



OAKLANDS FARM SOLAR PARK

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Environmental Statement

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Oaklands Farm, Derbyshire

Detailed Gradiometer Survey Report

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Summary

A gradiometer survey was conducted over land at Oaklands Farm, Derbyshire (centred on NGR 423337 317716). The project was commissioned by Land Use Consultants Ltd with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features in support of a planning application for the development of the site as a solar farm.

The site comprises arable fields located just west of the village of Rosliston, Derbyshire, and covers an area of 202 ha. The geophysical survey was undertaken in several campaigns from 06 – 22 June 2022, 03 – 14 October 2022, and 29 August – 05 September 2023. Some areas of the survey are now beyond the final site boundary for planning application.

The survey has not identified any anomalies that can confidently be interpreted as archaeology. There is no evidence of the Roman Road thought to cross through the north of the site. The lack of significant archaeological anomalies thus seen in the detailed gradiometer survey is consistent with the rural character of the area and the use of the land for agriculture known from at least the medieval period onwards. However, several anomalies have been identified which have been interpreted as possible archaeology.

Two potential rectangular enclosures of unknown origin have been identified, both are located outside of the proposed final boundary for the solar farm. The orientation of the rectangular enclosure respects the alignment of a nearby former field boundary, which may imply a date roughly contemporary with the field boundary, although without further investigation this is difficult to say with certainty. The second oval enclosure is more fragmentary. Band or upcast material was identified surrounding it, however, its provenance as an enclosure is less certain. While it has some morphological similarities to heingi-form monument seen in the wider area, it is unlikely that it had performed a similar function.

Other isolated anomalies have been interpreted as potentially archaeological, several of which are likely to represent historical field boundaries not present on available mapping.

Multiple former field boundaries corresponding to those on the Second Edition OS mapping have been identified across the site. A trackway has similarly been identified.

The site suffers from significant areas of increased magnetic responses. Two significant overhead cable routes stretch the length of the site, causing significant disturbances in the dataset which may distort or overpower magnetic responses from buried archaeology below in a buffer between 40 m to 75 m. Other areas of increased magnetic response are thought to be caused by farming activity which could as well obscure weaker features.

The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing, drainage, trackways, and services.

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Oaklands Farm, Derbyshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Land Use Consultants Ltd to carry out a geophysical survey at Oaklands Farm, Derbyshire (centred on NGR 423337 317716) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in support of a planning application for the development of the site as a solar farm.

1.2 Scope of document

1.2.1 This report presents a brief description of the methodology followed by the detailed survey results and the archaeological interpretation of the geophysical data.

1.3 The site

1.3.1 The site is located within the Trent Valley, just west of the village of Rosliston and 3 km south of the centre of the town of Burton upon Trent, in the county of Derbyshire.

1.3.2 The survey comprises 202 ha of agricultural land split across two areas, currently utilised for a mixture of crop and pasture. Park Farm is located to the north and Oakland Farm to the south. The site is bounded to the north by Walton Road. Immediately north across the road is the site of the former Drakelow Power Station, hereafter referred to as 'Drakelow Power Station'. The total survey area extends beyond the final site boundary due to the reduction in extent of the scheme's solar panel array since the beginning of fieldwork.

1.3.3 To the west and east, the site is generally bounded by agricultural land or woodland, although certain areas back onto commercial or domestic buildings such as P6, which abuts Chapmans Nurseries to the east, and P1, which abuts a farmyard to the east. At its southernmost point, the site is bounded by an unnamed road. The site also backs onto Oaklands farm at its southern border, with O14 directly abutting the farm.

1.3.4 Two roads also run across the site. Running on an east – west alignment across the centre of the site, Rosliston Road separates P3 and P2 in the north from P1 in the south. Further south, Coton Road runs on a south-east to north-west alignment and separates O3, O4, and O5 in the north from O1 and O2 in the south. Coton Road also provides the south-western-most boundary for O15 and O16.

1.3.5 A stream also runs through the centre of the site. This is a tributary of the River Trent.

1.3.6 The site undulates, varying from 91 m above Ordnance Datum (aOD) at the southern edge to 56 m aOD at the northern edge. The rest of the site varies between 88 m aOD and 61 m aOD and is 20 – 40 m higher than the nearby floodplain of the river Trent.

1.3.7 Two sets of overhead cables traverse the site. Both sets of cables extend the whole length of the site from north – south and originate from Drakelow Power Station to the north. The first set of powerlines run from the power station to Rosliston Road. At Rosliston road, the cables turn to a more north-east to south-west alignment. They exit the site from field O5. The second set of power cables run from the power station and exit the site at field O3.



- 1.3.8 The solid geology primarily comprises Sandstone of an Edwalton Member. A small amount of a Gunthorpe Member Siltstone is recorded across fields O4, O5, O10, O11, O19, and O20 and a small area of Mudstone of an Edwalton Member is recorded in the western portion of O16. Superficial deposits vary throughout the site, including a Thrusington Member Diamicton in the north and south; clay, silt, sand, and gravel alluvial deposits across the west; and areas of mid-Pleistocene glaciofluvial sand and gravel deposits in the south and west (BGS 2023).
- 1.3.9 The soils underlying the site are likely to consist of brown earths of the 541r (Wick 1) association, stagnogleyic argillic brown earths of the 572f (Whimple 3) association, stagnogley soils of the 711c (Rufford) association, and stagnogley soils of the 711m (Salop) association (SSEW SE Sheet 3 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

2 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

- 2.1.1 A Historic Environment Assessment (HEA) was prepared by Land Use Consultants for Oaklands Farm Solar Park which examined the potential for the survival of buried archaeological remains within the development area and a 2 km and 5 km study area (HEA; LUC 2023). The following background is not exhaustive but has been compiled using information summarised from the HEA and publicly available online resources, combined with the results of Wessex Archaeology's previous investigations in the area and in-house resources. A 1 km search radius was used.

2.2 Summary of the archaeological resource

Prehistoric

- 2.2.1 Prehistoric activity within the study area is relatively minimal. Some Mesolithic or early Neolithic finds have been documented but are mainly limited to surface finds of flint scatters, although many of these have not been formally categorised. The closest find to the site is a flint scatter including a scraper knife, two miscellaneous implements, and four flakes found in the field immediately to the north of P3.
- 2.2.2 2.4 km west of Fields O16 and O15 is the Neolithic ritual complex Timber circle, hengi-form monument and part of a pit alignment at Catholme (NHLE 1019109). The timber circle has been interpreted as representative of a large building for meeting or ceremonial purposes, while hengi-form monuments are thought to have been ritual or ceremonial centres closely linked with burial. The hengi-form monument represented here is one of only 24 known examples within the UK. Although the remains here are damaged by ploughing, they are considered to be well preserved below ground.
- 2.2.3 Immediately north of the timber circles, a series of multi-period earthworks potentially representative of a cursus is scheduled as Enclosures and cursus 300 yds (270 m) SE of Efflinch (NHLE 1006073).
- 2.2.4 At least one barrow cemetery is represented within the Trent River floodplain. This Monument, Remains of barrow cemetery 350 yds (320 m) SW of Tucklesholme Farm (NHLE 1006076), is 2 km west of field O16. Whilst the monument has been badly damaged through ploughing, at least five ring ditches have been identified at the site. These are thought to have belonged to Bronze Age barrows.



- 2.2.5 Additionally, the scheduled Circular enclosures centred 270 m west of Wychnor Junction (NHLE 1006072), 2.8 km south-west of Field O16, also contains four ring ditches, as well as several pit alignments. These are currently dated to the earlier Neolithic and may similarly be interpreted as remains of a barrow cemetery. Alternatively, the alignment of pits and ring ditches here may be interpreted as a henge monument, which may be suggestive of other ritual activity.

Iron Age and Romano-British

- 2.2.6 Just outside of the study area, 1 km west of O16 is the scheduled Slight univallate hillfort 230 m south-west of Old Hall Cottages (NHLE 1017742). Slight univallate hillforts generally date to the late Bronze Age or early Iron Age and can appear in a variety of shapes, although are usually on or near a hilltop. These hillforts may have had a variety of purposes, including stock enclosures or settlements. This particular example is thought to date to the Iron Age, is ovoid in shape and included impressive defences. Human remains have been found within the southernmost portion of the hillfort.
- 2.2.7 Roman activity is also minimal within the study area. A possible Roman road runs through field P13 on a north-west to south-east alignment, although this route is conjectural. A large cropmark immediately south of where the proposed alignment of the road crosses the river Trent has been interpreted as possibly representative of a Roman Fort. The cropmark is located 570 m west of P14. The cropmark has alternatively been interpreted as representative of a prehistoric enclosure.
- 2.2.8 The enclosure at Lad's Grave, close to the southern tip of the site is known from cropmarks and ascribed an "unknown medieval date" in the HER entry (MDR7113). This cropmark is visible, to an extent, on recent digital aerial photography available online and does not align with the axes of fields recorded in this area on early historic mapping which are of probable medieval date. It is more likely that the enclosure is of later prehistoric to Romano-British date and may represent an element of a field system.
- 2.2.9 Archaeological work immediately north of St Laurence's Church in Walton-on-Trent in 2005 revealed some Roman features, including gullies, ditches, postholes, pits, and pottery.
- 2.2.10 Surface finds of Roman artefacts, including coins, pottery, and metal objects such as brooches, have been found across the study area.

Anglo-Saxon and Medieval

- 2.2.11 Anglo-Saxon activity, such as a probable cremation cemetery, a late Saxon enclosure and a large settlement including at least 65 buildings, is visible outside of the study area, within the river Trent's floodplain. Many of these examples are found in association with older ceremonial places; the large settlement is located at Catholme, which also contains evidence of a Neolithic ritual complex.
- 2.2.12 These settlements largely persisted throughout the medieval period. Generally, larger villages such as Walton-on-Trent, 1 km to the west of the survey area, appear to have developed on the lower slopes of the Trent valley, to the west of the site, whilst the settlements to the east of the site and further away from the floodplain remained as small hamlets clustered around smaller tributary streams. Whilst many of these villages no longer retain their medieval character, several still contain a parish church which is medieval in origin. Primary examples of this are the Church of St Laurence (NHLE 1159347) in Walton-on-Trent and St Mary's Church (NHLE 1159242) in Rosliston. Both churches are Grade II*



listed. Both churches were heavily restored in the 19th century but retain features from the medieval period. A medieval chapel was also built at Coton in the Elms, although it no longer survives.

- 2.2.13 As well as settlements, moated and monastic buildings are recorded in the area. Two moated sites are recorded in the Drakelow area, and a possible moated site has also been identified at Walton-on-Trent.
- 2.2.14 In the early medieval period, much of the land around and within the site belonged to Burton Abbey. Burton Abbey was founded in the 7th or 9th century and was also recorded in the Domesday Book. The abbey was the most important in Staffordshire for much of the medieval period until its dissolution in 1539. The presence of the Abbey was the impetus for much of the surrounding town to develop. This became Burton-on-Trent.
- 2.2.15 Much evidence for medieval agriculture is visible within the study area. Large areas of ridge and furrow are visible across the area including within the site at Field P11.

Post-Medieval

- 2.2.16 Many of the surviving buildings within the local villages of Rosliston, Coton in the Elms and Walton-on-Trent date to the post-medieval period. Seven listed buildings from the period are located in Walton-on-Trent. Six of these are Grade II listed (NHLE 1334600, NHLE 1061407, NHLE 1096427, NHLE 1334601, NHLE 1096426, NHLE 1311096), whilst Walton Hall is Grade II* listed (NHLE 1159300). Walton-on-Trent is a village-based conservation area. Three Grade II listed buildings from the period are located in Coton in the Elms (NHLE 1311322, NHLE 1334613, NHLE 1096452). A farmhouse located within the north of the study area, adjacent to Fields P11 and P12, also dates to the post-medieval period and is Grade II listed (NHLE 1096453).
- 2.2.17 The post-medieval landscape in the area also saw the expansion of country manors and landscaped parkland. A small-scale example of this is the above Walton Hall, which was built in the 1720s and set in a small parkland. On a grander scale was Drakelow Hall. Whilst a small deer parkland was established at Drakelow from the medieval period onwards, a large hall was built on the site during the Elizabethan era. By 1817, the hall had associated parklands covering at least 175 acres and by 1824/5, this had increased. By the end of the 19th century the parkland had expanded further again. The hall was occupied until the early 20th century, when the cost of running the hall became too high. The hall was sold in the 1930s and demolished for the construction of the Drakelow power station. No traces of the hall survive, although a garden wall, sunken gardens, stable block, cottages, and some gate piers with adjoining walls associated with the hall and parkland do survive and are now Grade II listed (NHLE 1311251, NHLE 1334614, NHLE 1096454, NHLE 1158871).

20th Century and Modern

- 2.2.18 Much of the structure of settlements and industry in the study area remained the same through the 20th and 21st centuries, retaining agriculture as a central industry. Much of the land remained rural farmland, although there has been a renewed interest in woodland with a significant number of woodland plantations appearing in the eastern portion of the study area. These plantations are associated with the creation of the 'National Forest' from the 1990s onwards. Rosliston houses a visitor centre for the National Forest.
- 2.2.19 One of the major additions to the landscape since the mid-20th century is the creation of the Drakelow Power Station. This replaced what had been Drakelow Hall and included three



co-located coal-fired generating stations. The first of the three stations (individually known as Drakelow A, Drakelow B and Drakelow C) was opened in 1955. Drakelow A – C have since been decommissioned and demolished, but a substantial power substation remains on the site. Other developments on the site include an Energy from Waste facility, employment land, and housing.

2.3 Recent investigations in the area

Geophysical survey

- 2.3.1 Geophysical and walkover survey was used on areas of the site in 1997 for a proposed pipeline route. Similarly in 2007, geophysical survey was used along a gas pipeline route across the centre of the site.
- 2.3.2 A ploughed field survey was also undertaken on some sections of the site adjacent to Walton-on-Trent and Rosliston in the 1980s.

3 METHODOLOGY

3.1 Introduction

- 3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 6 – 22 June 2022, 3 – 14 October 2022, and 29 August – 5 September 2023. Field conditions at the time of the survey were good throughout. An overall coverage of 197 ha was achieved. Several areas near the high voltage electric cables were not surveyed due to the interference with the survey equipment, The survey area was adjusted throughout the course of the project. All areas designated for the survey were surveyed.

3.2 Aims and objectives

- 3.2.1 The aims of the survey comprise the following:
- To determine, as far as is reasonably possible, the nature of the detectable archaeological resource within a specified area using appropriate methods and practices; and
 - To inform either the scope and nature of any further archaeological work that may be required; or the formation of a mitigation strategy (to offset the impact of the development on the archaeological resource); or a management strategy.
- 3.2.2 In order to achieve the above aims, the objectives of the geophysical survey are:
- To conduct a geophysical survey covering as much of the specified area as possible, allowing for on-Site obstructions;
 - To clarify the presence/absence of anomalies of archaeological potential; and
 - Where possible, to determine the general nature of any anomalies of archaeological potential.

3.3 Fieldwork methodology

- 3.3.1 The cart-based gradiometer system used a Carlson RTK GNSS instrument, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS) and Leica Geosystems. Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceeds European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015).



3.3.2 The detailed gradiometer survey was undertaken using four SenSys FGM650/3 magnetic gradiometers spaced at 0.5 m or 1 m intervals and mounted on a non-magnetic cart. Data were collected with an effective sensitivity of $\pm 8 \mu\text{T} \pm 1000 \text{ nT}$ at a rate of 100 Hz, producing intervals of 0.02 m along transects spaced 4 m apart.

3.4 Data processing

3.4.1 Data from the survey were subjected to minimal correction processes. These comprise a 'Destripe' function ($\pm 5 \text{ nT}$ thresholds), applied to correct for any variation between the sensors, and an interpolation used to grid the data and discard overlaps where transects have been collected too close together.

3.4.2 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

4.1 Introduction

4.1.1 The detailed gradiometer survey has identified magnetic anomalies across the Site. The overview figures are presented at a scale of 1:7500 (**Figures 2 to 5**). Results are presented as a series of greyscale plots and archaeological interpretations at a scale of 1:2000 (**Figures 6 – 39**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale image.

4.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous responses, burnt or fired objects, and magnetic trends (**Figures 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

4.1.3 Numerous ferrous anomalies are visible throughout the dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

4.1.4 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be present than have been identified through geophysical survey.

4.1.5 Gradiometer survey may not detect all services present on Site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g., CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on Site.

4.2 Gradiometer survey results and interpretation

4.2.1 A weak positive linear anomaly has been identified in P2 at **4000 (Figure 11)**. The anomaly has an east – west alignment and is 117 m long by 1.5 m in wide. It is representative of a ditch-like feature, likely a field boundary that predates available mapping for the area and is therefore of unknown date.

4.2.2 Further south, two weak positive L-shaped anomalies have been identified in PF10 at **4001 (Figure 11)**. The two anomalies form a rectangular shape that occupies a space of 19 m by 13 m. The anomalies are indicative of ditch features and the rectangular shape suggests a small enclosure of an unknown date. While it is possible this relates to archaeological activity, it is equally likely to relate to modern agriculture.



- 4.2.3 A weak positive L-shaped anomaly has been identified in PF8 at **4002 (Figure 15)**. The anomaly is 1.5 m wide and extends on a north-east to south-west orientation for 30 m before it turns towards the south for a further 12 m. It indicates a ditch-like feature that could relate to a former boundary. However, it could equally relate to modern agricultural activity, such as ploughing or drainage. This feature is located outside the final site boundary.
- 4.2.4 A cluster of four positive anomalies has been identified in PF7 at **4003 (Figure 13)**. The largest and strongest of these anomalies is curvilinear in shape, with an anomaly width of 3 m and length of 20 m. In the centre of the cluster is a roughly circular anomaly with a diameter of 3 m. The remaining two anomalies in the cluster are amorphous, measuring 2 m by 5 m and 3.5 m by 6.5 m respectively. Overall the anomalies occupy a rectilinear area of 13 m by 14 m and comprise ditch-like features with a possible central pit. There is a weak negative response surrounding the anomaly, indicative of a bank feature or upcast material. While this has some morphological similarity to the hengi-form monument seen in the wider study area (NHLE 1019109), this feature is on a significantly reduced scale and as such is very unlikely to have performed a similar function. It most likely relates to a small enclosure of unknown date. Additional investigations would be required to confirm the origin of the feature. This feature is located outside the final site boundary.
- 4.2.5 A linear anomaly measuring 227 m bisects the southern portion of O3 on an east – west alignment at **4004 (Figure 37)**. It is up to 3 m wide and is considered likely to represent a ditch-like feature related to an early field boundary, predating the earliest available mapping.
- 4.2.6 Several weak positive linear anomalies (**4005 – 4019**) have been identified throughout the survey area (**Figures 7, 9, 13, 15, 17, 19, 21, 23, 25, 27, 33, 35, 37, 39**). They are up to 3 m wide and up to 280 m long indicating ditch-like features. They relate to former field boundaries that are visible on the Second Edition OS mapping from 1902.
- 4.2.7 A number of modern agricultural anomalies have been identified within the site. They are the result of modern ploughing, drainage systems, and a track (**4020 – 4024, 4025 – 4027, 4028**). Additionally, areas of increased magnetic response dominate large parts of land parcels O1, O3, O4, O6, O7, O11, O14, O15, O16, O17 and O22. This is indicative of the distribution of magnetically enhanced material and is related to modern agricultural fertilisation.
- 4.2.8 Several trends have also been observed across the survey area, particularly in O10 and O20. These are too weak to offer any confident interpretation. They are likely a result of modern agricultural practices, but an archaeological origin cannot be wholly rejected without further investigation.
- 4.2.9 Several areas of broad, irregular, weakly positive magnetic responses have been identified in the southern portion of the survey area. They are indicative of topographic changes and geological variations in the superficial geology.
- 4.2.10 Two large powerlines stretch across the length of the site. They create areas of increased magnetic responses which are caused by electromagnetic fields along them. This obscures the data in a buffer between 40 m to 75 m around them.
- 4.2.11 Additionally, numerous strong, dipolar, linear dipolar anomalies have been identified on a variety of orientations across the site. These anomalies have been interpreted as modern services.



- 4.2.12 The survey has also detected multiple isolated clusters of low magnitude and dipolar anomalies that have been interpreted as either geological or ferrous in origin. These likely relate to natural variation in the soils and background geology and are of little archaeological impact.

5 DISCUSSION

- 5.1.1 The survey has not identified any anomalies that can confidently be interpreted as archaeology. There is no evidence of the Roman Road thought to cross through the north of the site. The lack of significant archaeological anomalies thus seen in the detailed gradiometer survey is consistent with the rural character of the area and the use of the land for agriculture known from at least the medieval period onwards. However, several anomalies have been identified which have been interpreted as possible archaeology.
- 5.1.2 Two potential rectangular enclosures of unknown origin have been identified, both are located outside of the proposed final boundary for the solar farm. The orientation of the rectangular enclosure respects the alignment of a nearby former field boundary, which may imply a date roughly contemporary with the field boundary, although without further investigation this is difficult to say with certainty. The second oval enclosure is more fragmentary. Band or upcast material was identified surrounding it, however, its provenance as an enclosure is less certain. While it has some morphological similarities to heingi-form monument seen in the wider area, it is unlikely that it had performed a similar function.
- 5.1.3 Other isolated anomalies have been interpreted as potentially archaeological, several of which are likely to represent historical field boundaries not present on available mapping.
- 5.1.4 Multiple former field boundaries corresponding to those on the Second Edition OS mapping have been identified across the site. A trackway has similarly been identified.
- 5.1.5 The site suffers from significant areas of increased magnetic responses. Two significant overhead cable routes stretch the length of the site, causing significant disturbances in the dataset which may distort or overpower magnetic responses from buried archaeology below in a buffer between 40 m to 75 m. Other areas of increased magnetic response are thought to be caused by farming activity which could as well obscure weaker features.
- 5.1.6 The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing, drainage, trackways, and services.



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APPENDICES

Appendix 1 Survey equipment and data processing

Survey methods and equipment

The magnetic data for this project were acquired using a non-magnetic cart fitted with four SenSys FGM650/3 magnetic gradiometers. The instrument has four sensor assemblies fixed horizontally 1 m apart allowing four traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 0.6 m separation and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of $\pm 8 \mu\text{T}$ over $\pm 1000 \text{ nT}$ range. All of the data are then relayed to a CS35 tablet, running the MONMX program, which is used to record the survey data from the array of FGM650/3 probes at a rate of 20 Hz. The program also receives measurements from a GPS system, which is fixed to the cart at a measured distance from the sensors, providing real time locational data for each data point.

The cart-based system relies upon accurate GPS location data which is collected using a Leica Captivate system with rover and base station. This receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015) for geophysical surveys.

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.01 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the detailed survey is downloaded from Bartington and Sensys systems for processing and analysis using in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- GPS DeStripe – Determines the median of each transect and then subtracts that value from each datapoint in the transect. May be used to remove the striping effect seen within a survey caused by directional effects, drift, etc.
- GPS Base Interpolation – Sets the X & Y interval of the interpolated data and the track radius (area around each datapoint that is included in the interpolated result).
- Discard Overlaps - Intended to eliminate a track(s) that have been collected too close to one another. Without this, the results of the interpolation process can be distorted as it tries to accommodate very close points with potentially differing values.



Typical displays of the data used during processing and analysis:

- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.
- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.



Appendix 2 Geophysical interpretation

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural, and uncertain origin/geological.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Possible archaeology – used for features which give a response, but which form no discernible pattern or trend.

The modern category is used for anomalies that are presumed to be relatively modern in date:

- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative, or broad bipolar (positive and negative) anomalies.



Appendix 3 OASIS form

OASIS Summary for wessexar1-519437

OASIS ID (UID)	wessexar1-519437
Project Name	Geophysical Survey at Oaklands Farm, Derbyshire,
Sitename	Oaklands Farm, Derbyshire,
Sitecode	262680
Project Identifier(s)	Oaklands Farm, Derbyshire, 262680
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Planning Id	
Reason For Investigation	Planning: Pre application
Organisation Responsible for work	Wessex Archaeology
Project Dates	08-Jun-2022 - 05-Sep-2023
Location	<p>Oaklands Farm, Derbyshire, NGR : SK 23071 16710 LL : 52.747521237692844, -1.659661204505922 12 Fig : 423071,316710</p> <p>NGR : SK 23675 18228 LL : 52.76114450084254, -1.650607177802163 12 Fig : 423675,318228</p> <p>NGR : SK 22895 16036 LL : 52.74147199463079, -1.662314297437142 12 Fig : 422895,316036</p>
Administrative Areas	<p>Country : England County : Derbyshire District : South Derbyshire Parish : Rosliston Parish : Walton upon Trent Parish : Drakelow</p>
Project Methodology	<p>The cart-based gradiometer system used a Carlson RTK GNSS instrument, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS) and Leica Geosystems. Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceeds European Archaeologiae Consilium recommendations (Schmidt et al. 2015).</p> <p>The detailed gradiometer survey was undertaken using four SenSys FGM650/3 magnetic gradiometers spaced at 0.5 m or 1 m intervals and mounted on a non-magnetic cart. Data were collected with an effective sensitivity of $\pm 8 \mu\text{T} \pm 1000 \text{ nT}$ at a rate of 100 Hz, producing intervals of 0.02 m along transects spaced 4 m apart.</p>

Project Results	<p>Two potential enclosures of unknown origin have been identified, one rectangular and one circular. The orientation of the rectangular enclosure respects the alignment of a nearby former field boundary, which may imply a date roughly contemporary with the field boundary, although without further investigation this is difficult to say with certainty. The circular enclosure is more fragmentary, making its provenance as an enclosure less certain.</p> <p>Other isolated anomalies have been interpreted as potentially archaeological. These most likely relate to former field boundaries not present on available mapping.</p> <p>Multiple former field boundaries corresponding to those on historical OS mapping have been identified across the site. A trackway has similarly been identified.</p> <p>The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing, drainage, trackways, and services.</p>
Keywords	
Funder	Private or public corporation Land Use Consultants Ltd
HER	Derbyshire County Council - unRev - STANDARD
Person Responsible for work	Tom Richardson
HER Identifiers	
Archives	



Coordinate system: OSGB 1936 British National Grid

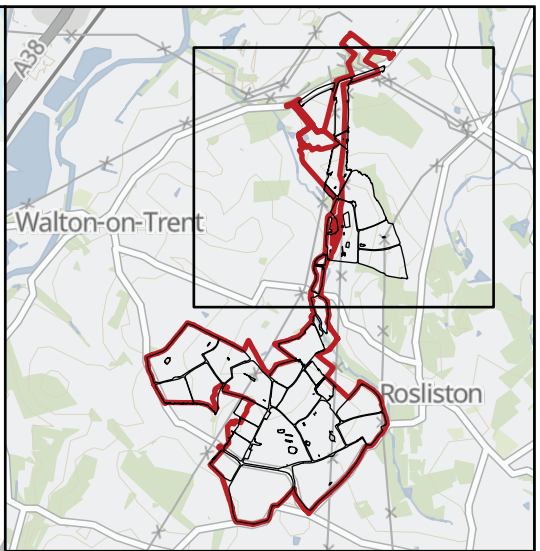
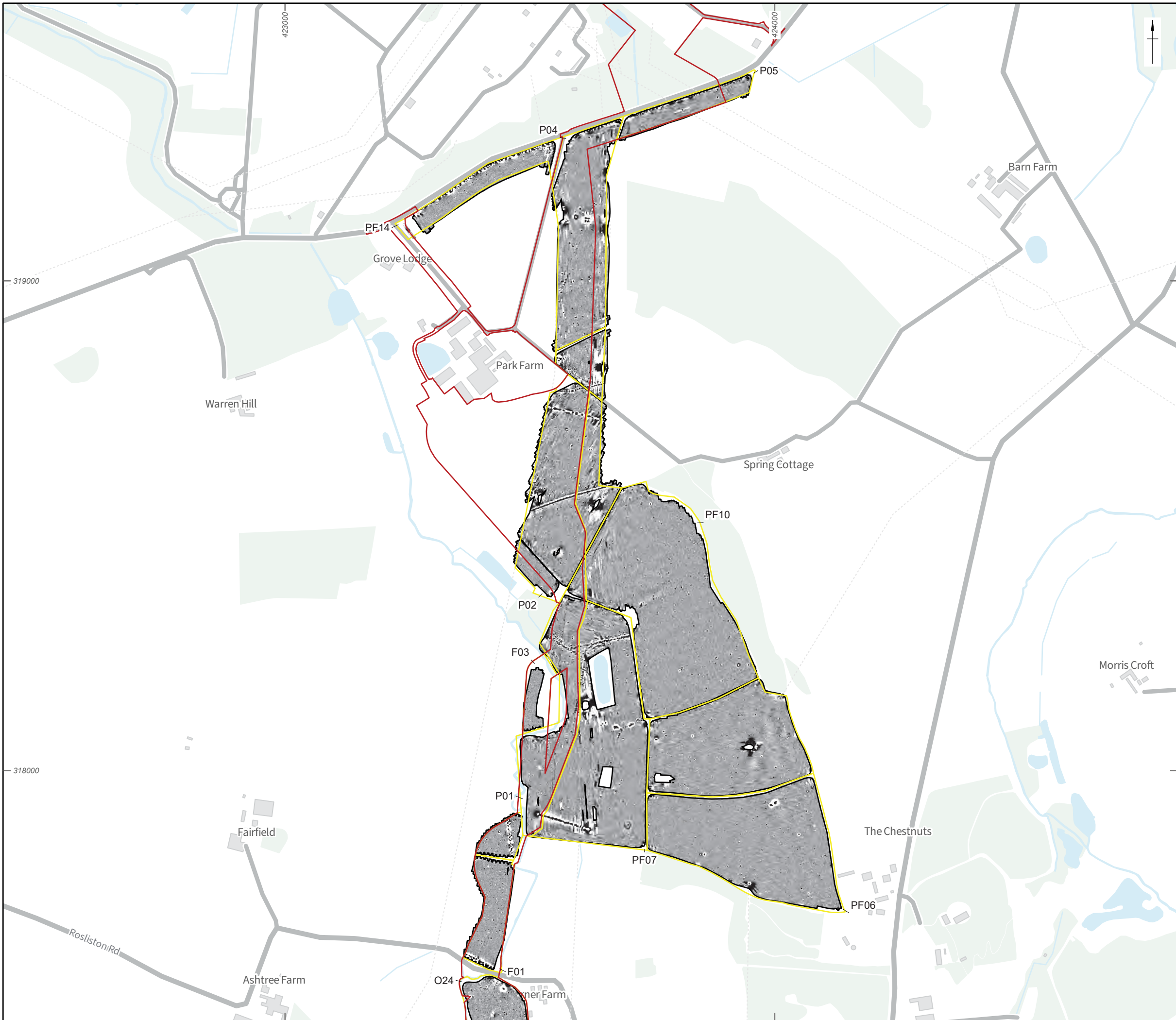
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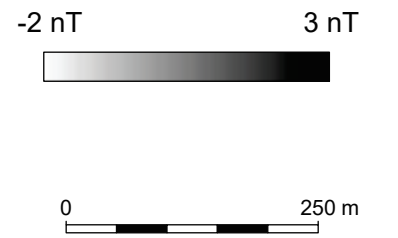
Figure 1: Site location and survey extent



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- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



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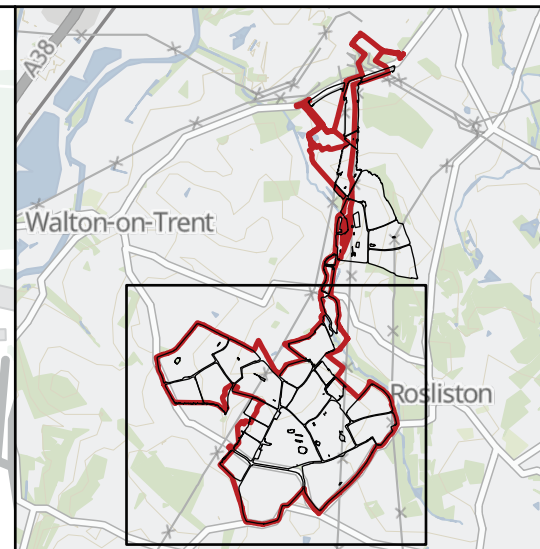
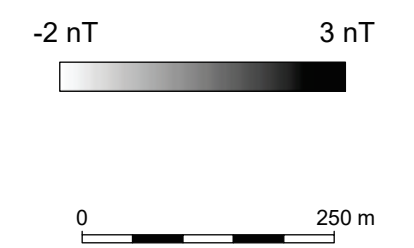
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Figure 2: Detailed gradiometer survey results: Overview greyscale plot



- ▭ Site boundary
- ▭ Land parcel
- Detailed survey extent



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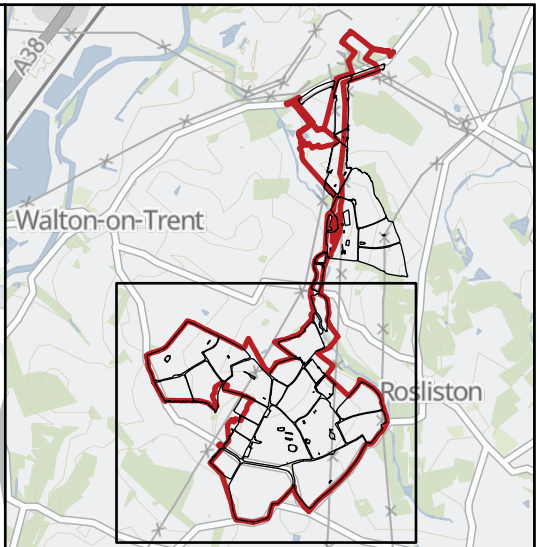
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Figure 4: Detailed gradiometer survey results: Overview greyscale plot



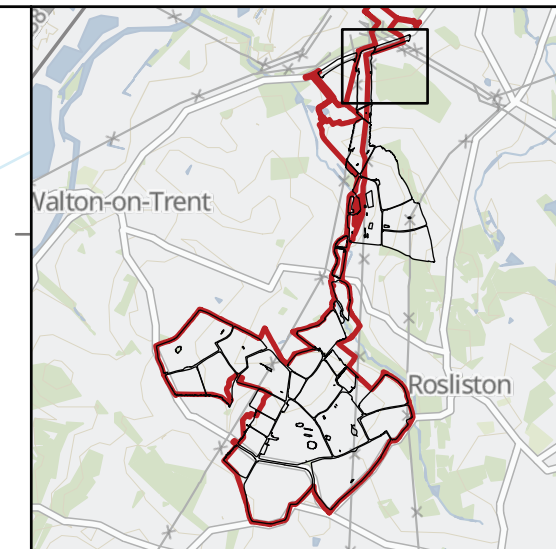
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- ▬ Land parcel
- Detailed survey extent
- Possible archaeology
- ▬ Former field boundary
- ▬ Historic cultivation
- ▬ Trend
- ▬ Drain
- ▬ Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- ▬ Modern service



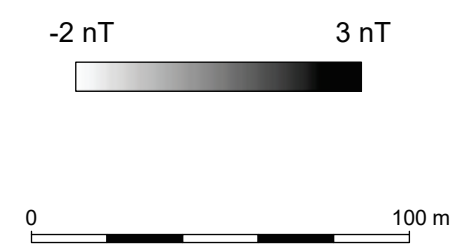
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Figure 5: Detailed gradiometer survey results: Over interpretation



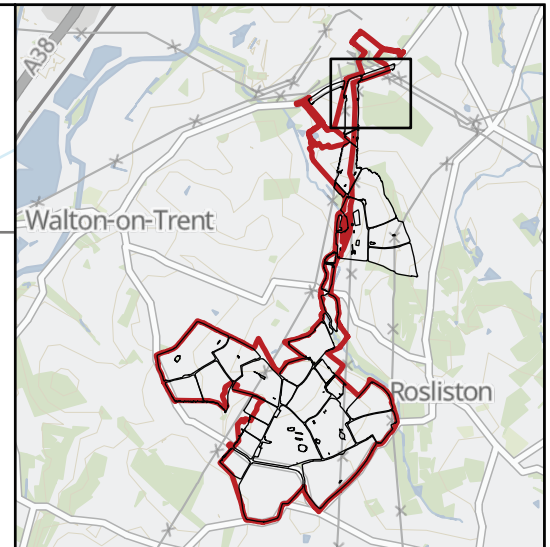
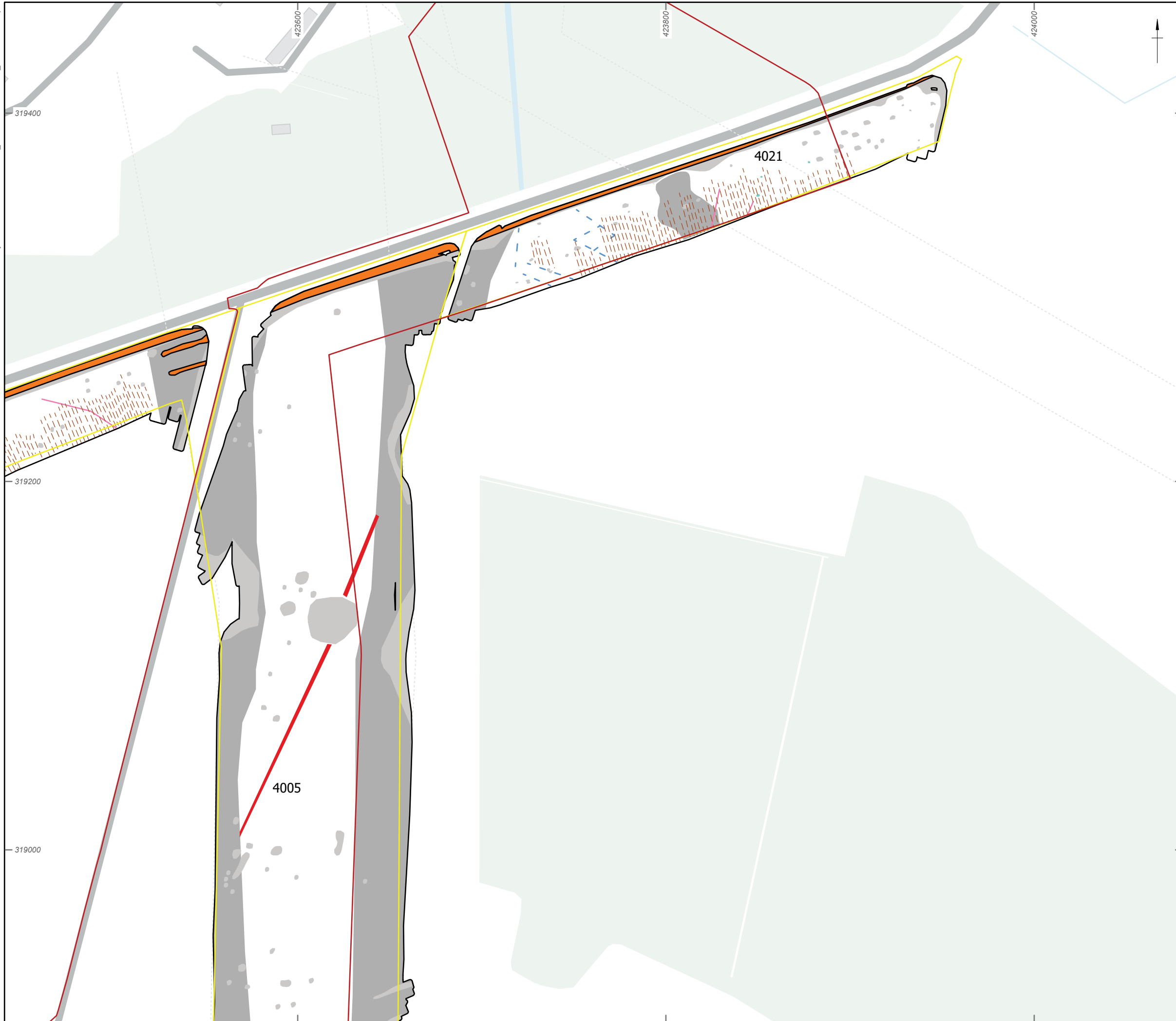
- Site boundary
- Land parcel
- Detailed survey extent



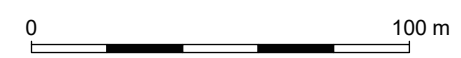
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Figure 6: Detailed gradiometer survey results: greyscale plot (P05, PF14)



- Site boundary
- Land parcel
- Detailed survey extent
- Possible archaeology
- Former field boundary
- Trend
- Drain
- Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service



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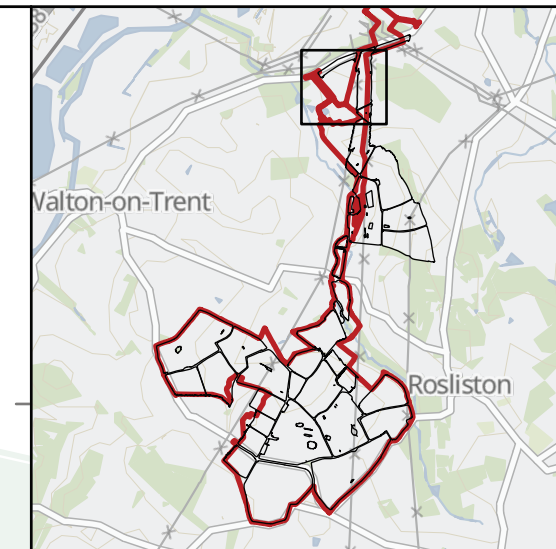
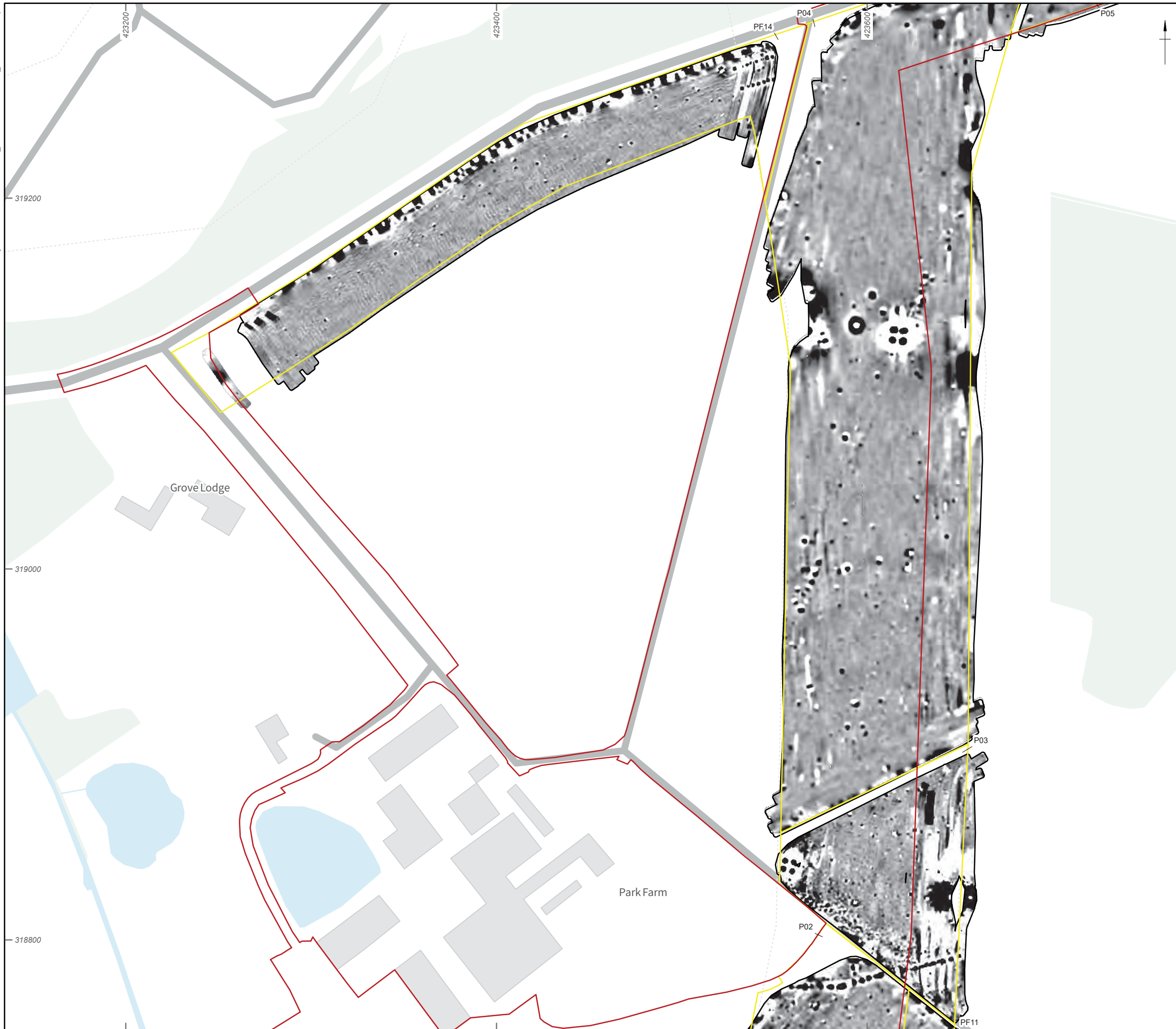
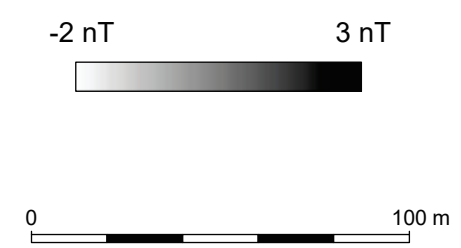
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Figure 7: Detailed gradiometer survey results: interpretation PF14)



- ▭ Site boundary
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- Detailed survey extent



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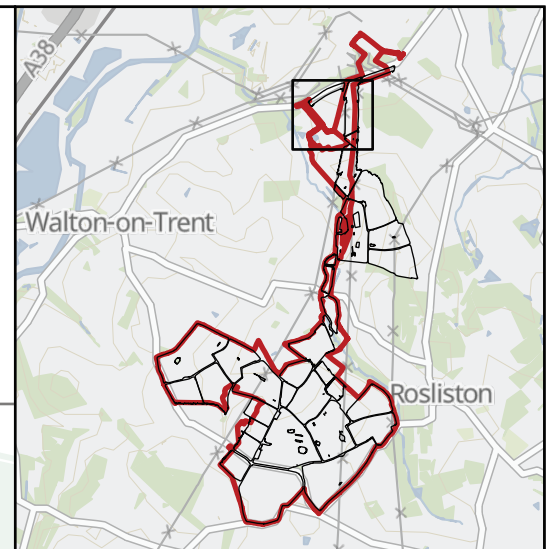
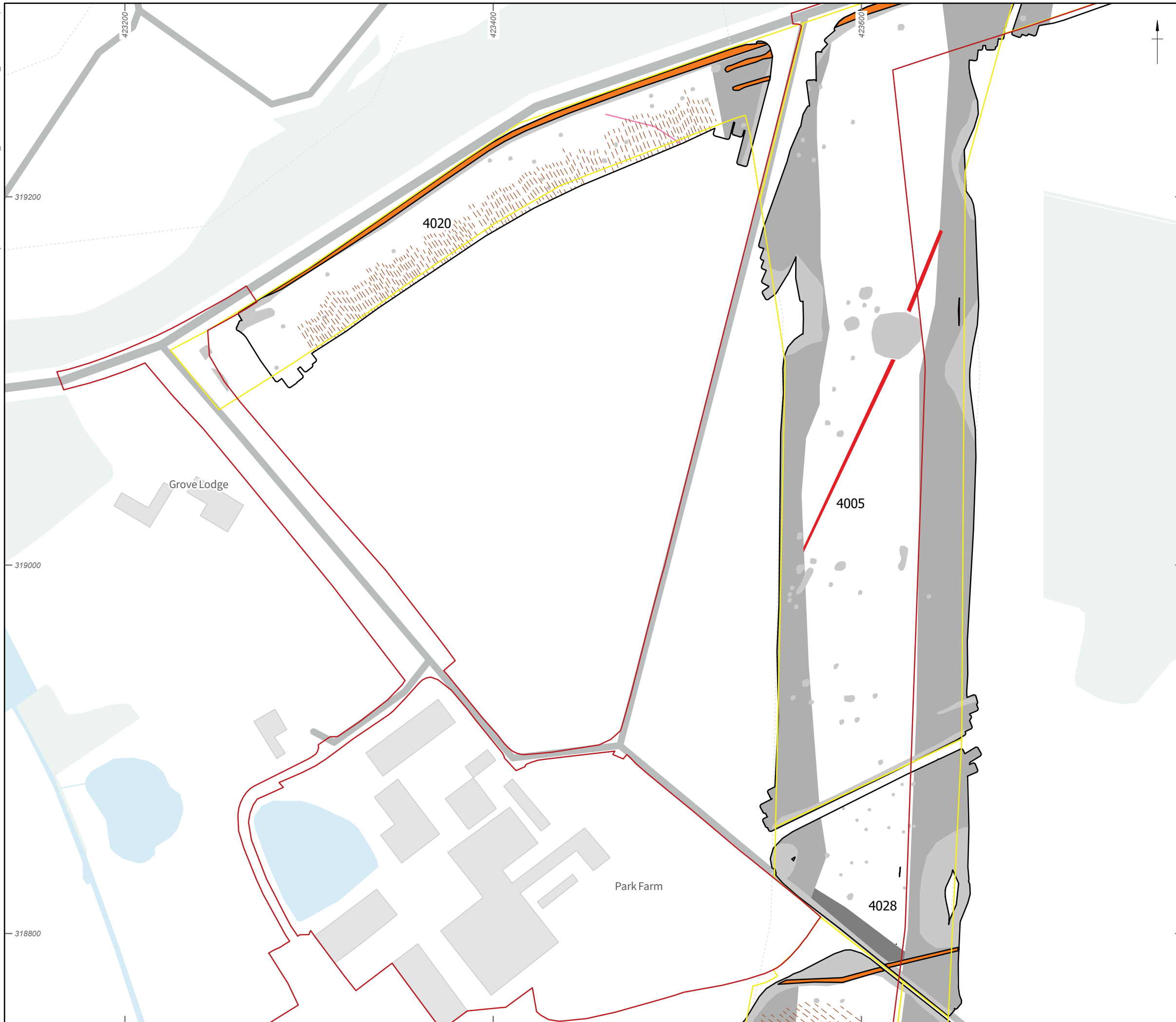
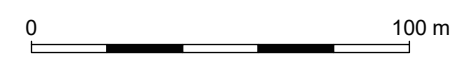
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Figure 8: Detailed gradiometer survey results: greyscale plot (P03, P04, PF14)



- ▬ Site boundary
- ▬ Land parcel
- Detailed survey extent
- Possible archaeology
- ▬ Former field boundary
- ▬ Trend
- - Drain
- ▬ Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service



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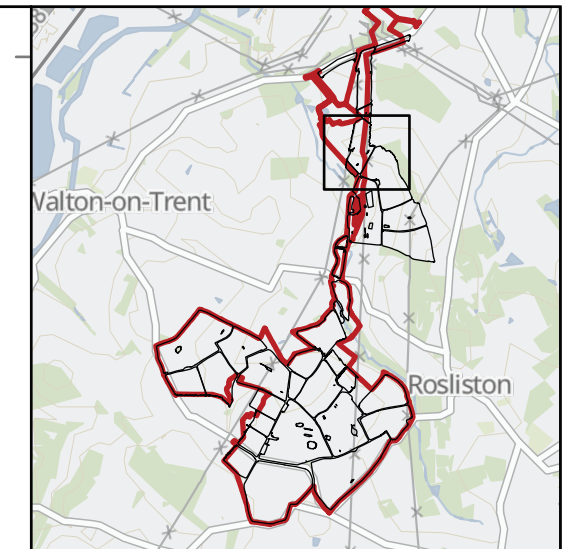
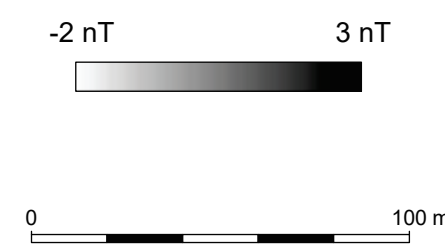
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Figure 9: Detailed gradiometer survey results: interpretation P04, PF14)



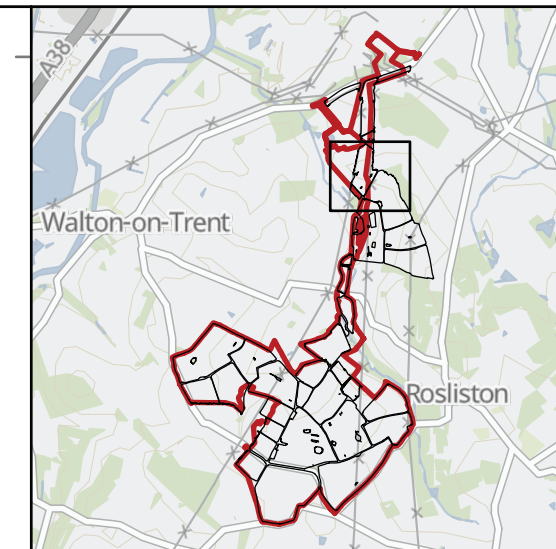
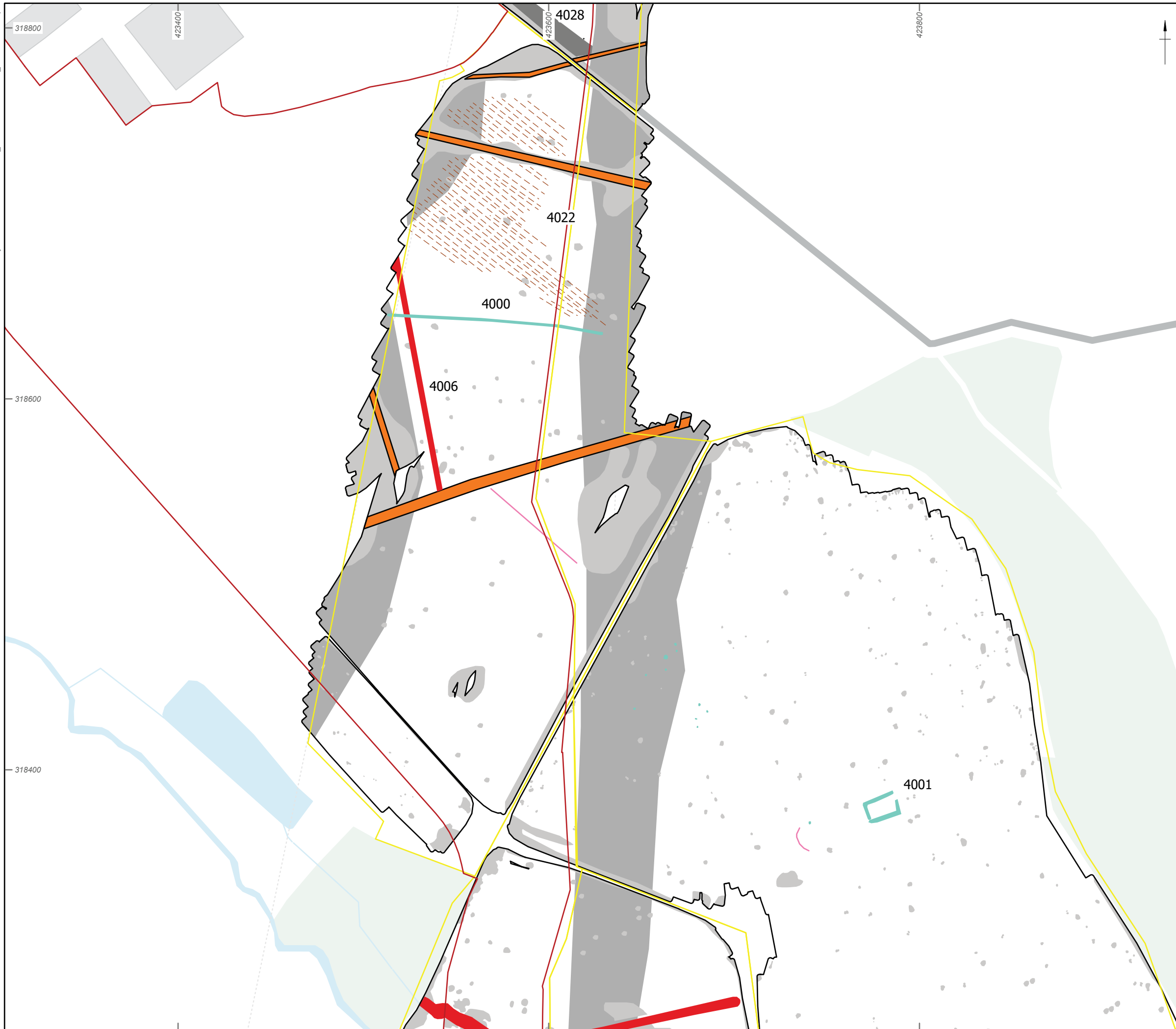
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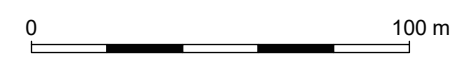
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Figure 10: Detailed gradiometer survey results: greyscale plot (P01, P02, PF10, PF11)



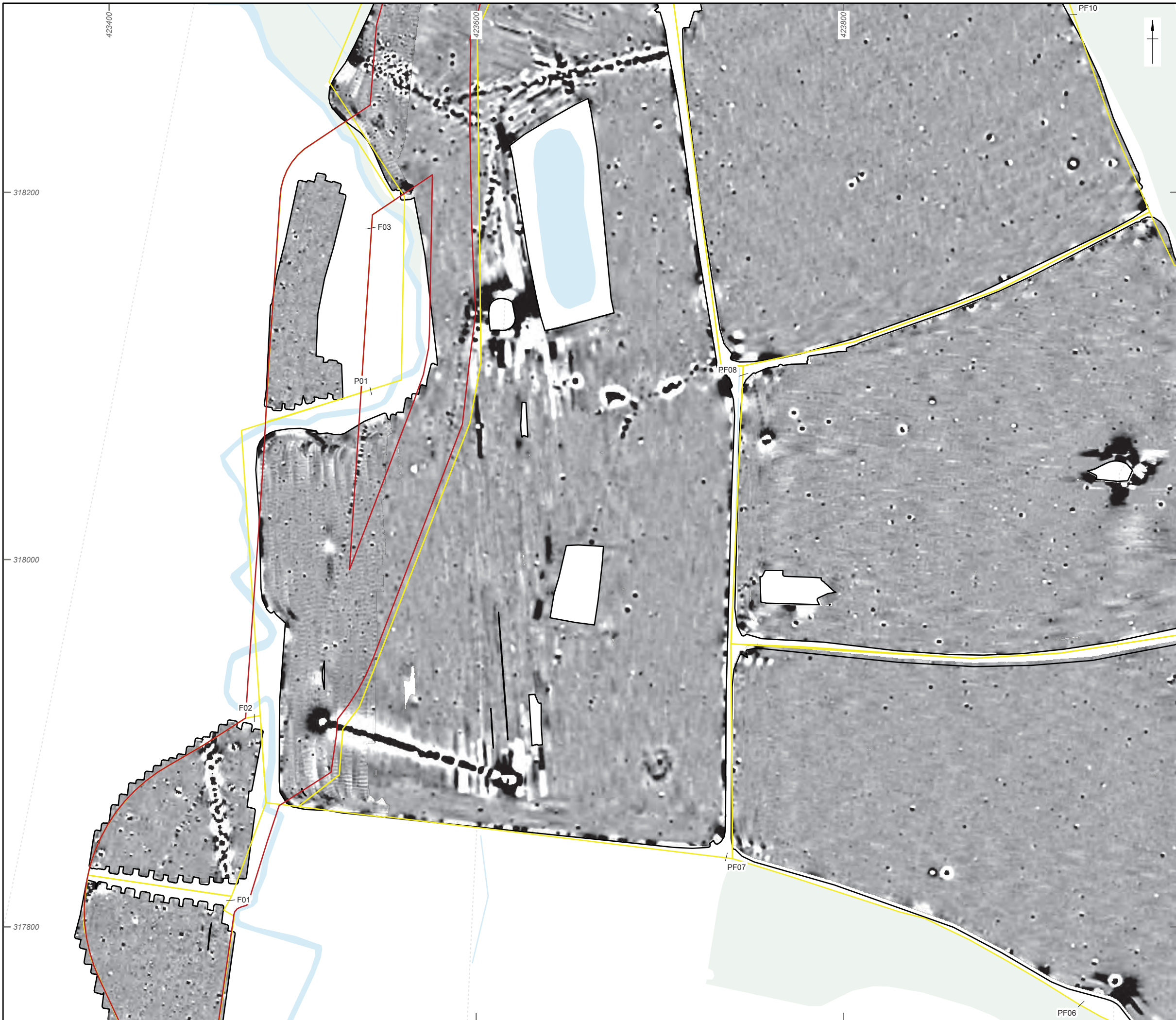
- Site boundary
- Land parcel
- Detailed survey extent
- Possible archaeology
- Former field boundary
- Trend
- Drain
- Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service



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Figure 11: Detailed gradiometer survey results: interpretation P02, PF10, PF11)



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- ▭ Detailed survey extent



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Figure 12: Detailed gradiometer survey results: greyscale plot (F01, F02, F03,P01,PF06, PF07, PF08, PF10)



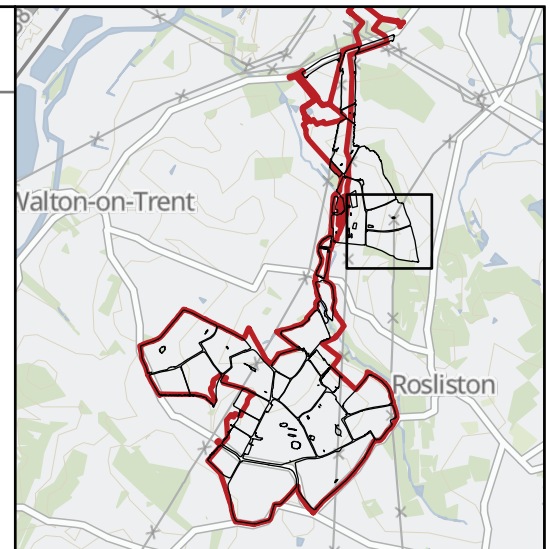
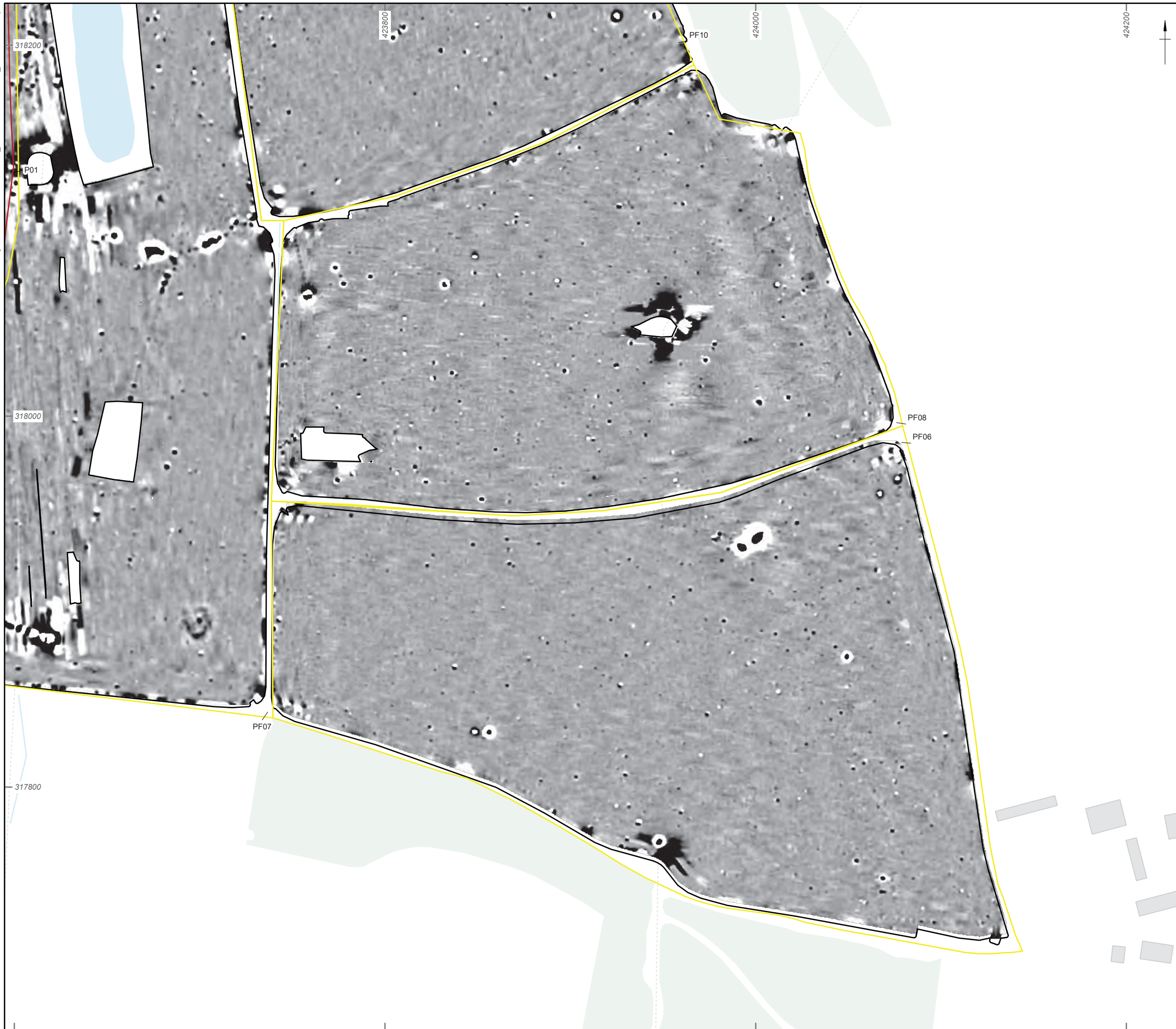
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- Former field boundary
- Trend
- - - Drain
- Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service



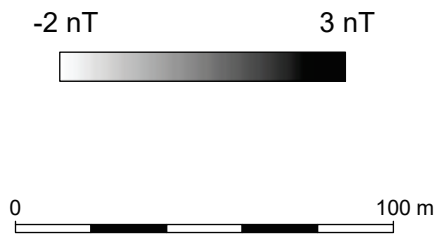
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Figure 13: Detailed gradiometer survey results: interpretation F02, F03,P01,PF06, PF07, PF08, PF10)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



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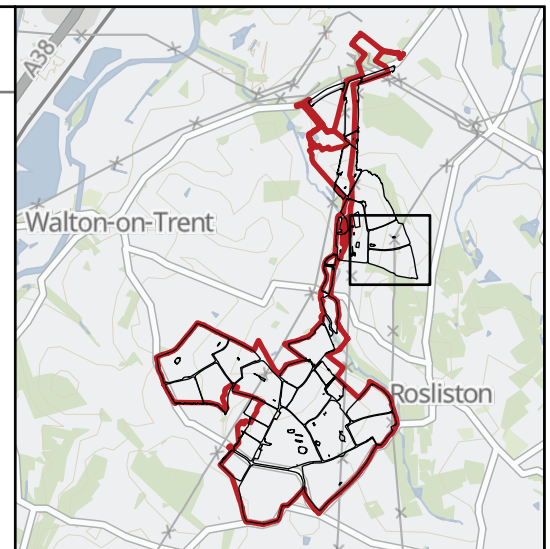
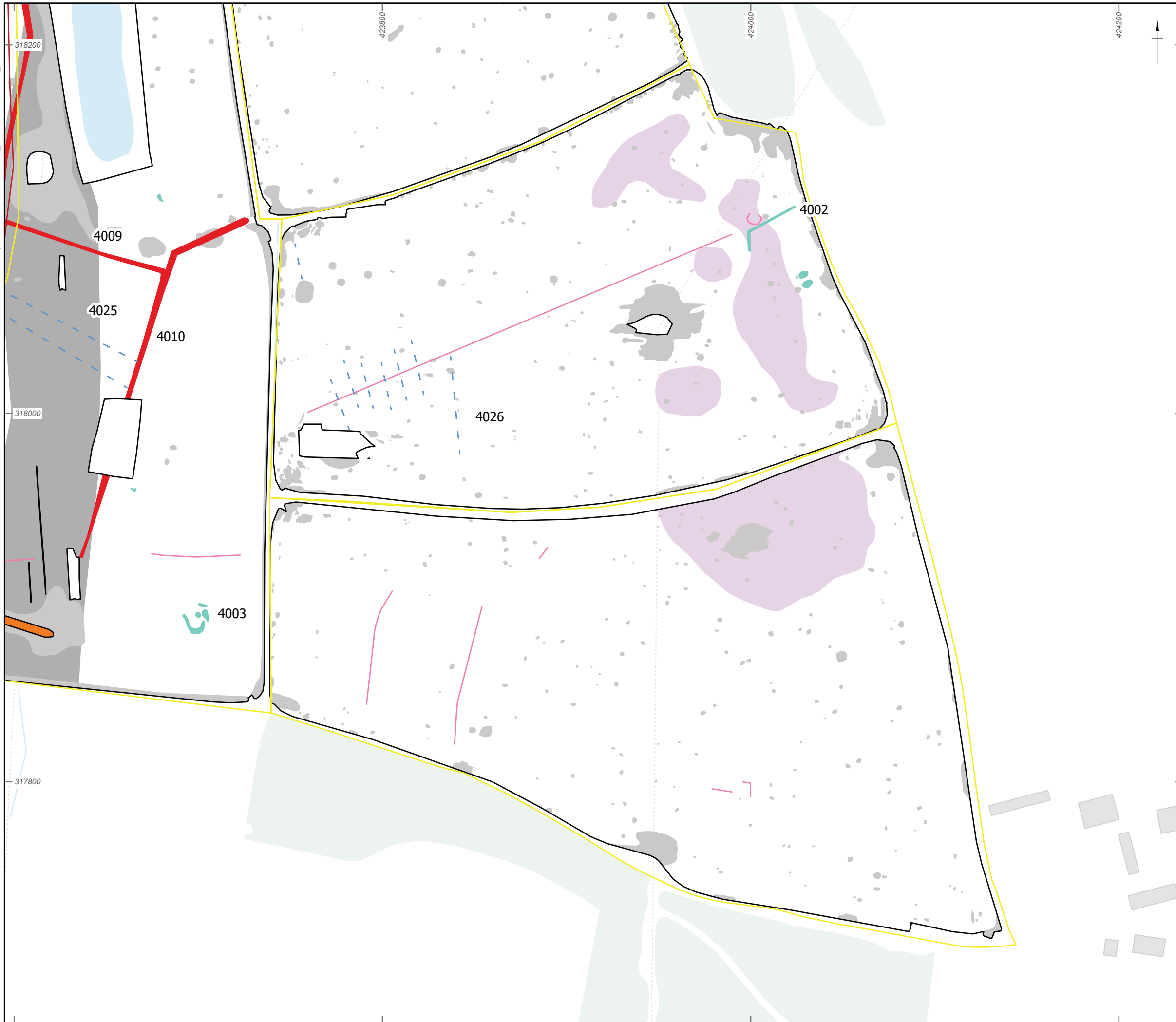
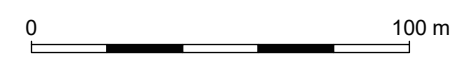
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Scale: 1:2,000	Revision: 0	

Figure 14: Detailed gradiometer survey results: greyscale plot (P6, P8)

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- Site boundary
- Land parcel
- Detailed survey extent
- Possible archaeology
- Former field boundary
- Trend
- Drain
- Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service



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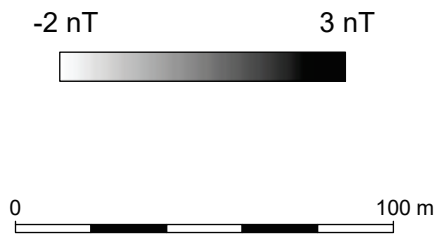
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Figure 15: Detailed gradiometer survey results: interpretatio P8)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



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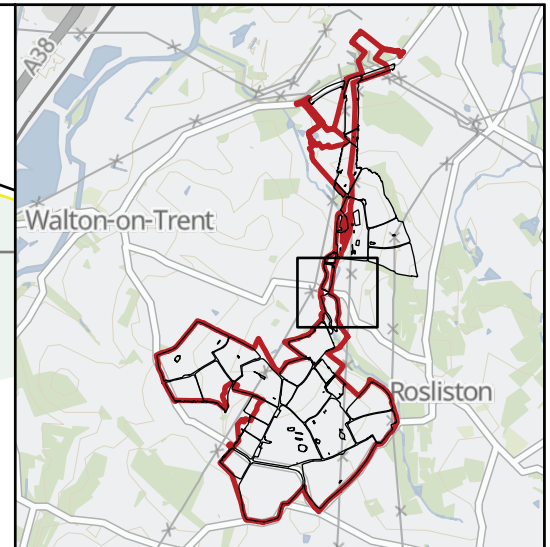
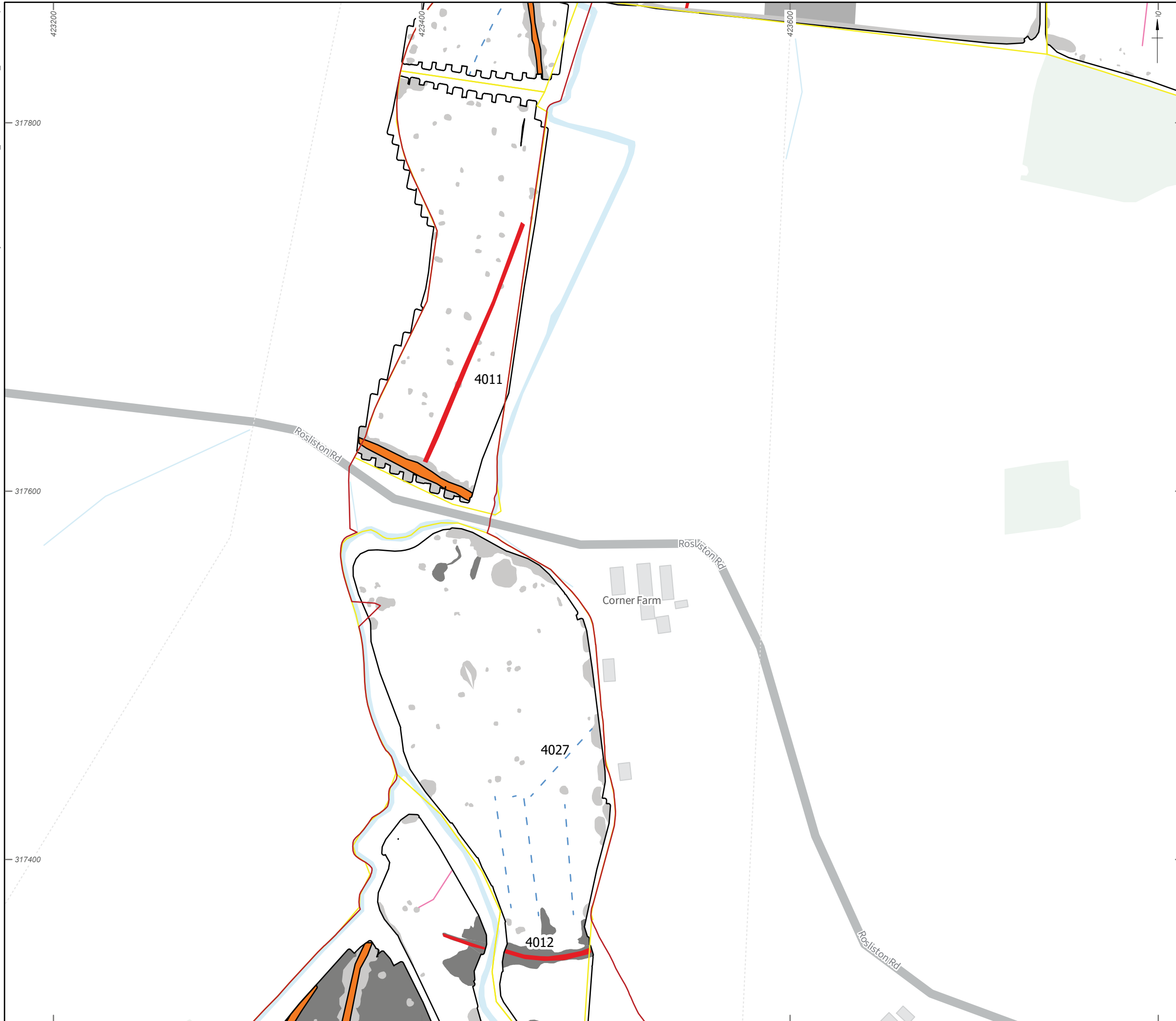
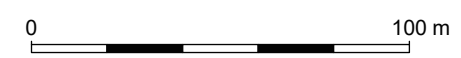
Date: 23/11/2023	Created by: RP	
Scale: 1:2,000	Revision: 0	

Figure 16: Detailed gradiometer survey results: greyscale plot (F01, O23, O24)



- ▬ Site boundary
- ▬ Land parcel
- Detailed survey extent
- Possible archaeology
- ▬ Former field boundary
- ▬ Trend
- ▬ Drain
- ▬ Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service



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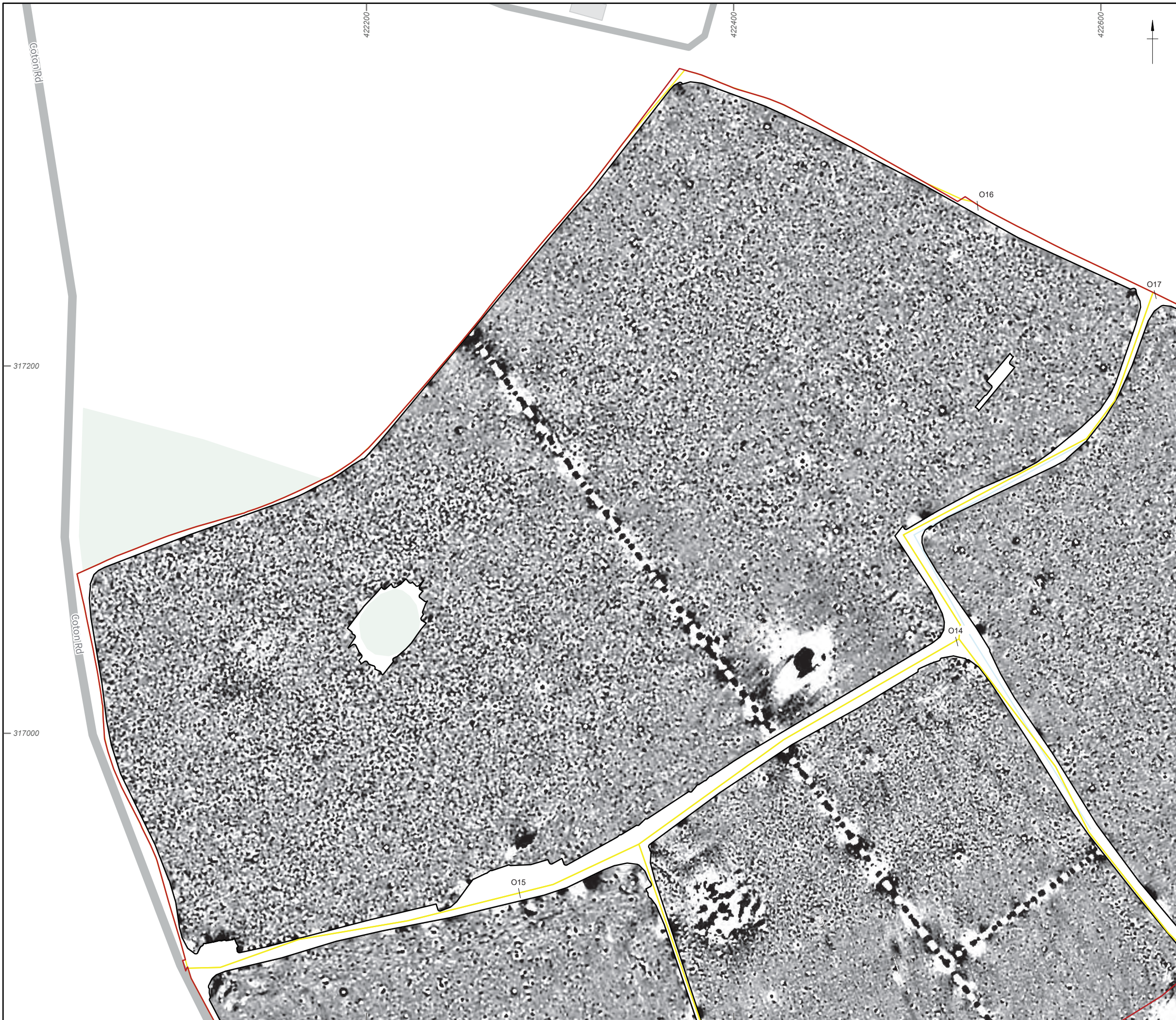
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Figure 17: Detailed gradiometer survey results: interpretation (O23, O24)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



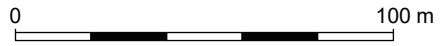
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Figure 18: Detailed gradiometer survey results: greyscale plot (O14, O15, O16, O17)



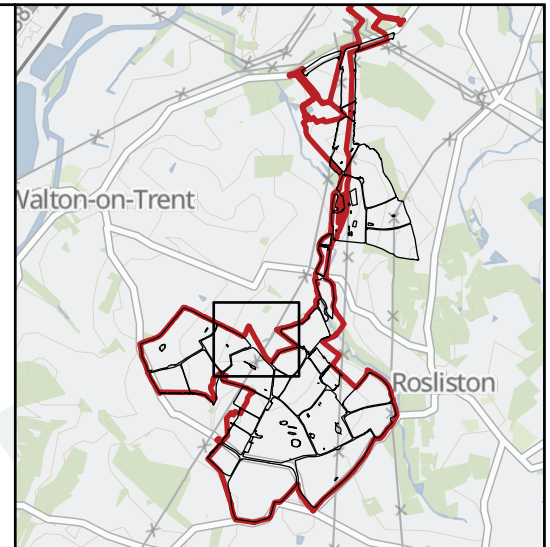
- Site boundary
- Land parcel
- Detailed survey extent
- Possible archaeology
- Former field boundary
- Trend
- Drain
- Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service



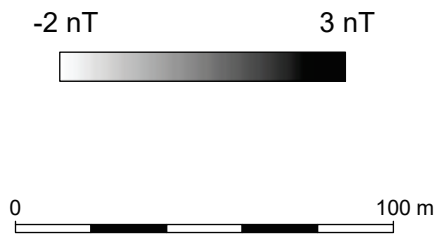
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Figure 19: Detailed gradiometer survey results: interpretation O15, O16, O17)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



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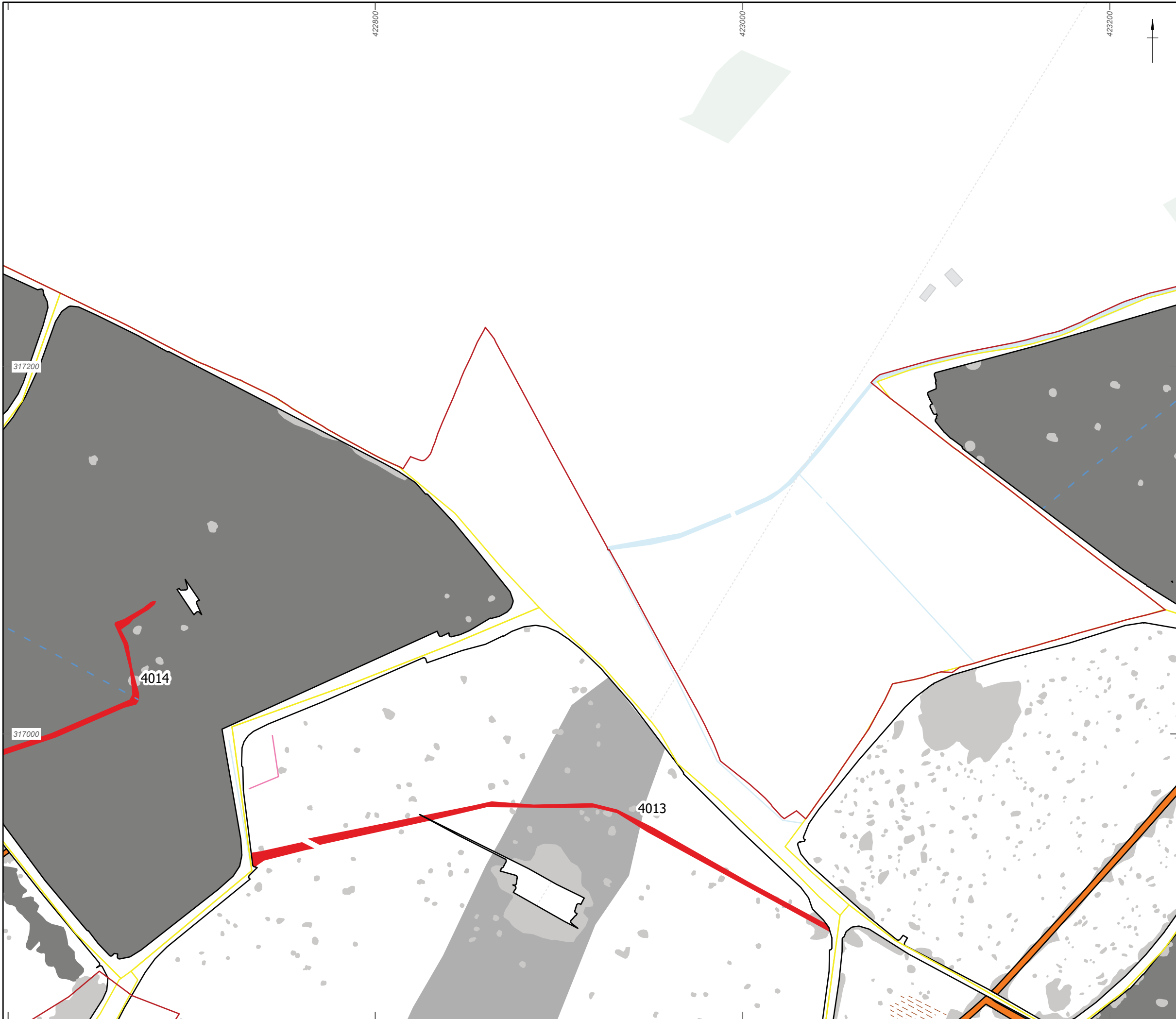
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Scale: 1:2,000	Revision: 0	

Figure 20: Detailed gradiometer survey results: greyscale plot (O13, O17, O19, O22)



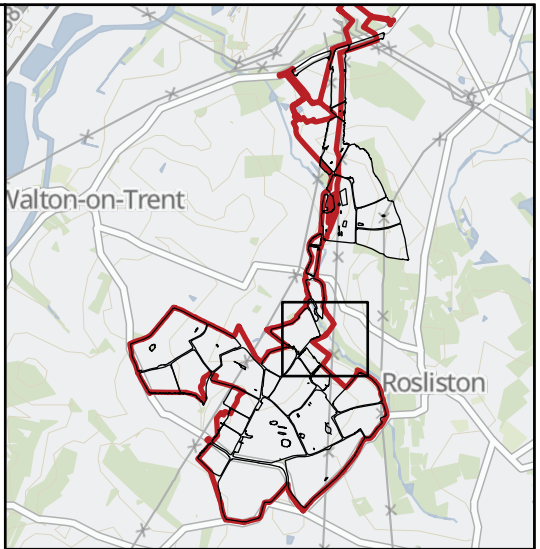
- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent
- ▭ Possible archaeology
- ▭ Former field boundary
- ▭ Trend
- Drain
- Agricultural feature
- ▭ Increased response
- ▭ Geology
- ▭ Ferrous
- ▭ Increased response - Powerlines
- ▭ Modern service



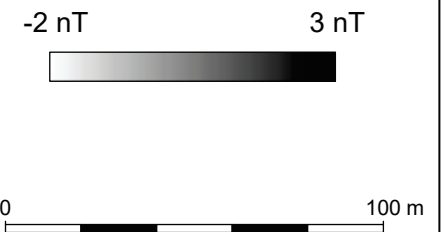
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Figure 21: Detailed gradiometer survey results: interpretation O17, O19, O22)



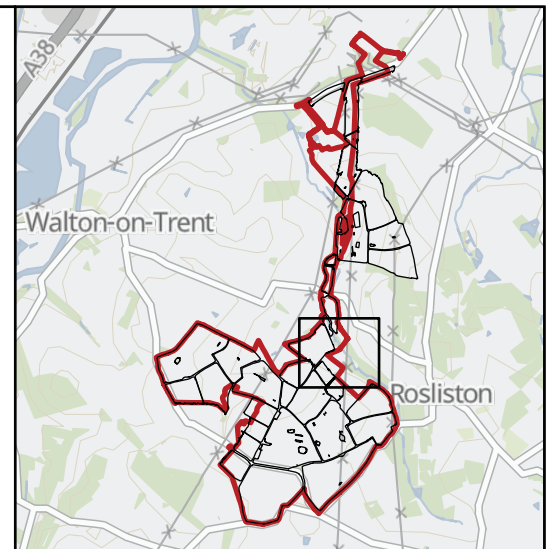
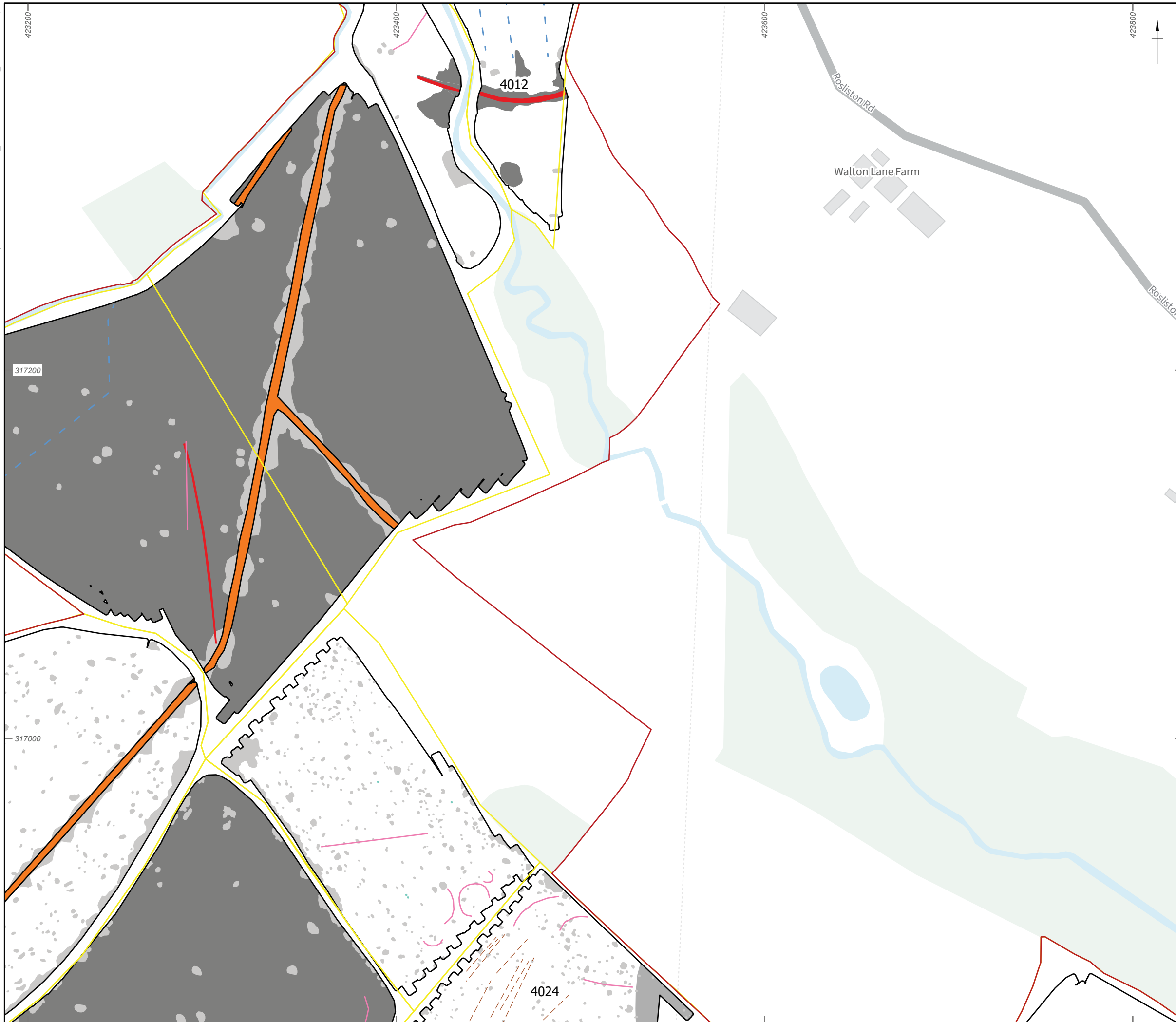
- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



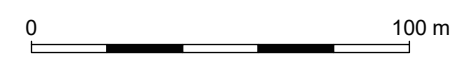
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Figure 22: Detailed gradiometer survey results: greyscale plot (O10, O11 O19, O20, O22)



- Site boundary
- Land parcel
- Detailed survey extent
- Possible archaeology
- Former field boundary
- Trend
- Drain
- Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service



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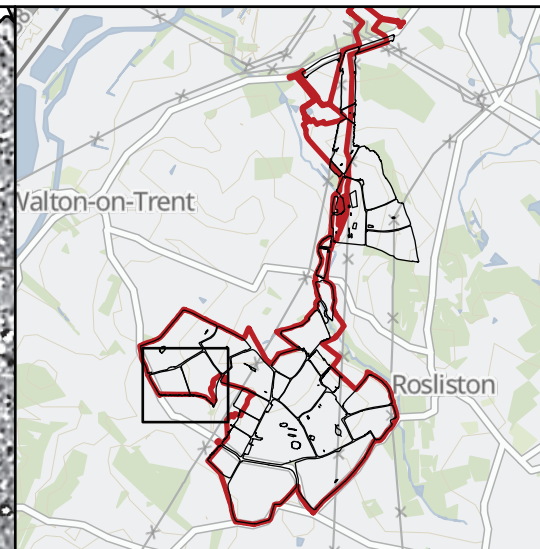
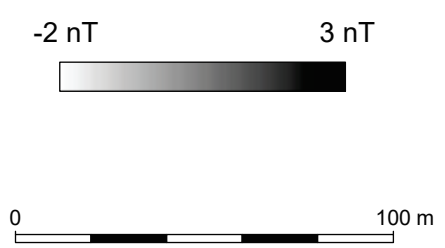
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Figure 23: Detailed gradiometer survey results: interpretation O11 O19, O20, O22)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



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Figure 24: Detailed gradiometer survey results: greyscale plot (O14, O15, O16)

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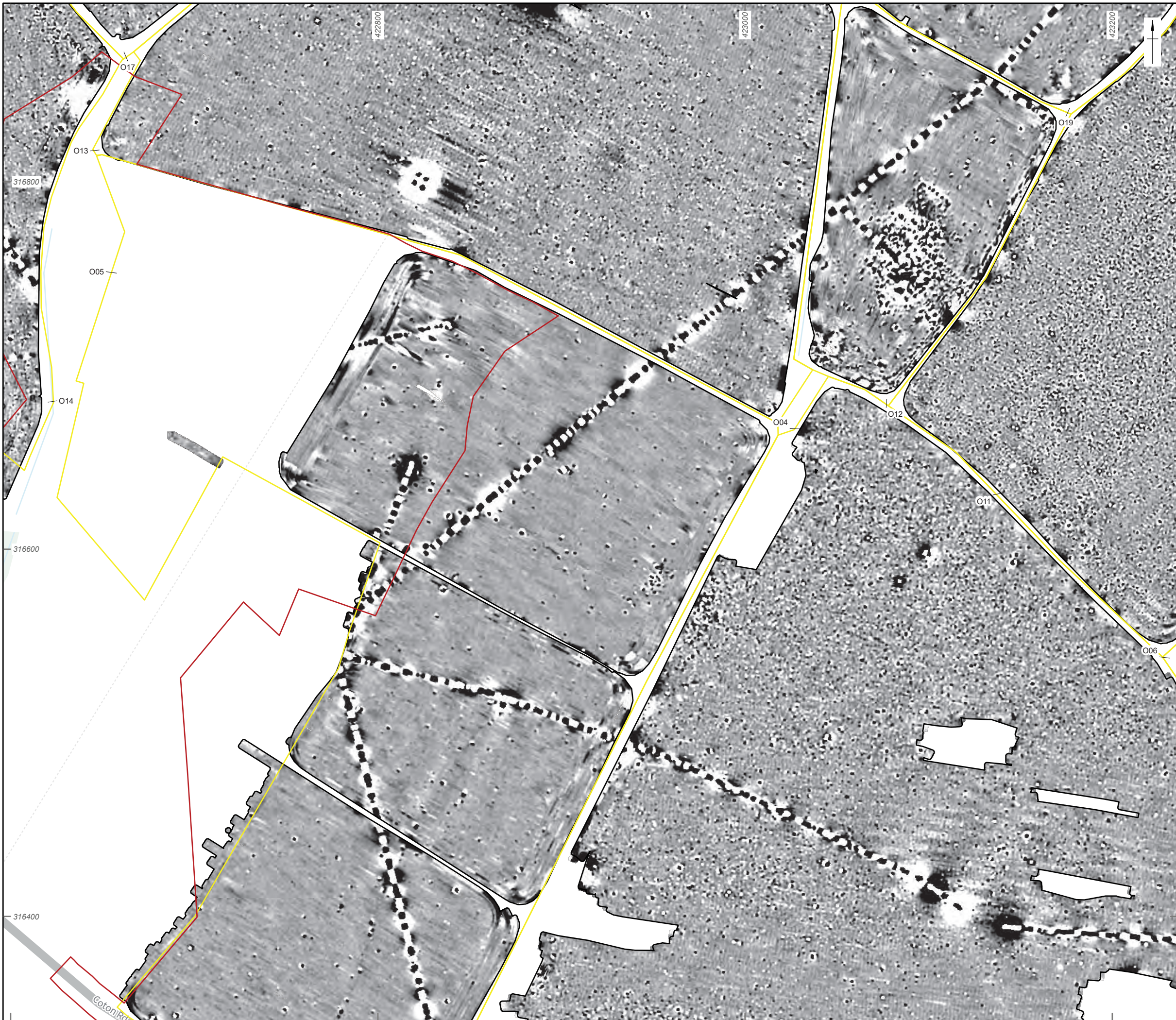
- Site boundary
- Land parcel
- Detailed survey extent
- Possible archaeology
- Former field boundary
- Trend
- Drain
- Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service

0 100 m

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Figure 25: Detailed gradiometer survey results: interpretation O15, O16)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent

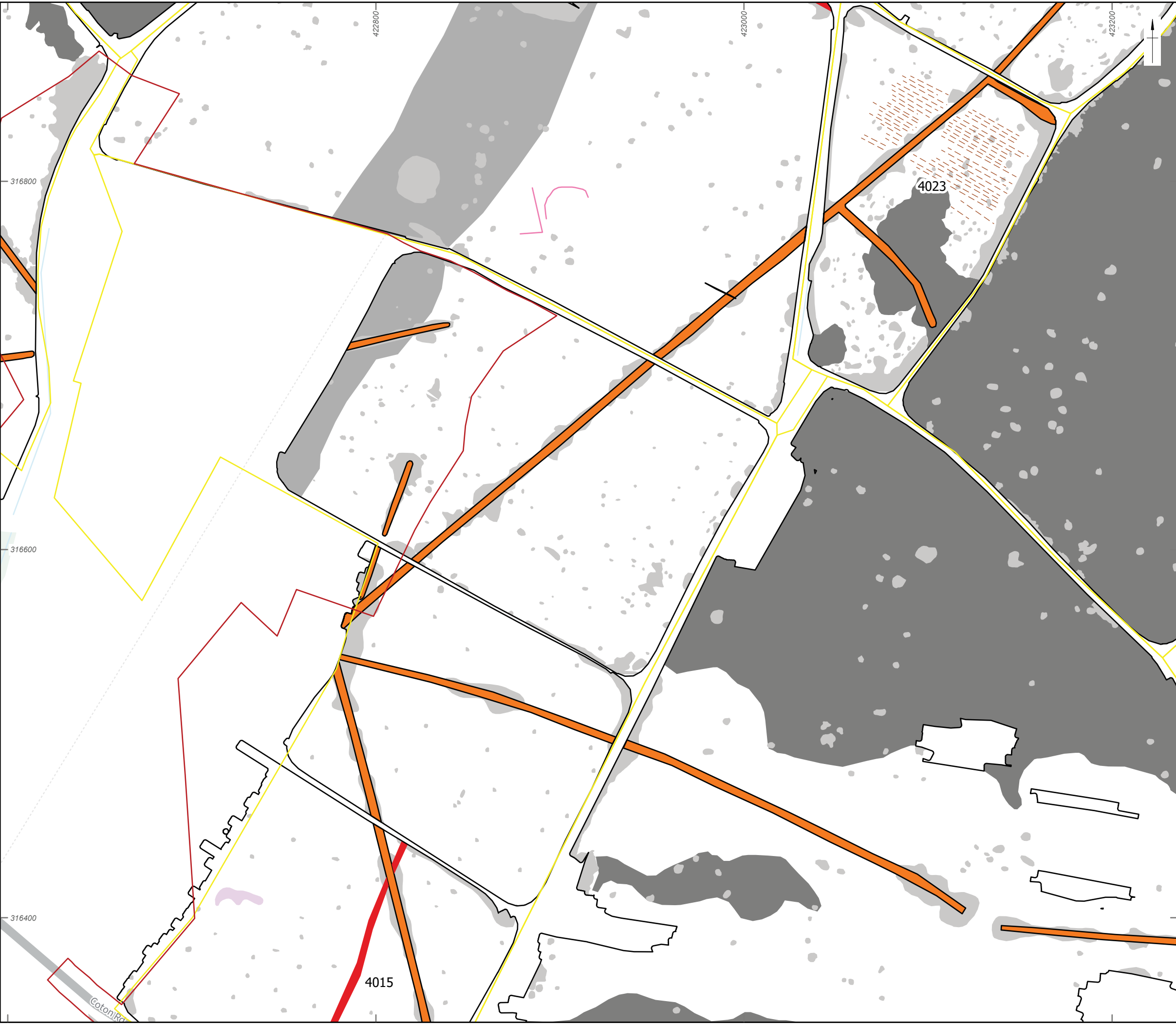


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Figure 26: Detailed gradiometer survey results: greyscale plot (O4, O5, O11, O12, O13)

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- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent
- ▭ Possible archaeology
- ▭ Former field boundary
- ▭ Trend
- - - Drain
- - - Agricultural feature
- ▭ Increased response
- ▭ Ferrous
- ▭ Increased response - Powerlines
- ▭ Modern service

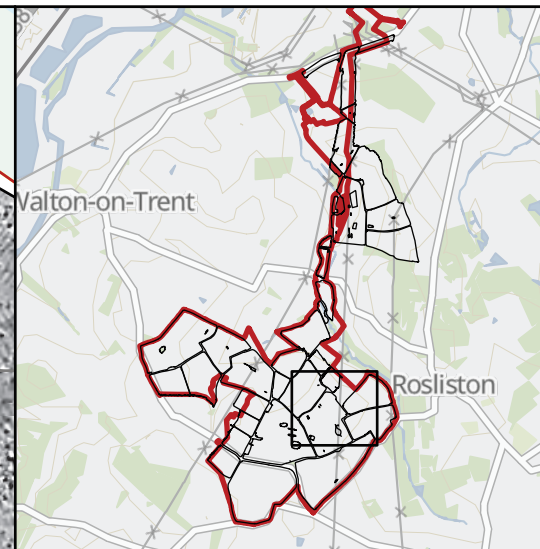
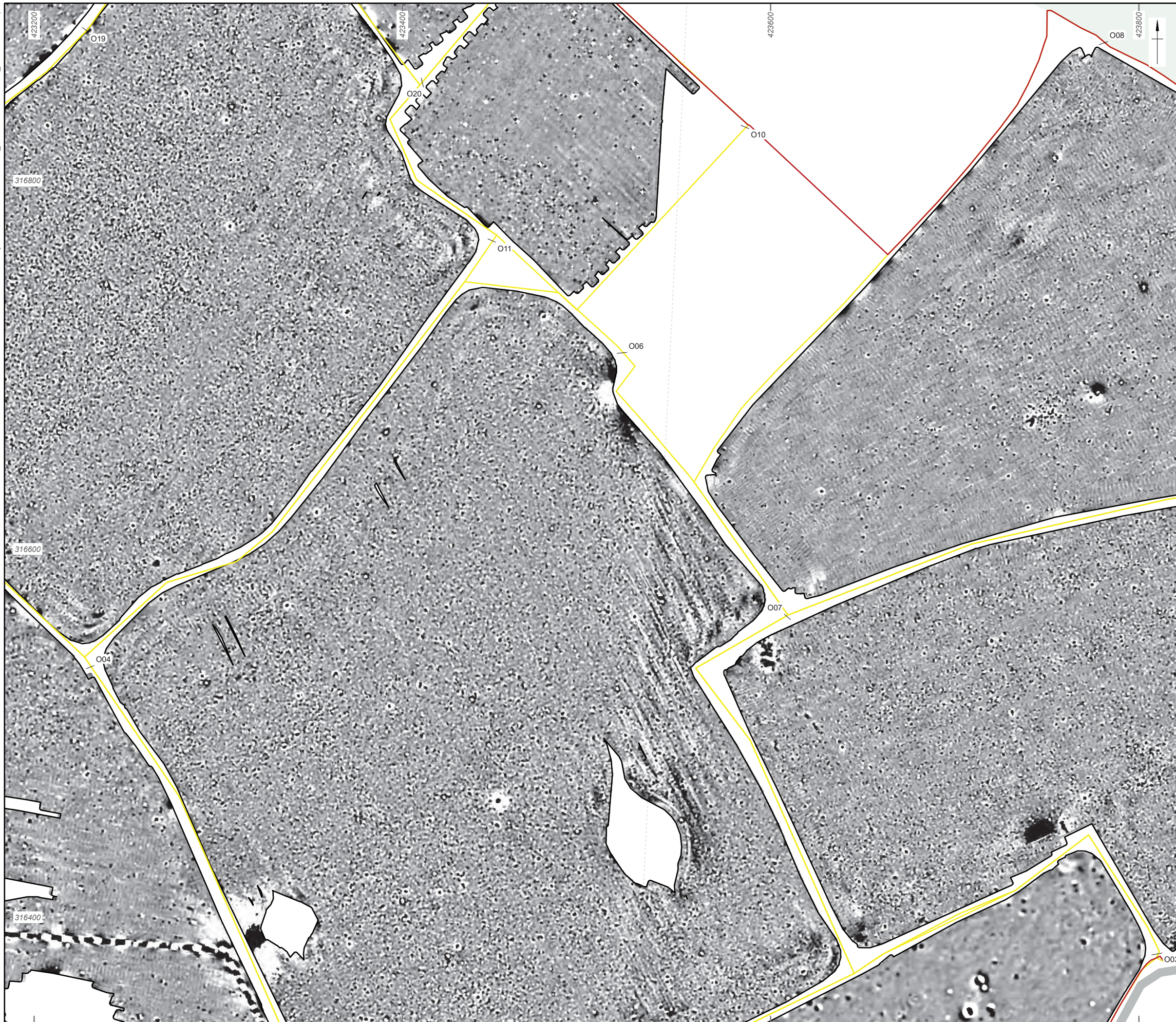
0

 100 m

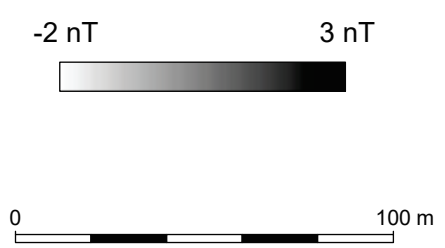
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Figure 27: Detailed gradiometer survey results: interpretation (O5, O11, O12, O13)



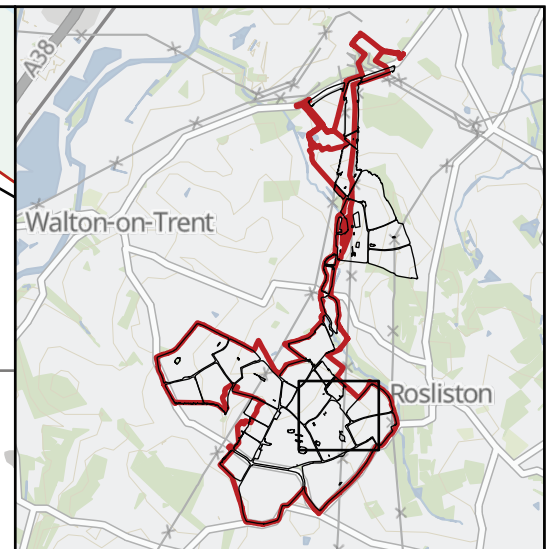
- Site boundary
- Land parcel
- Detailed survey extent



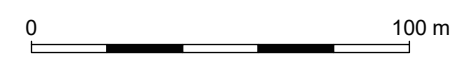
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Figure 28: Detailed gradiometer survey results: greyscale plot (O4, O6, O7, O8, O10, O11)



- ▬ Site boundary
- ▬ Land parcel
- ▭ Detailed survey extent
- Possible archaeology
- ▬ Former field boundary
- ▬ Trend
- - - Drain
- - - Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- ▬ Modern service

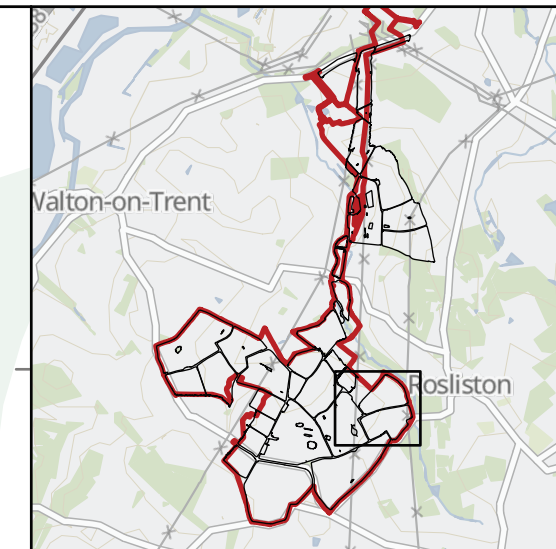
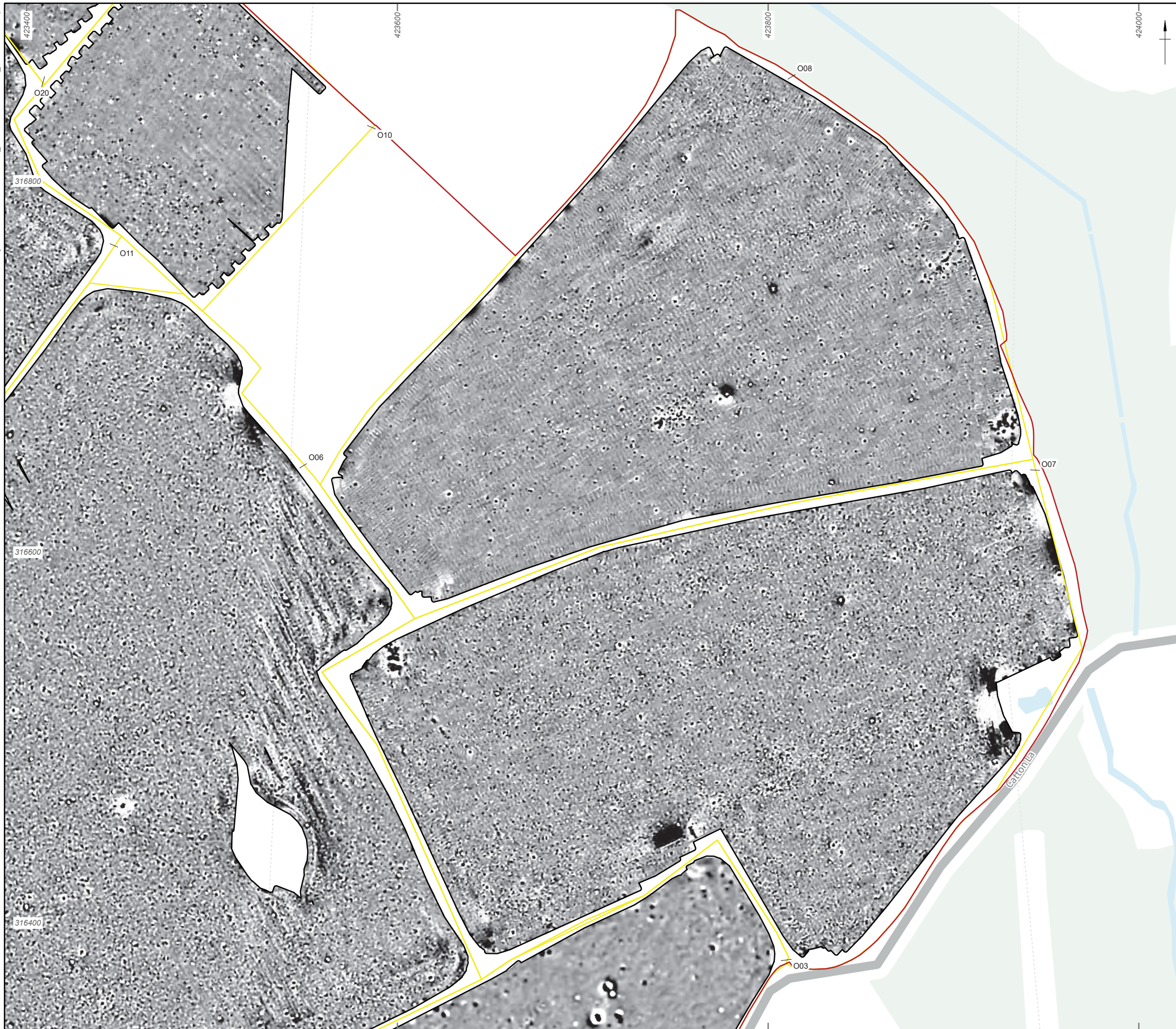


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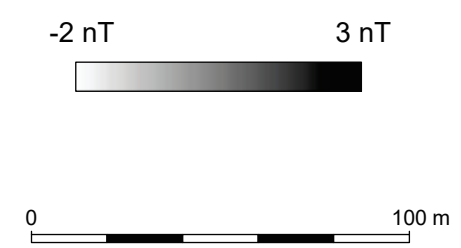
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Scale: 1:2,000	Revision: 0	

Figure 29: Detailed gradiometer survey results: interpretation O6, O7, O8, O10, O11)

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- ▭ Site boundary
- ▭ Land parcel
- Detailed survey extent

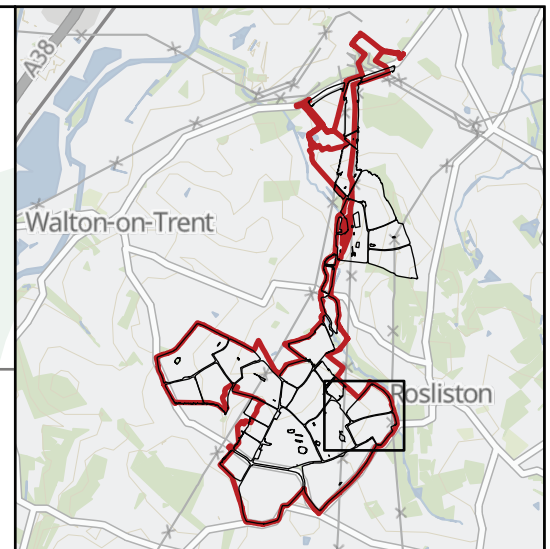
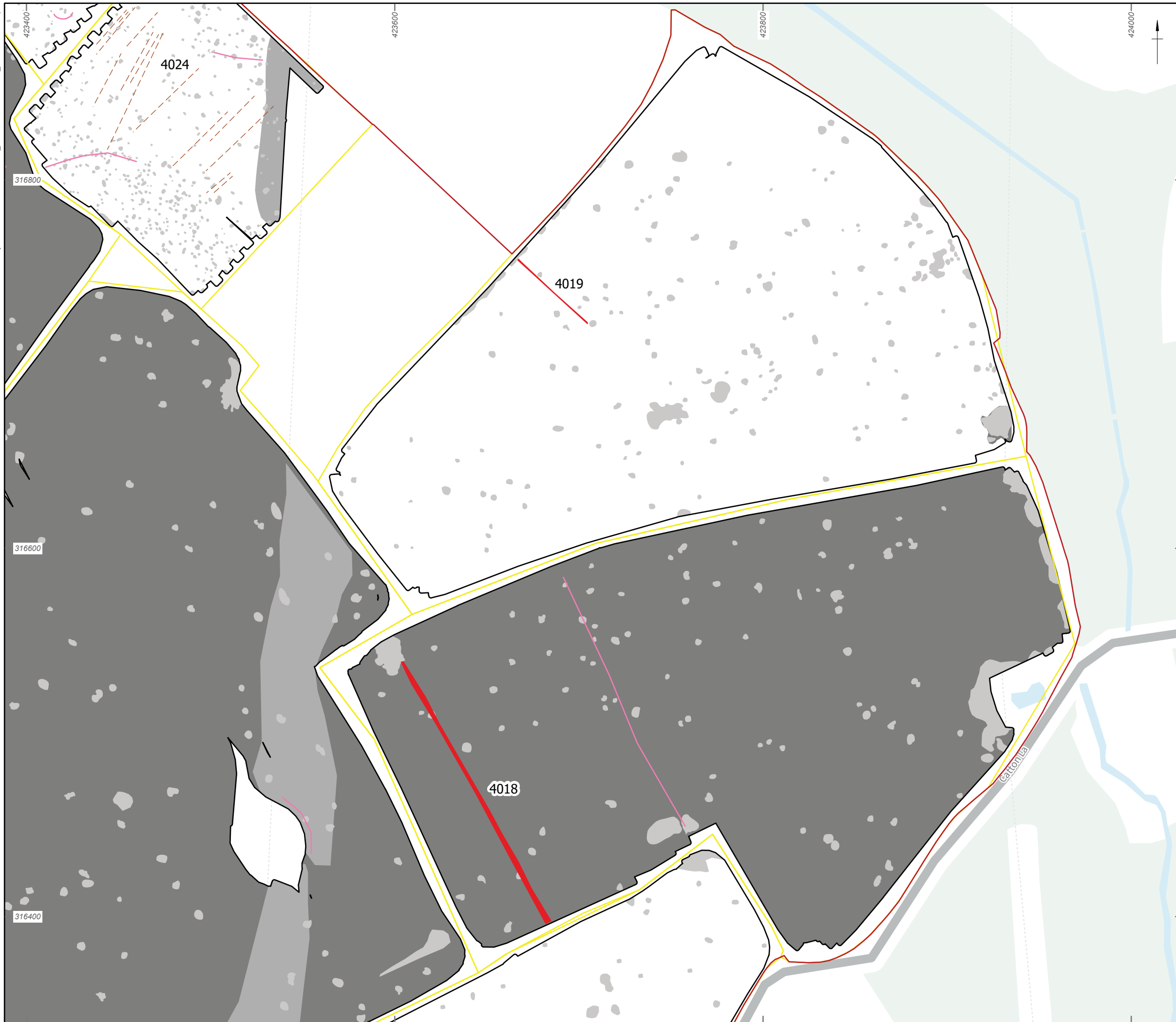


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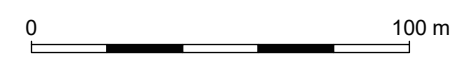
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Figure 30: Detailed gradiometer survey results: greyscale plot (O3, O6, O7, O8, O10)

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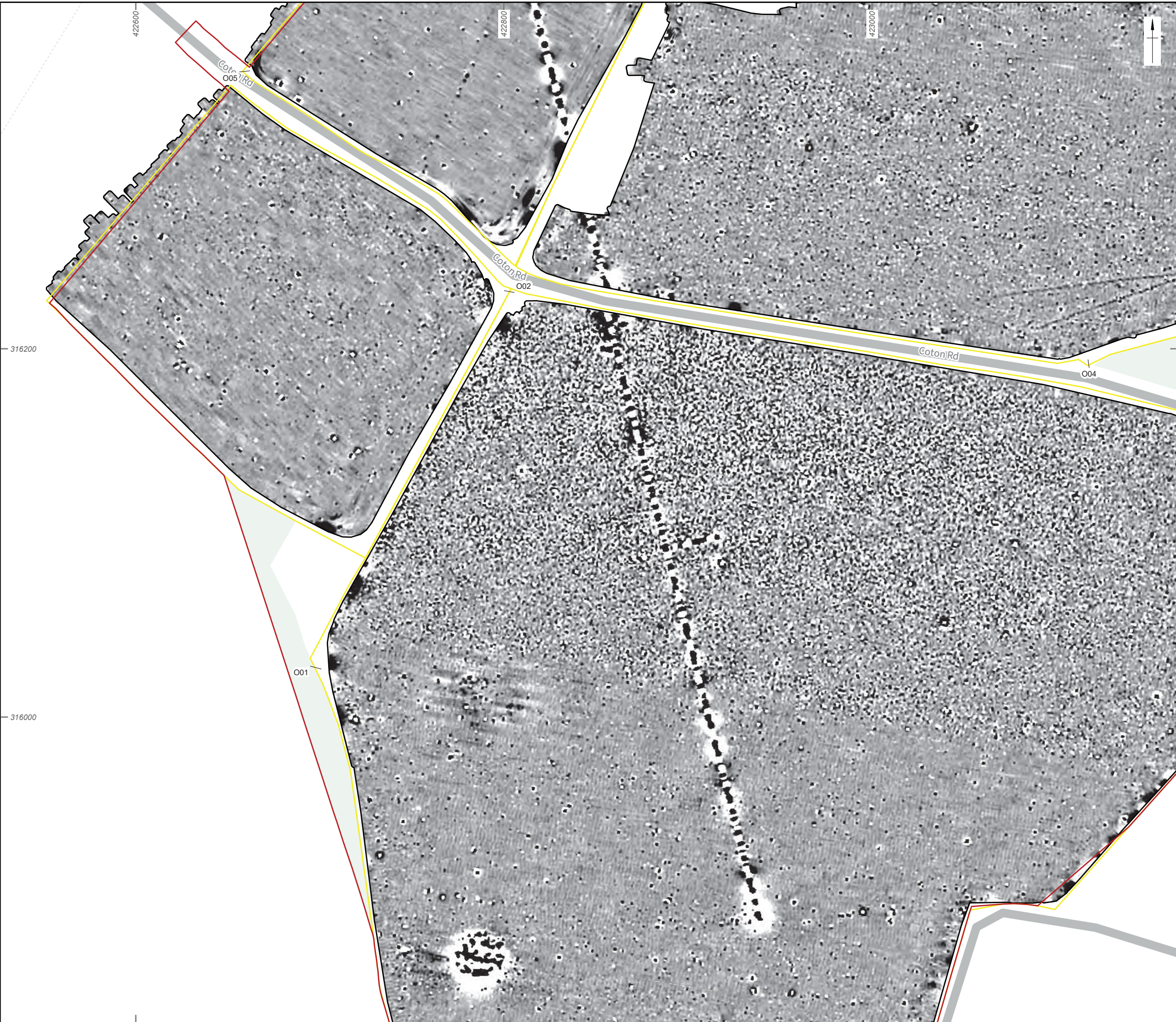
- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent
- ▭ Possible archaeology
- ▭ Former field boundary
- Trend
- - Drain
- - Agricultural feature
- ▭ Increased response
- ▭ Geology
- ▭ Ferrous
- ▭ Increased response - Powerlines
- ▭ Modern service



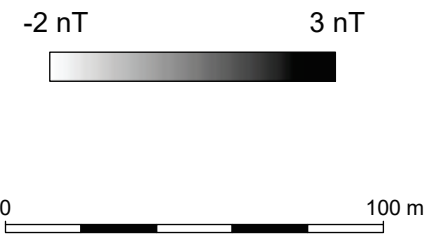
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Figure 31: Detailed gradiometer survey results: interpretation (O6, O7, O8, O10)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



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Figure 32: Detailed gradiometer survey results: greyscale plot (O1, O2, O4, O5)



- ▭ Site boundary
- ▭ Land parcel
- Detailed survey extent
- Possible archaeology
- ▬ Former field boundary
- ▬ Trend
- - Drain
- ▬ Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- ▬ Modern service



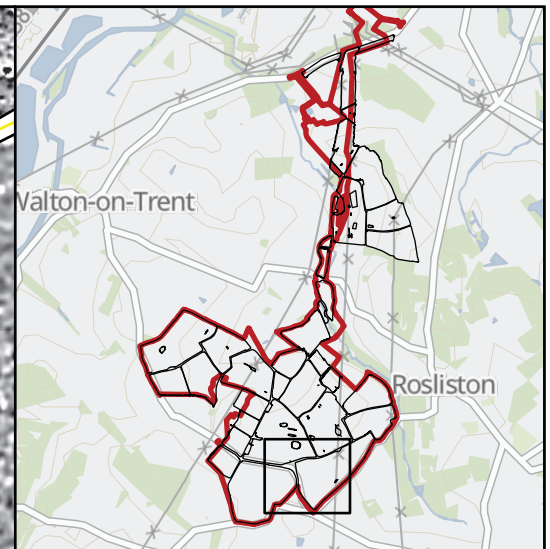
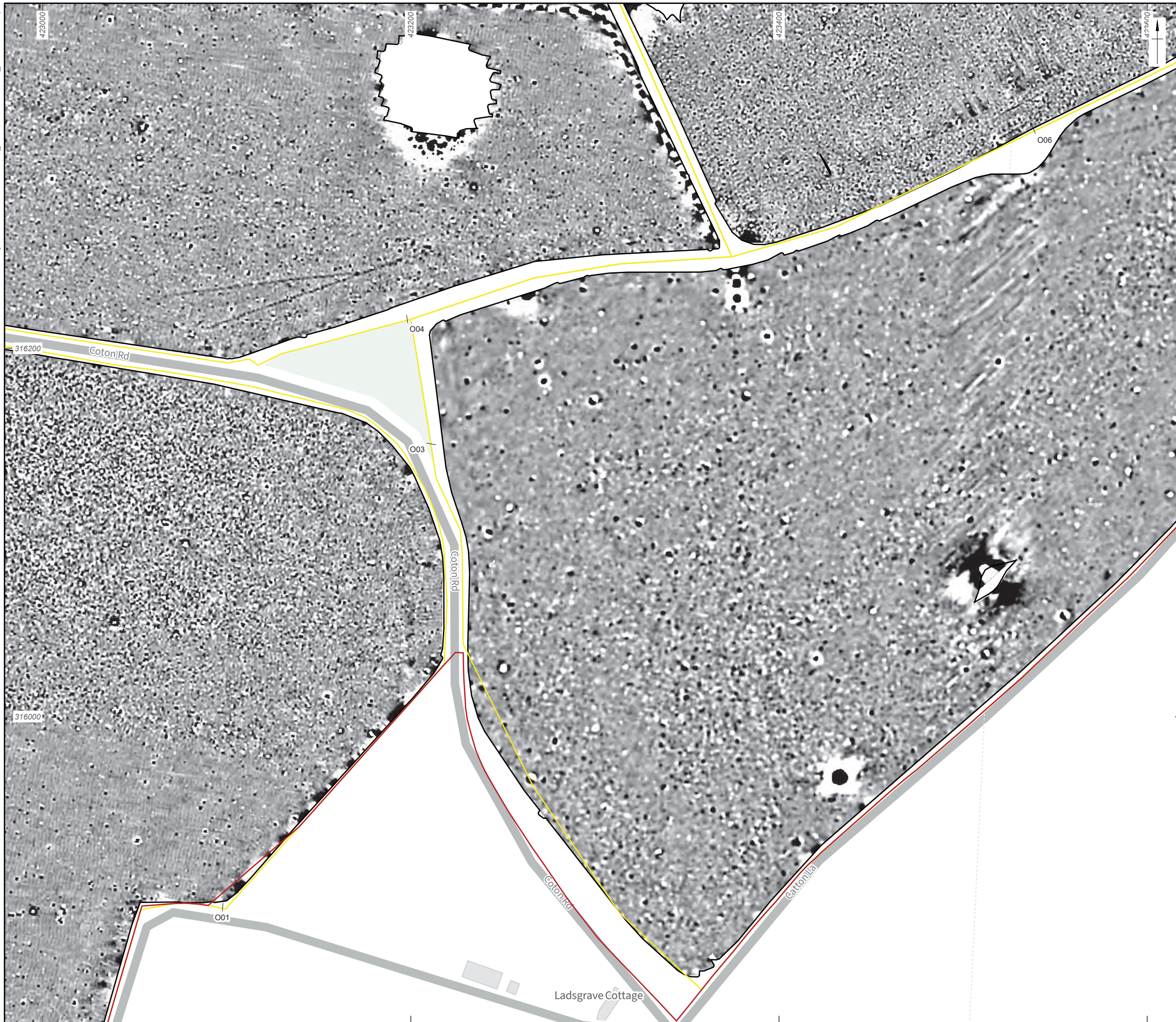
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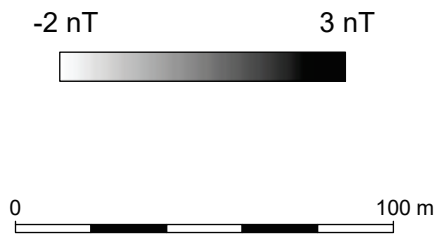
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Figure 33: Detailed gradiometer survey results: interpretation O2, O4, O5)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



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Figure 34: Detailed gradiometer survey results: greyscale plot (O1, O3, O4, O6)



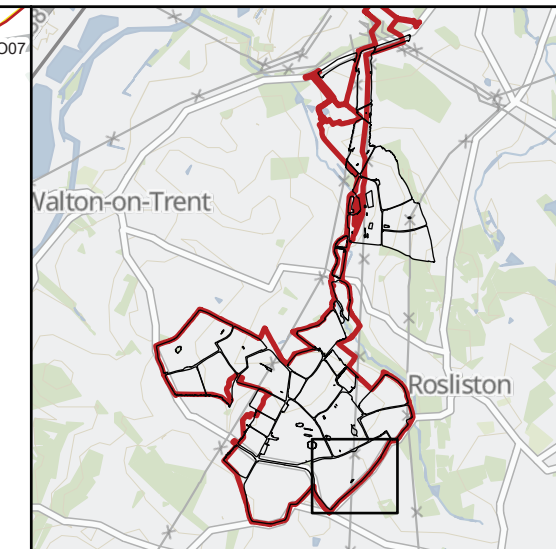
- ▭ Site boundary
- ▭ Land parcel
- Detailed survey extent
- Possible archaeology
- ▬ Former field boundary
- ▬ Trend
- - - Drain
- - - Agricultural feature
- Increased response
- Geology
- Ferrous
- Increased response - Powerlines
- Modern service



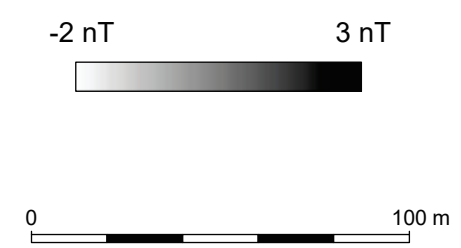
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Figure 35: Detailed gradiometer survey results: interpretation O3, O4, O6)



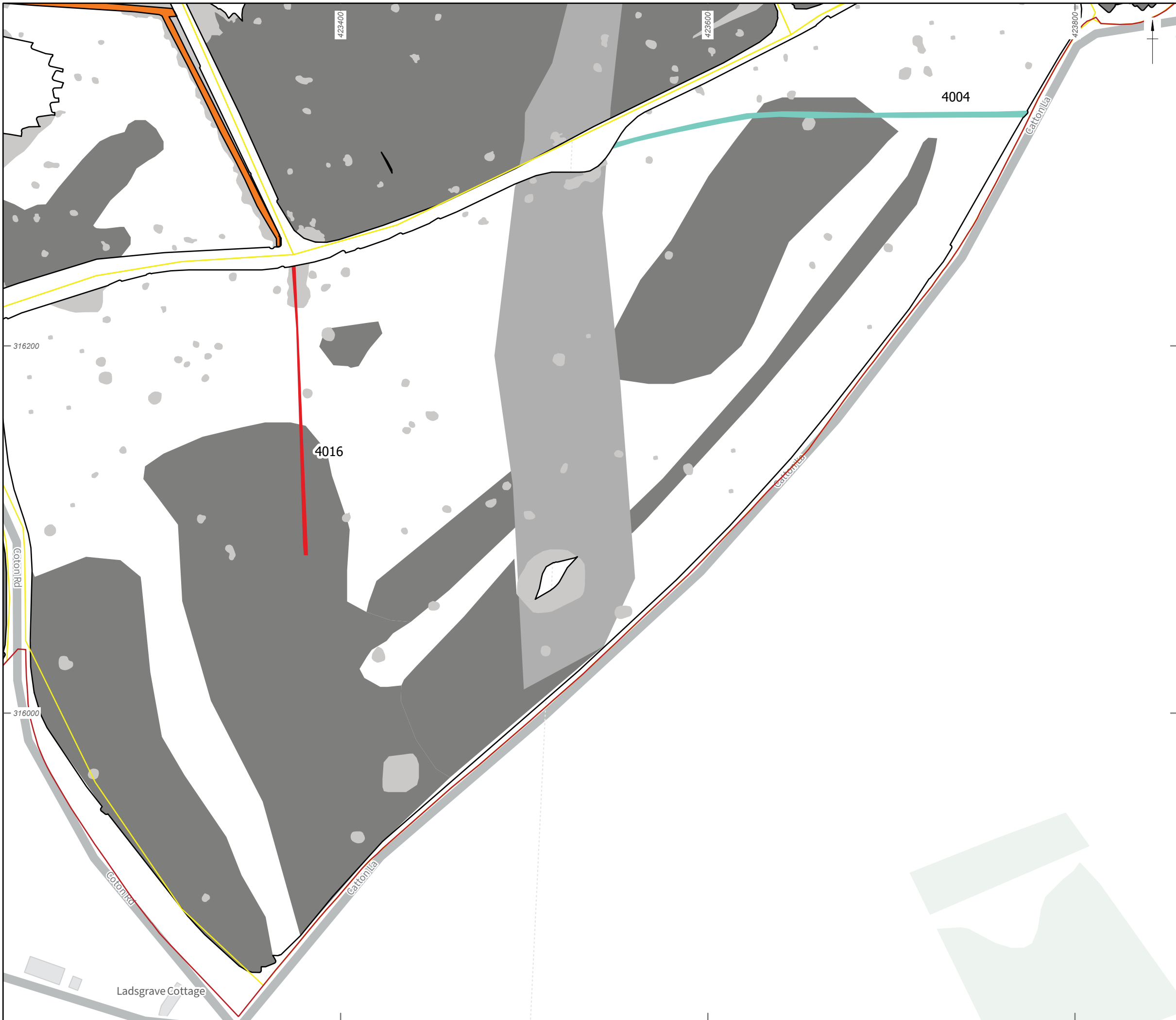
- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



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Figure 36: Detailed gradiometer survey results: greyscale plot (O3, O4, O6)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent
- ▬ Possible archaeology
- ▬ Former field boundary
- ▬ Trend
- - Drain
- ▬ Agricultural feature
- ▭ Increased response
- ▭ Geology
- ▭ Ferrous
- ▭ Increased response - Powerlines
- ▭ Modern service



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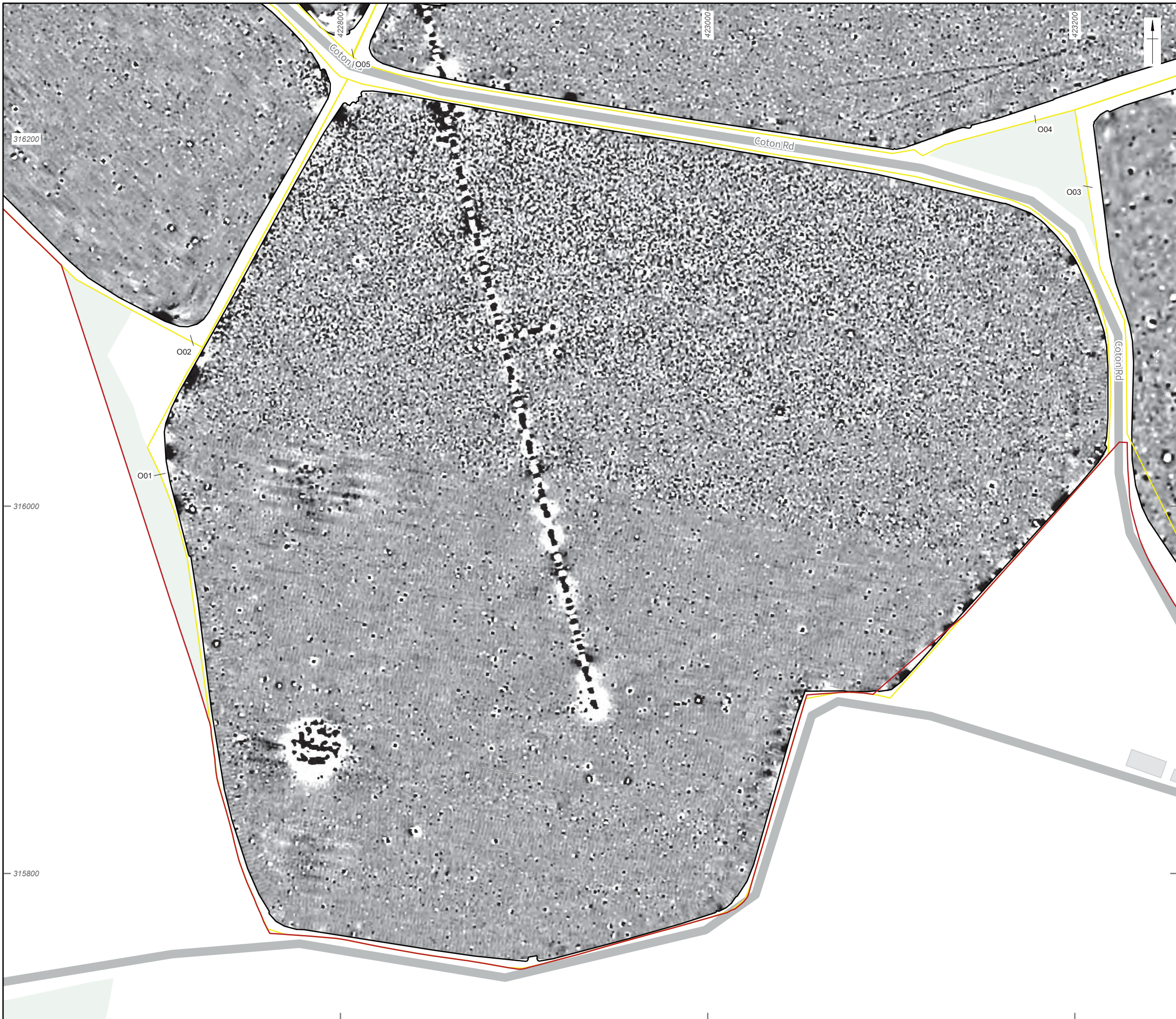
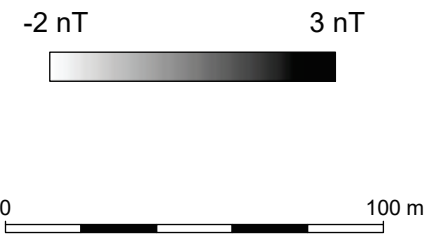
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Figure 37: Detailed gradiometer survey results: interpretation O4, O6)



- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent



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Figure 38: Detailed gradiometer survey results: greyscale plot (O1)

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- ▭ Site boundary
- ▭ Land parcel
- ▭ Detailed survey extent
- ▭ Possible archaeology
- ▭ Former field boundary
- ▭ Trend
- - - Drain
- - - Agricultural feature
- ▭ Increased response
- ▭ Geology
- ▭ Ferrous
- ▭ Increased response - Powerlines
- ▭ Modern service



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Figure 39: Detailed gradiometer survey results: interpretation



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