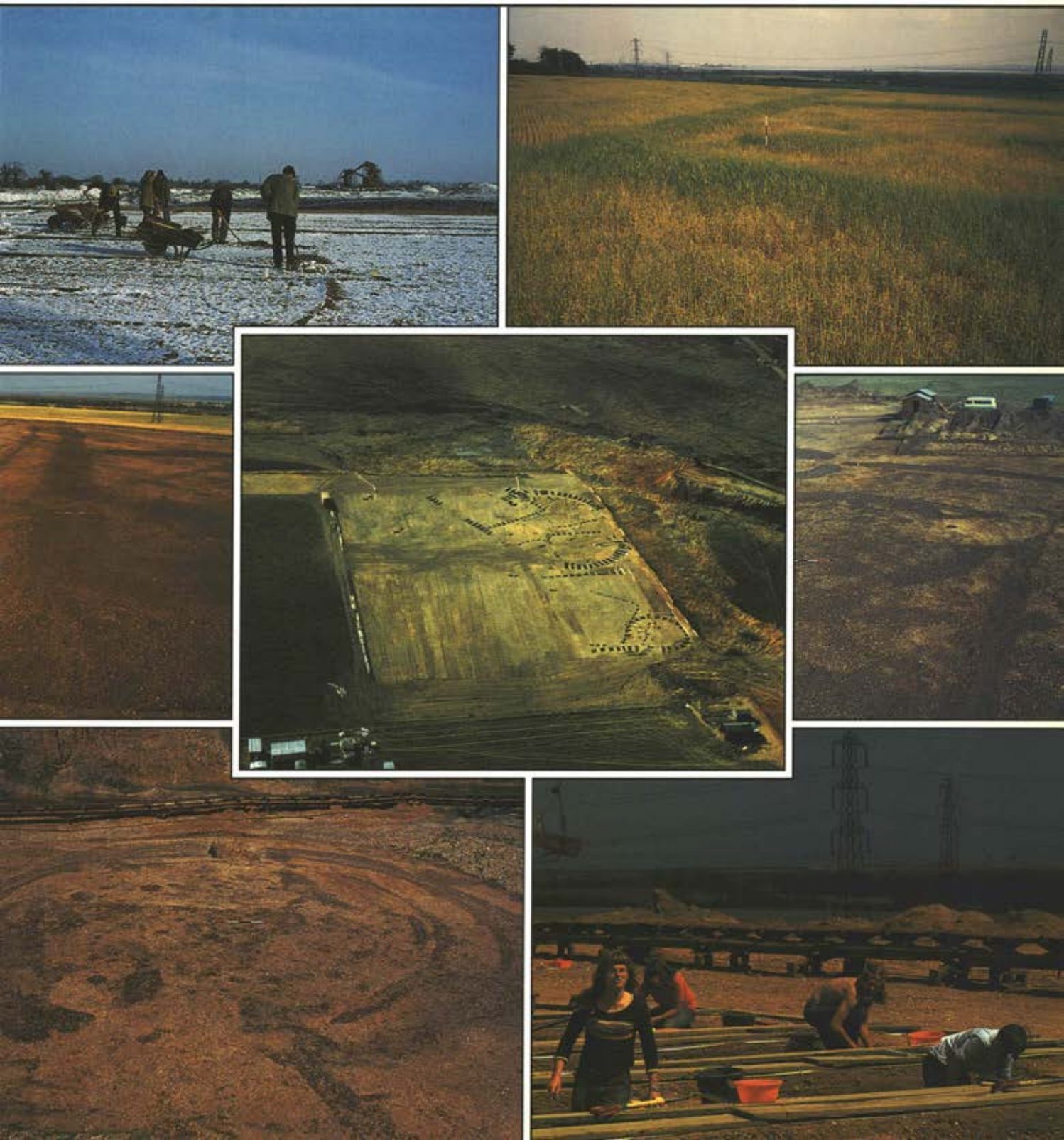
English Heritage

EXCAVATIONS AT MUCKING

Volume 1: the site atlas

Excavations by Margaret and Tom Jones

Ann Clark



Excavations at Mucking

Volume 1: the site atlas

English Heritage

Archaeological Report no 20

Excavations at Mucking

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excavations by Margaret and Tom Jones

with contributions by
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Foreword

By the close of the Mucking project some 45 acres of Essex countryside had been explored and over 44,000 features had been examined and recorded. To present, but more importantly to interpret, the information so recovered, the first and foremost task was to compile a detailed site plan. With this to hand, concentration and dispersal, relationship and superimposition can be readily perceived. Here in the Mucking site atlas we can at last appreciate this vast 'multi-period palimpsest' in all its complexity. As an aid to research, the atlas will form an essential companion to all the forthcoming volumes in the series as each in turn explores in detail the main aspects of the site.

Let us not underestimate the tasks which had to be performed to bring this volume to fruition. The field project alone had covered 13 years. Methods and strategies had to be developed to deal with problems as they arose. An ever-changing army of volunteers and supervisors led inexorably to some variation in recording methods and conventions. What today can be recorded with relative ease using an Elta could only be achieved at Mucking with the utmost diligence and difficulty. Much time and judgement has gone into verification and, where justified, reconciliation of the data recorded and, not surprisingly, some adjustments were found to be necessary. After much thought, it seemed best to present the results as an atlas of 25 sheets based on the original 100ft squares. Inevitably, a few errors escaped detection and could not be rectified once the sheets had been printed. Those discovered before the publication deadline are listed on pp vii–viii.

It seemed appropriate to include with this volume a brief history both of the excavations and of the successive phases in the post-excavation processing, together with summary accounts of the major periods of occupation which the excavations have revealed. With these go a number of specialist reports which, because of their general nature, are best placed here rather than in the forthcoming, period-specific, volumes.

To the dedicated work of Margaret and Tom Jones who directed the project in the field, to the many specialists and volunteers who have helped to process the product of that project during the post-excavation phases, and to Ann Clark and the illustrators on whose shoulders the final burden of production was to fall, I record here my grateful thanks and admiration.

I H Longworth MA PhD FSA
Mucking Management Committee

Publisher's note

This first volume in the Mucking publication series, *The site atlas*, will be followed, also in 1993, by Volume 2, *The Anglo-Saxon settlement*, by Helena Hamerow. Future volumes will comprise reports on the Roman period by Chris Going, on aspects of the prehistoric period by Elizabeth Healey and John Etté, and on the Anglo-Saxon cemeteries by Sue Hirst and Dido Clark.

In addition to these publications, Ann Clark is preparing an introduction to the archive held in the British Museum's stores.

The presentation and organisation of the report

The main author of the report is Ann Clark, and all sections not attributed to other authors are by her. The text was largely written in January 1991.

The appendix on p 37 consists of a full bibliography of all publications relating to the Mucking excavations up to 1989, compiled by the excavators and P M Barford. The bibliography of references cited in this volume is to be found on p 39.

The method of presentation adopted for the sheets of site atlas plans is described on pp 15–17. The scale rule is to be found on the back cover of the printed volume, and the key to the plans is on the inside back cover. The site was recorded in imperial measurements, which have been retained throughout all volumes where they pertain to the primary site records, including the coordinates on the site atlas.

The drawing of the site atlas plans was completed in early 1991 and the sheets were printed in mid 1991. However, work on interpretation of the phasing has continued since that time, and is available in the site archive. Later volumes in the series will, as far as possible, incorporate the most up-to-date interpretation.

The errata list below reflects the problems encountered in preparing the site atlas for publication (see pp 15–17). The errors and omissions were noted during a rapid scan of the plans undertaken just before the publication deadline, and cannot be considered to be a comprehensive list. A set of site atlas plans incorporating all the corrections listed below is available for consultation in the site archive.

Errata

The 100ft square on plan 19 (SW corner grid coordinate 1800N 300E) has been missing at least since the transfer of the MPX archive to the British Museum. Thus ditch 10050 (1800N 370E) in the adjacent square to the south on plan 16 is incomplete.

The whole of the excavated box and its features (11900) at 1705N 420E on plan 16 should have been omitted. This box is shown in its correct position and at the correct orientation a little to the south at 1697N 420E.

A substantial part of GH 44 is missing from plan 6; it lies at the edge of the excavated area (770N 100E), is only partly drawn, and is labelled cut 13575. An edge of GH 43 is also missing on plan 3 where it forms a junction with plan 7 at 250N 400E. A further discrepancy between plans has been noted on plans 17 and 18: ditch 6281 has a butt end on plan 17 at 1448N 798E, and the same ditch appears on plan 18 with a butt end at 1446N 802E.

PG 69 (15007; 1210N 640E) on plan 14 should be PG 68.

Ditch 3996 (300N 80W) on plan 5 should be PG 13, as it is on the adjacent plan 2 to the south.

Well 7'b' (2072; 195S 430E) on plan 1 should read Well 7'c'

The feature numbered 5795 (1002N 290E) on plan 10 should be 5794, as on the square to the south.

The feature which crosses plans 13 and 17 (1400N 598E) bears two different numbers: 4084 on plan 13 and 7940 on plan 17. Likewise, pit 25163 (2400N 433E) on plan 22 becomes 25240 on plan 24.

Two post-built structures have erroneously acquired PHB numbers as if they were part of the series verified by H Hamerow (p 16) as Anglo-Saxon 'posthole buildings': PHB 54 (mc 10178, centred approximately 1710N 710E) on plan 17 and PHB 55 (310N 250E) on plan 3.

Six Anglo-Saxon buildings included in Hamerow's series are unlabelled as such on the plans, as follows:

PHB 19	1260N 100E	plan 12
PHB 23	1020N 550E	plan 11
PHB 29	2030N 1010E	plan 21
PHB 51	2460N 840E	plan 25
PHB 52	2060N 900E	plan 21
PHB 53	1040N 310E	plan 10

MPX identified 109 penannular gullies or round houses (PG/RH) of which 53 were 'uncontested'. The 'PG' label was retained for those with gullies while 'RH' was applied to post-built round houses with no evidence of a gully. This series was extended to incorporate features identified during the site atlas verification procedure. However, the following have not been labelled as PG/RH on the atlas:

PG 16, 3286, 300N 120W, plan 2
RH 111, 8479, formerly PG 22, centred 335N 240E, plan 3
PG 15, 14161, 305N 40W, plan 5
PG 33, 4827, 530N 230E, plan 6
PG 34, 4829, 538N 225E, plan 6
PG 37, 7990, 604N 205E, plan 6
PG 12, 1312, 290N 465E, plan 7
PG 35, 15732, 555N 565E, plan 8
PG 36, 9614, 607N 610E, plan 8
PG 38, 9618, 630N 620E, plan 8
PG 41, 9182, 743N 707E, plan 8
PG 42, 9272, 765N 667E, plan 8
PG 43, 13100, 895N 453E, plan 10
RH 47, centred *c* 975N 265E, plan 10
PG 49, 14414, 995N 280E, plan 10
PG 53, 5808, 1070N 284E, plan 10
PG 55, centred *c* 1063N 315E, plan 10
PG 57, 5741, 1095N 305E, plan 10
PG 54, 15228, 1044N 594E, plan 11

PG 60, 6456, 1100N 800E, plans 11, 14
PG 59, 12480, 1118N 342E, plan 13
PG 61, 5848, 1110N 285E, plan 13
PG 62, 5291, 1105N 267E, plan 13
PG 63, 5303, 1110N 233E, plan 13
PG 60, 6456, 1110N 785E, plan 14
PG 95, 10204, 1770N 558E, plan 17

In addition, the large circular feature centred at approximately 385N 505E, plan 7, should have been labelled 'ENIGMA'; Kiln 2 on plan 7 should have been labelled 'a' at 323N 610E and 'b' at 318N 620E; and the soilmark on plan 10 at 1000N 286E should have the number 14474.

Several large, unhachured features are unnumbered, as at 1360N 860E, plan 14. Some of these are Test Holes, eg 2286N 950E, 2282N 953E, and 2239N 945E on plan 23, 200S 405E on plan 1, and the box at 185N 80E on plan 2. Other unnumbered or unnamed features at the edges of plans may be identified on the adjacent plan, eg ditch 4179 (1260N 603E) on plan 14, which is in fact PG 77 and is shown as such on the adjacent plan 13; similarly, the postholes at 1398N 655E on plan 14 are part of PHB 6, mc 7819, on the adjacent plan 17.

Occasional duplicate numbers occur on features crossing 100ft squares, eg grave *1020* (1435N 600E) on plan 17. These errors are due to the late change in the format of the site atlas.

Transposition of digits has occurred, eg ditch 25610 (2143N 800E) on plan 22 becomes 25601 on plan 23.

Illegibility has caused ditch 25284 on plan 24 to be mislabelled 25484 at 2547N 780E. However, the excavated ditch 25770 (2400N 1048E) on plan 23 becomes F25769 where it is a soilmark on the adjacent plan 25. This is technically correct, since 25769 represents the fill of 25770 and fill numbers are generally ascribed to soilmarks where the feature is not excavated (p 16), although this is in fact a rather over-zealous application of the system.

Several numbered non-linear features do not have hachures, implying that they are 'modern'. However, this lack of hachures may in some cases be incorrect. A number of *Grubenhäuser* have dashed edges, which indicates a lack of clarity in the soilmark at the surface; these edges should have been hachured to indicate that the features were excavated. Many pits, however, were only half-sectioned, and in these cases the lack of hachures will indicate this.

The change in the use of the prefix 'mc' is explained on p 16. The 'ground-level buildings' noted during MPX should have received mc numbers, as for example mc 5896 (*c* 1350N 230E) and mc 12661 (*c* 1345N 260E), both on plan 13, representing GLB 7/53 and GLB 6/42 respectively. However, many others lack their identifying mc prefix, eg the postholes at *c* 2015N 863E on plan 21, ascribed GLB 7/52 in the MPX archive, and those at *c* 2322N 916E on plan 23, ascribed GLB 5/33. The MPX criteria for recognition of these features were nowhere clearly stated, although, as noted on p 14, there was no time during the BM/EH project for systematic investigation of the secondary MPX archive.

There are many omissions from the plans of information relating to various edges of clearing, excavation, or quarrying. While these are not essential to the interpretation of the features, they do add a dimension to appreciating the circumstances of the excavation and its progress. In some cases, such information offers an explanation for gaps or blank areas, eg the gap between the conveyor belts on plan 10 at *c* 1010N 240E, where the space was filled with a ramp, a note of which should have been inserted. For the most part the omissions are dates; where these exist, they are available in the archive, on the corrected version of the site atlas plans.

1 Introduction

This volume is the first in a series which reports on the excavations (1965–1978) at Mucking, Essex (NGR: TQ 673803). The unphased site plan (1:180) is presented here as a site atlas on 25 sheets (plans 1–25). This atlas gives the backdrop and context to the other reports and will form a crucial source of reference for them. Covered in this volume are the background to the excavations (by the excavator, M U Jones), the post-excavation phases, a summary of the periods covered in future volumes, and various specialist reports which are of a general nature and not necessarily period-specific (geology, slags, and fired clay, as well as cropmarks and a summary of the radiocarbon dates). In addition, the volume attempts to chart the chequered history of an excavation project spanning some 25 years (divided here into the three distinct periods of excavation, post-excavation (MPX 1978–85; see p 12), and archive and publication (BM/EH project 1986–89; see p 14)). The period has seen considerable changes in excavation methods and post-excavation strategies, of many of which Mucking has been both a pioneer and a victim. This volume has been written after completion of the archive phase, but before completion of the specialist volumes.

Mucking represents the largest area excavated for the longest continuous period (from 1968), although its beginnings in 1965 were unexceptional. In an atmosphere of burgeoning awareness of the potential threat to archaeological sites from gravel extraction, as elucidated by aerial photography, part of the Mucking cropmark first featured as a photograph (Fig 1) published by J K St Joseph (1964, pl xxxvii b). Through the joint efforts of D G Macleod, then assistant curator of Prittlewell Priory Museum, Southend-on-Sea, and D A Wickham, chief librarian of Thurrock, some 40 acres of cropmark were proposed for scheduling under the Ancient Monuments Acts. At the instigation of S A Butcher and later J G Hurst (both then Assistant Inspectors of the Inspectorate of Ancient Monuments, Ministry of Public Building and Works), an eight-week exploratory excavation began in 1965 under the direction of M U Jones with W T Jones acting as assistant director and photographer. The excavations continued for 12 years until 1977 when they were substantially completed, although some work on the quarry margins, peripheral to the main site, took place in the following year.

By the end of the excavation the site covered about 18.22 hectares (45 acres) and had established itself as a forerunner in the study of landscape archaeology. The excavators regularly submitted finds for the Exhibits at the Ballots of the Society of Antiquaries and reports for various annual excavation reviews. The Appendix (p 37), originally compiled by the excavators and P M Barford, consists of a separate bibliography of all Mucking publications up to *c* 1989. Mucking monopolised a local journal (*Journal of the Thurrock Local History Society (Panorama)*) and featured in several conference papers. In 1970 the finds from six graves from Anglo-Saxon cemetery I were considered of sufficient national importance to be acquired by the British Museum (registration numbers 1970, 4–6 1/30, Graves *90, 92, 99, 102, 117, 120*). The multinational team of excavators (from as far afield as the Netherlands, Poland, Czechoslovakia, the USA, and Australia) ensured Mucking an international reputation. Few at the time can have failed to hear of the 'multi-period palimpsest'.

The archive

The excavations undertaken on an unprecedented scale under rescue conditions produced a vast archive of material, notably some six tonnes of ceramics, from an estimated 44,000 features, together with records comprising 363 site notebooks and some 5000 plans which are stored in the archaeological repository of the British Museum (Departments of Prehistoric and Romano-British Antiquities and Medieval and Later Antiquities), currently at Blythe Road, London W14. Access can be gained by reference to the appropriate Department at the Museum. The stacks of drawers, cupboards, and plan presses are now the monoliths which represent the Mucking landscape.

The various categories of finds were ascribed and separated during the excavation and immediate post-excavation period (referred to in this report as MPX; see p 12). Some categories or individual groups are being assessed and verified as part of the current publication process to produce specialist reports. The quantities, however, are so great that no comprehensive evaluation has been possible and any work will be based, on the one hand, on the nature and reliability of contexts and, on the other, on the various sampling strategies appropriate to the publication. It is not possible to be more specific at this stage.

The finds as acquired by the British Museum were generally divided by material type, with the exception of the grave assemblages. **Pottery and ceramic material** include: prehistoric pottery (ranging from Neolithic to Iron Age); Romano-British pottery including separate categories of material associated with the kilns and other types such as samian, mortaria, and amphorae; Anglo-Saxon settlement pottery from the *Grubenhäuser* (separated from that from other settlement contexts); a small quantity of medieval pottery; fired clay separated into types identified and devised by P M Barford (who has prepared a text for independent publication), which include a range of loomweights, spindlewhorls, oven fragments, perforated blocks, belgic bricks, thin slabs, briquettes, firebars, and structural daub; metalworking debris including mould wrap and mould fragments; in addition, several thousand other fragments were deemed by MPX as too small for typological analysis (categorised as 'scrap'); tile and patterned wall daub were separated. **Metalwork** includes iron, copper alloy, coins (ranging from potins and various Roman denominations to *sceattas*), and slag (see p 31). **Other categories** include glass, charcoal and soil samples, stone, including flint, with its various tool types and débitage identified, and animal and human bone (the survival of both of which was extremely poor). A basic list of all these finds (in some cases incomplete) is available in the form of print-out from the computerisation phase of

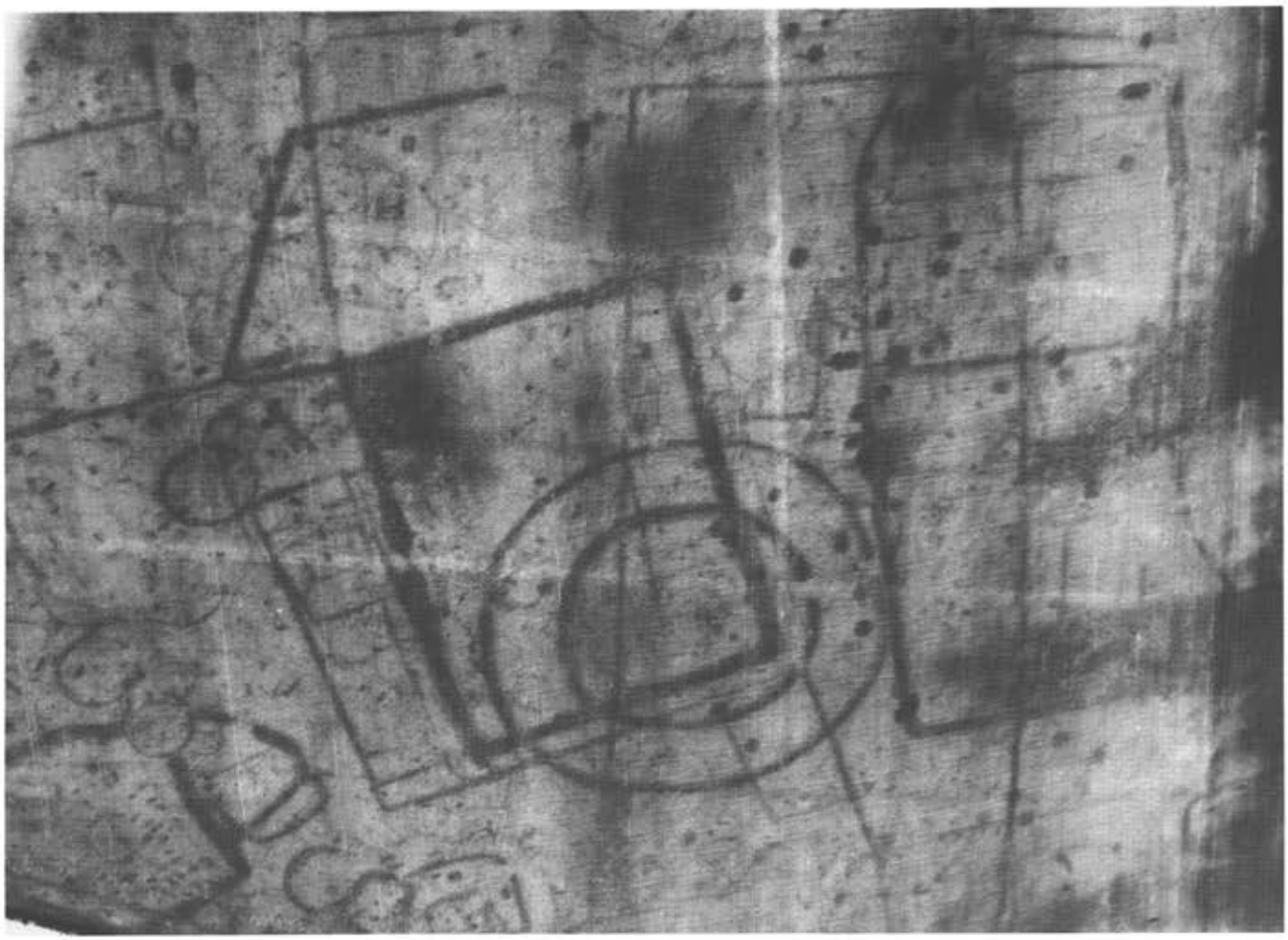

Fig 1 Aerial photograph of cropmarks at the southern end of the site (CUC AFK 8; Crown copyright)

MPX (see p 12). In addition there are various notebook records of finds and pre-computer indexes. The field notebooks also contain the notes of finds as they were excavated from the features.

The excavation archive represents the largest and most complex in terms of curation and conservation which the Museum has in its guardianship. The many periods it represents and the diversity of material and records require collaboration between several departmental interests. The long-term physical storage and conservation of such a range of artefacts alone pose considerable problems, not only in arranging suitable environments and storage methods for the different artefact types, but also in defining distinct/separate areas for curatorial responsibility while maintaining some archaeological integrity for the contexts from which the material derived. The first impact of the extent of this dilemma presented itself to the BM/EH project.

The logistics of working through the paper archive alone, together with the problems inherent in the record (outlined below), however, were sufficient to absorb the BM/EH team for the majority of its three-year programme. Hence an integration of finds and records was barely begun, let alone any but the most basic phasing of the site.

The phasing of the site is currently being undertaken by C J Going as a precursor to the work for the Romano-British and Iron Age volumes. This entails an assessment based on the field notebook references to the finds from features (and perforce makes an assumption about the original identifications). Indeed, this is the only practical method for elucidating as comprehensive a view as possible of the various archaeological landscapes. The distinctive and readily definable features for the periods which have been investigated as part of the BM/EH project provided a first stepping stone and, together with the phasing work, our perception of how those fit within the palimpsest should be broadened so that the forthcoming volumes can be put into perspective by future research.

Location

The site lay above the 30m (100ft) contour of the Boyn Hill Terrace (the gravel from which has been extracted), occupying a strategic position overlooking the Thames estuary and close to what has been cited as one of the lowest natural crossing points of the river (Fig 2a; M U Jones 1973, 6). The complex geology is outlined in a separate report (p 26), and M U Jones discusses the local

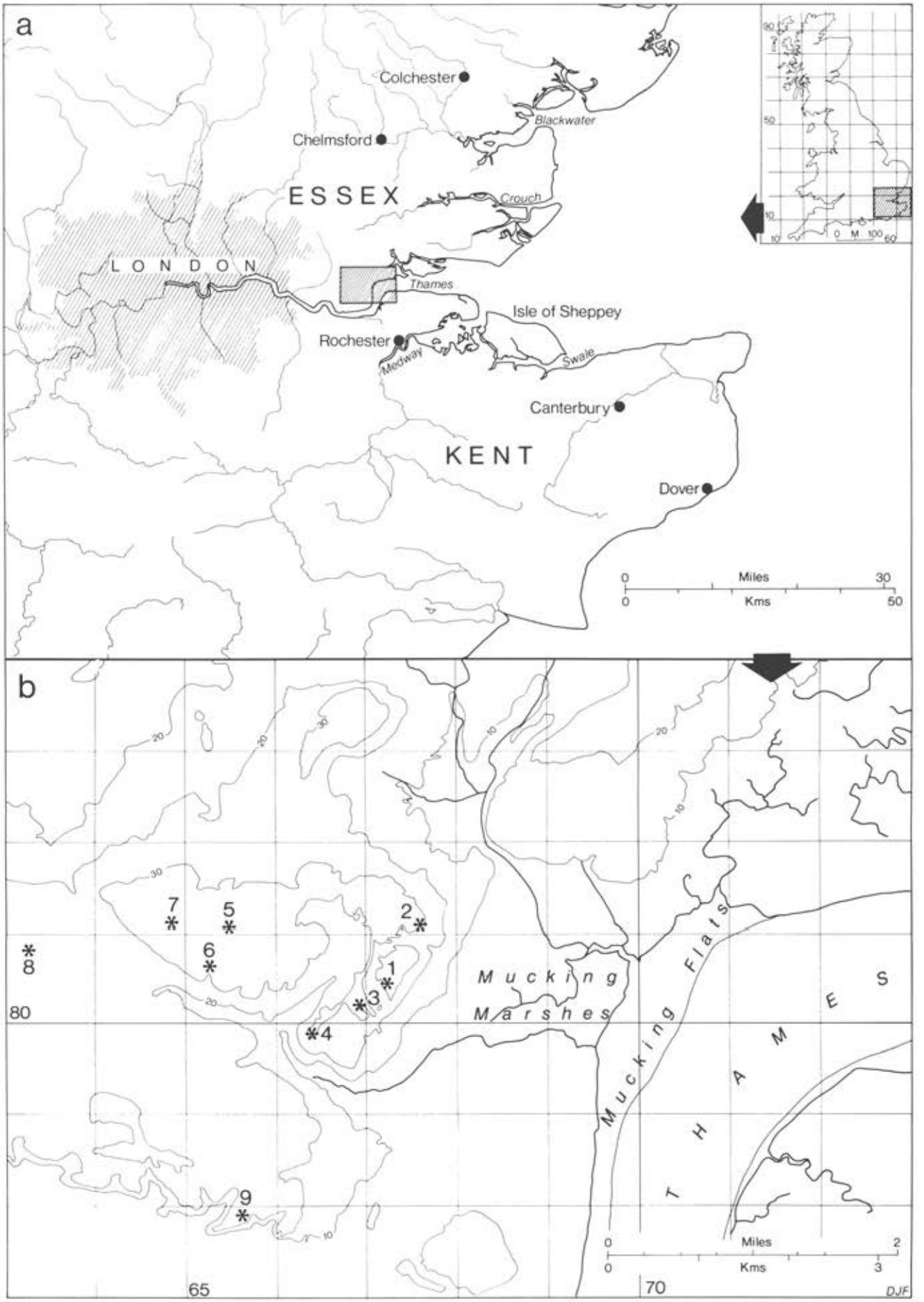

Fig 2 Location map: A The site in its regional setting; B Detailed site location showing relief and other sites in the vicinity: 1 Mucking; 2 North Ring; 3 Linford; 4 Rainbow Wood; 5 Orsett 'Cock'; 6 Orsett causewayed enclosure; 7 Rectory Road, Orsett; 8 Baker Street, Orsett; 9 Gun Hill, Tilbury

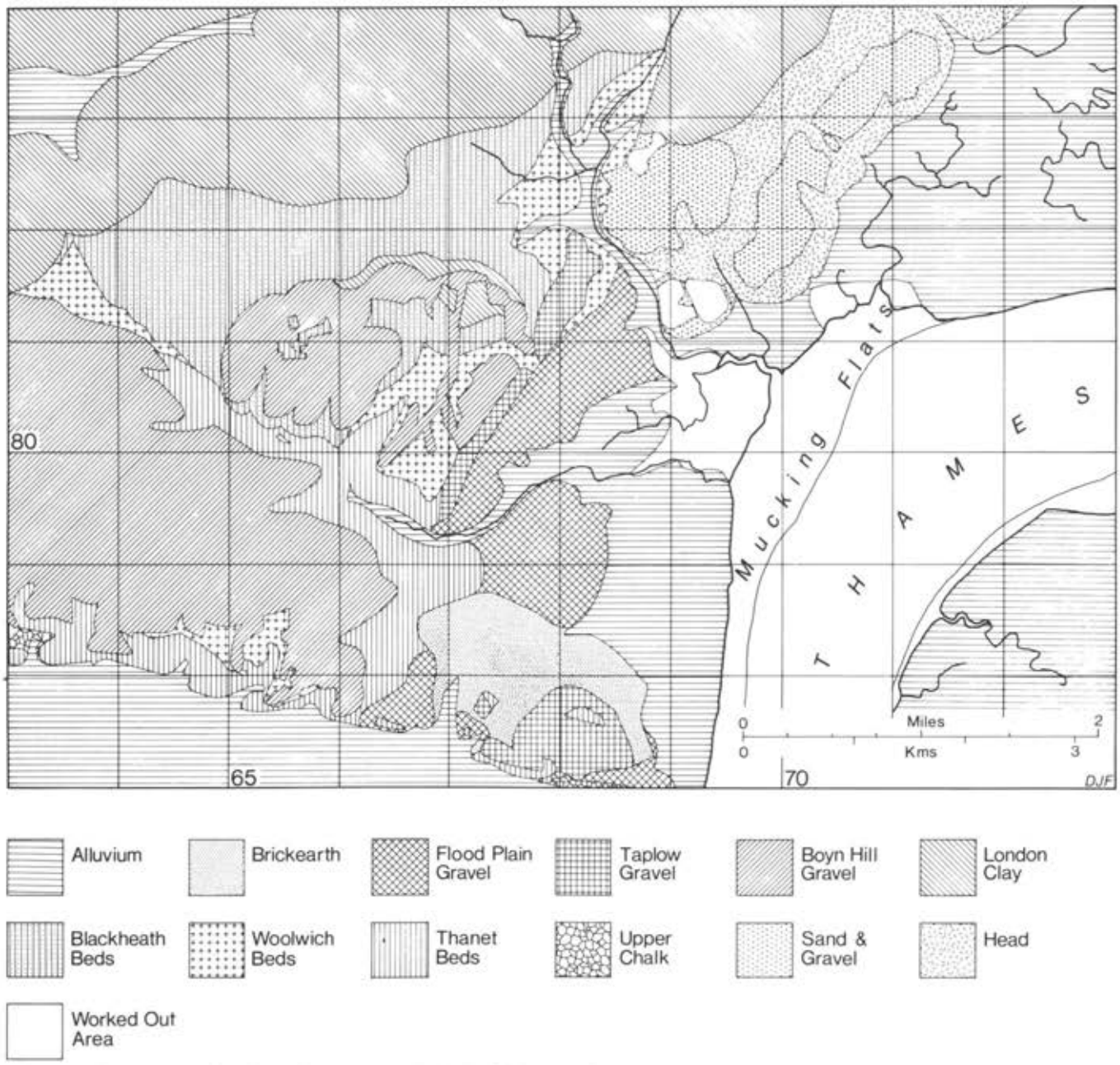

Fig 3 Geology map, taken from the 1:50,000 Geological Survey Maps

geological and pedological conditions as they affected the excavation (p 7). On the 1:50,000 Geological Survey Maps (Fig 3) Mucking is at the junction of four plans (257, 258/259, 271, 272); 258/259 is based on a survey of 1968 and 1971–2 while the others are based on surveys between 1903 and 1923. A small adjustment to the boundary in the area of Stanford Le Hope was made necessary by some discrepancy in the surveys. The soils are of the St Albans series (see p 7). The locally available brickearth and alluvial clay provided satisfactory sources for the manufacture of a range of ceramics, while flint from the gravel was of adequate quality for making tools. Unfortunately little can be ascertained with regard to the former environment as the acidity of the soil has led to poor bone survival and a sample of pollen prepared to assess the potential of a programme of pollen analysis showed poor preservation (Greig 1981).

Other archaeological investigations in the immediate vicinity (Fig 2b) have produced evidence for the importance of this area for settlement over several millennia. Wilkinson (1988, 129) considers that it '...has one of the most extensively man-made landscapes of any part of Britain...'. Sites 1–6 on Figure 2b all lie above the 30m contour on the same terrace. North Ring (Fig 2b, site 2) is a late Bronze Age earthwork only about 1km away from the Mucking South Rings (Fig 4); both are surrounded by archaeological evidence for a range of contemporary activities (Bond 1988). Linford (Fig 2b, site 3), less than 0.5km away, produced evidence from

the early Iron Age to the Anglo-Saxon periods (Barton 1962). Rainbow Wood (Fig 2b, site 4), about 800m away from Mucking, produced a small cluster of Iron Age pits and postholes (Potter 1974). Within 2km to the west are two sites (Fig 2b, sites 5 and 6): site 5 at Orsett 'Cock' was a rectangular triple-ditched enclosure with occupation from the middle Iron Age to the first century AD (Toller 1980), while less than 500m to the south-southwest (Fig 2b, site 6) is a causewayed enclosure dating to the middle Neolithic. The same site also produced an early Iron Age assemblage from a possible small enclosed settlement (Hedges and Buckley 1978). Approximately 600m to the west of these sites at 36m OD is a small early Iron Age settlement at Rectory Road (Fig 2b, site 7). This is not on the Boyn Hill Terrace but on mixed deposits of the Tertiary Blackheath Beds (Wilkinson 1988, 11–13). The site at Baker Street, Orsett (Fig 2b, site 8), is on the Boyn Hill Terrace but below the 30m contour. It produced evidence of late Bronze Age settlement and some uncertainly dated occupation of the post-late Iron Age and post-Roman periods (Wilkinson 1988, 13–17). Gun Hill, Tilbury (Fig 2b, site 9), had evidence of Iron Age, Romano-British, and Anglo-Saxon occupation (Drury and Rodwell 1973).

Acknowledgements

Foremost are the excavators, Margaret and Tom Jones, without whose unstinting devotion over 20 years these publications would not have been possible.

The following acknowledgements complement those of Margaret Jones (p 9). It is not possible to give individual credit to the thousands of people who have been involved in the project from its inception. Those who have made specific or specialist contributions will feature in the appropriate volumes in the series.

From the MPX years I would like to mention Jonathan Catton's outstanding dedication; he not only took part in the excavations over many years and was res-ponsible for the salvage work on the quarry margins, but was also the prehistorian and data manager during MPX.

The work on Mucking was primarily financed by the Inspectorate of Ancient Monuments in the Department of the Environment (now English Heritage). As inspectors, Sarnia Butcher and John Hurst were most closely involved with overseeing the excavation, while Sarnia Butcher had the unenviable task of monitoring progress through MPX, with the assistance of her staff, Alison Cook, Pamela Irving, Evelyn Palmer, and Margaret Wood, and Frank Gardiner of the Ancient Monuments Illustrators' Office.

I am especially grateful to Frank Gardiner, who has patiently guided many illustrators and has advised on all aspects of illustration and production, but cannot be held responsible for the final product. The site plans for the atlas were originally traced by Adrian Jarrett during MPX, and the corrections and additions were drawn by Dawn Flower and George Taylor. George Taylor was responsible for all the 'last corrections', and for producing the final site atlas plans and the overall plan (Fig 6). Roger Jones, formerly of the Ancient Monuments Laboratory, has given advice and offered technical expertise in all computer matters; his training of staff and instant support made computerisation of the context data during the BM/EH phase possible. Thanks are also due to Val Horsler who, as a 'late arrival' to the project, has seen this volume through its final editing and production.

I would like to thank all those who took part, in whatever capacity, in the final (BM/EH) phase of post-excavation and publication work, in particular the British Museum Assistants from both the departments involved (Prehistoric and Romano-British, and Medieval and Later), especially Bob Bailey. Of the team members and volunteers I would like to thank the following: Lucy Churchill, Dido Clark, Jon Etté, Jill Guthrie, Ben Hall, David Jennings (for his work on the slag contexts), Neil McCain, Alison Mills, Kate Morton, Marina Papa, Alison Taylor, Steve Trow, Brian Weightman, Sarah Wild, and Jenny Woolmer. To the main period specialists who have been involved as part of the corporate effort I extend my warmest thanks for their cooperation and forbearance: Jon Etté, Helena Hamerow, Elizabeth Healey, Sue Hirst, and Chris Going.

The long-suffering members of the BM/EH Management Committee – Sarnia Butcher, John Cherry, John Hurst, Stephen Johnson, Ian Longworth, and Leslie Webster – have advised throughout the final stages.

I owe a special debt of gratitude to all my family and friends who have been so supportive, especially: my mother; Margaret Wood, for her brilliantly incisive comments on an early draft; John Barrett, Sarah Williams, and Leo Biek; Peter, who typed long into the night and patiently offered sustained moral support at all times; and finally Christopher, for whom Mucking has become synonymous with motherhood.

2 Background

by M U Jones

Introduction

The following account of aspects of the background to the Mucking excavation to accompany the site atlas has been assembled after the transfer of the finds and archive from Thurrock Local History Museum to the British Museum. Thurrock provided premises and a base, plus the use of services such as copying, throughout the eight years of excavation processing. The material was then transferred to the British Museum.

Initial interest in St Joseph's classic photograph (1964) of the Mucking cropmarks discovered during research flights in 1959 focused on what was believed might be a Neolithic henge. The excavation was set up initially to investigate this monument (since named the South Rings, Fig 4) in its setting. It was decided to hold a trial excavation in order to gain familiarity with the terrain. The 'henge' itself, not reached until 1966, turned out to be a late Bronze Age earthwork in a landscape containing a long settlement range from prehistoric to Anglo-Saxon. The aim of the excavation consequently veered from the investigation of a specific feature to the rescue of a multi-period landscape.

In the 1960s the archaeology of cropmarks was attracting much attention. In 1960 the Royal Commission on Historical Monuments (England) had published a survey of the situation (RCHM(E) 1960), which suggested that cropmark sites could be handled by excavating those features which could be classified by shape. However, the writer had already experienced gravel pit archaeology at Lechlade, Glos, and Stanton Low, Bucks. Morphological criteria alone were considered unreliable and this hardly seemed the right course to follow at Mucking. The 1955 excavation in the adjoining (Linford) quarry (Barton 1962) was not the result of cropmarks but of the finding of prehistoric pottery on quarry spoilheaps by local schoolboys (Thurrock Museum Acc no 649). The discoveries included rare Anglo-Saxon features and finds from what was the first Essex settlement to be shown on the Ordnance Survey Map of Britain in the Dark Ages (1966).

Gravel had been quarried in Orsett quarry since the 1940s. The method still followed in 1965 used a dragline which stood on the working face. Its metallic screech dominated the next 13 years. This dug topsoil, subsoil, and any 'soil' patches and threw them evenly over the quarry floor up to 8m below, ready for reinstatement when quarrying ceased. The underlying gravel was next fed into a hopper supplying an electrically driven conveyor. This led to the washing and grading plant, about a quarter of a mile (400m) away on the East Tilbury Road (known locally as Buckingham Hill Road or Buckman's Hill Road), which ran from the A13 to East Tilbury. Gravel was also loaded on to lorries to supplement the hopper's capacity, and for direct sales.

*'B horizon' and 'B/C horizon' are elsewhere in this volume referred to as 'ploughsoil' and 'subsoil' respectively.

Trial excavation

The trial excavation took place alongside the road, in an area about 400×200m. This was made available following the 1965 harvest and contained cropmarks of a complex of what seemed to be penannular gullies representing round houses and related compounds (the ABC enclosures, Fig 4, site atlas plans 2 and 5). An unexpected discovery was a mixed inhumation/cremation Romano-British cemetery within the largest compound (RB Cem I, Fig 4). As was the usual practice in the 1960s, labour and equipment were supplied by the local Superintendent of Works. Following the writer's experience at Lechlade a box scraper had been ordered. However, one was not available and an unsuitable front-loading Drott was sent instead. To avoid excess compaction, scraping was kept to the B horizon.* This proved satisfactory in the first experimental area, since the professional labourers were easily capable of the extensive hand-clearing then required. However, when using student labour, scraping over most of the site was aimed at a lower level, at the B/C horizon.* Labour comprised a gang of up to five experienced workmen, who were accustomed to team piecework. They were excellent at site clearing following topsoil removal, but less adaptable on fine work using trowels. Planning and recording were carried out by a small team of archaeological students.

The results of this trial excavation, together with quarrying methods and needs on the one hand and the available archaeological resources (notably labour) on the other, determined excavation strategy. Working so close to the quarry face created an early problem: the lack of fixed points. The telegraph poles along East Tilbury Road had recently been resited, while the cropmark area was virtually without hedges. This problem was met by basing the trial excavation grid on a plough furrow cut in the stubble by the farmer, T Lindsay of Walton Hall Farm, to mark out the next quarry intake. Because the best stance for planning soilmarks is facing north, the first grid coordinates were read from left to right giving nominal North and East readings.

Mechanical excavation and quarrying

Rescue archaeology in a gravel pit was in the 1960s a question of opportunism. The then Ministry of Public Building and Works had intended to schedule the cropmark area, but this was not done. Successful archaeological operations therefore had to depend on constant adjustments to fit the way the quarry worked and the demands of its personnel, which were in turn affected by such imponderables as required outputs, the thickness of the gravel, and the weather. It had been possible to organise the trial excavation in an area clear of quarrying. Thereafter it was a constant struggle to keep ahead – a battle not always successful, as is

reflected in the many gaps in the site plan up to the 500N grid line (Fig 4, site atlas plans 1, 2, 3, 4, 5, 7, and the southern end of plan 6), including spaces within the South Rings ditches and some of the interior of enclosures RBI and RBII (Fig 4), which must explain in some degree the virtual absence of posthole structures.

Following new management by Hoveringham Gravels Ltd, and their greatly increased output, tracked vehicles towing box scrapers (graders) were introduced. They were used for the South Rings areas and for the bulk of subsequent work. Because some control of topsoil removal was essential if shallower features were to survive, it became standard practice that some, if not all, of the costs of scraping were borne by the excavation. This made possible the choice of a smaller machine, when available, and also supervision of the direction and depth of scraping as well as control of routes by which the topsoil was conveyed from the site to the quarry floor. Air photographs helped to select routes with fewer cropmarks (M U Jones 1974, pl xxix), but no accurate plot of these was then available (p 23).

The conveyor system consisted of several lengths of rubber belting connected by hoppers. The length which directly concerned the excavation was that which terminated on the quarry face. As the face receded this length was swung round to make a new strip of gravel accessible. It follows that the ground between this belt and the face was out of bounds, though there were several dramatic last-minute efforts, with the cooperation of quarry staff, to complete excavation on the wrong side of the belt. *Grubenhaus* 105 (site atlas plan 13, 1216N 365E) with its floor carpeted with pottery sherds and raw clay loomweights could not be dug in haste, while final work on a prototype kiln (Kiln 22, site atlas plan 12, 1155N 195E) disclosed that it had been dug partly through a prehistoric burial (*786*) in a planked coffin. Another instance of cooperation occurred when a fixed length of belt laid unwittingly across Anglo-Saxon Cemetery I (Fig 4, site atlas plan 12) was raised to allow excavation beneath it.

Planning

Ideally, any excavation grid – especially of landscape sites – should conform to the National Grid. However, it was not at first foreseen how extensive the excavation would prove to be. The Mucking grid lines were 19° east of OS grid north. However, 1966 brought the problem of extending the grid, bearing in mind that quarrying had cut off the excavation area from its one fixed point. This problem was solved by the timely assistance of J Webb, member of Thurrock Local History Society, who had access to appropriate equipment – theodolite and 500ft steel tapes. Back readings were taken along the plough furrow base line as far as the road hedge, where it was possible to place a fixed point. The excavated grid gave 'south' readings, south of the northing zero grid line, and 'west' readings, west of the easting zero grid line (see Fig 4 and p 11). As each excavation area became available, between harvest and quarrying, enough new basic points were created to carry the grid eventually across 3000ft (*c* 915m). Using diagonal checks, wooden pegs were set out at 50ft (15.24m) intervals. When the ground was cleared ready for excavation each 50ft square was covered by a 10ft (3.05m) interval grid marked by labelled 6in nails. A temporary baseline was thrown off the site grid at about 2000N 500E (site atlas plan 20). This was needed to plan features exposed by machine scraping of an area it had been decided to abandon, which lay north-west of a wooded area (OS parcel no 2265) on the west edge of the site, and was consequently out of sight. The grid was also extended to include the North Ring.

Provisional site plans were produced at intervals, to illustrate interim reports. The first was a sketch of the cropmarks in relation to the Linford Quarry site in 1968 (Jones *et al* 1968, fig 3) by J Webb. Then it became possible for photographic reductions of 1:60 site plans to be made by the then DoE photographic department at a scale of 1:750. Although these were on paper and therefore not precise, they were amalgamated to create site plans (Jones and Jones 1974, fig 1; M U Jones 1974, fig 2). In 1978 the plan was updated and anomalies which existed in some of the first areas were adjusted by T Westwood of RCHM(E) Air Photographs Unit. In 1980 he produced a version showing the site grid (100ft squares) on stable film, which has been used as a base plan for Figure 4. The final stage was to have been an editing of feature plans (usually at 1:12) on to film versions of each 100ft square plan to make up the site atlas, beginning with the last areas to be planned. This was barely begun before the transfer to the British Museum.

Excavation strategy

There was no organised fieldwalking survey. However, the writer walked the cropmark areas and adjacent slopes after ploughing and potato ridging. Finds of any period were extremely rare and were mostly flints. As a check on possible loss of finds, a control area about 16m square within Anglo-Saxon Cemetery II was dug by hand from the stubble. It showed that cremation pots had already lost their rims. Two *Grubenhäuser* (GH 81, site atlas plan 21, 2055N 905E, and GH 82, site atlas plan 23, 2135N 990E; see back cover photograph) were also dug by hand. No finds or soilmarks were seen until the level of gravel was reached. However, during topsoil/subsoil removal by box scraper, a concentration of flints was found. They suggested a possible knapping floor (site atlas plan 17, square 1700N 500E), near GH 124. In general, however, archaeological evidence did not appear until the B/C horizon.

Geology, soils, and weather (Fig 3)

The geology is discussed elsewhere in this report (J N Carreck, p 26) and the soils are the subject of a separate report by H Keeley (1972). They are considered here only in terms of their direct effect on the excavation. Since there were very few structures using imported material – flint nodules, clay, and chalk – Mucking was virtually a soil site. Excavation was concerned with three subsoils:

1 The gravel itself, as thick as 8m, down to the point where it disappeared on the lower slopes.

2 Fine-grained Thanet Sand underlying the gravel, which acted as an aquifer causing damp patches to appear along the terrace slopes. One such patch is indicated by the herringbone pattern of modern land drains at 600N 700E (site atlas plan 8). Thanet Sand was encountered in the shafts of Romano-British wells and in the lower fills of some features along the east terrace slopes, notably the north-east corner of the North Enclosure (Fig 4).

3 Brickearth deposits overlying the gravel on the eroded terrace slopes. This was a structureless silt which quarrying avoided. It did not produce cropmarks. The aerial photograph (CUC air photograph BJC 78 in M U Jones 1974, pl xxvii) shows very clearly how the 'tongues' of brickearth (illustrating the partially fluviatile nature of this silt) cloaked the cropmarks. It had been hoped that any excavation of this close textured subsoil might yield more structural detail than was usual in gravel features, but this was not the case.

Excavation took place almost entirely on gravel, within the 100ft contour. The gravel consisted of heavy, loose sand and rounded flint pebbles, which drained very rapidly. Of his land on the gravel terrace the farmer, T Lindsay, remarked that crop failures were frequent, and his best crop was growing cropmarks for archaeologists! Kohlrabi had been grown there, but since the war there had been a monoculture of barley with the exception of an area of lucerne.

The tithe map of 1846 shows a dozen rectangular or strip fields (Fig 5), but these had been combined into field OS parcel no 5044 (163 acres), which extended to Walton Hall Road, and into OS parcel no 5580 (16 acres), now part of Blue House Farm at TQ 682809. Postwar farming on land without hedges provided near ideal conditions for extensive cropmarks. However, several factors meant that these cropmarks were not so easy to recognise, excavate, and record. Firstly, mechanical clearing above such a loose gravel demanded close supervision since many features were shallow. Secondly, excavation was much influenced by the weather. In dry conditions colour contrasts were diminished and the fills of features tended to shrink in area. Some diggers cleaned the sides of pits etc so vigorously that they overscraped them. In the drought of 1976, an exceptionally strong wind devil sucked up clouds of sand and even finds trays from the excavation. The ditch fill of Barrow 5 (which had produced a vague cropmark) could not at first be seen since it had dried to a monochrome with the adjacent gravel. Good soil definition occurred when frozen fills were thawing out. Thirdly, since the gravel/sand ratio was not uniform, its characteristics influenced the fills of features. In areas of larger pebbles, for instance, the fills of deeper ditches had a loose central primary fill, where the heavier pebbles had rolled furthest down from the bank. Furthermore, the roundness of the pebbles tended to prevent them from stratifying along angles of rest. This made sections difficult to interpret and draw. Finally, many cropmarks were not caused by archaeological features but by patterned ground (see below).

During the first summer water was brought to the site (by the local fire brigade on a practice run), and stored in an excavated ditch trench. For a time the only water was that brought in containers. Then T Lindsay allowed water to be piped over 500m from Walton Hall Farm. This availability of water proved to be a major factor in handling archaeological features.

The general extent of excavation was determined by the cropmark area. Initially, the shallow gravel along the east terrace slopes, of which much was covered by brickearth, was left unquarried, and a quarry road ran along it. But as the thick gravel deposits became exhausted these shallow margins were dug out. Rescue along the margins brought to light some notable additions to the site plan, mostly Romano-British in date: the remaining length of the southern arm of the North Enclosure (Fig 4), ditches extending down the slope, wells, a fourth Romano-British cemetery (Fig 4), a Romano-British stone coffin burial (W T Jones 1979), and Barrow 4. This certainly suggests, if it cannot prove, that the main area of at any rate Romano-British and Anglo-Saxon settlement must have lain on more fertile land further down the terrace slopes.

Patterned ground

Periglacial features (Jones *et al* 1968, 228–30; M U Jones 1974, 187) assumed many forms on the Mucking gravel and would have made an interesting study by themselves. Those which were most clearly defined contained a 'fill' of yellowish brown silt resembling brickearth. An early example which looked like a circular pit was machine sectioned and referred to J N Carreck (see p 29). Another, also round, with a gravel core, contained a Neolithic sherd in its late fill. A section showed a silt fill which diminished to a point. An irregular feature (1004, site atlas plan 16, 1775N 210E), in an area which was mostly abandoned, produced many flints. It was possibly caused by a blown-over tree which left a hollow where the root ball had been. This would have made a sheltered spot for flint knapping. Linear and reticulated patterned ground was quite rare, although one example even showed ditch-like sections.

Since artefacts, notably flints, but occasionally sherds, were often found in the top few inches of periglacial features, the simplest way to determine their origin was to excavate at least the top level; from *c* 900N periglacial features were planned, a procedure which helped considerably in their interpretation. As well as pit and gully-like shapes the plan demonstrated that arcs and even rings were typical (M U Jones 1974, fig 3).

Patterned ground was of concern, not only during excavation but also in interpreting cropmarks in areas still to be excavated or abandoned. Of the latter, the most significant was the area lying between the trial excavation and 1000N 100W (Figs 4 and 7, and p 24). Cropmarks had consistently reflected dense occupation extending north-west from the South Rings. So when the quarry foreman, R Lanham, offered to move the working face to allow more excavation time, it seemed a simple alternative between identifiable ditches, pits,

round house gullies, and *Grubenhäuser* and an isolated enclosure in an area of small, scattered, indeterminate cropmarks. Unfortunately, some of these must have been graves of Anglo-Saxon Cemetery I.

Acknowledgements

How to thank the thousands of people who took part in the Mucking excavation and the start of post-excavation (MPX)? And how to assess individual contributions? Many are already immortalised as a posthole setting, a length of ditch, a roundhouse, or a pottery kiln. It would be rash to embark on a list of names, although a few are already published in interim reports. Clearly this is a situation which computers should have handled. So, since an attempt at traditional acknowledgment would have resulted in many omissions, I must begin with an apology for the inevitable gaps, and then go on to thank contributors in groups. The range of these groups, incidentally, illustrates how versatile in their contacts excavation directors must be.

From the initial decision to follow the trial excavation, employing professional labourers, with student excavators, came the need to establish a camp. From the beginning local bodies – Council, Museum, Society – were supportive (Essex County Council had not then, in 1966, set up its Archaeology Section). Memorable gifts for the camp included:

a bedstead for the camp organiser

deck blankets from discontinued cruise liners

a worn-out lorry which made a splendid dormitory

help from Venture Scouts in putting up site huts to free diggers (at that time very thin on the ground) to dig

a contractors' pensioned-off hut which served until the excavation ended as cook house, mess hut, and shelter for varied activities

regular supplies from their charity allocations from local firms manufacturing margarine and detergents

painting a water tank black to absorb heat and so warm its contents for a watering can shower; etc, etc

Here I must acknowledge the succession of cook/excavators (the best were from the USA) whose arrival at breaks with fresh bread (eaten with peanut butter and honey) is a vivid memory.

At the camp site (on the quarry floor) official bodies who might have invoked stringent regulations and frowned at so Bohemian a settlement instead took a helpful line. So did the landowners (the trustees of Surridge Disposals Ltd), who also presented the finds. So did: the farm tenant, the late Tom Lindsay of Walton Hall Farm; W Morant, the farm manager of Blue House Farm; the gravel extractors (Hoveringham Gravels Ltd) and their staff; the earthmoving contractors; and the Army, whose 'aid to the local community' took the form of topsoil removal and a 1ft interval contour survey of the site.

The Museum helped with local contacts and best of all offered storage, at first in Tilbury (where a flood encroached on some finds boxes) and then in Grays' new library/museum complex. This was backed up by loans and use of equipment – typewriters, copying machines, etc – and new lighting on the sixth floor, where excavation finds and materials were stored without charge right through to the end of the excavation, and where post-excavation (MPX) began in what was by then extremely cramped accommodation.

Mucking spanned three metamorphoses of what is now English Heritage, though personnel changes were few. Reay Robertson-Mackay (for the prehistoric period), Sarnia Butcher (for Romano-British), and John Hurst (for post-Roman) maintained their support for what had become to many a white elephant of a rescue excavation. As government allocations led to improved rescue excavation grants, it was possible to employ more site assistants. However, they also had to cope with an always increasing demand for gravel, especially for local road building, and an always decreasing depth of the gravel layers. Too late to affect the rescue excavation was the acceptance of the underlying Thanet Sand (previously neglected) for some construction work.

A very much appreciated innovation allowed the excavation directors (the writer and W T Jones) to do spells of work in London free from site distractions, which facilitated contacts with laboratory and drawing office staff and allowed the production of interim reports, plans, etc. One outcome, assembled at short notice, was the production of chapter 6 in *Recent archaeological excavations in Europe* (Jones and Jones 1975).

Financial support from other official bodies must also be acknowledged: Thurrock District Council, Essex County Council, the British Museum, and the Society of Antiquaries. The British Museum helped too with the queue for conservation, as also did the Netherlands State Service, who must be thanked in addition for the gift of Dutch sand shovels which made light work of Mucking flint/gravel.

Apart from the continual need for conservation, mostly of grave goods, some requests for scientific back-up from the Ancient Monuments Laboratory were made. There were several attempts at image enhancement: an ultra-violet lamp was shone on body silhouettes at night (beneath a blanket), a plastic cast of a silhouette was attempted, and chemical sprays on a *Grubenhaus* floor would, it was hoped, develop traces of timber. Soil was analysed and pollen identified, advice on periglacial features was obtained, and a phosphate survey of the slopes below the excavated site was undertaken. Thermo-couples were loaned for a trial kiln firing. Resistivity surveys were made in the area of Anglo-Saxon cemetery I for the more rapid recognition of graves. Seeds preserved in the clay of Saxon pots and in a Romano-British corndrier were identified. Scientific contributions included animal bone reports, while the Passmore Edwards Museum consolidated a deposit of red deer antlers and loaned a member of staff to process queried finds of stone. Several thousand charcoal identifications were made, and their distribution later mapped by digital plotter. Palaeomagnetic and radiocarbon dates were obtained.

Air photographs of the cropmarks, mostly from the Cambridge University Collection and the Air Photographs Unit of RCHM(E), were of course the foundation of the excavation and were in constant use for reference. Photographs of the site under excavation were also taken by local fliers: Aerofilms of Grays, Southend Air Photography, and J P J Catton.

And now to the group which deserves the principal acknowledgement: the excavators themselves, without whose labour the cropmark picture would undoubtedly have remained a latent image (though a few significant finds might have escaped damage during their journey along the quarry conveyor, and surfaced to join the thousands of unprovenanced finds in British archaeology). Mega-excavations like Mucking were products as much of a definite ethos of students of the 1960s and 1970s as they were the outcome of cropmark photography. For most participants Mucking was primarily an educational experience. The significance of this labour force (the writer's first experience with student excavators *en masse*) was brought home with a thud in 1977 (the final year), which coincided with vacation allowances and Manpower Services Commission projects. It had soon become evident – when an illustrated letter to *The Times* in 1966 yielded one digger – that British universities were unlikely to produce the numbers needed. Copying a Welsh henge excavation, overseas recruitment began in Czechoslovakia. By the mid 1970s, students from anywhere between Alaska and Australia evidently found Mucking a convenient base from which to explore the British Isles. And as far as staff were concerned, Mucking provided nursery slopes for a number who are now part of the archaeological establishment; one might mention the Vice-Director of the Institute of the History of Cultural Material in Poland...!

3 The excavation

In total, some 5000 students and volunteers excavated at Mucking. From 1968 work continued all through the year. As M U Jones has noted (p 8), winter conditions were more suited to the recognition of soilmarks. The ephemeral nature of these is exemplified by a section of ditch only being clearly visible for five minutes during six weeks' intensive work on one part of the site. The *Notes for excavators* (held in the archive) exhort the diggers to the challenge of '100% rescue'. M U Jones (1974, 186) rated their success as 75%. It is not clear, however, how much evidence was lost in the mechanical stripping of the ploughsoil and subsoil made necessary by the pressures of quarrying (Anon 1966). M U Jones considered (1974, 193) that 'the modern surface is taken as approximating to the ancient', at least on the more level areas of terrace. However, the eroded terrace slopes to the east produced only traces of comparatively substantial features, for example GH 114 (site atlas plan 14, 1210N 902E) which was only a few millimetres deep. It has been estimated that a depth of some 300–450mm was removed by mechanical scraping. Deep steam ploughing during the 1920s and 1930s may have removed some of the occupation evidence. Yet '...surfaces adjacent to Saxon huts littered with bones and broken pottery' were recorded (M U Jones 1975/6, 35). M U Jones has noted (p 7) that fieldwalking and a trial area dug by hand from the topsoil added little information. In an adjacent area on the A13 and M25 rescue excavations Wilkinson (1988, 6) also found fieldwalking results disappointing and little was visible until the stripping of the topsoil.

Methods

This account of excavation methods is in part a summary, sometimes verbatim, of *Notes for excavators* and *Notes for site assistants* (copies in the archive). It is presented here to elucidate something of the strategy and to demonstrate the divergence between these instructions and their interpretation as practised in the field (p 15).

The excavation progressed broadly from the south end of the site to the north. The surface which presented itself to the excavators was cleared with a fork and shovel (or hoe). Where appropriate, soilmarks were brushed around their perimeter to avoid smearing and to clarify their shapes in plan. There were considerable problems in clearly defining the soilmarks so that 'sometimes it is necessary to resurface more than once for a feature to show' (*Notes for excavators*). The methods of excavation owe much to Dutch sand techniques 'where the natural is excavated along with archaeological features...to elucidate different features...' (Jones *et al* 1968, 229). The importance of soilmark plotting was considered paramount as 'a good deal of interpretation can be attempted at the soilmark stage. Overlapping soilmarks and pebble lines demonstrate stratification much more reliably than sections cut through gravelly fills' (ibid, 229).

The features thus identified were 'marked out' and excavation proceeded in horizontal levels (or spits) of variable depth depending 'on the feature and time available' (*Notes for excavators*). These were usually 3, 6, or 9 inches (76, 152, 229mm) to enable 'differences in fill to be seen and plotted in plan' (*Notes for excavators*).

Each marked out excavation trench was ascribed coordinates, whether a box laid out across a ditch, a quadrant, or half of a non-linear feature such as a pit or *Grubenhaus*. Any archaeological layers or features subsequently encountered in the excavation were to be similarly referenced with coordinates. Finds were to be separated for each level within each identifying coordinate. The coordinates are given as northings (or southings, where the grid (p 7) was extended beyond the zero line) and eastings (or westings), ie in the opposite manner to OS grid references. In addition, certain features, enclosures, and the cemeteries were given identifying prefixes and numbered serially (see p 12). Some of these identifications have turned out to be erroneous, but they have become a useful shorthand and Figure 4 shows those most commonly used.

Plans

Plans of the cleared soilmark surface included the positions of trenches, the relationships of soilmarks, and the labelling of natural features. These were produced for each of the 100ft (30.5m) site grid squares at a scale of 1:60. Diagnostic finds were also plotted where possible. Any excavated features were denoted by hachures and any apparently blank areas were noted as having no soilmark visible. In addition, feature plans at 1:12 were made.

4 Post-excavation

This can be divided into two distinct eras. The first (see below) followed on immediately from the end of the excavation in 1977 until 1985. It was based at Thurrock Museum, under the direction of the excavator, and is referred to as MPX – an acronym for Mucking Post-excavation. The second (p 14), from February 1986 until March 1989, was under the aegis of a joint British Museum and English Heritage (Historic Buildings and Monuments Commission for England) Management Committee (here referred to as BM/EH) under the direction of Ann Clark.

Mucking Post-excavation (MPX)

Some preliminary processing took place while the excavation was in progress and during intervals in it. From 1977 efforts were being made towards completing the outstanding washing and marking of the finds, and a card index recording features by type and location had been tried out but not continued. Catalogues of specific finds and dossiers of typed-up notebook entries for certain feature types were produced. In addition to those features numbered on site further classes were numbered each in its own series, giving the following as individually identified features: graves (whether inhumations or cremations) (GR/CREM); barrows; round houses or penannular gullies (RH/PG); ground level or posthole buildings (GLB/PHB); *Grubenhäuser* (GH); wells; kilns; corndriers (CD).

Most effort was directed towards producing a computerised archive (see below). This required the input of specialist skills in identifying objects and at least 30 people had an involvement in dealing with objects alone. An enormous conservation programme undertaken by the Ancient Monuments Laboratory (chiefly by Glynis Edwards) during the excavation and afterwards is still in progress. The plans of the 100ft site grid squares were traced on to film with a view to publication.

Many researchers were attracted to MPX for the quantity and diversity of material which the site provided. Several were already acknowledged specialists in their chosen field of study. For others Mucking went some way to launching them in their careers. The thick correspondence files and records of visitors in the archive are ample evidence. Suffice it to say, the specialist reports which appear in this and forthcoming volumes represent only a fraction of the work undertaken.

Computerisation of the archive

Although computers were widely used in archaeology during the 1970s, most of the growth in computer applications has taken place in the last decade. In 1978 Mucking became a forerunner in the field. It was seen to have sufficiently exciting potential to attract the interest of Dr I Graham as part of a research project on handling data in the humanities for the British Library. Dr Graham developed a system written in Assembly language to run on a Zilog Development System (on loan from the Institute of Archaeology, London). On completion of the project in 1979, the Zilog was withdrawn. A year elapsed until, in 1980, MPX acquired a Midas 3. This was an early Z80 based microcomputer with a 64K memory and twin 8-inch 484K floppy disk drives, running the CP/M1.4 operating system. It was considered to be one of the most advanced microcomputers of the time. In order to maximise its use the Midas was modified to become two computers, each with a 64K memory.

During 1980 and 1981 J Moffett developed the data capture system as part of a sandwich course (School of Archaeological Science, University of Bradford). The original system had to be rewritten initially in 8080 Assembly language and then Z80 to run on the Midas 3. In collaboration with M U Jones, J Moffett identified various requirements for data entry which resulted in the development of the 'question sourcefile' (QSF). This was later referred to as 'data definition files' (Catton *et al* 1982).

The QSFs had to be designed to be input by inexperienced staff and to be comprehensible to them. They comprised a series of questions with a range of acceptable answers. A series of self-explanatory keywords was used. Three categories of data relating to features, documentation, and artefacts, and totalling in excess of 10 megabytes, were input. The majority of the data related to the artefacts. 'The aim was to be comprehensive yet succinct, always bearing future analysis in mind' (Catton *et al* 1982, 40). In an attempt to be objective, it was hoped that a classification of artefact types would 'emerge from the database'. In some cases the specialists themselves designed QSFs for their own data. In other cases QSFs were designed to record, it was hoped, every possible analytical contingency. However, it should be said that for most specialists this was their first experience of computerisation. The recording was very detailed; for example, there were up to 79 questions for a single sherd or sherd group of Anglo-Saxon pottery. Such detailed recording was bound to obscure any broad patterns and was input in many cases without any clear view about retrieval. There were problems in the degree of subjective judgement required to answer some questions and a lack of definition of ambiguous terminology. All this gave inconsistent responses.

For the most part, where retrieval was envisaged, it took the form of a variety of programs written by Moffett as part of a research project (Moffett 1983) for the development of excavation databases on a Midas 3HD, using the CP/M2.2 operating system. Although never consolidated into a single data manipulation program, these produced histograms, bar charts, and distribution plots (M U Jones 1985) for a Houston DMP-6 digital plotter. Distribution plots became an integral part of the publication strategy so that it was envisaged that 'to a large extent this treatment (dot distributions) will take the place of vertical stratigraphy' (Catton *et al* 1982, 36).

For Mucking, Level III (Frere report 1975) and the computerised archive became synonymous. However,

since its inception the computing had been one element of a series of research projects, managed at Grays by a self-trained member of MPX staff (J Catton) whose main brief was officially an analysis of the prehistoric pottery, and input largely by part-timers. In 1984 the then Inspectorate of Ancient Monuments of the Department of the Environment recognised the need for some full-time computer expertise and appointed S Pierpoint. His brief was to provide retrieval and feedback as required to MPX. This entailed the transfer of data from Midas 3 to a PDP11/73 running Microsoft Xenix version 2.9 operating system where it could be loaded into Informix, a relational database management system.

By 1985 all the computer expertise had departed, and little had been achieved towards fulfilling M U Jones's hope 'that archaeologists will have less need to be articulate in the literary sense when there is a machine which will make the data self-explanatory' (Catton *et al* 1982, 43). Although it had been established at an early stage that below 5% was an acceptable error rate, no comprehensive assessment had been made. By 1985 this had several dimensions: input errors; errors in editing files already input; errors in amalgamating files; and finally errors in the transfer process between different media and systems.

Moffett used the experience of the Mucking computerised data to epitomise 'The Deep Thought Syndrome' where 'the computer is fed masses and masses of data in the great hope that when THE button is pressed a report will appear out of thin air' (Moffett 1989). The error rate, while possibly not great in percentage terms, was such that subsequent manipulation proved extremely difficult, if not impossible. Several specialist requirements had to be abandoned. These requirements had become an essential part of the post-excavation and publication programme and so fundamental strategies had to be reconsidered. It seemed that many artefact specialists had been seduced by the 'number-crunching' potential which computerisation had offered. Given the brief to produce *catalogues raisonnées* in fulfilment of the requirements of the Frere report, it is unsurprising that the temptation to concentrate efforts on quantification of wide-ranging attributes took precedence over an elucidation of the archaeological contexts. For the purposes of publication, the data input between 1978 and 1985 have been largely deemed, as Moffett has so candidly said (1989, 13), 'an accident of history'. In the end Moffett felt (pers comm) that 'the computer was more of a hindrance than a help to the publication of the site of Mucking'.

There are, however, two notable exceptions. Firstly, following an arduous period of verifying and editing, H Hamerow was able to utilise some of the Anglo-Saxon pottery data (Hamerow 1993; volume 2 of this series). Secondly, retrieval from the 8-inch floppy disks of the notebook and plan indexes was partially successful following painstaking editing of field delimiters and other anomalies by R Jones (formerly of the AM Lab). This produced a printout which was essential to the contexting process undertaken from 1986 to 1989.

As a coda to this, the British Museum, on acquiring the Mucking archive, was keen to employ its GOS system – a powerful hierarchical database which makes possible the detailed recording of individual objects. This was being used as an adjunct to the registration process but would have had severe restrictions in terms of ordering the archive which entailed the elucidation of interrelationships between contexts and assemblages. Finally, after much discussion and almost a year into the project, a Torch computer running Informix as a relational database was installed. The context records primarily holding cross-references between features and their documentation have been input. Thanks to not inconsiderable efforts by R Jones these data can now be read on the new British Museum Prime system, but whether they can be restored to their full relational capacity will be left for the future to establish.

The end of MPX

Mucking fell within the golden decade of archaeology. The birth of Rescue in 1971 was a response to an exponential increase in plough damage and threats to urban, motorway, and mineral extraction sites leading to archaeological excavations, together with an urgent need to address the problems of post-excavation and publication. The excavations at Mucking were of some six years' standing and the frisson caused by the discoveries, particularly the Anglo-Saxon cemetery and settlement, was felt throughout the archaeological community both in Britain and abroad. The following sections reveal the extent to which Mucking on the one hand evolved with the changes in policies and controls and on the other suffered some detrimental effects as an anachronism. The Frere report (1975) placed an obligation on excavators to make available the totality of evidence. As has been noted, for MPX, Level III (the ordered archive) came to signify the computerised data. To comply with Level IV (publication), in November 1976 M U Jones produced an impressive draft for the 'definitive report', comprising a compendious list of finds and features relating to 'Successive Human Landscapes'. Each period was to be produced as a separate fascicule.

A need for tighter managerial control of archaeological projects was reflected in the publication of the Cunliffe report (1983). In the following year, 1984, the Backlog Working Party of the Directorate of Ancient Monuments and Historic Buildings (DAMHB), Department of the Environment (DoE), was set up (chairman – B W Cunliffe; members – I H Longworth, P J Fowler (succeeded by the late A Carter), S A Butcher, and J G Hurst) to facilitate the publication or the public availability of government-sponsored pre-1973 excavations. DAMHB had invested at least £85,000 in the excavations at Mucking (records for funding and supply of materials were not comprehensive). By March 1982 the cost of post-excavation work was estimated as £157,000 and by December 1985 the total cost to DAMHB amounted to some £254,000. In addition were the services provided primarily by the Ancient Monuments Illustrators, who undertook the drawing of hundreds of finds, and staff of the Ancient Monuments Laboratory who, in addition to the conservation programme already mentioned (pp 9, 12), provided radiocarbon, environmental, and technical services. Funding from other sources has not been specified (but see M U Jones's acknowledgements (p 9)).

There was growing dissatisfaction among the members of the Backlog Working Party at the extent of progress after some seven years of MPX. This led to a polarisation of views between the excavator and the Backlog Working Party which gave rise to the threat of terminating MPX. In May 1982 M U Jones roused all those who had patronised Mucking with a widely circulated supplication extolling the site's unparalleled results. This won a short-lived reprieve until the following year when key members of staff were contracted directly by the Inspectorate to complete specific pieces of work. Nonetheless, MPX struggled on, with increasing dependence on the Manpower Services Commission, until late in 1985.

Erratic and inadequate funding accounted for great difficulties in maintaining a team with sufficient expertise through the MPX years. Thurrock Borough Council provided invaluable premises for MPX, as they had done during the excavation. However, by present standards the accommodation could not but fall far short of the area needed for such a vast archive, and it is to the credit of all those who worked there that they coped with such cramped conditions.

Post-excavation and publication (BM/EH)

Introduction

In June 1985 the Mucking Management Committee (J Cherry (BM), I H Longworth (BM), S A Butcher (EH), and J G Hurst (EH)) was set up to implement the recommendations of the Backlog Working Party. English Heritage undertook to provide a grant for the British Museum to appoint a project team of four (one manager and three project assistants) who were to have 'the task of preparing the ordered archive in the British Museum and devising and implementing a publication research design'. In addition, the British Museum would contribute to the team two members of their staff (Museum Assistants), one from each of the two departments with curatorial responsibility for the archive – the Department of Prehistoric and Romano- British Antiquities and the Department of Medieval and Later Antiquities. The project was to be based in extremely spacious accommodation at a British Museum outstation and was to run for two years. In February 1986 the team manager and museum assistants began work. Two of the three members of the project team were finally in post in June of the same year. The delayed appointment of the team allowed for adjustment to the programme, so that in practice the project was extended to March 1989. With the retirement of J G Hurst in August 1987 and S A Butcher in March 1988, the composition of the Committee altered to include J S Johnson (EH) and L Webster (BM).

Initially the funding agreed by the Backlog Working Party was to be £113,500. This figure was revised in August 1986 to give a further £71,000 to cover additional staff costs which had not been foreseen at the outset. The total figure was to include the payment of all project staff and specialists. In February 1988 a further £102,015 was allocated for certain selected specialist work and to cover further unforeseen increases in salary and fee rates. £40,000 was also earmarked for publication costs. In June 1989, after the formal end of the project, a joint approach was made by the British Museum and English Heritage to Treasury for a further £46,000 to enable specialist work to continue into 1992. Welcome though it was, each change in funding had implications for planning which could not always be predicted.

Constraints

The limited timescale and resources necessitated a stringent and rigorous approach in order to satisfy the dual brief of ordering the archive and achieving publication. For the British Museum, on the one hand, an ordered archive was an essential prerequisite to registration, in fulfilment of their accountability to the Trustees for all items in their collections. For English Heritage, on the other hand, there was a need to discharge responsibility for publication of the site.

In contrast to the comprehensive approach to publishing an evolving landscape which M U Jones had outlined in 1976, this project had to be selective. Furthermore, in conflict with the recommendations of the Frere (1975) and Cunliffe (1983) reports, which set down guidelines for post-excavation procedures, the ordering of the archive and publication elements had to proceed in tandem if the objectives were to be achieved. At the outset it was hoped that much of the pre-existing work, both that undertaken at MPX and that of the specialists, could be incorporated. However, it soon became apparent for a number of reasons outlined in the previous sections that a new approach to cataloguing the archive would have to be sought. Initially, the British Museum had appointed a part-time archivist, M Bruce-Mitford, to deal with compiling an index of the documentation and site records. This work was abandoned owing to the clear need for an integrated approach to the finds and records. In practice, the vast secondary archive produced by MPX was not investigated systematically.

Ordering the archive

Ordering the archive concentrated on producing a definitive site plan (the atlas as presented here). Most specialists who had worked on the project were dealing with various classes of material isolated from their contexts. All were clamouring for context information. As outlined above (p 11), a single feature or context could have had several coordinates ascribed to each portion. Although the system was designed to maximise the potential for analysing distributions of material, it produced an exceptional number of coordinates in feet and inches (each with a susceptibility for transposition of digits). It fragmented features and archaeological contexts, and was cumbersome for ready reference. At the start of the project it was recognised that there was an urgent need to cross-reference plans and notebooks and then to ascribe the new context numbers to the finds. The first two stages are complete, but it is estimated that only a third of the 1.7 million finds have been put into context.

To streamline the system a series of context numbers was generated. These were applied to all features bigger than about 2ft (600mm) in diameter unless such small features taken together formed part of an obvious structure identified during the excavation or MPX. 'Multicut' (mc) and 'multifill' (mf) numbers were allocated to these features.

A form was designed by S Trow to record the context numbers (cuts and fills), references to any relevant site notebooks or plans, and any stratigraphic relationships. This information was input on to a relational database (see p 13). Each feature was to be given a 'cut' number and fill numbers appropriate to any identifiable stratigraphic layers. In practice the meaningful ascription of fill numbers was fraught with difficulties. The archaeological layers, clearly visible on the section drawings, were rarely defined, despite the instructions to excavators and site assistants to record them along with the excavation levels (or spits). Thus where levels cut across different layers the latter were difficult to reference. However, most features of any depth displayed primary, secondary, and tertiary fills in the section drawings. In an attempt to overcome the difficulties of recording fills an arbitrary expedient measure was taken to ascribe three context numbers to the fills. The hope was that it would be possible to elucidate and refine the fill numbers at the stage of putting material into context.

Two examples serve to demonstrate the solutions provided. The first concerns the *Grubenhäuser* for which fills were clearly visible in the sections. However, H Hamerow (1993) demonstrated that the patterning which she identified in the ceramics transcended *Grubenhäuser* fills. All finds from each of these features were therefore treated as one context, and to conform with this treatment only one number was given to the fills of each *Grubenhaus*. The second example pertains to the South Rings. Most levels cut across several layers but, by careful measurement of the levels against drawings of the nearest available section for a given excavation box, the context or range of contexts could be isolated. It was found that, by using several section drawings in collaboration, an average depth for the fills could be ascertained for those areas lacking sections. This was a painstaking assessment applied wih extreme caution and corroborated by further information from the finds bags which was not obtainable from other records. In this case some of the finds were in fact separated by fill.

Elsewhere on the site the instances where archaeological layers had been isolated were in the minority and the problems were exacerbated where an excavation box contained several features or recuts not apparent in the soilmark. In these cases one coordinate and level could not only relate to several layers in a feature, but also to several features. Given these problems, in retrospect the task would have been simplified by ascribing single numbers to each feature and only elaborating as necessary where the records (often enhanced by information on finds bags) could clarify the relationship between levels and layers.

By present-day standards the on-site recording was inadequate. There was no description given of the cuts and the description of the fills generally only appeared on keys to section drawings which varied from brief statements to idiosyncratic descriptions of texture and colour. The terminology used in these was not standardised. This caused particular problems when attempts were made to relate independently excavated portions of a single feature. In extreme cases it has been difficult to relate and interpret layers even across a single baulk. The corollary is that descriptions given of the sections in the forthcoming volumes have replicated the original description, however cumbersome.

Considering the number of personnel who were involved in recording during the excavation, it is not surprising that so many problems came to light. These included illegible handwriting, transposition of coordinates (or the digits within them), conflicting notebook and plan/section information, and inconsistent use of symbols on the plan. For some features there was no apparent notebook record and for others there were only drawings. The scale of the problems undoubtedly reflects the scale of the excavation and the rescue conditions under which it operated. Excavators and specialists alike must be familiar with them. However, in a smaller-scale excavation discrepancies can be more readily resolved on site or in the period immediately following the excavation.

The 'contexting' of the site proved a much more time-consuming task than anticipated. A single feature could be recorded on several plans and in several notebooks, without following any logical sequence. The index by 100ft square to plans and notebooks, produced from the MPX computerised data, was by no means comprehensive and new references were constantly discovered. It cannot be over-emphasised that the production of a definitive site plan, backed by full documentation of the paper archive (both as a manual and computerised record), has been an outstanding achievement within the 31 months' active life of this project.

Site atlas

The MPX tracings of the 100ft square field plans (each referred to by its south-west corner grid coordinate) form the basis of the 25 site plans presented with this volume. As inherited, these lacked any feature numbers. Only linear features, with the exception of the 'modern' ditches (see below), had hachures. Even with such a relatively clear and simple form of presentation, the excavators had recognised the need for publication of such a vast plan in atlas format. Dyelines of these squares were used as working copies for the editing and amendment which formed an integral part of the contexting process (see above). With the exception of the burials (see below), the numbers alongside features are the 'cut' context numbers. Initially some attempt was made to ascribe batches of numbers to different areas of the site, with the lowest numbers at the south end of the site and the highest at the north end. This was in an attempt to follow the general trend of the excavation. In practice, however, as the batches of numbers allocated to each of the four areas became exhausted, considerable intermixing of the original sequences occurred, although some evidence of sequence progressing from south to north can be seen.

Numbers prefixed with an 'F' pertain to apparently unexcavated soilmarks or those subsequently designated 'natural'. The 'F' in this case relates to the 'fill', since many yielded finds during the initial scraping of areas of the gravel surface. Initially, there was some confusion over the use of the 'mc' prefix (see above). The original intention was that it should be used only for groups of postholes which had been identified as plausible structures in the field or during MPX. Some of the BM/EH team, however, saw it as a means of isolating any recognisable posthole structures. Attempts were made to eliminate such later interpretations, but this may not have been comprehensively achieved. The prefix 'recut' has also been added to reflect evidence from section drawings or field notes. While every effort was made to check for consistency in application of these prefixes, some errors are bound to have occurred.

Towards the beginning of the BM/EH project it was decided to superimpose all conveyor belts, quarry edges, edges of excavation, and edges of clearing. This was in an attempt to give a visual impression of the dynamics of the excavation. In several instances these edges account for truncated features and discrepancies. A notable example of a staggered join between two sections of a ditch excavated over a period of five years can be seen on site atlas plan 4 (65N 520E; ditch 296 was excavated in 1973 and the same ditch (3005) was excavated in 1978). It is hoped that the various edges give some indication as to which areas were cleared. Where the records specify that adequate clearance or excavation was not possible, this has been noted.

Owing to the problems of identifying features in the brickearth (p 8), this has been traced on to the site plan where it has been noted in the original records. Similarly, natural features probably of periglacial origin (see Jones (p 8), Riley (p 24), Carreck (p 30)) have been plotted. A section line or an excavation box generally indicate those which have been excavated.

The numbers on the site atlas, with the exception of the graves, are the cut numbers from the contexting process. The burial numbers for both cremations and inhumations are shown in italics to distinguish them from the context numbers. Context numbers for all these features can be found in the archive, but for the sake of simplicity and consistency with other published references, burial numbers have been retained. In addition, all features serially numbered on site, or during MPX, have been labelled. One exception is the 'ground-level' (or 'posthole') buildings. These acquired a complex series of numbers during MPX (prefixed GLB). All structures distinguished in this way have been given multicut (mc) numbers (but see the errata list on pp vii–viii). However, since only a selection of them have been confirmed by H Hamerow as Anglo-Saxon 'posthole buildings', only those verified for the Anglo-Saxon settlement report have been labelled as 'posthole buildings' in the PHB prefixed sequence of numbers (see below).

Where no stratigraphic relationship of two cross-cutting features is stated in the record, none is shown on plan. It was, however, impossible to check every instance, and subsequent specialist work may reverse this. A dashed line indicates a soilmark or uncertain edge, and is also used where the top of a feature did not appear as a soilmark on the cleared surface but only at lower levels. Where the location, size, or orientation of a feature is ambiguous, a question mark is placed inside it. The same symbol has been used where a section line is uncertainly located. The original drawings had two symbols which became inconsistently applied. These were a dashed line to indicate 'an indistinct soilmark' and aligned question marks to represent 'uncertain soilmark'. While every effort was made to clarify the distinction between these to give only one level of uncertainty, it has not always been possible.

Many features have been ascribed 'modern' in the field records. However, clear definition of this was not found in the archive. It was assumed that the so-called 'modern' features were a meaningful group, and so they have been distinctively represented without hachures (as in the archive) even where excavated. The excavator has subsequently defined these as shallow with a distinctive dark, loose, smelly fill and occasional modern finds. An indication of the excavated portions is given by the baulk and/or section lines. The arrangement of some ditches (as noted on p 8, 9218, site atlas plan 8, 600N 700E) would lead one to believe that they are recent field drainage ditches. Others appear on the nineteenth-century Tithe Map, but whether they owe their origin to earlier land boundaries is at present uncertain. Figure 5, taken from the Tithe Map, shows that the field boundaries existing at that time do not appear to respect earlier ditches. The area of the excavations falls within Wilkinson's sub-region 5 of randomly-aligned fields (1988, 120, figs 95, 96). It is also cited, from Domesday sources, as an area of moderate woodland. Although Anglo-Saxon Cemetery II broadly respects pre-existing Roman ditches, the latter had silted up by this time or may not have been maintained.

As the complexity of the site records unfolded, so aspirations for the site atlas developed. The aim was to produce an unphased site plan which gave as much information as possible, not only about the archaeology but also about the excavation and the problems inherent in the records. An effort was therefore made to indicate the precise extent of the excavation. This meant that hachures had to be applied to all excavated features large enough to take them (with the exception of the graves, 'modern' ditches, and 'natural features').

Since publication of the atlas was central to the project, all decisions and draughting had to evolve alongside the processing of the records. What has resulted, therefore, emerged in a piecemeal fashion with considerable backtracking. In addition, several different illustrators were involved in drawing the site atlas, and a late decision, after the formal cessation of the project, to change the format of the presentation (see below) entailed many last-minute corrections. Inconsistencies and errors were discovered at a late stage, by which time resources were not available to make corrections. Visually most striking are the differing sizes of symbols for quarry edges and conveyor belts and the fact that some of the labelling of non-archaeological features dominates the plans unduly. Other inconsistencies include discrepancies in the sizes of features which received hachures and, more important, omissions or variances of feature numbers across plans or 100ft squares.

The north point as shown in the plan is Ordnance Survey grid north which is 19° west of Mucking grid north. True north is 2° west of Ordnance Survey grid north and magnetic north is 7° to the west of true north at the time of the excavation (the writer is grateful to D Barraclough, Geomagnetic Research Group, for this information relating to the years of excavation).

Presentation

The publication of some 241 squares drawn at a scale of 1:60 posed considerable problems. If features and numbers were to remain legible, no overall site plan on a single sheet would be possible. At 1:480 the overall plan measures 1.86×0.90m. Although this is an excellent scale for studying the spatial patterning of the features it precludes any lettering or numbering. Ideally, such a plan should have been produced together with the atlas, but this would have involved redrawing the site atlas in its final form without numbers and other symbols, and this was beyond the resources of the project.

The original format of the atlas was to have been pairs of 100ft squares on A3 sheets, bound loose-leaf. The schema for these pairs was rigidly adhered to throughout the project. After the end of the project, a new format was instigated by English Heritage, and the problem of executing this fell to G Taylor.

The result gives 25 A1 or A2 plans at a scale of 1:180; a scale rule is provided (on the back cover) for ease of reference. The schematic plan of the site on each sheet shows which squares are covered on that plan. However, the fact that the original squares were not true is made clear by this mosaic. The misalignment of the intermediate 10ft (3m) grid lines shows this, as does the staggered joining of features across squares. The stretching of the original graph paper and of the dyelines which formed working copies, and the possible distortion introduced by photographic reduction (ITEC), have all contributed to what is estimated as a 5% margin of error. In addition, during the BM/EH project, successive corrections to the same feature on tracing film resulted in a loss of definition and accuracy. G Taylor has matched the squares to produce a 'best fit' and it is a tribute to his meticulous work that the plans have a coherence.

The reduced squares were mounted on board and it was proposed that any corrections would be made directly on to the bromides, which would then be sent for production as camera-ready copy. However, the fragile nature of the artwork meant that the boards could not be subjected to much handling, and there was little opportunity for checking. Proofs were not produced and by this time the project had been disbanded for some time, with the consequence that there were no personnel who had long-term knowledge of the history of the project and the problems encountered in producing the site atlas. The long errata list on pp vii–viii is the result of last-minute checking, and is presented with the intention of covering all actual errors or types or error noticed at this late stage.

Site plan (Fig 6)

The plan was produced from photographic bromides of the 100ft squares reduced to 1:250. This scale was an early attempt to provide the plan at a more useable decimal scale. However, subsequent reductions reverted to a duodecimal system in order to facilitate archive work in imperial measurements. The bromides were made up into a mosaic of the whole site and reduced to 1:480. At this stage the excavated features were blacked in to give some impression of the completeness of excavation. It was not possible at that stage or scale to specify internal areas of the excavation which were incompletely investigated. The plan was then reduced to fit an A3 page.

Conclusion

In a short introductory text which pre-empts the phasing and specialist work, it is difficult to do justice to such a vast, multi-period site. However, the definition of the contexts and the site atlas, as published here, should give a sound basis for future investigation of the landscapes which the excavations have disclosed. In addition, Mucking will undoubtedly remain a landmark in the evolution of the discipline. The significance of this can only now begin to emerge as we become more introspective, retrospective, and self-critical about the techniques we use, both for researching the archaeological resource and for the management of projects.

It is hoped that this series of volumes will attract researchers to continue the work on the archive with the aim of filling the many gaps and ultimately of realising the site's full potential and giving it the prominence due to it in this region of national archaeological importance (Wilkinson 1988).

5 Summary by period

Since much of the work leading towards publication is still in progress, it is not possible to give a comprehensive overview nor to present, as had been hoped, phase plans. To some extent what is presented here reflects the deficiencies in funding (see p 14). The summaries have been kindly provided by specialists still working on the material. Work on the Anglo-Saxon cemeteries, now part of an ongoing programme undertaken by S Hirst and D Clark, is not sufficiently advanced to allow the contribution of a summary to this volume.

Early prehistory

by E Healey

Although Palaeolithic finds are well known elsewhere on the Boyn Hill Terrace (Wymer 1980), at Mucking there were no clearly identifiable tool forms and only a few rolled artefacts are tentatively ascribed to the Palaeolithic. Evidence of Mesolithic activity is almost as sparse, and nothing that is certainly Mesolithic has been found *in situ*, although the presence of a tranchet axe, some microliths, and the use of a blade technology demonstrate that there was some activity here. The nature of this must be assessed in relation to other riverine areas (Wilkinson and Murphy 1986; Frome 1976).

By the Neolithic period there is more concrete evidence of activity, with the occurrence of ceramics, lithics, and pits, often with discrete distributions. Nineteen catalogued early Neolithic (Mildenhall Style) sherds were recovered as well as a number of body sherds. Of particular interest are three pits (11636, site atlas plan 17, 1727N 776E; 6349, site atlas plan 18, 1514N 821E; 6342, site atlas plan 18, 1578N 835E) which also had associated lithic assemblages, and one of these (11636) had an axe polishing stone. The full extent of the spatial distribution is difficult to establish.

Later Neolithic activity is better documented and defined. One unstratified sherd is of Peterborough tradition (Mortlake Style). The rest of the pottery is Grooved Ware. The Grooved Ware was found in relatively large quantities in a limited area (the south-western corner of plan 17) in 13 features which all seem to have been contemporary. There was only one sherd residual in a later pit outside this area. In one feature there seems to have been a deliberate deposit of pottery. The lithics associated with the Grooved Ware are fairly typical of domestic assemblages and are quite different from the Earlier Neolithic, showing less core preparation, more irregular dorsal scarring, and less blade-like proportions. It is interesting to note the consistent use of good quality flint for retouched pieces (Manley and Healey 1982). One pit (6234, site atlas plan 17, 1521N 558E) also produced a sandstone rubber.

The beaker presence is more varied: one burial (*137*, site atlas plan 7, 207N 448E) with a silhouette showing flexed knees had a complete corded beaker and 11 barbed and tanged arrowheads, perhaps from a quiver. Finds of multiple arrowheads are a relatively rare phenomenon. The rest of the beaker pottery seems to represent a domestic assemblage and provides an opportunity to consider associated lithic industries in these contexts. Although broadly contemporary, the distributions of the Grooved Ware and Beaker pottery are mutually exclusive. The other burial (*786*, site atlas plan 12, 1152N 192E) is more likely to be Early Bronze Age. The barrows or ring ditches (Fig 4, 1–7), though somewhat ambiguous, were probably in use at about this time. The Middle Bronze Age activity, clearly represented by ceramics some of which were found in 'clay pits' (eg 25539, site atlas plan 23, 2289N 950E, and 25748, site atlas plan 23, 2392N 940E), also produced some idiosyncratic flint. In general, however, it is not easy to identify the associated lithic industries of this period.

The Late Bronze Age

by J P A Ettè

The Late Bronze Age period is dominated by the South Rings enclosure (Fig 4, site atlas plan 3). Originally termed 'mini-hillfort', this type of enclosure has more recently become known as the Springfield Type, based on the contemporay Springfield Lyons site located further to the north in Essex (Essex County Council 1977).

The construction of the South Rings heralded a significant change in the landscape. The pre-existing Middle Bronze Age rectangular field systems were superseded by a single massive double-ditched enclosure superimposed upon the south-westernmost identifiable field. The earlier Middle Bronze Age features are dated by Deverel-Rimbury style ceramics of south Essex (Brown forthcoming, in the prehistoric volume in this series) and a flint assemblage.

The South Rings enclosure held an unparallelled strategic location in terms of its potential for controlling both east–west riverine routes along the River Thames and north–south land routes at the highest practical crossing point of the Thames between Essex and north Kent. It is therefore likely to have exercised significant control, not only over its immediate area but over a much wider region, including the Thames valley and extending to the continent. Trade may have been based on the control of salt manufacture and distribution from the adjacent salt marshes.

The enclosure comprised two concentric ditches which measured 4m wide by 1.5m deep and some 75m in maximum external dimensions, enclosing an area of 0.44 ha. The material from these ditches was used to form a box-revetted bank structure, probably topped by a palisade. The main evidence for internal embankments to the inner and outer rings was provided by the asymmetrical patterning of the secondary ditch fills. The enclosure ditches were interrupted by two opposed entrances, the larger of which, located to the east, featured complex entrance buildings with evidence for side chambers and gate structures.

A slightly offset circular gulley or slot (PG 5, site atlas plan 3, centred *c* 195N 237E), some 12m in diameter, comprised the principal internal structure of the enclosure. Unsystematic clearance of the interior prevented detailed analysis of the central building or the identification of further buildings, although a number of four- and six-post settings suggested the presence of additional structural remains. Activity within the enclosure is largely attested by a number of pits and postholes, some of which, sealed beneath the upcast banks, are thought to date to earlier periods of activity.

Rescue excavations began on the South Rings in September 1966 and continued on an *ad hoc* basis until the spring of 1968. The excavation resulted in the recovery of a nearly complete plan of the enclosure, although only parts were fully cleared for recording and some features were only partially excavated. As this was an area which was excavated at an early stage, it suffered particularly from haphazard recording and inadequate labour resourcing.

Excavation did produce a large assemblage of Late Bronze Age ceramics. Associated artefacts include fired-clay loomweights, fire bars, and briquetage, as well as small assemblages of flint and bone, the latter suggesting a partly pastoral economy. Other significant finds include bronze artefacts, crucible mould fragments, and metalworking debris indicating industrial production.

Deposition of human cranial fragments and quern stones in the primary fills of the main entrance terminals suggests that the site may have served a multiplicity of functions, both secular and sacred, the boundaries of which may not have been clear within Late Bronze Age society.

The South Rings formed only a part of the Late Bronze Age landscape. A cluster of three post-built round house structures is located to the north-east (all on site atlas plan 23: RH107, 2305N 958E; RH108, 2325N 950E; RH109, 2390N 930E) which, with other pit and posthole concentrations, suggests wider occupation of the Boyn Hill terrace in the Late Bronze Age period. To comply with restrictions imposed on the BM/EH post-excavation project, analysis has concentrated on the South Rings enclosure, although the broader landscape will be considered in more general terms.

Ten years after the South Rings excavations a second smaller circular enclosure, the North Ring, located 1km to the north, was excavated by D Bond for the Central Excavation Unit (Bond 1988). Radiocarbon dates indicate that the North Ring was not contemporary but more recent in date, suggesting a shift of focus to another strategic point overlooking the Mucking Creek.

The lack of evidence for recutting of its circular ditches suggests that, after a period of silting, an extensive burning horizon, and infilling, the South Rings enclosure was effectively no longer functioning as a landscape feature. By the late Iron Age period the ditches had been filled in to the extent that they were overlain by four round house structures (all on site atlas plan 3: PGs 6, 7, and 8, 240N 150E; PG 10, 260N 240E).

The Iron Age

by C J Going

With the abandonment of the South Rings in the later Bronze Age, the intensity of settlement appears to diminish. By contrast with the later Bronze Age, settlement focus in the latter half of the first millennium BC shifted to the north end of the site, to the North Enclosure, a univallate, trapezoidal-shaped earthwork approaching 1 ha in area. It had a single entrance on the western side. The north-east corner was divided off by a substantial ditch which enclosed the remains of a circular structure. A north-east to south-west trending ditch at the North Enclosure corner (6021 etc, site atlas plan 17, *c* 1620N 720E) extended from its south-west corner, running across the site at approximately the break of slope. Towards the end of the middle Iron Age an open settlement of round houses covered much of the western (level) part of the site. Associated with them was a substantial number of four-, six-, and nine-post structures, sited for the most part on the north-west (upslope) side of the large north-east to south-west trending ditch. Most of the *c* 110 round houses excavated appear to have been constructed in open land, although a few of them appear to be associated with enclosures (eg PG 65, site atlas plan 13, 1160N 310E; also ditches 10020/10022/10026, site atlas plan 16, centred *c* 1630N 360E). In the later Iron Age two, possibly three, more nucleated settlements developed. First to be excavated was a series of small earthwork enclosures (the ABC enclosures, Fig 4), sited at the south-western end of the terrace (3908/14007, site atlas plans 2 and 5, centred *c* 300N 100W; 3994, site atlas plan 2, *c* 250N 50W; 3/17/112, site atlas plan 2, centred *c* 100N 0E). Some 275m further to the north-east, on the western site margins, a series of further enclosures and round houses was constructed (the 'Banjo' settlement, Fig 4; site atlas plans 10, 12, and 13). To the south-east, towards the south-eastern site margins, was evidence of another settlement (western part, site atlas plan 7), but excavation here was carried out under salvage conditions and what remained was very sparsely planned and difficult to interpret.

During the mid to late first century BC an imposing multivallate earthwork was constructed over the South Rings, to the east of the ABC enclosures. The earthwork (RBI, Fig 4, 159; site atlas plans 2, 3, and 6) measured some 90×65m, with a single, western entrance (site atlas plan 3, centred 335N 130E). Again, the recording in the interior of this earthwork was largely salvage and, while some traces of occupation were noted, little is known of the internal layout of this substantial and imposing structure.

Concentrations of burials were found in six regions. On the western site margins, to the south-west of Anglo-Saxon Cemetery I, a small cremation cemetery was established in a small rectangular earthwork enclosure, measuring *c* 18×22m with a single entrance to the south-west (6773, site atlas plans 9 and 12). To the north-west of the 'Banjo' settlement, a small cemetery of inhumation burials was established alongside one of its ditches (5663, site atlas plan 12, *c* 1320N 150E), while

to the east two small groups of square-ditched barrows containing cremation burials of the first century BC were also recorded (burials *1010–1013*, site atlas plan 14, *c* 1340N 610E; enclosures 15060, 15058, 15067, and 15069, site atlas plan 11, *c* 1000N 500E).

The most extensive cemetery lay to the north-east of RBI. Here an unenclosed cremation cemetery containing at least 30 burials was found and excavated (site atlas plan 8, burials centred on 600N 450E). There were undoubtedly more, but overscraping removed much evidence. Most of the burials were small unurned cremations, and few of them contained grave goods. Finally, there was a scatter of burials in the vicinity of the ABC enclosures (site atlas plan 5, *c* 300N 130W).

The 'Banjo' settlement has a complex constructional history. Occupation in this area of the site lasted up to the time of the Roman conquest or shortly after. It is unlikely to have been the only settlement nucleus, however, which remained in use until the Roman period.

The Roman period

by C J Going

During the Roman era both the pattern of settlement and the agricultural landscape in which it was set were changed. Soon after the conquest period the landscape was parcelled up in a series of ditched enclosures, apparently initially based on the lengthy north-east to south-west trending ditch (see above) which linked the North Enclosure with the later Iron Age earthwork, RBI (Fig 4, 159). The earliest Roman enclosures (all on site atlas plan 6: 1446, 4876/1886, centred *c* 570N 300E; 1444/1890, centred *c* 670N 390E) formed, with a series of broad gores and droveways, the arable of a farmstead centred on the Double Ditched Enclosure (DD Enc, Fig 4; site atlas plans 10, 11, 13, and 14). In addition to this agricultural landscape, the hillside became the focus of industrial activities such as metalworking and pottery production.

Evidence of Roman settlement appears to have been in two regions – on the south-eastern site margins to the east of RBI (159), and roughly in the centre of the site. Here a farmstead (Fig 4, DD Enc; site atlas plans 10, 11, and 14), set in a ditched enclosure (6398) measuring *c* 130×90m, was excavated in its entirety. In its initial form the enclosure had an internal bank, indicated by interruptions in the internal ditches. Initially it had two entrances, one on the south side and one on its north-west corner. A ditch crossed this, probably acting as a sump (4384, site atlas plan 10, 955N 448E), but this was subsequently blocked off by a recut, leaving as the principal entrance a timber-flanked gateway set in the east side.

The main enclosure was subdivided by a ditch running north-west to south-east (15052/15226, site atlas plan 11, *c* 1090N 510E to 1000N 720E) with a single, roughly central causewayed entrance close to an initial well (Well 4, site atlas plan 11, 1050N 630E). The southern subdivision was itself split into two roughly equal parts by a second internal ditch (4441/15194), again with a causewayed access (site atlas plan 11, 1005N 615E). A tongue of brickearth extended into this part of the site, making the recognition of features difficult. As a result, internal features were sparse save for a second well (Well 6, 15452/15450, site atlas plan 11, 945N 740E). A corner of the western subdivision was set aside for a small ditched cemetery (cemetery II, site atlas plans 10 and 11, *c* 1050N 500E), established close to the square-ditched barrows of the later Iron Age, and utilising their common northern boundaries as its northern edge. It, too, was embanked, the upcast being distributed between the mounds of the barrows themselves. The burials in the cemetery were almost exclusively cremations of the Flavian to later Antonine periods, although there were one or two later inhumation burials.

The northern part of the enclosure was again subdivided, this time by a fence line (mc 15048, site atlas plan 14, centred *c* 1165N 650E), running roughly parallel with the eastern and western sides of the enclosure. Further post lines (4200, mc 15048 again), noted running parallel with the northern and eastern ditched boundary (6398), possibly delimit a garden.

The principal buildings of the farmstead were set in the north-eastern part of the enclosure. These comprised an aisled building, measuring some 17×6m, which probably formed the main dwelling (site atlas plan 11, centred 1095N 655E). Other buildings include a granary constructed on a foundation of five sleeper beams (site atlas plan 14, centred *c* 1199N 710E), a rectangular structure surrounded by an oval-ended possible eavesdrip gully (site atlas plan 14, centred *c* 1190N 760E), together with a fragmentary rectangular sleeper-beam structure (site atlas plan 14, *c* 1147N 790E). There was little evidence of stone or tile construction, and the curving line of the eavesdrip gully surrounding the building noted above suggests that it was thatched.

While this settlement appears to have developed towards the end of the first century AD, its period of occupancy is uncertain; burnt debris retrieved from Well 4 strongly suggests that the main building was destroyed by fire some time towards the end of the second century or early in the third. That Well 4 had gone out of use by this time is clear from the fact that it had been substantially backfilled before the burnt debris was placed in it. It is possible, then, that by the end of the second century the enclosure was largely used for agricultural, and not domestic, purposes.

The lack of later domestic evidence on the site as a whole is noteworthy and suggests that during the later Roman period the site was given over to agriculture. The farmstead enclosure was enlarged by the cutting of a ditch (6287), which survives on the west, south, and southern part of the east side. This was recut at least once, but there is little evidence of activity in the interior of the enclosure. However, cemetery II continued to be used. Among the later inhumation burials is one (*888*, site atlas plan 10, 1090N 493E) datable to the middle or later fourth century AD by the inclusion of a bossed 'Romano-Saxon' pottery vessel. The grave was cut into the by now largely infilled ditch (6398).

Elsewhere on the site, settlement evidence is tantalisingly elusive. At its south end, east of enclosure ditch 159 (RBI), are a number of subdivided enclosures which appear to denote some form of settlement, but the excavation here approached salvage conditions, and this,

together with the rather fugitive nature of the evidence uncovered, makes interpretation difficult in the extreme. Debris of building was recovered, principally from a substantial pond-like feature (15852, site atlas plan 7, centred 385N 505E), much of which was burnt. There seems little doubt that there were some additional buildings in this area of the site.

Together with the agricultural use of the landscape there was a dispersed industry producing pottery. The earliest of the 23 recognised kilns date to the early Roman period (eg Kilns 18 and 20, site atlas plan 10, 1040N 1070E, 1005N 235E), but six are fully Romanised, both in their production technology and in their repertoire of products. Most of these kilns were in field ditches, but one, Kiln 4 (site atlas plan 6, 750N 370E), was built in a small enclosure (8964/8969) and may have been constructed in a shelter of some kind. Its products date to the later second/early third centuries AD, and since its enclosure cuts ditch 14444 (at 710N 383E), a ditch dividing two of these small rectangular enclosures of early Roman date, it is clear that these had been allowed to silt up by then.

Later Roman settlement evidence is surprisingly slight. Some time in the later third or early fourth centuries AD Iron Age earthwork enclosure 3908/14007 (site atlas plans 2 and 5), which formed part of the so-called ABC complex at the extreme south-western end of the site, began to be reused as a cemetery, but its 60 or so inhumation burials cannot be closely dated owing to their general lack of grave goods. On the eastern margins of the site Cemetery IV (site atlas plan 8, centred 565N 740E) also contains a number of burials which are datable to the fourth century, eg *1086*. Contemporary settlement evidence is rare, however, and difficult to establish with confidence. A search was therefore made for concentrations of material which might be dated to the post mid fourth century. While this did reveal a number of features which might be datable to the later fourth century and after, it suggested that fourth-century activity on the site, with the exception of the cemeteries, was almost wholly agricultural.

This activity appears to have included the remodelling of the ditched field system by throwing together the earlier land parcels into a series of larger fields (ditch 8315/4794 and recut 4797, site atlas plan 6). How long this phase of activity lasted is not entirely clear. Ceramics characteristic of the later fourth century in Essex, principally Oxfordshire oxidised wares and late shell-tempered pottery, are restricted to a thin scatter across the southern part of the site, but significantly they tend only to occur in levels 0–1 of the later ditch fills. While these are not necessarily true stratigraphic levels, they make it clear that even the later agricultural ditches had silted up to a considerable degree by this time. It is, therefore, hard to resist the conclusion that the landscape was effectively *agri deserti* by the later fourth century, and that the principal activity was the continued use of cemeteries I, IV, and to a lesser extent II (Fig 4).

This suggests that the settlement focus in the later first to second centuries had moved away from the site by the third century, and that the site was effectively an agricultural landscape in the third and early fourth centuries. By the later fourth century the landscape itself was no longer being maintained; ditches were being allowed to silt up, and the lack of maintenance strongly suggests that the landscape was being returned to scrub or rough grazing.

This raises important questions about the significance of the placing of the Saxon settlement at this site. If the landscape was in effect semi-derelict, having been deteriorating since the later fourth century, the incoming Saxons would have found themselves on a landscape which had been allowed to return to scrub for a substantial period, perhaps as little as 50, but probably more like 75 years.

The early to middle Anglo-Saxon period

by H Hamerow

Mucking provided the first opportunity to excavate an Anglo-Saxon settlement and associated burials simultaneously. Anglo-Saxon cemetery II (site atlas plans 6, 8, 10, and 11) was a mixed cemetery containing *c* 274 inhumations and *c* 480 cremations, while Anglo-Saxon cemetery I (site atlas plan 12) was a smaller inhumation cemetery, containing up to 62 graves, the western extent of which is unknown. The settlement comprised at least 53 posthole buildings and 203 sunken huts (*Grubenhäuser*) and is the most extensive early Anglo-Saxon settlement excavated to date. The metalwork and coin evidence from the settlement suggests uninterrupted occupation from the first half of the fifth century to the beginning of the eighth century.

The ceramic evidence, taken together with certain chronologically diagnostic metalwork and glass, provides the key to the spatial and chronological development of the settlement.

Roughly four broad phases of settlement were identified. The initial phase, consisting of *c* 77 *Grubenhäuser* and at least two posthole buildings, was relatively dense. In the sixth century the main focus of occupation shifted northward. This was smaller (*c* 13 *Grubenhäuser* and 8 posthole buildings), more dispersed, and possibly shorter-lived. The third phase shifted further to the north-east and was again relatively dense (*c* 55 *Grubenhäuser* and *c* 20 posthole buildings), with some alignment of buildings apparent. In the course of the seventh century the settlement (*c* 54 *Grubenhäuser* and 23 posthole buildings) became widely dispersed and shifted away from the edge of the terrace.

Mucking is thus best described as a shifting hamlet, at times perhaps more than one. The layout of the settlement lacks any clear plan, or large 'central' buildings, in apparent contrast to the social hierarchy evidenced in the Anglo-Saxon cemeteries.

The evidence regarding the origins of the Anglo-Saxon settlement, and particularly for the presence of Germanic *foederati*, is inconclusive, though the hypothesis remains plausible. Despite apparent continuity of land use from the Romano-British period, there is no clear evidence for socio-economic continuity or for the integration of the Romano-British and Anglo-Saxon communities. The Roman ditches had largely silted up by the time of Anglo-Saxon settlement though some, at least, remained visible and served as boundaries (see below).

Middle Saxon, medieval, and later

by C J Going

During the middle Saxon period the settlement density on the Mucking ridge diminished greatly, and some time after the seventh–eighth centuries the site was abandoned as a settlement and reverted principally to agriculture. Of this agricultural landscape some observations are clearly required. In the early post-Roman era some, at least, of the surviving Romano-British and prehistoric earthworks continued to serve as boundaries (Roman ditches 6287 and 9110, site atlas plans 11 and 8, for example, delimit Saxon cemetery II). But at some time during the post-Roman period a field system which bears little relationship to its predecessor was laid out (ditches 5532, 5534, 5536, 5538, 5542, 5639, 5871, 5900, 5994/5938, 6209, and 6228/6290, site atlas plans 12, 13, and 15–17).

Of these ditches two (5516/5639 and 5938/6118) appear to respect GH 86 and PHB 1. This suggests contemporaneity with some parts at least of the Saxon settlement and implies, therefore, an origin in the middle Saxon period.

The succeeding field system, which eventually embraced the entire ridge, probably evolved piecemeal from the middle Saxon system. Its principal elements are probably of Saxo-Norman or later date. One of these, the much-recut ditch 10397, clearly cuts across Saxon posthole buildings (eg PHB 8 and 32) and GH 167 and 172, and thus postdates them. This latter field system, part of the arable of Walton Hall and adjacent farms, appears to have endured, with a number of modifications, until well into the ninteenth century, when surviving elements of it were planned for the tithe map (Fig 5). Comparison of the system with this map shows that by this time the process of field amalgamation was well advanced. Further mapping in the nineteenth and early twentieth centuries shows the process of field enlargement continuing, and by the mid twentieth century elements only of its principal boundaries remained in conjunction with a number of entirely recent field boundaries.

Set within this system of fields and enclosures were a number of buildings and structures, the most obvious being a post-base windmill (9479, site atlas plans 8 and 11, centred *c* 802N 661E), sited in the south-eastern corner of the field enclosed by ditches 5048 and 9172. This structure is unlikely to have been earlier than the later twelfth–thirteenth centuries AD, and pottery from the terminal arms suggests that it was dismantled in the fifteenth–sixteenth centuries. Further to the north are the postholes of an aisled barn (site atlas plan 11, centred 1080N 650E) which, while it is of possible Roman date (no medieval pottery was noted from the posthole fills), may belong, in view of its alignment with ditch 6569, to the medieval period.

Within the field system a few isolated features were found and excavated. The most characteristic were a number of sheep or other animal burials. These are not closely datable but are probably recent and represent the burials of diseased livestock.

6 The Mucking cropmarks

by D N Riley

Discovery and photography

The earliest air photograph showing cropmarks at Mucking appears to be a high level vertical view of the area taken by a German aircraft of the Luftwaffe in 1943. This photograph, however, only shows a few small and indistinct marks. The importance of the cropmarks at the site was first realised when Professor J K St Joseph photographed them on 16 June 1959, after which Mucking was included in the flying programme of the Cambridge University Committee for Aerial Photography every year except two (1963 and 1968) until 1975. One of the 1961 photographs was reproduced in the first of St Joseph's long series of articles in *Antiquity* entitled 'Air reconnaissance: recent results' (St Joseph 1964). The site was also recorded during flights made by J N Hampton for the Air Photography Unit of the Royal Commission on Historical Monuments (England) (RCHM(E)) between 1971 and 1977, and by others, including J P J Catton. In total well over 400 archaeological air photographs were taken (see, for example, Fig 1). Although the majority were oblique views, a small number of verticals were also taken from the Cambridge aircraft. In most cases the photographs show cropmarks, though soilmarks are also recorded on areas of gravel that were stripped of surface soil before gravel extraction from the pit that eventually engulfed the whole site, and some photographs record the progress of the excavation.

The prominent cropmarks at the southern end of the site, the South Rings and the surrounding features, were only photographed on five occasions when they were showing well (16 June 1959, 12 and 14 June 1961, 14 June 1962, and 18 June 1966), but they were then so distinct and detailed that it is unlikely that much more would have been recorded by a longer and more intensive aerial investigation. At the northern end of the site, distinct marks were photographed in 1970, 1972, 1973, and 1975.

In the central part of the site the cropmarks give much less information. For some years part of the land was temporarily under grass, in which marks developed only above a few major archaeological features. When the area was under barley, however, well-defined cropmarks were seen.

The interest roused by the Cambridge discovery and photography of the cropmarks was the stimulus that caused the commencement of excavation on a large scale on the site. While the work was in progress, photographs then guided the excavation of the major archaeological features, though, as will be seen, they gave very little assistance on minor features such as the multitude of small pits and postholes. The excavation would have been helped even more if a plan of the site or part of it, like that given here, could have been provided before work commenced.

The plan (Fig 7)

Most of the cropmarks at Mucking were in a single hedgeless field, and the many photographs taken at low level from the Cambridge and RCHM(E) aircraft include few of the reference points identifiable both on the ground and on a large scale map that are necessary as the foundation of a site plan. Fortunately, a series of overlapping vertical photographs taken from a high level by the RAF in April and May 1969 cover much more ground than the low level views and record the positions of many landmarks. Four stereo pairs from these high level vertical photographs were set up on an analytical plotting apparatus at the Air Photography Unit of the RCHM(E), and a 1:2500 plan of the site was prepared. The photographs show a long strip of bare gravel (A–H on Fig 7) on which soilmarks give the positions of archaeological features that had previously caused the formation of cropmarks. A few cropmarks are also seen at N. The plan gives the position of the soilmarks and the few cropmarks to an accuracy in the order of ±0.5mm at this scale, or about ±1m at ground scale.

This plan and some of the low level oblique photographs made possible the selection of a number of reference points between A and H at positions on the cropmarks identifiable on the 1:2500 plan of the corresponding soilmarks. All was then ready for the preparation of plans from the obliques, which was done at the Air Photography Unit with the aid of a microcomputer using the AERIAL program written at the School of Archaeological Sciences, University of Bradford (Haigh 1989). None of the low level photographs showed more than a part of the very large site, so 11 were selected (Cambridge VW 37, 43, 64; YG 64; ADI 20, 25; AFK 8; BBS 67, 70; RCHM(E) TQ 6780/33/344, TQ 6780/47/263), from which individual plans at a scale of 1:1250 were produced. Each plan included the National Grid, drawn in 100m squares.

In the final stage, the drawing reproduced on Figure 7 was made by combining the individual plans. It was found that there was good agreement between overlapping plans from different photographs of the southern part of the site, where the ground was fairly level and the reference points extended over a long strip of land. Various plans of the northern end of the site were also in reasonable agreement in an area close to the reference points based on cropmarks near N on Figure 7, but there were some discrepancies in the centre of the site approximately between F and M, where there was a lack of reference points and some unevenness in the ground. It was necessary to make a best fit between several individual drawings of this area. Despite these problems the end result was a very satisfactory plan of the cropmarks. Figure 7 is to be found on the fold-out sheet facing p 17.

Cropmarks and excavation results – the archaeological features

Particularly at the southern end of the site, the cropmarks at Mucking must be among the clearest ever recorded. The distinct marks were all in barley growing on thin soil (a brown earth of the St Albans series) above gravel, conditions which are well known to favour the development of cropmarks. At the eastern edge of the site, however, the gravel was overlain by brickearth, on which cropmarks did not appear, as is normally the case on clayey soils. A darker tone on the photographs shows where the barley was growing above brickearth.

The findings of a previous study of the cropmarks in a sample area, the North Enclosure, have already been published (Riley 1987, 95–8). In this report the distinctness of the cropmarks was compared with the fillings and the dimensions of the archaeological features that had caused them. Loam-filled ditches were found to have caused more distinct marks than those with gravelly filling, and the wider and deeper ditches and pits to have caused more distinct marks than the narrower or shallower ones. Those less than 0.5m across rarely caused marks, and small features, such as nearly all the postholes, were therefore not seen. These conclusions were in accordance with experience gained by excavators at many gravel sites, though never put into writing. There was one surprise: although the fillings of the *Grubenhäuser* were relatively shallow (about 0.15–0.45m below the surface of the gravel), they were often shown by very distinct marks. The cause of this was evidently the presence of a basal layer of ash and charcoal, because above other *Grubenhäuser* from which the ash and charcoal were absent there were only faint marks, giving confirmation of the importance of this component of the fillings.

Many other points arise when a comparison is made of the cropmark plan (Fig 7) with the results of the excavation. A few comments are given below on matters of general interest:

a) The cropmarks were very thoroughly investigated by the excavation. The only notable items on Figure 7 which were evidently caused by man-made features, but were not investigated, are parts of enclosure B and a few lengths of ditch near the South Rings. At D are two unexcavated curvilinear features, but it is not possible from inspection of the photographs to be sure whether they were of periglacial or human origin.

b) Little of the land towards the west side of Figure 7 was excavated, but it is unlikely that any substantial archaeological features were missed, because in this area there were very few cropmarks indicating ancient ditches. There were, however, a great number of cropmarks in the form of small flecks and patches, most of which were apparently caused by natural phenomena (see below). Figure 7 only shows them in a small rectangular sample area (K), but they also occurred over most of the rest of the site.

c) The plan shows the deep ditches of all the major enclosures on the site, though some are incomplete. In contrast, only about 20% of over 100 excavated round houses are indicated by the rings or parts of rings formed above their shallow gullies (cf M U Jones 1979, 69). Four of the seven Bronze Age barrows are shown by ring ditches.

d) Various gaps in the cropmarks indicated the entrances of the enclosures, though it may be noted that no definite gap could be seen in the marks above the narrow north-west entrance through the outer ditch of the South Rings.

e) *Grubenhäuser* were shown by large dark spots, which tended to have a distinct outline and a slightly oblong shape, though some were less definite and could have been due to large pits. A well (F) in the large double ditched enclosure was also marked by a large dark spot. The cropmark plan (which was made with only occasional reference to the excavation plan) gives the sites of about 80% of the 213 *Grubenhäuser* excavated.

f) The only postholes given on the plan are the two 'four posters' at C, C'. More would probably have been identified if they had not been camouflaged by the flecks and small patches of probable natural origin. It may be added that, while most postholes were probably too small to produce marks, it is always more difficult to interpret features marked by spots than by lines on air photographs.

g) The small flecks of probable natural origin were also a source of confusion when examining the sites of cemeteries at B, E, and K, but it seemed certain that some small but well defined spots at B and E gave the positions of graves. At K, the marks on the cemetery site could possibly have indicated graves, but were more difficult to interpret.

Cold climate patterned ground

Many marks of apparently natural origin have been mentioned. In addition to the flecks and other small marks, and the dark areas of crop over the brickearth, there were various lines which joined to form irregular networks of polygons. The latter were typical of those caused by frost cracks or ice wedge casts (Wilson 1982, 148), natural features in the gravel, which were formed during periods of intense cold. They have not been included in the drawing.

The small flecks and patches varied in shape. Some were crescent-shaped and a few were small rings. Some could have been caused by man-made pits, but it is virtually certain that most were natural in their origin, caused by an extremely cold climate. They have not been drawn except in a rectangle (K) on Figure 7, and even here many of the flecks had to be omitted because they were faint and indeterminate.

Dr J N Carreck, who examined sections visible in gravel workings adjacent to the site early in 1966, reported that while the lower layers were bedded river

gravel, the upper layers were mainly solifluction gravel, formed during a period of cold climate during the Pleistocene. In many places he observed pockets of red loam in the solifluction gravel, probably surface material that had been included in the gravel under conditions of alternating freeze and thaw (see p 29). Many of them probably caused marks to form in crops. Similar inclusions of yellowish silt in the gravel were very frequently encountered by the excavators, who had to examine all to make sure that they were not of archaeological importance (M U Jones 1974, 187).

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7 Specialist reports

The geology

by J N Carreck

Outline of the geology of the Mucking district

Introduction

This is composed essentially of the Upper Chalk overlain by the oldest Tertiary deposits, the Palaeocene sediments, below Lower Eocene beds, then by Pleistocene deposits, the youngest of which, the 'Flood Plain' Terrace and Trail, descend to present river level and below, beneath the Holocene alluvium (Dines and Edmunds 1925; King and Oakley 1936).

Stratigraphy

The sequence of deposits in this district, although only partly exposed by erosion and quarrying, is set out in Table 1 (Whitaker 1889; Sherlock 1960), but many aspects of the Pleistocene succession are very controversial (Zeuner 1959).

The Holocene alluvium consists of fluviatile to estuarine marsh clays, shell marl, three main peat beds, some sand, and basal gravel, laid down in temperate climatic environments from the Boreal phase to the present. Its thickness reaches *c* 12–15m at Tilbury Fort, and at least 16m at Thames Haven, increasing in the mid-river bed and down the estuary where it merges into marine sediments.

The Trail deposits of the Last Glaciation are poorly bedded, ill-sorted sludge accumulations of confused clay, sand, and gravel, up to *c* 3m in thickness, owing to solifluction in a subarctic climate in the periglacial area south of the fluctuating ice sheet. They mantle the Taplow and Flood Plain Terraces, invade the upper parts of their deposits, giving rise to frozen ground structures, particularly round Grays, and descend into the Buried Channel in association with the latter terrace deposits.

The Flood Plain Terrace deposits consist of waterlaid gravels, sands, and brickearths, seen from Low Street and East Tilbury to Gobions and Mucking Ford, lying on a terrace bench cut in the Thanet Sands at *c* 0 to –3m OD, and their upper surface can reach a height of *c* 5–8m or more, whilst they also pass down into the Buried Channel beneath the Trail. In this district the Channel reaches depths of *c* –21 to 30m, increasing greatly further down the estuary.

The Taplow Terrace deposits are well bedded sands, gravels, and brickearths resting on a bench at *c* 8–9m OD, eroded in the Chalk and Thanet Sand round Grays. They rest against the bluff cut in those formations and rise to *c* 12–18m. In places they overlie the Coombe Rock, confused chalk rubble and marl with Tertiary debris, formed by solifluction on the Chalk outcrop in a similar manner to the Trail. The Coombe deposit occurs particularly at West Thurrock and Stifford, and extends to near East Tilbury.

The Boyn Hill Terrace deposits are composed of gravels, sands, and loams, resting round Orsett on a bench of Thanet Sand at *c* 21–30m. At Hornchurch and Upminster, Essex, and Swanscombe, Kent, they contain sedimentary, metamorphic, and igneous erratics of southern and western origin (Baden-Powell 1951). At the two adjacent Essex localities they overlie Lower Chalky Boulder Clay containing many such erratics. These terrace deposits at Chadwell St Mary, Orsett, and Mucking have yielded many Middle Acheulian artefacts comparable with those in the well-documented Middle Gravels in that Terrace, of Hoxnian age, at Swanscombe (Roe 1968, 58, 64, 65). At Mucking and other localities the river gravels are overlain by solifluction (trail) deposits probably equivalent to the uppermost deposits at Barnfield pit, Swanscombe.

The Lower Chalky Boulder Clay forms the surface of much of south Essex north of a line which in this district passes through Havering-atte-Bower, Upminster, Brentwood, and Billericay, except where removed by valley erosion, and there is a small area at Langdon Hill. This glacial clay, bluish grey with contained sand and much chalk debris, also contains many erratics including some of Jurassic rocks, older sediments, vein quartz, and metamorphic and igneous rocks. It reaches 11m in thickness at some localities in this district.

The Glacial Gravels underlie the boulder clay and consist of poorly bedded, unsorted, mainly flint gravel, sand, and loam. They contain many erratics derived from the boulder clay, varying from small pebbles to boulders sometimes up to 0.3m in length. These deposits attain a thickness of up to 2.5m near Colchester.

The Pebble Gravel, a variant of the Plateau Gravels, is mainly composed of Tertiary flint pebbles with some quartz pebbles, chert, and sandstone debris, in a sandy matrix, most probably derived from the Lower Greensand. In some parts of the Raleigh Hills and at Havering-atte-Bower it overlies Bagshot Beds. It occurs between Great Warleigh and Brentwood above London Clay, and at Hockley Wood near Rayleigh it overlies an erosion surface of that formation at *c* 53m OD, rises to *c* 63m OD, and contains nearly 30% of Lower Greensand debris. Its relationship to the Plateau Gravels of the Swanscombe district is uncertain.

The Bagshot Beds are marine sands, fine grained and often current bedded with thin clay intercalations and pebble beds. At Brentwood they are *c* 11–12m thick, at Langdon Hill up to *c* 10m, and the same at Billericay.

The Claygate Beds are evenly bedded pale clay, sand, and loam with ferruginous concretions, of marine origin. Their thickness varies from *c* 12m at Brentwood to *c* 4m at Rayleigh.

The London Clay consists of bluish grey, marine clays with septarian nodules of argillaceous limestone, *c* 137m in thickness at Brentwood. Its southern boundary here runs through Stifford, Orsett, Horndon on the Hill, and Stanford le Hope.

The Blackheath Beds are marine sands with abundant flint pebbles, and molluscan shells in places, in the

Table 1 The sequence of deposits

Periods	*Stages*	*Deposits*
Holocene	Flandrian, Post-Glacial	Alluvium of the Thames, its tributaries, marshes and estuary
Late Pleistocene	Devensian (Weichselian) Glaciation	Solifluction deposits equivalent to the Slades Green Trail, Erith, Kent; Buried Channel complex; 'Flood Plain' Terrace deposits
	Ipswichian (Eemian) Interglacial	'Taplow' Terrace deposits, some above coombe rock of the Baker's Hole Coombe Rock cold phase (type locality, Northfleet, Kent)
	Wolstonian (Saalian) Glaciation	Essex solifluction gravels equivalent to the Upper Gravel, and Upper Loam of Barnfield Pit, Swanscombe, Kent
Middle Pleistocene	Hoxnian (Holsteinian) Interglacial	'Boyn Hill' Terrace deposits, approximating to the Middle Gravels sequence of Barnfield Pit
	Anglian (Elsterian) Glaciation	Lower Chalky Boulder Clay; Glacial Gravels
Lower Pleistocene	?	Pebble Gravel; Plateau Gravels of the Swanscombe outlier
Lower Eocene	Cuisian?	Lower Bagshot Beds, *c* 3–10m in thickness; Claygate Beds, *c* 4–12 m in thickness
	Ypresian	London Clay, *c* 115–150m in thickness
Palaeocene	Sparnacian	Blackheath Beds, *c* 6–15m in thickness; Woolwich Beds, *c* 6–17m in thickness
	Thanetian	Thanet sands, *c* 9–27m in thickness
Upper Cretaceous	Senonian	Upper Chalk, *M coranguinum* Zone, *c* 60m in thickness

Orsett neighbourhood, where they are of uncertain thickness owing to often being indistinguishable from the Basement Bed of the London Clay.

The Woolwich Beds consist of thin beds of estuarine to freshwater clay, rich in molluscan shells, and sand, and usually more marine grey sand with small flint pebbles forming the base. They are exposed at Mucking Heath, and vary in thickness from 10m at Mucking Ford to 17m at Romford and 22m at Brentwood. Most of the numerous sarsens found in the local Pleistocene gravels appear to have been derived from silicified parts of the sands.

The Thanet Sands are fine grained marine sands, pale grey to yellowish and buff in colour, with *c* 0.3m at the base being tinted green by iron silicate (glauconite) and filled with green coated flints, the Bull Head Bed. These beds are 14–15m in thickness at Grays and Romford, 20m at Brentwood, and 14m at Mucking Ford. In the 1960s they were worked commercially in a pit adjoining the Mucking archaeological sites.

The Upper Chalk outcrops in the Mucking district as fairly soft, white, blocky chalk of high purity containing many large flint nodules in layers with tabular flint bands. It belongs only to the upper part of the *Micraster coranguinum* Zone and is visible in quarries near Grays and in the low cliffs above the marshes at East Tilbury, lying at *c* 150m below the surface at Langdon (Laindon) and *c* 10m below at Mucking Ford.

Structure

The Chalk and Lower Tertiary beds, beneath the Pleistocene deposits, underlie the whole area, being part of the southern limb of the mid-Tertiary London Basin syncline. There local folds superimposed upon the main syncline include the anticline bringing the chalk sufficiently high to outcrop from Purfleet to Tilbury Marshes. The higher beds of chalk were removed by erosion in Lower Tertiary times and here they form an irregular surface beneath the Thanet Sands.

Landscape evolution

There is much evidence to indicate that in early Pleistocene times forerunners of the present Thames and Surrey area rivers Mole and Wey became confluent, flowing from south-west of the site of London north-eastward into the Hertfordshire area, then eastward through the Essex area and the North Sea region. This river system evidently laid down a series of deposits collectively known as Plateau Gravels. Through this period and the later Pleistocene a number of advances of the Arctic ice sheets brought vast accumulations of boulder clay and glacial gravel into the Essex area. During the periodic glacial retreats the area underwent climatic changes through subarctic to temperate in the

interglacials. After the early Pleistocene the present course of the Thames was slowly established, and on the south-east Essex shore of its estuary local rivers were developed, those in this neighbourhood being ultimately the Ingrebourne near Rainham, the Mar Dyke near Purfleet, and the Crouch at Burnham. Owing to successively lower Pleistocene sea levels the downward sequence of river terraces was formed, culminating in the Buried Channel complex descending to –30m OD and more, during the Last Glaciation. After its close about 10,000 years before the present, disappearance of the ice sheets with release of vast quantities of melt water led to the Flandrian Transgression, a rise in sea level to that of the present in the estuary with considerable deposition of estuarine sediments, including those of the marshes of Holocene age, still in process of accumulation (Devoy 1980).

Thus the Chalk and Lower Tertiary beds have been eroded by the Thames from the early Pleistocene onward, giving rise to the broad valley passing former river cliffs still visible at Woolwich, Swanscombe, and East Tilbury, flanking areas of marsh land. Temporary halts in the deposition of sediment resulted in surfaces developing tree growth, and later flooding, which led to the formation of peat beds which were later buried by marsh clay. The three main peat beds occur near Gravesend, the lower and middle being probably of late Mesolithic and Neolithic age, and the highest, at *c* 2.0–2.7m below the present alluvium surface, forming a human occupation level in the Roman period (Spurrell 1889).

Late Pleistocene Boyn Hill terrace gravels, Orsett

Hoveringham's gravel and sand workings at Hoford Road, near Mucking, Essex, were examined in January and April 1966. The account was edited from direct tape recordings and was revised in March 1989.

Extensive sections showed a thick, well bedded series of true river terrace gravels, with traces of pale sand probably of the Thanet Sand, Lower Tertiary, in the base of the pit. Some sections at the top of the gravels exhibited strong evidence that solifluction in a periglacial environment had modified the fluviatile gravels or deposited sludged gravel and clay above them. These upper deposits are seemingly connected with frozen ground polygons visible as farm cropmarks on air photographs in and adjoining the Mucking archaeological sites. In the 1970s there was a Thanet Sand quarry close by, showing deep gravel-filled channels cut in the Sand.

Fluviatile gravels

Sections under Hoford Lane

These showed a thickness of only *c* 1.8m of deposits, the base being hidden by talus. The upper part was of ill-sorted, poorly bedded gravel, clearly due to solifluction, but the lower was a river deposit, varying through reddish, stony, sandy loam, fairly well bedded loamy sand with pebbles, to nearly stoneless, dark ochreous loam, becoming more stony below. This was better bedded, showing layers of pebbly loam contrasting with more sandy layers. Occasional large flints of subangular shape occurred, and a thickness of 0.9m of the pebbly seams with long flat pebbles lying scattered horizontally. Layers between the reddish loams were sandy and more yellowish or dark yellowish brown.

The junction between the solifluction deposits and the river gravels was fairly horizontal, except at one point where a solifluction festoon penetrated the latter deposits. Nearby these consisted of well bedded loam, with alternate sandy and clayey divisions, quite thin with few stones. The junction of the solifluction and river deposits was clearly marked. The river gravel below was reddish brown, argillaceous loam with few pebbles and intervening light yellowish sand and many small pebbles. No disturbance was seen at any point. Occasional sarsen boulders occurred, the two largest being nearly spherical; one was *c* 0.5m in length, 0.4m in width, and 0.3m in height, well rounded and not mammillated, while the other was flat, *c* 0.1m in width and length, and *c* 0.6m in height, slightly mammillated. These were of quartzitic sandstone enclosing some nodular limonitic ironstone. They were not *in situ* but lay near the washing plant at the northern end of the workings.

Material seen at the washing plant

The coarsest stone heap from the gravel screening machine showed almost entirely flint, consisting of many well rounded pebbles of Lower Tertiary type, subangular flint, occasional red stained ('jasperised') flint pebbles, and subangular reddish pink, quartzitic sandstone. About 50% of the stones were Lower Tertiary flint pebbles, the rest subangular and frequently angular, apart from those broken during screening. Some material in the screened gravel had probably come from the solifluction deposit, which may be expected to be of purely local origin.

Section on the eastern side of the pit

In a section about 6m in depth solifluction gravel was seen, but about 2.4m below the ground surface a current bedded sand appeared fairly suddenly beneath, consisting of alternations of brown loamy sand and yellow sand, both loamy and sandy parts with few pebbles. Nearby, the lower half of a section about 4.5m in depth consisted of very well current bedded sand, yellow generally but with manganese hydroxide stains on foreset planes and sometimes small pebbles set along horizontal planes.

Just beyond the end of the conveyor belt nearest the archaeological site the operator of the mechanical excavator said that he had just recently found two large boulders, which were still in the gravel face there. M U Jones said that there was another, a sarsen boulder lying in the water on the pit floor close by, and there in a dry part was an angular sarsen *c* 0.9m in length and 0.3m in depth as far as was visible, and *c* 0.7m in width at one end. It was of grey quartzitic sandstone weathered to a reddish brown. On the pit floor, about 0.3m above water level, lying about 0.6m apart, were two sarsens or two fragments of one. Each appeared to be about 0.6m in

height but may have been much larger if followed into the current bedded, pale pebbly sand from which they projected in the section.

Solifluction gravels

Sections under Hoford Lane

In the main old workings the slight gravel sections on the western face showed a depth of only about 1.8m, the base being obscured, of fine flint gravel, poorly sorted, of subangular and angular flints, many Tertiary pebbles whose long axes were frequently nearly vertical, and others set at all angles with few or no signs of bedding. This only seemed to apply to the top 0.9m or 1.2m of gravel and the base looked very like a solifluction festoon. Nearly all the Tertiary flint pebbles were set nearly vertically, forming a downward loop, and beneath was only loamy brown sand with apparently very few pebbles. The matrix between the stones from top to bottom, however, seemed to be the same brownish loam. The solifluction gravel contained Tertiary pebbles of all sizes up to 40mm, often set nearly vertically, as were some subangular flints. Other constituents were at various angles. Low in the section, however, the pebbles seemed quite well bedded, so indicated a normal river gravel.

Nearer the archaeological excavations these features were much more clearly seen. Approximately 0.9m of loamy brown sand, packed with Tertiary flint pebbles and angular and subangular flints, very poorly sorted with no apparent bedding and long axes at all angles, was present. This deposit was of a pale buff colour in contrast to the brownish loamy river gravels with yellowish sandy partings, seen below.

In another section of the solifluction deposits nearly all the elongated pebbles were set vertically. At yet another location the long axes of pebbles were so often set vertically that many lay parallel to each other in rows.

This was clear evidence of periglacial conditions affecting the pre-existing river terrace deposits.

Section on the eastern side of the pit

In a section about 6m in depth, beneath the soil, fairly fine gravel with many Tertiary pebbles, occasionally up to about 0.1m in length, occurred. The matrix was yellowish brown loamy sand and the pebbles were very poorly sorted, lying at various angles, occasionally vertically, so this was evidently the same solifluction gravel as before but probably about 1.5m in thickness.

In the cutting for the conveyor belt on the eastern face, the upper half of the section showed a reddish brown stony loam with Tertiary pebbles and some subangular flint pebbles, sweeping down in the form of downwardly directed contortions quite clearly and suddenly distinguished from the underlying river gravel. Further contortions, of sinuous form, were seen nearest the archaeological site, and others extended about 4m to the south. In particular, a very sinuous, almost recumbent fold with reddish argillaceous loam on each side of it was seen, showing the pebbles set along the contortions with red loam above and below. This was typical trail but the only example of a very considerable fold seen by the writer in this pit, although it appeared to be only *c* 0.2m in height and *c* 0.4m in width, but was probably elongated laterally to a greater extent, both in its upper and lower limb. It resembled some seen in glacially contorted deposits of Pleistocene age in Cambridgeshire.

The pits filled with red loam

The foreman at the washing plant said that he and his men often found clay-filled gulleys or channels in the gravels, and M U Jones had reported the presence of such structures to the writer. It was thought that these could be of archaeological significance. On April 1 1966, on the eastern face of the new workings, a pit filled with pebbly red loam, exposed by a mechanical excavator to a depth of 0.4m, was examined. The deposit on each side was pale buff to ochreous sand with some pebbles, but the line of contact at the sides of the red loam infilling was quite stony. At one side the long axes of the Tertiary flint pebbles were set at a high angle, parallel with each other. The width of the pocket of loam was *c* 1.5m at the base, just above the floor of the active workings. The contrast between the argillaceous infilling and the sand on each side was considerable and fairly sudden. The width of this infilling increased to *c* 3m immediately below the subsoil, where it formed a feature with a transverse section apparently semicircular or perhaps elliptical, but probably in fact circular. This probably produced a cropmark, visible to air photography, on the farmland above.

Elsewhere on the eastern side of the workings close to the conveyor belt an apparently basin-shaped depression was seen, about 3.6m in width, but the base of this hollow was not clearly seen. The filling appeared to be more stony in the lower part but only a depth of 1m was visible. Its sides sloped gently inward.

Close to the archaeological site the excavator operator said that he had recently left a patch of reddish clayey loam on the floor of the workings, that had filled some form of cavity. The writer examined the remains of this pocket. It was at least 1.2m in width and consisted of mottled grey to buff to reddish brown argillaceous loam with Tertiary pebbles and some subangular pieces of flint, as before. This was evidently very similar to other pockets seen in the face of the workings. The writer could see no other trace of such a pocket on the pit floor.

In the farther workings near the wood on the eastern side of the pit the section was rather inaccessible and degraded. A red loam mass, although its actual shape was not clearly seen, appeared to occupy a depression or hollow about 1.8–2.1m in width, the upper 0.6m being obscured by weathering and plant growth, so there was probably about 1.3m in depth of red loam. Below it was normal, very pebbly gravel, and just to the south, close to the top of the section, was current bedded gravel, and then again below the pebbly gravel was more current bedded gravel. It was thus fairly certain that the whole section was in river gravel except for the loam-filled depression.

The reddish loam filling the pockets appeared to be a distinct solifluction deposit, seemingly later than the trailed gravel that invaded the river gravel.

Cropmarks seen on the adjacent farm land

On the air photographs provided by M U Jones there is a rather obscure system of reticulate lines and other dark markings, very suggestive of cold climate patterned ground of tundra polygon type as observed on the Severn Main Terrace, ascribed to the last Glaciation, at Kidderminster, Worcestershire (Shotton 1962; West 1977), and at Boxstead, Essex (French 1976, 237, fig 12.5). The present writer has been unable to determine any certain relationship of the loam-filled pits in the Mucking gravels to these structures seen above on the farmland. Such small loam infillings could only appear in the photographs as very small dark spots, and the large scale polygonal outlines shown as cropmarks would be the surface manifestation of vertical structures seen in the upper part of the gravels. The loam-filled pits or involutions may pass upward into frozen ground polygons but there is no clear indication (French 1976, 229). The contortions in the Mucking gravels described above did not appear to be connected with any such features but would be difficult to detect. The abundant dark spots seen in one photograph do not display linear arrangement across the ground surface but from the road, passing eastward immediately north of the archaeological features causing cropmarks on the south, a belt of polygonal markings, in places of quite wide dark lines, runs in a straight line eastward then fades away. There is no visible connection between the polygonal markings and the dark spots. Some other parts of the photograph show reticulate polygonal lines much less distinctly.

Conclusions

The above evidence indicates that the river gravels assigned by the Geological Survey to the Boyn Hill Terrace are overlain by solifluction gravel (trail) festooned into their upper surface by a Late Pleistocene glacial advance. Cylindrical or basin-shaped depressions in the upper surface of these river gravels are filled with a stony reddish loam, apparently as digitations from above. This appears to be of later age than the trailed gravel. The loam is probably a decalcified solifluction deposit formerly overlying the trailed gravel, and may well have originally occurred as a continuous sheet on the relatively flat surface of the ground above over a wide area. M U Jones reported a similar deposit recently cleared from the archaeological site, and noted apparent tongues of brickearth seen as dark masses in air photographs. It is possible, however, that these may be the upper margin of deposits at the top of a lower terrace series, resting against the bluff between the Boyn Hill and Taplow Terrace benches.

The trailed gravel overlying and invading the Boyn Hill Terrace river gravel may well be contemporaneous with the Upper Gravel of Swanscombe, Kent, now correlated with the Saalian Glaciation. The red loam apparently penetrated both these gravels, and so was subsequent to the solifluction phase that produced the trailed gravel. It was probably formed during the same glaciation, but one must consider the cold phases responsible for the Coombe Rock on the Chalk outcrop and the later trail that descends into the Buried Channel.

No Palaeolithic implements nor Pleistocene animal remains have been found in these workings to the knowledge of the workmen, M U Jones, and the writer. The gravels and loams are probably all decalcified. Middle Acheulian hand axes are, however, known from pits at the same level in gravels mapped as belonging to this terrace at Mucking, Orsett, and Chadwell St Mary, comparable with those found in the Middle Gravels, of Hoxnian Interglacial age, at Swanscombe (Roe 1968, 58, 64, 65). Despite the large number and variety of far travelled constituents of the terrace gravels of Boyn Hill or slightly earlier age at Dartford Heath, Kent, and to a lesser extent at Swanscombe, the writer could not detect any erratics in the present quarry. Evidently the gravels there were formed from purely local sources separated from entry of erratics into the district at that time. At this pit the surface of the terrace deposits lies between 33m OD on the north and 29.4m OD on the south, and they consist of about 2.4m of solifluction gravel overlying about 3.6m of the river gravel, so the terrace bench, not clearly visible in the gravel pit, must lie at about 26.7–23.4m OD. At Swanscombe the terrace bench lies at *c* 33–22.5m OD (Dines *et al* 1938, 23).

It appears that the loam-filled pits were formed during a glacial phase subsequent to the Hoxnian interglacial, in the region of permafrost to the south of an ice sheet. During times of thaw, when the underlying river gravels were saturated with melt water, it is probable that the red loam was intruded downward into the more fluid, waterlogged parts by gravity, aided by cryogenic movement due to alternating freeze and thaw judged by the vertical orientation of long axes of pebbles at the sides of the loam infillings.

If the red loam possessed a greater average density or loading relative to that of the gravels beneath, it would have given rise to gravity controlled downward digitations or involutions into them during successive periods of seasonal melting of ice present in the gravels.

These columns of loam appear to have approximately circular transverse sections and taper upward, judged in particular by the example clearly seen in vertical section on April 1. They appear to agree most closely in form with pocket or plug involutions (French 1976, 42, 43, 229, fig 12.2) which, however, are considered to have originated by upward movement of material from below, the converse of the apparent mode of origin of the Mucking examples. Unfortunately there is no general agreement among specialists as to the precise origins of such structures seen in a wide variety of situations.

The solifluction gravels exhibit the typical features of trail and were doubtless accumulated as a sludge of pebbles, sand, and clay that slowly moved downhill, dragging up and contorting the sodden river gravel below into complex forms. Such contorted deposits are commonly seen above terrace deposits in this area, typically on the Boyn Hill Terrace at Clapton, north-east London (Whitaker 1889, 406, 407, figs 75, 76). There the contorted trail also forms downward involutions, closely resembling those in this Mucking pit, suggesting that the contortions and loam-filled cavities here may, in fact, only be variants of one deposit; but the

matter is uncertain. Trail, probably of a later date, overlies Taplow Terrace deposits at and near Ilford and Grays, Essex.

The rock types

by F Talbott

(revised 19.2.1989 by J N Carreck)

It must be stressed that quantitative analysis was not available for this study because of the lack of computer services.

This report deals with rock types used as artefacts and others showing no sign of human use. Most of the stone from this excavation was referred to the writer, with the exception of lavas, flint, and chalk, though a sample selection of these rock types was examined withe the aim of ascertaining source areas (see below).

The rocks utilised comprised sandstone (siliceous/sarsen, calcareous, and feldspathic), grit (including Millstone Grit), flint conglomerate, quartzite, and greensand. Sarsen stone was the most utilised rock type, which is to be expected as it is found rather commonly in the area. It is derived from local Palaeocene arenaceous beds, generally the Woolwich Beds as around Orsett village. Sarsens posed the problem of natural surfaces looking as though they had been ground; in such cases other signs of utilisation were looked for before classifying the object as an artefact.

A large proportion of the other rock types used for artefacts may have had a common source in the glacial gravels of north Essex; and a small amount of sandstone, apparently from the Triassic Bunter pebble beds of the Midlands, was used for whetstones, probably because of its smooth surface.

Hertfordshire conglomerate ('pudding stone') was also used in small amounts for querns. It has two likely sources, one as concretionary masses in Woolwich Beds at local sites along the Mar Dyke at Aveley, the other again in the glacial gravels of north Essex. It is probable that both sources were used; rocks from the latter may well have been brought to Mucking by trading and the conglomerate is likely to have been part of this. Other rock types used as artefacts and likely to have their source in glacial gravels are quartzite, Millstone Grit, and dolerite. The first two were utilised in fairly large quantities. The greensand and calcareous sandstone both probably came from the Lower Greensand of Kent.

Not all of the large amounts of stone extracted from the excavations had been used for artefacts; the utilised rocks were also found unutilised, and in addition the following unutilised rocks were identified: limestone, Kentish Rag from the Lower Greensand, phosphatic nodules, chert, septaria, jasperised flint, and slate. It is likely that the sources for this non-utilised material are localised gravel deposits, although other sources are listed below.

Both dolerite and slate could have originated in the glacial gravels, and jasperised flint occurs in many Pleistocene gravels in this district. Chert occurred in fair quantities and most probably came from the local Boyn Hill Terrace gravels, derived from the Lower Greensand of Kent or Surrey, but it does occur in the Pebble Gravels of which the nearest occurrences are at Havering-atte-Bower and the Langdon (Laindon) Hills. Septarian nodules are easily obtainable from the London Clay, which outcrops less than 1km north of the site. Small pieces of Jurassic limestone could be from glacial deposits, but closely resemble the oolitic limestone, probably from an outcrop in Oxfordshire, of which a coffin found here was constructed. Phosphatic nodules are from Lower Pleistocene Crag deposits, or the Gault in East Anglia, Kent, or Surrey. Kentish Rag could only have come from the Hythe Beds of the Lower Greensand of Kent, the nearest part of its outcrop being in the Sevenoaks-Maidstone district.

The last three rock types are volcanic lava, chalk, and flint. The nearest Chalk outcrops at Grays and East Tilbury, as well as the North Downs round Gravesend, Kent. All true flint originates in its upper parts, but chalk in derived form is widespread in Pleistocene boulder clays in Essex, and flint is the main constituent of the Thames terrace gravels and glacial gravels of northern Essex. Basaltic lava was used chiefly for rotary querns found here, but not for saddle querns, and three types, Andernach, Mayen, and Niedermendig, are represented, imported from Germany. Not all lava fragments, however, showed utilisation.

The slags and metallurgical residues

by G McDonnell

Introduction

In total, 365kg of slags and residues were recovered. The details of their classification and analyses are discussed in McDonnell (forthcoming). The classification was based on morphological criteria, and the weight of each slag type from each area/context was recorded. The slags and residues were divided into diagnostic and non-diagnostic groups. The former are slags that are products of an ironworking process, while the latter group may have derived from any high temperature activity. In some instances they can be assumed to have derived from an ironworking process, by association with diagnostic residues.

The total weight of each slag type is given in Table 2, and the diagnostic slags are grouped according to process. The shorthand nomenclature for each slag or residue type is also given. In this table and throughout the report the Dense Iron Silicate slag (DIS) has been identified as a smelting slag. Detailed chemical analysis and examination of its distribution cast some doubt on this interpretation (McDonnell forthcoming). The absence of well-dated, large deposits of this slag means that it does not figure significantly in this report. The material classed as 'other' included charcoal and coal fragments etc.

Table 2 also gives the total amount of each slag type that was included in the large concentrations (see below) and the isolated single large deposits (p 33). It is also calculated as a percentage of the total of each type. This demonstrates that less than half the smelting tap slag and the dense iron silicate slag was present in the

Table 2 Total weight of each slag type

	Total weight (kg)	*Concentration weight (kg)*	%
Diagnostic slags			
Smelting slags			
Tap slag (TSL)	13.100	5.424	41
Slag block (SLB)	93.685	62.045	66
Dense Iron Silicate slag (DIS)	23.368	7.603	32
Smithing slags			
Hearth bottom (HBM)	69.003	40.103	58
Smithing slag lumps (SSL)	115.443	70.532	61
Hammer scale (present?)	0.012		
Cinder (CKR)	13.304	7.682	58
Non-diagnostic slags			
Hearth/Furnace lining (HLN)	22.271	13.462	60
Fuel Ash Slag (FAS)	14.984	5.626	37
Other	4.585	1.410	31
TOTAL	369.755		

identified concentrations. In particular, over 4kg of the DIS was from isolated find spots. The slag blocks were all represented (66%) in identified contexts, but this is because they tended to occur in large lumps, thus causing the deposits readily to exceed the minimum quantity for analysis. About 60% of both types of smithing slag were present in the identified concentrations. The hearth or furnace lining was also well represented but less than 40% of the two other non-diagnostic slags were in the identified concentrations.

The spatial analysis is therefore based on a significant percentage of the total weight of slags recovered from the excavations. This is particularly valid for the examination of ironworking residues, because where there has been a significant amount of activity, eg a small rural 'smithy' or the smelting of ores that are poorer than about 90% iron oxide, iron slags are generated as a waste by-product. They tend to be dumped into pits or one length of ditch, rather than thinly spread across a site. The distribution can be radically altered either by later disturbance or by the use of slags for cobbling or hard-core. The examination of these distributions assumes that they can be considered to be representative of the use of ironworking techniques at Mucking.

Spatial distribution of the slags

Determination of groups

The concentrations were determined by examination of quantities greater than 1kg. The area around such points (in terms of northing and easting coordinates) were examined for slag, and extended accordingly. In general slag concentrations occurred in large features, eg ditches. The absence of 'floor levels' and 'working surfaces' prohibited the identification of working areas.

Distributions

The areas are given as spreads, ie readings North1, North2 by East1 and East2. Negative values indicate

Table 3 Concentrations of slags

Concentration number	*Site atlas plan*	*North1*	*North2*	*East1*	*East2*	*Total weight (kg)*	*Date*
1	1	-228	-230	345	356	3.9	R-B
2	3	160	188	135	155	12.2	?
3	2	190	200	80	100	16.4	Late R-B/A-S
4	2	230	242	-75	-81	5.2	Late R-B/A-S
5	3	297	303	271	265	2.8	?
6	7	353	353	447	447	3.0	?
7	7	375	382	715	725	5.2	A-S
8	3, 6	393	410	145	155	1.9	R-B/A-S
9	7	449	449	575	575	2.3	?
10	6	725	726	110	115	1.9	(GH 42) A-S
11	6	755	770	90	110	26.8	(GH 44/45)A-S
12	10	840	910	140	210	50.8	R-B 1st cent AD & A-S
13	10	903	907	219	219	8.4	?A-S
14	10	930	942	165	169	2.9	R-B 1st cent AD?
15	11	1041	1053	622	642	13.0	(Well 4) R-B
16	21	1898	1903	968	979	6.7	(GH 129) A-S
17	20, 22	2095	2106	635	775	9.9	(GH 173) IA?
18	22	2140	2148	780	786	10.2	(GH 179) A-S
19	25	2445	2455	915	922	12.8	(GH 196) A-S
20	25	2490	2500	960	980	21.8	(GH 202) A-S

Table 4 Single deposits of slag (weight in kg)

Site atlas plan	*North*	*East*	*Context*	*Weight*	*Type*	*Date*	*Comment*
2	250	–40	?3994	2.100	SLB	Post-R	
5	350	–152	14129	1.200	SLB	?	also DIS (0.345)
10	818	272	6050	1.500	DIS	?	also fired clay
10	820	396	12327	1.875	SLB	?	no other finds
11	950	750		1.000	DIS	?	unstratified
13	1247	447	8840	5.000	SLB	A-S?	
16	1797	373	10050	1.650	DIS	IA?	
20	1853	481	GH 98	1.300	HBM	A-S	

southings and westings respectively (p 7). A full listing is given in Table 3. The more detailed discussion of the contexts which have been dated will be given in the forthcoming period volumes. There were also some large individual slag pieces, mostly examples of SLB, which gave 'apparent' high slag concentrations; these are examined separately.

Isolated single deposits of large quantities of slag

There were eight deposits of single lumps of slag. They are possibly significant because of the presence of slag blocks, which by definition may occur as single lumps. These data are presented in Table 4.

The occurrence of the different types of slag (slag block, Dense Iron Silicate, and hearth bottom) as large single deposits is as expected. There is very little dating evidence for any of the deposits, and given their isolation any associated evidence must be treated cautiously. The best dated slag block is the largest found in pit 8840 (1247N 447E), the pit which cut a ditch (8838) and which was also cut by a *Grubenhaus* (GH 106). It can therefore be argued that the slag is Anglo-Saxon or later. The only other dating is for the block found at 250N 40W, which was probably from a ditch (3994) that can be definitely dated as post-Roman. The large hearth bottom from GH 98 could be dated to the Anglo-Saxon period, but it may also have been reused as is suggested for the hearth bottoms found in GH 42 (concentration 10). The Dense Iron Silicate was dated by association with the flint gritted ware (cut 10050). This pottery is dated from late Bronze Age to late Iron Age, and could therefore date this slag to the Iron Age. It also occurred in association with a slag block (350N 152W), which would suggest an Anglo-Saxon date.

Conclusions

In general the slags and residues are not well dated, nor can they be dated on morphological grounds, with the exception of the slag blocks (SLBs). The problem is further confused by the probability of slags from earlier periods being redeposited in later features. The large deposits of slag are derived from 'large' features, eg ditches and *Grubenhäuser*, which probably puts a bias on the interpretation. It can be assumed that on most settlement sites dated to the (late) Iron Age or later some smithing activity would have been carried out. Therefore the recovery of small amounts of smithing slag is expected. The type of smithing would influence the quantity and distribution of the slag. Occasional small-scale activity may be carried out at any suitable place, rather than at a permanent 'smithy'. In such instances the slag would occur in small quantities and would be widely distributed, which would not allow it to be isolated and identified in the general multi-period spread of slags that is present at Mucking.

The quantities of slag ascribed to each period are given in Table 5; these amounts exclude the isolated finds discussed above. Smithing was carried out in the Iron Age and Romano-British periods, and both smelting and smithing debris in the Iron Age context is very low and would normally be ignored as 'background' level. It must only be interpreted as evidence for smithing having been carried out in this period. The presence of smelting slag in the Romano-British period is doubtful since one lump was a fragment of slag block recovered from an area where there was Anglo-Saxon smelting. The evidence for ironworking is strongest in the Anglo-Saxon period. There is an indication of continuity from the Romano-British period (concentration 12). The total amount of slag recovered from the whole site is not as great as might be expected. This is probably due to the sampling strategy and because large features, in which the slag was concentrated, were not fully excavated.

Table 5 Summary of slag distributions by period

Period	*Smelting slags*	*DIS*	*Smithing slags*	*Non-diagnostic slags/residues*
Iron Age		0.085	1.223	0.510
Romano-British	0.040	0.780	29.183	3.222
Anglo-Saxon	39.544	2.040	40.067	7.769

Non-ferrous metalworking finds

by J Bayley

There is evidence of Bronze Age bronze casting at both North and South Rings. At the former site one crucible and four mould fragments and some scrap metal were found (Bond 1988), while the latter produced a further seven mould fragments of comparable type (109N 281E, 120N 230E, 159N 260E, 268N 206E, 380N 100E) and a Late Bronze Age copper ingot (110N 335E).

Contexts dated to the Iron Age produced four further clay mould fragments. Three are from object moulds (2057N 652E, 2077N 651E, 2085N 680E) but one is an incomplete ingot mould with traces of silver and gold on it (236N 167E); the metal had probably been melted in the mould. A crucible of typical Iron Age form (301N 53W) which had been used to melt bronze was also found, as well as four further fragments of similar form, also with traces of bronze (1835N 845E, 2085N 680E) (M U Jones 1980, fig 2).

Saxon *Grubenhäuser* produced the mating fragments of a piece mould for a square-headed brooch from GH 109 (1040N 650E) (Webster in Hamerow 1993), as well as two other less diagnostic mould fragments (234N 387E, 1481N 695E), two crucible or mould fragments (2260N 900E, 2265N 896E), and a rim sherd from a definite crucible (1687N 474E). This had been used to melt gunmetal (a copper-tin-zinc alloy) and had an added outer layer which stood proud of the rim, suggesting it had continued upwards to form a lid. Crucibles of this form are known from middle Saxon sites in northern England and from earlier sites in Wales and Scotland (Bayley 1991).

Two further crucible sherds (1444N 623E, 2047N 673E), one possible mould fragment (1491N 680E), and a piece of hearth lining with traces of copper and tin (2106N 676E) came from contexts that were undated.

The quantity of non-ferrous metalworking finds is not large and they show no close spatial clustering, which suggests that they are chance survivals of what must once have been larger groups of similar material. The existence of non-ferrous metalworking finds at almost all periods of settlement at Mucking is unexpected, but the fragmentary nature of the finds and their low frequency may explain why similar evidence has not been found in excavations of comparable sites where smaller areas have been examined.

8 Radiocarbon dates

The results are presented in chronological order from the oldest to the most recent. They have been calibrated according to the Stuiver and Pearson high precision curve (1986). The Ancient Monuments Laboratory (AML) number is included. The charcoal was identified by C A Keepax.

1 HAR-450 (submitted 10.10.73)
AML-727181-786, charcoal: combined sample of partially humified oak
From a planked coffin in Grave *786* (site atlas plan 12; 1152N 193E)
3580±90 BP, Del C13 –23.4%/10
Calibrated date: one sigma 2115–1780 cal BC; two sigma 2195–1695 cal BC

2 HAR-2342 (submitted 1.6.77)
AML-776304, charcoal
From the primary fill of Barrow 5 (site atlas plan 23; 2267N 1034E)
3290±80 BP, Del C13 –24.4%/10
Calibrated date: one sigma 1680–1510 cal BC; two sigma 1750–1420 cal BC

3 HAR-2340 (submitted 1.6.77)
AML-776303, charcoal
From the primary ditch fill of Barrow 5, associated with Ardleigh-type pottery (site atlas plan 23; 2269N 1030E)
3210±80 BP, Del C13 –23.3%/10
Calibrated date: one sigma 1600–1420 cal BC; two sigma 1680–1315 cal BC

4 HAR-2339 (submitted 1.6.77)
AML-776301, charcoal
From Barrow 3 ditch fill which had no archaeologically datable material (site atlas plan 21; 1962N 1075E)
3100±90 BP, Del C13 –24.8%/10
Calibrated date: one sigma 1495–1265 cal BC; two sigma 1590–1105 cal BC

5 HAR-2343 (submitted 1.6.77)
AML-776302, charcoal dust
From a pit (25131) which contained calcined flint; the pit cut the silted ditch of Barrow 4 (site atlas plan 23; 2172N 1175E)
2980±100 BP, Del C13 –25.0%/10
Calibrated date: one sigma 1395–1040 cal BC; two sigma 1450–920 cal BC

6 HAR-2337 (submitted 1.6.77)
AML-776299, charcoal; carbonised twig
From a pit (25487; cut by GH 187) which produced a good pottery assemblage (site atlas plan 23; 2295N 899'6"E)
2929±130 BP, Del C13 –25.6%/10
Calibrated date: one sigma 1375–930 cal BC; two sigma 1450–820 cal BC

7 HAR-1708 (submitted 27.5.76)
AML-750430, charcoal; twiggy *Quercus* sp and *Populus* sp from large timbers
From the primary silts of the South Rings outer ditch (310; site atlas plan 3; 140N 340'9"E)
2810±70 BP, Del C13 –25.1%/10
Calibrated date: one sigma 1045–900 cal BC; two sigma 1250–820 cal BC

8 HAR-1630 (submitted 27.5.76)
AML-750426, charcoal; mainly *Quercus* sp and *Alnus* sp
From the secondary silts of the South Rings inner ditch (303; site atlas plan 3; 144N 293E)
2790±90 BP, Del C13 –25.3%/10
Calibrated date: one sigma 1045–840 cal BC; two sigma 1256–800 cal BC

9 HAR-1634 (submitted 27.5.76)
AML-750431, charcoal; *Quercus* sp and *Salix* sp
From the primary silts of the South Rings outer ditch (310; site atlas plan 3; 165N 345E)
2770±110 BP, Del C13 –25.7%/10
Calibrated date: one sigma 1040–820 cal BC; two sigma 1260–790 cal BC

10 HAR-2338 (submitted 1.6.77)
AML-776300, carbonised grain and ?other seeds
From a storage pit containing a group of pottery which may range from the Middle Bronze Age to the earliest Iron Age (25564; site atlas plan 23; 2243N 1008E)
2360±70 BP, Del C13 –21.4%/10
Calibrated date: one sigma 515–390 cal BC; two sigma 765–255 cal BC

11 HAR-1633 (submitted 27.5.76)
AML-750429, charcoal; large timbers and branches of *Quercus* sp
From a charred post butt of a rectangular six-post structure (10226; site atlas plan 17; 1749N 587E)
2090±70 BP, Del C13 –23.6%/10
Calibrated date: one sigma 195–35 cal BC; two sigma 365 cal BC – cal AD 60

12 HAR-1632 (submitted 27.5.76)
AML-750428, charcoal; large timbers and branches of *Quercus* sp
From a charred post butt of a nine-post rectangular structure (site atlas plan 13; 1309N 514'5"E)
2020±70 BP, Del C13 –24.5%/10
Calibrated date: one sigma 110 cal BC – cal AD 60; two sigma 200 cal BC – cal AD 120

13 HAR-2344 (submitted 1.6.77)
AML-776227, charcoal and charcoal dust
From the ash layer of an Anglo-Saxon hearth (11640) cut into the Roman turfline of a 2m deep ditch (site atlas plan 17; 1751N 768E)
1400±80 BP, Del C13 –25.7%/10
Calibrated date: one sigma cal AD 595–675; two sigma cal AD 460–780

14 HAR-451 (submitted 10.10.73)
AML-731273, wood
From Grave *871*, Anglo-Saxon Cemetery II (site atlas plan 11; 830N 584E)
1390±80 BP, Del C13 –25.0%/10
Calibrated date: one sigma cal AD 600–675; two sigma cal AD 530–780

15 HAR-2341 (submitted 1.6.77)
AML-776298, charcoal
From charred timbers in the fill of Anglo-Saxon GH 115 (site atlas plan 14; 1330N 660E)
1480±70 BP, Del C13 –25.2%/10
Calibrated date: one sigma cal AD 555–643; two sigma cal AD 420–670

Appendix: a bibliography of publications on Mucking up to 1989

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by Cherry Lavell

Abbreviations have been used for Neolithic (Neo), Bronze Age (BA), Late Bronze Age (LBA), Romano-British (RB), and Anglo-Saxon (AS) entries. Figures 1–3 are signalled by the page numbers on which they occur, hence 2 (Fig) means the figure on page 2. Likewise 33 (Tab) means the table on page 33. The throw-out figures (Figs 4–7) have their figure numbers added, as (Fig 4). Feature numbers and site atlas plan numbers are given in bold, as: wells, no **4**; site atlas plans, **8**. Note that there may be several entries on a single page, especially for site atlas plan numbers. Subheadings are in chronological order (Neo to AS) where that is more appropriate than alphabetical order, with any non-chronological subheads placed first. Please see the contents list for contributors to this volume.

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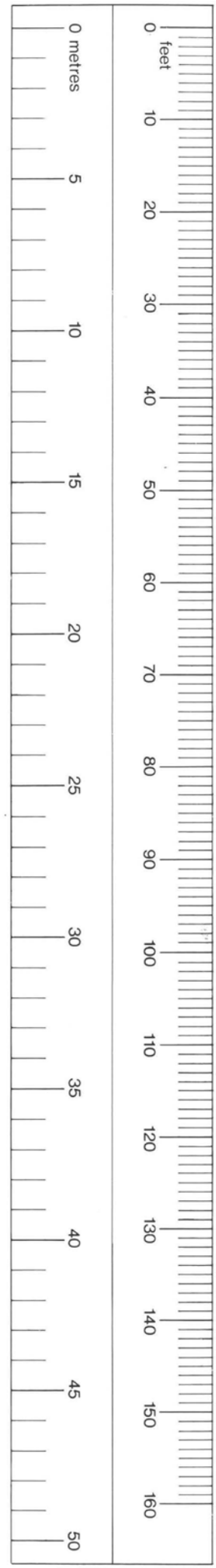
KEY TO SITE ATLAS PLANS

- LIMIT OF EXCAVATION
- QUARRY EDGE
- EXCAVATED EDGE OF SMALL OR MODERN FEATURE
- STRING LINE
- LINE OF PROJECTION
- SOILMARK
- HEDGE
- PERIGLACIAL FEATURE
- ANIMAL DISTURBANCE
- BRICKEARTH
- UNCERTAIN SOILMARK
- EXCAVATED EDGE
- EXCAVATED FEATURE, WITH UNCERTAIN TOP EDGE
- FEATURE TRUNCATED BY EDGE OF EXCAVATED BOX
- BOTTOM OF RECUT DITCH SHOWING IN SECTION
- SIDE OF CONVEYOR BELT
- CONVEYOR BELT STAND
- WALL
- ? FEATURE OF UNCERTAIN LOCATION OR SIZE
- FLOOR
- REVETMENT
- GRAVE (no in italics)
- ● CREMATION (no in italics)
- GH GRUBENHAUS
- PG PENANNULAR GULLY
- PHB POSTHOLE BUILDING
- mc MULTICUT
- mf MULTIFILL
- CD CORNDRIER
- RH ROUND HOUSE
- QTH QUARRY TEST HOLE
- F FILL OF SOILMARK

For reasons explained on p 17 there is a slight variation of scale in the atlas. The ruler is based on the average scale of the atlas as a whole. Deviations of +0.8% and –1.4% occur overall.



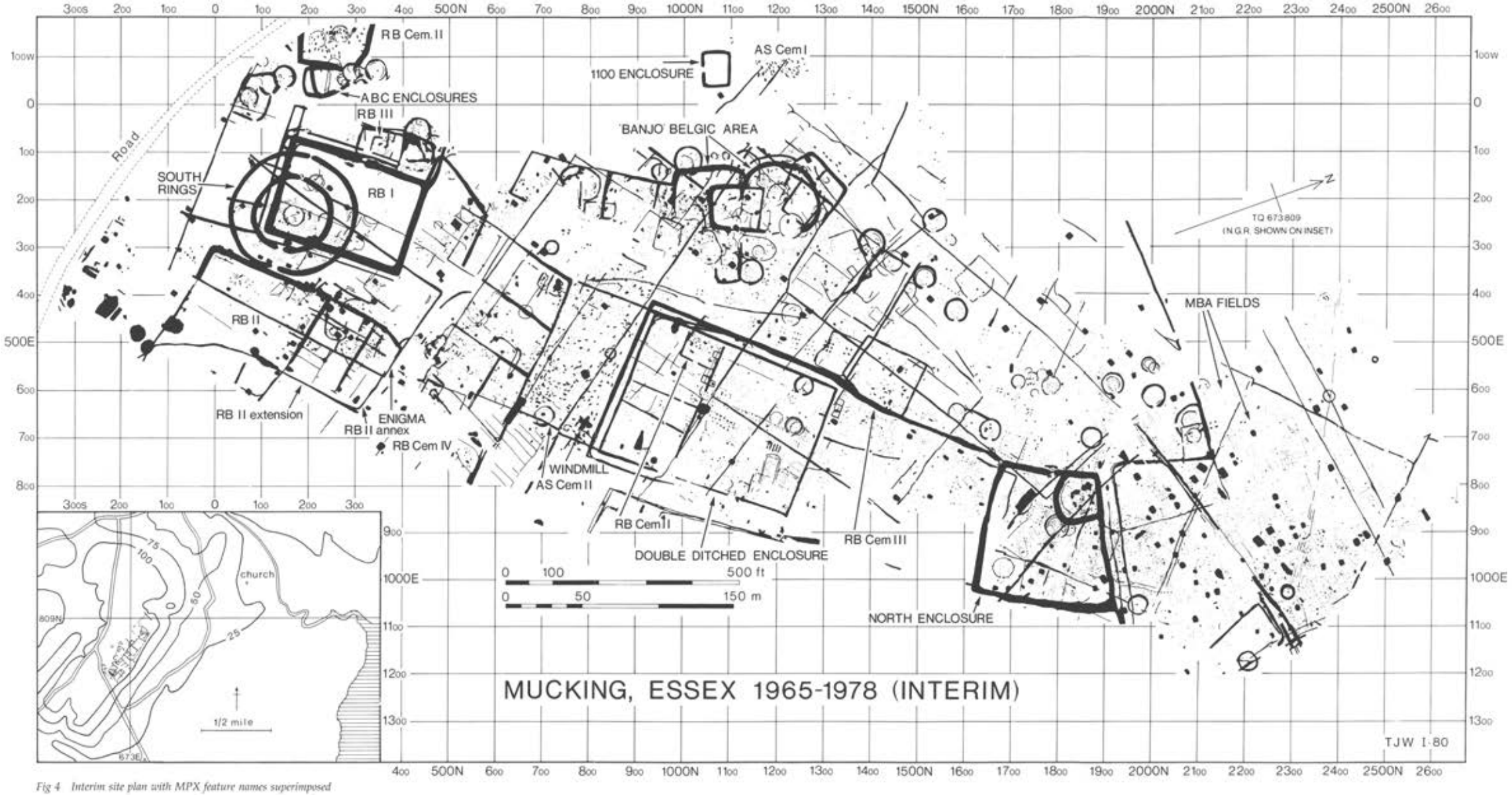


Fig 4 Interim site plan with MPX feature names superimposed

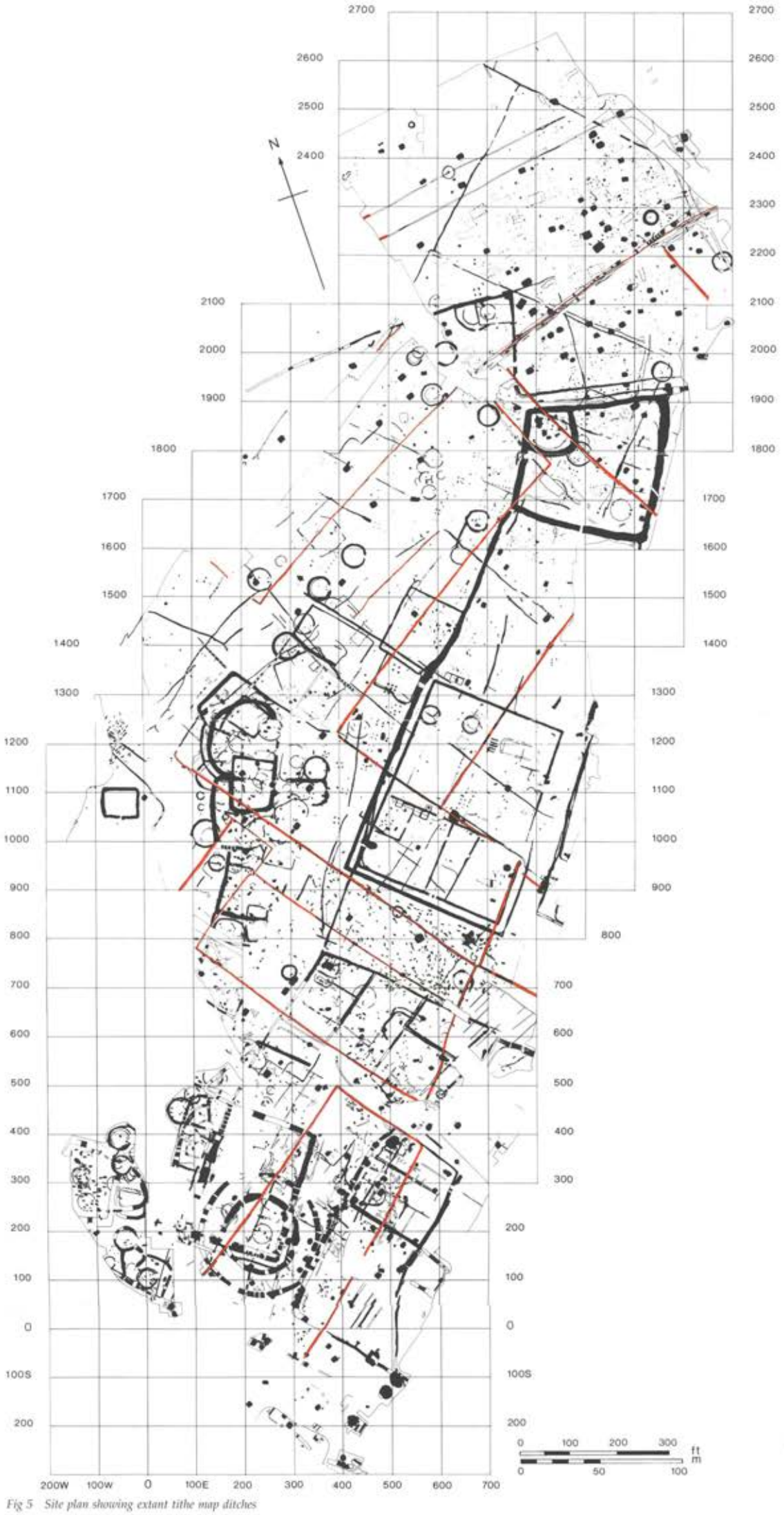


Fig 5 Site plan showing extant tithe map ditches

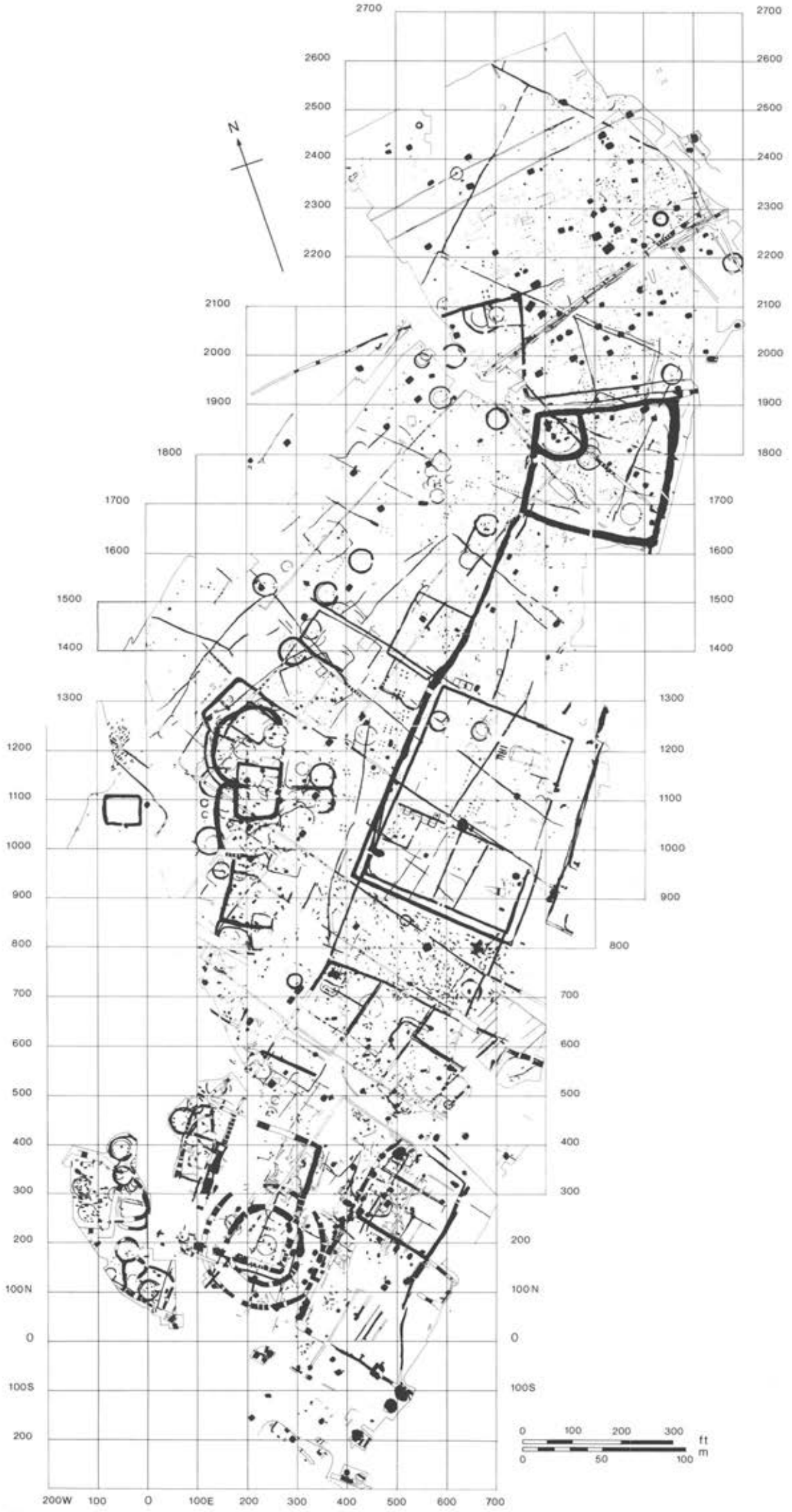


Fig 6 Overall site plan with excavated features blacked in

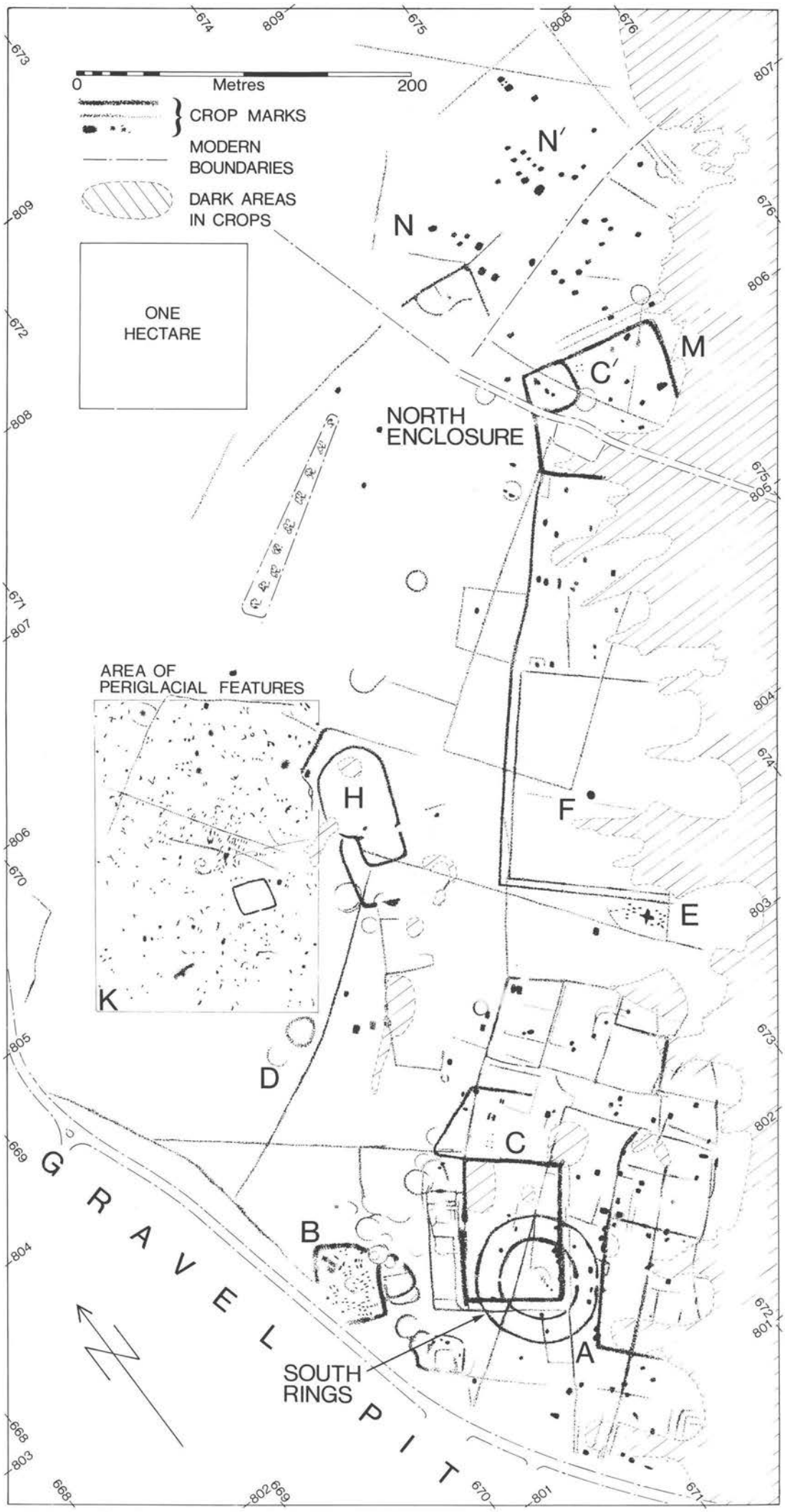
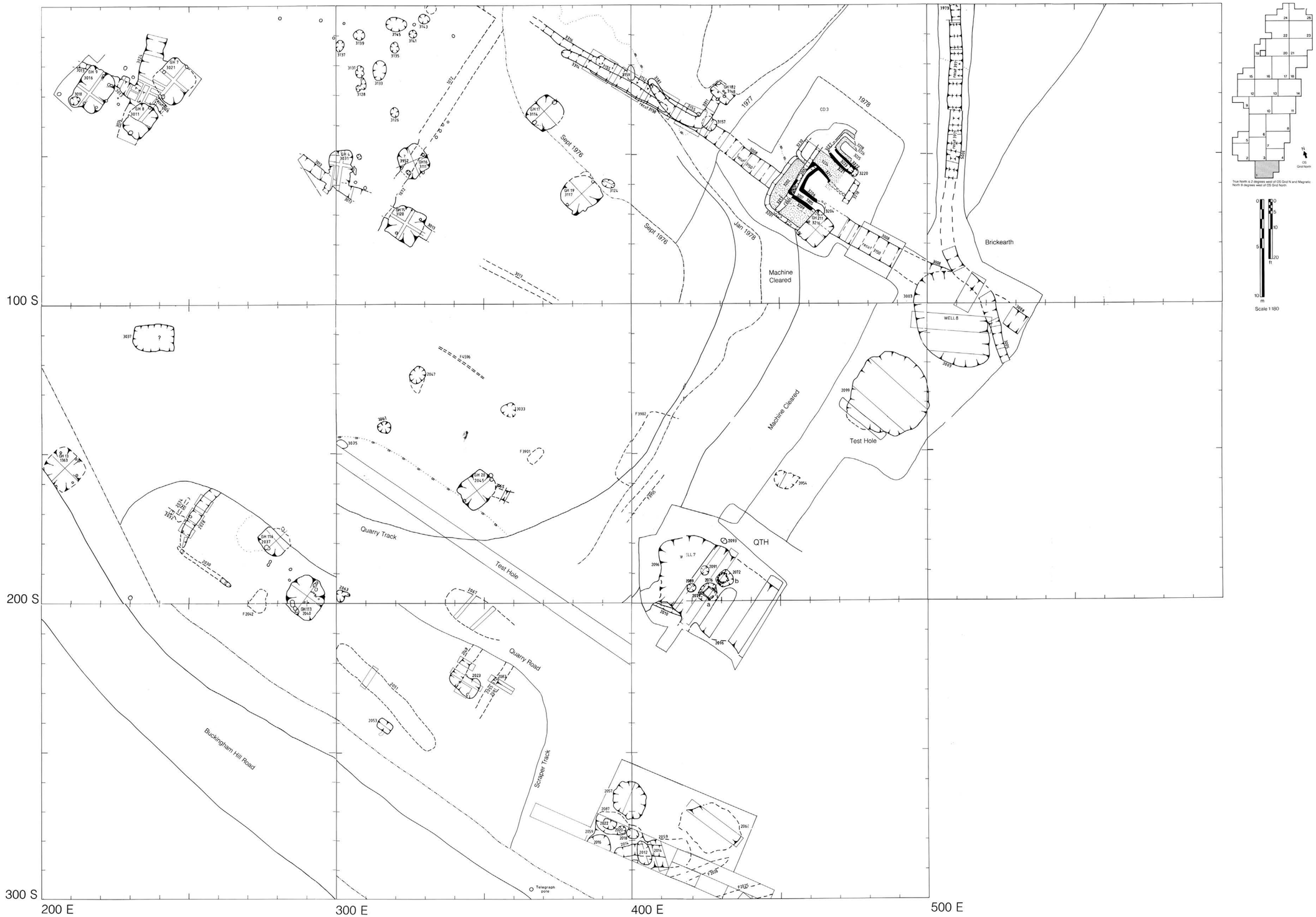
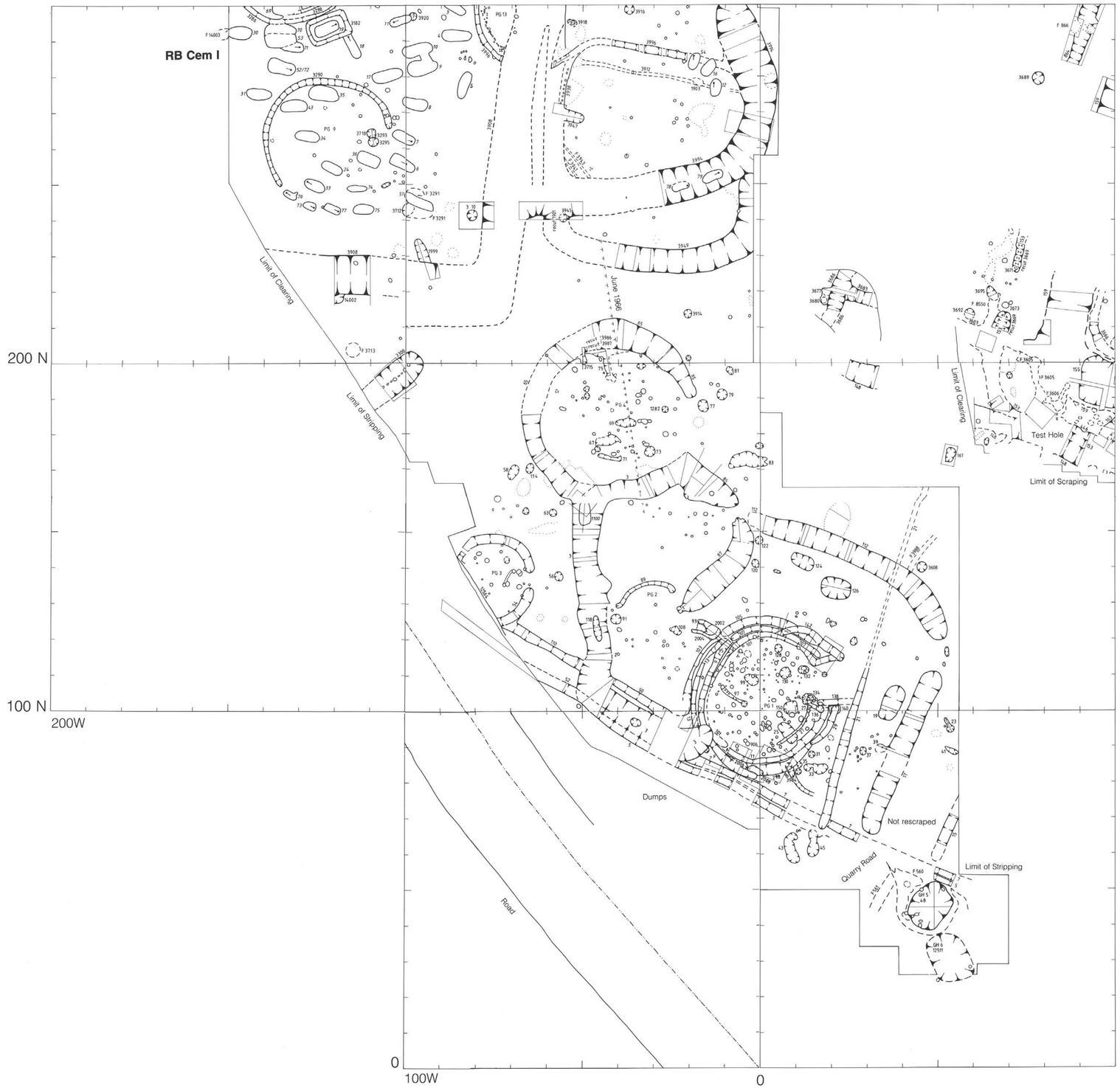


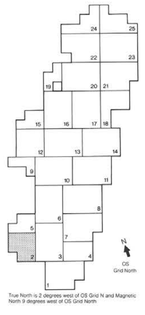
Fig 7 Cropmark plan with National Grid references

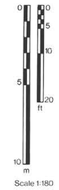
Plan 1


100 S
200 S
300 S
200 E
300 E
400 E
500 E
Sept 1976
Jan 1978
1977
1978
Machine Cleared
Brickearth
WELL 8
Test Hole
QTH
Quarry Track
Quarry Road
Scraper Track
Buckingham Hill Road
Telegraph pole
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North
OS Grid North
Scale 1:180

Plan 2


RB Cem I
Limit of Clearing
Limit of Stripping
June 1966
Limit of Clearing
Test Hole
Limit of Scraping
Dumps
Not rescraped
Quarry Road
Limit of Stripping
Road
200 N
100 N
200W
100W
0
0


OS Grid North
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North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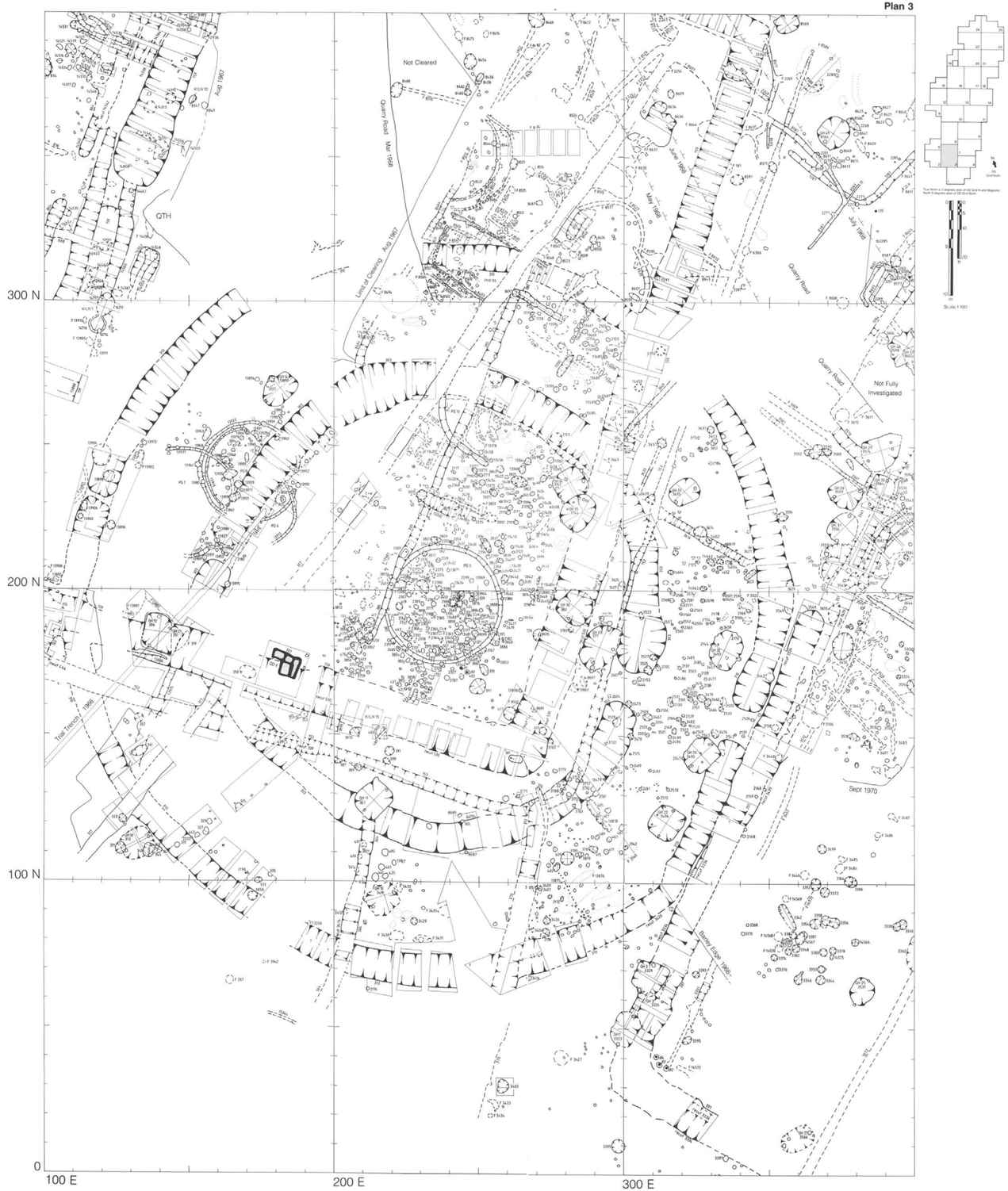
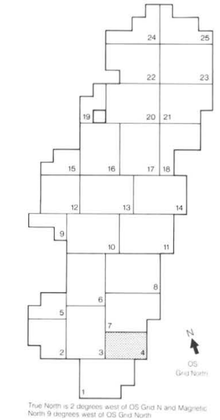
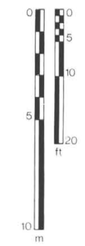
Plan 3


300 N
200 N
100 N
0
100 E
200 E
300 E
Not Cleared
Quarry Road
Mar 1968
Limit of Clearing
Aug 1967
QTH
Aug 1967
Jun 1968
May 1968
July 1968
Quarry Road
Quarry Road
Not Fully Investigated
Sept 1970
Trial Trench 1968
Banner Edge 1968
Scale 1:100

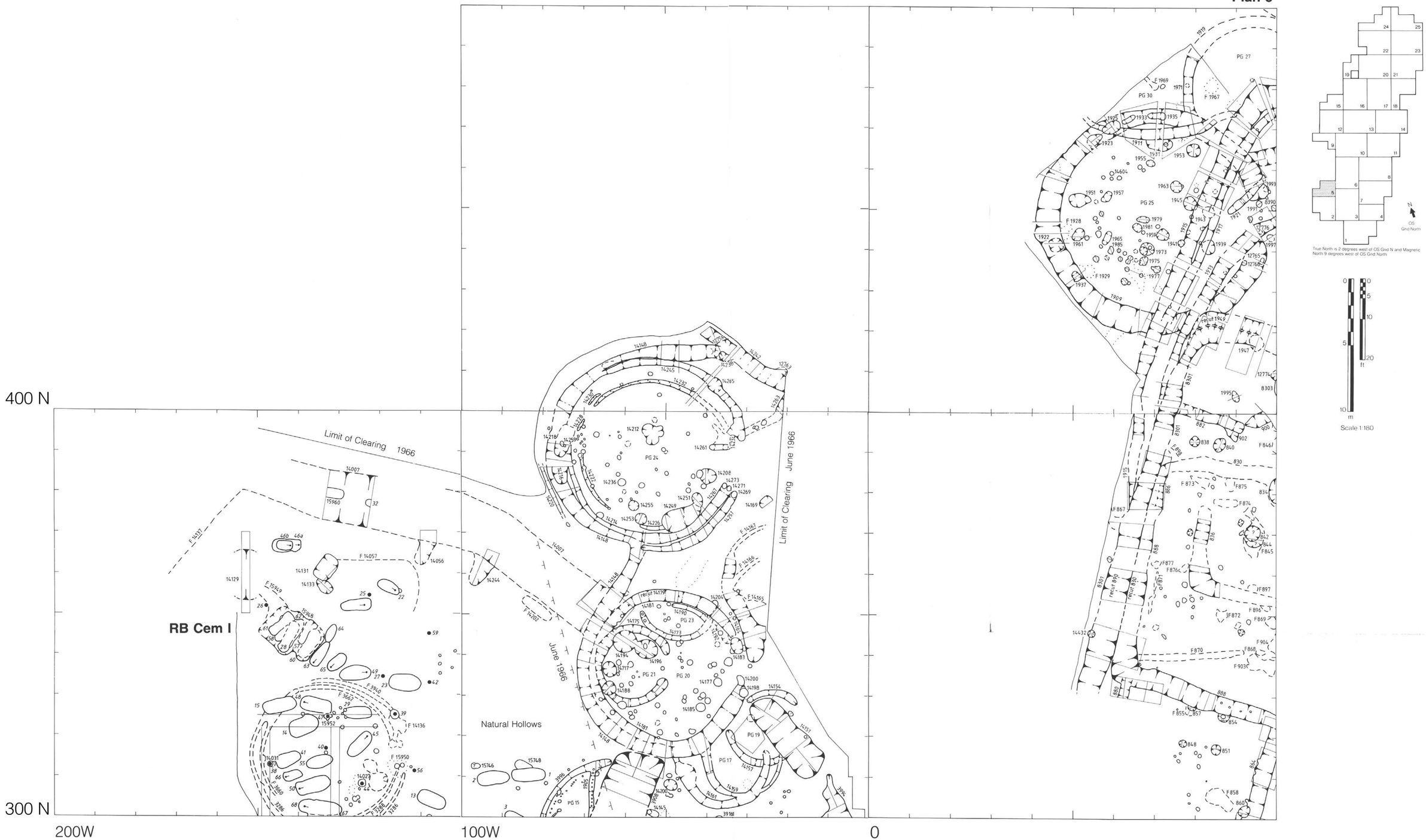
Plan 4



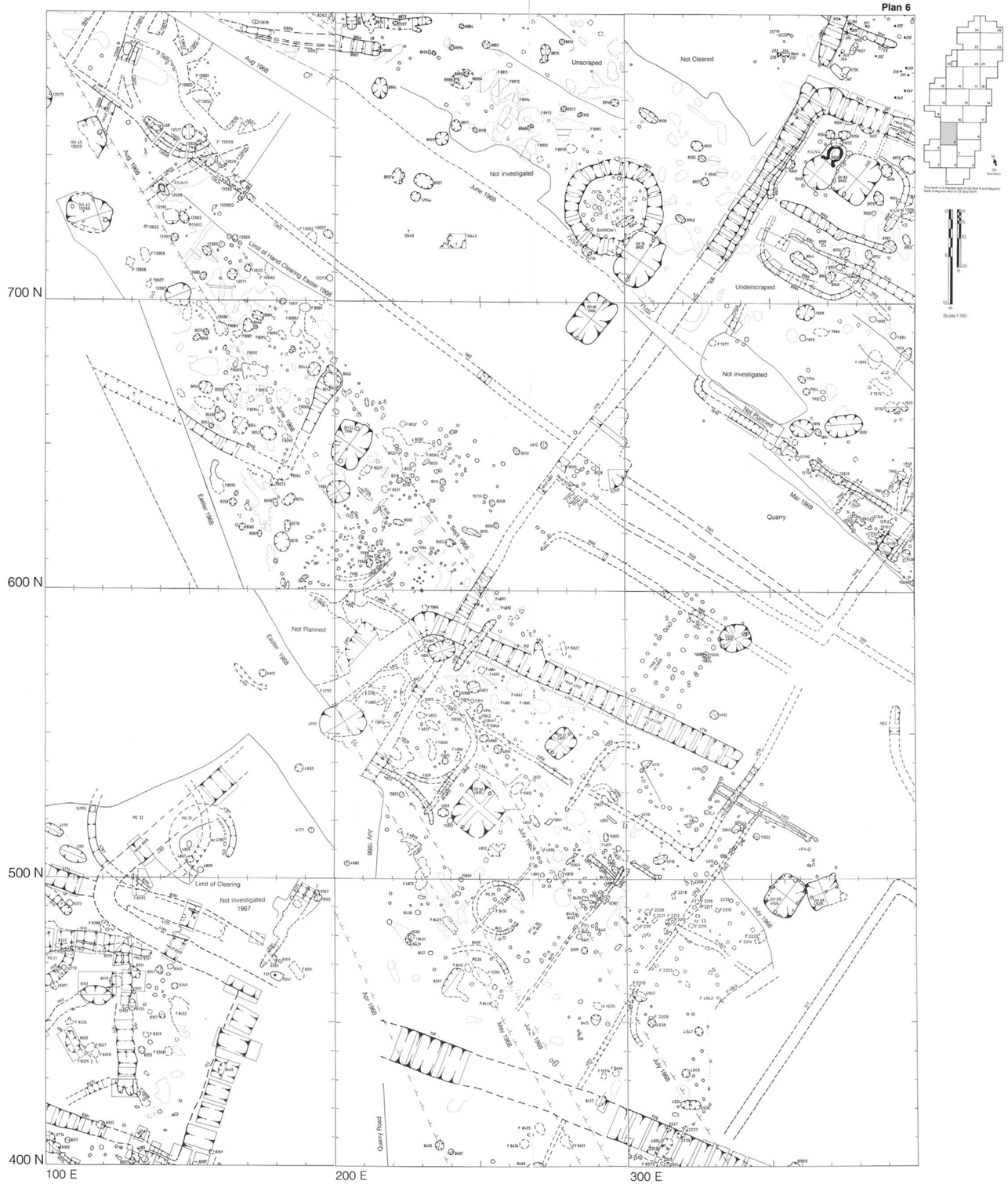


Scale 1:180

Plan 5


400 N
300 N
200W
100W
0
Limit of Clearing 1966
June 1966
RB Cem I
Natural Hollows
PG 27
PG 30
PG 25
PG 24
PG 23
PG 21
PG 20
PG 19
PG 17
PG 15
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North
OS Grid North
Scale 1:180

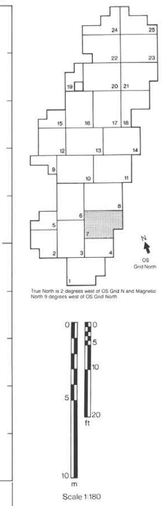
Plan 6


Unscraped
Not Cleared
Not investigated
Aug 1968
June 1969
Limit of Hand Clearing Easter 1968
Underscraped
Not investigated
Not Planned
Quarry
Mar 1969
Easter 1968
Not Planned
July 1968
Limit of Clearing
Not investigated
1967
Apr 1968
May 1968
June 1968
July 1968
Quarry Road
700 N
600 N
500 N
400 N
100 E
200 E
300 E

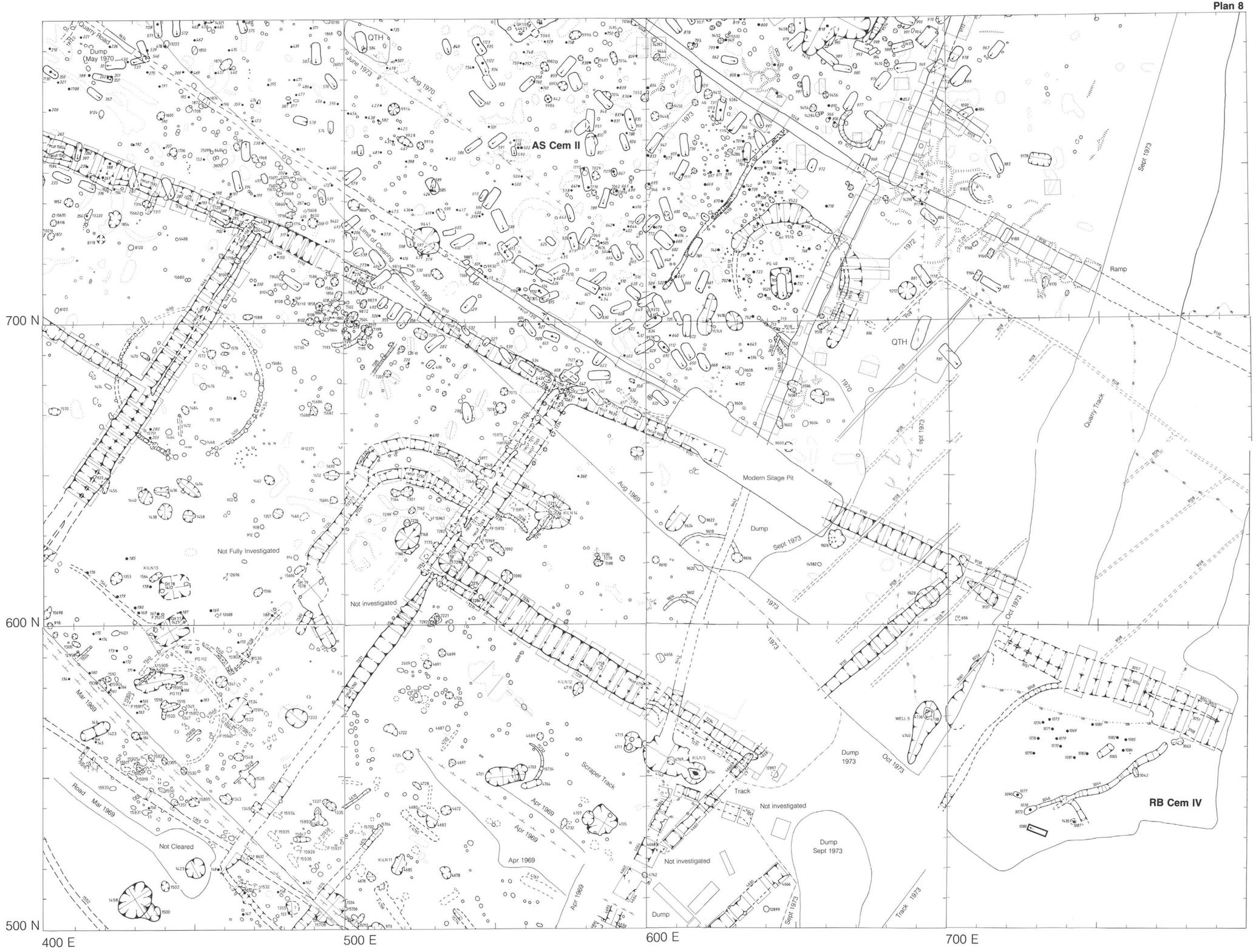
Scale 1:180

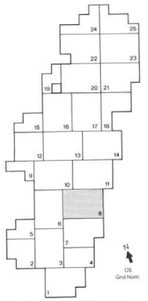
Plan 7


400 N
300 N
200 N
400 E
500 E
600 E
700 E
Not Cleared
Roughly Excavated
Machine Scraped only 1969-9
Not investigated
Not investigated
Not investigated
Not investigated
Aug 1968
1977
1978
1978
July 1969
Quarry Road
Quarry Road
Bailey Edge
KILN 2
KILN 3
KILN 8
KILN 9
WELL 1

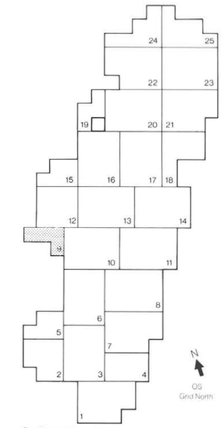

True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North
Scale 1:180

Plan 8

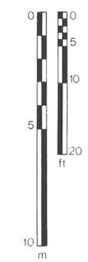




Scale 1:180



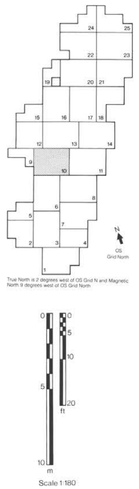
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North



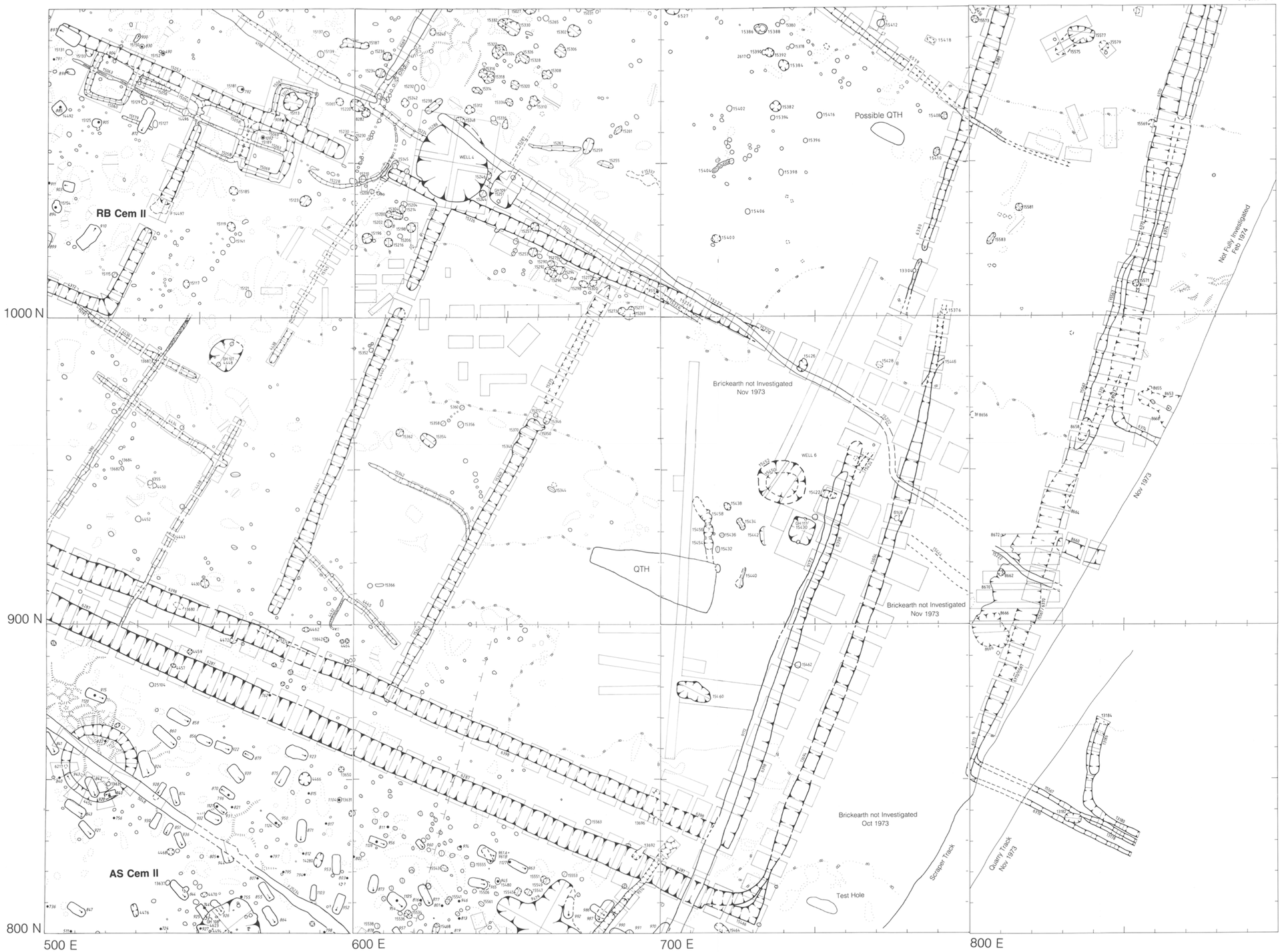
Scale 1:180

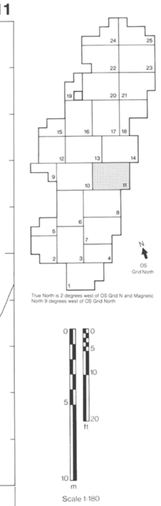
Plan 10

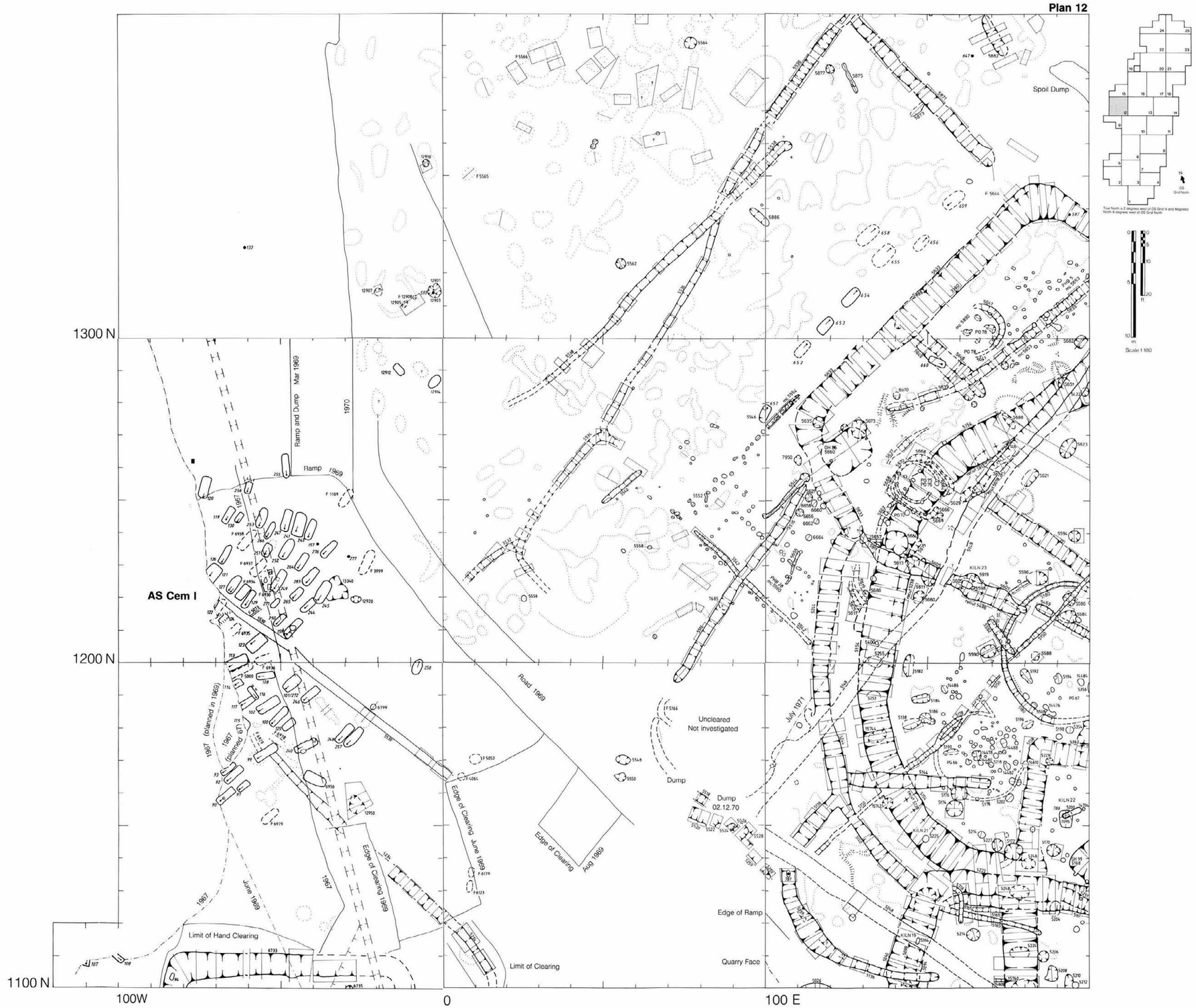

1000 N
900 N
800 N
100 E
200 E
300 E
400 E
RB Cem II
AS Cem II
QTH
Apr 1972
June 1972
July 1972
Line of Ramp
Quarry Road June 1970
Nov 1969
Limit of Clearing
Scraper Track
Scraper Track Dec 1972
Edge of Clearing Sept 1972
Oct 1972
Mar 1975
KILN 6
KILN 18
KILN 20
PG 50
PG 51
PG 52
PG 56
PG 45
PG 48


OS Grid North
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North
m
ft
Scale 1:180

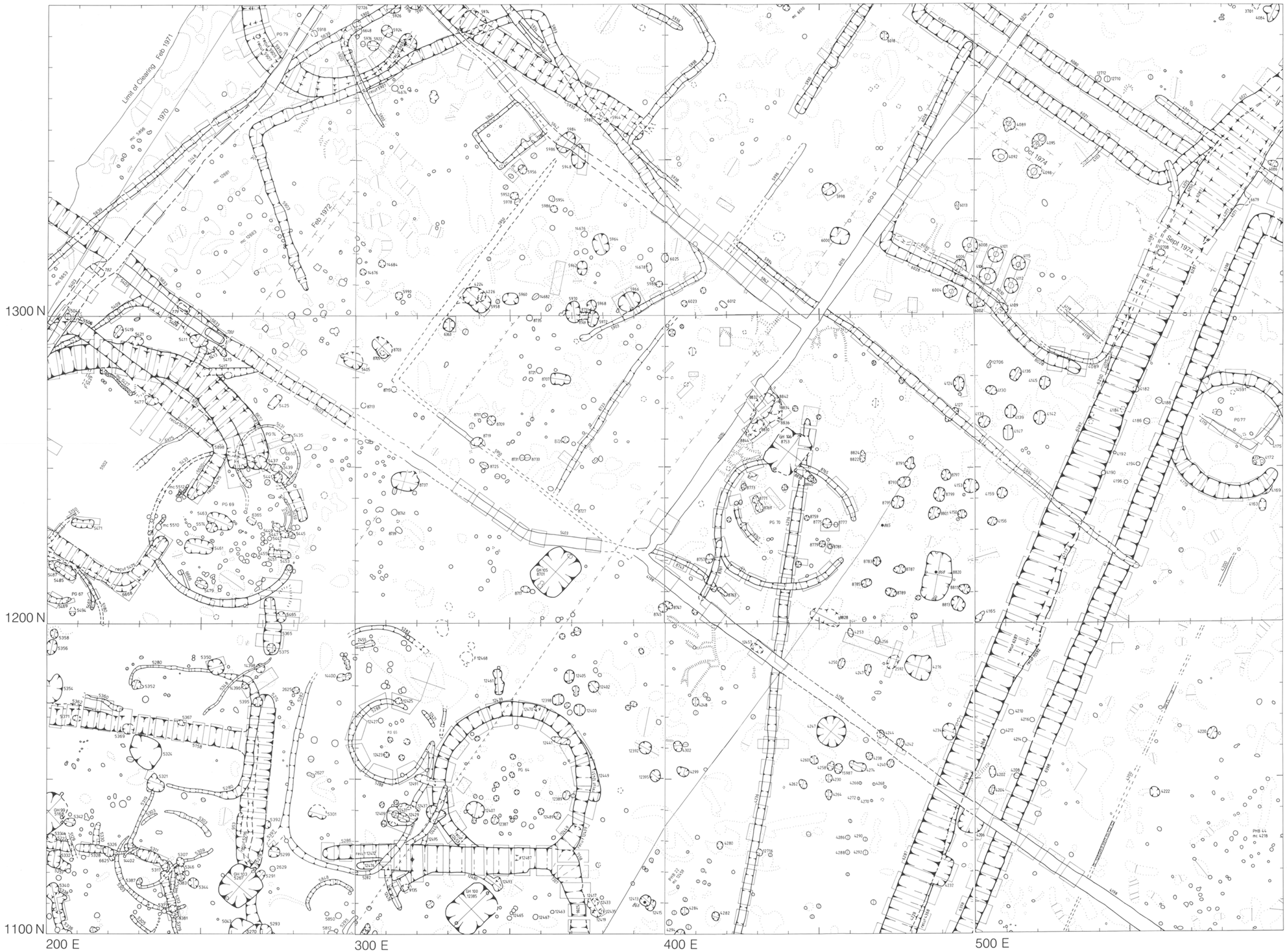
Plan 11

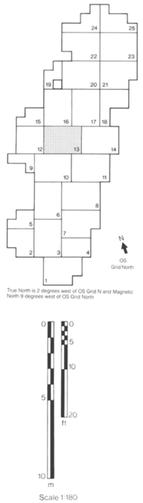

RB Cem II
AS Cem II
WELL 4
WELL 6
QTH
Possible QTH
Brickearth not Investigated
Nov 1973
Brickearth not Investigated
Nov 1973
Brickearth not Investigated
Oct 1973
Test Hole
Scraper Track
Quarry Track
Nov 1973
Not Fully Investigated
Feb 1974
1000 N
900 N
800 N
500 E
600 E
700 E
800 E


OS
Grid North
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North
Scale 1:180


Plan 12
1300 N
1200 N
1100 N
100W
0
100 E
Spoil Dump
Ramp and Dump Mar 1969
Ramp 1969
1970
AS Cem I
Road 1969
Uncleared
Not Investigated
Dump
Dump
02.12.70
July 1971
Edge of Clearing June 1969
Edge of Clearing Aug 1969
Edge of Clearing 1969
June 1969
1967 (clamped in 1969)
1967 (clamped 67)
1967
Limit of Hand Clearing
Limit of Clearing
Edge of Ramp
Quarry Face
KILN 23
KILN 22
KILN 21
KILN 19
Scale 1:180

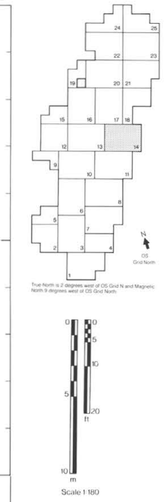
Plan 13


Limit of Clearing Feb 1971
Feb 1972
Oct 1974
Sept 1974
1300 N
1200 N
1100 N
200 E
300 E
400 E
500 E


OS Grid North
Scale 1:180

Plan 14

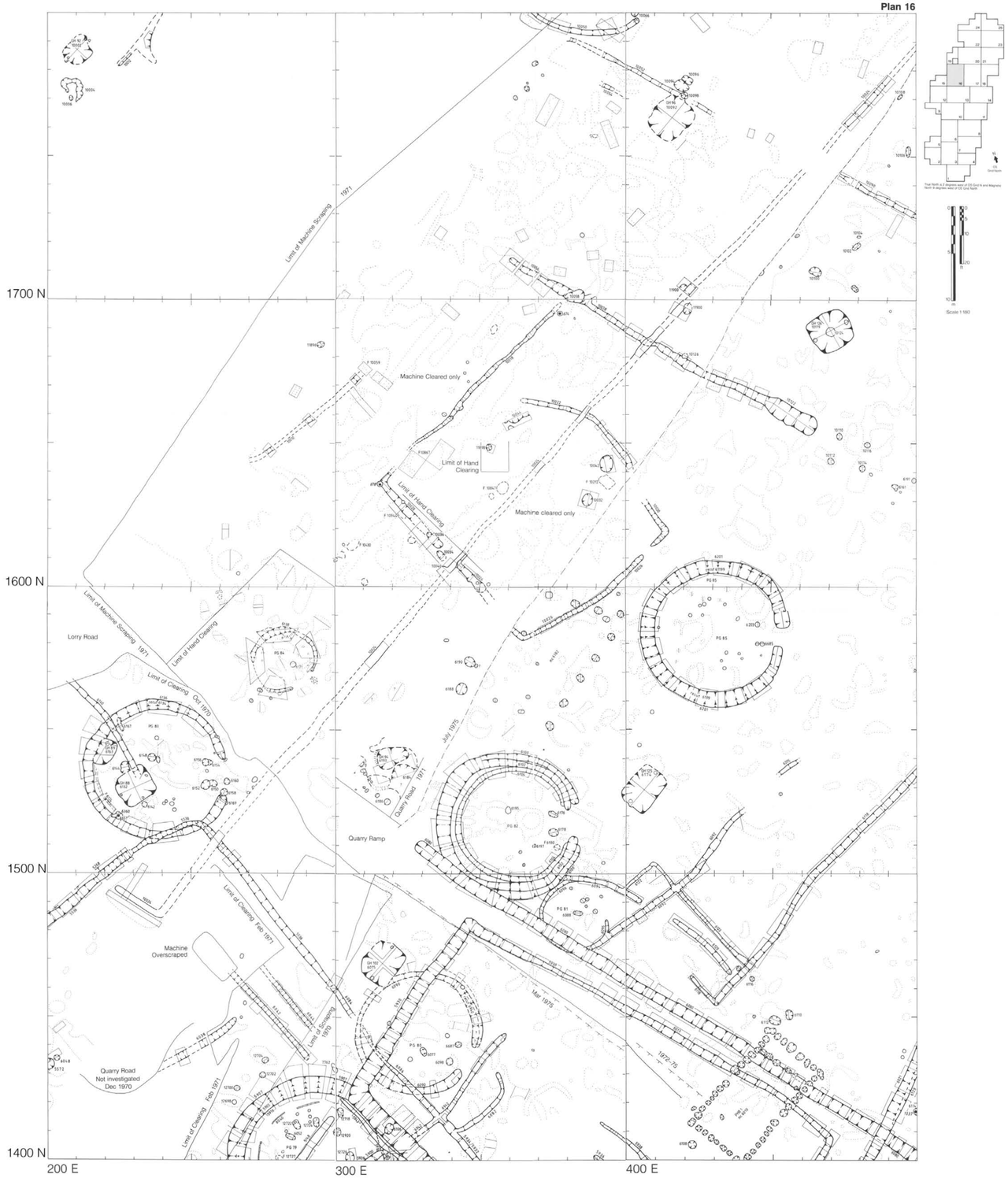

1300 N
1200 N
1100 N
600 E
700 E
800 E
900 E
Limit of Clearing Dec 1972
Edge of Scraped Area Oct 1972
Edge of Scraped Area Oct 1972
QTH
QTH
QTH
QTH
Apr 1974
Mar 1974


OS Grid North
Scale 1:180

Plan 15

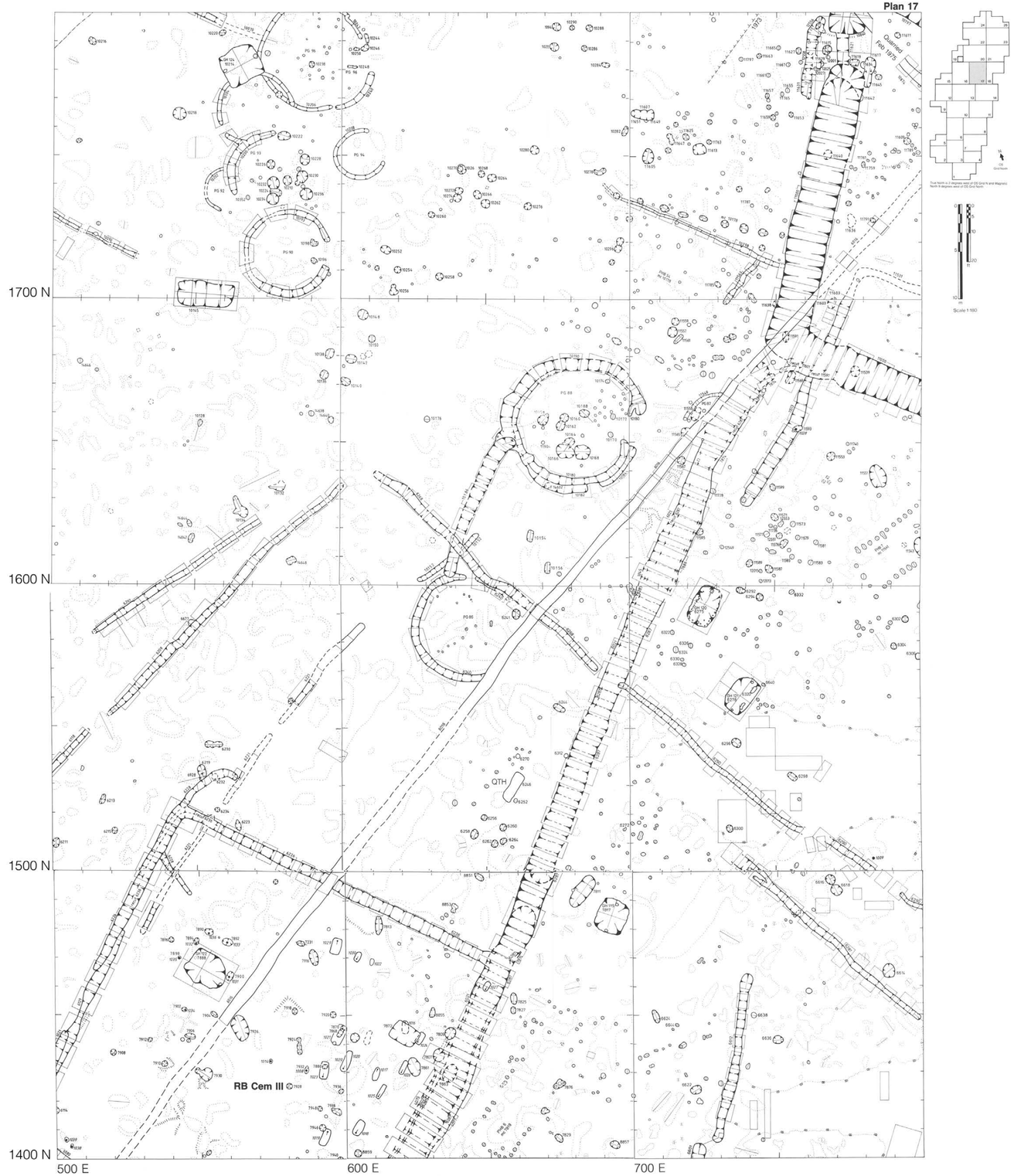

Quarry Track
1970
1500 N
1400 N
100W
0
100 E
5607
56
14672
14670
14668
14666
5576
5582
12918
5578
5574
5572
6046
6034
6068
6070
6072
6062
6056
6058
6060
6064
6066
6036
6038
F 6073
5536
5248
5572
5871
6032
2910
24
25
22
23
19
20
21
15
16
17
18
12
13
14
9
10
11
8
6
5
7
2
3
4
1
N
OS Grid North
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North
0
5
10
m
0
5
10
20
ft
Scale 1:180

Plan 16


1700 N
1600 N
1500 N
1400 N
200 E
300 E
400 E
Limit of Machine Scraping 1971
Machine Cleared only
Limit of Hand Clearing
Limit of Hand Clearing
Machine cleared only
Lorry Road
Limit of Machine Scraping 1971
Limit of Hand Clearing
Limit of Clearing Oct 1970
July 1975
Quarry Road 1971
Quarry Ramp
Limit of Clearing Feb 1971
Machine Overscraped
Limit of Scraping 1970
Quarry Road Not investigated Dec 1970
Limit of Clearing Feb 1971
Mar 1975
1972-75

Scale 1:180

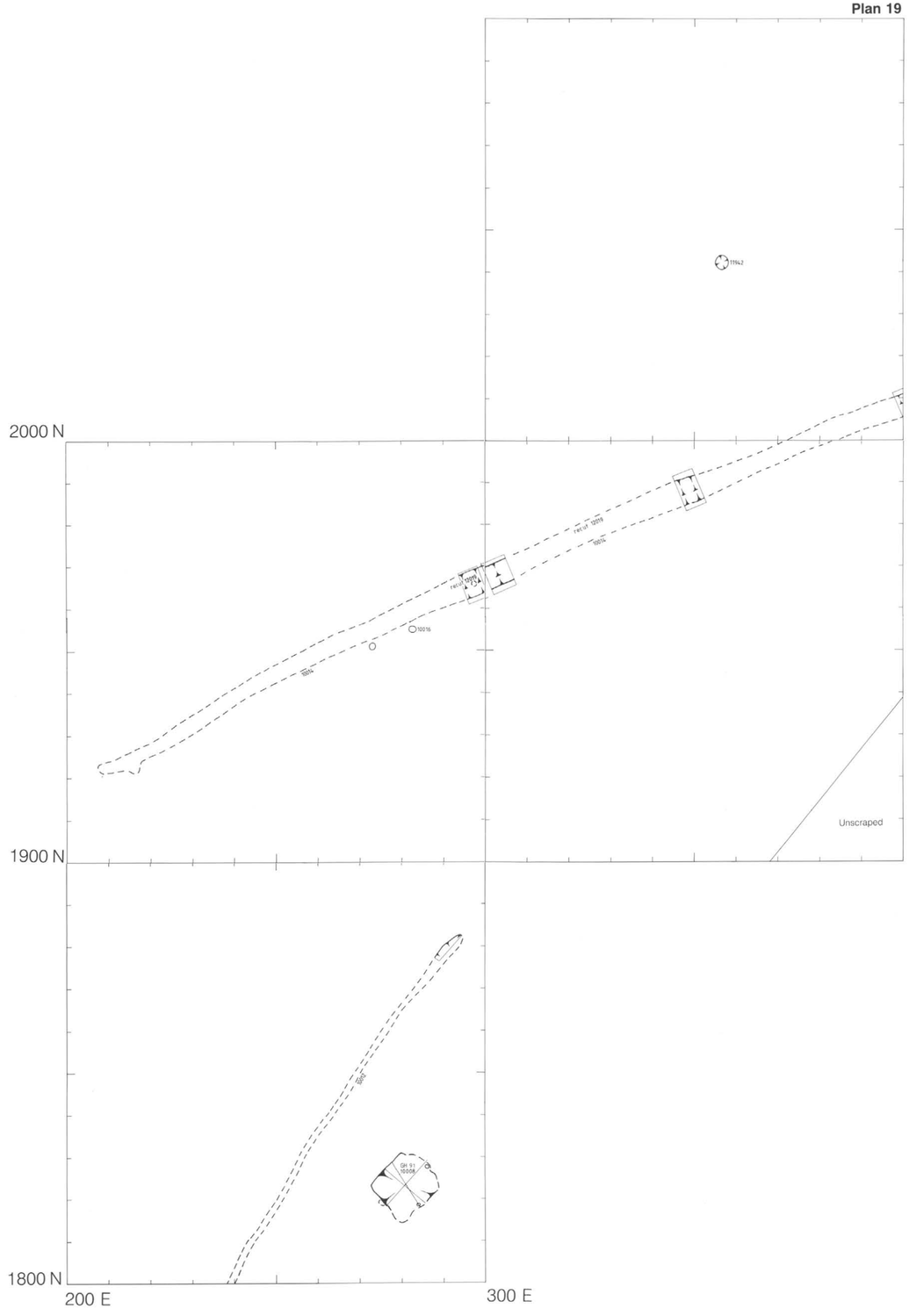
Plan 17

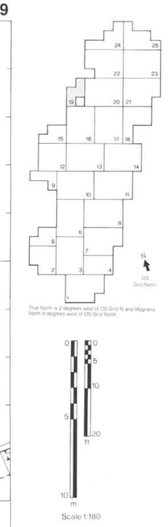

1700 N
1600 N
1500 N
1400 N
500 E
600 E
700 E
RB Cem III
QTH

Scale 1:150

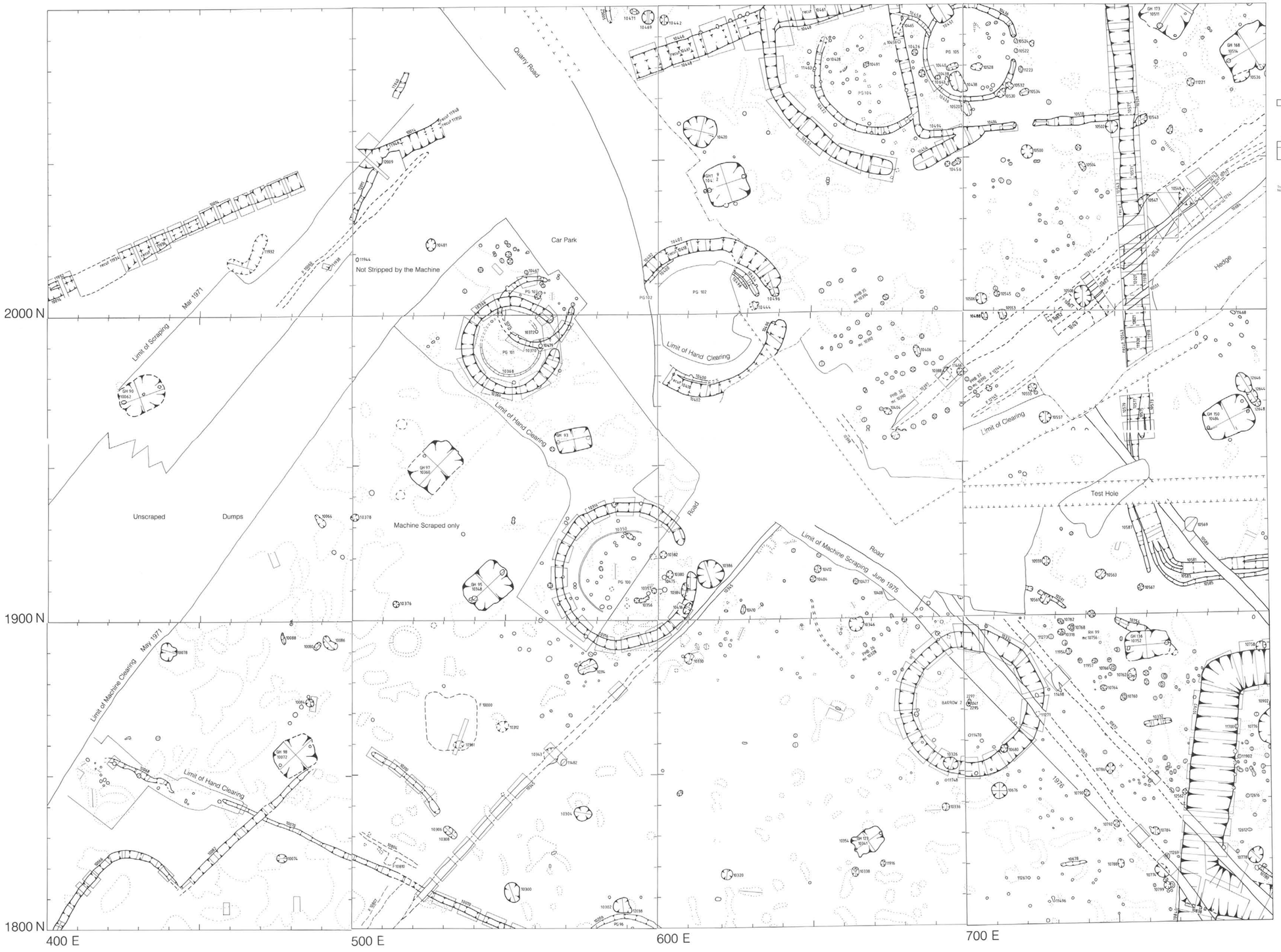

Plan 18
800 E
900 E
1000 E
1700 N
1600 N
1500 N
1400 N
800 E
Modern Silage Pit
QTH
Limit of Machine Scraping
Path
Dump
Not Cleared
Limit of Hand Clearing
Test Hole
Machine Scraped only
Limit of Hand Clearing
Scale 1:150

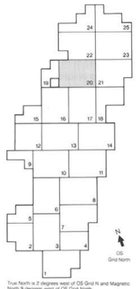
Plan 19

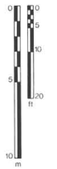

2000 N
1900 N
1800 N
200 E
300 E
11962
10016
FELLF 12009
100N
GH 91
100.06
Unscraped


24
25
22
23
19
20
21
15
16
17
18
12
13
14
9
10
11
6
8
5
7
2
3
4
1
OS Grid North
True North is 2.2 degrees west of OS Grid N and Magnetic North 8 degrees west of OS Grid North
0
5
10
20
m
Scale 1:180

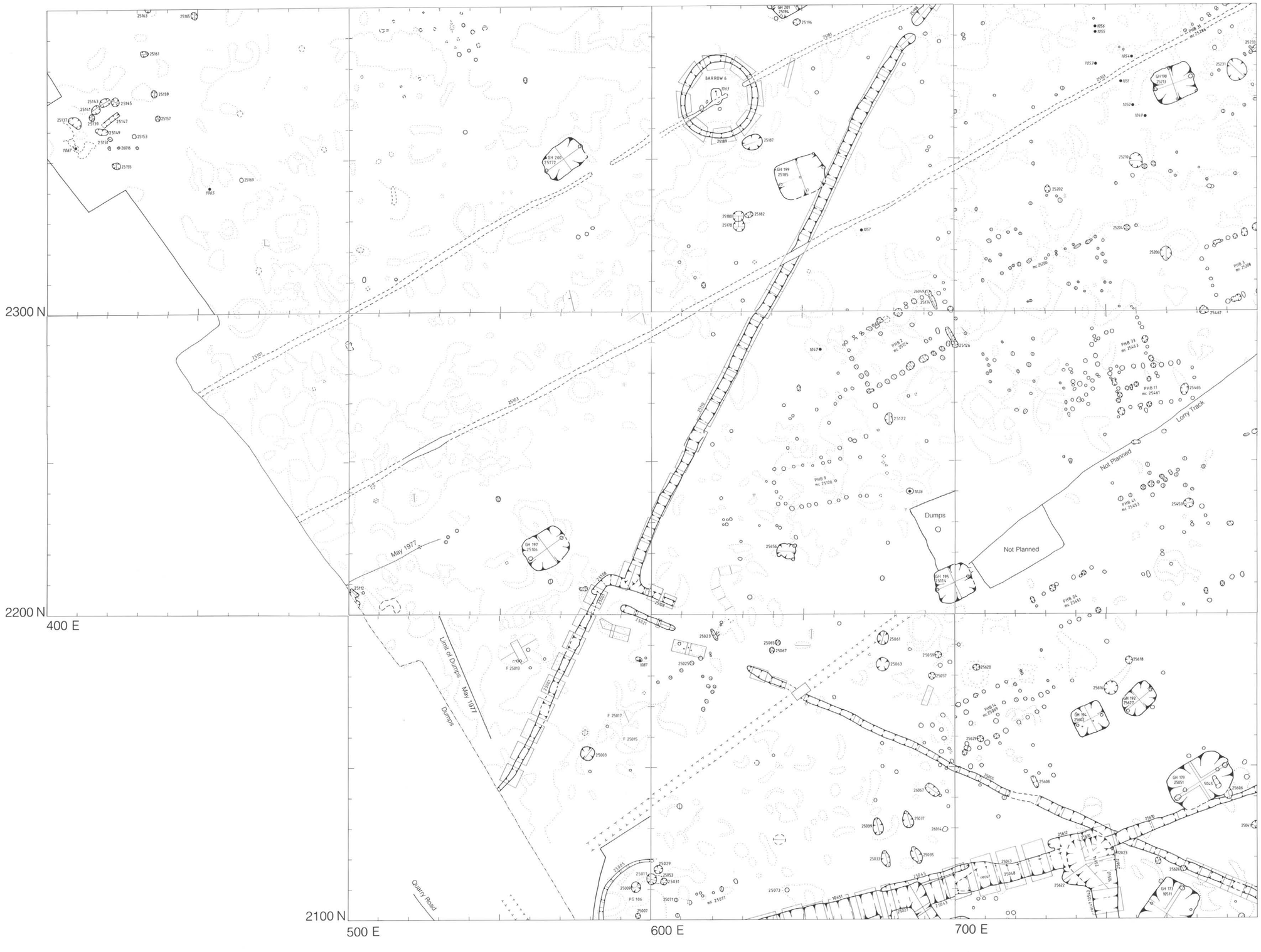
Plan 20

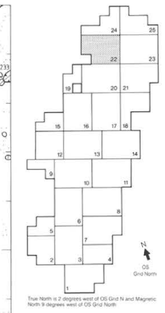

2000 N
1900 N
1800 N
400 E
500 E
600 E
700 E
Quarry Road
Car Park
Not Stripped by the Machine
Limit of Scraping
Mar 1971
Limit of Hand Clearing
Limit of Clearing
Hedge
Test Hole
Unscraped
Dumps
Machine Scraped only
Road
Limit of Machine Scraping June 1975
Limit of Machine Clearing May 1971
BARROW 2
PG 102
PG 101
PG 100
PG 105
PG 104
PG 98

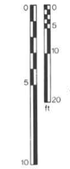

OS Grid North
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North


m
ft
Scale 1:180

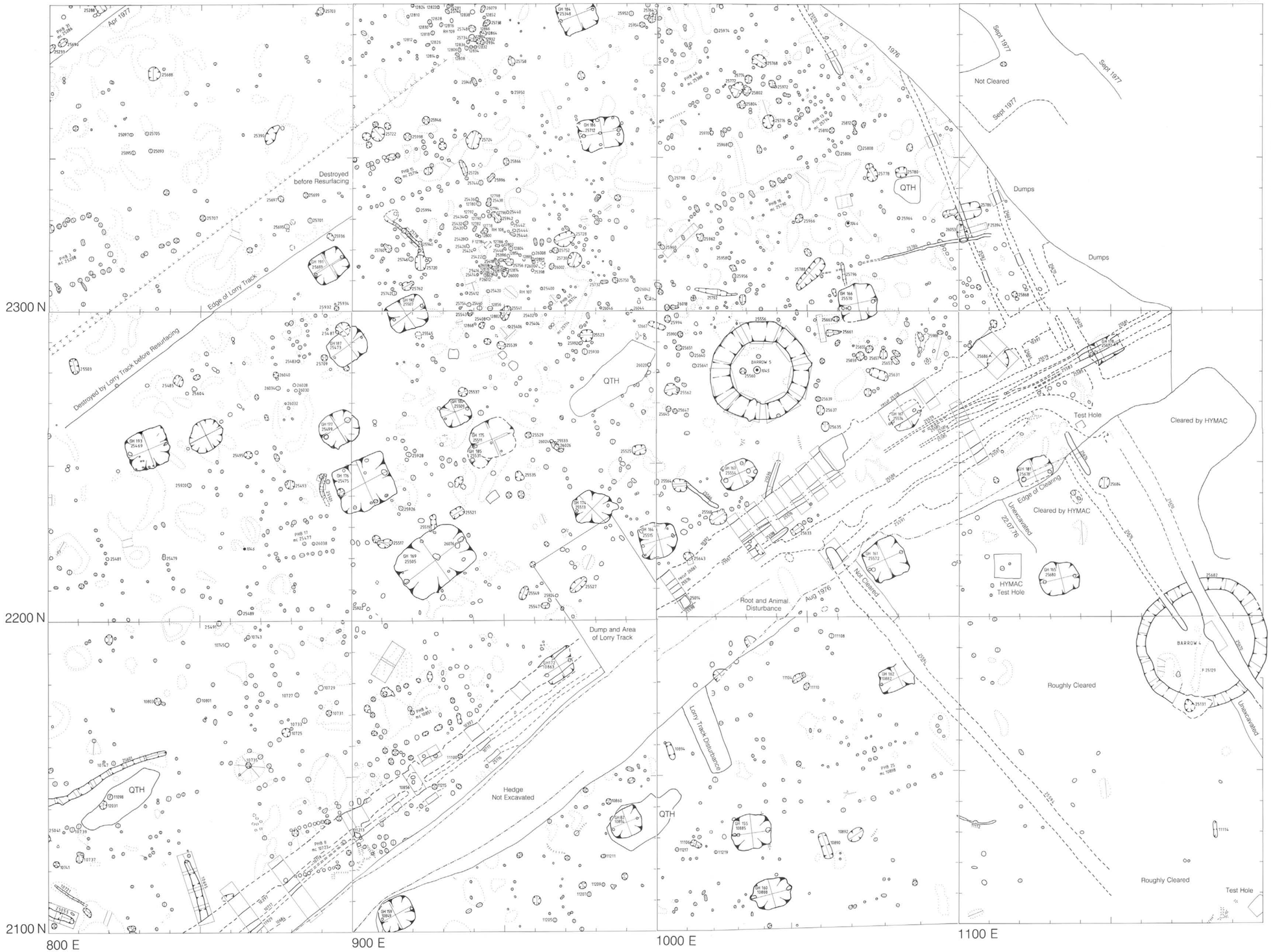

2000 N
1900 N
1800 N
800 E
900 E
1000 E
1100 E
Nov 75
Sept 1977
May 1976
1976
May 1976
Coppmark showing Brickearth Limit July 1975
BARROW 3
QTH
Destroyed by Dragline Feb 1976
Scale 1:180


2300 N
2200 N
2100 N
400 E
500 E
600 E
700 E
BARROW 6
Dumps
Not Planned
Lorry Track
Not Planned
May 1977
Limit of Dumps May 1977
Dumps
Quarry Road

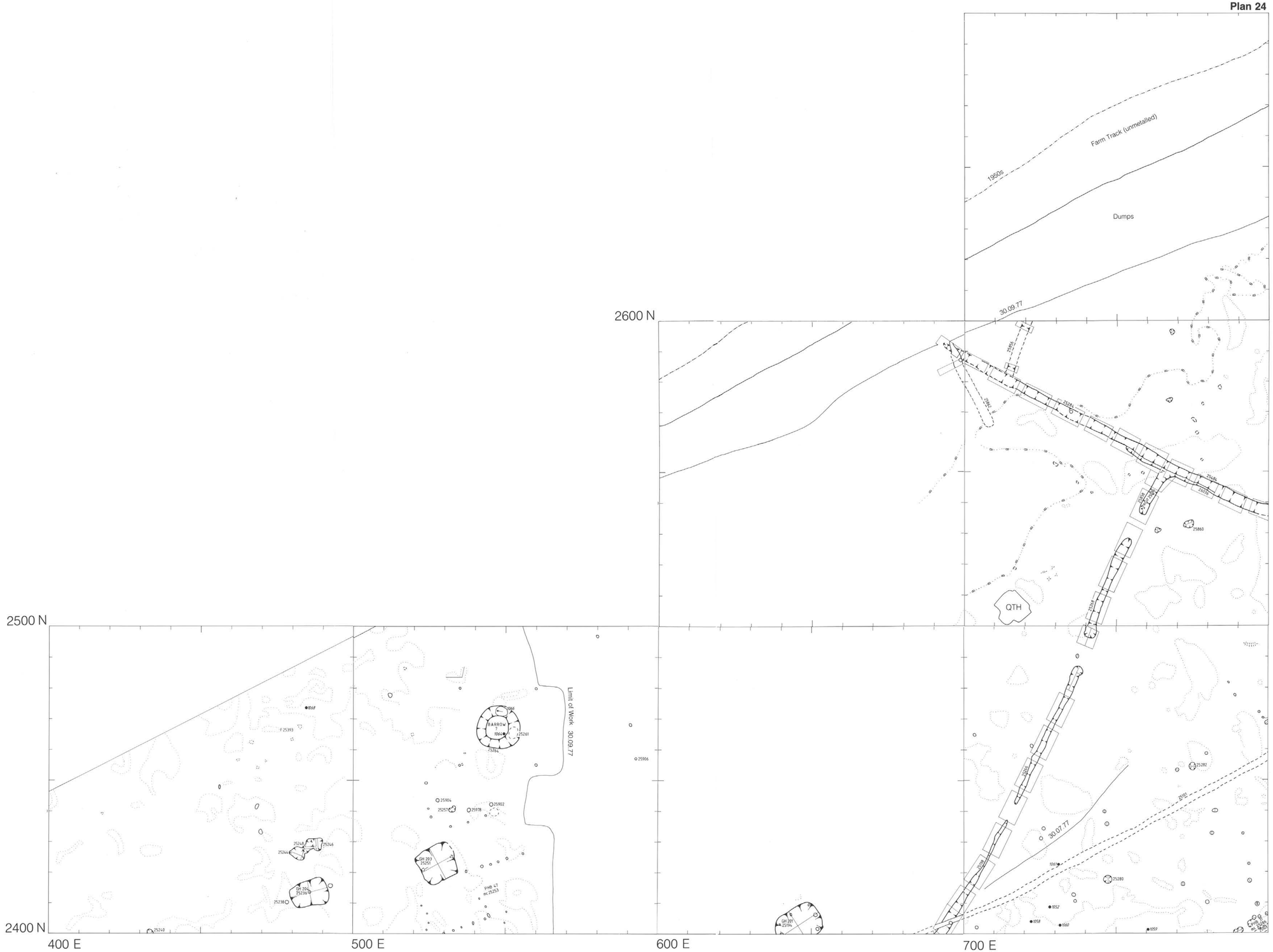

N
OS Grid North
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North


0
5
10
m
0
5
10
20
ft

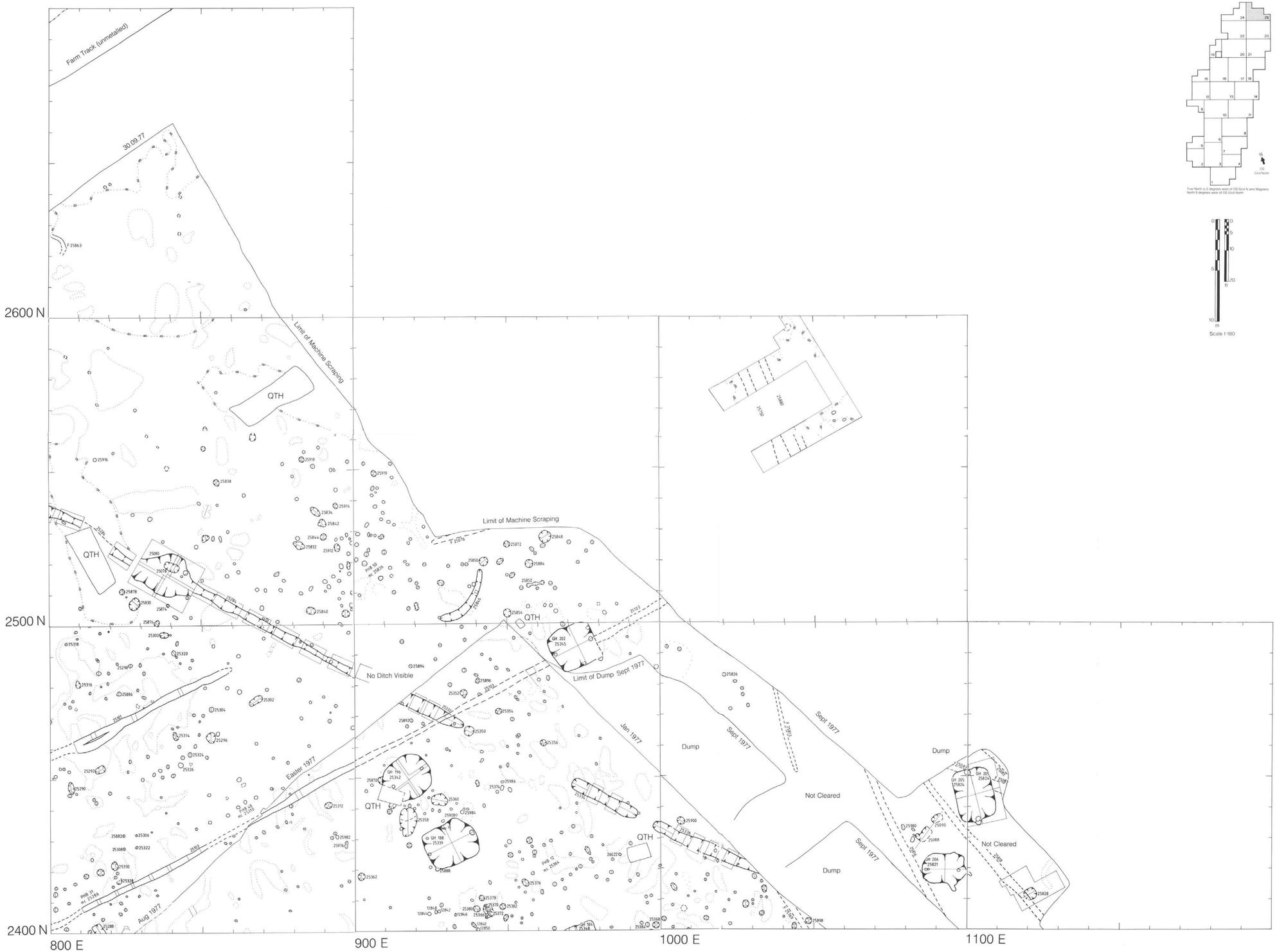
Scale 1:180


2300 N
2200 N
2100 N
800 E
900 E
1000 E
1100 E
Apr 1977
Sept 1977
Not Cleared
Destroyed before Resurfacing
Edge of Lorry Track
Destroyed by Lorry Track before Resurfacing
QTH
Dumps
BARROW 5
Test Hole
Cleared by HYMAC
Edge of Clearing
Unexcavated 22.07.76
HYMAC Test Hole
Root and Animal Disturbance
Aug 1976
Dump and Area of Lorry Track
Lorry Track Disturbance
Hedge Not Excavated
BARROW 4
Roughly Cleared
Unexcavated

Plan 24


Farm Track (unmetalled)
1950s
Dumps
30.09.77
2600 N
25856
25862
25284
25484
26036
25858
recut 25486
25860
QTH
25268
2500 N
F 25393
1068
BARROW
7
1066
1064
25261
25264
Limit of Work 30.09.77
25906
25904
25902
25257
25978
25248
25246
25244
GH 204
25236
25238
GH 203
25251
PHB 47
mc 25253
25240
GH 201
25194
25266
25198
30.07.77
25101
25282
25280
1061
1052
1058
1060
1059
PHB 31
mc 25286
25103
2400 N
400 E
500 E
600 E
700 E
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
N
OS
Grid North
True North is 2 degrees west of OS Grid N and Magnetic North 9 degrees west of OS Grid North
0
5
10
m
0
5
10
20
ft
Scale 1:180

Plan 25



Scale 1:180

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Front cover
A collage of views of the Mucking excavations.