

# **GSB**

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**PROSPECTION Ltd**

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## **GEOPHYSICAL SURVEY REPORT 2007/45**

### **Antonine Wall Phase III Glasgow Bridge to Westermains**



**Client:**



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*Specialising in Shallow and Archaeological Prospection*

**GSB Survey No. 2007/45**

**Antonine Wall Phase III: Glasgow Bridge to Westermains**

<b>NGR</b>	NS 63600 73100 (west) to NS 64300 73500 (east)
<b>Location</b>	Approximately 1.5 km west of Kirkintilloch in two fields immediately south of the A803 Kirkintilloch Road.
<b>District / Parish</b>	East Dunbartonshire / no parish data available
<b>Topography</b>	Varied: central high ridge, sloping down towards north and the eastern and western ends
<b>Current land-use</b>	Arable; under young crop at time of survey
<b>Soils</b>	Brown forest soils with gleying (SSS, 1982).
<b>Geology</b>	Drifts derived from Carboniferous sandstones, shale and limestones
<b>Archaeology</b>	Antonine Wall, Military Way, fortlet, possible associated features
<b>Survey Methods</b>	Magnetic (fluxgate gradiometry) and resistance.

**Aims**

To identify and accurately locate the Antonine Wall, any traces of the Military Way and the fortlet at Glasgow Bridge. To identify any other features which might be associated with the fortlet or the Wall. In particular it was hoped that a large scale magnetic survey across an uninterrupted stretch might prove useful in assessing whether towers/turrets were present along the line of the Rampart. The work forms part of a continuing programme of research commissioned by **Historic Scotland**, as part of their proposal to promote the Antonine Wall to World Heritage Status.

**Summary of Results\***

The Antonine Ditch has been clearly detected by both survey techniques; the magnetic response is generally uniform across the site while the resistance anomalies vary, depending on localised natural factors. Evidence for the Rampart is more tentative and intermittent, though at their most coherent, the magnetic responses suggest a partially intact base constructed of highly magnetic cobbles. The Military Way remains elusive; though a few faint trends have been identified which might represent the line of the road, natural and modern agricultural factors make this interpretation highly inconclusive. The ditches of the fortlet appear in both datasets but no obvious internal features have been detected. No anomalies that can be obviously attributed to postulated Rampart towers have been identified; the nature of these features makes them very difficult to detect by either technique, thus an absence of geophysical evidence cannot prove or disprove their presence along the Antonine Wall.

**Project Information**

**Project Co-ordinator:** C Stephens  
**Project Assistants:** J Adcock, E Collier, R Green, J Tanner, G Taylor & I Wilkins  
**Date of Fieldwork:** 4th - 8th Feb & 11th - 15th Feb 2008  
**Date of Report:** 23rd May 2008

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

### Survey Specifications

#### Method

For all survey techniques: the survey grid was set out using an EDM and tapes and tied in to the Ordnance Survey (OS) grid using a Trimble differential GPS system; see tie-in diagram included on the Archive CD.

Technique	Traverse Separation	Reading Interval	Instrument	Survey Size
Magnetometer - Scanning (Appendix 1)	-	-	-	-
Magnetometer – Detailed (Appendix 1)	1m	0.25m	Bartington Grad 601-2	9.6ha
Resistance – Twin Probe (Appendix 1)	1m	1m	Geoscan RM15/MPX 0.5m probe separation	2.5ha
Ground Penetrating Radar (GPR) – 250MHz (Appendix 1)	-	-	-	-

#### Data Processing

	Magnetic	Resistance	GPR
Tilt Correct	Y	N	-
De-stagger	Y	N	-
Interpolate	Y	Y	-
Filter	N	Y	-

#### Presentation of Results

Report Figures (Printed & Archive CD): Location, desk based information, data plots and interpretation diagrams on base map (Figures 1-8).

Reference Figures (Archive CD): Data plots for reference and analysis at 1:500 and 1:625. Some areas have been subdivided for display at 1:500 (see List of Figures). Tie-in information (Figure T1).

Plot Formats: See Appendix 1: Technical Information, at end of report.

#### General Considerations

Conditions for data collection were good, the ground being gently undulating, under a young crop and free from obstructions.

The general impact of the geology on both techniques has been detailed in previous reports (GSB 2006/11 and GSB 2006/80). Although the effects are noticeable along certain sections of the survey they have not overly hampered analysis of the results.

During the survey, piles of cobbles were observed lying in rough ground at the field edges. These were tested with the magnetometer and found to be highly magnetic. Such cobbles, scattered in the topsoil are likely to be responsible for a proportion of the small positive and some dipolar anomalies detected throughout the survey area. Although it is not certain that these cobbles were ploughed out from the Wall, it is reasonable to assume the Rampart base was constructed of cobbles/stones with similar magnetic properties.

## Results of Survey

### 1. Background Information (Desk Based)

#### *The Antonine Wall*

- 1.1 The course of the Wall across the two fields is undisputed. The line of the Ditch was relatively easy for MacDonald to trace (1934 pp153-154); sections of this feature were still faintly visible as amorphous hollows to the OS surveyors in 1980 (OS, 1980) and the line is also represented by cropmarks.
- 1.2 No excavated remains of the Wall are present within the current fields. Excavations between Glasgow Bridge and Cadder, roughly 1km west of the current area, uncovered remains of the Ditch and Rampart, the latter only partially preserved as a c.2.8m wide band of cobbles and boulders with no kerb stones recovered. The ground upon which the Rampart was laid had been levelled by a terrace cut into the slope (Dunwell & Coles, 1998 pp461-479).

#### *The Military Way*

- 1.3 No definitive evidence for the Military Way exists within the current survey area. Parallel cropmarks at (A) follow the line of the Wall and lie roughly 48m from it and may, therefore, be significant, though they are spaced some 18m apart.
- 1.4 A second pair of parallel cropmarks is present at (B), aligned with the Wall and roughly 74m to the south. Extending this line westwards would place it just south of the fortlet. However, the cropmarks are only 2.5m apart, they extend from a slight kink in the eastern field boundary and they also follow the line of recent cultivation; they could therefore represent a former boundary feature or more recent agricultural activity such as drainage.

#### *Other Features*

- 1.5 The fortlet at Glasgow Bridge (C), is visible in the AP transcriptions, located in the southwestern corner of the survey area. A Roman camp (D) lies immediately outside the current area of investigation.
- 1.6 Both Hadrians Wall and the Antonine frontier in Germany (the *limes*) had towers/turrets erected along their line at roughly one third of a mile intervals. To date, no evidence for similar features has been uncovered along the Antonine Wall and it is unknown whether any such towers were constructed. If they did exist they are presumed to be roughly 3m square, built of timber, with foundation postholes dug into the Rampart (Breeze 2006 pp86-87).

#### *Previous Geophysics*

- 1.7 Previous geophysical survey was carried out along a 40m wide strip as indicated. The results are fully reported in GSB 2006/80 and can be summarised as follows: the Ditch was clearly located, evidence for the Rampart was tentative and no anomalies obviously relating to the Military Way were identified. In particular, the survey was unable to clarify the origin of cropmarks (B) above.

## 2. Results of Magnetic (Gradiometer) survey

*Labels (Mn) in the text below refer to specific anomalies annotated on the Geophysical Interpretation, Figure 4. The Archaeological Interpretation is given in Figure 5. Although the survey is divided into two areas separated by a field boundary the results are discussed for the dataset as a whole.*

- 2.1 The general nature of the background responses recorded across the site can be roughly divided into three zones (see Figure 4). In Zone 1, situated mostly on lower lying ground, broad, relatively strong, sinuous positive and negative responses predominate. The change coincides in part with a similar variation in the resistance results (see paragraph 3.1 below). While some of the noise in the vicinity of known archaeology may have a human origin, the overall impression is that of natural variations, suggesting a change in the underlying geology/soils. The central portion of the survey (Zone 2) occupies higher ground sloping gently down to the west and more steeply to the north. The levels of background fluctuation here are comparatively low, but with a high incidence of small scale discrete positive anomalies (only a selection of these are digitised on the interpretation). This suggests a generally uniform geology/subsoil with spreads of cobbles and other magnetic debris in the topsoil. The western limits of Zone 3 are defined by anomalies (M1) which may represent a natural outcrop. East of this the data are generally magnetically quiet; very few discrete small scale positive anomalies are present but several weak sinuous anomalies and trends have been recorded that share the same broad orientation. These "washed out" responses suggest an area of alluvial deposits possibly crossed by former water channels. The topography in this zone is flat to the west sloping down to the east and north.
- 2.2 Before discussing the responses of likely and possible archaeological interest, one further natural feature is worthy of mention. Towards the western end of the survey, well defined positive and negative linears (M2) and (M3) lie on either side of a shallow linear hollow (see photograph Figure P1 on the archive CD); between them the data are magnetically quiet. It is suggested that these anomalies represent natural outcrops on the sides of what was once a more pronounced channel, possibly a former stream bed, that has silted up. Neither anomaly can be clearly traced to the north of the Antonine Ditch, though amorphous responses (?M2) may represent a continuation of this outcrop; possibly indicating a widening of the channel.
- 2.3 The most visually prominent response of archaeological interest is a well defined negative linear anomaly (M4), with a slight positive northern edge, that extends along the entire length of the survey and represents the Antonine Ditch. There is little variation in the strength and form of the response across the changing topography/natural of the site.
- 2.4 Anomalies that may represent the Rampart are present at (M5) to (M8) and they vary in character. The linear band of noisy (increased magnetic) responses (M5) in the centre of the survey, occupies the highest part of the field, where the soils were visibly more stony on the surface. This type of response could have been produced by the magnetic cobbles of a partially intact Rampart base. This interpretation is supported by the resistance survey (see below) but has not been made definitive (i.e. only classified as ?Rampart) because (M5) is not precisely aligned with the Ditch but appears to be veering away at its western end. It is possible the responses reflect rampart material disturbed/displaced by later cultivation. Anomaly (M6) has the same form as (M5) but the interpretation is more cautious, as it extends only a short distance and, although parallel to the Ditch is only 4m south of it and does not "line up" with (M5).
- 2.5 Anomalies (M7) in Area 2 comprise parallel trends with some small areas of increased magnetic response. The intermittent nature of the responses makes the interpretation tentative, but, if correct, would seem to suggest a poor level of preservation of the Rampart at this location.
- 2.6 At the western end of the survey, responses (M8) have a different form, comprising truncated positive linear anomalies and trends that vary in strength and definition; at one point they appear to be bounded by a pair of parallel indistinct negative linears. The responses are not wide enough to represent the entire base and they are weaker than the noisy responses described above. It may be that the anomalies do represent the partial remains of a cobbled Rampart base but a possible increased depth of topsoil over them has caused a reduction in the signal strength

at the surface. Alternatively, the weaker nature of the responses could indicate an increased level of damage of the feature. The negative anomalies may reflect some element of landscaping/terracing associated with the construction of the Rampart (see paragraph 1.2 above), but their poor definition makes this interpretation cautious.

- 2.7 The survey has yielded no clear evidence for postulated towers within the Rampart. Although some discrete small responses are present within the bands of increased magnetic response described above, they do not form any obvious rectangular patterns and are likely to have been produced by individual large cobbles/boulders. A group of pit type anomalies (M9) at the western end of the survey forms a roughly rectangular pattern approximately 5m by 6m and may be of archaeological interest. However, the dimensions are larger than those expected for a postulated tower and the anomalies are adjacent to those attributed to the Rampart; thus no precise interpretation can be given. Two discrete positive responses (M10) in Area 2 coincide with the position of a resistance anomaly of possible interest (see paragraph 3.16 below) and viewing both datasets together, (M10) might be interpreted as post pits. However, based on conventional spacings, they lie too close to the ditch to represent part of a possible Rampart tower. Furthermore, it must be stressed that, viewed in isolation, no significance would be attached to the magnetic responses; their position may be fortuitous and an archaeological interpretation is especially cautious.
- 2.8 No anomalies that can be definitively linked to the Military Way have been detected in the datasets. Faint trends and an indistinct negative linear (M11) in the centre of the survey run roughly parallel to the possible Rampart (M5) and c.15m to the south. They could reflect the traces of the road that has all but disappeared; however the responses are barely visible above background levels and are also on roughly the same alignment as recent cultivation, making this interpretation speculative. Further to the east weak anomalies and trends (M12) follow the line of the cropmarks described in paragraph 1.3, but their poor definition precludes any firm interpretation. Moreover, they appear somewhat sinuous, which might tend to support a natural origin.
- 2.9 The ditches of the fortlet are apparent as negative responses (M13); they seem to be appended to the Rampart and have a break midway along the southern arm most probably indicating an entrance. Positive and negative anomalies (M14) extend roughly southwards from this break and could indicate a trackway, but the poor definition of these responses makes an archaeological interpretation tentative. A few small scale anomalies have been classified as *?Archaeology* primarily because they lie within the fortlet, but little can be said about their precise nature. Their position may be coincidental and a natural origin cannot be dismissed.
- 2.10 The parallel linear arrangement of anomalies (M15) north of the Ditch suggests an anthropogenic origin, but whether archaeological or more recent in date is uncertain. If the former, their alignment would suggest they are not related to the Antonine Wall.
- 2.11 A trend (M16) within the postulated former stream channel forms a rectilinear pattern that would suggest an anthropogenic origin, but, as with (M15) above, whether modern or ancient cannot be determined.
- 2.12 The negative and positive anomalies at (M17) correspond with a distinct rectangular high resistance anomaly (paragraph 3.17 below). It is solely on this basis that the magnetic responses have been assigned to the *?Archaeology* category; viewed in isolation their ill-defined nature precludes any firm interpretation. The linear bands immediately west of (M17) do not match the resistance results; although an archaeological origin for them cannot be completely discounted, a natural or modern factor seems equally likely.
- 2.13 The anomalies at (M18) are difficult to interpret. The main elements are negative, forming a roughly oval shape, c.17m by 13m, with positive responses around the edges and a single discrete positive in the centre. They are located approximately 13m south of the Rampart. The negative anomalies could suggest a deliberately cut feature, thereby indicating human intervention; but to what purpose, and whether ancient or more recent cannot be determined. Alternatively the responses could have a natural origin, though in the absence of detailed information on the underlying solid geology no more precise interpretation can be given.

- 2.14 Linear dipolar anomaly (M19) has been produced by a ferrous pipe. Immediately north of this a negative linear that crosses the Antonine Ditch is thought to reflect a recent drainage feature. The large dipolar anomaly and magnetic disturbance (M20) in the northwestern is likely to be modern in origin, though there is nothing on the surface to suggest its exact cause.

### 3. Results of Resistance Survey

*Labels (Rn) in the text below refer to specific anomalies annotated on the Geophysical Interpretation, Figure 7. The Archaeological Interpretation is given in Figure 8.*

#### Area 1A

- 3.1 Resistance values in this dataset vary between 100 and over 300 Ohms, a relatively broad range (for a site on the Antonine Wall). An area of low resistance dominates the eastern half of the survey area and has obscured responses from low resistance archaeological features. The western limits of this low area correspond roughly with the edge of Zone 1 (see paragraph 2.1 above) and suggests a localised change in the underlying soils/geology, with the soils to the east retaining a significantly higher amount of moisture.
- 3.2 The Antonine Ditch appears as a well defined low resistance anomaly (R1) in this area. This is the more typical response for the Ditch and indicates that the ditch fill has retained moisture close to the surface. This could be solely due to the soil type, but could also suggest the Ditch is not as deeply cut at this point. A narrower band of higher resistance along the southern edge of (R1) suggests compacted earth (the Berm) between the Ditch and Rampart. High resistance immediately north of (R1) may reflect the outer mound, although natural factors may also be partially responsible.
- 3.3 Short linear high resistance anomalies c. 3.5m wide (R2) have an alignment and position corresponding to the Rampart. Although the broad range of resistance values mean that (R2) are not visually dominant, they are, nonetheless relatively discrete, suggesting a partially intact Rampart base.
- 3.4 No definitive evidence for the Military Way has been identified. A pair of trends (R3) spaced roughly 3.5m apart, lie south of the fortlet, c.40m south of the Wall and may be of interest. However, they lie within a broader zone of high resistance (see paragraph 3.7 below) and are only evident in the filtered data; moreover, they do not match the turn of the Wall at this location. Consequently they have been classified simply as ?*Archaeology* and even this interpretation is tentative.
- 3.5 The ditches of the fortlet appear as characteristic low resistance anomalies (R4). As with the magnetic data, (R4) show the fortlet apparently appended to the Rampart to the north and with an opening along the southern arm. Unlike the magnetic results, the ditches are only partially represented in the resistance data; the eastern arm disappears into the broader low resistance zone described in paragraph 3.1 above and is only visible as a faint trend in the filtered data. A narrow high resistance linear inside the western arm of (R4) may reflect an internal earthwork but is equally likely to have been produced by the edge of the fortlet ditch.
- 3.6 There is no clear evidence for features within the fortlet. A few weak trends around the entrance have been classified as ?*Archaeology*, but as they have been defined primarily from the filtered data, this interpretation is cautious.
- 3.7 A high resistance zone in the southwestern corner of the grid displays some hints of rectilinearity along its edges. While this could suggest anthropogenic features, no obvious patterns can be discerned within the zone that would support this interpretation. No anomalies are present in the magnetic data at this location to suggest archaeological features and a natural origin seems likely.

**Area 1B**

- 3.8 The range of values recorded in this block is comparatively low (c.170 to 220 Ohms) and this is the only of the three areas where the current cultivation trend is represented in the data as small scale resistance changes. These factors are likely to arise from well drained soils and broadly uniform subsoils/geology.
- 3.9 The Antonine Ditch appears as a high resistance anomaly (R5); this type of response has been obtained elsewhere along the Wall (GSB 2006/11 and GSB 2006/80) and can occur where moisture has drained away from the upper layers of the ditch fill. North of (R5) less distinct linear bands of higher resistance are likely to have been produced by the outer mound.
- 3.10 Linear higher resistance zone (R6) is attributed to the Rampart. The band is too broad to have been produced solely by the Rampart base and seem likely to reflect a spread of material from the damaged feature. Within (R6) some more discrete high resistance anomalies can be discerned (in the colour plots and filtered data); these partially correspond with the bands of increased magnetic response (paragraph 2.4 above) and are thought to represent the Rampart base.
- 3.11 No other anomalies of particular interest are noted in this area. The responses obtained are similar in character to those recorded by the previous survey at Westermains (GSB 2006/80); based on this, it was considered that further expansion of this block would not yield any additional useful information.

**Area 2**

- 3.12 A broader range of resistance values has been recorded in this area (c.180 to over 330 Ohms) although in this instance some of the highest values affecting the statistics may have been produced by anthropogenic features (see paragraph 3.17 below). A low resistance band is present at the western end of the grid; it has a distinct edge which corresponds to the edge of magnetic Zone 3 (paragraph 2.1 above) and is attributed to a localised change in soils/geology. This low resistance band will have obscured responses from archaeological features. For much of the dataset, however, the background values do not display extremes of variation.
- 3.13 Low resistance linear (R7) has been produced by the Antonine Ditch. The anomaly disappears into the area of low resistance described above and is visible only as weak trends in the filtered data and relief plots. The Ditch is bisected by the pipe (see paragraph 2.14 above); as expected this modern service has not had such an impact on the resistance results, appearing only as a narrow higher resistance response attributed to the fill of the pipe trench. That said, the coherence of anomaly (R7) is reduced in the vicinity of the pipe and this is thought to arise from modern disturbance of the soils.
- 3.14 High resistance anomalies bounding the northern side of the Ditch may reflect material associated with the outer mound.
- 3.15 The Rampart has not been clearly located in this area. Linear high resistance anomalies (R8) are relatively well defined but lie only c. 3m south of the Ditch, closer than the standard spacings for Ditch and Rampart. Trends (R9) lie along the mapped line of the Rampart and coincide partially with magnetic anomalies attributed to this feature, but are weaker and less well defined. Based on the corroborative evidence from the magnetic survey, (R9) have been interpreted as *?Rampart*; the weak nature of the anomalies possibly indicating a poor level of preservation (also suggested by the magnetic data). However the position and form of (R8) would suggest they are of archaeological interest and they may indicate compacted ground (the Berm) between the Ditch and Rampart.
- 3.16 High resistance anomaly (R10) also lies on the line of the Berm but it has a rectangular shape, c.11m by 8m, with relatively well defined edges, which could suggest a more deliberate compaction of the earth for some purpose. Two distinct positive magnetic anomalies (see paragraph 2.7 above) are located approximately at two corners of the rectangle and it is tempting



to suggest that the results represent the base of a structure such as a tower. However, based on conventional dimensions (R10) is too big and too close to the Ditch to represent a postulated Rampart tower. Moreover the position of the magnetic responses may be completely coincidental. A possible archaeological origin for (R10) is posited but its precise function remains unclear.

- 3.17 The pattern of responses at the northern edge of the survey area is interesting. Low resistance at the grid edge gives way to distinct areas of high resistance on either side of the Antonine Ditch. Within with these zones, more discrete very high resistance anomalies (R11) and (R12) can be discerned in the colour plots and filtered data; these - particularly (R11) have a distinct rectangular shape which would support an archaeological interpretation. A modern stream is present c.13m north of this anomaly group. It is possible that this stream followed a different course in earlier times, in which case the low resistance might represent the silted up stream channel and anomalies (R11) and (R12) the footings for a bridge across the stream. The survey could not be expanded north of the stream to test the theory and the magnetic data do not show any similarly discrete rectangular anomalies at this location (see paragraph 2.12 above); thus the interpretation remains cautious.

#### **4. Conclusions**

- 4.1 As with many other locations along the Antonine Wall, the Ditch has proved to be the most readily identifiable element, clearly detected by both geophysical techniques. At this site variations in topography and soils/geology have had no impact on the magnetic response produced by this feature, but have affected the resistance results giving rise to both low resistance (the conventional response) and high resistance anomalies.
- 4.2 The Rampart appears only intermittently in both datasets and the responses tend to be less well defined, making interpretation cautious. The magnetic responses assigned to this feature vary somewhat in form; this may reflect levels of preservation of the feature, though natural factors, such as the depth of topsoil overburden may also be a contributory factor. At their most coherent the magnetic responses would indicate that the cobbles used in the Rampart base are highly magnetic.
- 4.3 As with most of the other locations investigated, evidence for the Military way is scant and highly tentative.
- 4.4 The ditches of the fortlet have been identified by both techniques, though the clarity of the resistance results has been affected by localised natural variations. Neither dataset has produced clear evidence for internal features.
- 4.5 No anomalies have been identified which can be obviously related to Rampart towers. The nature of these postulated features (wooden remains, postholes less than 1m in diameter) would tend to make them very difficult to detect by either technique, due to the general levels of background magnetic response and the relatively broad range of resistance values. Thus the absence of geophysical evidence does not resolve the question of whether such features existed along the Antonine Wall.

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Figure T1	Tie-in Information	not to scale
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Figure P1	Photograph of site showing possible natural channel
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## Appendix 1: Technical Information

### Instrumentation

#### Fluxgate Gradiometer: Geoscan FM36/256 and Bartington *Grad601-2*

Both the Geoscan and Bartington instruments comprise two fluxgate sensors mounted vertically apart; the distance between the sensors on the former is 500mm, on the latter 1000mm. 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 sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. The fluxgate gradiometer suppresses any diurnal or regional effects. Generally, features up to 1m deep may be detected by this method. Having two gradiometer units mounted laterally with a separation of 1000mm, the Bartington instrument can collect two lines of data per traverse.

#### Resistance Meter: Geoscan RM15

This instrument 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 most common arrangement is the Twin Probe configuration which involves two pairs of electrodes (one current and one potential): one pair remain in a fixed position, whilst the other measures the resistance variations across a grid. The resistance is measured in ohms and, when 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. The nature of the overburden and underlying geology will cause variations in this depth.

#### GPR: Sensors & Software Noggin Smartcart

The Noggin system includes an onboard digital video logger (DVL III), 250 MHz or 500MHz antenna, an odometer wheel and battery. It is, therefore, a fully integrated system. The built-in software uses the integrated odometer to provide an accurate distance measurement to the response. The data are recorded in digital format and can be processed to produce depth slice maps, 2D sections or 3D cubes.

### Display Options

#### XY Trace

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.

#### Greyscale

This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all values below the given range are represented by the minimum intensity shade. 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. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

#### Relief Plot

This is a method of display that creates a three dimensional effect by directing an imaginary light source on a given data set. Particular elements of the results are highlighted depending on the angle of strike of the light source. This display method is particularly useful when applied to resistance data to highlight subtle changes in resistance that might otherwise be obscured.

#### 3D Surface Plot

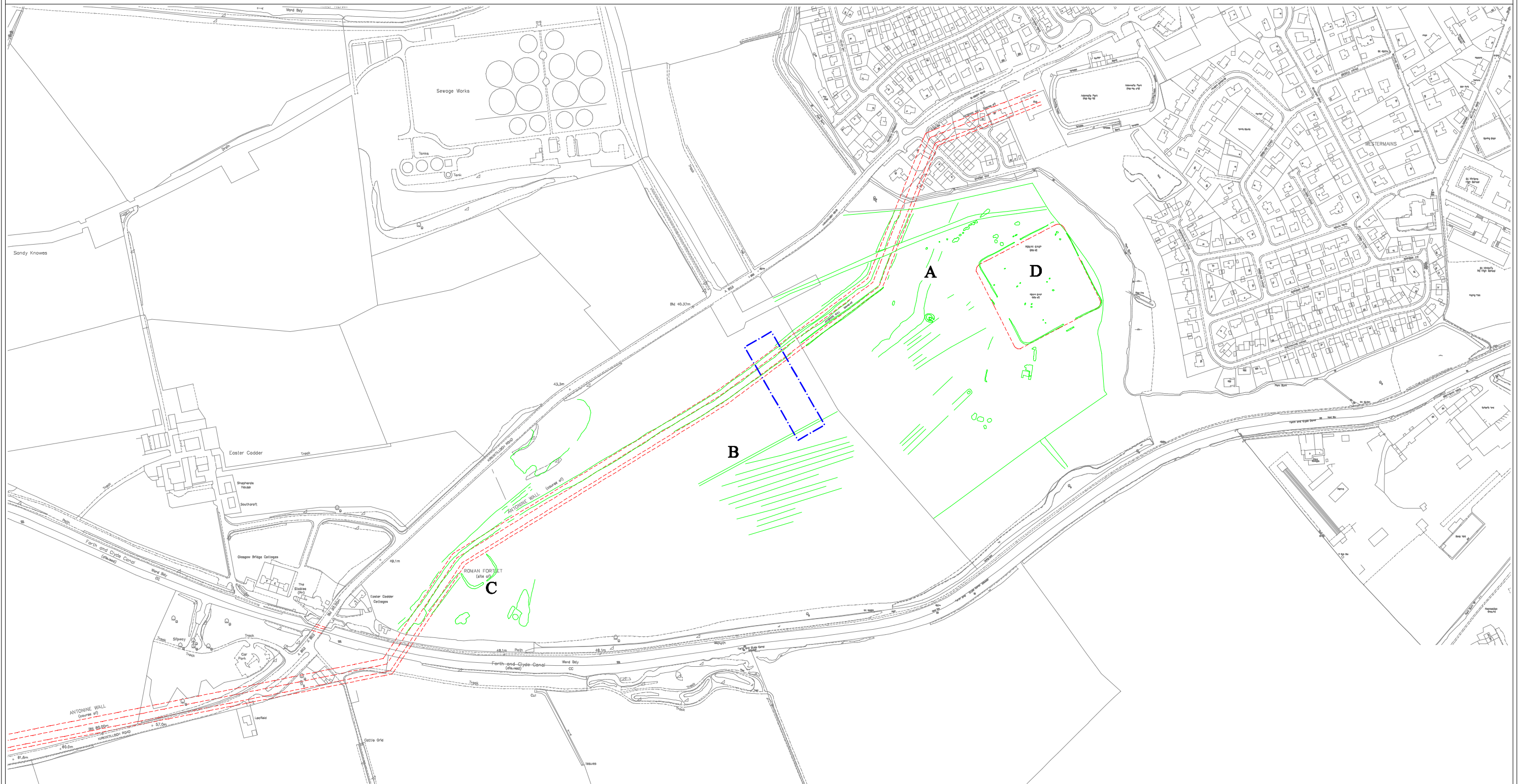
This is similar to the XY trace, but in 3 dimensions. Each data point of a survey is represented in its relative position on the *x* and *y* axes and the data value is represented in the *z* axis. This gives a digital terrain, or topographic effect.

#### Radargram

Radar data comprise a record of reflection intensity against the time taken for the emitted energy to travel from the transmitter down to the reflector and back to the receiver. The resultant plot is effectively a vertical section through the ground along the line of the traverse, with time (depth) on the vertical axis, displacement on the horizontal axis and reflection intensity as a grey or colour scale.

#### Time Slice

If a number of radargrams are collected over a grid, or in conjunction with GPS data, it is possible to reconstruct the entire dataset into a 3D volume. This can then be resampled to compile 'plan' maps of response strength at increasing time (or depth) offsets, thus simplifying the visualisation of how anomalies vary beneath the surface across a survey area.



Aerial Photographic transcriptions provided by RCAHMS.  
1980 working Ordnance Survey maps provided by RCAHMS.  
© Crown copyright RCAHMS






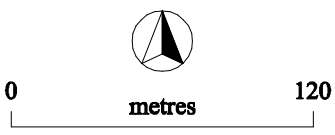
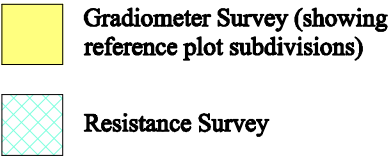
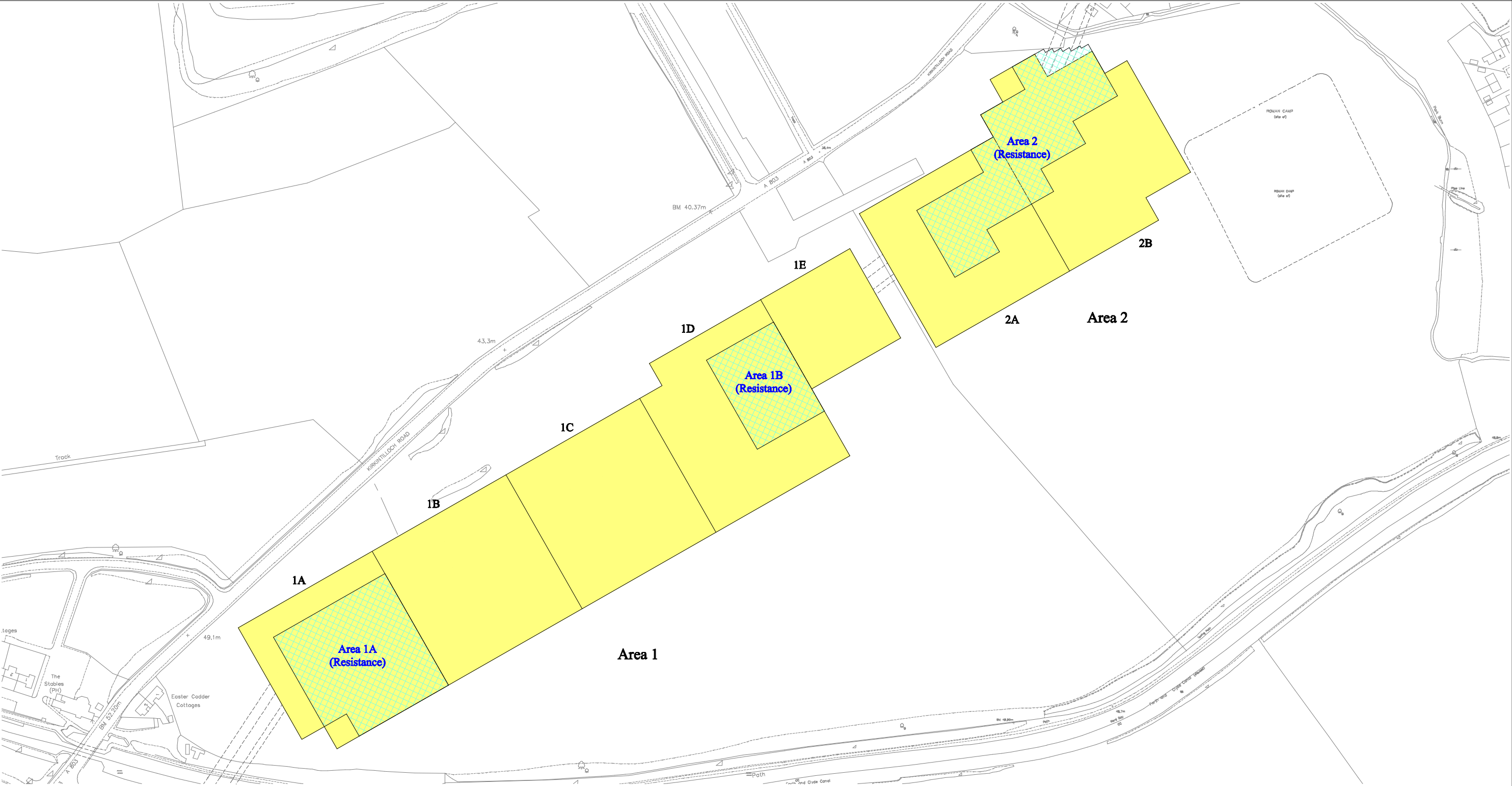
-  Line of Antonine Wall - OS 1880 (current)
  -  Aerial Photographic transcriptions (RCAHMS)
  -  Previous Geophysical Survey (GSB 2006/80)

Figure 1



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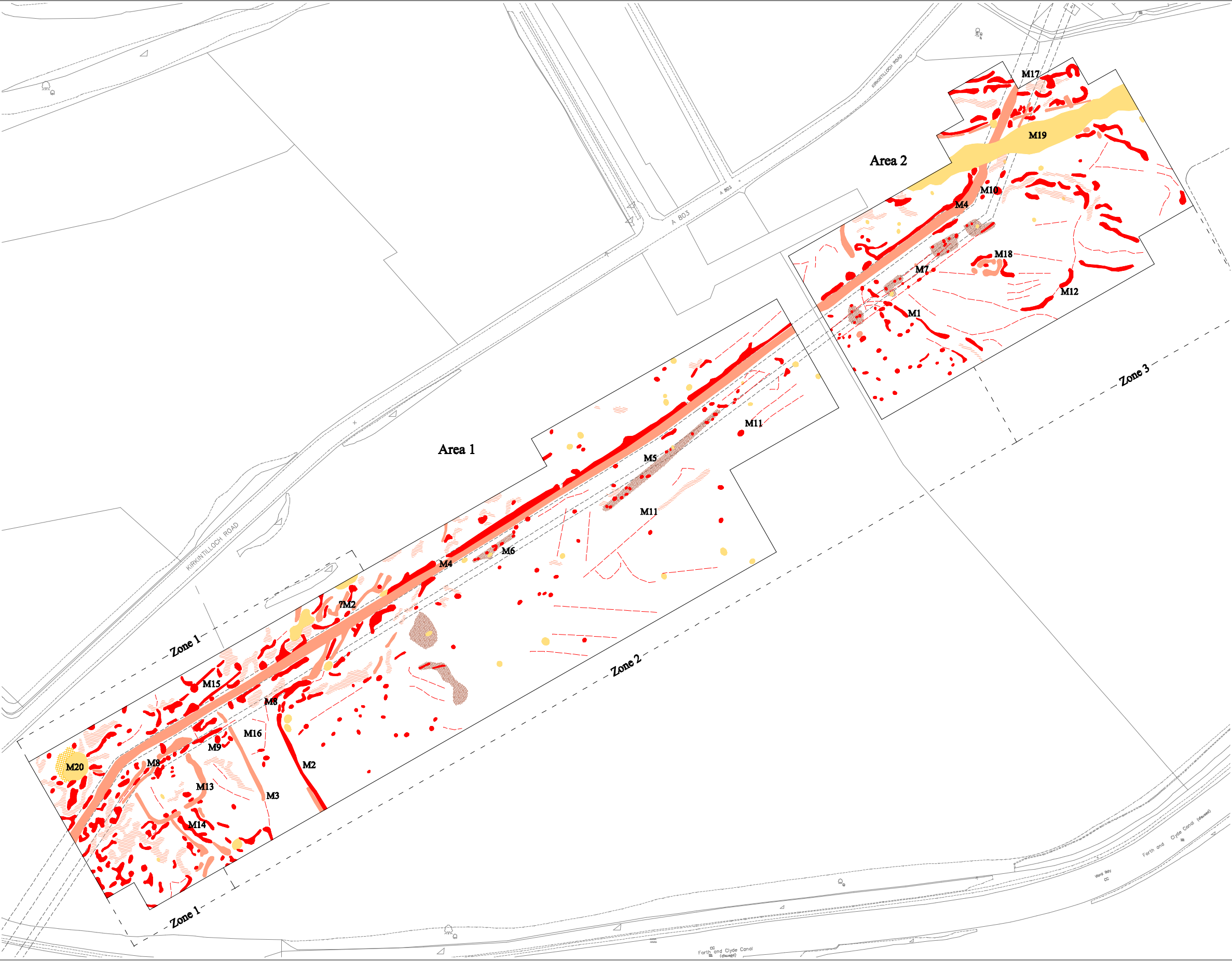
Figure 2



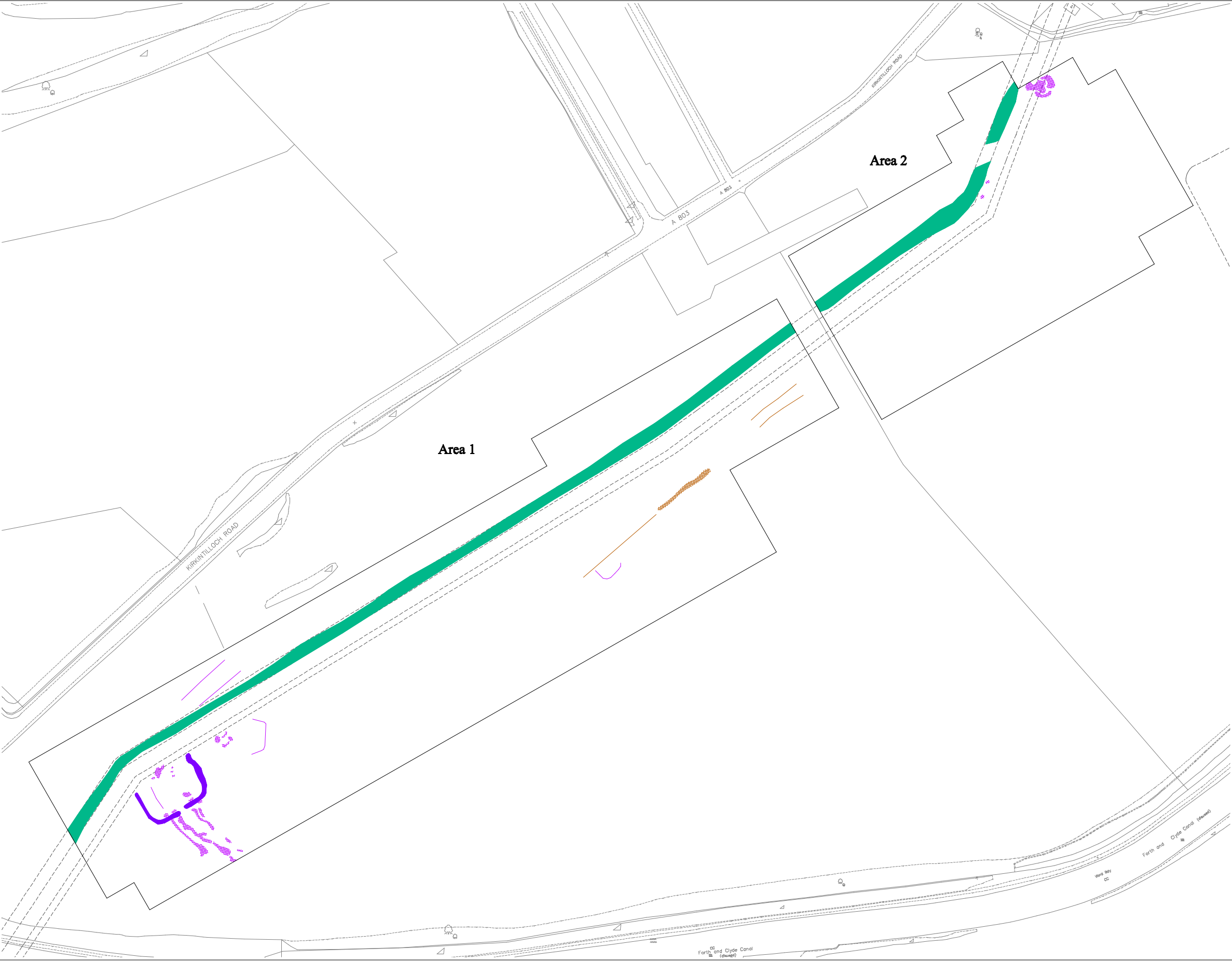


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Figure 3

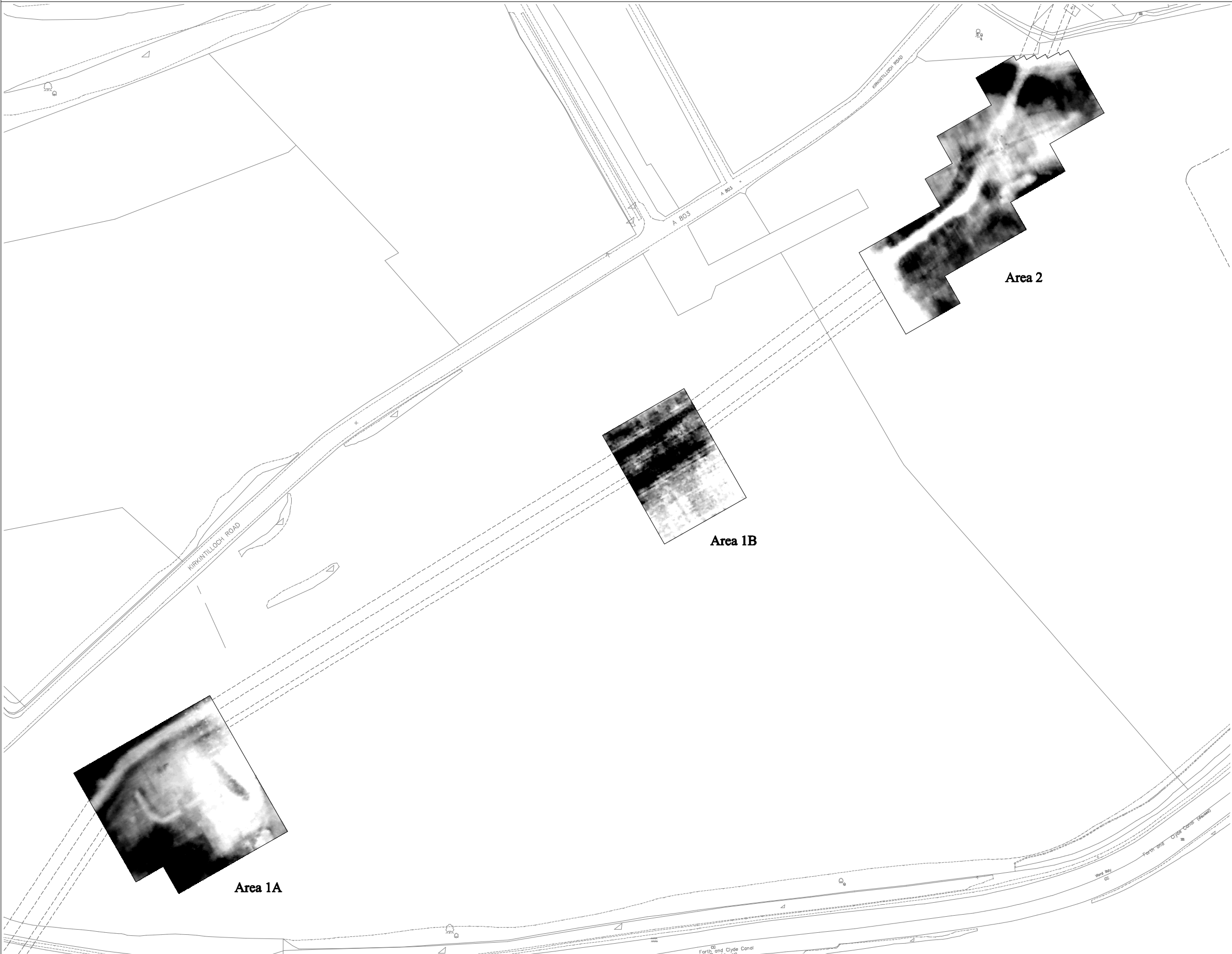


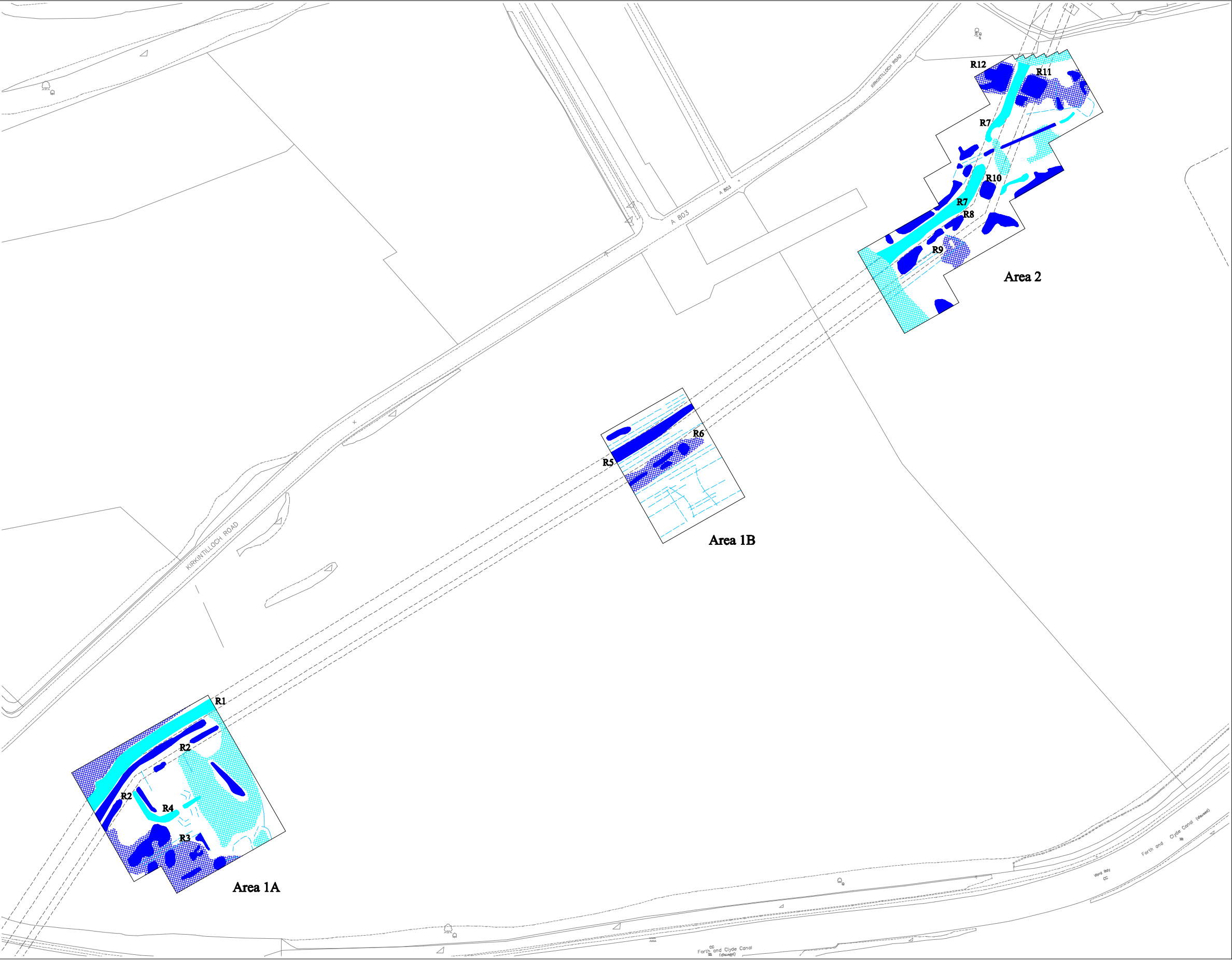




- Antonine Wall - Ditch
- Antonine Wall - ?Rampart
- Antonine Wall - ?Military Way
- Archaeology
- ?Archaeology

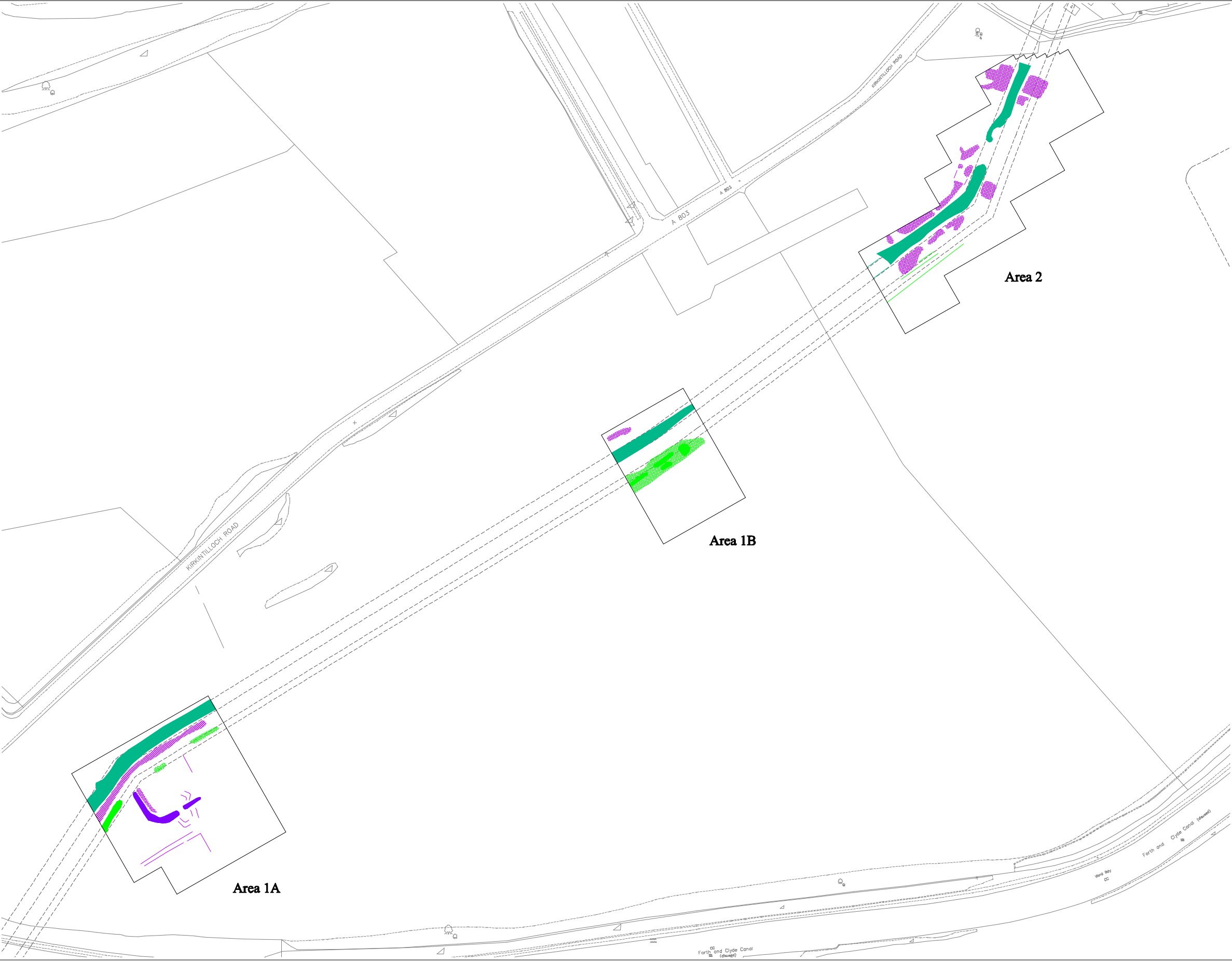






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Figure 7



- Antonine Wall - Ditch / ?Ditch
- Antonine Wall - Rampart
- Antonine Wall - ?Rampart
- Archaeology
- ?Archaeology

