

Chapter 12

Geophysical Survey

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INTRODUCTION

A range of geophysical methodologies has been applied at Yarnton and of these, magnetic survey has proved to be most fruitful with approximately 29 ha of the project area covered with this technique. As discussed in the preceding volume (Linford forthcoming) interpretation of geophysical results within a period based volume is often complicated by the palimpsest of multi-phase anomalies that must, individually, be identified and separated during the discussion. This is certainly the case with the current volume, although the interpretation presented here has greatly benefited from comparison with the excavation results that has informed the identification of Iron Age and Roman activity within the geophysical survey data.

BACKGROUND

Despite the application of a range of geophysical techniques, including magnetic, earth resistance and GPR survey, initial results from the Yarnton project area proved disappointing. This was, perhaps, unsurprising given the acknowledged difficulties presented by the alluvial conditions thought to dominate much of the site (Clark 1992). However, perseverance with mainly magnetic survey techniques was eventually rewarded at Cresswell Field where a wealth of geophysical anomalies, related to mainly Iron Age and Roman settlement activity at the site, were revealed (Linford 1995).

The success of this latter survey reinvigorated the campaign of geophysical survey to investigate how the substantial variation in the quality of results might be explained, particularly the influence of local geology and the phase of archaeological settlement under scrutiny. Whilst not all of the geophysical surveys have proved as successful as Cresswell Field, anomalies related to a continuum of activity from the mid-Neolithic to the post-medieval have been recorded and proved by excavation throughout the study area. Indeed, geological variation appears to be far more crucial when determining the quality of expected geophysical survey results and this is very much reflected by the profundity of successful surveys conducted on the Second Gravel Terrace sites, above the alluviated flood plain (see below).

The influence of geology and soils

The project area lies over a substrate of Oxford Clay and Kellaways Beds that outcrop between deposits of glacial river gravels and more recent alluvium (Institute of Geological Sciences 1972; Fig. 12.1). Throughout this region the gravels are arranged in a series of terraces along the sides of the river valleys of which, following the classification by Sandford (1924), the floodplain deposits and Second (Summertown-Radley) Terrace occur within the project area. Due to the lateral movement of the Thames southward down the dip-slope of the

underlying Jurassic strata, the Summertown-Radley Terrace covers a large, gently sloping surface to the north of the current river course (Richardson *et al.*, 1946, 118-9). As a result, the boundary between the Summertown-Radley and floodplain gravel is often indistinct, although in the Yarnton-Cassington area it would appear to follow the 60 m OD contour (Fig. 12.1).

The floodplain gravel terrace is cut by a number of buried channels that, in part, are visible during periods of wet weather as linear depressions in which water collects. Alluvium extends gradually from these channels, tending to form lake-like expanses rather than following the course of the channels, with the floodplain gravel deposits occurring as slightly raised islands.

A variety of soils are found over the project area (Soil Survey of England and Wales 1983) but are mainly clayey soils belonging to the Thames and Kelmscot Associations with finer loamy soils of the Badsey 1 Association developed over the floodplain river alluvium affected by groundwater and seasonal waterlogging. Soils of the Badsey Sutton Series are found over the Second Gravel Terrace deposits surrounding the village of Cassington.

Despite the generally low magnetic susceptibility of both the terrace gravels and the underlying clay, results from a number of topsoil susceptibility surveys over the Second Gravel Terrace demonstrate that, under suitable conditions, sufficient iron minerals are available for significant magnetic enhancement to occur. Much lower susceptibilities have been recorded from the soils developed over the floodplain and it is likely that the seasonally waterlogged nature of these soils has led to considerable gleying of constituent iron minerals.

As noted in the previous volume (Linford forthcoming) a far greater impediment to magnetic survey has been the wide scatter of ferrous detritus found principally upon the floodplain. This would appear to emanate from a combination of highly magnetic ballast used for track bedding of the former railway line crossing the site and ferrous material derived from a commercial composting facility. Fortunately, the density of this ferrous detritus was not too great to adversely effect the quality of detailed recorded survey over the project area, but did hamper the use of unrecorded scanning to locate potential areas of archaeological activity.

METHODOLOGY

The majority of geophysical results discussed in the current chapter were magnetic surveys conducted with Geoscan FM36 fluxgate gradiometers. These instruments are ideally suited to recording the variation in the vertical component of the Earth's magnetic field due to the presence of magnetically enhanced, near-surface features. Unless stated otherwise, data for the fluxgate gradiometer surveys were conducted over 30 m grid squares utilising a sample interval of 0.25 m along north-south orientated traverses separated by 1m east-west.

Geophysical survey on the floodplain presented more particular problems due to the expectation of weak magnetic anomalies generated by more deeply buried target features sealed by alluvial overburden. Under such conditions more highly sensitive, non-differential magnetometers should improve the identification of subtle anomalies, particularly if the data is recorded at a high sample density. Suitable instrumentation was not readily available within the UK during the programme of field work at Yarnton, but a limited number of sites were surveyed in conjunction with Dr. Jörg Faßbinder, Bayerisches Landesamt für Denkmalpflege, München, Germany, as part of a wider research project examining the

applicability of high-resolution magnetometry to a variety of English sites (Cole *et al.*, 1999). The high-resolution surveys were conducted with a pair of Scintrex CS-2 optically-pumped caesium vapour magnetometers collecting total magnetic field measurements from parallel sondes separated by 0.5 m (Becker 1995). All high-resolution data were collected at an enhanced sample interval of 0.25 m by 0.5 m, with comparative fluxgate surveys conducted over the same areas at an identical sample interval.

In addition, topsoil magnetic susceptibility values were determined from either recovered soil samples or *in situ* measurements made with a contact field coil. All measurements were made with a Bartington MS2 susceptibility meter with a MS2B dual frequency, 10 cc laboratory coil or MS2D 20 cm diameter field coil. Laboratory measurements were made at two frequencies (470Hz and 4700Hz) on fresh samples subsequently air-dried to determine the dry mass used for the calculation of mass specific magnetic susceptibility (Thompson and Oldfield 1986). It was hoped that the susceptibility data would assist with the interpretation of the detailed magnetometer results, particularly in areas containing weakly magnetic topsoil.

RESULTS

Processed geophysical survey results from the individual sites are presented as linear greytone images at an appropriate scale for each data set. The statistical distribution of data values for each plot is shown as a histogram with a corresponding graphical key detailing the mapping of data values to subsequent shades of grey between extremes of black (low) and white (high). Additional representations of the results, including the analysis of the raw data, are not included but were employed during the interpretation of the data. A graphical summary of significant anomalies is included with each data plot. Figure 12.1 shows the distribution of geophysical survey sites throughout the project area in relation to the approximate divide between the floodplain and the Second Gravel terrace, following the 60 m contour.

Cresswell Field

Prior to excavation a gradiometer survey was conducted over an area of indistinct crop mark evidence occurring on a slight rise within Cresswell Field (Linford 1995). Further gradiometer survey was conducted following the excavation but this data was compromised by the development of the site for gravel working and an increased concentration of ferrous disturbance hampering the identification of subtle magnetic anomalies. The contrast between the two data sets was so great that an additional area of fallow land encompassing part of the original survey area was resurveyed to examine the extent of the ferrous disturbance. This produced almost identical results to the original data set and confirmed that the ferrous litter must have been introduced since this date; possibly as a by-product from the adjacent organic waste processing activity. Fluxgate gradiometer data from all three surveys is shown in Fig. 12.2 together with a graphical summary of significant magnetic anomalies.

Superficial anomalies within the data include the response to both the modern plough pattern (extant at the time of the 1995 survey) and underlying evidence for a system of former ridge and furrow agriculture [CW1] which corroborates the NS orientation of former agricultural patterns determined through aerial photography.

Additional recent disturbance is associated with the telegraph poles crossing the survey area [CW2] to the N and a highly magnetic response [CW3] located within the apparent course of the palaeochannel [CW4]. The intense nature of [CW3] suggests it represents buried ferrous material, possibly abandoned agricultural machinery.

The palaeochannel [CW4] appears to represent a boundary to the multi-period settlement revealed at the site that all anomalies, with exception of the presumed medieval ridge and furrow plough pattern respect. Similar anomalies have been recorded throughout both the project area and at other fluvial sites in association with former river channels although determining the precise cause of the response has often proved elusive (*e.g.* Linford 1994; Cole 1995). Possible explanations for these anomalies include the accumulation of sediment with a high magnetic susceptibility within the channel or the development of a (p)DRM as water borne magnetic minerals settle from suspension and align themselves with the ambient magnetic field (Butler 1992, 66-74).

The proximity of the settlement activity to the most pronounced anomaly associated with the palaeochannel may well account for the local concentration of enhanced magnetic material derived from the occupation into the channel depression. Alternatively, this section of the channel may have offered more suitable, lower energy, conditions for the formation of a (p)DRM. This latter mechanism may explain the intermittent nature of these anomalies through varying turbidity conditions, which appears to effect the stability of the (p)DRM formation process (*cf* Ellis and Brown 1998; Rees 1961). Certainly, geophysical survey results from the floodplain suggest that the magnetic anomalies associated with palaeochannels at this site form along the edges rather than in the more deeply scoured centre of the former channel.

A diffuse magnetic anomaly [CW5] is found to the E of the site where the settlement activity is apparently much reduced. Due to the surrounding topography this anomaly is unlikely to represent a former palaeochannel and no corroborative evidence is found in the AP record. However, it is possible that [CW5] represents a geomorphological feature, possibly a discontinuity between the gravel and underlying clay.

A series of more significant anomalies [CW6-10] represent a number of enclosure ditches and hut circles that, with the exception of [CW6] and [CW7] were all confirmed through subsequent excavation to be of Iron Age date. The largest of these [CW10] appears to form part of a rectangular enclosure continuing beyond the survey area into the course of the Victorian railway. Note the significant magnitude of response (approximately 10nT) arising from the north-eastern section of this [CW10], suggesting the inclusion of highly enhanced material from a semi-industrial process, such as pottery production or metal working (*cf* David and Payne 1993).

A linear ditch-type anomaly [CW11] apparently forms part of a field system or an incomplete enclosure extending to the N where it continues as a more subtle response. Along elements of its course [CW11] appears as a double linear anomaly although it is difficult to determine whether this represents a more significant causative feature, such as the drainage ditches surrounding a former trackway, or a recut of the original ditch system.

Anomaly [CW12] was revealed to be a Roman ditch infilled with later Saxon occupation debris possibly associated with [CW13 and CW14] that were identified as sunken feature buildings of the same period. A further sunken feature building was identified at [CW15]

although this anomaly is confused by the superposition of the response from the adjacent palaeochannel. Due to the distinctive response of the sunken feature buildings the location of further similar features may be tentatively proposed beyond the excavation area at the location of anomalies [CW16-19]. One of these responses [CW18] lies beyond the postulated enclosure ditch [CW11] together with [CW15], which suggests [CW11] predates the Saxon, activity, possibly representing a Roman field boundary.

A further group of diffuse magnetic anomalies [CW21-23] W of the palaeochannel may also be indicative of settlement activity related to a subtle curvi-linear response [CW24]. However, the presence of the diffuse anomaly [CW23] is more suggestive of a geomorphological origin.

Anomaly [CW25] was found to represent a rectangular post-Medieval enclosure abutting an NS field boundary that failed to produce a discernible magnetic response. Again, the palimpsest of superimposed strongly magnetic anomalies both within and surrounding the enclosure, together with the orientation of the field boundary along the same alignment as the ridge and furrow may have obscured the identification of significant anomalies related to this phase of activity.

Topsoil samples were recovered at 30 m intervals along the two orthogonal traverses (Fig. 12.2(A) inset bar graphs). There is little apparent correlation between the values of enhanced topsoil magnetic susceptibility and the concentration of magnetic anomalies revealed by the magnetometer survey. However, the values do appear to fall over areas associated with the palaeochannel to the north and west of the site. Overall, the topsoil susceptibility values are high with respect to those recorded on the floodplain which may well be due to the influence of recent ploughing redistributing occupation enhanced material into the modern plough soil.

Worton Settlement

Further evidence for Iron Age and Roman settlement on the Second Gravel Terrace was found east of Worton Rectory farm, where three separate magnetometer surveys were conducted to elucidate the aerial photographic record from this area (Fig. 12.3). Two of these surveys were investigated during June 1996 as part of an ongoing collaborative research project comparing high sensitivity caesium magnetometer data to the results from more routinely applied fluxgate instrumentation. It was hoped that the application of high sensitivity magnetometers would aid the identification of anomalies from weakly magnetic features such as the Anglo-Saxon timber buildings revealed during excavation at both the Yarnton Saxon site and Cresswell field.

Just such a feature was suspected due east of Worton Rectory farm where aerial photography (Featherstone and Dyer 1994) has located a rectilinear anomaly with similar dimensions to the other timber buildings surrounded by an extensive palimpsest of additional cropmarks. An initial fluxgate gradiometer survey in the vicinity of the rectangular cropmark (Site B) successfully located a corroborative magnetic anomaly, although the quality of the data was impaired by the over-grown nature of the site (Fig. 12.3). The landowner kindly agreed to remove this vegetation and also allowed an additional survey to be conducted over more open ground to the north used as horse paddocks (Site A) whilst the clearance work was in progress. This latter area also contains an extensive pattern of cropmarks.

Site A

The results from this area (Figs 12.3 and 12.4) are dominated by a 20 m wide band of intense disturbance running approximately E-W through the SE corner of the survey [W1]. Analysis of a stacked XY traceplot representation of this data suggests that this disturbance is caused by a quantity of near-surface ferrous material that may possibly represent a recent rubbish dump. However, no evidence of surface disturbance was observed in the paddock during the survey and no cropmark anomaly is discernible in aerial photographs taken in 1968. This would suggest that the disturbance is relatively recent.

Additional linear anomalies within this area correspond to the pattern of cropmarks recorded by the 1968 aerial photograph (AP) and include a curvilinear portion of the distinctive circular cropmark [W2] of possible Iron Age date which is, unfortunately, affected by the band of disturbance [W1]. A portion of the double linear anomaly [W3] is also visible south of [W1] although the change in orientation evident in the AP data is masked by this latter disturbance. A distribution of discrete positive anomalies are also found to correlate with a number of sub-rectangular cropmark patterns identified from the AP. Whilst the smaller of these may represent a scatter of pits the magnitude of response demonstrated by several of the anomalies [W4-9] is reminiscent of results recorded over sunken feature buildings at Barrow Hills, Radley (Bartlett forthcoming). A discontinuous series of linear ditches [W10] may form a larger enclosure that is only partially described within the limited survey area. Whilst [W10] has been identified from the geophysical data as a possible Iron Age or Roman enclosure these anomalies may well relate to later activity associated with the Saxon settlement of the site and the interpretation must remain highly tentative.

Site B

The initial survey of this site (Fig. 12.3) covered a 60 m × 60 m area prior to the removal of the vegetation and readings were collected at a standard sample resolution of 0.25 m × 1.0 m. The results of this survey have been severely curtailed by the much denser population of thistles to the north of the area which required the magnetometer to be elevated above the height of the vegetation, attenuating the magnetic response of the data to the north. However, despite these constraints the survey has successfully located a number of significant anomalies including [W10] that appears to be half of the rectilinear cropmark identified in the aerial photographs.

Once the precise location of the cropmark had been established on the ground a more detailed survey was conducted over a 40 m × 40 m area from which the vegetation had been cleared. This latter area was surveyed with both a fluxgate gradiometer and a high sensitivity Scintrex CS-2 caesium magnetometer at an identical sample interval of 0.25 m × 0.5 m. Results from the two detailed surveys are shown in Fig. 12.4 and demonstrate a broad agreement between the two instrument types with the outline of the Saxon building appearing as a rectangular anomaly [W11] in both data sets. The outline of the ditch in the high-resolution data suggests a less continuous response with some correlation between discrete magnetic pit-type anomalies and the location of excavated timber-pits.

The building also contains an additional pit-type response [W12] and a linear ditch-type anomaly [W13] that enters from the SE corner of the survey and appears to alter direction as it exits to the N. Subsequent excavation revealed that [W12] corresponds to the location of a large pit, post-dating the construction of the timber building and [W13] to the course of a Roman field boundary ditch, not associated with the later Saxon activity.

A diffuse area of magnetic disturbance [W14] appears on both plots producing a greater magnitude of response in the total field data and is related to an earlier sunken feature building cut by the timber building. Two pit-type anomalies [W15] to the south are prominent in both the detailed data shown in Fig. 12.4 and in the initial data shown in Fig. 12.3 and are likely to contain a highly enhanced magnetic fill. Further activity is evident to the south of the survey and the faint outline of a second rectangular anomaly [W16] may be tentatively proposed. This latter anomaly coincides with a presumably Roman ditch-type response [W17] running parallel to [W13], which is replicated in the AP evidence. Additional cropmark anomalies correlate with indistinct magnetic responses [W18] and [W19] in the south of the survey area.

Anomalies [W20], [W21] and [W22] all demonstrate a strong response particularly evident within the total field data. Whilst these anomalies may well represent a series of pits an interpretation as further sunken feature buildings cannot be entirely discounted.

Worton 1992

During March 1992 a 60 m × 60 m trial fluxgate gradiometer survey was conducted over the agricultural land to the south of Worton 1996 Site B to assess the geophysical response of project area (Fig.12.5). Although this area has never been tested through excavation the survey reveals a palimpsest of strong magnetic anomalies which replicate the fine detail evident in the cropmark data (Fig.12.3). A circular anomaly [W23] is adjacent to a series of pit type responses [W24] that correlate with the position of an apparent enclosure within the cropmark data. Two sides of a larger enclosure [W25] are found to the west where they adjoin a number of linear anomalies [W26] forming a large rectangular enclosure revealed by the cropmark data beyond the limit of the geophysical survey.

A third enclosure evident in the cropmark data to the north correlates with anomaly [W27]. Both the data sets show a large sub-circular anomaly within the enclosure that the magnetic data resolves into a pit-type anomaly surrounded by a more diffuse magnetic response [W28]. Whilst there is no excavation data available to confirm the origin of these anomalies, the morphology of the apparent enclosures [W23], [W25] and [W27] revealed by this survey are reminiscent of Iron Age settlement activity and may be cautiously interpreted as such.

Four topsoil samples were recovered from the centre of each 30 m survey square for the laboratory determination of magnetic susceptibility. Figure 12.5 (inset) shows the variation of magnetic susceptibility and the considerable enhancement that has occurred within the square containing [W23], suggesting more intense occupation activity within this area.

Geophysical evidence for Iron Age and Roman activity on the Floodplain

There is a marked contrast between the results from magnetic survey over the floodplain and those sites investigated on the Second Gravel Terrace. In general, the magnitude of magnetic response is far lower over the floodplain resulting in a much reduced density of recorded anomalies. Curiously, only Neolithic and Bronze Age features on the floodplain appear to have retained a sufficient magnetic contrast from the surrounding subsoil to be detectable as positive magnetic anomalies. Later occupation, whilst certainly present, has failed to produce a consistent geophysical response despite the often obvious magnetic contrast between such features and subsoil revealed during excavation.

Site 5

The only geophysical evidence for Iron Age or Roman activity to be revealed during fluxgate magnetometer survey over the floodplain appeared in the vicinity of a Neolithic enclosure, subsequently excavated as Site 5. Sections of this enclosure ditch were first discovered during the invasive 2% trial trenching evaluation and subsequent magnetic survey (Fig. 12.6) of this area revealed a rectilinear anomaly [NE1] truncated by the modern field boundary to the east. Interpretation of the data from this site is hampered by the extremely weak magnetic response of the feature and the plethora of ferrous detritus incorporated into the topsoil from the organic waste processing site. Thus, it is impossible to discern whether discontinuities along the course of [NE1] represent entrances into the enclosure or a variation in the magnetic response.

Few significant anomalies have been identified within the enclosure other than a group of pit type responses [NE2] obscured by more recent ferrous litter. A tentative linear anomaly [NE3] is found just beyond the enclosure to the north running parallel to the course of the enclosure ditch that may, possibly, represent a recut of this feature. Activity beyond the enclosure is limited to a scatter of possible pit-type anomalies to the north ([NE4] and [NE5]) and S ([NE6] and [NE7]). However, no morphological identity is suggested by these groups and it seems equally likely that these anomalies may relate to less significant geomorphological or tree-throw features.

The single, Roman feature located through geophysical survey was, ironically, found during an earlier attempt to locate the Neolithic enclosure following the trial trenching evaluation. This initial survey was erroneously positioned to the north of the Neolithic enclosure but revealed a negative linear anomaly [NE8] that correlates with the location of an alluvium filled, Roman field boundary ditch.

Magnetic susceptibility survey of the Site 5 excavation surface

The magnetic response of the archaeological features was further investigated through a magnetic susceptibility survey conducted over the topsoil stripped excavation surface. The survey, shown in Fig. 12.7, was conducted with a Randall susceptibility meter at a 0.5 m × 0.5 m sample interval (Challands 1995).

Due to extremely dry weather conditions difficulty was encountered with evenly removing topsoil from the site and some areas of enhanced A/B horizon soils remained producing enhanced readings in the magnetic susceptibility survey ([MS1], [MS2]). However, in general the excavation surface was successfully stripped back to the natural sand and gravel. This latter substrate has extremely low susceptibility in contrast to the fill of the Neolithic enclosure ditch that has produced the highest readings recorded in the survey area. The magnetic enhancement appears to be concentrated in the NW part of the ditch, possibly suggesting a focus of activity within the enclosure. The ditch terminals found at the apparent entrance to the enclosure [MS3] also demonstrate an enhanced susceptibility as does the remains of a pit-feature [MS4] cut into the southern course of the ditch. The magnetic response of other cut features is more variable with little obvious correlation between their location and areas of enhanced susceptibility.

An N-S orientated section of Roman ditch [MS5] was detected with a low susceptibility cut fill into an area of magnetically enhanced, possibly burnt, sand and gravel. Unfortunately, the magnetic susceptibility survey does not extend to overlap with the original fluxgate magnetometer survey that revealed the negative anomaly [NE8] related to the course of the

NS Roman field boundary. However, it seems reasonable from the low susceptibility of [MS5] to suggest that this may represent a continuation of [NE8] to the S.

Magnetic susceptibility survey of the Site 4 excavation surface

Figure 12.8(B) shows results from a similar magnetic susceptibility survey conducted over the location of a Bronze Age ring ditch identified in the Site 4 stripped excavation surface. Unfortunately, the initial fluxgate gradiometer survey did not extend over the majority of this site. However, as the gradiometer survey failed to produce any significant magnetic anomalies related to underlying archaeology, it seems unlikely that the ring ditch would have produced an identifiable response. This may, in part, be explained by the very low values of topsoil magnetic susceptibility recorded over the area covered by the fluxgate gradiometer survey (Fig. 12.8(A)).

The magnetic susceptibility survey conducted over the excavation surface did, however, reveal a degree of magnetic enhancement associated with the archaeological features in comparison to the sand and gravel substrate. The Bronze Age ring ditch is clearly defined and also contains a number of pits and tree throw features. A single linear Roman ditch cuts through the ring ditch and this too exhibits a slightly enhanced magnetic susceptibility ($\kappa = \sim 10$ to 20×10^{-5}) and clearly identifies the majority of the features identified during excavation.

Geophysical survey of the Site 21 excavation surface

This site, located on the edge of a palaeochannel, revealed the remains of a late Bronze Age / early Iron Age gravel causeway. Again, no indication of this feature appeared within the initial fluxgate gradiometer of the site conducted prior to the excavation. However, both fluxgate gradiometer and magnetic susceptibility survey (Challands 1998) conducted over the stripped excavation surface successfully recorded an anomaly due to the gravel causeway (Fig.12.9).

The fluxgate data (Fig. 12.9(A)) reveals a number of anomalies that were not evident in the surface survey including responses associated with a gravel causeway and a modern ceramic field drain running NS across the length of the site (marked *GC-GC'* and *FD-FD'* respectively on Fig. 12.9(A)). Comparison of this data with the susceptibility results (Fig.12.9(B)) suggests that many of the magnetometer anomalies are produced by the remanent magnetisation of the features rather than an induced magnetisation arising from the susceptibility of the sediments. For example, neither the field drain nor the alluvium along the course of the palaeochannel produce a distinct susceptibility contrast in Fig. 12.9(B), however, both are easily discernible in the fluxgate data (Fig. 12.9(A)). The magnetic response of the gravel causeway is of interest as it would appear to be either constructed from a higher susceptibility material than the channel deposits or have had magnetically enhanced topsoil compacted along its course during use. Furthermore, both surveys provide evidence for a second, slightly weaker, linear anomaly to the west of the excavated gravel causeway, suggesting a previous alignment of the crossing.

DISCUSSION

Geophysical survey throughout the Yarnton project area has, undoubtedly, been influenced by the gradual environmental change to floodplain conditions on the lower lying ground. This change appears to be particularly acute during the Iron Age / Roman transition that may well explain the high degree of variability within the geophysical survey results. For example, Roman field boundary ditches have been revealed through excavation to form an extensive

agricultural landscape over both the higher ground and the floodplain. The physical dimensions and depth of overburden is also largely similar for many of these features, yet it is only on the Second Gravel Terrace that these have produced an identifiable magnetic anomalies.

In part, this may reflect a shift in the density of permanent settlement to the higher ground as the floodplain develops. By the Roman period use of the floodplain may well have become seasonal, with the focus of settlement activity located on the Second Gravel Terrace on dry land immune from winter flooding. As concentrated settlement activity is associated with a local increase in the magnetic susceptibility of the topsoil, the identification of cut features through magnetic survey, where such enhanced material accumulates, will often diminish at a distance from the focus of occupation (e.g. Cole *et al.*, 1995, fig. 1).

In this case neither geophysical survey nor aerial photography has identified the expected centre of Roman activity around a building complex, such as a farmstead villa. This is, perhaps, unsurprising given the varying success of both methodologies over the project area. It is also arguable that, from a geophysical perspective, the remains of a Roman building would be more readily detectable through earth resistance rather than the wide area magnetic survey that was deployed (David 1995). However, earth resistance survey was deemed to be impractical within such an extensive project area and also proved ineffective during trials conducted over a number of the floodplain sites.

Geophysical results from the floodplain suggest an additional constraint on the location of anomalies related to Iron Age and Roman activity. In general, geophysical survey is hampered over floodplains due to the increased depth of alluvial overburden and the leaching of magnetic iron minerals from waterlogged archaeological features. Curiously, neither process seems to be overbearing on the Yarnton floodplain. The alluvial overburden, recorded during topsoil stripping prior to gravel extraction, was found to be quite variable and only reached an excessive depth in isolated “lakes” to the south of the project area. The majority of the archaeological activity, however, was focused on raised gravel terraces within the floodplain and these areas were covered by a minimal overburden.

In addition, magnetic survey over the floodplain did successfully detect anomalies related to a number of prehistoric features including a possible Neolithic enclosure, a Bronze Age barrow and the remains of burnt tree throw bowls. Given that these features would have been established before the transition to a floodplain, in theory, they should also have been subjected to the most prolonged leaching of iron minerals during the subsequent waterlogged conditions. The survival of these magnetically enhanced prehistoric features suggests a more complex magnetisation process, particularly in the period following the onset of floodplain conditions.

This is partly illustrated through the geophysical results from Site 5 where a single Roman ditch was detected as a “negative” magnetic anomaly with respect to the response of the weakly magnetic sand and gravel substrate. The subsequent magnetic susceptibility survey over the stripped excavation surface confirmed the very low susceptibility of the alluvium filling this cut feature. It would appear that rapid alluviation during this period may well account for the absence of other similar cut features within the geophysical survey data, instantly erasing the magnetic finger print that might otherwise survive within the archaeological record.

Not all of the Iron Age and Roman features on the floodplain failed to develop an enhanced magnetisation. Both the linear Roman ditch in Site 4 and the possible Iron Age gravel causeway found in Site 21 exhibit a higher magnetic susceptibility than the surrounding sand and gravel substrate. However, this enhanced magnetisation was only proved during geophysical survey over the stripped excavation surface when the features themselves were all clearly visible. It is possible that such weakly magnetic archaeological features would still be detectable through surface geophysical survey, providing suitable high sensitivity instrumentation was available. Comparative magnetic surveys, conducted within the project area between fluxgate gradiometers and a high sensitivity caesium magnetometer, produced encouraging results, although the limited availability of the high sensitivity instrumentation precluded a thorough test of this equipment over the floodplain sites.

In conclusion, a degree of caution must be urged when interpreting the Iron Age and Roman landscape from the geophysical survey results at Yarnton alone. The strong magnetic response to this phase of activity over the Second Gravel Terrace sites confirms the high fidelity that may often be expected from geophysical data to complement the available aerial photographic record in this area. However, the more variable magnetic response exhibited over the floodplain restricts the interpretation of the geophysical data set. Indeed, the apparent absence of fluxgate gradiometer anomalies associated with Iron Age or Roman activity over the floodplain fails to accurately reflect the archaeological record established through subsequent excavation. Currently, the complex processes of magnetisation on the floodplain are not fully understood and it is hoped that further research into the magnetic properties of excavated features may enlighten this position. This research, together with the deployment of more highly sensitive geophysical instrumentation, may well extend the application and interpretation of magnetic survey results over similar floodplain environments.