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GEOPHYSICAL SURVEY REPORT 2005/78

GRAYFLEET EAST
Lincolnshire

Client:

Northern Archaeological Associates

On behalf of

WINGAS


GSB PROSPECTION Ltd
Report No. 05/78
GRAYFLEET EAST
Archive CD

ELI 6660 SLI 10670 PRN 46158 L11178

SITE SUMMARY SHEET

2005 / 78 Grayfleet East, South Cockerington, Saltfleetby Lincolnshire

NGR: TF 426 907

Location, topography and geology

The site lies within the parish of South Cockerington, 1.5km to the north of Saltfleetby St Peter and approximately 9km to the northeast of Louth. The site is bound by Grayfleet Drain to the south and two smaller drains to the north and east. Topography of the site is flat and ground cover consisted of a newly sprouting crop. Soils of the area belong to the Wallasea 2 association (813g) formed from a parent of marine alluvium (SSEW, 1983).

Archaeology

Extensive cropmarks within the application area have been plotted by the English Heritage National Mapping Programme and these indicate a medieval moated site, building platform and associated features. Pottery and other artefacts were identified during a site inspection by the client (P. Cardwell, *pers comm.*).

Aims of Survey

A pilot magnetic survey over the cropmarks was undertaken to establish whether archaeological remains could be detected within the geological background of this site. Significant anomalies were found and additional detailed work was then undertaken in area of unknown potential. This work forms part of a wider research being undertaken by **Northern Archaeological Associates (NAA)** on behalf of Wingas Storage (UK) Ltd.

Summary of Results *

The initial survey of the site (Area 1) produced a complex set of responses. Some of these are almost certainly to be a result of the presumed medieval site; for example, a negative magnetic anomaly to the west of this complex clearly corresponds with one element of the cropmark evidence. In addition, to the southeast of the complex, the results show a possible moat ditch surrounding the occupation. The northern section of the ditch appears to have a more natural form and it peters out as a magnetic anomaly.

The natural responses seen in Area 1 are seen to continue into Area 2 and they may be masking archaeological features.

In the remaining survey areas (Areas 3 to 5) the magnetic anomalies have been interpreted as being either past field boundaries or drains. Ploughing and other linear trends are also evident in Area 4 but whether the latter are of archaeological interest is unlikely.

*** It is essential that this summary is read in conjunction with the detailed results of the survey.**

SURVEY RESULTS

2005 / 78 Grayfleet East, South Cockerington, Saltfleetby Lincolnshire

1. Survey Area

1.1 The magnetic survey was undertaken in two phases. During the first phase 2ha of detailed gradiometry was carried out over the cropmarks, shown in Figure 1 at a scale of 1:2500. Subsequently a further four areas (Areas 2 to 5) were investigated, The locations were selected by the client, to give an additional 2ha of detailed gradiometry survey, again as sown in Figure 1. The magnetic survey was undertaken using Bartington Grad 601-2 instruments.

1.2 The survey grid was set out by ***GSB Prospection Ltd.*** and tied in to building corners as shown on the ordnance survey (OS) using an EDM system. Permanent markers were left *in situ* within the field boundaries as marked in Figure T1 and T2 which can be found at the back of the report.

2. Display

2.1 Figures 2 and 3 show the data as summary greyscale and interpretation images, respectively, at a scale of 1:2000 for the site.

2.2 In the archive section, included on the CD at the front of the report, the results are displayed as X-Y traces and greyscale images, all with accompanying interpretations at a scale of 1:500. For display at this scale Area 1 has been subdivided, but is discussed as a whole in the text below. The display formats and the interpretation categories used are discussed in the *Technical Information* section at the end of the text.

2.3 Letters in parenthesis refer to anomalies highlighted within the interpretation diagrams.

3. General Considerations and Complicating factors

3.1 The site was ideal for survey as the topography was flat and ground conditions consisted of a young crop.

3.2 A pumping station was located to the south of Area 1, which has had an effect on the data immediately surrounding the building.

3.3 The site soils are classified as Walasea 2 (813g), which are effectively formed in a marine environment. Alluviated zones in general can be problematic due to depth to archaeology and the presence of characteristic pedological / geological responses. However, areas of marine alluviation carry with them the possibility of considerably stronger natural responses due to the production of iron sulphides. Such responses can be expected at this site and a staged approach was undertaken, with a pilot survey (Area 1) covering a zone of known archaeology.

4. Results of Detailed Survey

Area 1

4.1 A group of strong anomalies is visible within an area of increased magnetic response (A) that has clear archaeological potential. It is difficult to define the precise extent of the anomalies although they do form a vaguely circular pattern. The majority of these anomalies coincide in the general area of the cropmark features.

4.2 The unusual negative response (B) coincides exactly with one element of the cropmarks, though it is not known why the response is negative; it may mark the boundary of the settlement area. The response at (C) could be an extension of the anomaly but its interpretation is unclear.

4.3 Archaeological response (D) is magnetically stronger than the surrounding anomalies suggesting a burnt fill of the feature.

4.4 A peculiar curving band (E) bisecting the southern section of the survey data is thought to be archaeological, possibly a ditch surrounding the main focus of potential archaeological anomalies noted above. However, the archaeological nature of this anomaly is not proven and it may be that it indicates a change in geology or simply some natural soil variation. The negative response (F) is likely to relate to this feature as well.

4.5 The negative and positive magnetic responses at (G) and (H) are thought to have a natural (pedological) origin, though possibly intermingled with archaeological features. Being located to the south of the drains they seem most likely to past flooding of the site or marine deposits.

4.6 A linear response (I) running northwest to southeast is a field drain, marked on the OS map but has now been in-filled. The response is stronger in the southern section of the data and peters out amongst the natural responses in the north (J).

4.7 A large ferrous response (K), in the southwest corner of the data has been produced by the presence of a pumping station. This has masked the continuation of the ditch response (E), and possibly any other detectable archaeological remains.

4.8 The site was generally free from ferrous anomalies; those present, within the limits of the data are caused by field boundaries and drains.

Area 2

4.9 Area 2 was appended to the original survey area (Area 1). Natural responses (L) are clearly a continuation of (G) and (H) seen in Area 1, though the south-east limit of these anomalies appears to match the location of a known cropmark. Within these natural responses are a few anomalies, most notable (M), which appear archaeological.

4.10 Anomaly (E), the curving ditch-like response in Area 1, may terminate at (N) though the anomalies are far from clear as they seem to peter out at this point.

4.11 A number of ferrous anomalies are seen within Area 2. They tend to be small and randomly scattered. The most likely explanation is that this represents modern material located in the topsoil.

Area 3

4.12 A single linear anomaly (O) runs northeast southwest through the surveyed area. This is presumed to be a field drain. A few additional anomalies (P) appear to be natural. The ferrous responses are suspected to be modern in origin and located on the surface or within the top soil.

Area 4

4.13 The strong linear magnetic anomaly (Q), bisecting Area 4, coincides with a known field boundary from historic map sources. Anomaly (R) is also a recorded field boundary, however the magnetic response is far weaker. One possible explanation for the variation of response, from the two anomalies, is that (Q) may have an associated pipe or service. However it is also possible that the field boundary was formed partly by a ditch which has subsequently been in filled with modern material containing ferrous debris. This explanation is based on field observations as a large number of modern (20th Century) materials was seen in this area during the survey. A break is seen within anomaly (Q) which may be a past field entrance. The detection of the field boundaries is encouraging. This is a good indication that any archaeology detectable by fluxgate magnetometer should be evident within the survey area.

4.14 At the southeast end of anomaly (Q) there appears to be a spread of ferrous material (S). This magnetic disturbance may just be the result of ploughing through the field boundary. However there are some of the magnetic trends such as (T), identified within the surveyed area, that do not follow the same orientation as the ploughing. It is not clear what, if any, significance should be placed on these few linear anomalies. As with the previous areas the numerous random ferrous responses are presumed to be modern.

Area 5

4.15 In Area 5 the same ploughing trends as seen in Area 4 are visible, with the same orientation. A suspected natural anomaly (U) has been highlighted. In the southeast corner the anomaly appears stronger. It is possible that this is not natural but relates to either a former field boundary or the present adjacent dyke.

4.16 This area is generally free from ferrous responses, the few identified appear random and presumed modern.

5. Conclusions

5. 1 Area 1 contains the most potential archaeology; the concentration of responses coincides with the area of known cropmarks and is the most likely location for the medieval site. A possible moat has also been identified within the area. In the northern section of the site archaeological features may be present but partially masked by natural responses. These natural responses are also seen in the adjacent Area 2 and again some potential archaeological features have been identified within the data.

5. 2 Area 3 shows a small field drain but no obvious archaeology. Area 4 shows two past field boundaries, ploughing trends and several magnetic trends of unknown significance.

5. 3 Area 5 also contains evidence of ploughing and a natural response although it is possible it relates to a past field boundary or the current adjacent dyke.

Project Co-ordinators: E Wood and I Wilkins
Project Assistants: J Anderson, M Brolly, C Gaffney, S Hodgeson and C Stephens

Date of Survey: 26th October 2005 and 8th-9th November 2005
Date of Report: 22nd November 2005

References:

SSEW 1983. *Soils of England and Wales. Sheet 4, Eastern England.* Soil Survey of England and Wales.

ARCHI *Archaeological Sites Index*: www.digital-documents.co.uk

TECHNICAL INFORMATION

The following is a description of the equipment and display formats used in **GSB Prospection Ltd (GSB)** reports. It should be emphasised that whilst all of the display options are regularly used, the diagrams produced in the final reports are the most suitable to illustrate the data from each site. The choice of diagrams results from the experience and knowledge of the staff of **GSB.**

All survey reports are prepared and submitted on the basis that whilst they are based on a thorough survey of the site, no responsibility is accepted for any errors or omissions.

Instrumentation

(a) Fluxgate Gradiometer - Geoscan FM36 / FM256 and Bartington *Grad*601-2

Both the Geoscan and Bartington instruments comprise two fluxgate magnetometers mounted vertically apart at a distance of 500mm and 1000mm, respectively. The gradiometers are carried by hand, with the bottom sensor approximately 100-300mm from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The fluxgate gradiometer suppresses any diurnal or regional effects. Generally features up to one metre deep may be detected by this method. Readings are logged at 0.25 intervals along traverses 1.0m apart, unless stated otherwise in the report. Having two gradiometer units mounted laterally with a separation of 1.0m, the Bartington instrument can collect two lines of data per traverse. The *Grad*601-2 has greater sensitivity afforded by the increased fluxgate separation, but this also increases the instrument's susceptibility to external sources of interference.

(b) Resistance Meter - Geoscan RM15

This measures the electrical resistance of the earth, using a system of four electrodes (two current and two potential.) Depending on the arrangement of these electrodes an exact measurement of a specific volume of earth may be acquired. This resistance value may then be used to calculate the earth resistivity. The "Twin Probe" arrangement involves the paring of electrodes (one current and one potential) with one pair remaining in a fixed position, whilst the other measures the resistance variations across a grid. The latter pair are often termed 'mobile', while the 'fixed' are also often called 'remote' or 'stationary'. The resistance is measured in ohms and the calculated resistivity is in ohm-metres. The resistance method as used for standard area survey employs a probe separation of 0.5m, which samples to a depth of approximately 0.75m, although the nature of the overburden and underlying geology will cause variations in this generality. The technique can be adapted to sample greater depths of earth and can therefore be used to produce vertical "pseudo sections". In area survey readings are logged at 1.0m x 1.0m intervals using a 0.5m separation, unless stated otherwise in the report.

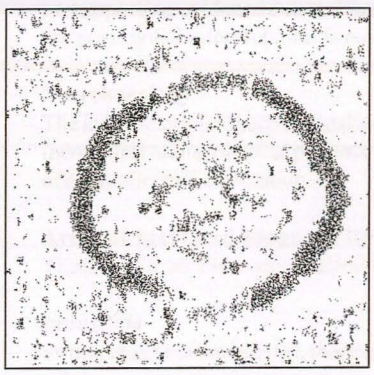
(c) Magnetic Susceptibility

Variations in the magnetic susceptibility of subsoils and topsoils occur naturally, but greater enhanced susceptibility can also be a product of increased human/anthropogenic activity. This phenomenon of susceptibility enhancement can therefore be used to provide information about the "level of archaeological activity" associated with a site. It can also be used in a predictive manner to ascertain the suitability of a site for a magnetic survey. Sampling intervals vary widely but are often within the 5- 20m range. The instrument employed for measuring this phenomenon is either a field coil or a laboratory based susceptibility bridge. The field coil measures the susceptibility of a volume of soil. The laboratory procedure determines the susceptibility of a specific mass of soil. For the latter 50g soil samples are collected in the field. These are then air-dried, ground down and sieved to exclude the coarse earth (>2mm) fraction. Readings are made using an AC-coil and susceptibility bridge, with results being expressed either as SI/kg x 10^{-8} or m^3/kg.

Version Date: October 2005

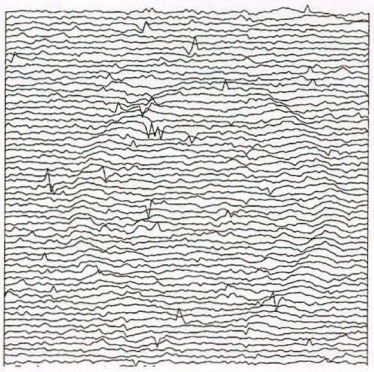
Display Options

The following is a description of the display options used. Unless specifically mentioned in the text, it may be assumed that no filtering or smoothing has been used to enhance the data. For any particular report a limited number of display modes may be used.



(a) Dot Density

In this display minimum and maximum cut-off levels are chosen. Any value that is below the minimum will appear white, whilst any value above the maximum will be black. Values that lie between these two cut-off levels are depicted with a specified number of dots depending on their relative position between the two levels. Assessing a lower than normal reading involves the use of an inverse plot that reverses the minimum and maximum values, resulting in the lower values being presented by more dots. In either representation, each reading is allocated a unique area dependent on its position on the survey grid, within which numbers of dots are randomly placed. The main limitation of this display method is that multiple plots have to be produced in order to view the whole range of the data. It is also difficult to gauge the true strength of any anomaly without looking at the raw data values. However, this display is favoured for producing plans of sites, where positioning of the anomalies and features is important.



(b) XY Plot

This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane. The output may be either colour or black and white.

(c) Greyscale

This format divides a given range of readings into a set number of classes. These classes have a predefined arrangement of dots or shade of grey, the intensity increasing with value. This gives an appearance of a toned or grey-scale. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. While colour plots can look impressive and can be used to highlight certain anomalies, greyscales tend to be more informative.

Terms commonly used in the graphical interpretation of gradiometer data

Ditch / Pit
This category is used only when other evidence is available that supports a clear archaeological interpretation e.g. cropmarks or excavation.

Archaeology
This term is used when the form, nature and pattern of the response is clearly or very probably archaeological but where no supporting evidence exists. These anomalies, whilst considered anthropogenic, could be of any age. If a more precise archaeological interpretation is possible then it will be indicated in the accompanying text.

? Archaeology
The interpretation of such anomalies is often tentative, with the anomalies exhibiting either weak signal strength or forming incomplete archaeological patterns. They may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.

Areas of Increased Magnetic Response
These responses show no visual indications on the ground surface and are considered to have some archaeological potential.

Industrial
Strong magnetic anomalies, that due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.

Natural
These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions e.g. palaeochannels or magnetic gravels.

? Natural
These are anomalies that are likely to be natural in origin i.e geological or pedological.

Ridge and Furrow
These are regular and broad linear anomalies that are presumed to be the result of ancient cultivation. In some cases the response may be the result of modern activity.

Ploughing Trend
These are isolated or grouped linear responses. They are normally narrow and are presumed modern when aligned to current field boundaries or following present ploughing.

Trend
This is usually an ill-defined, weak, isolated or obscured linear anomaly of unknown cause or date.

Areas of Magnetic Disturbance
These responses are commonly found in places where modern ferrous or fired materials are present e.g. brick rubble. They are presumed to be modern.

Ferrous Response
This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes or above ground features such as fencelines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.

NB This is by no means an exhaustive list and other categories may be used as necesssary.

List of Figures

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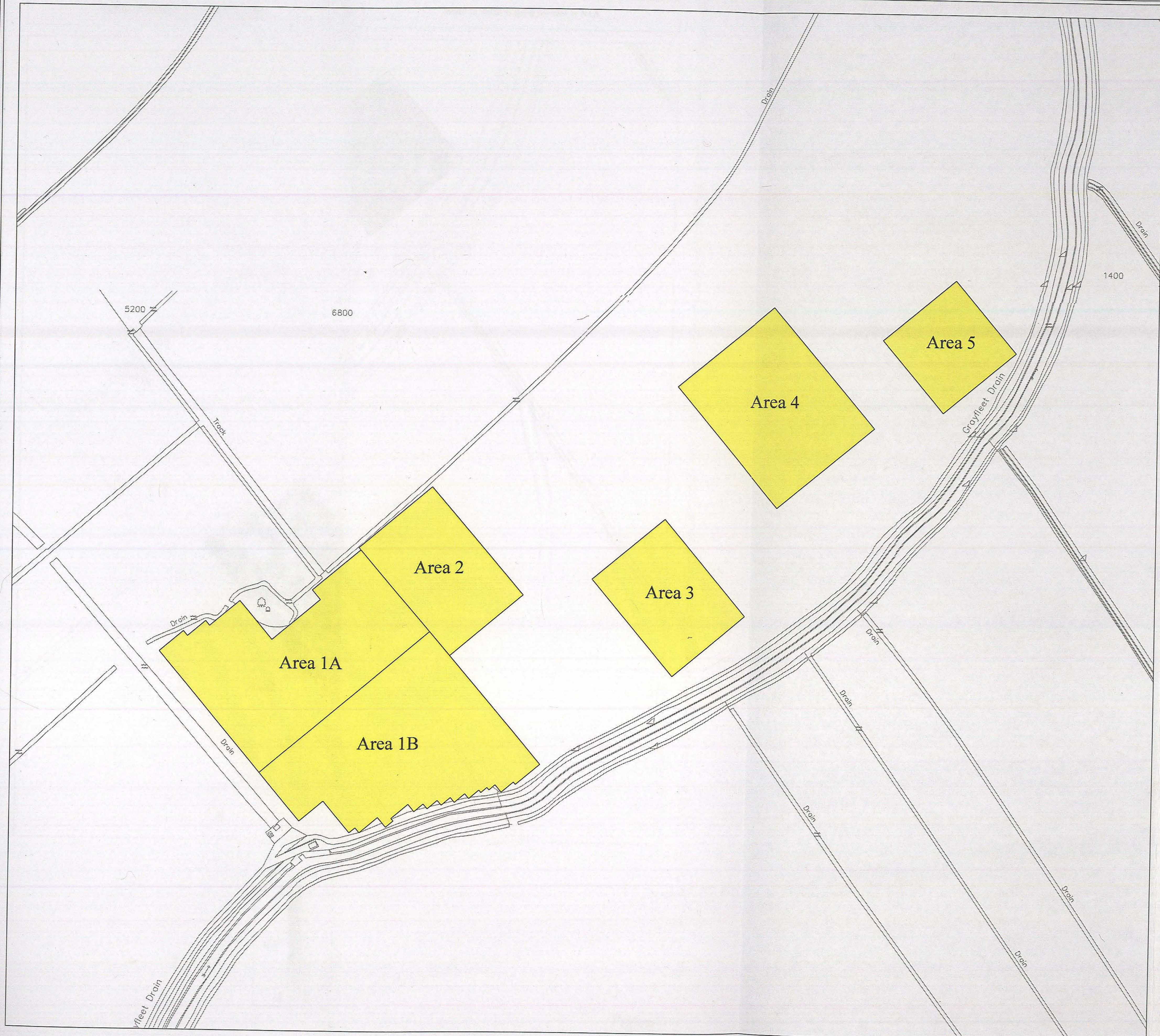
PROJECT: 2005/78 GRAYFLEET EAST

TITLE: Location Diagram

Based on digital mapping provided by NAA



Gradiometer Survey

0 metres 100

Figure 1

GSB PROSPECTION Ltd.	PROJECT: 2005/78 GRAYFLEET EAST	TITLE: Summary Greyscales	Based on digital mapping provided by NAA

Figure 2

GSB PROSPECTION Ltd.	PROJECT: 2005/78 GRAYFLEET EAST	TITLE: Summary Interpretation	Based on digital mapping provided by NAA

Archaeology (positive / negative anomaly)

?Archaeology (positive / negative anomaly)

Area of Increased Magnetic Response

Trend

Former Field Boundary

?Natural (positive / negative anomaly)

Drain

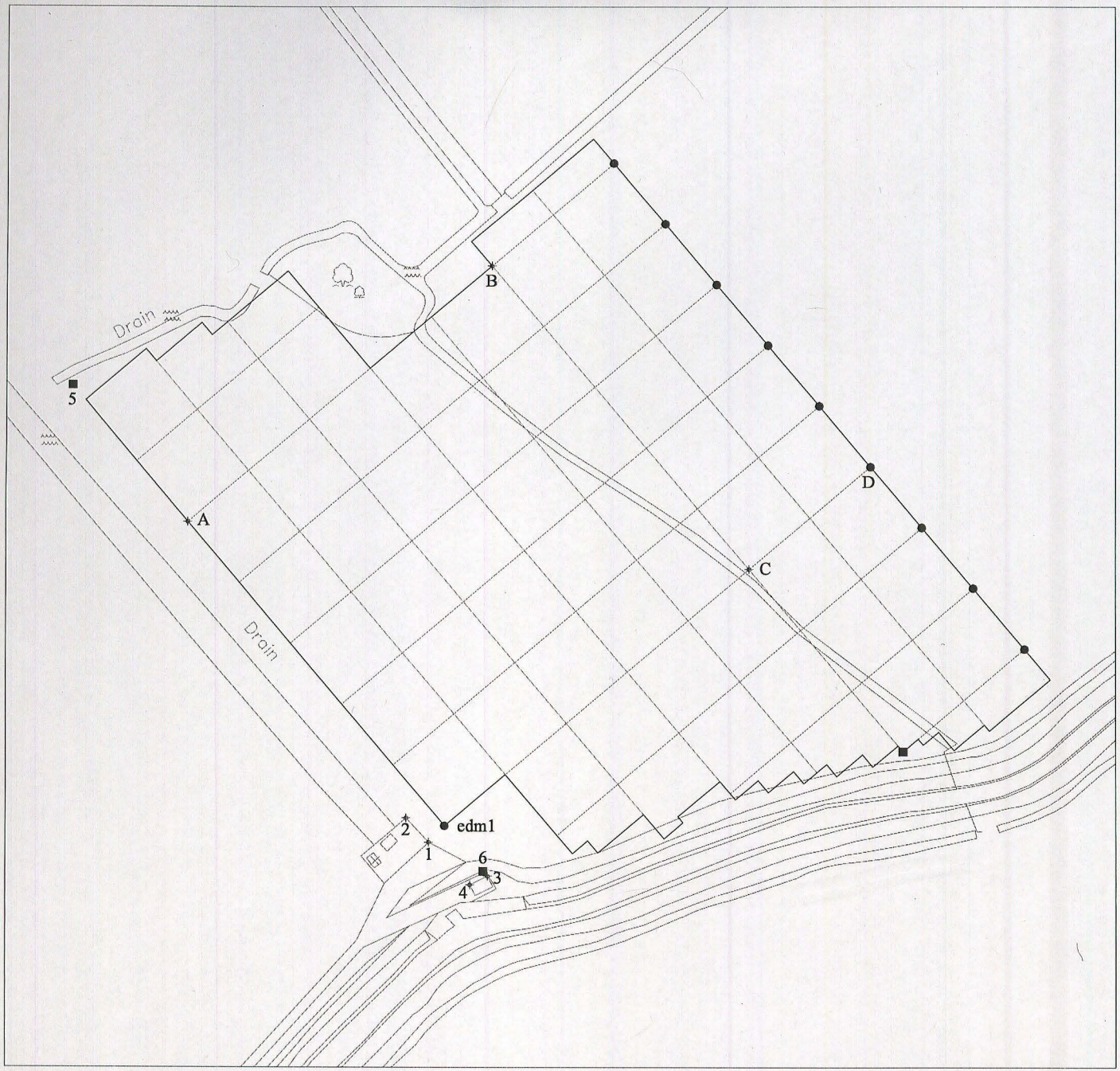
Ploughing

Magnetic Disturbance

Ferrous

0 metres 80

Figure 3



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PROJECT: 2005/78 GRAYFLEET EAST

TITLE: Tie-in Information: Area 1

Based on digital mapping provided by NAA

EDM 1 – cane/peg left in situ. Hz0 on the SW corner of the compound

Point	Angle	Distance	Notes
1	0	5.760	Corner of Compound
2	58.882	10.138	Corner of Compound
3	275.447	16.634	Building Corner
4	292.827	16.163	Building Corner
5	95.800	144.985	Stake
6	275.800	15.026	Stake
A	95.800	100	Grid Point
B	140.800	141.414	Grid Point
C	185.800	100	Grid Point
D	185.800	140	Grid Point

■ Stakes left *in situ*

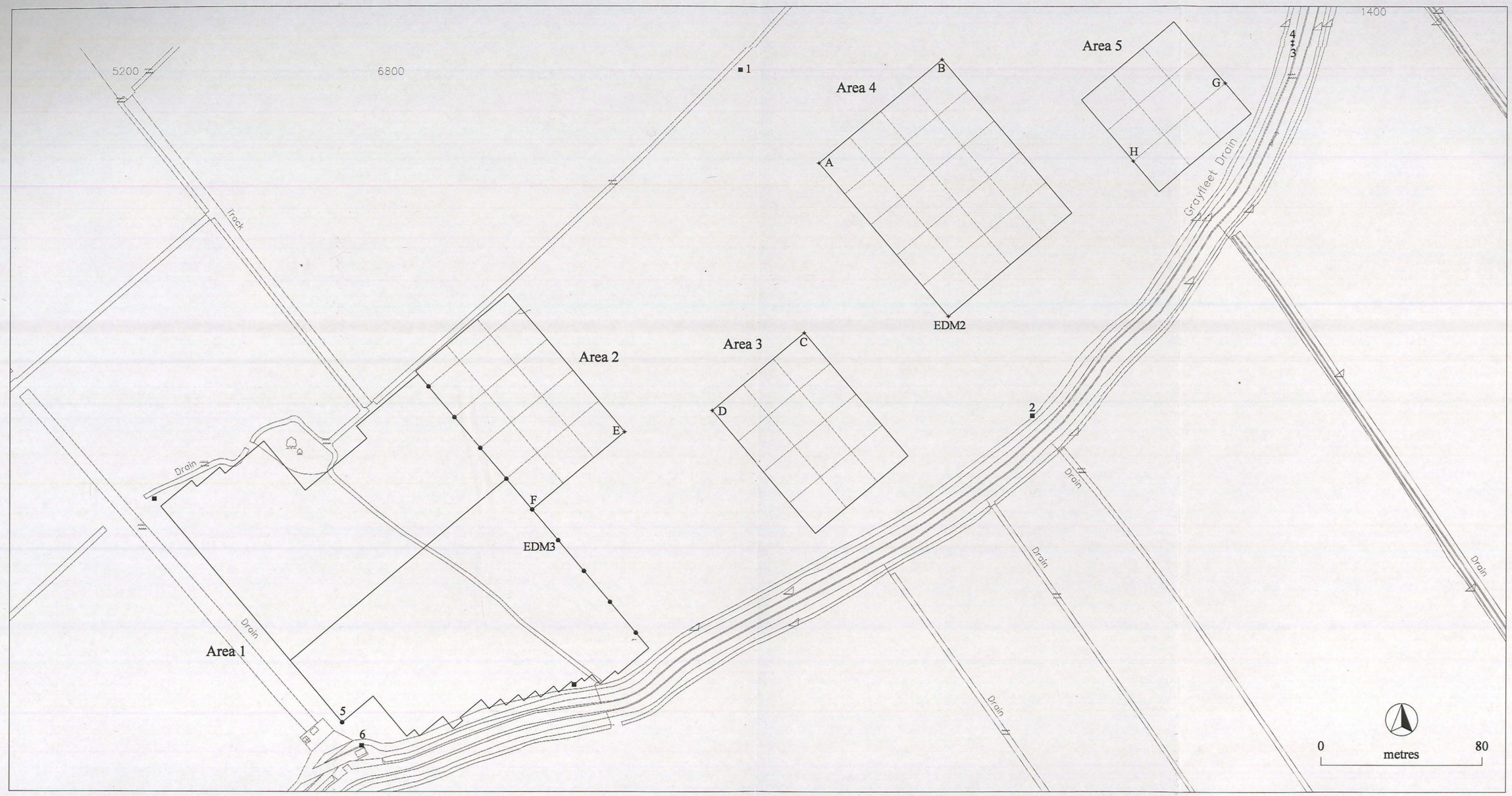
● Pegs left *in situ* (cane at edm point)

⌖ EDM Tie-in Point

0 60

metres

Figure T1



EDM 2 – Peg left in situ.

Point	Angle	Distance	Notes
1	00.0000	160.774	SW Stake
2	180.0010	64.468	SE Stake
3	91.847	218.010	Strut of bridge gateway
4	91.478	219.070	Southern Bottom corner of bridge gate
A	00.0000	99.959	Grid corner - Area 4
B	38.7175	128.007	Grid corner - Area 4
C	303.627	71.980	Grid corner - Area 3
D	288.390	126.395	Grid corner - Area 3
E	290.655	171.093	Grid corner - Area 2
F	285.245	227.963	Grid corner - Area 2
G	89.998	180.046	Grid point - Area 5
H	90.006	120.017	Grid point - Area 5

EDM 3 – Peg left in situ

Point	Angle	Distance	Notes
1	151.2660	250.887	SW Stake
2	205.4810	243.391	SE Stake
3	186.1685	440.253	Strut of bridge gateway
4	185.9700	441.286	Southern Bottom corner of bridge gate
5	0.0000	140.135	EDM 1 (cane)
6	353.8910	140.956	Stake from original survey
A	164.7775	227.924	Grid corner - Area 4
B	168.7585	305.908	Grid corner - Area 4
C	180.0975	160.024	Grid corner - Area 3
D	180.0975	99.982	Grid corner - Area 3
E	161.2505	63.191	Grid corner - Area 2
F	89.9925	19.929	Grid corner - Area 2
G	185.7470	401.940	Grid point - Area 5
H	186.7460	342.288	Grid point - Area 5

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PROJECT: 2005/78 GRAYFLEET EAST

TITLE: Tie-in Information: Areas 2 to 5

Based on digital mapping provided by NAA

Figure T2