6 An alternative interpretation could place the SCP peak (1970 AD) at 0.42 m. This would give a sedimentation rate of approximately 0.3 cm yr^{-1} for the period 1950 – 1970 (0.48 – 0.42 m). Extrapolating this higher sedimentation rate is more than sufficient for SCPs to be present at the base of the sequence. However, this would mean that the most recent 53 years (since 1970 AD) is represented by the uppermost 2 cm which would suggest a dramatic reduction in accumulation rate, a hiatus in accumulation in recent times, or a loss of the surface material.

4.4.7 The SCP size data indicates that continuous accumulation of larger SCPs occurred from 0.48 m onwards which would indicate the presence of industrial coal and / or oil-fired sources closer to Morden Bog. While an exhaustive documentary search has not been undertaken, it is noted that a coal-fired power station operated in Poole between 1950 and 1993 while further to the east, Fawley oil-fired power station operated from 1971 to 2013. An increase in SCP size at Morden Bog from 1950 AD may therefore be expected as a result of the commissioning and operation of these facilities and this would agree with 1950 AD occurring at 0.48 m. If so, the single larger SCP observed at 0.58 m could be a result of movement from upper, more contaminated levels as described above.

4.4.8 In summary, a ca. 1950 AD date for 0.48 m is considered reliable and, assuming the sequence is complete with similar accumulation rates over the most recent decades, shows

excellent agreement with a SCP concentration peak at 0.46 m dating to 1970 AD. This seems the most likely chronology. If so, the presence of SCPs through to the base of the sequence indicates either a higher average sedimentation rate in this earlier section or the movement of SCPs from more contaminated levels above.

4.5 Pollen assessment

4.5.1 A total of 12 samples were assessed from borehole WA-25a, with the three basal samples deriving from the lowermost herbaceous peat unit, two samples deriving from the silty peat unit, and the remaining seven samples deriving from the upper peat in which plant material was encountered in abundance. Pollen was encountered in the majority of samples in relatively high abundance, with only two samples not achieving an assessment count of 100 TLP (1.24 m bgl, 0.99 m bgl). Floral diversity was found to be moderate, mainly due to the dominance of certain taxa within each sample (discussed further below). **Appendix 4** summarises the results of the assessment.

Basal herbaceous peat

4.5.2 The three lowermost samples were derived from a peat unit described as a 'dark brown fibrous slightly silty fine herbaceous peat with root fibres throughout'. The middle sample, 1.24 m bgl, contained pollen in low abundance, but when present, broadly mirrored that encountered in the underlying (1.29 m) and overlying (1.19 m) samples and as such, will be discussed together. Arboreal pollen dominates, but is restricted in floral diversity. The assemblage is typified by *Pinus* (pine), supported by *Betula* (birch), with a shrub contribution from *Corylus-Myrica* type (hazel or sweetgale) and Ericaceae (heathers). Herbs are limited to Poaceae (wild grasses), Cyperaceae (sedges) and occasional grains of *Artemisia* (mugwort), in addition to isolated grains of *Filipendula* (meadowsweet), *Plantago* (plantains) and *Rumex* (docks and sorrels). Spores are dominated by an abundance of *Sphagnum* (moss), with only occasional spores of Pteropsida (monolete) undiff (ferns) and *Pteridium* (bracken) of note. Aquatics are rare, exemplified by occasional grains of *Menyanthes* (bogbean) and *Myriophyllum* (water milfoil). No other microscopic evidence was noted, except for occasional microcharcoal fragments in the sample of low pollen abundance (1.24b m bgl).

Silty Peat

4.5.3 Two samples (1.09 m, 0.99 m bgl) were derived from the upper and lower boundaries of a unit described as a 'black, fine silty soft peat'. Pollen was encountered in restricted numbers within the lower sample (1.09 m). However, the majority of grains encountered at this depth were encountered in the overlying sample 0.99 m bgl and as such will be discussed together. As with the underlying samples derived from the basal peat, arboreal pollen dominant, but again *Pinus* and *Betula* the only trees of note, whilst *Corylus-Myrica* type is encountered in high numbers, supported by occasional grains of Ericaceae. Herbs are once again restricted to occasional grains of Poaceae and Cyperaceae. Spores are encountered in much lower numbers than in the underlying unit, although once again *Sphagnum* is the most common. Similarly, aquatics are restricted to isolated grains of *Menyanthes*. Supporting microfossil evidence is restricted to an abundance of microcharcoal in the uppermost sample derived from the silty peat unit (0.99 m bgl). Grain crumpling and corrosion was also common within the uppermost sample from this unit.

Upper peat

4.5.4 Seven samples were derived from the upper peat unit, described as a peat unit with 'an abundance of fine rootlets' and was found to be full of plant remains with limited evidence of humification. The pollen assemblages were broadly similar throughout, but some

differences were encountered with height towards the top of the profile and will be commented on as appropriate.

4.5.5 The assemblages differ to that encountered below due to there being a much more diverse arboreal signal within the unit. In addition to *Pinus* and *Betula*, grains of *Alnus* and *Ulmus* are common, in addition to isolated grains of *Quercus*. Furthermore, the uppermost four samples (0.59-0.44 m bgl) contained isolated grains of *Fagus* (beech). Shrubs are once again typified by *Corylus*-*Myrica* type, present in higher numbers than encountered with depth, in addition to Ericaceae (the grains of which show some morphological variations to likely infer the presence of a number of species, including *Calluna* and *Erica* for example). Isolated grains of *Hedera helix* (ivy) and *Salix* (willow) were also noted.

4.5.6 Herbs follow a broadly similar trend to that encountered with depth, with Poaceae and Cyperaceae once again the most common, with occasional grains of other herbs such as *Rumex*, *Ranunculus* and *Plantago*, for example. It was also noted that within the uppermost three samples (0.52-0.44m bgl) larger grains (37µm) of Poaceae were occasionally encountered, likely representing cereal pollen. In addition, the uppermost samples contained a number of grains of a polyzonocolpate grain with a broadly acuminate obtuse grain shape, provisionally identified as *Utricularia* (bladderwort). Spores are once again typified by *Sphagnum*, although occasional spores of *Pteridium*, *Polypodium* (common polypody) and Pteropsida (monolete) undiff were also noted. Aquatics remain restricted and include *Myriophyllum*, *Sparganium emersum* type (e.g. bur reed) and *Hydrocotyle* (pennywort). Supporting microfossil evidence was restricted to occasional testate amoebae (e.g. at 0.52m and 0.44m depth) including *Difflugia* sp, and *Centropyxis* sp.

4.6 Diatom assessment

4.6.1 A summary of the diatom assessment is presented in **Table 4**. The diatom taxa and pH preferences of the diatom species are shown in **Appendix 5**.

Table 4 Summary of diatom assessment results for borehole WA-25a

Sample number and Depth (m bgl)	Diatoms	Diatom Numbers	Quality of preservation	Diversity	Assemblage type	Potential for % count
<1> 0.44	+	high	good	mod	Acid	good
<2> 0.59	+	high	good	mod	Acid	good
<3> 0.79	+	high	mod	mod	Acid	good
<4> 0.89	+	low	v poor	low	Acid	low
<5> 0.99	-	-	-	-	-	none
<6> 1.09	-	-	-	-	-	none
<7> 1.19	-	-	-	-	-	none

Key: mod – moderately well preserved; acid – acidophilous; aero – aerophilous; nonpk – non planktonic

4.6.2 Diatoms are absent from the three bottom samples in borehole WA-25a and are poorly preserved in sample <4> at 0.89 m bgl. It is possible that the bottom three samples represent the basal peat, that would probably have had diatom communities living on the contemporary surface, or that the aquatic environment of the pond was unsuitable for the long term preservation of diatom silica. Factors such as movement of water, under saturation of water with silica and possibly cycles of drying out and rehydration cause breakage and dissolution of diatom valves. Therefore, although living diatoms are common on bog surfaces, for example growing in peatland pools, and epiphytically on bryophytes, the fossil record is often lost from accumulating peat.

4.6.3 Diatoms are typically abundant in peatland pools (Kingston 1982). However, there is also significant loss of diatoms from the stratigraphic record in peatland environments. The absence or poor preservation of diatoms from the lower part of the core can be attributed to taphonomic processes. This is probably the result of silica dissolution caused by a combination of groundwater movement, possibly the extreme acidity, the under-saturation of water with dissolved silica and cycles of drying and rehydration (Flower 1993; Ryves *et al.* 2001).

4.6.4 In the top four samples there are non-planktonic acid water diatoms. In the top three samples these diatom assemblages have high numbers of valves with good or moderate preservation and moderate diversity. There is therefore good potential for percentage diatom analysis of the top three samples from 0.44 to 0.79 m bgl.

4.6.5 The diatoms taxa in the top three samples in WA-25a are all non-planktonic and represent shallow water habitats. The dominance of acid water taxa, associated with oligotrophic, brown water is notable. The most acidic, acidobiontic, diatoms are commonest in the top two samples. These acidobiontic diatoms are *Tabellaria quadriseptata* and *Brachysira serians*. The relative abundance of these extremely acid diatoms probably reflects post-industrial acidification and may also be reflected in the increasing concentrations of SCPs towards the top of the core.

4.6.6 The most diverse group of diatoms in the four diatomaceous samples at the top of the core are acidophilous species. These include *Achnanthes scotica, Brachysira vitrea, Fragilaria virescens* var. *exigua, Frustulia rhomboides* var. *saxonica, Tabellaria flocculosa, Tabellaria fenestrata, Pinnularia abaujensis, Pinnularia biceps, Pinnularia microstauron, Eunotia* sp. including *Eunotia incisa, Eunotia rhomboidea* and *Eunotia naegelii* (see **Appendix 5**). Other circumneutral taxa present but less common in these samples include *Fragilaria construens* var. *venter, Fragilaria brevistriata, Neidium affine, Pinnularia sudetica* and *Sellaphora pupula*.

5 DISCUSSION

5.1 Introduction

5.1.1 A targeted geoarchaeological borehole survey was undertaken in and around the Decoy Pond at Morden Bog National Nature Reserve (NNR). The geoarchaeological borehole survey and palaeoenvironmental assessment were undertaken in order to provide further information on the archaeological and palaeoenvironmental potential of the deposits in the area of the pond that may be impacted by the proposed restoration, and facilitate an informed decision with regard to the requirement for, and methods of, any further archaeological and geoarchaeological work that may be required, including palaeoenvironmental analysis.

5.1.2 A total of 28 hand auger boreholes were undertaken using a Russian corer (**Figure 3**), with a total of five retained and forming a sedimentary archive against which further work can be recommended. One of these, borehole WA-25a was selected as the master sequence for palaeoenvironmental assessment and scientific dating on the basis of the thickness of the organic deposits in this core, and its location towards the centre of the pond where the thickest deposits are expected to have accumulated. A second borehole, WA-10a, was also radiocarbon dated in order for chronological comparison against the deposits in WA-25a.

5.1.3 One of the aims of the work was to address the specific research questions outlined in Oxford Archaeology (2022) (see **Section 1.2**), the majority of which are addressed below.

5.1.4 At the time of the work the surface of the pond was recorded at approximately 9.40 m OD, with water depths ranging between 0.05 and 0.50 m at the location of the boreholes (**Appendix 6**). The central part of the pond was not accessible at the time of the work due to water depths exceeding 1.0 m, although the distribution of boreholes and observation of the deposits in the pond was considered fully adequate to address the aims of the work.

5.2 Sedimentary sequence

5.2.1 The sequence of deposits at the Site comprised well preserved plant remains overlying humified peat, in turn overlying coarse Sands. These Sands are considered likely to represent fluvial deposits of either Upper Pleistocene or early Holocene date, and form the template upon which the organic deposits of Holocene age have accumulated. These sediments underly both the pond and the broader valley in which peat deposits have accumulated.

5.2.2 The organic deposits are widespread both within and outside of the pond, and form part of the sequence that has accumulated during the Holocene in a stream valley draining south towards the River Piddle. No basal (e.g. clay) lining to the pond was identified during the borehole survey, and on the basis of the expected age of the underlying Sands, it is considered unlikely that one was used in the construction of the pond.

5.2.3 The profile of the deposits in the area of the pond has been reconstructed using deposit modelling (see **Figures 4** to **7**). There is a general decline in the surface of the Sands from a level of c. 8.3 m OD in the west to c. 7.4 m OD in the east; in the area of the pond, a depression in the surface of these Sands is evident to a level of c. 7.8 m OD (best illustrated in **Figure 4**).

5.2.4 How the surface of these Sands relates to the pond is currently unclear. There are two hypotheses as to the origin of this depression. It may relate to a natural feature, perhaps associated with a broadly north-south aligned early Holocene palaeochannel, the surviving topography of which may have been exploited during the construction of the pond; alternatively, construction of the pond may have resulted in a cut in to these Sands to a level of c. 7.8 m OD, the overlying material having accumulated within this feature.

5.2.5 The combined results of the palaeoenvironmental assessment and scientific dating, including radiocarbon dating and the analysis of Spheroidal Carbonaceous Particles (SCPs) and provisional age modelling for the deposits, have helped to test these hypotheses.

5.3 Chronology

5.3.1 SCPs were observed in every analysed sample in borehole WA-25a (at levels between 0.40 and 0.68 m bgl) suggesting that this part of the sequence post-dates the mid-19th century. A marked increase in SCP concentration observed at 0.48 m represents a date at, or close to, 1950 AD (see **Figure 12**). Similarly, a radiocarbon date at a depth of 0.64 to 0.65 m bgl in WA-10a suggests a relatively modern chronology (probably the 1960s and 1970s) for this part of the sequence.

5.3.2 However, on the basis of the radiocarbon dating of borehole WA-25a, there is significant uncertainty as to the age of the deposits in the lower part of the sequence (i.e. those below c. 0.98 m bgl). The radiocarbon measurement is unfortunately very imprecise due to the problems in the calibration curve associated with the release of old carbon into the atmosphere since the industrial revolution. Assessed in isolation, the largest density of the 95% probability (69%) suggests this part of the deposit could date to between cal AD 1810–

1920, although there is a 26% probability that it occurred between cal AD 1690–1730 (prior to the construction of the pond).

5.3.3 It is possible to refine the dating of the sequence using different iterations of depth models, taking into account prior information. For the top part of the sequence, the 1950 peak at 0.48 m bgl from the SCP analysis results (see **Section 4.4**) and the known age of the top sample (the sampling year) are inserted as priors. For the bottom part of the sequence, there are two options. In model 1, it is assumed that the peat deposit within the pond is a continuation from the pre-existing bog deposit naturally occurring in the area. In this model (**Figure 8**), it is likely that the sample taken at 1.15 m bgl dates to *cal. AD 1690–1835 (1690–1725 at 55% probability)* (**Figure 9**) based on its position within the depositional sequence, with the oldest peat recorded in the borehole sample formed between *cal. AD 1535–1820 (1535–1705 at 55% probability)*.

5.3.4 In model 2 (**Figure 10**), it is assumed that the formation of the peat deposit captured in this sequence post-dates the construction of the pond in 1724, suggesting the sample taken at 1.15 m bgl dates to *cal. AD 1810–1910 (1810–1850 at 51% probability,* **Figure 11**), while the base of the peat deposit recorded in the borehole dates to sometime between *cal. AD 1730–1830.*

5.4 Vegetation history and biostratigraphy

5.4.1 The basal samples, derived from the lower peat unit and overlying silty peat, contained two samples with restricted pollen preservation, with the remaining three samples containing good pollen assemblages. These samples are typified by the presence of pine and birch, in addition to hazel or sweetgale and heathers. The herb signal is restricted to wild grasses and sedges, whilst there are also isolated grains of mugwort. Given the abundance of moss, supported by the presence of heathers, wetland environments in the form of wet heath and/or valley bog with adjacent dry heath are suggested to have prevailed at this depth. At this stage, it is not possible to differentiate between the trizonocolpate grains recorded as hazel or sweetgale. Given sweetgale is a common plant in wetland/bog settings, its presence is likely, but similarly, the presence of a supporting arboreal signal of birch and pine (in addition to the diversification of this signal with height, potentially related to more recent afforestation) likely means that there will be some hazel within this allocation too.

5.4.2 In addition to assessing pollen preservation, abundance and diversity within the sequence, one aim of this assessment was to assess whether a boundary was present between older natural peat (that developed prior to the excavations for the decoy pond), and the more ‘contemporaneous’ peat that accumulated within the pond after its construction. The borehole recorded a stratigraphic boundary at 0.98m, where a silty peat is overlain by a peat rich in organic remains. The palynological assessment has also identified a shift in the pollen signal at this boundary. Those samples derived from above 0.98 m bgl contain a more diverse arboreal signal. In addition to the pine and birch that was common at depth, grains of alder, elm and oak become common with height. There is also an increase in the presence of hazel or sweetgale, in addition to heathers (although to a lesser extent). There also appeared to be an abundance of charcoal within the upper sample from the silty peat, to infer the potential for allochthonous input (e.g. fires) prior to the onset of peat development above this unit.

5.4.3 When analysing the assemblages within the upper herbaceous peat unit, there are further differences with height, namely the presence of isolated grains of beech above 0.59m bgl, and the presence of likely cereal pollen above 0.52m bgl. This could allude to a further/alternative biostratigraphic boundary within the sequence worthy of consideration.

5.4.4 The presence of beech within the upper samples provides a maximum age for this part of the sequence, given that beech arrived in Britain at c. 3000 BP. The absence from the underlying samples (both the basal peat, silty peat and the base of the overlying herbaceous peat) could infer that these deposits predate this. However, it is equally possible that the environment in which the peat formed, likely representing valley bog or wet heath, was not conducive to the growth of beech. There is however the presence of large monoporate grains that may be cereal grains within the uppermost three samples, which would likely infer a more recent age for these samples. Finally, the presence of bladderwort in the uppermost samples, in addition to sporadic presence of testate amoebae (with the genus *Difflugia* sp and *Centropyxis* sp., both being most often associated with very wet conditions, such as bog pools; Charman et al 2000), suggest pond like conditions were present by this time.

5.4.5 Diatoms were absent from the bottom three samples of core WA-25a (below c. 0.98 m bgl). Above this level, the diatom assemblage is indicative of acid, oligotrophic, shallow water habitats. There are a diverse range of acidophilous diatoms throughout that reflect naturally acid environments. Acidobiontic taxa, with optima in very acid, often acidified, environments, appear to increase toward the core top and probably reflect post-industrial acidification. This could be supported by the particle concentrations in the SCP record, that also confirm the post 19th Century age of the sequence. The diversity of acidophilous, acidobiontic and other non-planktonic taxa in the top samples suggest that the sediments are derived from pond sediments rather than diatoms from the mire surface preserved in the peat.

6 CONCLUSION AND RECOMMENDATIONS

6.1.1 On the basis of these results, the pollen and diatom assessments are indicative of a transition in the sediments at 0.98 m bgl, at the interface between the humified peats and the poorly humified plant remains (**Figure 12**), that may relate to a transition from peat associated with the naturally forming valley bog or wet heath to deposits forming within the decoy pond.

6.1.2 Further refinement to the age model for WA-25a, in the form of additional SCP analysis below 0.70 m bgl and additional radiocarbon dating in the lower part of the sequence (below 0.98 m bgl) may help to refine our understanding of the chronology of the sequence and to test these biostratigraphic boundaries (see below). Recommendations for any further analysis can be made on the basis of this revised chronology.

6.1.3 Additional radiocarbon dating and SCP analysis of the lower part of the peat sequence in WA-25a is therefore recommended as outlined in **Table 5**.

Table 5 Recommendations for radiocarbon dating and SCP analysis

Borehole	Lithostratigraphic unit	Approximate depth (m bgl)	Radiocarbon dates (number of samples)	SCP analysis (number of samples)
WA-25a	Herbaceous peat	1.35	1	-
		1.20	1	-
	Upper peat, silty peat	0.70 to 1.10	-	15
Total			**2**	**15**

REFERENCES

[14]Chrono 2019 '14Chrono Centre laboratory 14C pre-treatment protocols', http://14chrono.org/site/wp-content/uploads/2020/03/Lab_protocols.pdf (accessed 15.11.2022).

Battarbee, R.W., Jones, V.J., Flower, R.J., Cameron, N.G., Bennion, H.B., Carvalho, L. & Juggins, S. 2001 Diatoms. In (J.P. Smol and H.J.B. Birks eds.), Tracking Environmental Change Using Lake Sediments Volume 3: Terrestrial, Algal, and Siliceous Indicators, 155-202. Dordrecht: Kluwer Academic Publishers.

Bayliss, A. and Marshall, P. 2022 *Radiocarbon Dating and Chronological Modelling: Guidelines and Best Practice*. Historic England

Bayliss, A. and Marshall, P. 2022 *Radiocarbon Dating and Chronological Modelling - Guidelines and Best Practice*. Historic England

Bronk Ramsey, C. 2008 'Deposition models for chronological records', *Quaternary Science Reviews*, 27(1-2), 42–60.

Bronk Ramsey, C. and Lee, S. 2013 'Recent and planned development of the Program OxCal', *Radiocarbon* 55(2-3), 720-730.

Bronk Ramsey, C. 2009. 'Bayesian analysis of radiocarbon dates', *Radiocarbon* 51, 337-360.

Brown, D H 2011 *Archaeological Archives: a guide to best practice in creation, compilation, transfer and curation* (revised edition). Archaeological Archives Forum

Campbell, J., Fletcher, W., Hughes, P. and Shuttleworth, E 2016 A comparison of pollen extraction methods confirms dense-media separation as a reliable method of pollen preparation. Journal of Quaternary Science, 31 (6), 631-640.

Camburn K.E. & D.F. Charles (eds.). 2000 Diatoms of Low Alkalinity Lakes in the Northeastern United States. The Academy of Natural Sciences of Philadelphia, Special Publication 18. 152 pp.

Cappers, R. T. J., Bekker, R. M. and Jans, J. E. A. 2006 *Digital Seed Atlas of the Netherlands*. Groningen: Barkhuis Publishing.

Carey C, Howard AJ, Knight D, Corcoran J and Heathcote J (Eds) 2018 *Deposit Modelling and Archaeology*. https://www.brighton.ac.uk/_pdf/research/set-groups/deposit-modelling-and-archaeology-volume.pdf.

Charman, D., Hendon, D., Woodland, W.A. 2000 *The identification of testate amoebae (Protozoa: Rhizopoda) in peats*. Quaternary Research Association Technical Guide No. 9.

Chartered Institute for Archaeologists [CIfA] 2020 *Standard and Guidance for Archaeological Field Evaluation*. Reading, CIfA

English Heritage 2011 *Environmental Archaeology: A Guide to the Theory, Practice of Methods, from Sampling and Recovery to Post-excavation* (second edition). Portsmouth, English Heritage

Flower, R.J. 1993 Diatom preservation: experiments and observations on dissolution and breakage in modern and fossil material. Hydrobiologia 269/270: 473-484.

Gale, R. and Cutler, D. 2000. *Plants in Archaeology: identification manual of vegetative plant materials used in Europe and the southern Mediterranean to* c. *1500*. Otley: Westbury and Royal Botanic Gardens, Kew.

Hather, J. G. 2000. *The Identification of Northern European Woods: a guide for archaeologists and conservators*. London: Archetype.

Historic England 2015a *Management of Research Projects in the Historic Environment: the MoRPHE project managers' guide*. Swindon, Historic England

Historic England 2015b *Geoarchaeology: Using Earth Sciences to Understand the Archaeological Record*. Swindon, Historic England

Historic England 2020 *Deposit Modelling and Archaeology. Guidance for Mapping Buried Deposits.* Swindon. Historic England.

Hua, Q., Turnbull, J. C., Santos, G. M., Rakowski, A. Z., Ancapichún, S., De Pol-Holz, R., Hammer, S., Lehman, S. J., Levin, I., Miller, J. B., Palmer, J. G., and Turney, C. S. M. 2022. Atmospheric Radiocarbon for The Period 1950–2019. *Radiocarbon*, 64(4), 723-745.

Kingston, J.C. 1982. Association and distribution of common diatoms in surface samples from Northern Minnesota peatlands. In: Hákansson, H. & Gerloff, J. (eds.) Diatomaceae III, Beiheft 73 zur Nova Hedwigia, J. Cramer, Vaduz, 333–346.

Krammer, K. & H. Lange-Bertalot, 1986-1991. Bacillariophyceae. Gustav Fisher Verlag, Stuttgart.

Lindsay, R. 1995. *Bogs: The Ecology, Classification and Conservation of Ombrotrophic Mires*. Edinburgh: Scottish Natural Heritage.

Magri, D. 2008 Patterns of post-glacial spread and the extent of glacial refugia of European beech (Fagus sylvatica). *Journal of Biogeography* 35, 450–463.

McKinley, J I 2013 Cremation: excavation, analysis and interpretation of material from cremation-related contexts, in S Tarlow and L Nilsson Stutz (eds) *The Oxford Handbook of the Archaeology of Death and Burial*. Oxford University Press 147–71

McKinley, J I and Roberts, C 1993 CIfA Technical Paper 13 *Excavation and Post-excavation Treatment of Cremated and Inhumed Human Remains*

Millard, A. R. 2014. 'Conventions for Reporting Radiocarbon Determinations', *Radiocarbon* 56(2), 555–559.

Natural England 2022 Morden Bog NNR Decoy Pond Palaeo-environmental Assessment. Request for Quotation. Unpublished Document, Ref: NNRH@R07.

Oxford Archaeology 2022 Morden Bog NNR Decoy Pond and Overnight Shelter. *Archaeological Survey and Condition Assessment*. Unpublished Report for Natural England. Ref no: WMBOG21

Prendergast, E. M. 1985 The History of the Morden Duck Decoy 1724. *Proc Dorset Natur Hist Archaeol Soc 107.* Vol 107, pp. 19-22.

Preston, C. D., Pearman, D. A., Dines, T. D. 2002 *New Atlas of the British and Irish Flora: an atlas of the vascular plants of Britain, Ireland, The Isle of Man and the Channel Islands*. Oxford: Oxford University Press.

Reimer, P. J., Austin, W. E. N., Bard, E., Bayliss, A., Blackwell, P. G., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hajdas, I., Heaton, T. J., Hogg, A. G., Hughen, K. A., Kromer, B., Manning, S. W., Muscheler, R., Palmer, J. G., Pearson, C., van der Plicht, J., Reimer, R. W., Richards, D. A., Scott, E. M., Southon, J. R., Turney, C. S. M., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S. M., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A. and Talamo, S. 2020 'The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0–55 cal kBP)', *Radiocarbon* 62(4), 725–757.

Rose, N L, Appleby, P G, 2005 Regional applications of lake sediment dating by spheroidal carbonaceous particle analysis I: United Kingdom. *Journal of Palaeolimnology* 34, 349-361.

Ryves, D. B., Juggins, S., Fritz, S. C. & Battarbee, R. W. 2001 Experimental diatom dissolution and the quantification of microfossil preservation in sediments. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 172, 99-113.

Schweingruber, F. H. 1990 *Microscopic Wood Anatomy* (3rd edition). Birmensdorf: Swiss Federal Institute for Forest, Snow and Landscape Research.

Stace, C. 1997 *New Flora of the British Isles* (2nd edition). Cambridge: Cambridge University Press.

Stevenson, A.C., Juggins, S., Birks, H.J.B., Anderson, D.S., Anderson, N.J., Battarbee, R.W., Berge, F., Davis, R.B., Flower, R.J., Haworth, E.Y., Jones, V.J., Kingston, J.C., Kreiser, A.M., Line, J.M., Munro, M.A.R. & Renberg, I. 1991 The Surface Waters Acidification Project Palaeolimnology Programme: Modern Diatom / Lake-Water Chemistry Data-Set. ENSIS Ltd.: London. 86 pp.

Waterbolk, H. T. 1971 'Working with radiocarbon dates', *Proceedings of the Prehistoric Society* 37(2), 15–33.

Webster C 2008 South West Archaeological Research Framework (SWARF). https://researchframeworks.org/swarf/research-strategy/.

Wessex Archaeology 2023 *Morden Bog NNR Decoy Pond: Written Scheme of Investigation for Geoarchaeological Borehole Survey* 273310.01

APPENDIX

Appendix 1 Sediment description logs

Site Code: 273310	Site Name: Morden Bog	BH ID: 1
Coordinates (NGR) X: 391324.50	Coordinates (NGR) Y: 91378.69	Level (top): 9.19 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
1001	soft (0-29cm) to firm (from 29cm mid brown peat. fibrous material composed mainly of rootlets and Leaf material. leaf material mainly Carex. within firmer section some grey-brown material of slightly silty peat. at 79cm large piece of silver birch 11cm long. gradual to	Modern plant material in peat matrix	0.00-0.98	9.19-8.21	
1002	dark brown to black brown moderately firm humified peat. little herbaceous material, with fine rootlets only. refusal at 111cm.	peat	0.98-1.11	8.21-8.08	

Site Code: 273310	Site Name: Morden Bog	BH ID: 2
Coordinates (NGR) X: 391330.72	Coordinates (NGR) Y: 91380.85	Level (top): 9.19 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
2001	soft very fibrous peat. mid brown, frequent rootlets. infrequent woody and leaf material. leaf material mainly Potamogeton and Carex.	Modern plant material in peat matrix	0.00-1.00	9.19-8.19	
	void	Void	1.00-1.45	8.19-7.74	
2002	soft well humified slightly silty peat, dark grey brown. some rootlet material. gradual to	peat	1.45-1.62	7.74-7.57	
2003	mid brown slightly firm fibrous peat, with frequent fine woody and leaf material and rootlets. gradual to	peat	1.62-1.71	7.57-7.48	
2004	grey fibrous silty peat. frequent leafy and woody material and rootlets. leafy material includes phragmites. refusal at 195cm	peat	1.71-1.95	7.48-7.24	

Site Code: 273310	Site Name: Morden Bog	BH ID: 3
Coordinates (NGR) X: 391334.54	Coordinates (NGR) Y: 91377.36	Level (top): 9.15 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
3001	mid brown fibrous peat. rootlets and leaf material frequent throughout. leaf material predominantly Potamogeton and carex. some wood fragments but infrequent. gradual to	Modern plant material in peat matrix	0.00-1.16	9.15-7.99	
3002	light grey to brown-grey silty peat. well humified, with little root material present. gradual to	peat	1.16-1.25	7.99-7.90	
3003	grey-brown to light grey fibrous silty peat. frequent root and leaf material. leaf material predominantly Carex, some Phragmitesn. refusal at 142	peat	1.25-1.42	7.90-7.73	

Site Code: 273310	Site Name: Morden Bog	BH ID: 4
Coordinates (NGR) X: 391312.97	Coordinates (NGR) Y: 91365.40	Level (top): 9.12 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
	void 0-45cm.	void	0.00-0.45	9.12-8.67	
4001	loose organic fibrous material. roots and phragmites.	Modern plant material in peat matrix	0.45-0.57	8.67-8.55	
4002	loose soft mid brown peat, abundant of root material and Potamogeton material	Modern plant material in peat matrix	0.57-0.78	8.55-8.34	
4003	soft mid brown peat. regular rootlets and Potamogeton (?) leaf material, but less than above unit and finer organic leaf Rootlets. gradual to	Modern plant material in peat matrix	0.78-1.07	8.34-8.05	
4004	mid brown well humified peat, little rootlet material. refusal beyond 121cm, where peat becomes 4y peat with coarse sand at 121cm.	peat	1.07-1.21	8.05-7.91	

Site Code: 273310	Site Name: Morden Bog	BH ID: 5
Coordinates (NGR) X: 391350.96	Coordinates (NGR) Y: 91357.82	Level (top): 9.14 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
	void 0-29cm bgl	void	0.00-0.29	9.14-8.85	

5001	loose soft mid brown fibrous peat. mainly rootlets and woody material, including Silver Birch bark. leaf material rare and fine. gradual to	Modern plant material in peat matrix	0.29-0.88	8.85-8.26	
5002	dark brown to grey brown clayey peat. some rootlets but rare gradual to	peat	0.88-1.10	8.26-8.04	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 6**
Coordinates (NGR) X: 391272.21	**Coordinates (NGR) Y: 91354.34**	**Level (top): 9.33 m OD**

Context Number	**Description**	**Interpretation**	**Depth m bgl**	**Depth m OD**	**Samples**
	0-13cm void	void	0.00-0.13	9.33-9.20	
6001	soft mid brown loose fibrous peat with frequent rootlets, some woody material (twigs). gradual	Modern plant material in peat matrix	0.13-0.21	9.20-9.12	
6002	mid-brown to grey-brown soft slightly silty fibrous peat. rootlets present through. slightly more compact the underlying and overlying units. gradual to	Modern plant material in peat matrix	0.21-0.34	9.12-8.99	
6003	very fibrous mid brown peat. abundant rootlet, leaf and woody marterial, including some Phragmites	Modern plant material in peat matrix	0.34-0.80	8.99-8.53	
6004	soft dark brown-black well humified peat. little woody material. slight banding of paler colour. Sharp to	peat	0.80-0.94	8.53-8.39	
6005	coarse grey peaty sand	sand	0.94-0.95	8.39-8.38	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 7**
Coordinates (NGR) X: 391272.46	**Coordinates (NGR) Y: 91351.56**	**Level (top): 9.01 m OD**

Context Number	**Description**	**Interpretation**	**Depth m bgl**	**Depth m OD**	**Samples**
7001	mid brown very soft peat. herbaceous material abundant, composed of rootlets and Leaf material. some woody material. leaf material composed mainly of Potamogeton sp, with some Carex and some undetermined. gradual to void 30-38	Modern plant material in peat matrix	0.00-0.61	9.01-8.40	
7002	mid brown soft peat with frequent woody material. fine to medium sand of grey to black clasts. gradual to n	peat	0.61-0.66	8.40-8.35	

7003	mid brown soft peaty sand with little woody material, and infrequent rootlets. - coarse sand.	sand	0.66-0.75	8.35-8.26	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 8**
Coordinates (NGR) X: 391271.32	**Coordinates (NGR) Y: 91348.34**	**Level (top): 9.34 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
	void	void	0.00-0.26	9.34-9.08	
8001	loose mid brown peat. some fibrous material throughout, composed of Carex leaf material, rootlets. flint clast at 41cm bgl measuring 3x2cm. poorly humified fime-med sand present within peat 41-43cm. black band of well humified peat at 56cm-57 gradual to	peat	0.26-0.95	9.08-8.39	
8002	moderately compact well humified peat, black Infrequent rootlet material.	peat	0.95-1.00	8.39-8.34	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 9**
Coordinates (NGR) X: 391285.14	**Coordinates (NGR) Y: 91345.18**	**Level (top): 8.98 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
9001	void	void	0.00—0.63	8.98-8.35	
9002	peat. sandy poorly consolidated peat.	peat	0.63-0.70	8.35-8.28	
9003	fine-medium grey sand	sand	0.70-0.77	8.28-8.21	
	void	void	0.77-0.80	8.21-8.18	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 10**
Coordinates (NGR) X: 391342.96	**Coordinates (NGR) Y: 91325.77**	**Level (top): 9.07 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
	void 0-36cm	void	0.00-0.36	9.07-8.71	

10001	mid brown soft fibrous peat. rootlets frequent. some woody material	Modern plant material in peat matrix	0.36-0.50	8.71-8.57	
10002	very soft dark brown well humified peat. irregular rootlets.	peat	0.50-0.88	8.57-8.19	
10003	dark brown to black brown clayey peat. semi regular leaf and wood material. rootlets frequent. leaf material includes Phragmites and Bog Myrtle. refusal at 115	peat	0.88-1.15	8.19-7.92	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 11**
Coordinates (NGR) X: 391372.2	**Coordinates (NGR) Y: 91346.16**	**Level (top): 9.11 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
11001	Loose organic material, mainly root and rootlets	Modern plant material in peat matrix	0.00-0.25	9.11-8.86	
	void	void	0.25-0.50	8.86-8.61	
11002	Soft fibrous mid brown peat, mainly rootlets, some myrica gale and indeterminate leaf material and wood material gradual to	Modern plant material in peat matrix	0.50-0.62	8.61-8.49	
11003	Coarse grey slightly gravelly sand, Slightly organic at top of unit but decreases to base and sand becomes coarser towards base. Some organic leaf and rootlet material within. Sharp to	sand	0.62-0.87	8.49-8.24	
11004	Soft moderately well humified peat. Semi regular rootlets and fine leaf material, mid brown. Including phragmites leaf material gradual to	peat	0.87-1.08	8.24-8.03	
11005	Brown to blue grey clay, becoming greyer with depth	alluvium	1.08-1.15	8.03-7.96	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 12**
Coordinates (NGR) X: 391371.09	**Coordinates (NGR) Y: 91338.83**	**Level (top): 9.13 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
12001	mid brown loose soft organic material. mainly roots some woody material. gradual to	Modern plant material in peat matrix	0.00-0.86	9.13-8.27	
12002	mid brown fibrous peat. rootlets abundant, plus woody and leaf material. leaf material mainly Myrica gale. gradual to	Modern plant material in peat matrix	0.86-1.05	8.27-8.08	

12003	dark grey-brown organic silt with some rootlets and rare Myrica gale leaf material & fine indeterminate leaf material gradual to	Alluvium / organic alluvium	1.05-1.20	8.08-7.93	
12004	mid brown fibrous peat. frequent rootlets and fine leaf material, occasional coarse Phragmites leaf material. gradual to	peat	1.20-1.30	7.93-7.83	
12005	light grey-brown silty fibrous peat. regular leaf and rootlet material. leaf material mainly fine to large Phragmites material. gradual to	peat	1.30-1.59	7.83-7.54	
12006	brown grey to grey slightly fine sandy silt. some organic material including rootlets and Phragmites leaf material. refusal at 167cm.	Alluvium / organic alluvium	1.59-1.67	7.54-7.46	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 13**			
Coordinates (NGR) X: 391291.49	**Coordinates (NGR) Y: 91323.50**	**Level (top): 9.11 m OD**			
Context Number	**Description**	**Interpretation**	**Depth m bgl**	**Depth m OD**	**Samples**
13001	void to 82cm	Void	0.00-0.82	9.11-8.29	
13002	herbaceous woody peat	Peat	0.82-0.91	8.29-8.20	
13003	fine to coarse grey brownish sand	sand	0.91-0.94	8.20-8.17	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 14**			
Coordinates (NGR) X: 391351.86	**Coordinates (NGR) Y: 91332.20**	**Level (top): 9.07 m OD**			
Context Number	**Description**	**Interpretation**	**Depth m bgl**	**Depth m OD**	**Samples**
	void 0-40cm bgl	void	0.00-0.40	9.07-8.67	
14001	loose mid brown soft peat. fibrous. frequent rootlets , leaf material and woody material. high leaf material 55-77cm bgl. leaf material includes Quercus, Betula & Myrica gale.	Modern plant material in peat matrix	0.40-0.95	8.67-8.12	
14002	mid brown coarse sandy peat	peat	0.95-0.97	8.12-8.10	
14003	brown grey clayey peat. well humified	peat	0.97-1.02	8.10-8.05	
14004	grey coarse sand. quartz rich.	sand	1.02-1.05	8.05-8.02	

Site Code: 273310	Site Name: Morden Bog	BH ID: 16
Coordinates (NGR) X: 391304.56	Coordinates (NGR) Y: 91303.54	Level (top): 8.97 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
16001	void	void	0.00-0.80	8.97-8.17	
16002	loose, peat with some herbaceous and woody material	Modern plant material in peat matrix	0.80-0.92	8.17-8.05	
16003	coarse white sand	sand	92.0-1.00	8.05-7.97	

Site Code: 273310	Site Name: Morden Bog	BH ID: 17
Coordinates (NGR) X: 391372.70	Coordinates (NGR) Y: 91297.36	Level (top): 9.17 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
	void 0-15cm	void	0.00-0.15	9.17-9.02	
17001	soft mid brown fibrous peat. rootlets frequent. irregular woody and leaf material leaf material predominately Carex. . gradual to	Modern plant material in peat matrix	0.15-0.77	9.02-8.40	
17002	mid brown fibrous silty peat. roots frequent. irregular woody and leaf material. leaf material predominantly Phragmites. becomes greyish brown at base. Sharp to	peat	0.77-1.15	8.40-8.02	
17003	moderately firm mid brown slightly fibrous peat. rootlets frequent. fine leaf material frequent, and irregular large Phragmites leaf material in some locations. gradual to	peat	1.15-1.53	8.02-7.64	
17004	grey to brown grey clay and peat. peat well humified. very fine rootlets infrequent. refusal at 157	Peat/possible organic alluvium	1.53-1.57	7.64-7.69	

Site Code: 273310	Site Name: Morden Bog	BH ID: 18
Coordinates (NGR) X: 391349.62	Coordinates (NGR) Y: 91294.53	Level (top): 9.19 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples

18001	soft mid brown fibrous peat. rootlets frequent. some leaf material, predominantly of Carex. gradual to	Modern plant material in peat matrix	0.00-0.57	9.19-8.62	
18002	slightly sandy mid brown peat. woody material and rootlets present. gravel clast at 61cm bgl (1cmx1cm) gradual to	peat	0.57-0.72	8.62-8.47	
18003	mid brown fibrous peat. frequent woody and leafy material and rootlets. leaf material includes mainly Phragmites. some rare Carex gradual to	peat	0.72-0.97	8.47-8.22	
18004	brown grey peaty sand. sand coarse. Refusal at 100	sand	0.97-1.00	8.22-8.19	

Site Code: 273310	**Site Name:** Morden Bog	**BH ID:** 19
Coordinates (NGR) X: 391369.44	**Coordinates (NGR) Y:** 91292.91	**Level (top):** 9.22 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
19001	moderate firm to moderately soft mid brown fibrous peat roots and rootlets frequent throughout. phragmites leaf material infrequent from 35cm	Modern plant material in peat matrix	0.00-0.90	9.22-8.32	
19002	mid brown to dark brown slightly silty fibrous peat. frequent rootlets and semi-regular phragmites leaf material. gradual to	peat	0.90-1.21	8.32-8.01	
19003	mid brown to light grey-brown slightly fibrous moderately firm peat. rootlets and fine leaf material frequent throughout. slightly clayey from 137 to base. refusal at 148	peat	1.21-1.48	8.01-7.74	

Site Code: 273310	**Site Name:** Morden Bog	**BH ID:** 20
Coordinates (NGR) X: 391367.21	**Coordinates (NGR) Y:** 91288.83	**Level (top):** 9.16 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
20001	loose mid brown fibrous peat. rootlets frequent and woody material regular, including bark of Betula . wood piece from 35-50cm, bark preserved, poss. Salix sp.. from 80cm less woody and phragmites leaf material more frequent but rootlets still common	Modern plant material in peat matrix	0.00-1.20	9.16-7.96	

20002	dark grey brown silty peat. moderately well humified but rootlets still present. fine sand present in last 0.5cm. refusal at 148cm.	peat	1.20-1.48	7.96-7.68	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: BH21**
Coordinates (NGR) X: 391293.50	**Coordinates (NGR) Y: 91281.80**	**Level (top): 8.69 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
21001	0.0 - 41 no recovery (water + peat)	Void / modern material	0.00-0.41	8.69-8.28	
21002	coarse sandy herbaceous peat with small wood fragments	Peat	0.41-0.67	8.28-8.02	
21003	no recovery	void	0.67-0.79	8.02-7.90	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: BH22**
Coordinates (NGR) X: 391295.01	**Coordinates (NGR) Y: 91282.18**	**Level (top): 8.95 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
22001	0-86 no recovery (water and peat)	Modern plant material in peat matrix	0.00-0.86	8.95-8.09	
22002	herbaceous peat 0.86-92	Peat	0.86-0.92	8.09-8.03	
22003	92-97 medium sandy herbaceous peat	Peat	0.92-0.97	8.03-7.98	
22004	97-1.0 no recovery	Sand?	0.97-1.00	7.98-7.95	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: WA23**
Coordinates (NGR) X: 391296.82	**Coordinates (NGR) Y: 91281.46**	**Level (top): 9.23 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
23001	No recovery. At 0.95 base refusal but gritty texture. (sand at 0.95)	Peat to 0.95 then sand?	0.00-0.95	9.23-8.28	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: WA24**
Coordinates (NGR) X: 391349.55	**Coordinates (NGR) Y: 91310.62**	**Level (top): 9.24 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
	void 0-27cm	void	0.00-0.27	9.24-8.97	
24001	mid brown fibrous peat roots common. woody material semi regular. soft. less woody after 60cm. gradual to	Modern plant material in peat matrix	0.27-1.12	8.97-8.12	
24002	dark brown to black brown peat. well humified but fine wood/charcoal (1-2mm) frequent. gradual to	peat	1.12-1.24	8.12-8.00	
24003	mid brown fibrous peat. moderately soft. frequent rootlets and Phragmites leaf material, mainly fine but occasional larger fragments. clayey peat for last 3cm, refusal at 148	peat	1.24-1.48	8.00-7.76	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: WA25**
Coordinates (NGR) X: 391293.01	**Coordinates (NGR) Y: 91343.58**	**Level (top): 9.10 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
	void 0-28.	void	0.00-0.28	9.10-8.82	
26001	soft loose mid brown well humified peat. some rootlet and phragmites material within. trace amounts of coarse sand	peat	0.28-1.17	8.82-7.93	
26002	soft grey-brown coarse peaty sand. some rootlet material. clasts include quartz grain. refusal at 120cm	sand	1.17-1.20	7.93-7.90	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: WA26**
Coordinates (NGR) X: 391303.44	**Coordinates (NGR) Y: 91348.10**	**Level (top): 9.19 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
	void 0-40cm bgl	void	0.00-0.40	9.19-8.79	
25001	loose fibrous peat. mainly rootlets some leaf and woody material. leaf material includes Myrica gale. less leaf material after 10cm. gradual to	Modern plant material in peat matrix	0.40-0.80	8.79-8.39	
25002	brown to white coarse sand. peaty sand in top 6cm.	sand	0.80-0.90	8.39-8.29	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: WA27**

Coordinates (NGR) X: 391363.43	Coordinates (NGR) Y: 91367.33	Level (top): 8.92 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
	void	Void	0.00-0.30	8.92-8.62	
27001	brown fibrous silty peat. rootlets frequent & woody material gradual to	Modern plant material in peat matrix	0.30-0.70	8.62-8.22	
27002	pale grey-white coarse sand. very Sharp to	Sand	0.70-0.88	8.22-8.04	
27003	brown slightly clayey peat. well humified, some rootlets. gradual to	Peat	0.88-1.11	8.04-7.81	
27004	grey brown fibrous peat. rootlets frequent plus Phragmites leaf material. moderately gradual to	Peat	1.11-1.33	7.81-7.59	
27005	pale grey coarse sand. very little organic rootlets. refusal at 143	sand	1.33-1.43	7.59-7.49	

Site Code: 273310	Site Name: Morden Bog	BH ID: WA28
Coordinates (NGR) X: 391408.74	Coordinates (NGR) Y: 91313.17	Level (top): 8.84 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
28001	Mid brown fibrous peat. Rootlets abundant. Woody material and fine leaf material frequent. Wood material includes Betula bark. Gradual to	Modern plant material in peat matrix	0.00-0.86	8.84-7.98	
28002	Dark brown to blackish brown peat. Rootlets semi frequent, occasional phragmites leaf material. Charcoal/black wood 2mm sized.	peat	0.86-1.00	7.98-7.84	
28003	Void	Void	1.00-1.11	7.84-7.73	
28004	Grey-brown to brown fibrous peat. Frequent rootlets and phragmites leaf. Gradual to	peat	1.11-1.30	7.73-7.54	
28005	Grey brown silty peat. Semi regular root and occasional phragmites leaf material. Refusal at 150	peat	1.30-1.50	7.54-7.34	

Site Code: 273310	Site Name: Morden Bog	BH ID: WA29
Coordinates (NGR) X: 391337.84	Coordinates (NGR) Y: 91263.44	Level (top): 9.09 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples

29001	brown fibrous soft peat. rootlets frequent and wood regular, including large piece 10cm. wood includes possibly Alnus based on bark. leaf material infrequent in last 20cm, but includes complete Myrica gale leaves gradual to	Modern plant material in peat matrix	0.00-0.80	9.09-8.29	
29002	dark brown to dark grey-brown silty peat. rootlets infrequent. fine sand sparse within. fairly sharp to	peat	0.80-1.02	8.29-8.07	
29003	coarse pale grey sand. refusal at 104	sand	1.02-1.04	8.07-8.05	

Appendix 2 Sediment description logs for retained cores

Site Code: 273310	Site Name: Morden Bog	BH ID: 3a
Coordinates (NGR) X: 391334.54	Coordinates (NGR) Y: 91377.36	Level (top): 9.15 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
3001a	Dark brown, fine very fibrous rootlets and woody twigs within brown peaty water. Poorly consolidated	Modern plant material in peat matrix	0.00-0.05	9.15-9.10	
3002a	Void	Void	0.05-0.10	9.10-9.05	
3003a	Dark brown very fibrous fine rootlets and slightly silty indistinguishable disintegrated organic matter throughout. Diffuse contact with	Modern plant material in peat matrix	0.10-1.15	9.05-8.00	
3004a	Becoming finer and more silty peat, dark brown and decreasing coarse plant material. Diffuse contact with	Silty Peat	1.15-1.20	8.00-7.95	
3005a	Black fibrous peat, containing fine herbaceous remains, mostly rootlets and root fibres.	Peat	1.20-1.30	7.95-7.85	
3006a	Dark brown very fibrous fine rootlets and slightly silty indistinguishable disintegrated organic matter. Red/brown wood fragment embedded at 1.43. Diffuse contact with	Peat	1.30-1.53	7.85-7.62	
3007a	Becoming finer and more silty peat, dark brown and decreasing coarse plant material. Fine matted root fibres abundant	Silty Peat	1.53-1.70	7.62-7.45	

Site Code: 273310	Site Name: Morden Bog	BH ID: 10a
Coordinates (NGR) X: 391342.96	Coordinates (NGR) Y: 91325.77	Level (top): 9.07 m OD m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
10001a	Void (Modern plant roots and stems and water)	Void	0.00-0.48	9.07-8.59	
10002a	Slightly silty, dark to mid brown fine peat, very soft with abundant fine root fibres Mid humification.	Peat	0.48-1.07	8.59-8.08	
10003a	Lighter brown fine silty peat. Soft. Frequent fine fibrous root material.	Silty Peat	1.07-1.15	8.08-7.92	
10004a	Dark brown fibrous fine root matting within indistinguishable humified organic matter. Low-Mid humification Sharp to:	Peat	1.15-1.28	7.92-7.79	

10005a	Grey coarse sand, contains frequent quartz grains.	Sand	1.28-1.30	7.79-7.77	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 20a**
Coordinates (NGR) X: 391367.21	**Coordinates (NGR) Y: 91288.83**	**Level (top): 9.16 m OD**

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
20001a	Dark brown soft very fibrous fine matted rootlets and root fibres with traces of leaves and bark.	Modern plant material in peat matrix	0.00-0.58	9.16-8.58	
20002a	Void	Void	0.58-0.63	8.58-8.53	
20003a	Coarse dark and mid brown plant material – stems, roots with finer matrix of rootlets and root fibres. Little to no humification gradual to:	Modern plant material in peat matrix	0.63-1.60	8.53-7.56	
20004a	Becoming finer and slightly silty. Dark brown fibrous rootlets and indistinguishable organic matter	peat	1.60-1.70	7.56-7.46	

Site Code: 273310	**Site Name: Morden Bog**	**BH ID: 24a**
Coordinates (NGR) X: 391349.55	**Coordinates (NGR) Y: 91310.62**	**Level (top): 9.24 m OD**

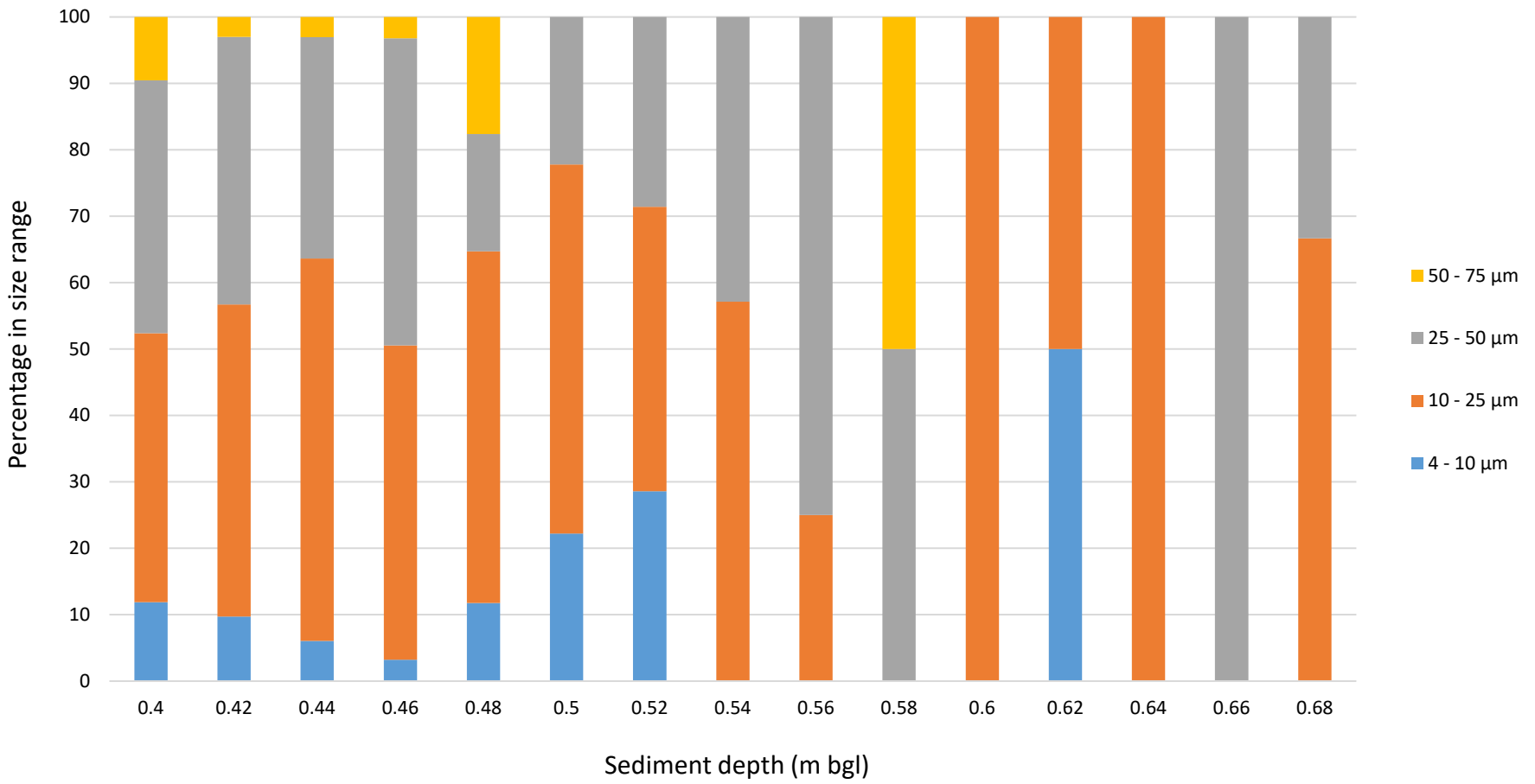
Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
24001a	Void (Modern plant roots and stems and water)	Void	0.00-0.40	9.24-8.84	
24002a	Soft slightly silty dark brown fibrous root fibres and disintegrated organic matter (misc) diffuse into:	Modern plant material in peat matrix	0.40-0.90	8.84-8.34	
24003a	Black silty soft peat. Well humified indistinguishable organic matter. Diffuse into:	Peat	0.90-1.15	8.34-8.09	
24004a	Mid brown soft silty peat with fine root matting throughout. Diffuse into:	Silty Peat	1.15-1.20	8.09-8.04	
24005a	Dark brown soft silty peat with fine rootlets throughout	Silty Peat	1.20-1.30	8.04-7.94	

Site Code: 273310	Site Name: Morden Bog	BH ID: 25a
Coordinates (NGR) X: 391293.01	Coordinates (NGR) Y: 91343.58	Level (top): 9.10 m OD

Context Number	Description	Interpretation	Depth m bgl	Depth m OD	Samples
25001a	Void	Void	0.00-0.40	9.10-8.89	
25002a	Dark brown to very dark brown very fibrous fine rootlets and slightly silty indistinguishable disintegrated organic matter throughout.	Modern plant material in peat matrix	0.40-0.47	8.89-8.63	
25003a	Dark brown very fibrous fine rootlets and slightly silty indistinguishable disintegrated organic matter throughout.	Modern plant material in peat matrix	0.47-0.52	8.63-8.58	
25004a	Coarse plant material – wood and stems, fibrous rootlets. Low degree of humification. Dark brown to mid brown. Diffuse contact with:	Modern plant material in peat matrix	0.52-0.73	8.58-8.37	
25005a	Slightly silty dark slightly greyish brown fibrous rootlets, small twigs. Matted. Fairly sharp to:	Modern plant material in peat matrix	0.73-0.98	8.37-8.12	
25006a	Black, fine silty soft peat. Generally absent of any coarse material. Well humified. Diffuse contact with:	Silty peat	0.98-1.10	8.12-8.00	
25007a	Dark brown fibrous slightly silty fine herbaceous peat with root fibres throughout. Low-mid humification. Diffuse contact with	Peat	1.10-1.21	8.00-7.89	
25008a	Fairly consolidated mid to lightish brown fibrous slightly silty fine herbaceous peat with root fibres throughout. Low-mid humification. Diffuse contact	Peat	1.21-1.28	7.89-7.82	
25009a	Dark brown fibrous slightly silty fine herbaceous peat with root fibres throughout. Low-mid humification.	Peat	1.28-1.40	7.82-7.70	

Appendix 3 SCP concentration data

Mean depth (m bgl)	SCP count	SCP conc. (gDM-1)	Upper 90% C.L. (gDM-1)	Lower 90% (gDM-1)	Size range (%)				
					<4	4 - 10	10 - 25	25 - 50	50 - 75
0.4	84	12014	13298	10729	0.00	11.90	40.48	38.10	9.52
0.42	134	18991	20598	17383	0.00	9.70	47.01	40.30	2.99
0.44	66	11453	12834	10071	0.00	6.06	57.58	33.33	3.03
0.46	93	19357	21325	17390	0.00	3.23	47.31	46.24	3.23
0.48	17	3804	4709	2900	0.00	11.76	52.94	17.65	17.65
0.5	9	2706	3590	1822	0.00	22.22	55.56	22.22	0.00
0.52	7	4250	5824	2676	0.00	28.57	42.86	28.57	0.00
0.54	7	1639	2246	1032	0.00	0.00	57.14	42.86	0.00
0.56	4	1073	1599	547	0.00	0.00	25.00	75.00	0.00
0.58	2	762	1291	234	0.00	0.00	0.00	50.00	50.00
0.6	2	446	754	137	0.00	0.00	100.00	0.00	0.00
0.62	2	415	702	127	0.00	50.00	50.00	0.00	0.00
0.64	1	308	610	6	0.00	0.00	100.00	0.00	0.00
0.66	1	330	653	7	0.00	0.00	0.00	100.00	0.00
0.68	3	1175	1840	510	0.00	0.00	66.67	33.33	0.00


Percentage in size range
100
90
80
70
60
50
40
30
20
10
0
0.4
0.42
0.44
0.46
0.48
0.5
0.52
0.54
0.56
0.58
0.6
0.62
0.64
0.66
0.68
Sediment depth (m bgl)
50 - 75 µm
25 - 50 µm
10 - 25 µm
4 - 10 µm

Appendix 4 Pollen assessment results

Borehole WA-25a		Upper peat							Silty peat		Peat		
Depth (m bgl)		**0.44**	**0.48**	**0.52**	**0.59**	**0.69**	**0.79**	**0.89**	**0.99**	**1.09**	**1.19**	**1.24**	**1.29**
Trees	*Alnus*	5	8	8	13	4	7	8					
	Betula	18	18	5	11	4	6	2	4	8	34	10	20
	Fagus	1	1	1	1								
	Fraxinus												
	Pinus	22	21	15	16	23	31	13	27	14	47	10	45
	Quercus	1	1		1	1	1	2					
	Tilia						1						
	Ulmus	1	1	3	1	3	1	3	1				1
Shrubs	*Corylus-Myrica* type	34	39	45	52	76	30	66	82	5	5	10	7
	Ericaceae undiff.	5	13	10	14	5	31	13	4	2	5	11	16
	Hedera helix			1				1					
	Salix			1	2						1		
Herbs	Poaceae	23	8	22	9	11	20	17	12	4	12	11	13
	Poaceae >37mic	3	2	4									
	Cyperaceae	5	13	11	4	2	4	5		1	16	4	9
	Apiaceae (Umbelliferae) undif.												
	Anthemis sp												
	Artemisia type									1	3	1	1
	Asteraceae					1				1	1		
	Brassicaceae		1				1						
	Caryophyllaceae												
	Centaurea cyanus												
	Centaurea nigra												
	Centaurea scabiosa												
	Chenopodiaceae												
	Cirsium type												
	Filipendula	2									1	1	
	Helianthemum												

Borehole WA-25a		Upper peat							Silty peat		Peat		
Depth (m bgl)		0.44	0.48	0.52	0.59	0.69	0.79	0.89	0.99	1.09	1.19	1.24	1.29
	Lactuceae												
	Mentha												
	Potentilla type							1					
	Plantago sp.							1				1	
	cf. Pinguicula	1											
	Ranunculus			1		1							
	Rhinanthus												
	Rumex				1	1		1				1	
	Sanguisorba												
	Scabiosa												
	Trifolium												
	Utricularia	8	1										
Spores	*Ophioglossum*												
	Polypodium			1			1		1				
	Pteridium	2										1	2
	Pteropsida (monolete) undif.		2	3	3		3		1		9	1	5
	Sphagnum	28	24	20	37	22	73	46	9	7	59	74	19
	Thelypteris												
Aquatics	*Hydrocotyle*	1					1						1
	Potemogeton												
	Menyanthes								1	2	1		
	Myriophyllum			1	1							1	1
	Sparganium emersum type	1	1										
	Typha latifolia												
Unknown sp.									xxx			x	
Charcoal													
Testate amoebae		x		x									
Pre-Quaternary pollen and spores													
Grain crumpling									x				

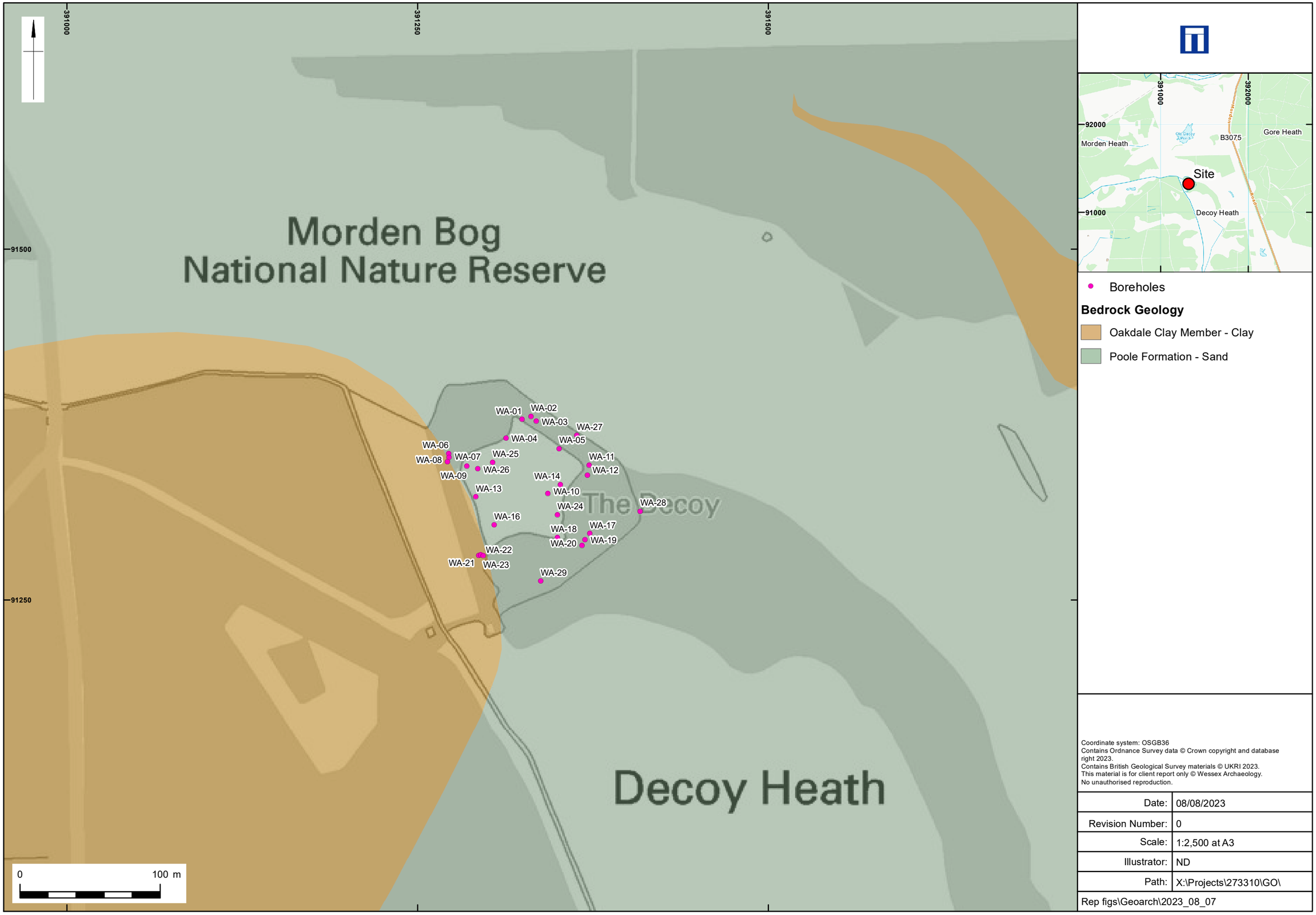
Borehole WA-25a	Upper peat							Silty peat		Peat		
Depth (m bgl)	**0.44**	**0.48**	**0.52**	**0.59**	**0.69**	**0.79**	**0.89**	**0.99**	**1.09**	**1.19**	**1.24**	**1.29**
Grain corrosion								xxx				
Abundance	high	high	high	high	high	high	high	high	low	high	low	high
Diversity	mod	mod	mod	mod	mod	mod	mod	mod	low	mod	mod	mod
Suitable for further analysis?	y	y	y	y	y	y	y	y	n	y	n	y

Appendix 5 Diatom assessment results

Diatom Taxon / Sample Depth (m bgl)	<1> 0.44	<2> 0.59	<3> 0.79	<4> 0.89
Acidobiontic				
Brachysira serians	1		2	
Tabellaria quadriseptata	3	3	2	1
Acidophilous				
Achnanthes scotica		1		
Brachysira vitrea			1	
Eunotia sp.				1
Eunotia flexuosa	1	1		
Eunotic incisa	1	1	1	1
Eunotia naegelii	1			
Eunotia pectinalis var. *minor*		1	1	
Eunotia pectinalis var. *ventralis*	1	1		
Eunotia rhomboidea	1	1		
Fragilaria virescens var. *exigua*		1	1	
Frustulia rhomboides	1	1	1	
Frustulia rhomboides var. *saxonica*	1	1	2	2
Pinnularia abaujensis	1		1	
Pinnularia biceps	1	1		
Pinnularia microstauron		1	1	
Tabellaria fenestrata	1		1	
Tabellaria flocculosa			1	
Other non-planktonic species				
Fragilaria construens var. *venter*		1	1	
Fragilaria pinnata		1	1	
Fragilaria brevistriata		1		
Fragilaria sp.	1	1	2	
Gomphonema acuminatum	1	1		
Neidium affine		1		
Nitzschia scalaris			1	
Pinnularia sudetica		1		
Sellaphora pupula		1		
Caloneis sp.				1

Appendix 6 Borehole and deposit model data

Borehole	Easting	Northing	Elevation	Total depth (m)	Water depth (m)	Retained borehole	Water surface (uncorrected) (m OD)
WA-01	391324.50	91378.69	9.19	1.15	0.21		9.40
WA-02	391330.72	91380.85	9.19	2.00	0.24		9.43
WA-03	391334.54	91377.36	9.15	1.50	0.28	Yes	9.43
WA-04	391312.97	91365.40	9.12	1.25	0.35		9.47
WA-05	391350.96	91357.82	9.14	1.60	0.33		9.47
WA-06	391272.21	91354.34	9.33	0.95	0.17		9.50
WA-07	391272.46	91351.56	9.01	0.80	0.24		9.25
WA-08	391271.32	91348.34	9.34	1.05	0.05		9.39
WA-09	391285.14	91345.18	8.98	0.80	0.45		9.43
WA-10	391342.96	91325.77	9.07	1.20	0.50	Yes	9.57
WA-11	391372.21	91346.16	9.11	1.20	0.29		9.40
WA-12	391371.09	91338.83	9.13	1.70	0.27		9.40
WA-13	391291.49	91323.50	9.11	0.94	0.27		9.38
WA-14	391351.86	91332.20	9.07	1.05	0.37		9.44
WA-16	391304.56	91303.54	8.97	1.00	0.28		9.25
WA-17	391372.70	91297.36	9.17	1.60	0.27		9.44
WA-18	391349.62	91294.53	9.19	1.05	0.25		9.44
WA-19	391369.44	91292.91	9.22	1.50	0.22		9.44
WA-20	391367.21	91288.83	9.16	1.50	0.29	Yes	9.45
WA-21	391293.50	91281.80	8.69	0.79	0.45		9.14
WA-22	391295.01	91282.18	8.95	1.00	0.35		9.30
WA-23	391296.82	91281.46	9.23	1.00	0.12		9.35
WA-24	391349.55	91310.62	9.24	1.50	0.26	Yes	9.50
WA-25	391303.44	91348.10	9.19	1.25	0.42		9.61
WA-26	391293.01	91343.58	9.10	0.95	0.33	Yes	9.43
WA-27	391363.43	91367.33	8.92	1.43	0.50		9.42
WA-28	391408.74	91313.17	8.84	1.55	0.36		9.20
WA-29	391337.84	91263.44	9.09	1.05	0.28		9.37



Site location and BGS bedrock geology

Figure 1

391000
391250
391500
91500
91250

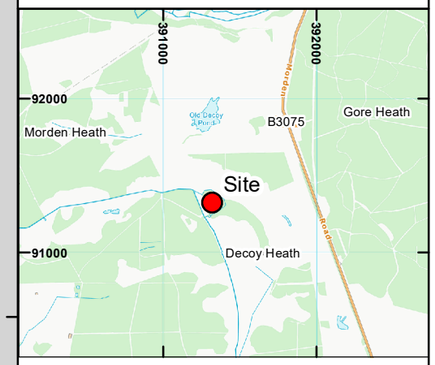
Morden Bog
National Nature Reserve

The Decoy

Decoy Heath

WA-01
WA-02
WA-03
WA-27
WA-04
WA-05
WA-06
WA-07
WA-08
WA-25
WA-26
WA-09
WA-11
WA-12
WA-14
WA-13
WA-10
WA-24
WA-28
WA-16
WA-18
WA-17
WA-20
WA-19
WA-22
WA-21
WA-23
WA-29

0
100 m



Boreholes

Superficial Geology

Alluvium - Clay, Silt, Sand and Gravel

Head - Clay, Silt, Sand and Gravel

Date:	08/08/2023
Revision Number:	0
Scale:	1:2,500 at A3
Illustrator:	ND
Path:	X:\Projects\273310\GO\
Rep figs\Geoarch\2023_08_07	

Site location and BGS superficial geology

Figure 2

391300
391400
91400
91300
WA-01
WA-02
WA-03
WA-04
WA-27
WA-05
WA-06
WA-07
WA-08
WA-09
WA-26
WA-25
WA-11
WA-12
WA-14
WA-10
WA-13
WA-24
WA-28
WA-16
WA-17
WA-18
WA-19
WA-20
WA-21
WA-23
WA-22
WA-29
0
50 m
391250
391500
91500
91250
Morden Bog
National Nature Reserve
Site
The Decoy
Decoy Heath
Boreholes
Transect 1
Transect 2
Transect 3

Date:	08/08/2023
Revision Number:	0
Scale:	1:800 at A3
Illustrator:	ND
Path:	X:\Projects\273310\GO\
Rep figs\Geoarch\2023_08_07	

Borehole and transect locations

Figure 3

X:\Projects\273310\Graphics_Office\Rep figs\Geoarch\2023_08_07

West

East

WA-07

WA-09

WA-26

WA-25a

WA-10a

WA-14

WA-12

WA-28

Depth (m OD)

9.4
9.2
9.0
8.8
8.6
8.4
8.2
8.0
7.8
7.6
7.4

Stratigraphy

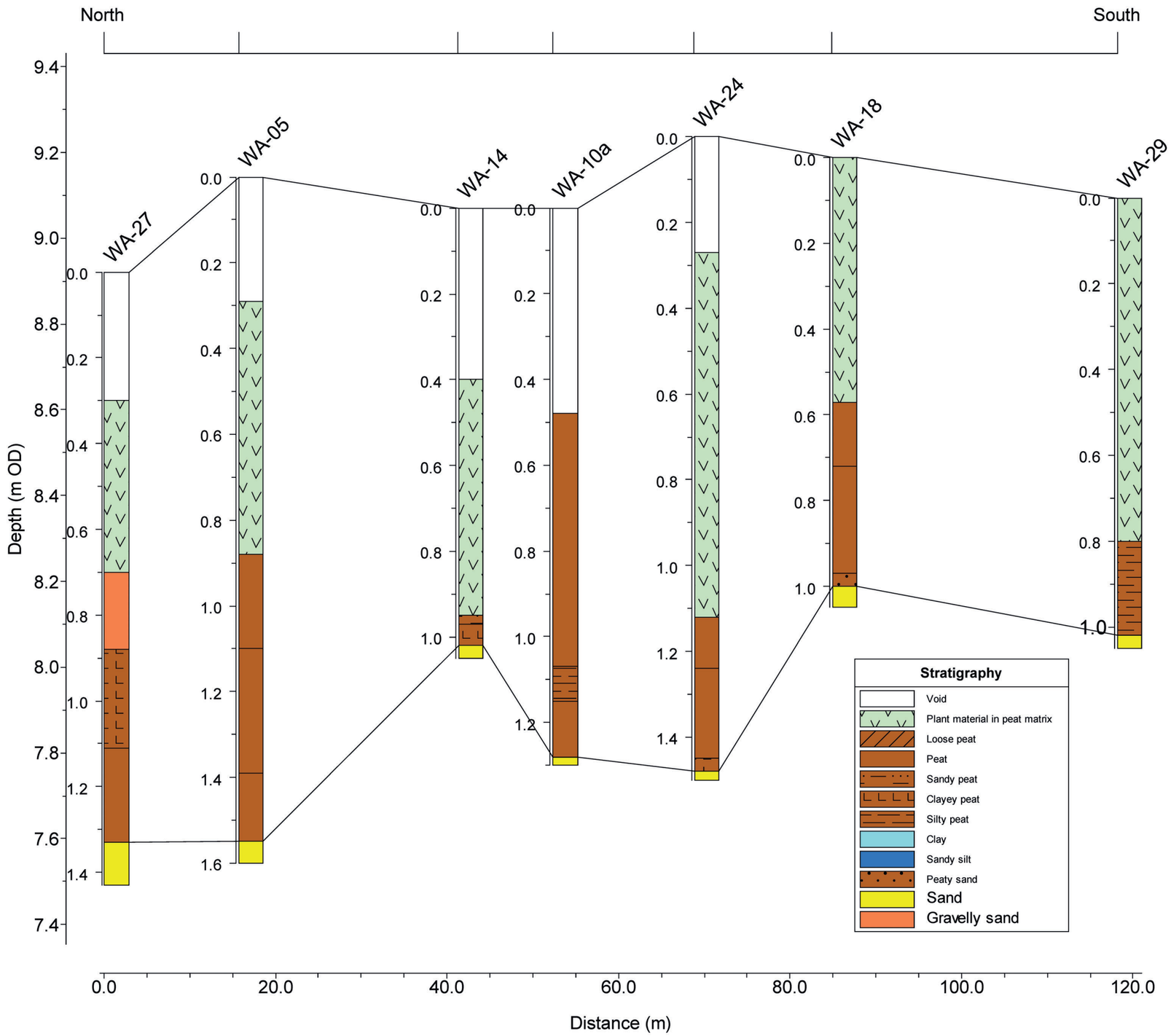
- Void
- Plant material in peat matrix
- Loose peat
- Peat
- Sandy peat
- Clayey peat
- Silty peat
- Clay
- Sandy silt
- Peaty sand
- Sand
- Gravelly sand

0.0 20.0 40.0 60.0 80.0 100.0 120.0 140.0

Distance (m)

Date: 09/08/2023	Created by: ND	Revision: 0	Scale: NTS

Figure 4: Transect 1



Date: 08/08/2023	Created by: ND	Revision: 0	Scale: NTS

Figure 5: Transect 2

X:\Projects\273310\Graphics_Office\Rep figs\Geoarch\2023_08_07

North

South

WA-02

WA-01

WA-04

WA-25a

WA-26

WA-13

WA-16

WA-22

WA-21

Depth (m OD)

Distance (m)

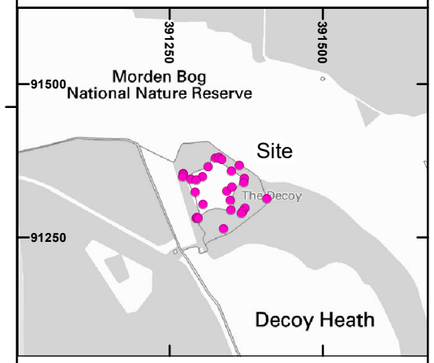
Stratigraphy

- Void
- Plant material in peat matrix
- Loose peat
- Peat
- Sandy peat
- Clayey peat
- Silty peat
- Clay
- Sandy silt
- Peaty sand
- Sand
- Gravelly sand

Date: 08/08/2023 | Created by: ND | Revision: 0 | Scale: NTS

Figure 6: Transect 3

391300
391400
91400
91300
WA-01
WA-02
WA-03
WA-04
WA-27
WA-05
WA-06
WA-07
WA-08
WA-09
WA-26
WA-25
WA-11
WA-12
WA-14
WA-10
WA-13
WA-24
WA-28
WA-16
WA-17
WA-19
WA-20
WA-18
WA-21
WA-23
WA-22
WA-29
0
50 m



Boreholes
Transect 1
Transect 2
Transect 3

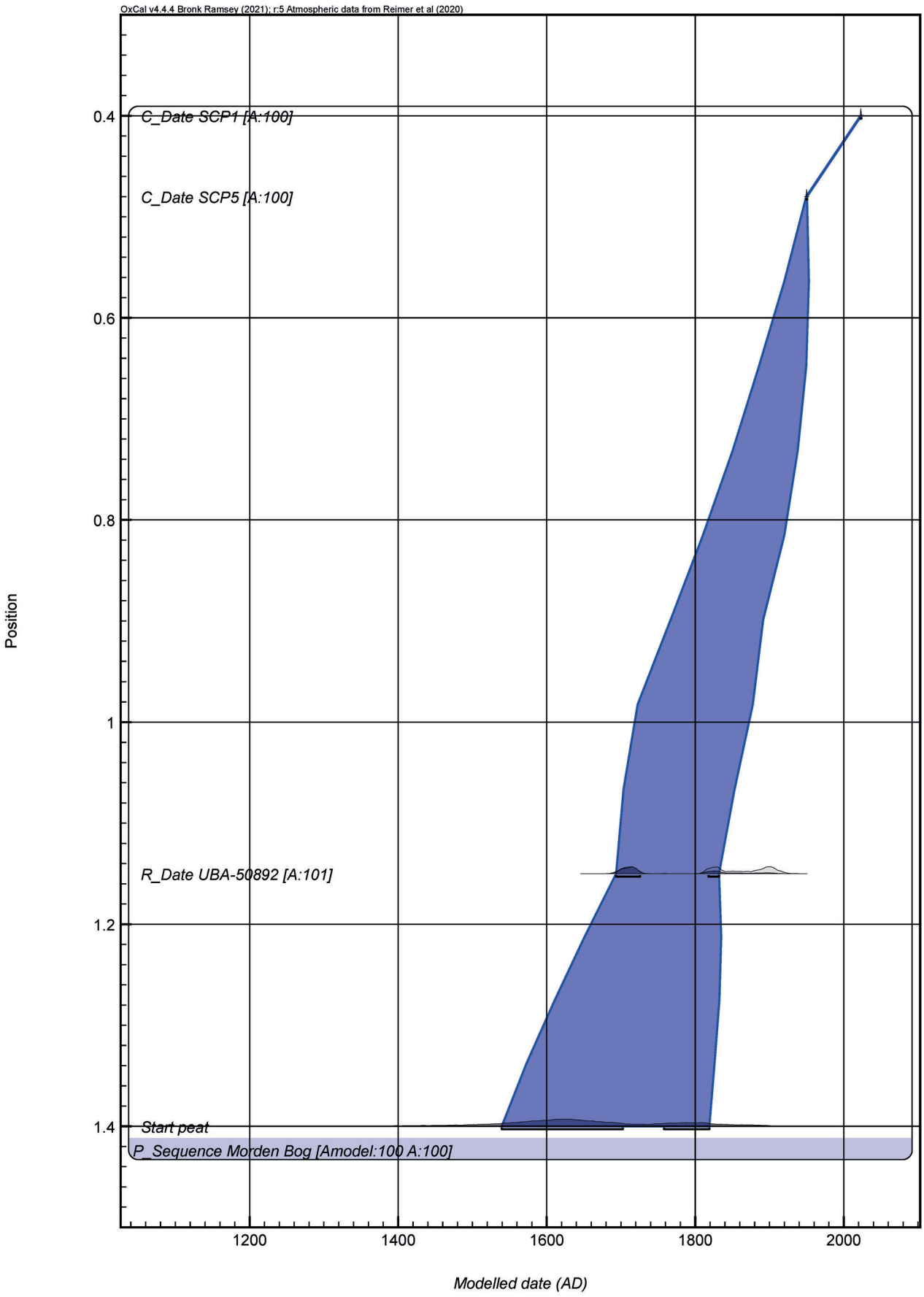
Sand surface
(m OD)

- 8.31 - 8.40
- 8.21 - 8.30
- 8.11 - 8.20
- 8.01 - 8.10
- 7.91 - 8.00
- 7.81 - 7.90
- 7.71 - 7.80
- 7.61 - 7.70
- 7.51 - 7.60
- 7.41 - 7.50
- 7.31 - 7.40
- 7.21 - 7.30
- 7.20 - 7.20

Date:	08/08/2023
Revision Number:	0
Scale:	1:800 at A3
Illustrator:	ND
Path:	X:\Projects\273310\GO\
Rep figs\Geoarch\2023_08_07	

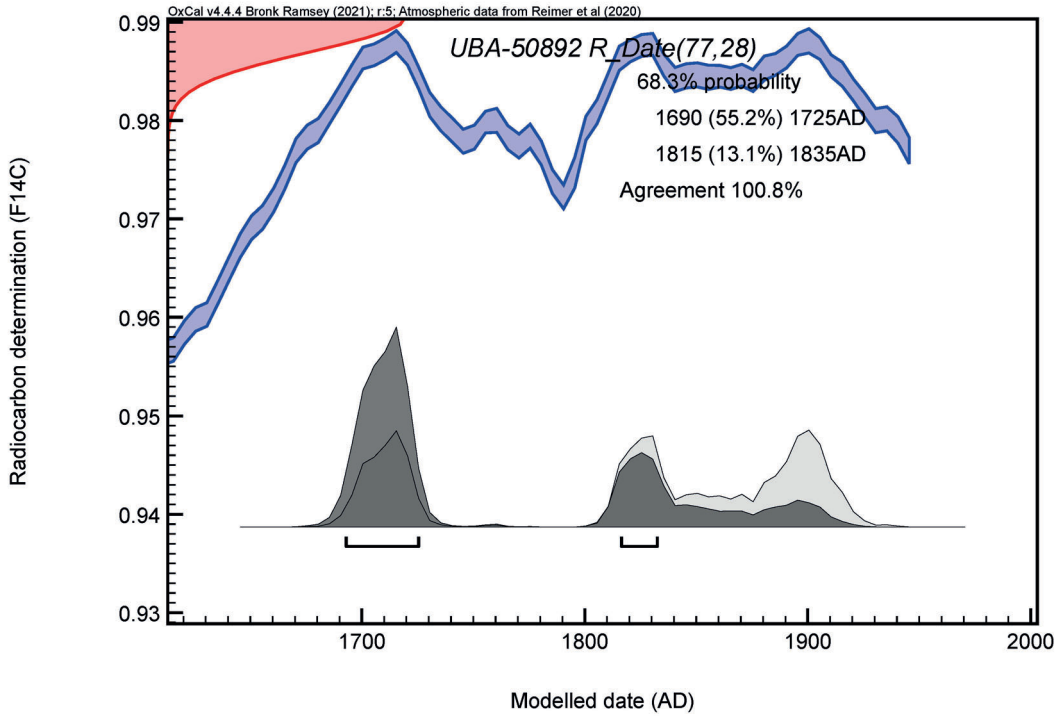
Surface of the Sand

Figure 7



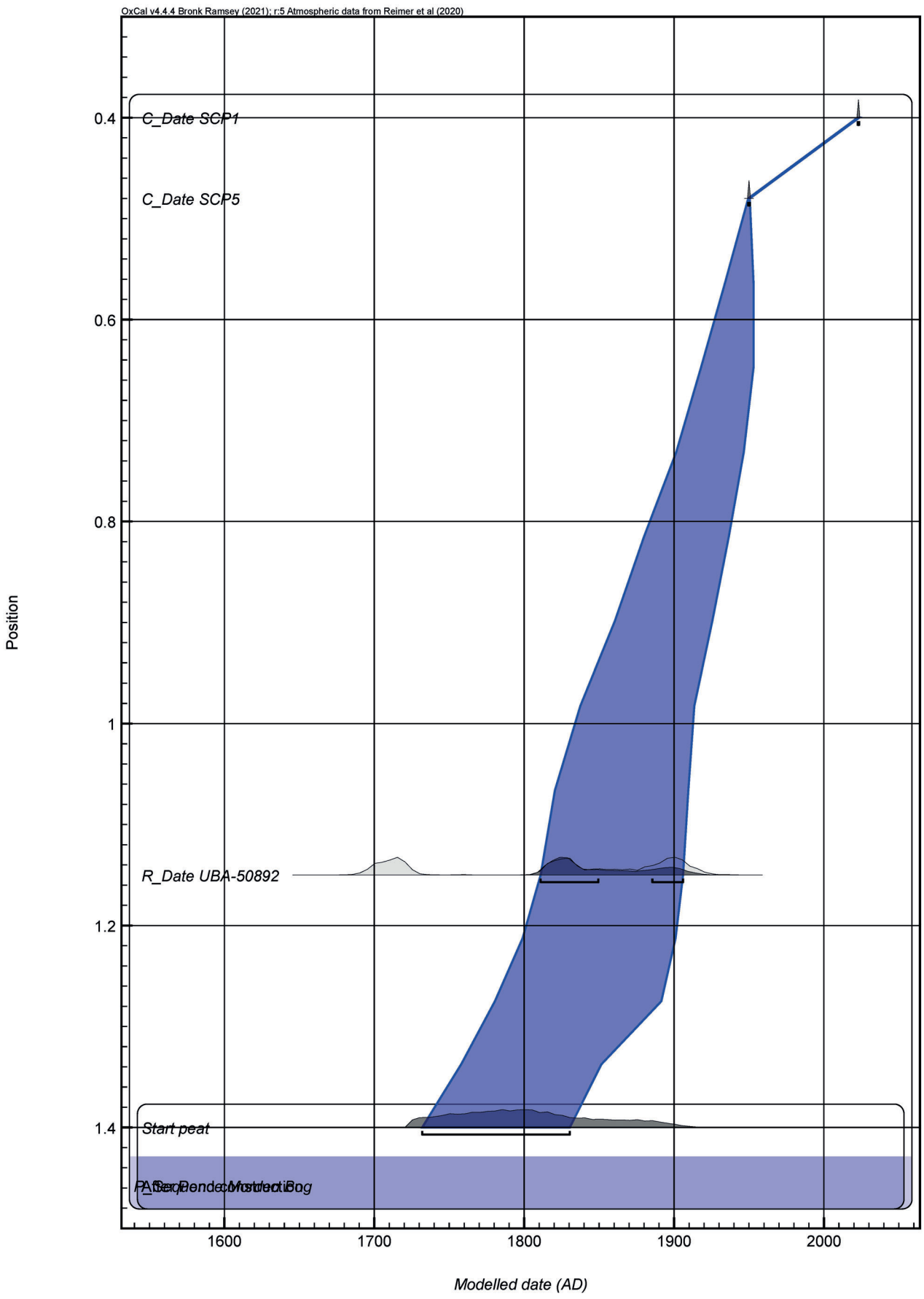
Date: 08/08/2023	Created by: ND	Revision: 0	Scale: NTS

Figure 8: Age depth model for borehole WA-025a (Model 1)



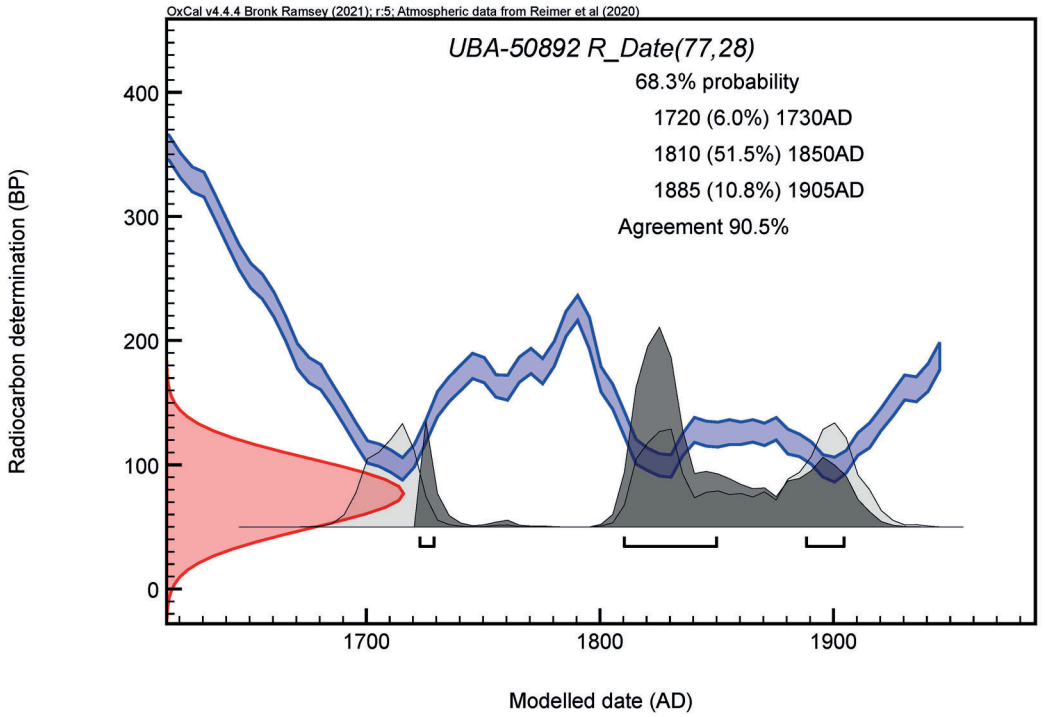
Date: 08/08/2023	Created by: ND	Revision: 0	Scale: NTS

Figure 9: Radiocarbon date results (Model 1)



Date: 08/08/2023	Created by: ND	Revision: 0	Scale: NTS

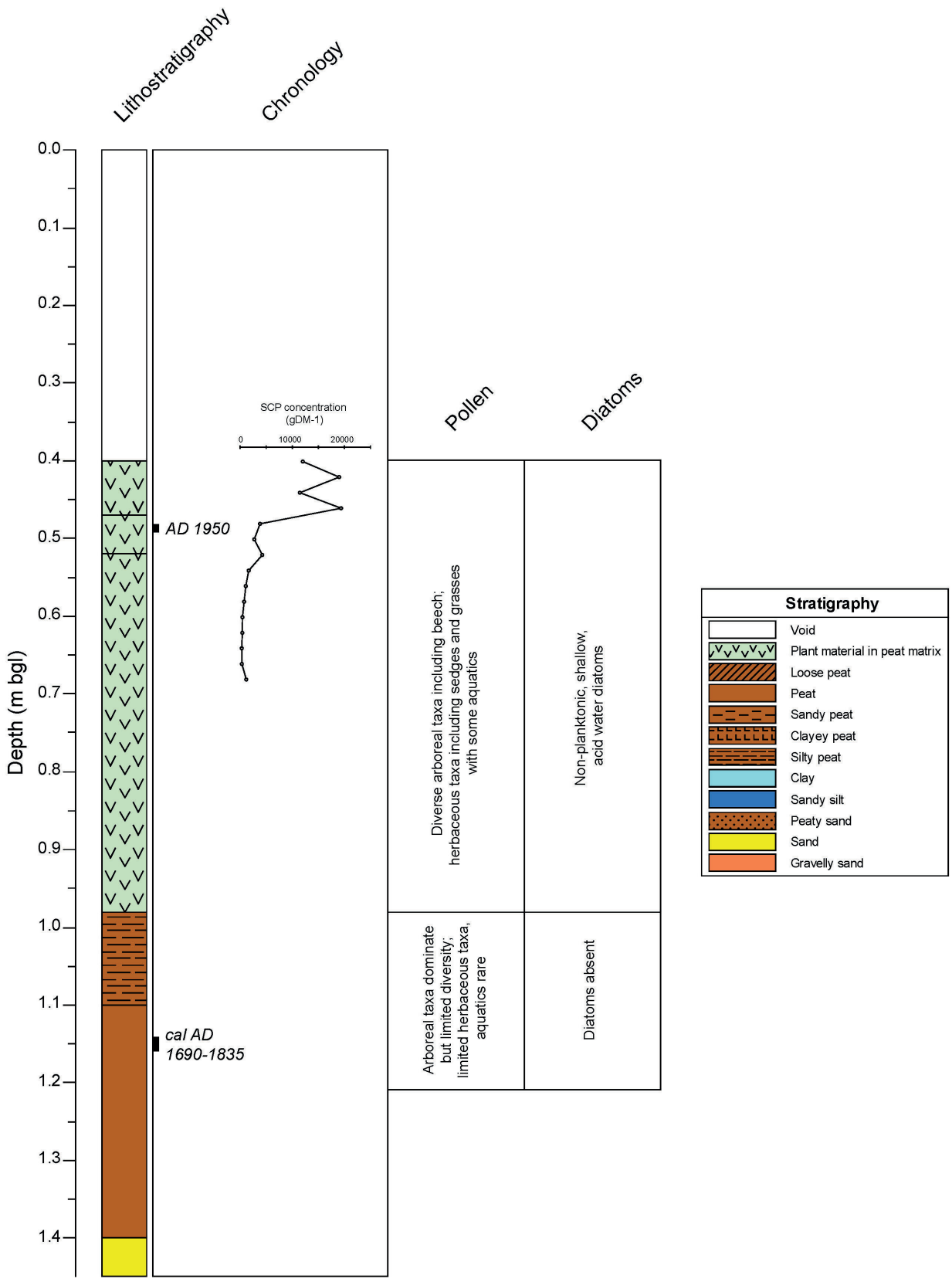
Figure 10: Age depth model for borehole WA-025a (Model 2)



Date: 08/08/2023	Created by: ND	Revision: 0	Scale: NTS

Figure 11: Radiocarbon date results (Model 2)

X:\Projects\273310\Graphics_Office\Rep figs\Geoarch\2023_08_07



Date: 11/08/2023	Created by: ND	Revision: 0	Scale: NTS

Figure 12: Lithostratigraphy and chronology of borehole WA-25a

Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www. wessexarch.co.uk

FS 606559