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Aberdeen Western Peripheral Route/Balmedie-Tipperty Lot 4 – Fastlink Invasive Archaeological Investigations

**Backburn Moss (Site 119)
Palaeoenvironmental Sampling
& Analysis Report**

Report No. 3045



CFA ARCHAEOLOGY LTD

The Old Engine House
Eskmills Business Park
Musselburgh
East Lothian
EH21 7PQ

Tel: 0131 273 4380
email: info@cfa-archaeology.co.uk
web: www.cfa-archaeology.co.uk

Author	Michael Cressey HND BA MSc PhD FSA Scot MIFA and Robert McCulloch BA PhD FRSGS
Illustrator	Tamlin Barton MA
Editor	Tim Neighbour BSc FSA Scot MIFA
Employer	Aberdeen City Council
Consultant	Jacobs UK Ltd
Date issued	January 2014
Version	2

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**Aberdeen Western Peripheral Route/Balmedie-Tipperty
Lot 4 – Fastlink
Invasive Archaeological Investigations**

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NON-TECHNICAL SUMMARY

1. A programme of peat sampling was carried out at Blackburn Moss Wetland (Site 119), which lies along the Fastlink section of the Aberdeen Western Peripheral Route/Balmedie-Tipperty (AWPR/B-T). A peat reconnaissance survey carried out in 2012 confirmed that the peat formed within Blackburn Moss was no deeper than 1.5m.
2. An overlapping core was extracted from the deepest point within Blackburn Moss at site AP23. Probing along a transect close to this sampling point confirmed that the base of the profile was gradual and formed within a very shallow basin. Following field assessment and recording of the character of the peat, palynological sub-sampling and analysis, AMS radiocarbon dating, and vegetation reconstruction were undertaken.
3. The palaeoenvironmental analysis of Blackburn Moss has demonstrated that the site provides a continuous record of environmental change from c.9,550 Cal yrs BP to the present that offers an insight into how the vegetation developed in sympathy with prevailing climatic conditions. The radiocarbon dating of the core has enabled inferences about the timing and rate of environmental change. In particular, the sequence of fenland to clearance and back to fenland between 4,840 and 3,190 Cal yrs BP, which occurs across the Neolithic and Bronze Age cultural boundary, is intriguing.
4. Recommendations are made to augment the analysis by additional pollen counting supported by three new radiocarbon dates at critical points within the peat sequence to provide a more robust statistical representation of the timing of woodland clearance and the emergence of farming within the study area.

1. INTRODUCTION

- 1.1 This report presents the results of peat sampling at Blackburn Moss (Site 119, NGR: NO 86865 90448, Fig. 1) carried out at the deepest point of the Moss (AP23) as identified by preliminary peat reconnaissance work carried out by Headland Archaeology Ltd in 2012 (Timpany 2012, Site 119, Fig. 2).
- 1.2 The employer for this project was Aberdeen City Council and overall responsibility for its delivery lies with the AWPR/B-T Managing Agent. Jacobs UK Ltd was appointed as the consultants, CFA Archaeology Ltd was the Contractor for this part of the programme of works, and the curator was Historic Scotland.

2. BACKGROUND

- 2.1 Two areas of peatland, Red Moss Wetland (Site 67) and Blackburn Moss Wetland (Site 119), along the Fastlink section of the planned Aberdeen Western Peripheral Route/Balmedie-Tipperty were identified as having potential to contain deep sediment sequences of peat and silts, which could be of palaeoenvironmental significance (Timpany 2012, 7). A palaeoenvironmental assessment carried out between August and October 2012 demonstrated that at both sites the peat depths were shallow, attaining a maximum depth of 1.2m at Red Moss and 1.5m at Blackburn Moss (Timpany 2012, 11-14). It was discovered that the peat survived in pockets rather than as continuous peat cover across the whole of each area. Peat was observed at both locations as having accrued over shallow water bodies, infilling small hollows in the landscape. The biostratification observed within the peat sequences was attributed to sedge and grass swamp communities with later colonisation by trees typical of fenlands, including birch, alder and willow.
- 2.2 As part of the peat distribution assessment, 45 auger point (AP) locations were established and used to create a 2D contour map of peat thickness for Blackburn Moss (Timpany 2012, Site 119, Fig 2, reproduced in this report as Fig 2a).
- 2.3 A range of prehistoric monuments and features are recorded in the immediate vicinity of Blackburn Moss Wetland, including the Scheduled Monument of White Hill, House and Field System (SM Index no. 4875), comprising prehistoric roundhouses and field systems, a findspot of a Late Bronze Age sword, megalithic standing stones, and cist and cairn burials. It was considered that a pollen sequence from Blackburn Moss would have great potential to inform on associated anthropogenic activity in the landscape.
- 2.4 Timpany (2012, 16-17) recommended that a core be taken from the deepest peat sequence encountered at Blackburn Moss for radiocarbon dating and further analysis. It was recommended that the chronology of the sequence should be attained through radiocarbon dating of the lower-third and basal layers of the peats in order to constrain in time evidence of anthropogenic impact on the landscape. If the dates were found to be from the later

prehistoric period, it was further recommended that pollen analysis (local and regional vegetation) together with peat humification analysis, loss-on-ignition (to define the nature of sediment or peat accumulation and / or erosion events) and plant macrofossil (local vegetation) analysis should be undertaken to investigate the impact of people in the landscape during the periods the archaeological features were active.

3. AIMS AND OBJECTIVES

- 3.1 Gross stratigraphical and fossil pollen records support inferences of environmental change influenced by dynamic changes in climate and also likely impacts from human activities in prehistory, and so provide valuable supporting evidence to advance our understanding of archaeological and wider landscape change.
- 3.2 The aim of the palaeoenvironmental sampling and analysis was to mitigate the partial loss of palaeoenvironmental evidence at Blackburn Moss Wetland (Site 119) through analysis of retrieved sediments and palaeoenvironmental remains to allow the local and regional environment and the development of Blackburn Moss in the Holocene, and human interaction with the environment during this period, to be more fully understood.
- 3.3 To achieve this, a continuous sample through the peat to the pre-Holocene surface was to be extracted from the area of Blackburn Moss Wetland (Site 119) where the palaeoenvironmental assessment report (Timpany 2012) indicated that peat was deepest.
- 3.4 Following core retrieval, the sample was to be cleaned and, based on a visual examination, a description of the botanical composition of the peat, as well as an estimation of the degree of humification, produced. Based on the visual inspection and advice from the palynologist, sub-sampling sections were to be identified and analysis of the palaeoenvironmental and geo-archaeological material surviving within these sub-samples undertaken to meet the aims. Two radiocarbon dates were to be obtained from two key positions within the core, based on the findings of the pollen analysis.
- 3.5 The four-stage approach set out in CFA's *Peat Coring Strategy* for Lot 4 was adopted to address the research objectives presented as Section 7 of the *Palaeoenvironmental Assessment* (Timpany 2012) and the aims stated above:

Stage 1 - Review of existing site information

Stage 2 - Core Retrieval

Stage 3 - Laboratory Analysis

Stage 4 - Reporting

4. TOPOGRAPHICAL SETTING

- 4.1 The AP23 coring site (Fig 1) was located in a small circular clearing c.50m in circumference, bounded to its north by stunted willow trees (*Salix caprea*). To the south (within c.30m) the ground rose by about 2m and was covered in a blanket of heather (*Calluna vulgaris*). At the base of the heather was a modern drainage ditch c.0.5m wide. At the coring site the dominant vegetation was sedge and grasses (undiff), horse tail (*Equisetum*) and marsh marigold (*Caltha palustris*).

5. METHODOLOGY

5.1 Peat Probing and Peat Core Extraction

- 5.1.1 CFA followed the theory, and practice of methods for palaeoenvironmental analysis described by English Heritage (2011) and field methodologies set out in English Heritage (2007). Soil classifications were based on the Soil Survey handbook, and sediments were described and recorded using Troels-Smith's scheme (Hodgson 1976, Troels-Smith 1955). The field examination of peat cores follows the standards described by the Association for Environmental Archaeology (AEA 1995).

- 5.1.2 The location of the AP23 auger site was identified and a 12m peat probe transect was established across the site. Probes were taken at 2m intervals along the transect in order to produce a profile of the basin in which the peat had formed (Fig 2b). The results confirmed the findings of Timpany (2012): the basin in which the peat had formed was shallow, with gradual sides and a basal depth of 1.5m.

- 5.1.3 Two 1m long overlapping cores were extracted from within 0.10m of the AP23 site using a hand-held Russian D-corer. The individual units within the peat sequence were recorded according to methodology in Troels-Smith (1955) and colour classifications were recorded using the Munsell soil colour charts. The position of the core was recorded to survey-grade accuracy ($\pm 10\text{mm}$) and plotted onto base maps.

- 5.1.4 The overlap position was recorded on the plastic gutter containers in the field whilst the sediment was still fresh. Observation notes were made on the biostratigraphic character of the open cores prior to their oxidation. The cores were sealed in cling film to maintain their moisture integrity and removed to cold storage.

5.2 Laboratory Methodology (Robert McCulloch)

Organic content

- 5.2.1 To assess the organic content of each sub-sample as a measure of bioproductivity/preservation of organic material each sub-sample was dried for >24 hrs and then combusted in a muffle furnace at 550°C for 4 hours. The

loss-on-ignition (LOI) enabled the calculation of the percentage organic content for each sub-sample. The results are presented in Fig 3a.

Pollen preparation and analysis

5.2.2 Fossil pollen samples were prepared in the Palaeoecology Laboratory at the Division of Biological & Environmental Science, University of Stirling, and using standard pollen preparation procedures (Moore *et al* 1991). To enable the Stage 3 analysis of the total concentrations of pollen in each sample, tablets containing *Lycopodium clavatum* spores of known concentration were added to each sample and the spores counted alongside the fossil pollen (Stockmarr 1971). Pollen was identified using an Olympus BX43 light microscope at $\times 400$ magnification with critical identifications made at $\times 800$ and assisted by a pollen reference collection and photomicrographs (Moore *et al* 1991). For this analysis a Total Land Pollen (TLP) sum of ≥ 100 pollen grains was obtained for each sample (Moore *et al op cit*). The pollen analysis results are presented in Fig 3b as a percentage pollen diagram.

Chronology

5.2.3 To constrain changes within the palaeoenvironmental reconstruction in time and to understand rates of change, two samples were taken for radiocarbon (^{14}C) Accelerator Mass Spectrometry (AMS) dating. These dates enable the construction of an age-depth model which is applied to the LOI, humification and pollen results. Samples were assayed at Beta Analytic.

6. CORING RESULTS

6.1 Field recording of the biostratigraphic profile

6.1.1 The biostratigraphic profile is described in Table 1 and shown on Fig 2c. The Von Post Scale (reproduced as Appendix 1) has been used in the assessment of degrees of decomposition of organic matter.

Unit	Depth (cm)	Summary Description	Von Post Scale
1	0-145	Well humified amorphous fen peat (Munsell 10YR2/2), very dark brown with abundant plant fibres and woody fragments. Occasional woody fragments becoming more frequent towards 0.80m depth.	H5
2	145-148	Very thin layer of more detrital-type peat (Munsell 10YR 2/2) Very dark brown with finer plant remains. Large woodier fragments absent. Both boundaries are gradational.	H9
3	148-150	Basal organic mud (10YR 5/2) Greyish-brown. Roots and plant remains absent. Plastic consistency. No mineral inclusions.	n/a

Table 1. Biostratigraphic Units in the SP23 peat core

7. LABORATORY ANALYSIS RESULTS (Robert McCulloch)

7.1 Chronology

7.1.1 The radiocarbon results are presented in Table 2.

Sample depth (cm)	¹⁴ C yrs BP	Cal yrs BP	¹³ C/ ¹² C Ratio	Lab Code
94-95	5,710±30	6,440 to 6,310	-31.4 ‰	Beta - 361683
147-148	8,720±40	9,560 to 9,520	-33.4 ‰	Beta - 361682

Table 2: Radiocarbon age results

7.2 Palaeoenvironmental Reconstruction

7.2.1 To aid description and interpretation, the Blackburn Moss site has been divided into Local Pollen Assemblage Zones (LPAZs) produced by Constrained Incremental Sum of Squares (CONISS) analysis of the significant land pollen taxa (>2%) identified within the record. The LPAZ scheme is applied to Figs 3a-b.

7.2.2 The gross stratigraphic results (visual stratification, organic content, humification and chronology) suggest a highly organic peat with frequent woody fragments overlying an organic-rich clay layer above an impenetrable base, likely to be glacial diamict. The humification results are high at the lower boundary of LPAZ B-1 as a result of the higher mineral content at the base of the core. During LPAZ B-1 and into the lower bounds of LPAZ B-2 the relatively higher proportion of mineral content results in the organic content being ~80% and, correspondingly, the % Transmission is slightly higher (~20%). Midway through LPAZ B-2 the organic content rises to ~95% (peat) and the humification lowers to ~10% and remains relatively constant for the rest of the record.

7.3 Palaeoecological results

7.3.1 The palaeoecological results are:

- **LPAZ B-1:** The pollen assemblage consists of *Betula* (birch) (~30%) and lesser proportions of *Alnus* (alder), *Corylus avellana* type (hazel), *Salix* (willow), Poaceae (grasses) and *Filipendula* (meadow sweet). The basal sample consists of *Calluna vulgaris* (ling, heath) and the proportion of alder increases to mid zone and then rapidly declines but all other components are relatively stable. During this period Cyperaceae (sedges) are prevalent at the site (>20%).
- **LPAZ B-2a:** The pollen assemblage predominantly comprises birch and rising proportions of alder and the herbaceous taxa (particularly meadow sweet) are reduced. *Pinus* (pine) present in LPAZ B1 and through LPAZ B-2a virtually disappears at the upper zone boundary.
- **LPAZ B-2b:** at the lower boundary alder reaches its peak (~50%) and then gradually declines and birch correspondingly increases. Arboreal taxa are most

dominant and herbaceous taxa are at a minimum and even sedges are much reduced.

- **LPAZ B-3:** The arboreal content shows a marked reduction during this zone, largely through the reduction in alder and *Quercus* (oak). Hazel shows a small peak and heather significantly increases during this zone along with sedges. At the same time as this reduction in tree cover and expansion of heath there is a small but sustained increase in charcoal.
- **LPAZ B-4:** The reduction in arboreal content of the previous LPAZ is dramatically reversed and alder and birch expand to previous levels in LPAZ B-2b, including small amounts of oak. Heath and other herbaceous taxa correspondingly diminish to the virtual exclusion of grasses.
- **LPAZ B-5:** Again the arboreal content is reduced and heath vegetation and sedges expand with smaller amounts of grasses returning.

8. INTERPRETATION

- 8.1 The radiocarbon dates, stratification and microfossil content from the coring at Blackburn Moss suggest that a continuous Holocene record from c.9,550 Cal yrs BP to the present has been captured. The eastern region of Aberdeenshire was ice free well before the onset of the Holocene, so the basal sediments are of weathered glacial diamict (Golledge 2002). It is likely that the site was drier during the Late-glacial (including the Loch Lomond stadial) which prevented the accumulation and preservation of organic material.
- 8.2 The resolution of the peat core is low (150cm spanning c. 9,550 Cal years) and the humification results suggest that the slow accumulation of peat was mirrored by the extensive breakdown of the plant material with only infrequent woody fragments remaining in the soft black humic-rich matrix. However, the fossil pollen content is very high and the preservation of the pollen grains is excellent. The radiocarbon dates indicate a relatively linear rate of accumulation and there is sufficient spatial and temporal difference between sub-samples to ensure that the palaeoenvironmental record from Blackburn Moss can be interpreted with a high degree of confidence:
- *Between c.9,550 and 8,000 Cal yr BP* the drier areas of the site were colonised by a more open covering of birch and lesser amounts of pine, hazel, grasses and tall herbs such as meadow sweet. The wetter areas of the site were likely favoured by the alder, willow and sedges. The pattern is indicative of the initial colonisation and development of a natural fenland vegetation during the humid-temperate climate.
 - *Between c.8,000 and 6,850 Cal yr BP* the ‘alder rise’ is recorded, a frequently observed occurrence across Scottish bogs and fenlands at this time (Tipping 1994). The arboreal cover at the site increased with a corresponding loss of the understory taxa. Mixed woodland of birch, alder, pine and oak was present together with a smaller cover of hazel and willow shrub. The increase in leaf

cover and concomitant evapotranspiration may have promoted relatively drier conditions: this interpretation is supported by the corresponding reduction in the sedges in the record while the grasses persist.

- *Between 6,850 and 4,840 Cal yr BP* the peak in alder suggests the dominance of wetland vegetation, an event contemporary with the decline in pine. The 'pine decline' is generally later in Scotland at c. 4,000 Cal yr BP (Tipping, 1994) but this is probably more a reflection of the wetter fenland characteristics of Blackburn Moss than limited woodland development. The rise in alder peaks mid-zone and then gives way to birch and the suggestion of relatively drier conditions. This is supported by the small but persistent appearance of charcoal at this time. Whether the fire was caused naturally or by human action, it remains difficult to burn wet wood, so the prevalence of fire tends to also indicate the availability of drier fuel.
- *Between 4,840 and 3,190 Cal yr BP* there was a substantial reduction in woodland cover, largely at the expense of alder. There is an increase in the amount of charcoal recorded and an expansion of heathland: this all suggests a shift to relatively drier conditions. The peat stratigraphy during this period remains unchanged and it is unclear to what extent this indicates radical changes at the site. However, there appears to have been an opening up of the canopy and either the migration of heath onto the site or the easier transport of heath pollen from the surrounding areas to the site. The charcoal particles are small (<50µm) which is indicative of more distal burning and so it may have been the result of the intentional burning of the surrounding muir by prehistoric communities at a time when climatic conditions favoured land clearance by fire.
- *At c.3,190 Cal yr BP* there was a rapid return to wetter conditions at the fen indicated by the expansion of alder. However, this was of relatively short duration and by c.2,260 Cal yr BP there was a return to the drier conditions favoured by birch. The dominance of woodland appears to have excluded (outshaded?) most herbaceous taxa until c. 910 Cal yr BP.
- *Between c. 910 Cal yr BP and the present*, the woodland canopy opened again, as indicated by the spread of sedges and the reduction in birch cover. The opening probably increased the visibility in the pollen record of the surrounding heath as evidenced by the increase in ling. Deliberate land clearance, in order to allow livestock grazing over areas that were poorly drained and too wet for cultivation, is likely to have taken place, but is not visible within the pollen record at the resolution provided at a count of 100 grains of TLP: increasing the count to 300 grains of TLP would be required to provide a more robust statistical examination of the indicators associated with local impacts such as woodland clearance and burning.

9. CONCLUSIONS

9.1 Aberdeenshire has few records of Holocene environmental change. The palaeoenvironmental analysis at Blackburn Moss has demonstrated the following:

- The peat core provides a continuous record of environmental change from c.9,550 Cal yrs BP to the present.
- The radiocarbon dating of the core enables inferences about the timing and rate of environmental change.
- The apparent sequence of fenland to clearance and back to fenland between 4,840 and 3,190 Cal yr BP occurs across the Neolithic and Bronze Age cultural boundary.
- The results of the analysis show that the whole of the Holocene is represented and the upper surface has not been truncated.
- The analysis provides a very important palaeoenvironmental record of the vegetation history of the surrounding area.

10. RECOMMENDATIONS FOR FURTHER WORK

10.1 The palaeoenvironmental analysis has demonstrate that a continuous record of environmental change from c.9,550 Cal yrs BP to the present has been captured by the core. Furthermore, the fossil pollen content is very high and the preservation of the pollen grains is excellent. It would, therefore, be possible to produce a more precise record of the local anthropogenic-driven impacts such as woodland clearance and deliberate burning episodes by carrying out further pollen counting supported by an additional three radiocarbon dates.

10.2 An increase in the pollen counts from the industry-standard 100 grains to the optimum 300 grains of TLP would enable the production of a more robust statistical examination of the indicators associated with local impacts such as woodland clearance and burning, as the landscape was opened up for farming. This would establish with greater accuracy the specific environmental impact of woodland clearance. An additional three AMS radiocarbon dates for critical points within the profile would constrain the major anthropological events in order to establish the timing at which they occurred.

10.3 The results should be presented as an article to be submitted to a suitable palynological/geographical peer reviewed academic journal for dissemination to a wider academic audience. The results would be placed in the context of the wider regional pollen and archaeological record.

11. ARCHIVING

11.1 The project archive, comprising all CFA record sheets, finds, plans and reports, will be deposited at the RCAHMS and will conform to current guidelines in MoRPHE (English Heritage 2006). The deposition of paper and

digital archives with RCAHMS will comply with their current requirements (RCAHMS 1996a, 1996b) and with the Archaeological Archives Forum (Brown 2007) and ADS guidelines for digital archives (Richards and Robinson 2001). All the pollen count data compiled during the analysis will be integrated into the site archive.

- 11.2 A summary statement of the results of this analysis will be submitted for publication in *Discovery and Excavation in Scotland* once all archaeological works are completed. An *OASIS Scotland* entry will be completed.

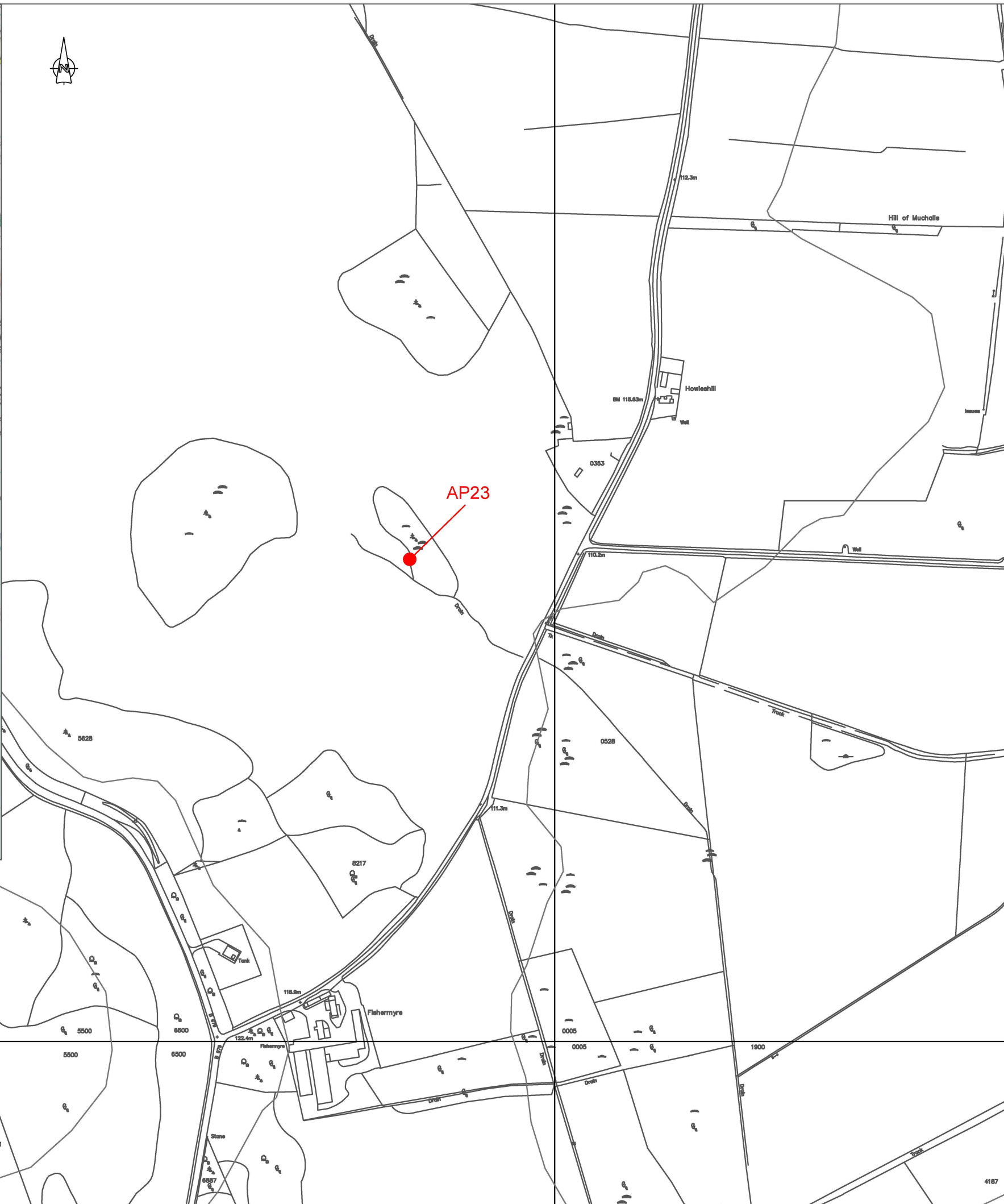
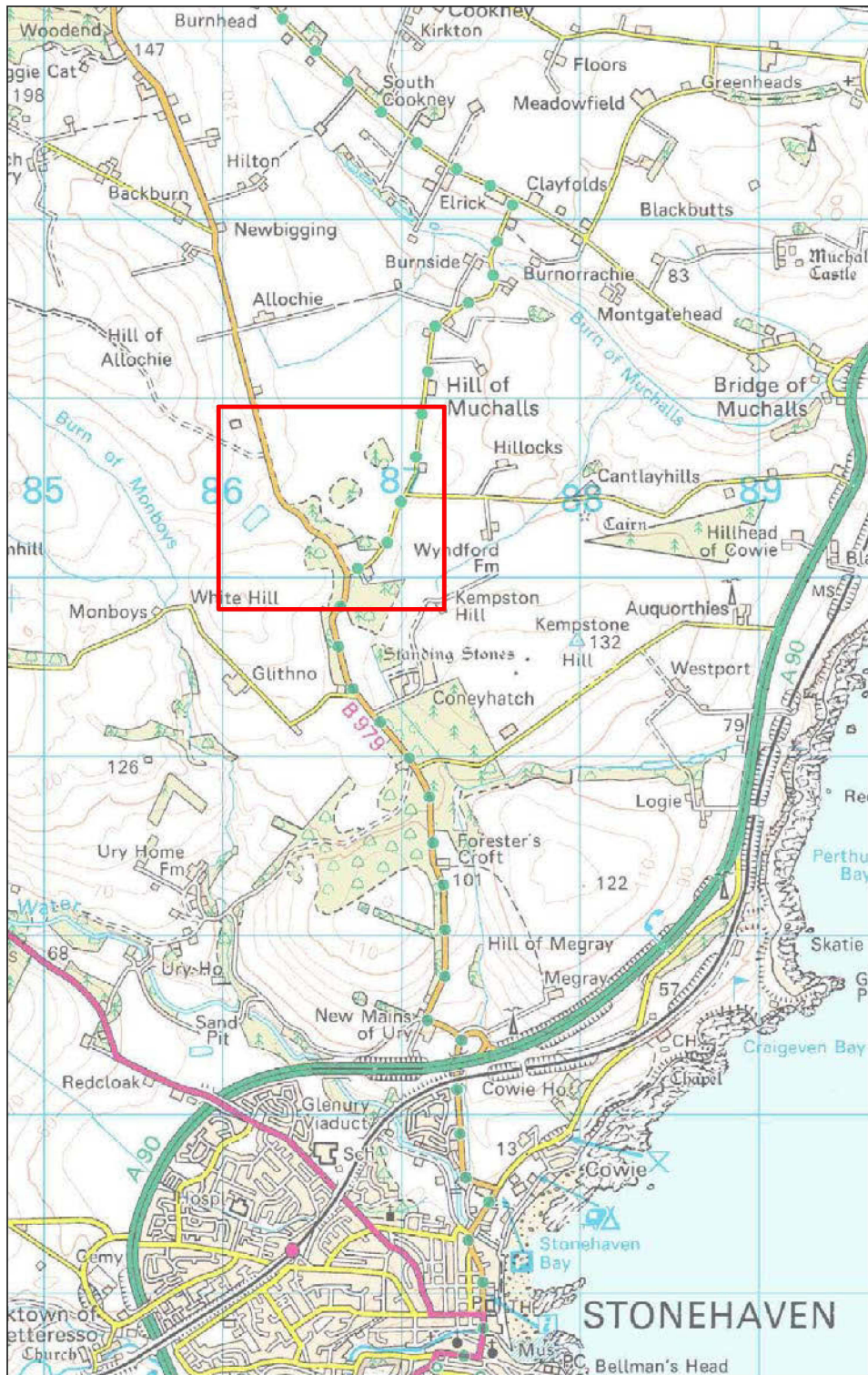
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APPENDIX 1: Assessment Matrix for Degrees of Decomposition, based on the Von Post Scale

Principal Diagnostic Features

Degree of Composition	Nature of water expressed on initial squeezing	Proportion of extruded fingers on further squeezing	Nature of plant remains	Texture	Description	Comments
H1	Clear, colourless	None	Unaltered	Very rough and very spongy	Undecomposed	Living or recently dead
H2	Almost clear, very pale yellow brown		Little altered, entire structures	Very rough and very spongy	Almost undecomposed	
H3	Slightly turbid brown		Broken in pieces but easily identified	Moderately rough, moulded residue when squeezed	Very slightly decomposed	
H4	Turbid brown		Broken into component fragments, leaves are easily identified	Very slightly soapy feel, moulded residue	Slightly decomposed	
H5	Strongly turbid brown, contains a little peat in suspension	Very little	Many difficult to identify	Slightly soapy feel. Moulded residue	Moderately decomposed	Plant remains become amorphous when squeezed
H6	Dark brown, one third of peat in suspension	One third	Many unidentifiable	Moderately pasty, moulded residue	Well decomposed	
H7	Very little water, dark brown	One half	Few remains identifiable	Very pasty, moulded residue	Strongly decomposed	
H8	Little or none	Two thirds	Only resistant fibres, roots bark etc identifiable		Very strongly decomposed	
H9	None	Almost all	Practically no identifiable structures	Feels greasy	Almost completely decomposed	
H10		All (unless to dry)	Completely amorphous	Feels very greasy	Completely decomposed except for microscopic structures (pollen)	



Key:

CFA ARCHAEOLOGY LTD
 The Old Engine House
 Eskmills Park
 Musselburgh
 East Lothian, EH21 7PQ
 t: 0131 273 4380
 f: 0131 273 4381
 e: info@cfa-archaeology.co.uk
 w: www.cfa-archaeology.co.uk

Fig. No:	1	Revision:	A
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Title:
Site location map

Project:
**Backburn Moss (Site 119)
 Palaeoenvironmental
 Sampling & Palynological
 Assessment**

Employer:
Aberdeen City Council

Scale at A3:
1:800

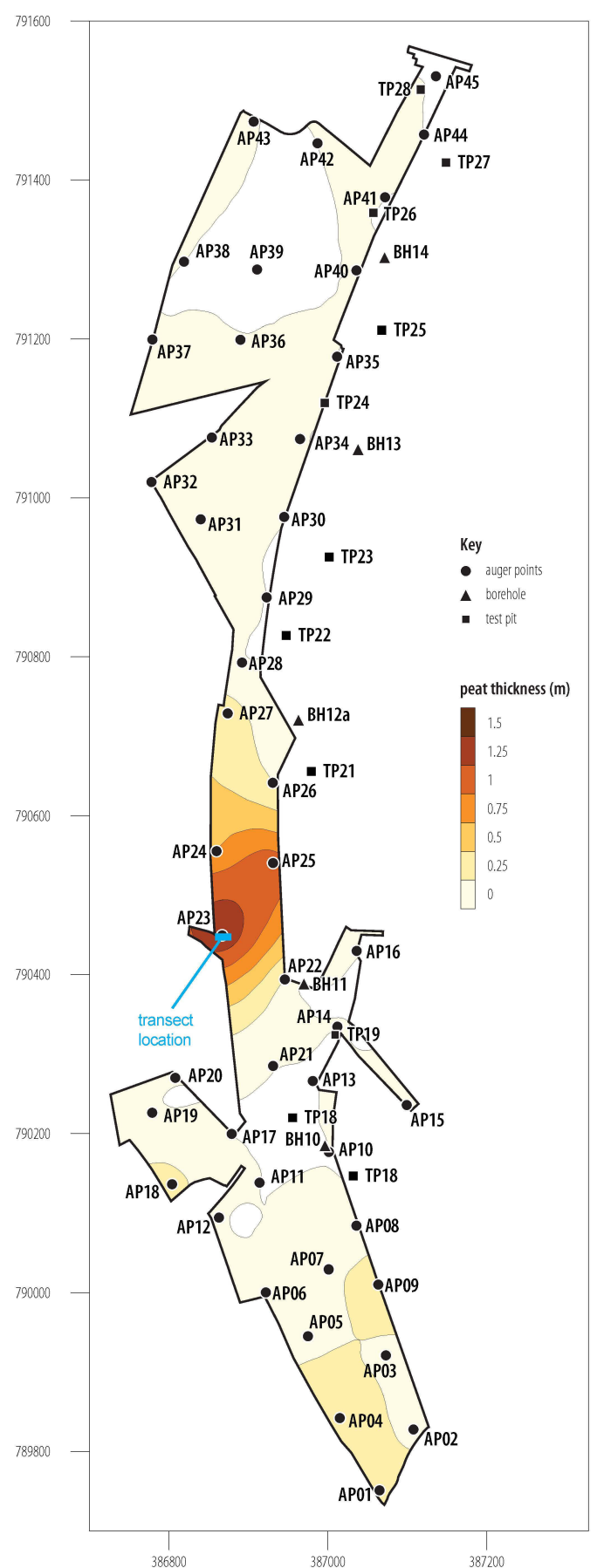


Fig. 2a - 2D contour map of peat thickness for Backburn Moss (Site 119) (after Timpany 2012, Fig 2)

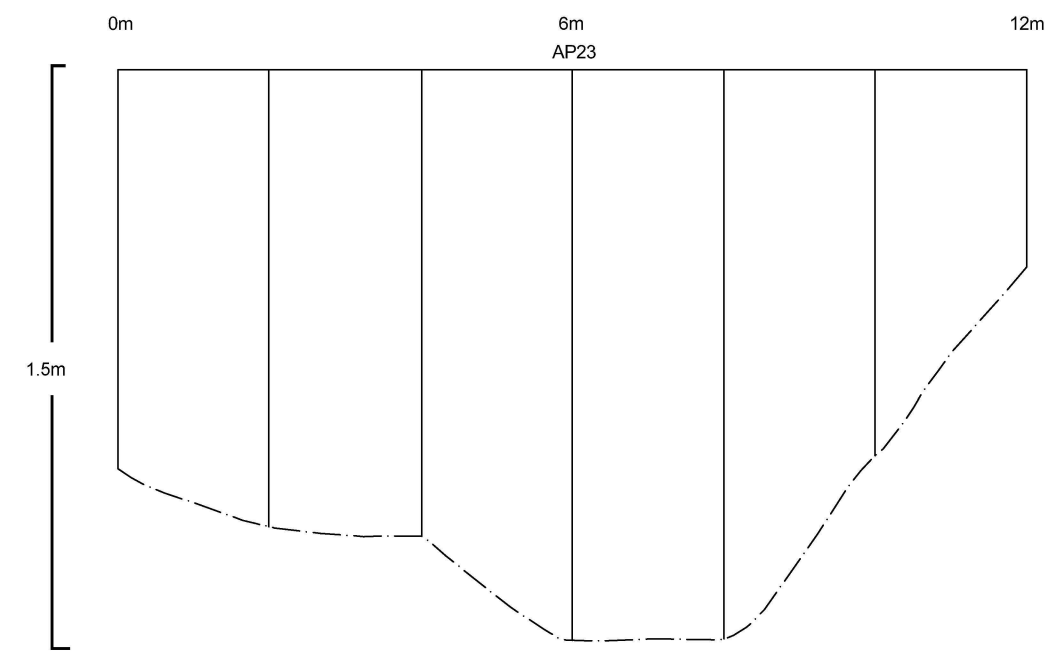


Fig. 2b - Schematic profile of peat basin

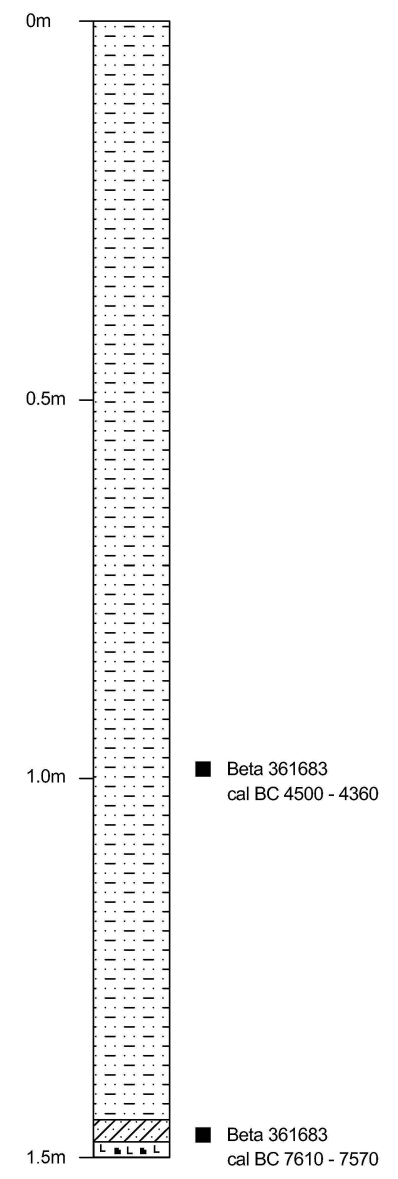


Fig. 2c - Biostratigraphic profile of AP23

Key to Lithology (after Troels-Smith 1955)

- Herbaceous peat
- Detrital peat
- Silty clay
- AMS radio carbon dating sample

CFA ARCHAEOLOGY LTD
 The Old Engine House
 Eskmills Park, Musselburgh
 East Lothian, EH21 7PQ
 T: 0131 273 4380
 F: 0131 273 4381
 e: info@cfa-archaeology.co.uk
 w: www.cfa-archaeology.co.uk

Fig. No:	2a-c	Revision	A
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Title
Plan and profiles

Project
**Backburn Moss (Site 119)
 Palaeoenvironmental Sampling
 & Palynological Assessment**

Scale at A3
 Peat basin profile, 1:100
 (vertical scale exaggerated),
 Core Profile, 1:10

Employer:
Aberdeen City Council

Drawn by:	Checked by:	Report No:
TB	MC	3045

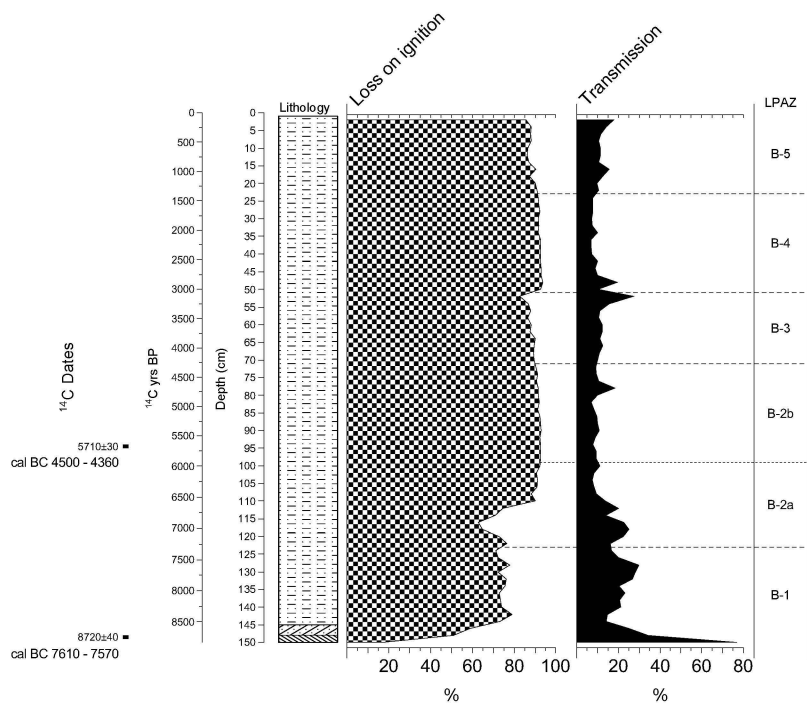


Fig 3a. - Percentage loss-on-ignition and humification profiles and local pollen assemblage zones (LPAZ)

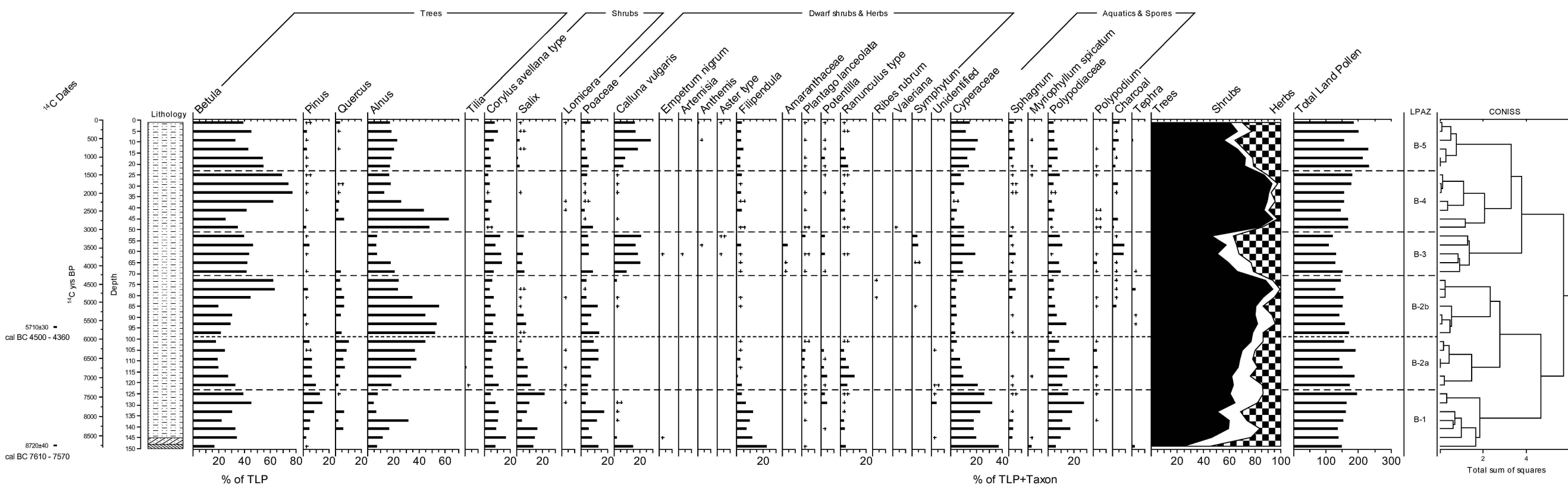


Fig 3b. - Percentage pollen diagram