PART II: THE SILCHESTER MAPPING PROJECT

CHAPTER 4

METHODOLOGY

INTEGRATION

The philosophy at the heart of the Silchester Mapping Project was the integration of datasets; it was never simply intended to be just another large-scale geophysical survey. Geophysical surveys provide a great foundation for understanding a site, but they are only a starting point, especially on complex multi-period sites. To be interpreted ideally they require triangulation with other data: with historic maps to chart now ploughed-out field-boundaries; with historical aerial photographs to see the remains of glasshouses and temporary agricultural buildings that never made it onto maps; with cropmark evidence to see how features which are difficult to see on certain subsoils using geophysics actually continue; with geological maps to see what large pits were potentially quarrying down into; and most importantly, with archaeological material culture from excavations, evaluations and fieldwalking to date features and attempt to add a chronological dimension to the palimpsest of features.

The following sections relay the data sources and also their problems and limitations. All were integrated as layers within Adobe Illustrator where much of the digitisation was done and exported into ArcGIS. The final section shows how information was integrated and selected for the Atlas (Chs 5–6).

The core study area comprised *c.* 700 ha around the town. It contains the walled town on the edge of the gravel plateau, rolling down to the Silchester Brook in the east, the West End Brook in the north, along the plateau ridge and Silchester Common to the west and following the road to Winchester and the linear earthworks south a little way. All such areas are ultimately arbitrary, and there are significant features which are brought into the discussion in all directions off the map. Major linear earthworks radiate out from the town, while to the north-west outside the core area is the Grim's Bank.

CARTOGRAPHY

The base map for the plans came from the Ordnance Survey services of Landline Data for the GIS and OS Digimap Carto for the illustrations. Both services have now been replaced in the ever-changing world of cartography. Printed Historic maps were examined from the University of Reading Map Library and also online through Digimap Ancient Roam (Table 4.1).

There are some curiosities in the above sources. Some details of excavations later than the edition of the maps were incorporated onto some versions; for example, the first two seasons of work by the Antiquaries in 1890–1 are dotted on to what otherwise appears to be the 1877 1:2500 map, suggesting some updating of OS editions took place as the seasons progressed.

LiDAR data were acquired from the Environment Agency Geomatics group. However, because their interest in fine topographic data relates to flood-risk analysis, the top of gravel plateaus was not their primary concern, so the coverage is not 100 per cent complete and is

TABLE 4.1. MAP SOURCES CONSULTED

1804	Stratfield Mortimer Enclosure map
1841	Silchester Enclosure map
1872	OS County Map of Hampshire 1:2500
1877	OS County Map of Berkshire 1:2500
1877	OS County Map of Berkshire 1:10560
1877	OS County Map of Hampshire 1:10560
1896	OS County Map of Hampshire (first revision)
1899	OS County Map of Berkshire (first revision)
1900	1:10560 first revision Maps of Berkshire and Hampshire
1913	1:10560 second revision Maps of Berkshire and Hampshire
1969	OS 1:2500
2008	OS Landline Data (for GIS) and OS Digimap Carto (for the Atlas)

relatively low resolution (1 m in some areas, 2 m in others); but it has enabled observations to be made of earthworks under the woodland.

DIGITISING THE ANTIQUARIES' EXCAVATIONS

The digitisation of the Society of Antiquaries' plans was taken from the season-by-season individual insula plans published in *Archaeologia*. The originals, from which the publisher's plates were created, still exist in the Society of Antiquaries' archives on large rolls of cartridge paper. Various different colourwashes were used to tint different walls, and these translated into various shades of grey in the published plans, though there appears to be no great consistency as to what these different shades actually represented; more often than not phasing, but this was not always clear. There was no additional information to be drawn from the archive drawings other than the observation that fine pencil marks showed a grid, which suggests how the plan was transferred across from the original site drawings (now lost).

The plans give the impression of professionalism, clarity and hence accuracy, which is correct, up to a point. Where individual buildings have been compared to the geophysical plan there has usually been a near-perfect match, and any deficiencies usually related to the blurriness of the geophysical survey data rather than the Victorian plan. However, when an insula as a whole was superimposed on the survey plan it was noted that not all the buildings were in quite the right position; some were out by a few metres. It would appear as if the Victorian methodology involved planning each individual house, and then errors occurred as the individual building plans were pasted together to form a composite to create an insula plan which was in turn converted into a plate for *Archaeologia*. This could have been suspected from the 'Great Plan', as examined closely, each individual building was hand-drawn and then glued on to Hodge's enlarged map. So, the 'Great Plan' provides a great overall impression, but absolute positional accuracy was variable to a small degree. The scale of the inaccuracies at their worst can be seen by placing side by side the plans from two different seasons of Insulae XXIIa and XXIIb (St John Hope and Fox 1900, pl. 8; St John Hope 1902, pl. 32). Here House XXII.4 crossed both blocks, but if those two are superimposed then sections of the Town Wall bordering the northern side of the blocks misalign by 6.5 m.

In coming to the interpretative plan here, the buildings have all been adjusted in a fashion that will be described in the final section of this chapter, so that in as far as we can tell they are in their correct position.

LOCATING PAST EXCAVATIONS

Linking the worlds of antiquarian sketches, Victorian military planning, National Ordnance Survey mapping and modern GPS augmentation is always going to involve compromises.

The Ordnance Survey plans until the early twenty-first century had a certain degree of latitude, especially in rural areas; their internal surveying manual (the 'Red Book') tolerated errors of up to 1 per cent on scales up to 200 m. Much archaeological cartography in the twentieth century involved re-drawing these maps by hand using Grant projectors to enlarge and reduce, introducing yet more errors. It was, therefore, perhaps not particularly surprising that while some excavations could be located with ease, others required certain approximations to be made, particularly in the case of Cotton's excavations in LP 6472 and 6667, and especially Boon's Trench H near the South Gate in LP 0001, where conflicting locational measurements were published (Cotton 1947; Boon 1969). Many other more recent excavation plans had similar issues but to a much lesser degree.

Some of the past excavations are known about, but unlocated. The Antiquaries dug a number of sections through the defences, particularly in their final 1909 season. Alas, no overall plan was published of where these were, though a few could be established from measurements published. A search in the Antiquaries' archives was fruitless as in 1993 the maps and plans from the Society's archives had all been transferred to RCHME (now the Historic England Archive in Swindon). The Antiquaries' 25″ OS maps of Silchester relating to the excavations had been misarchived there as part of the 'Hugh Braun Collection' (showing the location of medieval castles) but once re-discovered were seen to have on them faint pencil marks of the location of some, but not all, of the trenches cutting through the Outer Earthworks. Many of these excavations, such as those of the pottery kilns somewhere to the north of the town, remain a mystery. Where only the approximate position of a trench is known it has been shown in the Atlas in a different colour.

The plans of the earlier excavations by Stair (FIG. 3.2), Joyce, Munro and Langshaw (FIG. 3.7) have not been repeated within the Atlas, to minimise confusion. Often the Antiquaries reused Joyce, Munro and Langshaw's plans as those of the latter had been drawn by Henry Hodge who was to become their surveyor.

DIGITISING PAST SURVEYS

VERTICAL AERIAL IMAGES

Vertical aerial coverage was investigated and the following flights were scanned and included into the GIS. Between 1961 and 1986 the main changes in the landscape were the incremental growth of Silchester village and also the addition and removal of agricultural buildings. Three areas had long ranges of sheds, probably for poultry, up until they were removed in the late 1960s or early 70s. The remains of some show up in the geophysical survey data. One set of verticals from the summer of 1976 in the run-up to the drought provided excellent parchmarks.

1961 (covering up to the South Gate)
1966 (covering the whole study area)
1969 (covering the whole study area)
1976 (covering the whole study area showing exceptional parchmarks)
1981 (covering the whole study area)
1986 (covering down to Church Lane Farm)

OBLIQUE AERIAL IMAGES OF CROPMARKS AND PARCHMARKS

The aerial photographic interpretations have largely been adapted from the National Mapping Programme (NMP). This itself was largely based on the RCHME work published as Bewley and Fulford (1996). Some additions have been made to it, including several cropmarks transcribed by Corney to the south-east of the town near Church Lane Farm (Corney 1984).

Cropmark transcriptions can be of variable accuracy depending on the method used, the variability in topography, and the number of field-boundaries and other fixed points visible in the oblique photographs. When the NMP transcription was compared to the geophysical survey, it was noticed these features could occasionally be 5–10 m out, which is not unexpected, though on a couple of occasions in very large fields they were 25 m out. Where it was clear an aerial photographic feature related to specific geophysical ones, they have now been moved to correspond, with the geophysical survey being presumed to have greater locational precision.

Some of the cropmarks have also been removed from the printed images in the Atlas. This has happened where the cropmarks clearly related to recently removed field-boundaries which still appear on enclosure and OS maps. In their place the full original field-boundaries have been shown with the 'last known date on a map' indicated by the feature to give an indication when the feature was removed.

FIELDWALKING

Corney's maps of his ceramic scatters have been digitised as approximate spreads to indicate their general location (Corney 1984). These have been shown within the Atlas. The distribution plots from the University of Reading Student Projects Survey are less detailed so have not been reproduced (Ford and Hopkins 2011), but a comparison of the two datasets is provided in the commentary for each field, so the data can be compared with other information.

GEOLOGICAL MAPS

Data have been incorporated from both the British Geological Survey's solid and drift geological maps, their Soil Survey. This has a clear relevance for appreciating both the tail-off of geophysical features over the more clayey soils off the plateau top, and also in interpreting the large pit-like features to the south-west along the stream-bed which correlate with local clay deposits (see p. 417).

HISTORIC ENVIRONMENT RECORDS

The Historic Environment Records for the area were downloaded. These covered parts of Berkshire and Hampshire. The two systems differed, but both were integrated and incorporated into the GIS.

THE NEW GEOPHYSICAL CAMPAIGNS

TECHNIQUES

Archaeological geophysics provides a range of techniques that could be used (Gater and Gaffney 2003). Large-scale coverage was envisaged, which in 2005 meant that fluxgate gradiometry was the obvious technique to use. Some trials were undertaken with the equipment available at the time, and the relatively new Bartington Grad 601-2 was selected. 38 ha were surveyed by hand within the wall and 180 ha outside (FIG. 4.1).

While fluxgate gradiometry is the standard workhorse of archaeological geophysics, it is by no means perfect, and it was important to assess how much information was being lost by not using other techniques. Over the years we developed a test-bed area between the Forum and Insula IX (FIG. 4.2). We compared different gradiometry equipment: Geoscan Research FM256, Bartington Grad 601-2 and Foerster gradiometry system (Fry 2007); and colleagues from English Heritage came to experiment with a caesium magnetometer system and new forms of ground penetrating radar (GPR: Linford *et al.* 2010). Some experimental gamma-ray survey work has also taken place by Defence Science and Technology Laboratories, Nuvia and ourselves. We also conducted earth resistance survey in a few locations, using both the twin probe Geoscan RM15, and the mobile sensor platform MSP40. The most obvious features that were consistently missed by the fluxgate gradiometry but were picked up by resistivity were the Roman roads. Magnetic techniques consistently failed to show the hard-packed gravels against a natural gravel background, and a known limitation of the gradiometer technique is that it often struggles to detect flat laminar structures. The roads were only visible close to the town because

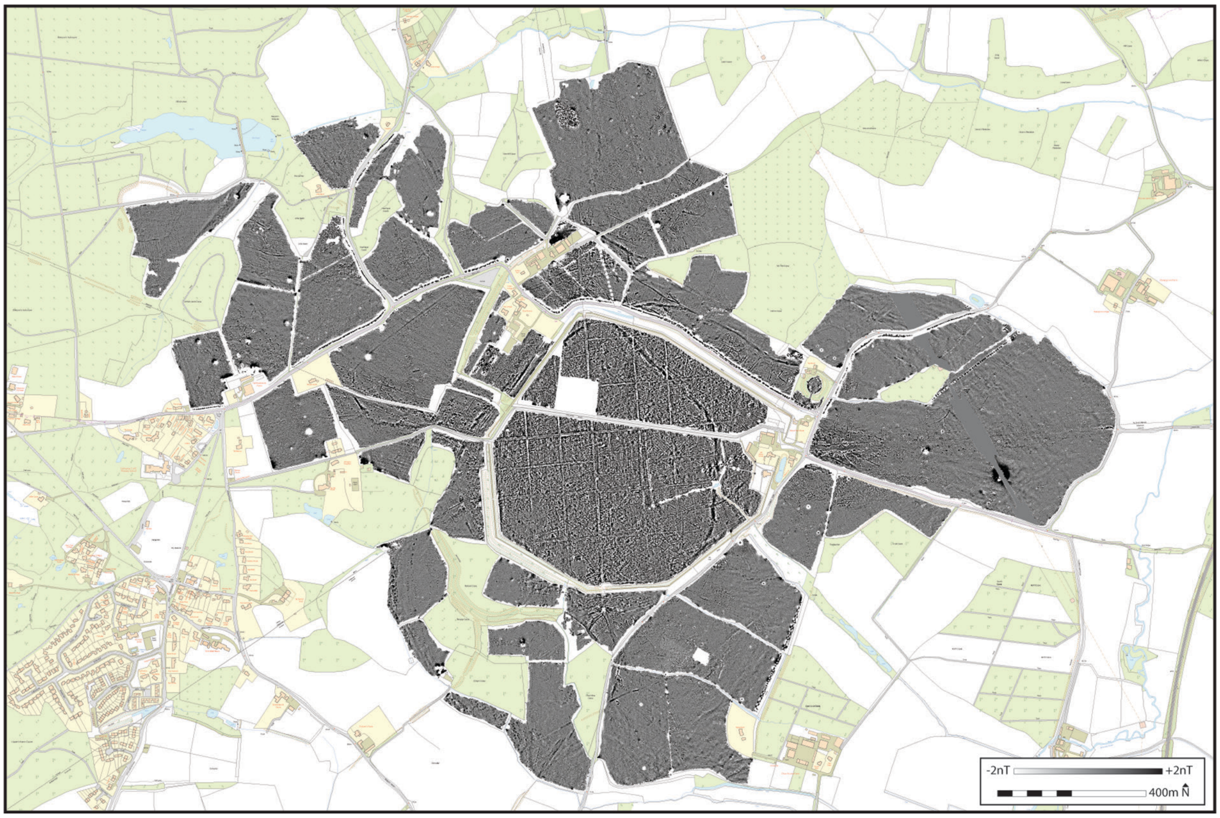

FIG. 4.1. The extent of the fluxgate gradiometry survey in and around Silchester.

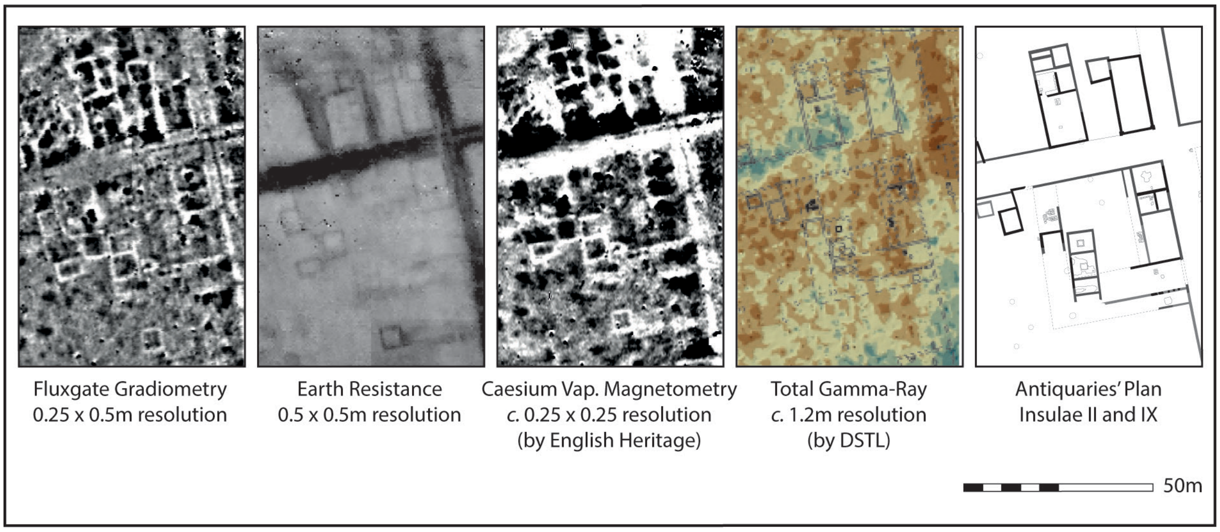

FIG. 4.2. Comparative techniques 1, from left to right: fluxgate gradiometry; earth resistance; caesium vapour magnetometry (by English Heritage); total gamma-ray (by DSTL); and from the Antiquaries' excavation (Insulae II and IX).

of the visibility of the ditches on either side of them providing a magnetic contrast. Finally Rob Fry conducted some electrical resistance tomography (ERT) and GPR traverses across a number of the ditches and earthworks to try to reveal their structure (Fry 2010).

Comparison of the fluxgate gradiometer with the caesium magnetometer showed that while the

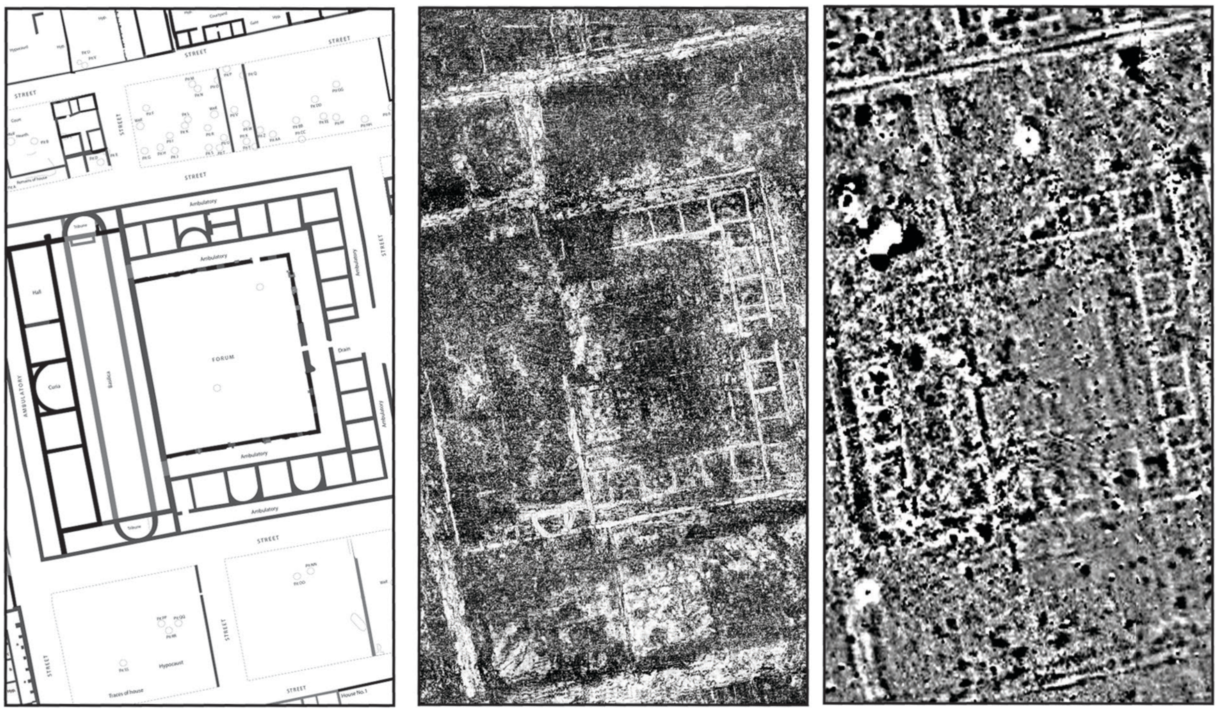

FIG. 4.3. Comparative techniques 2 – The Forum area: Antiquaries' plan (left); ground penetrating radar (middle); fluxgate gradiometry (right).

latter was more sensitive, the difference was marginal on this geology (for a deeper comparison see Linford *et al.* 2007) — the soil and geology being predominantly fine loamy soils over the gravel plateau, though sands and clays on the plateau slopes.

Later in the survey programme the opportunity arose to see some medium-scale GPR conducted by English Heritage (Linford *et al.* 2010). Again, while there is absolutely no doubt about the level of detail provided by GPR, the images show that for general coverage the gradiometry still compared against it very well (FIG. 4.3).

Fluxgate gradiometry was therefore the technique of choice for our broad coverage. Past work had shown that standard resolution work was not revealing plans even remotely comparable to Hodge's plan, so a high resolution survey was planned. Our benchmarks were the 1994–7 Wroxeter survey which had used 1.0 x 0.25 m (Gaffney and Gaffney 2000, 83), the 2001 English Heritage survey within Silchester which had done the same (Martin 2000), and the contemporary 2006–7 Caistor St Edmund Survey at 1.0 x *c.* 0.1 m (Bescoby *et al.* 2009, 289). We chose to reduce the transect width so that all of the interior, and the exterior in known 'high-intensity areas' from Corney's fieldwalking, was surveyed at a high resolution (0.5 x 0.25 m) while other peripheral areas were surveyed at a relatively standard resolution (1.0 x 0.25 m), in this case prioritising coverage over spatial resolution.

In selected locations we carried out follow-up work, including small areas of resistivity to try to understand what linear magnetic anomalies represented. In addition, Rob Fry conducted some Electrical Resistance Tomography and GPR transects across sections of the line of some of the defences to try to characterise the profiles of some of the in-filled ditches (Fry 2010).

FIELDSURVEY PRACTICALITIES

The interior was surveyed in 2006 as a teaching project, and in the case of the small enclosure adjacent to the church as a student dissertation in 2007 (Saffrey 2008). The exterior was surveyed in 2008–9 by Rob Fry with the assistance of three student placements: Lee Calderbank, Nick Crabb and Alice James. The survey around the Amphitheatre was also used as the basis for a dissertation (Crabb 2009). While there was some arable, much was now under pasture, and supported a wide range of livestock, from the more expected cattle and sheep, to ponies and shire horses, and even the more exotic lamas and alpacas.

POSITIONING

The survey was undertaken as Differential Global Positioning Systems (DGPS) were becoming more common, so while the majority of grids were laid out using DGPS, others were set out by EDM or tape and measured in to field-boundaries. It might be imagined that the advent of DGPS would mean that all our surveys could be located accurately, and that is true up to a point. However, the precision of DGPS on a global projection does not always match well with the not-quite-so-precise OS maps. Grid corners were occasionally found on the wrong side of a fence-line when imported into ArcGIS. In practice, therefore, many of the surveys were positioned using measurements to field-boundaries; so while there will be relative-positioning accuracy from the data within fields, there may be errors of up to a couple of metres in actual positioning relative to the general accuracy of OS maps.

GRADIOMETRY DATA PROCESSING

All the data were processed in a consistent manner using Geoscan's Geoplot v3. (1) Zero-mean traverse with a threshold of ±5 nT (increased to ±10 nT in some noisy fields). (2) Destaggering so that slight walking/handling issues could be eliminated from the data. The degree and consistency of stagger varied inversely to the experience of the operator, so some of the interior walked by students new to surveying required significant adjustments, and where the errors could not be alleviated in processing the grids were re-surveyed. (3) The data were interpolated from 0.5 x 0.25 m to 0.25 x 0.25 m. No smoothing or low-pass filters were used.

Within the Atlas the Interior sheets have been shown on a greyscale of ±7 nT; while the Exterior sheets have been shown at ±2 nT. The level of magnetic activity was so much stronger within the walls than outside, so that plotting them at the same contrast setting would never show both at their best.

Generally the data collection outside the Town Walls, obtained by a small team, was better than that in the interior, collected by a large number of students gaining experience.

PRELIMINARY INTERPRETATION: DIGITISATION

In order to turn these data into information the preliminary interpretation had to be undertaken. The challenges of doing this have been noted by other large surveys, such as the Wroxeter Hinterland Project (WHP). Quality assurance in terms of consistency is a real issue if different people are interpreting the same fuzzy images. Indeed it is also a problem when the same person is interpreting them at different stages of weariness. So, similar to the WHP, a series of criteria was drawn up for each type of feature. A variety of greyscale images were created for each plot so that it was easier to detect features of different magnitudes. Images were produced to aid interpretation on absolute linear greyscales of ±2, 7, 10 nT.

These were then exported into Adobe Illustrator, within which new layers were created for each feature type. These were then used for the maps within this volume; however, they were also then exported as DXF files into ArcGIS.

SECONDARY INTERPRETATION: COMBINATION AND ADJUSTMENTS

The approach to interpreting the geophysics taken here is at variance with many surveys, and quite deliberately so. As with many geophysical surveys it would have been possible to draw some sketchy lines around fuzzy buildings and create yet another image of the town, though one perhaps less aesthetically pleasing than the crisp clear Indian ink lines of Hodge's Great Plan or the Royal Commission's interpretation of the aerial photographic evidence.

TABLE 4.2. DESCRIPTION OF FLUXGATE GRADIOMETRY FEATURE CLASSES

Feature class	Description
Spikes	These are small localised highly magnetic responses in the dataset which give off strong adjacent positive and negative readings (dipoles). They usually denote metallic remains which can be ancient or modern, but can also represent other highly magnetised features such as hearths or furnaces. They are identified off a ±10 nT greyscale image highlighting readings over 10 nT as black, less than -10 nT as white and all others as a uniform grey.
Feature / Pit	The term 'pit' is potentially problematic as these responses could easily also mark the location of wells, cesspits, areas of light disturbance, or just patches of slightly magnetic anomalies in the ground. The 'pits' have also been subdivided into three categories which can help identify their use further and make it clearer which pits have a higher magnetic response due to the nature of their contents.
Pits >10 nT	Circular or irregular positive anomalies. Identified off a black and white image showing features above 10 nT and below -10 nT.
Pits >7 nT	Circular or irregular positive anomalies. Identified off a ±7 nT greyscale image.
Pits >2 nT	Circular or irregular positive anomalies. Identified off a ±2 nT greyscale image.
Modern disturbance	Areas with lots of dipolar spikes characterised by large magnetic variance.
Linear feature (positive)	Similar to pits, but elongated and with positive (black) values.
Linear feature (negative)	Similar to pits, but elongated and with negative (white) values.
Road drains	Linear features running axially down the supposed location of roadways (which do not show as and of themselves).
Victorian trenches	Linear features within the town that are often running diagonally across an insula in parallel lines.
Field drains	Linear features outside the Town Walls that run in parallel lines down the line of slope.
Modern features	Known modern interference, usually recent field-boundaries.
Noise	Noisy areas outside the Town Walls, potentially indicative of buildings (ancient or modern), though no clear outline can be discerned.
Walls	(Interior only) straight linear features, usually negative, usually adding detail to an existing known building from the Antiquaries' plans or aerial photography.
Possible buildings	(Exterior only) small areas showing rectilinear alignments, usually showing as negative features.
Interpretative additions	
Roads	Roads do not show up directly, but indirectly due to the lack of other feature classes encroaching on them, or because of the visibility of road-side ditches. There is therefore an element of judgement. They could be ascertained by use of resistance surveys, but this only took place in a small number of locations.
Cemetery area	Clusters of lowly-magnetic elongated pits which look as if they have a similar orientation suggestive of an inhumation cemetery.

The purpose of this Atlas is to integrate datasets. One of the best of these at Silchester is that of the Antiquaries' detailed building plans. It was possible to compare directly these plans with the geophysical results. On the majority of occasions the buildings would be very clear, and the match would be near-perfect. Other times the majority of walls would show in the geophysics, but there might also be a bit of noise, so the match was good. Occasionally the building was there

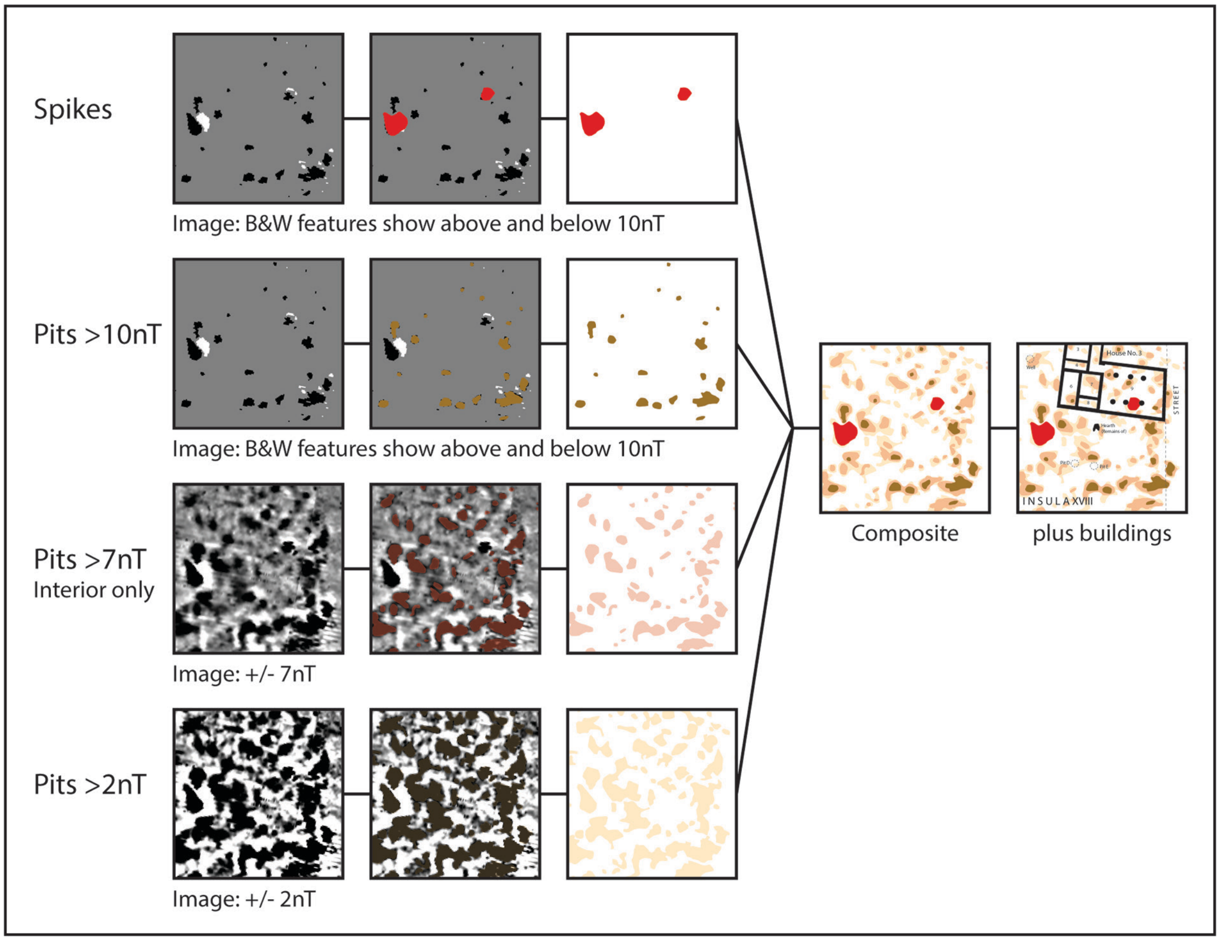

FIG. 4.4. Methodology 1: pits and spikes.

in the image, but only very faintly. There can be many reasons for these differences: perhaps the walls were under a much greater overburden of topsoil or sediment; perhaps the walls were made of a different material, had been robbed away or had been removed by the excavators? Only very occasionally was there an Antiquaries' plan where the corresponding geophysical image struggled to make a clear match, though even in those cases there were a few hints and common features to confirm the old house plan was not pure invention (FIG. 4.5).

Given the apparent reliability of the Antiquaries' house plans, it seemed sensible to use the best quality evidence as a basis for the interpretative plan, so the procedure has been to take the digitised plan, and to adjust its location so that it was precisely on top of its geophysical impression. The 'reproduced' plans of the Antiquaries' excavations in the Atlas of the Interior therefore show the houses in their slightly revised positions. When the houses had been digitised and superimposed over the geophysical survey data, it was clear that the survey was still managing to reveal a number of additional walls that the Antiquaries had not uncovered. These were then added to the plan.

Another source of evidence that we have are the digitised aerial photographs from the RCHME/NMP survey. The aerial photography interpreters had to make judgements about what were and were not real features. Most clearly related to features found by the Antiquaries, but a few did not. Sometimes new buildings, such as a rectangular structure on the north edge of the current excavations in Insula IX, proved to be so elusive upon excavation that they probably never existed at all. Another building was accidentally transcribed twice from different photographs: the 'Temple of Mars' in Insula XXXV (one image showed a simple square building which was transcribed to be in exactly the right place for the temple; a second better image, however,

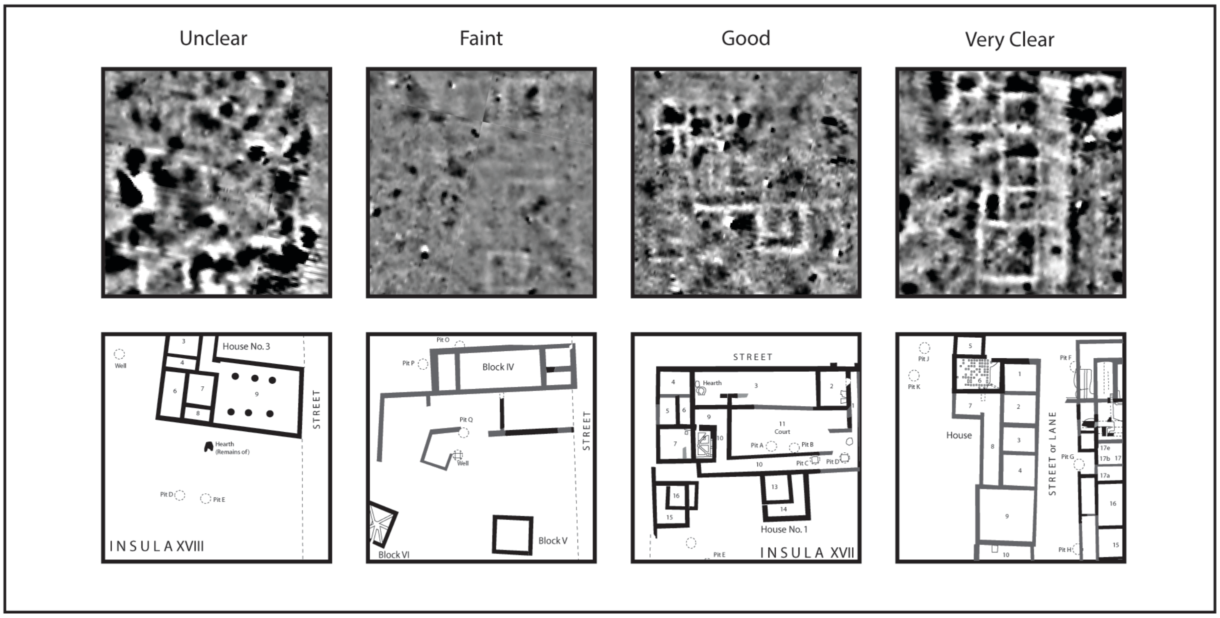

FIG. 4.5. Methodology 2: the visibility of houses in the fluxgate gradiometry data (greyscale ±7 nT).

showed the porch to the east, and recognised the slightly misaligned angle to the grid, but this duplicate was transcribed just a little to the north-east of its other apparition). Interpretations are fallible, but are the essence of archaeology. So, in a similar fashion to the combination of Hodge's plan and the geophysical survey, the aerial photographic plan was also superimposed over the combined interpretation to note additional features which had not already been noticed (FIG. 4.6).

The final plan, therefore, is a composite of geophysical pits, linear anomalies, Victorian building plans and other sources of evidence.

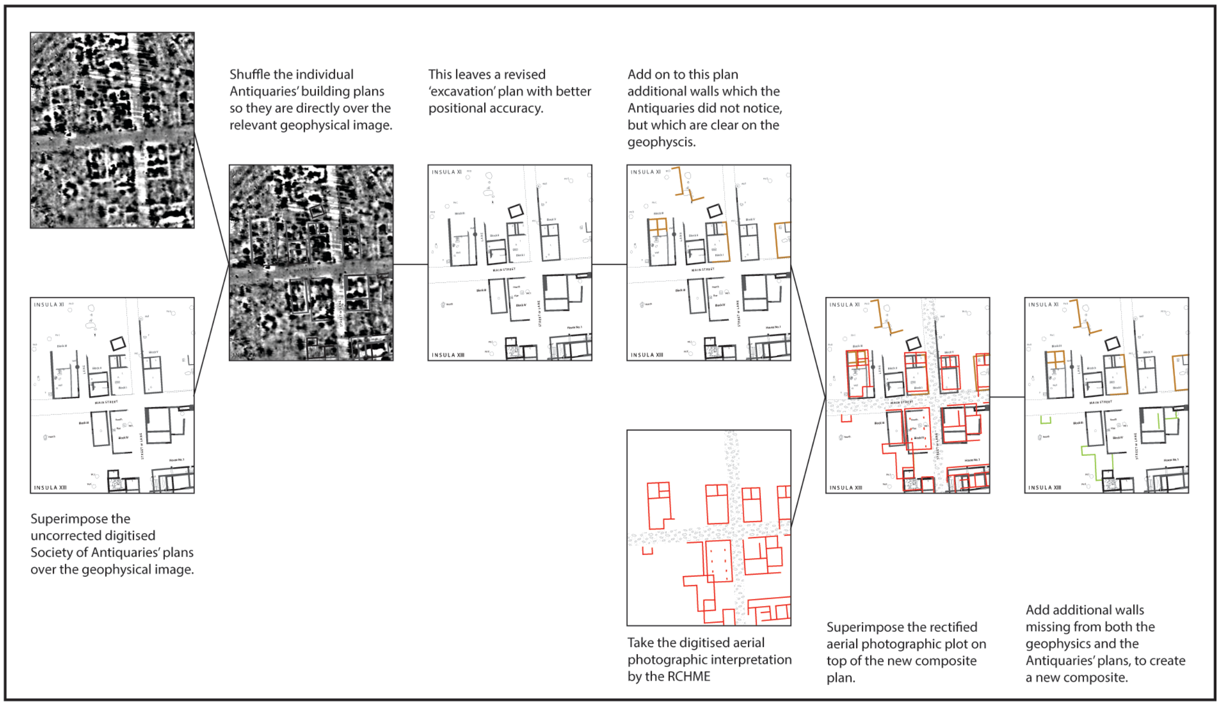

FIG. 4.6. Methodology 3: the positioning and combination of evidence for houses.

It is worth ending on a note of caution. These plans will still fail to show certain types of features. FIG. 5.18 compares the number of features found in the modern excavation of Insula IX to the features found by the Antiquaries. Since the gradiometry data only added a small number of walls and buildings on the overall interior plan to those noted by the Antiquaries, it is likely that the gradiometry too has missed a significant number of timber buildings. The geophysical data look as if they show pits and wells fairly well, and some areas of noise will be building areas, but the overall plan will be as deficient as the Great Plan was in not showing the presence of early timber buildings.

CREATING THE ATLAS

The Atlas contains multiple images of the varying datasets for each area, and a text which relates the interventions that have taken place within each area and the core evidence. Grid References have been removed from the images to hinder marginally any inappropriate subsequent metal-detecting at the site of certain features. The maps of the exterior are all aligned on National Grid North, while the maps of the interior are all aligned on the Roman street-grid, which is 4.1 degrees off National Grid North.