Gate Burton
ENERGY PARK

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Gate Burton Energy Park Limited

Shared Cable Route Corridor, Nottinghamshire and Lincolnshire

Detailed Gradiometer Survey Report

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Summary

A gradiometer survey was conducted over a shared cable route corridor for Cottam Solar Project, West Burton Solar Project and Gate Burton Solar Project, in Nottinghamshire and Lincolnshire (between NGR 484725, 382501 and NGR 481642, 378707). The project was commissioned by Low Carbon Ltd and Island Green Power with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features in support of a planning application for the grid connection corridor associated with solar photovoltaic (PV) generating panels and on-site energy storage.

The site comprises agricultural land located 7 km south of Gainsborough, covering an area of 370 ha. The geophysical survey was undertaken between 4 April – 5 May and 5 – 16 September 2022.

The gradiometer survey was successful in identifying anomalies that are associated with archaeological features that are located predominately in the western part of the site. These predominately comprise rectilinear anomalies suggestive of a series of Romano-British enclosures, possibly incorporating multiple phases of activity. The extensive Romano-British remains noted in the surrounding area reinforce this interpretation.

The fragmentary remains of further ditches, possible enclosures and pits have been identified throughout the site. Due to their lack of coherence or isolated nature it is not possible to identify any characteristics that would suggest a specific chronology and may range in date from prehistoric to post-medieval.

Several circular anomalies located in the north-east of the site, adjacent to the eastern bank of the river Trent have been identified as possible ditches and embankments of roundhouses or small round barrows. Whilst these features are topographically expressed in LiDAR data their interpretation is less than certain from the geophysical results alone, as they equally could equally relate to natural variation in superficial geological deposits close to the river.

Indications of former agricultural activity and 19th century enclosure of land has been distinguished throughout the site in the form of former field boundaries and areas of ridge and furrow. Other 19th century activity such as possible coal extraction pits, demolished buildings at Rectory Farm, and features associated with Marton Pumping Station have also been noted.

The remaining anomalies are thought to be natural or modern in origin and consist of land drains, ploughing regimes, services and a former concrete pylon base.

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The fieldwork was undertaken by Andrés Perez Arana, Amy Dunn, Cameron Ray, Joanne Instone-Brewer, Davor Cakanic, and Steven Heer. Rok Plesnicar processed and interpreted the geophysical data and prepared the illustrations. Rok Plesnicar, Andrés Perez Arana and Patricia Edwards wrote the report. The geophysical work was quality controlled by Patricia Edwards. The project was managed on behalf of Wessex Archaeology by Tom Richardson.

Shared Cable Route Corridor, Nottinghamshire and Lincolnshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Low Carbon Ltd and Island Green Power to carry out a geophysical survey along a shared cable route corridor for Cottam Solar Project, West Burton Solar Project and Gate Burton Solar Project, in Nottinghamshire and Lincolnshire (between NGR 484725, 382501 and NGR 481642, 378707) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in support of a planning application for the grid connection corridor associated with solar photovoltaic (PV) generating panels and on-site energy storage.

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 northern-eastern portion of the site is located 7 km south of the town of Gainsborough and 1 km south of the village of Gate Burton. The southern-western extremity of the site is located 17 km north-west of Lincoln, adjacent to the Cottam Development Centre Power Station, in the county of Lincolnshire.

1.3.2 The survey area comprises 370 ha of agricultural land, subdivided into 57 fields currently utilised for a variety of crops divided by mature trees and hedgerows. The River Trent bisects the survey area on a north – south alignment. Each field has been assigned an identification number (**100** – **156**). These land parcels are labelled on **Figure 2** – **7** for ease of reference.

1.3.3 The site is mostly flat averaging around 8 m above Ordnance Datum (aOD) barring the land north of Marton village at the north-eastern perimeter of the corridor which inclines to 24 m aOD.

1.3.4 The survey area's bedrock geology is mainly composed of Mudstone of the Mercia Mudstone Group, except for the easternmost section of the site where a narrow band of Mudstone of the Penarth Group separates the rest of the site from an area of Mudstone and Limestone of the Scunthorpe Mudstone Formation. Superficial geology is formed of sand and gravel of the Holme Pierrepont Sand and Gravel Member, located across most of the corrido. Additionally, alluvial clay, silts, and gravels are recorded for both sides of the River Trent, and pockets of glaciofluvial sand and gravel deposits are recorded towards the eastern perimeter of the corridor (BGS 2022).

1.3.5 The soils underlying the site (moving north-east to south-west of the site) are likely to consist

1.3.6 of typical stagnogley soils of the 711f (Wickham 2) association, typical sandy grey soils of the 821b (Blackwood) association, typical brown sands of the 551d (Newport 1) association, and pelo-alluvial grey soils of the 813c (Fladbury 2) association (SSEW E Sheet 4 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer surveys.

2 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

2.1.1 A Written Scheme of Investigation (WSI) was prepared by AECOM (2022) together with publicly available online resources. A study area of 1 km from the proposed corridor options was defined in order to identify designated and non-designated cultural heritage assets. The following background is not exhaustive but is summarised from aspects of the WSI and other publicly available online and in-house resources that are considered relevant to the interpretation of the geophysical survey data.

2.2 Summary of the archaeological resource

2.2.1 There are no designated heritage assets recorded within the site, but there are three scheduled monuments within the wider study area. This includes the Roman town of Segelocum (NHLE 1003669), a Roman fort south of Littleborough lane (NHLE 1004935), and the moated site Fleet Plantation near Rampton (NHLE 1008594).

2.2.2 The River Trent extends, north – south through the eastern extent of the site. The river is a major arterial river which results in a focus of settlement and development adjacent to the river. The earliest human activity identified on the site consists of flint nodules dating to the Middle Palaeolithic found within the River Trent close to the proposed crossing locations (Fields 115 – 118). In the wider study area in the settlement of Torksey, located 1.6 km south of the centre of the site, a flint adze dating from the Upper Palaeolithic or Mesolithic period was recovered.

2.2.3 There are limited remains that have been recovered that indicate occupation activity of the site relating to the early prehistoric period at the site. However, on the southern side of the survey area, 400 m to the east of Field 154, evidence of Late Neolithic – Early Bronze Age activities were identified. A Beaker pot was retrieved near the bottom of a small pit during archaeological investigations (May 2000).

2.2.4 There is evidence for Iron Age/Romano-British activity within the survey area indicated by several areas of cropmarks indicating a possible settlement 850 m west of Cottam. However, in the wider study area extensive Romano-British remains are recorded and summarised below.

2.2.5 The site is crossed by Till Bridge Lane, a Roman road linking Ermine Street north of Lincoln to a ford crossing the River Trent at Matron to Segelocum in the north-east perimeter of the site (Fields 102 – 105). The Roman town of Segelocum, located 2.2 km north-east of the north-east perimeter of the site, is a scheduled monument and previous archaeological investigations identified extensive settlement evidence including building foundations, pavements, kilns, ovens, and multiple small finds. Although the scheduled area for this site lies outside the survey area, previous geophysical survey undertaken on behalf of Historic England identified that the town extends beyond the extent of the scheduled boundary.

2.2.6 A scheduled Roman fort, south of Littleborough Lane located adjacent to the north-east perimeter of the site has been identified from analysis of aerial imagery as a series of cropmarks. Following this a study of the site was undertaken in 1997 into the Romano-British landscape of this area. The work identified a possible Iron Age and definite Romano-British landscape with a roadside settlement and evidence of agricultural activity and manufacturing evidence activities, as well as significant collection of small finds identified from field walking. Further evidence of Romano-British settlement, agricultural practices, and a military presence in for the form of a fort at Gate Burton, located 1 km north of the north-eastern perimeter of the survey area. These sites combined, contribute to the overall understanding of the significance of the Roman presence in this area.

2.2.7 In the winter of AD 872 – 73, the Viking Great Army made camp at Torksey. Their camp has been identified to the north of Torksey village in the parishes of Brampton and Torksey, located 2 km to the east of the south-west perimeter site. The camp was recorded as supporting several thousand individuals, including warriors, craft workers, and merchants.

2.2.8 There is evidence of the development of the local landscape in the early medieval and medieval period, including areas of ridge and furrow and trackways. Many of the extant settlements in the study area, such as Littleborough, Gate Burton, Marton, Torksey, and Rampton, were formed during this period and have a structural feature from this date surviving. The villages and hamlets of Litteborough, Morton, and Rampton retain their medieval churches, all listed at Grade I, whilst the church at Gate Burton was demolished and rebuilt in the post-medieval period. Furthermore, the scheduled medieval moated site at Fleet Plantation lies adjacent to the southern boundary of the survey area. Finally, there are numerous features identified from aerial photographs of unknown dates across the site. Several of these features may relate to farming and landscape practices dated to the early medieval and medieval periods.

2.2.9 The post-medieval period is characterised by the continuation of the development of the aforementioned medieval settlements already established in the wider study area, mostly dating to the 18th and 19th century. However, the settlements of Gate Burton and Torksey differ, where the majority of the medieval settlement were destroyed, and stately homes were built in the post-medieval period. The scheduled monument and Grade I listed building of Torksey Castle is an early post-medieval house constructed in 1560. It is now ruinous with only its west façade and part of the rear wall surviving above ground. The parkland associated with Gate Burton Hall, located 1.5 km north of the site, contains the deserted medieval settlement of Gate Burton. This is a classic example of population dispersal caused by emparking (the enclosing of land to create parkland) in the 18th century. The Grade II* listed hall was built in 1774 – 80.

2.2.10 A map regression of the survey area from Ordnance Survey (OS) data from 1885 depicts the area as agricultural land, subdivided by regular fields. Many of these field boundaries have been removed in the current landscape to create larger fields in modern times. The Manchester – Sheffield – Lincolnshire Railway is also recorded as crossing the site. The designated landscapes at Gate Burton and Knaith estates are also clearly defined, and the boundaries of the historic areas have notable shrunk since these maps were produced in the 19th century.

2.3 Previous work in the surrounding area

2.3.1 A geophysical survey was conducted immediately north of the current survey area by Wessex Archaeology (2022). The survey was carried out in support of a PV solar farm associated with this cable corridor. The survey identified anomalies indicative of Iron Age or Romano-British enclosures, with potential evidence of settlement activity. A small number

of oval and penannular features were also identified as possible Iron Age or Romano-British roundhouses.

3 METHODOLOGY

3.1 Introduction

3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 4 April and 5 May 2022 and 5 September and 16 September. Field conditions at the time of the survey were appropriate for the geophysical survey. An overall coverage of 200.5 ha was achieved. A set of two overhead powerlines are noted traversing the area from Cottam Development Centre Power Station towards the north-east, crossing Fields 137, 138, 149, 141, 143 and 144. The areas around them were not surveyed due to interference from the high voltage affecting the effectiveness of the gradiometer data. Several fields were overgrown and inappropriate for the survey.

3.1.2 The methods and standards employed throughout the geophysical survey conform to that set out in the WSI (AEOM 2022), as well as to current best practice, and guidance outlined by the Chartered Institute for Archaeologists' (CIfA 2014) and European Archaeologiae Consilium (Schmidt *et al.* 2015).

3.2 Aims and objectives

3.2.1 The aims of the survey comprise the following:

- To investigate the archaeological potential of the Grid Connection Corridor.
- To assess the presence / absence of potential archaeological anomalies.
- To determine the level of risk that the archaeological resource would present to the Schemes.
- To inform the emerging design
- To inform the scope of further evaluation.

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 Leica Captivate RTK GNSS instrument, which receives corrections from a network of reference stations operated by the OS and Leica Geosystems. Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceed 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 1 m intervals and mounted on a hand-pushed non-magnetic cart.

Data were collected with an effective sensitivity of ±8 µT over ±1000 nT range 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 background removal median function with an effective window of 50 m, applied to correct for any variation between the sensors, a discard overlaps function where transects have been collected too close together and an interpolation used to grid the data.

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 gradiometer survey has identified magnetic anomalies across the site. Results are presented as a series of greyscale plots and archaeological interpretations at a scale of 1:2000 (**Figures 8** to **47**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale images

4.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous responses, burnt or fired objects, and magnetic trends. These are presented on separate figures to the greyscale plots, with the detailed interpretation plans provided on the odd figure numbers. 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 The geophysical survey has identified several features that are likely to be associated with archaeological remains. These are predominantly located to the west of the Cottam Power Station and are associated with linear and curvilinear ditch features.

4.2.2 Numerous positive and strong positive linear anomalies have been identified in Field 141 at **4000** (**Figure 37**). These have been interpreted as archaeological and possible archaeological remains. The linear anomalies appear to be interconnected, arranged in a rectilinear alignment. They cover an area of 136 m by 100 m in a north – south orientation, with individual widths of 2 m wide. The western portion of the arrangement appears to extend beyond the edge of the survey area. These kinds of anomalies relate to ditch-like features and their form and arrangement is indicative of a Romano-British series of enclosures. Different intensities of anomalies and slightly misaligned parts could indicate different phases in the development of the enclosures.

4.2.3 The strongest responses are located in the middle of feature (**a**), forming internal divisions of 7 m by 45 m on a north – south alignment with slightly smaller divisions to the west of it. To the north are two further smaller divisions that are both 7 m wide and 22 m long (**b**). On the eastern side of (**a**), several ditch-like features appear to have a further rectilinear plan. Smaller positive discrete anomalies with diameters of up to 1.5 m are located within and in the surrounding area. These indicate pit-like features, such as postholes within the ditch. A larger circular dipolar anomaly has been identified next to (**c**) with a diameter of 6 m. This anomaly is indicative of a larger pit-like feature or a possible area of burning. A weakly defined ditch-like feature (**d**) located at the south-eastern end of the enclosure is on a similar alignment as the main enclosure. On the northern part of the enclosure, in Field 136, is a linear ditch-like feature (**e**) that is delimiting the extent to the north. It is 65 m long on an east – west alignment.

4.2.4 Located 70 m to the south of **4000** is a smaller cluster of weak positive linear anomalies that are on an orthogonal alignment, at **4001** (**Figure 37**). They cover an area of 52 m by 17 m on a general north – south orientation and are up to 1.5 m wide. They indicate ditch-like features. A small rectilinear subdivision is noted in its northern part which is 8 m long and 4 m wide. These features are on the same alignment as and could relate to, the larger enclosure at **4000**. However, there is no visible connection between the two sites and the anomalies are less coherent making their interpretation more tentative. Given the extensive Romano-British remains noted in the wider study area, (consisting of settlement, agricultural practices, and military activity) this strengthens the interpretation of a Romano-British settlement enclosure at **4000** and **4001**. Whilst it is unclear from the geophysical results alone whether these enclosures form remains of a settlement or are in fact agricultural enclosures. Further archaeological investigations would be required to confirm this.

4.2.5 Located 600 m to the south of **4000**, in Field 146 is a further rectilinear arrangement of weak positive anomalies **4002** (**Figure 41**). They are on a north – south orientation and cover an area of 110 m by 80 m. The anomalies are up to 2 m wide indicating ditch-like features that form an enclosure. The north-eastern portion (**a**) is delimited by a smaller rectilinear enclosure that is 46 m long by 40 m wide on a north – south orientation. It has two smaller internal divisions and two possible entrances along the northern side. On the western side of it is a smaller enclosure that is 40 m long by 28 m wide on an east – west orientation. The western side has not been identified within the dataset. A positive linear anomaly (**c**) divides the enclosure on an east – west alignment. It is 92 m long with a 3 m wide gap that may relate to a former entrance 42 m from the western side. To the south of it is a smaller rectilinear enclosure (**d**) that is 35 m by 23 m on a north – south alignment. The anomalies in this part of the enclosure are significantly weaker than the anomalies in the northern part. The enclosure has been identified as Romano-British in origin and is possibly contemporaneous with the enclosure at **4000**. The southern part likely indicates a different phase of activity due to the weaker anomalies.

4.2.6 A small rectilinear array of weak positive linear anomalies at **4003** has been identified 200 m to the south of **4002** (**Figure 43**). The anomalies are up to 2 m wide and form an enclosure that is 45 m long by 32 m wide on an east – west alignment. A 13 m by 9 m division is located in the eastern part (**a**). The larger part of the enclosure (**b**) is open towards the west. A stronger positive anomaly has been identified 40 m further to the north (**c**). It is 22 m long and 2 m wide, with an addition that is extending 6 m to the north. It is on the same alignment as the main part of the enclosure and is likely part of its northern extent. This enclosure is likely Romano-British in origin; however, a more accurate interpretation is not possible due to weak magnetic anomalies.

4.2.7 A positive oval anomaly at **4004** has been identified in Field 125 (**Figure 29**). It is 27 m long and 16 m wide on a north-west to south-east alignment. It suggests a ditch-like feature, where the ditch is up to 3.5 m wide with a possible embankment on the internal side. The

shape and magnetic response of the feature suggests a possible enclosure of unknown date.

4.2.8 An arrangement of linear positive anomalies and broader dipolar anomalies have been identified at **4005** – **4006** in Field 132 (**Figure 31**). They stretch along the side of the railway line. The linear anomalies are up to 2 m wide, on an ESE – WNW orientation. Two strong dipolar anomalies, oval in shape, are located at **4005**. They occupy an area of up to 9 m by 4.5 m and indicate larger pit-like features or areas of burning. Two similar smaller anomalies are located 30 m south at **4006**. They are circular, with diameters of up to 6 m and likely indicate pit-like features or areas of intense burning. These features could indicate a set of smaller enclosures, likely animal pens, less likely to be settlement remains. The possible presence of burning suggests there is also potential for industrial activity.

4.2.9 Further to the south-east, in fields 131 and 133, are two groups of weak positive linear anomalies at **4007** and **4008** (**Figure 31, 35**). They are up to 50 m long and 2 m wide aligned WNW – ESE indicating ditch-like features. A semi-circular feature is located at the edge of Field 131, with a diameter of 11 m. It likely relates to a ring ditch or a small enclosure of unknown date. The linear features are attributed to old field divisions, not noted on available historical maps, however, they could as well be a result of natural undulation in the superficial geology.

4.2.10 In the centre of Field 136 is a positive linear anomaly at **4009** (**Figure 33**) that is aligned north – south. It is 51 m long but fragmented into four parts of various lengths and up to 1.5 m wide. This indicates a ditch-like feature that has the same orientation as the enclosure to the south at **4000**, which could suggest contemporaneity. A very weak positive, linear anomaly has been detected, aligned perpendicular to the north – south anomaly, aligned on an east-south-east orientation. It is also fragmentary in nature with an overall length of 35 m. At its eastern end, it turns southwards for an additional 7 m. It indicates a ditch-like feature. However, its different orientation suggests it is an older field boundary or drainage ditch of unknown origin. Located adjacent to the ditches is an alignment of five positive, discrete anomalies with diameters of up to 4.5 m. The form of these anomalies indicates pit-like features that are about 25 m apart. They have been interpreted as possible storage or refuse pits, although their linear alignment may suggest post holes for a former boundary. However, they equally could reflect natural features related to natural variation in superficial deposits.

4.2.11 A strong dipolar anomaly that is rectangular in form has been identified in Field 134 at **4010** (**Figure 39**). It has a circular-shaped central anomaly measuring 5 m in diameter with two semi-circular dipolar responses on its eastern and western sides. They are 13 m long and 3 m wide. It is unclear from the geophysical results alone what this feature might represent. Its strongly dipolar response could suggest ferrous and or fired material possibly associated with the development of the Manchester – Sheffield – Lincolnshire Railway. This is due to the proximity of the remains of the railway embankment forming the northern boundary of Field 134. Another interpretation could be a large extraction pit that has been capped or backfilled with highly magnetic material. This is due to the fact this portion of the site is noted on OS 10-mile, Iron and Steel Map of 1945 as having probable concealed coalfields present.

4.2.12 A small L-shaped positive anomaly **4011** is located along the eastern edge of Field 149 (**Figure 43**). It is up to 2 m wide and runs on east – west orientation for 13 m where it turns south for an additional 12 m. It indicates a ditch-like feature likely related with old field divisions.

4.2.13 A cluster of weak positive linear anomalies has been located in the south-western extremity of the site in Field 151 at **4012** (**Figure 45**). These anomalies form a broad rectilinear shape covering an area of 43 m by 25 m. It is open to the south and east and extends beyond the

survey area to the west. It likely indicates the remains of a smaller ditched enclosure of unknown date. However, the weak and relatively isolated nature of the anomaly makes confident interpretation difficult.

4.2.14 A positive linear anomaly **4013** is traversing Field 152 on a north – south alignment (**Figure 47**). It indicates a fractured ditch-like feature that is up to 2 m wide and 68 m long. After 13 m, it has a 13 m gap, before it continues for an additional 42 m. It likely indicates an old field boundary that is absent from historical mapping.

4.2.15 A broad weakly positive anomaly at **4014** has been identified traversing Field 154 (**Figure 47**). It is up to 7 m wide and exits the survey area on the northern and southern sides. It likely indicates a ditch-like feature or compacted surface such as a path or a track. It could equally relate to a modern agricultural activity or be a result of natural processes and as such not significant for archaeological interpretation.

4.2.16 To the east of the River Trent in Field 115, a cluster of weak positive circular anomalies with associated internal negative responses have been identified at **4015** – **4018** (**Figure 21**). They correspond to cropmarks similar in form noted on satellite imagery (Google Earth, 2022) and are also expressed topographically in Environment Agency LiDAR data for the area. They are between 4 – 9.5 m in diameter with overall widths of 1.5 – 2.5 m. The positive elements of the anomalies indicate cut features while the negative indicate banks or upcast material. These could relate to ditch features with an internal pit and may be associated with round houses or barrows. However, due to their proximity to the River Trent, a natural origin is equally likely.

4.2.17 In the eastern part of Field 116 is a fragmented L-shaped weak positive linear anomaly at **4019** that is 46 m by 32 m long and up to 3 m wide (**Figure 21**). It is aligned on a north – south and east – west orientation. This indicates a ditch-like feature, possibly the remains of a former field enclosure due to its shape. Additionally, its alignment respects an area of ridge and furrow (**4057**) noted in this area which suggests a contemporary date.

4.2.18 In the south-east of the site in Field 113a are numerous positive linear anomalies at **4020** – **4024** (**Figure 19**). They are broadly arranged on an orthogonal pattern covering an area measuring 330 m east – west and 125 m north – south, with an average width of 2 m. These anomalies have been interpreted as ditch-like features. Dispersed throughout these ditches are several discrete positive anomalies measuring 2 – 3 m in diameter, likely representing pits. Whilst these ditches and pits likely indicate archaeological activity of unknown origin, it is difficult to provide any further interpretation due to the narrow survey area in this portion of the scheme.

4.2.19 In the south-west of Field 107 located in the east of the scheme, is a weak positive linear anomaly at **4025** (**Figure 15**). It is somewhat fragmented but is orientated on a north-west to south-east alignment for 62 m and 2 m wide, continuing to the south beyond the edges of the survey area. This anomaly indicates a ditch-like feature however its isolated nature makes further interpretation challenging. While it may represent archaeological activity, it could equally relate to modern agricultural activity.

4.2.20 Numerous weak positive linear anomalies are present throughout the survey area (**4026** – 4050). Each anomaly has an average width of 2 m, and they vary in length and orientation. Combined these anomalies represent the 19th century pattern of land division and have been interpreted as former field boundaries. They all correspond with boundaries identified on 1898 OS mapping.

4.2.21 Evidence of historical agricultural practices presented in the form of ridge and furrow have been identified located predominately to the east of River Trent. The clearest representations are seen in Fields 100, 102, 107, 113 and 116 at **4051** (**Figure 9**), **4052** (**Figure 11**), **4053** (**Figure 15**), **4054** – **4056** (**Figure 17**), and **4057** – **4060** (**Figures 21** and

23). They are defined as areas of parallel, weak positive linear anomalies that are broadly aligned on an east – west and north – south orientation with gaps of 5 – 8 m between each linear.

4.2.22 Several areas of increased magnetic response have been identified throughout the survey area. These are characterised as coherent areas of dipolar anomalies which vary in shape. These likely relate to spreads of modern and or manmade material. Whilst some of these anomalies correspond with features present on historical mapping and will be discussed further, the remaining anomalies are thought to relate to landscaping or manmade material. The first example of these areas of increased magnetic response (that match historical mapping) has been detected in the eastern portion of the site in Field 105 at **4061** – **4064** (**Figure 13**). These anomalies correspond with the remains of Rectory Farm as noted on OS 25 Inch map from 1892. Further discrete areas of increased magnetic response are located at **4065** (**Figure 17**) in the north-east of Field 113. These correspond with similar shaped features noted on either side of north-east to south-west aligned embankment that connects to the remains of the Marton Pumping Station drainage ditch that forms the northern boundary of this field. These are noted on the OS 25 Inch map from 1892 however there is no further information as to what these features pertain to. Finally in the east of Field 139 at **4066** (**Figure 37**) a circular shaped dipolar anomaly has been identified which indicates a former pylon base.

4.2.23 Several broad, weak positive anomalies have been identified as natural variations in geological deposits. The clearest example of these is located adjacent to the banks of River Trent in Fields 115 and 116 to the east of the river and 117 – 122 on the western side (**Figures 21** - **27**) at **4067** and **4068** where a broad north – south, sinuous anomalies are seen. This broadly corresponds with a band of alluvial deposits including clays, silts, sands, and gravels deposited by the adjacent river (BGS 2022).

4.2.24 More recent agricultural interventions or land improvements in the form of drainage ditches and ploughing have been noted in the results of the geophysical survey, throughout the whole site. Numerous strongly positive and dipolar linear anomalies that can be seen aligned either parallel to each other or forming a ‘herringbone’ pattern have been identified widely across the site. These are characteristic of a network of land drains.

4.2.25 Several magnetically strong dipolar linear anomalies have been identified throughout the site, indicating the presence of modern services, such as cables or pipelines.

5 DISCUSSION

5.1.1 The gradiometer survey has been successful in identifying anomalies that are associated with archaeological features predominately in the western part of the site. These predominately comprise rectilinear anomalies suggestive of a series of Romano-British enclosures, possibly incorporating multiple phases of activity. No distinct settlement activity was identified within the enclosures; however, a number of pits and areas of burning indicate that the site may have been utilised for more than agricultural purposes. The extensive Romano-British remains noted in the surrounding area, consisting of settlement, agricultural practices, military activity, and a Roman Road reinforces this interpretation.

5.1.2 The fragmentary remains of further ditches, possible enclosures, and pits have been identified throughout the site. Due to their lack of coherence or isolated nature, it is not possible to identify any characteristics that would suggest a specific chronology and may range in date from prehistoric to post-medieval.

5.1.3 Several circular anomalies located in the north-east of the site, adjacent to the eastern bank of the River Trent have been identified as possible ditches and embankments of roundhouses or small round barrows. Whilst these features are topographically expressed

in LiDAR data their interpretation is less than certain from the geophysical results alone, as they could equally relate to natural variation in superficial geological deposits close to the river.

5.1.4 Indications of former agricultural activity and 19th century enclosure of land has been distinguished throughout the site in the form of former field boundaries and areas of ridge and furrow. Other 19th century activity, such as possible coal extraction pits, demolished buildings at Rectory Farm, and features associated with Marton Pumping Station have also been noted.

5.1.5 The remaining anomalies are thought to be natural or modern in origin and consist of land drains, ploughing regimes, services, and a former concrete pylon base.

6 REFERENCES

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May 2000, An Iron Age and Romano British Settlement at Moor Pool Close, Rampton, Nottinghamshire. Summary of Watching Brief and Excavations from June 1999 to January 2000, p 12 (Unpublished document). SNT2273.

Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 *Guidelines for the use of geophysics in archaeology: questions to ask and points to consider.* EAC Guidelines 2, Belgium: European Archaeological Council.

Wessex Archaeology 2022 *Gate Burton Energy Park, Lincolnshire Detailed Gradiometer Survey Report.* Document Ref.: 257660.03

Cartographic and documentary sources

Ordnance Survey 1983 *Soil Survey of England and Wales Sheet 3, Soils of Midland and Western England.* Southampton.

Online resources

British Geological Survey Geology of Britain Viewer (accessed November 2022) [redacted]

Google Earth (accessed November 2022) [redacted]

Old Maps (accessed November 2022) [redacted]

APPENDICES

Appendix 1: Gradiometer Survey Equipment and Data Processing

The magnetic data for this project were acquired using a non-magnetic cart fitted with four SenSys FGM650/3 magnetic gradiometers. The instrument has eight sensor assemblies fixed horizontally 0.5 m apart allowing eight 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 ±8 µT over ±1000 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 FMG650/3 probes at a rate of 100 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 rover. 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 survey is downloaded from the system for processing and analysis using both commercial and 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.

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 within the defined window. May be used to remove the striping effect seen within a survey caused by directional effects, drift, etc.

- 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.

- 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).

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

Project Details:

Project name		Shared Cable Route Corridor, Nottinghamshire and Lincolnshire			
Type of project		Detailed gradiometer survey (Field evaluation)			
Project description		The gradiometer survey was successful in identifying anomalies that are associated with archaeological features that are located predominately in the western part of the survey. These predominately comprise rectilinear anomalies suggestive of a series of Romano-British enclosures, possibly incorporating multiple phases of activities. The fragmentary remains of further ditches, possible enclosures and pits have been identified throughout the site. Due to their lack of coherence or isolated nature it is not possible to identify any characteristics that would suggest a specific chronology and may range in date from prehistoric to post-medieval. Several circular anomalies located in the north-east of the site, adjacent to the eastern bank of the river Trent have been identified as possible ditches and embankments of roundhouses or small round barrows. Whilst these features are topographically expressed in LiDAR data their interpretation is less than certain from the geophysical results alone, as they equally could indicate a natural or modern origin. Indications of former agricultural activity and 19th century enclosure of land has been distinguished throughout the site in the form of former field boundaries and areas of ridge and furrow. Other 19th century activity such as possible coal extraction pits, demolished buildings at Rectory Farm and features associated with Marton Pumping Station have also been noted. Finally, all other features identified in the geophysical survey are thought to be modern in origin and consist of land drains, ploughing regimes, services and a former concrete pylon base.			
Project dates		**Start:** 4-4-2022		**End:** 16-9-2022	
Previous work		yes			
Future work		Not known			
Project Code:	257661	**HER event no.**	If relevant	**OASIS form ID:**	wessexar1-507476
		NMR no.	N/A		
		SM no.	N/A		
Planning Application Ref.					
Site Status		none			
Land use		Agricultural			
Monument type		enclosures	**Period**	Romano-British	

Project Location:

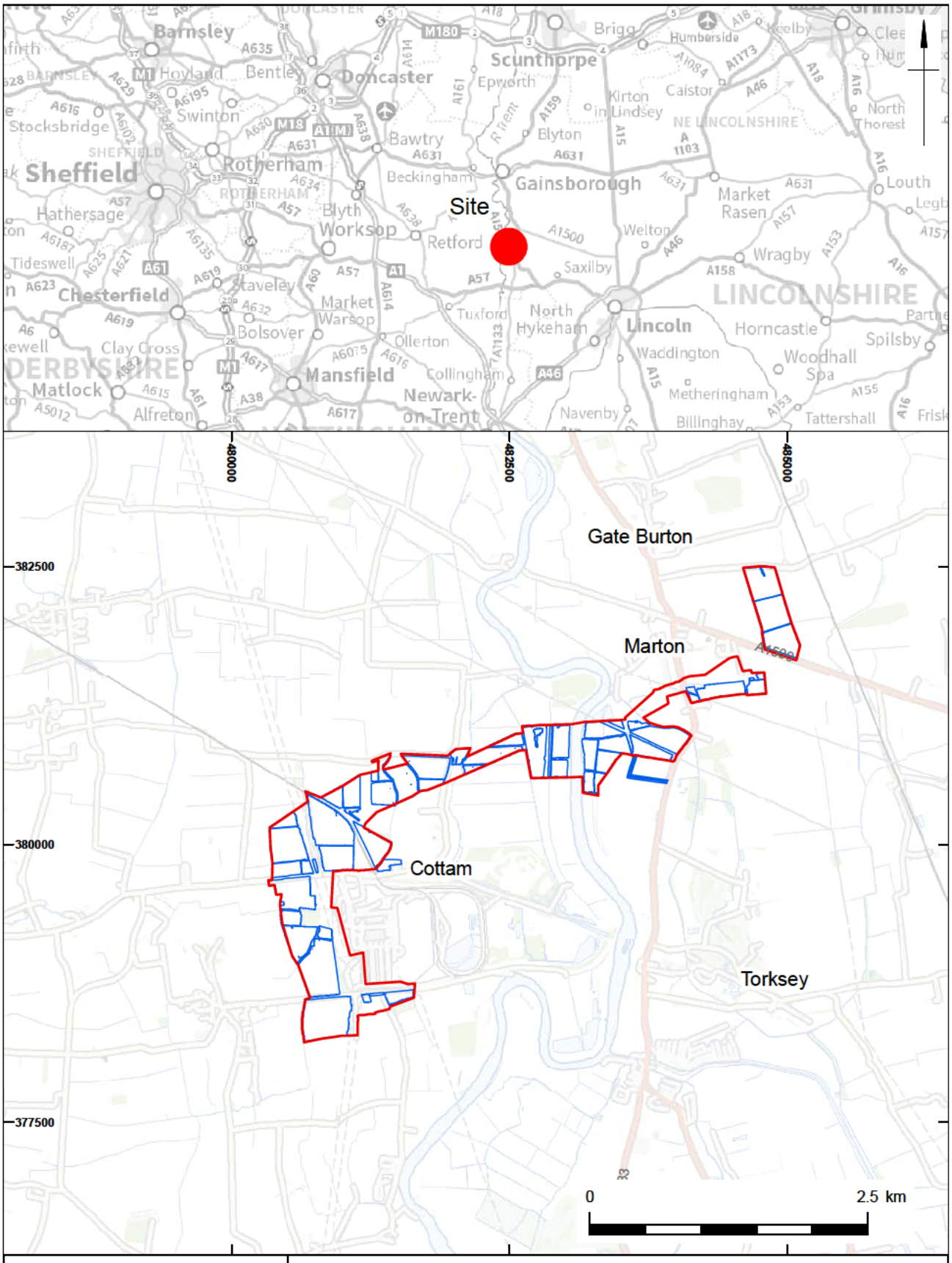
Site Address	High street, Marton			**Postcode**	DN21 5AL
County	Lincolnshire	**District**	West Lindsey	**Parish**	Gate Burton
Study Area	370 ha	**Height OD**	14 - 30 m aOD	**NGR**	484725, 382501

Project Creators:

Name of Organisation	Wessex Archaeology		
Project brief originator	Aecom	**Project design originator**	Client
Project Manager	Tom Richardson	**Project Supervisor**	Rok Plesnicar
Sponsor or funding body	Aecom	**Type of Sponsor**	Client

Project Archive and Bibliography:

Physical archive	N/A	**Digital Archive**	Geophysical survey and report	**Paper Archive**	N/A
Report title	Gate Burton Cable Corridor, Lincolnshire			**Date**	2022
Author	Wessex Archaeology	**Description**	Unpublished report	**Report ref.**	257661.3



Site boundary

Detailed survey extents

Coordinate system: OSGB36

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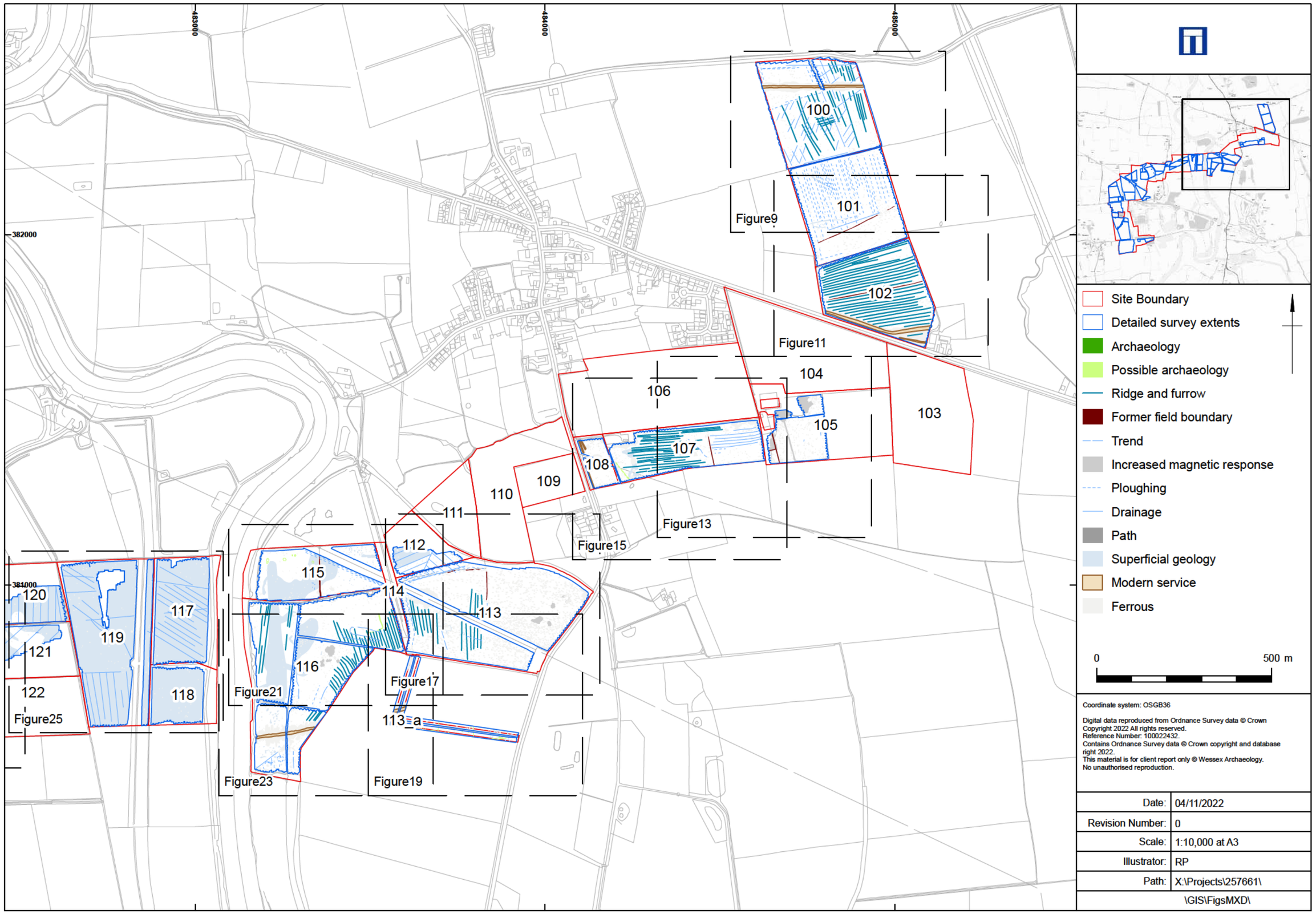
Path:	X:\PROJECTS\257661\GIS\FigsMXD		

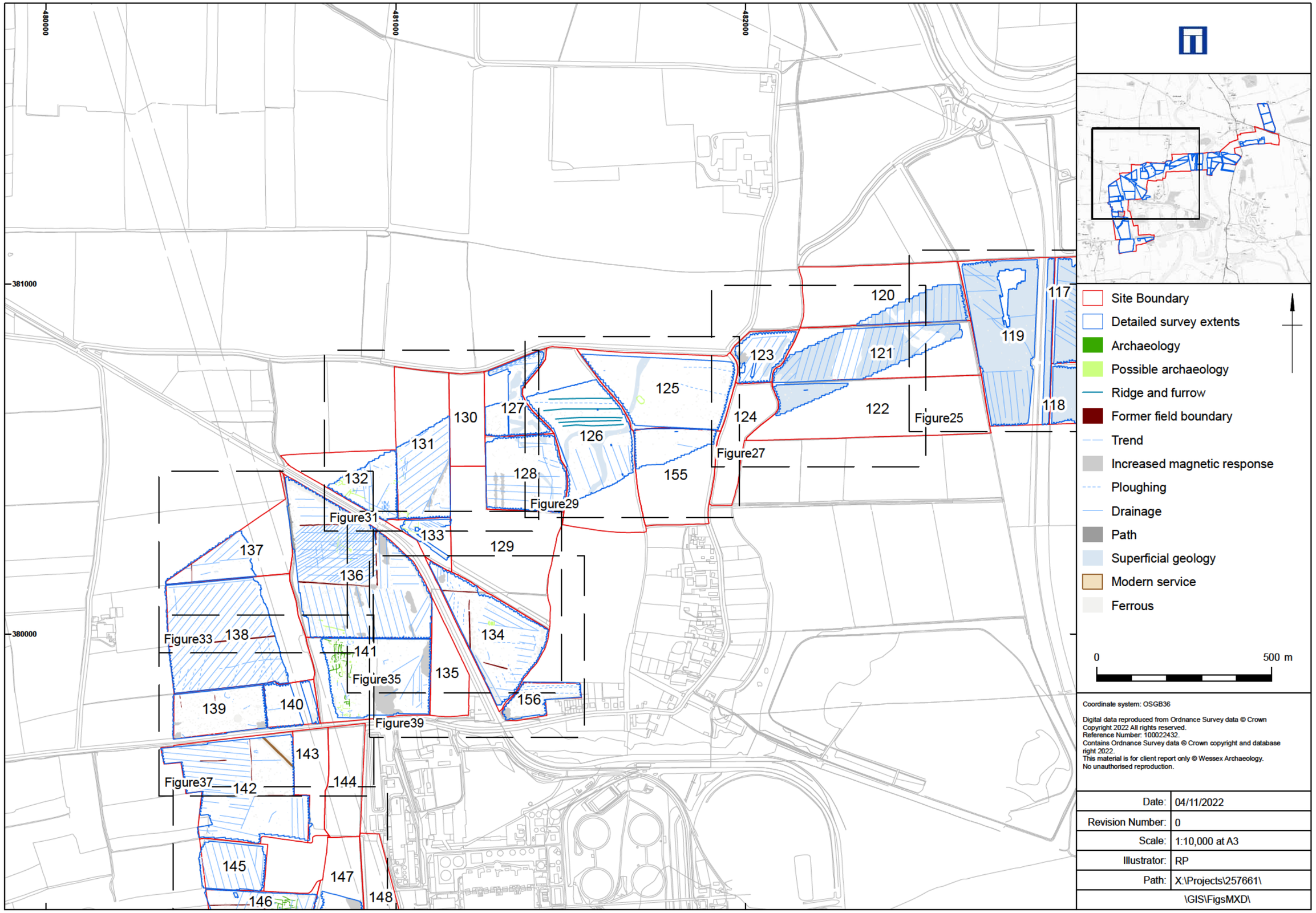
Site location and survey extent

Figure 1



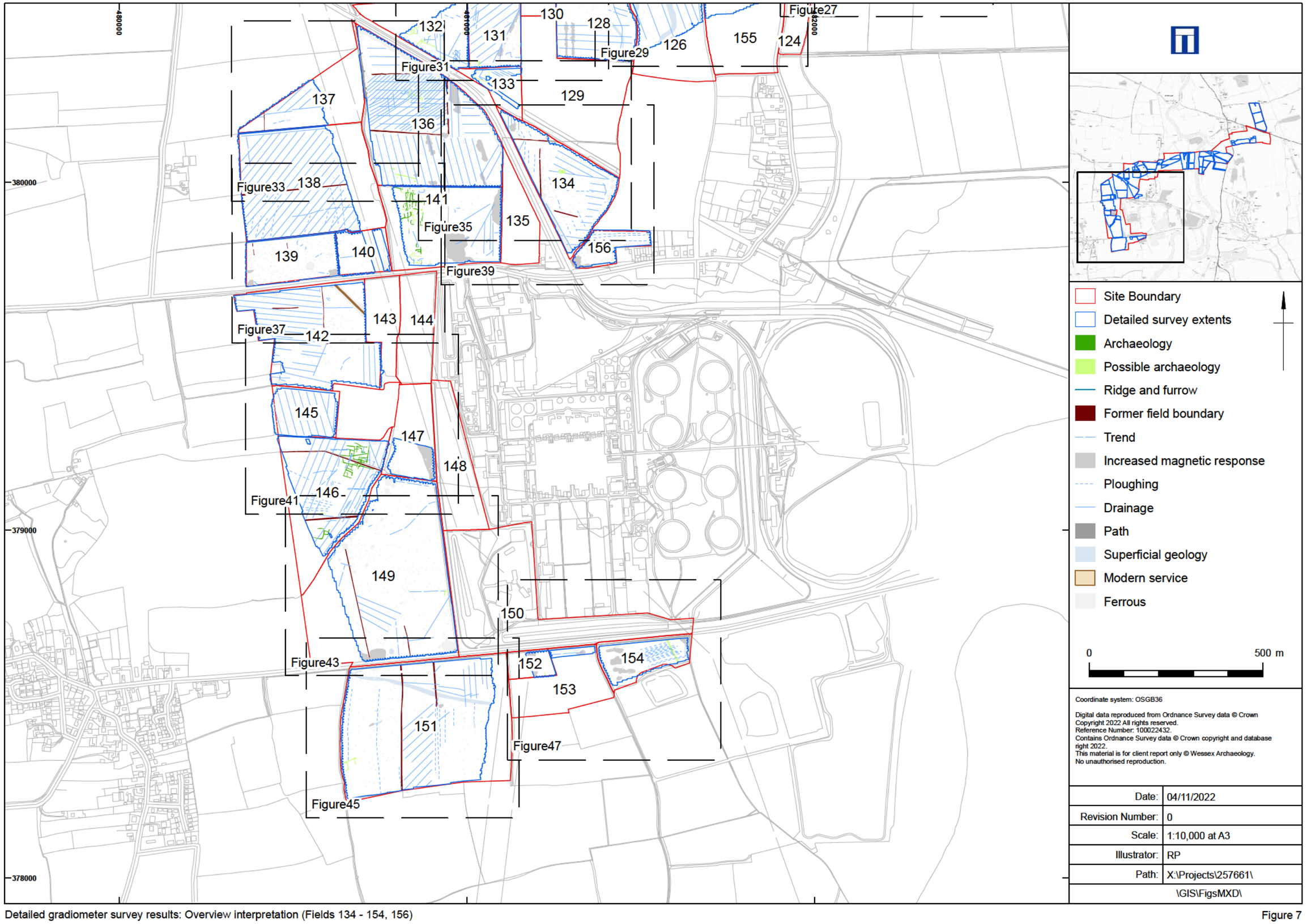
Detailed gradiometer survey results: Overview interpretation (Fields 100 - 119)

Figure 3



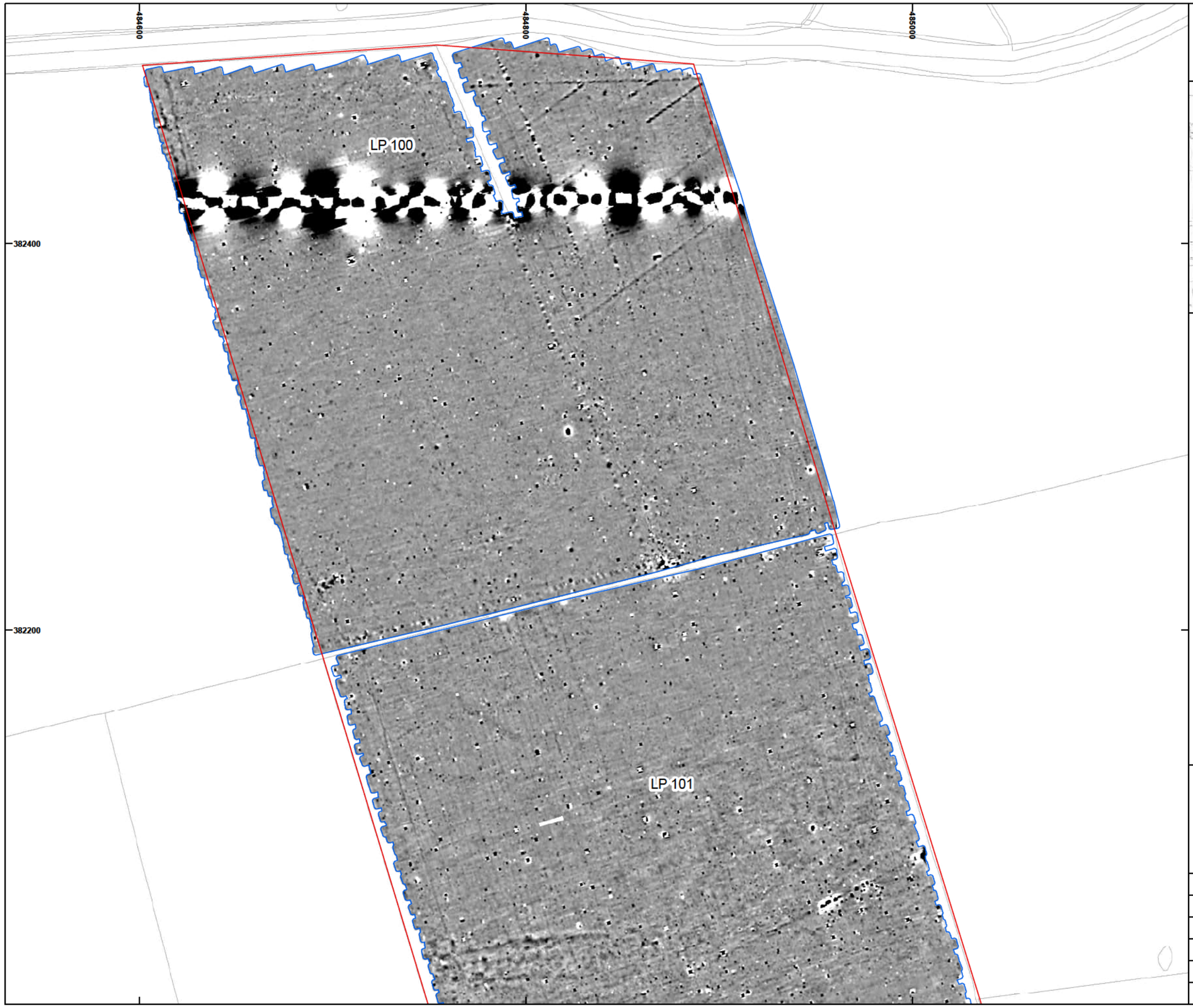
Detailed gradiometer survey results: Overview interpretation (Fields 119 - 145, 155, 156)

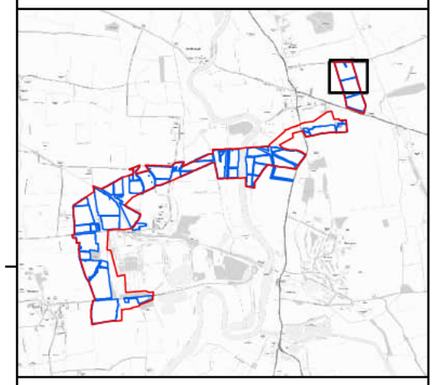
Figure 5



Detailed gradiometer survey results: Overview interpretation (Fields 134 - 154, 156)

Figure 7





Site Boundary

Detailed survey extents

-2 nT

3 nT

0

100 m

Coordinate system: OSGB36

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Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
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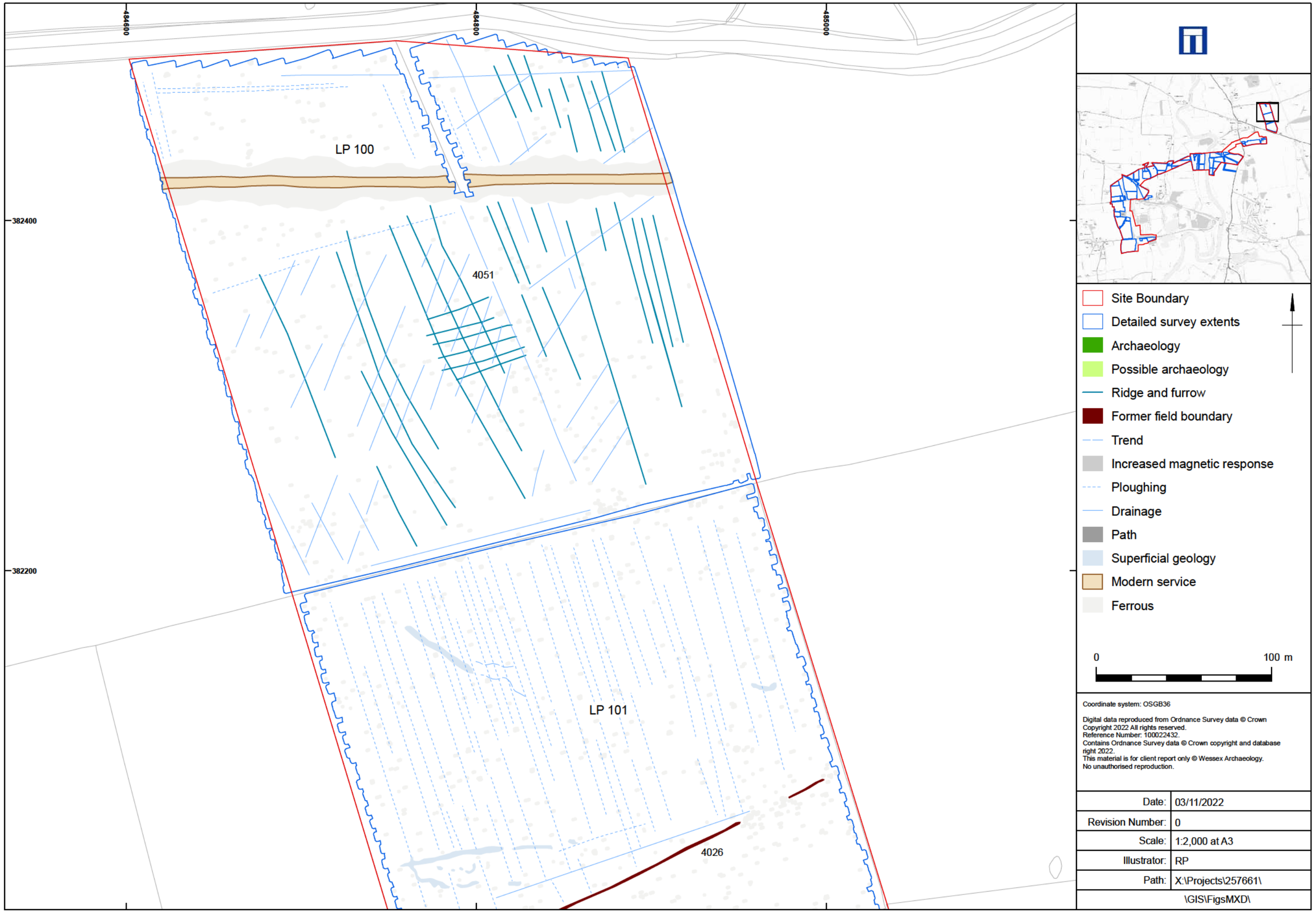
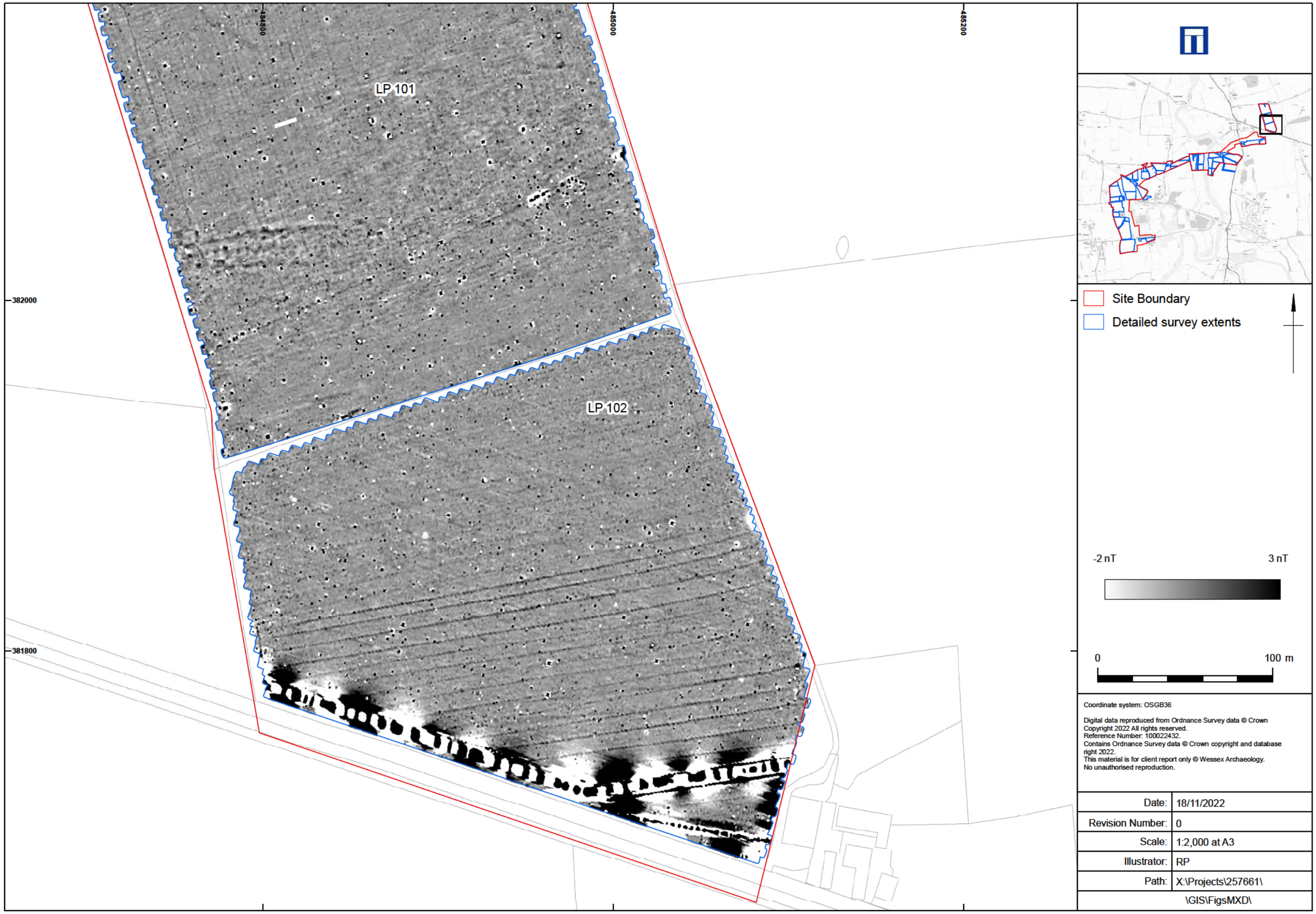
Detailed gradiometer survey results: grayscale plot (Feilds 100, 101)

Figure 8



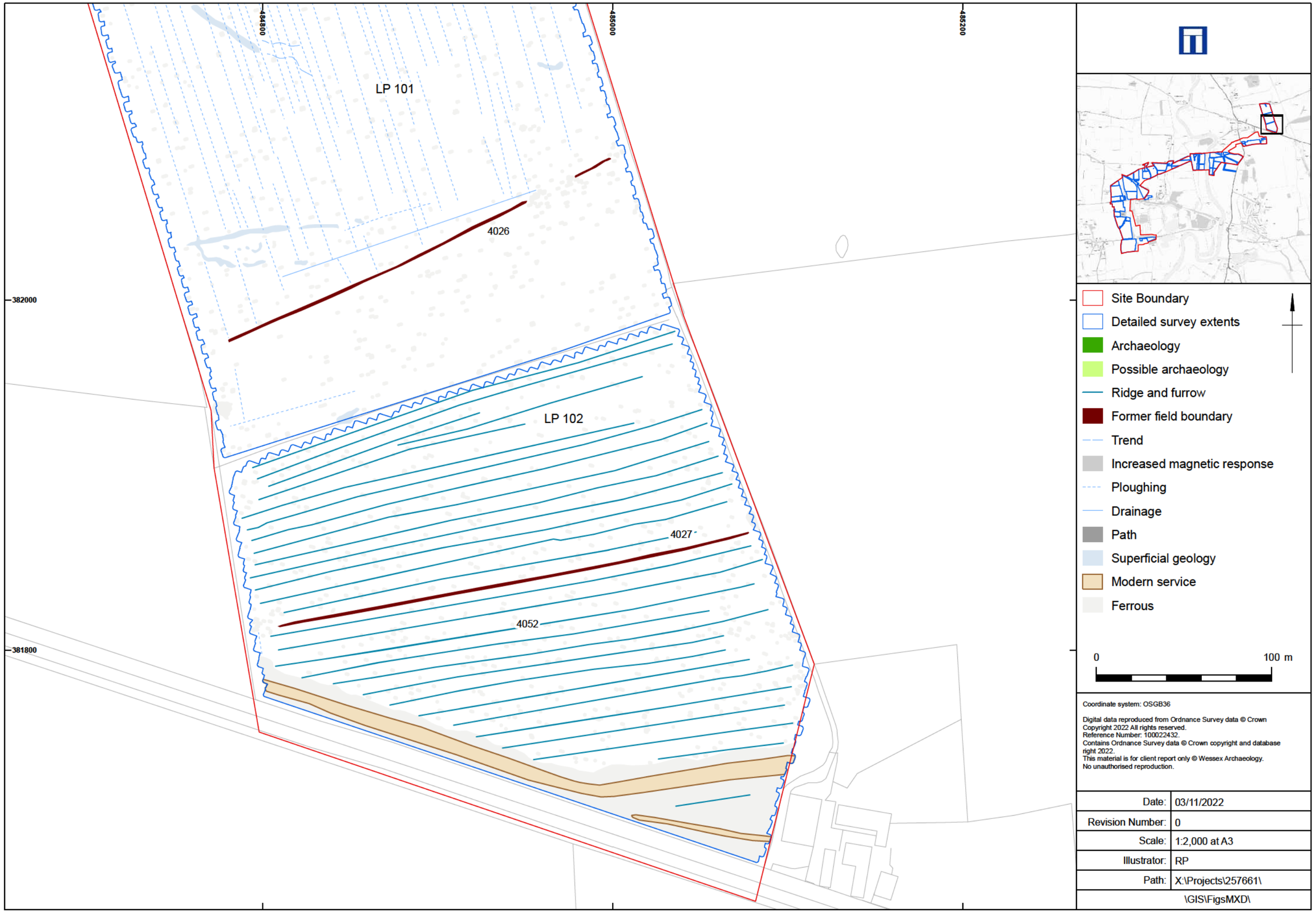
Detailed gradiometer survey results: interpretation (Feilds 100, 101)

Figure 9



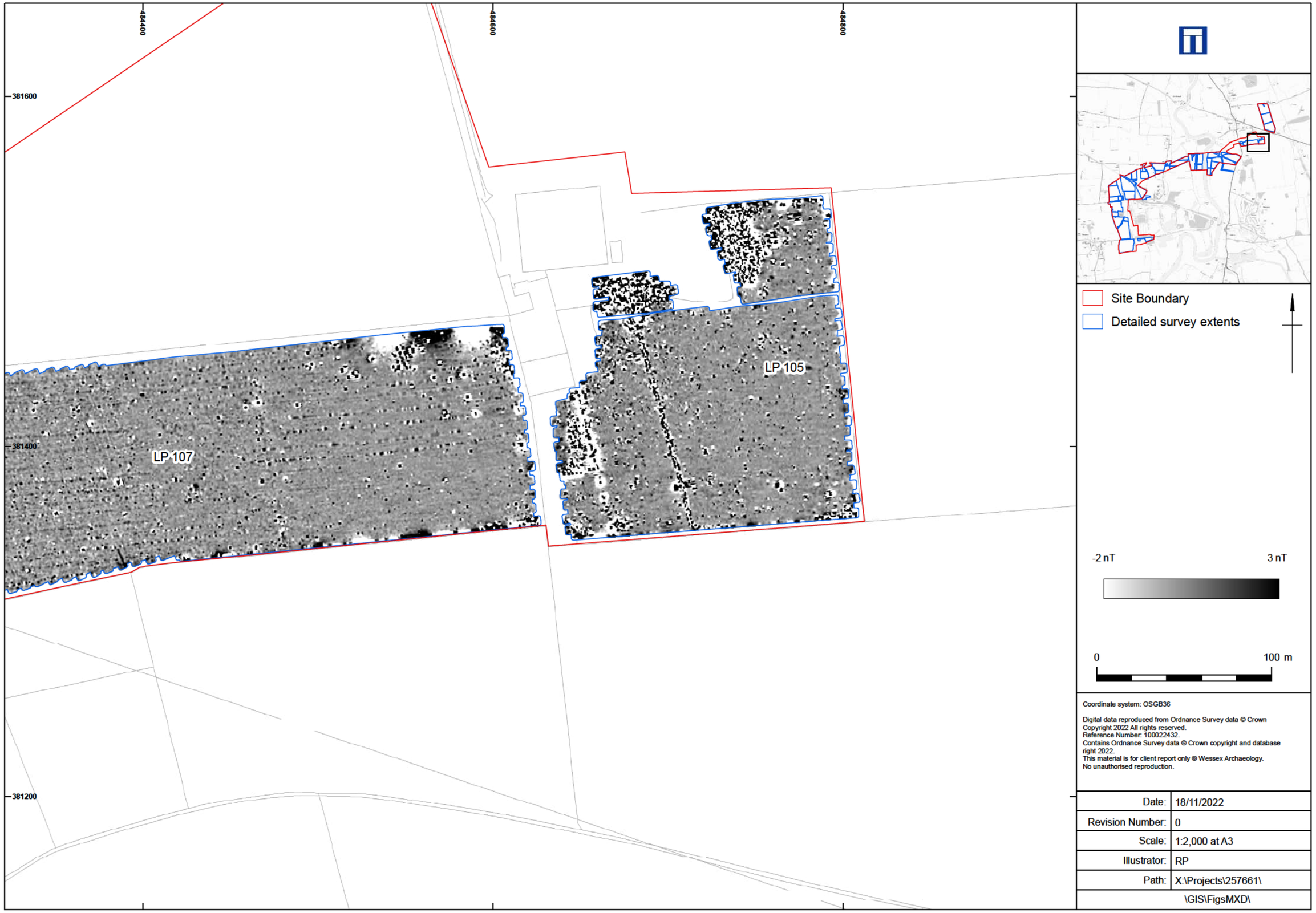
Detailed gradiometer survey results: grayscale plot (Fields 101, 102)

Figure 10



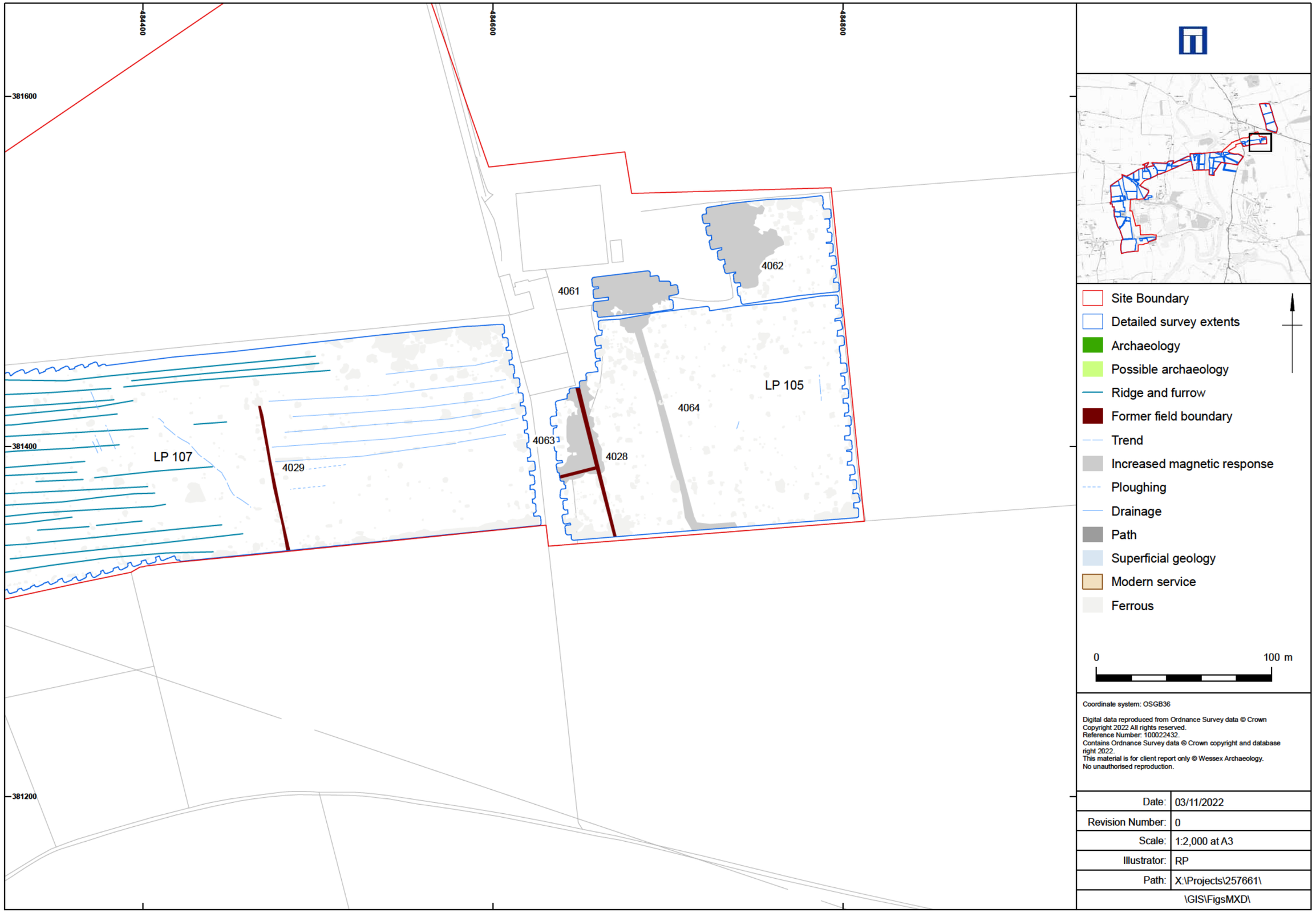
Detailed gradiometer survey results: interpretation (Fields 101, 102)

Figure 11



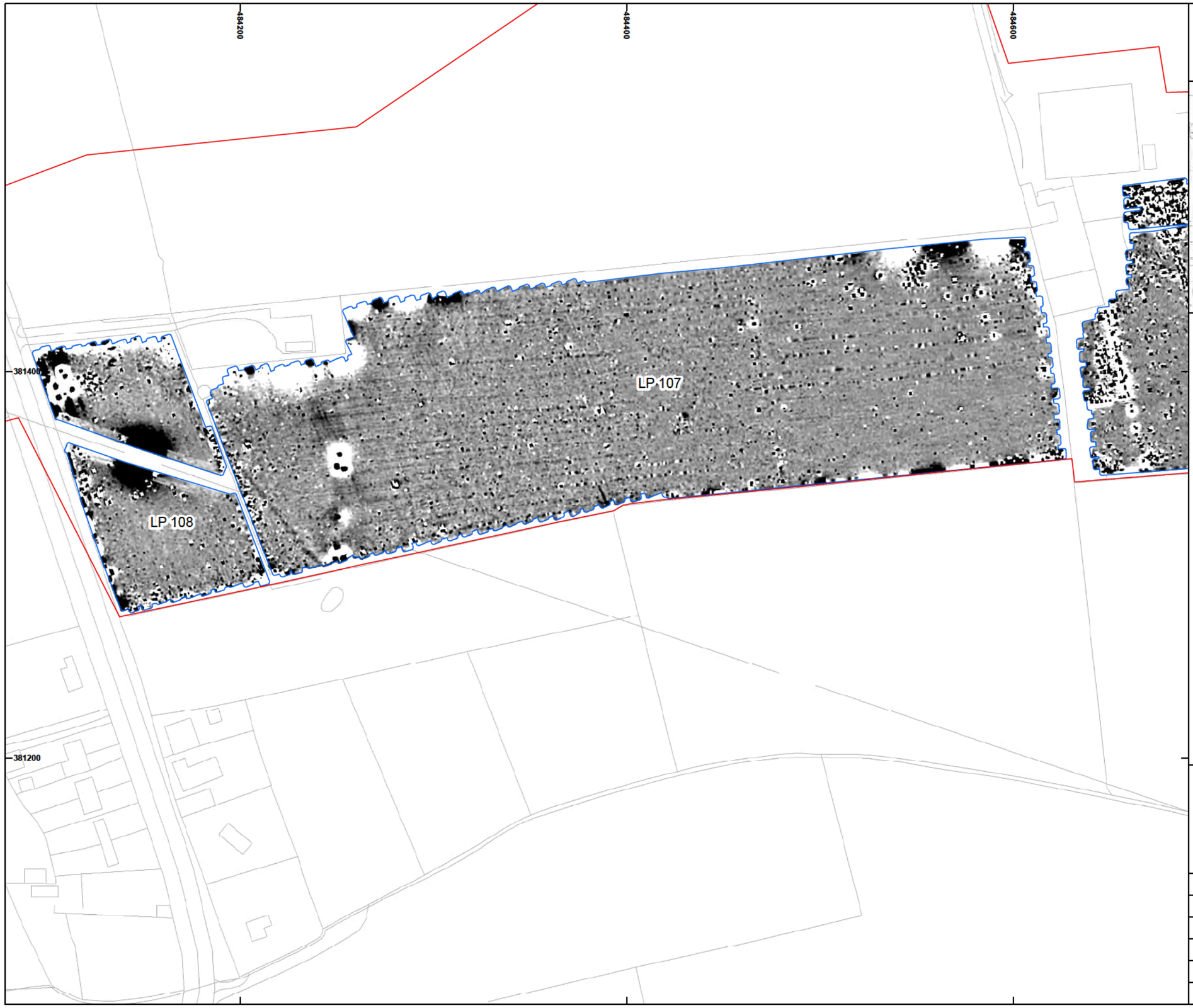
Detailed gradiometer survey results: grayscale plot (Fields 105, 107)

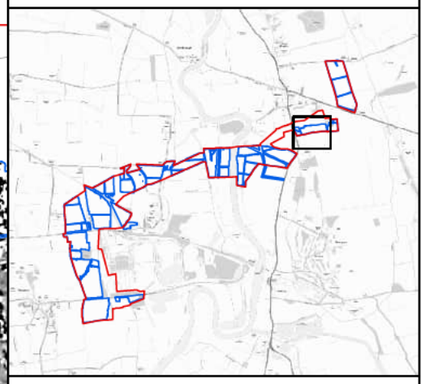
Figure 12



Detailed gradiometer survey results: interpretation (Fields 105, 107)

Figure 13





Site Boundary

Detailed survey extents

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0 100 m

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Revision Number:	0
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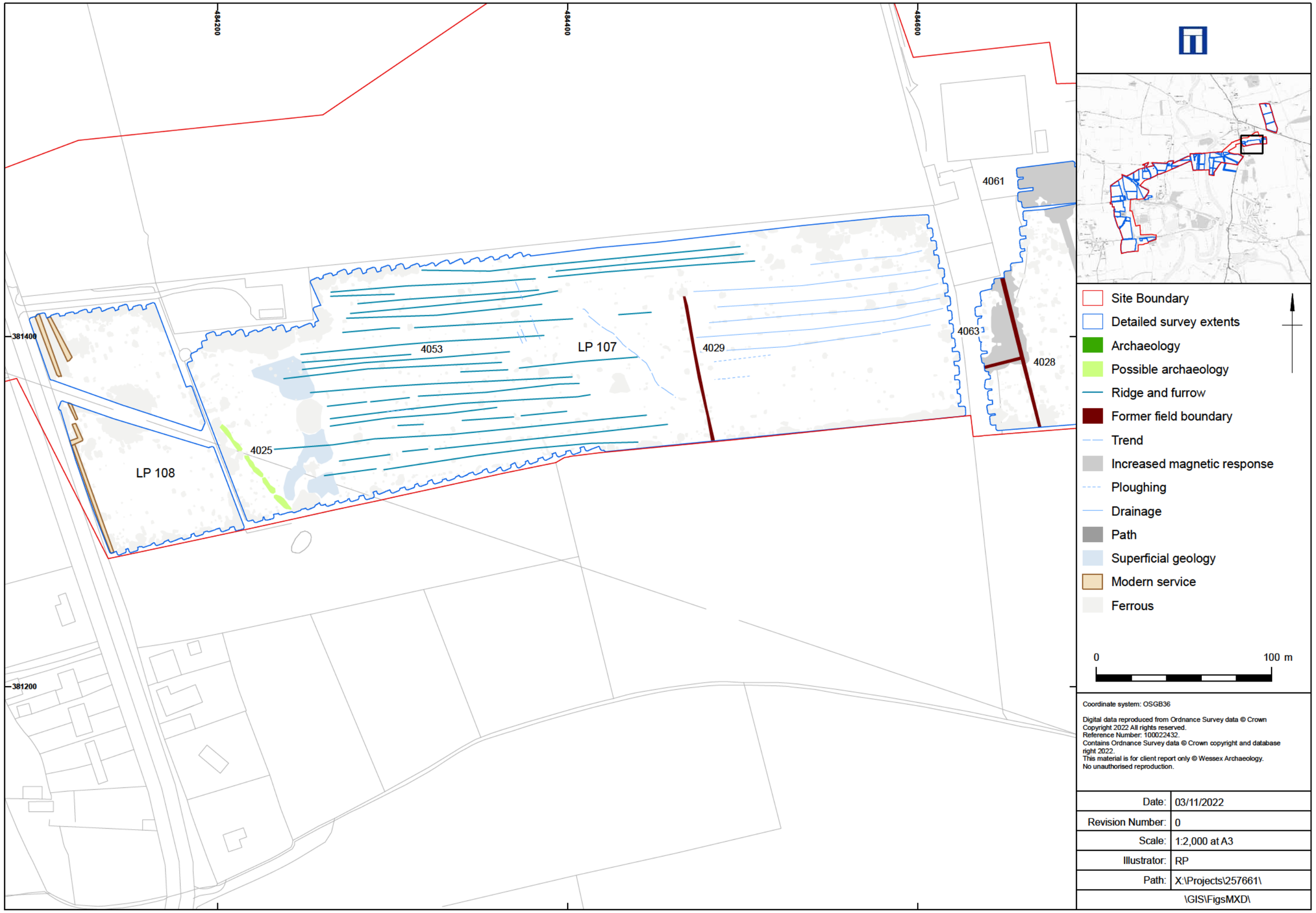
Detailed gradiometer survey results: grayscale plot (Fields 107, 108)

Figure 14



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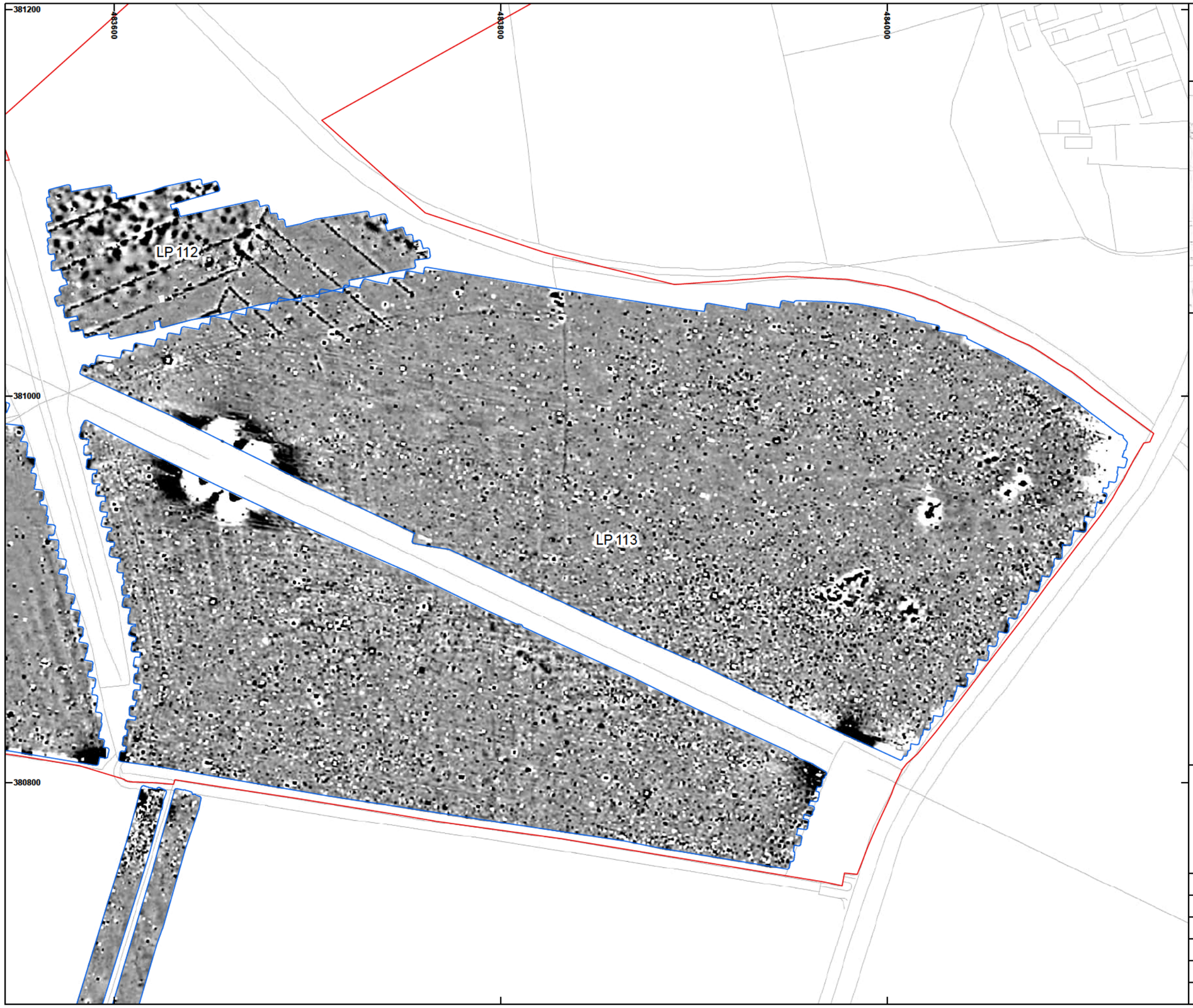
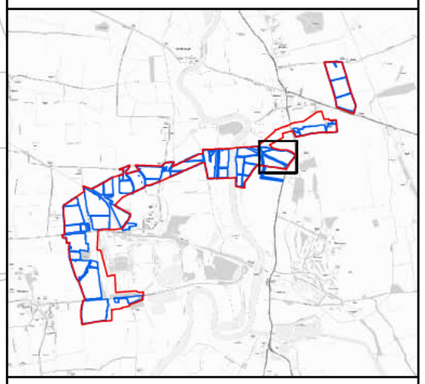
Detailed gradiometer survey results: interpretation (Fields 107, 108)

Figure 15





Site Boundary

Detailed survey extents

-2 nT 3 nT

0 100 m

Date:	18/11/2022
Revision Number:	0
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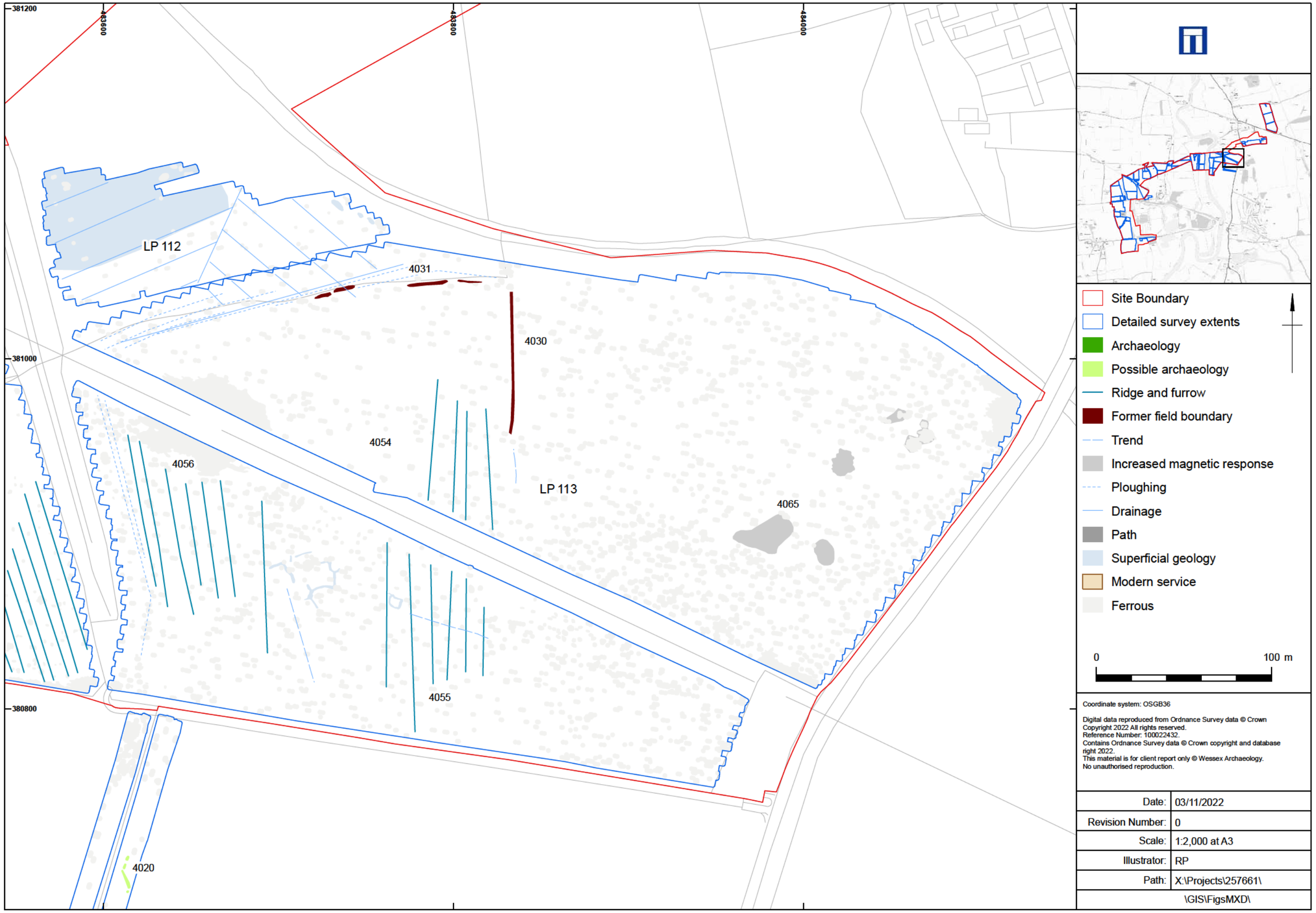
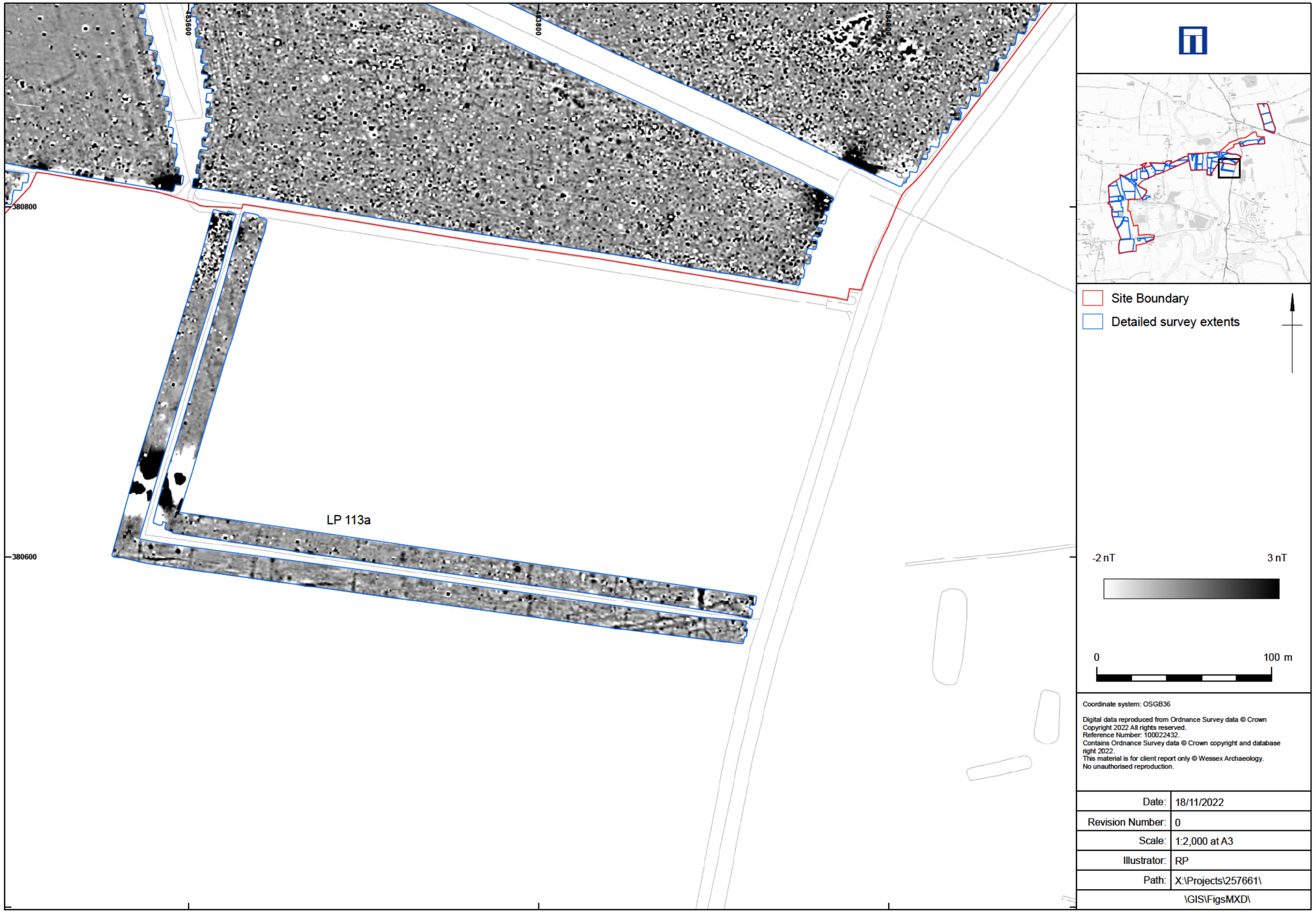
Detailed gradiometer survey results: grayscale plot (Fields 112, 113)

Figure 16



Detailed gradiometer survey results: interpretation (Fields 112, 113)

Figure 17



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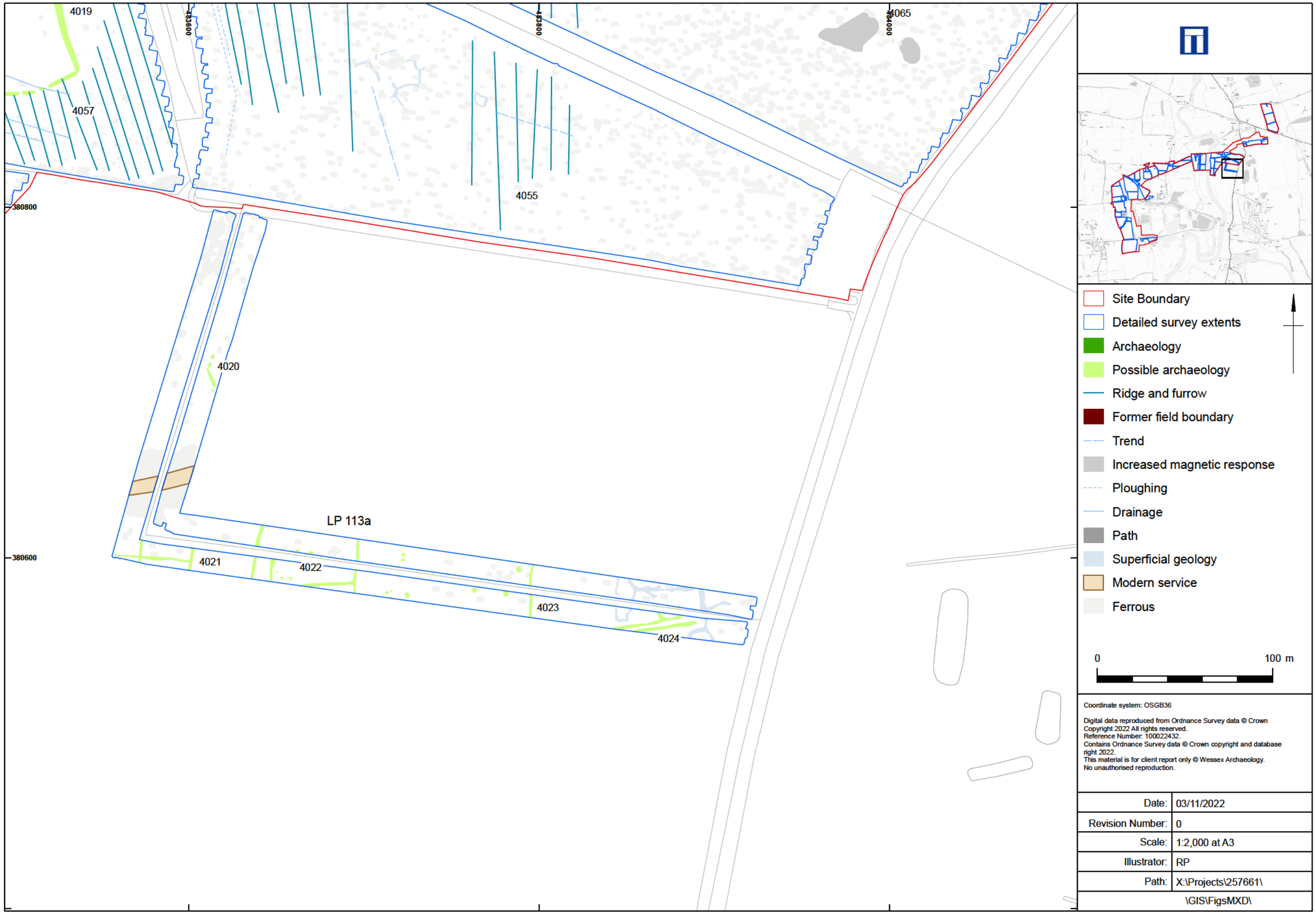
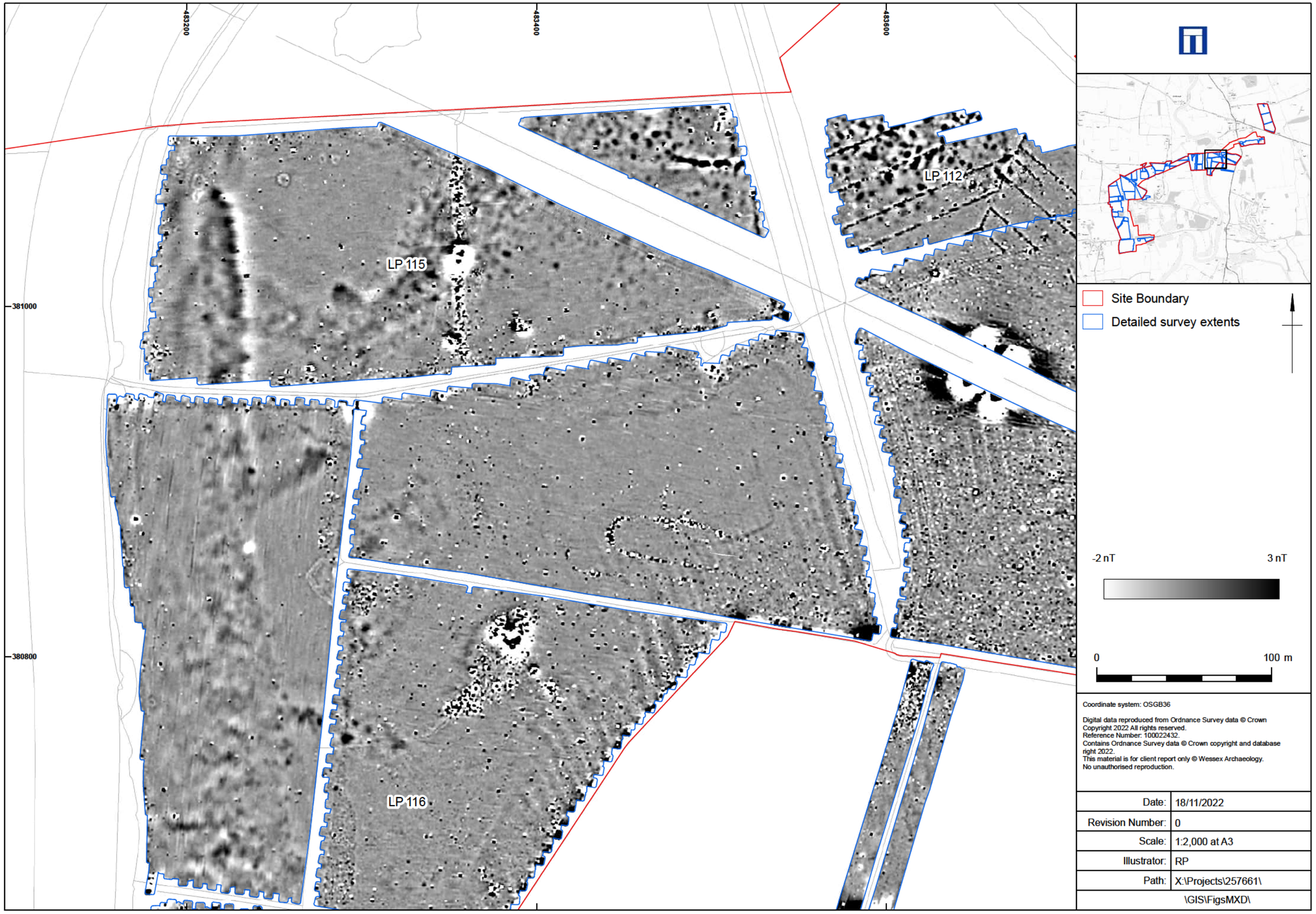
Detailed gradiometer survey results: grayscale plot (Fields 113, 113a)

Figure 18



Detailed gradiometer survey results: interpretation (Fields 113, 113a)

Figure 19



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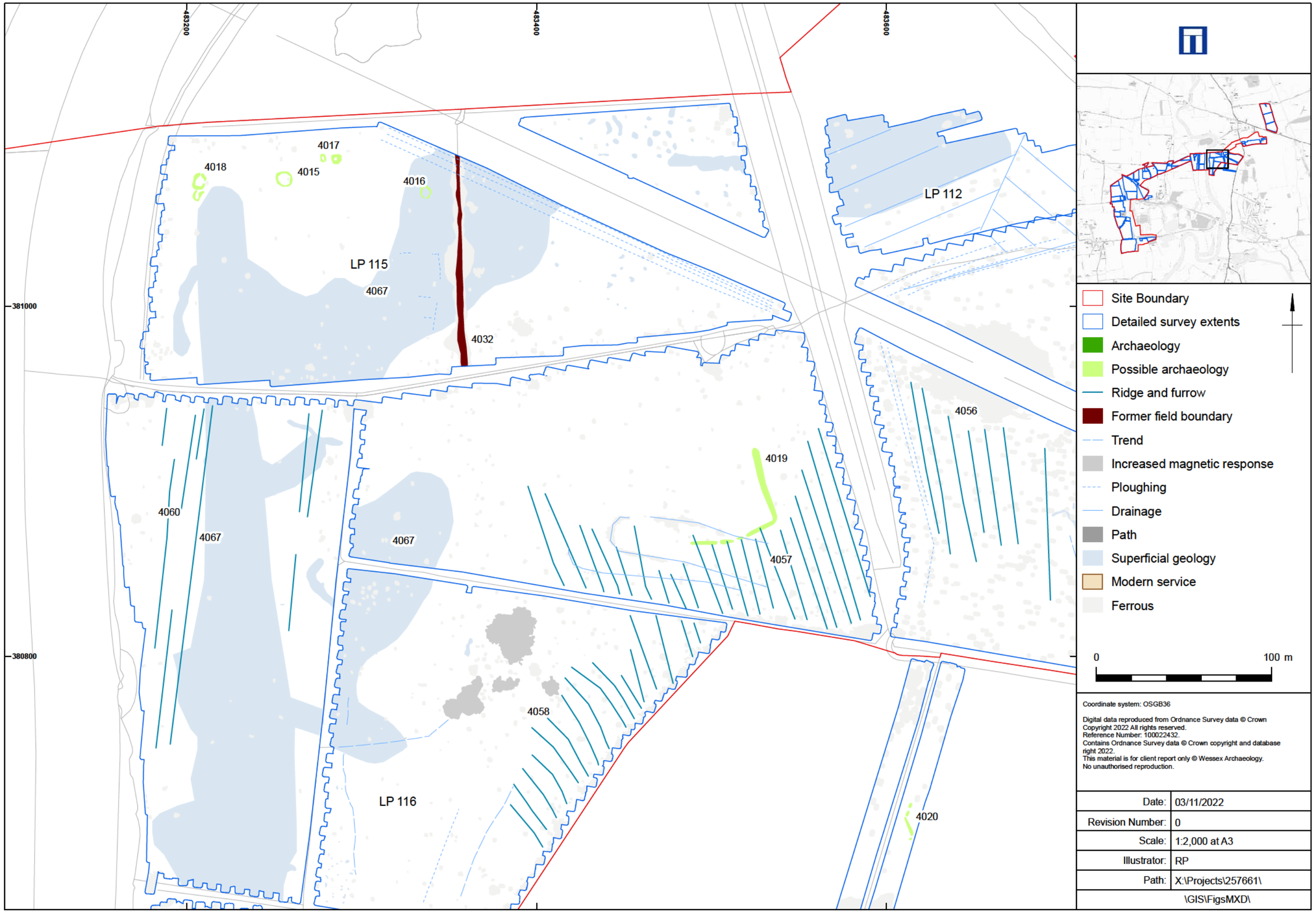
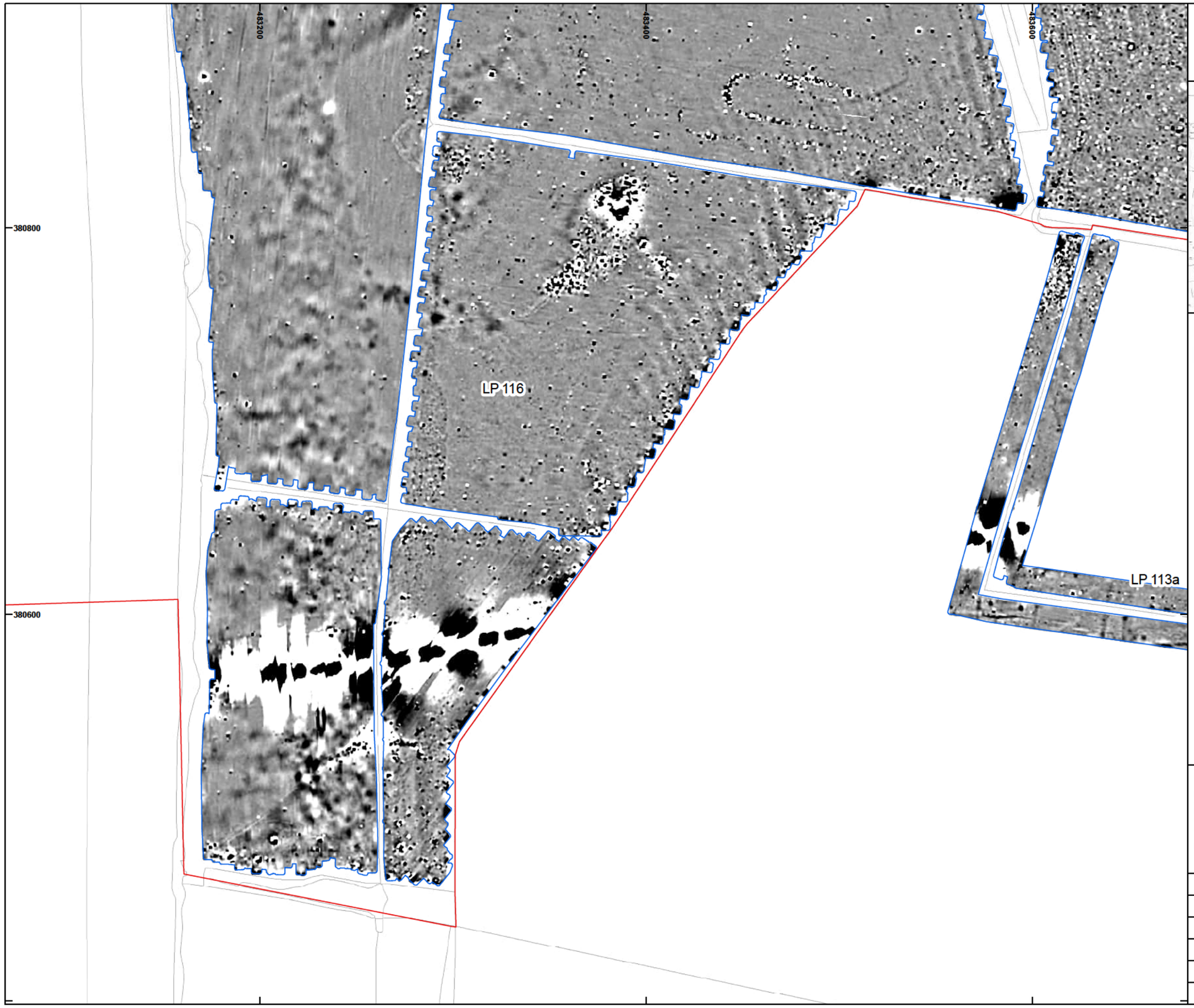
Detailed gradiometer survey results: grayscale plot (Fields 115, 116)

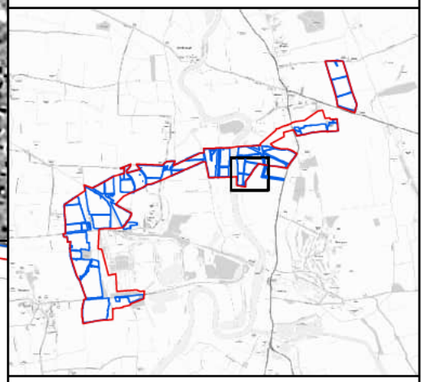
Figure 20



Detailed gradiometer survey results: interpretation (Fields 115, 116)

Figure 21





Site Boundary

Detailed survey extents

-2 nT

3 nT

0

100 m

Coordinate system: OSGB36

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
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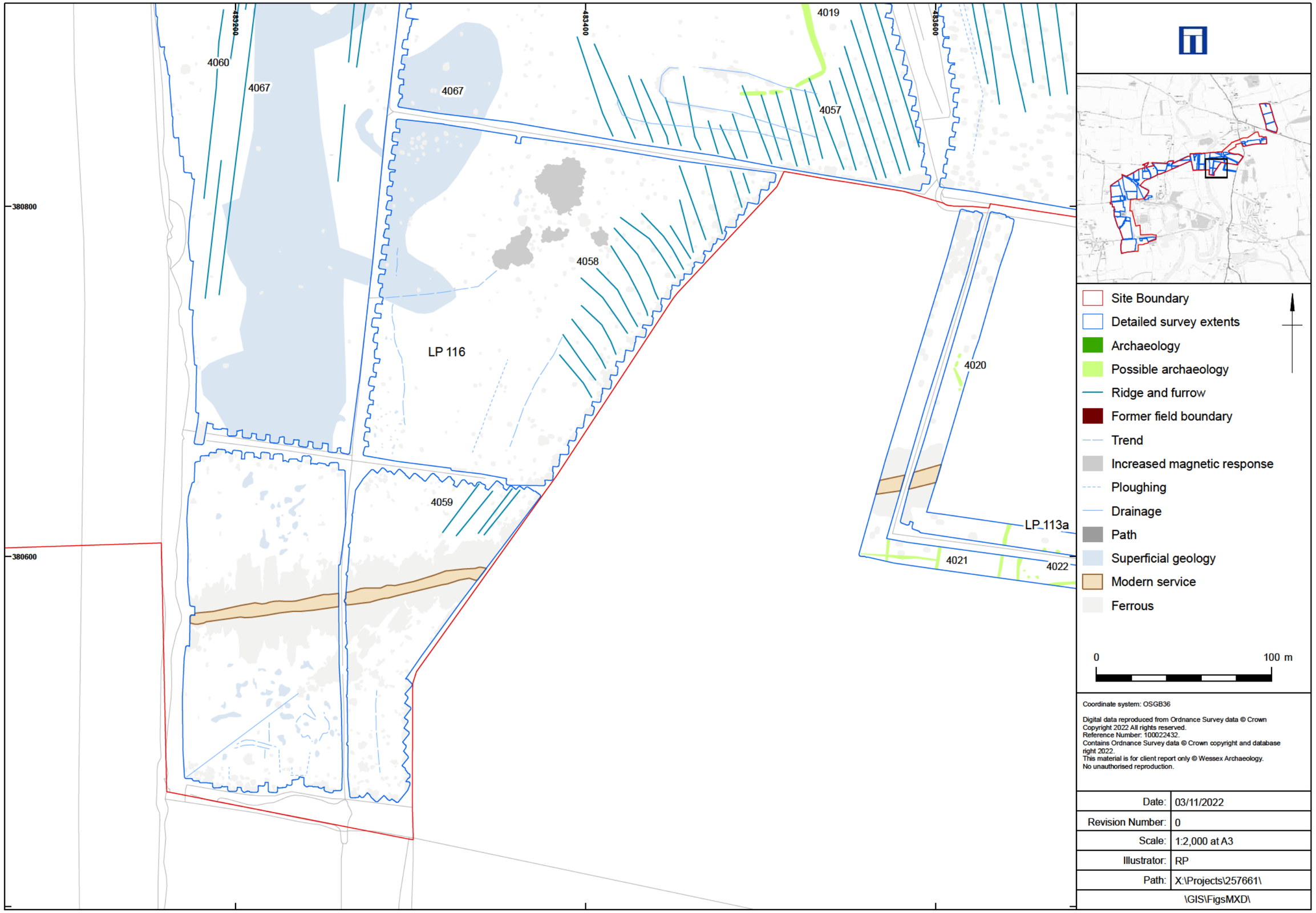
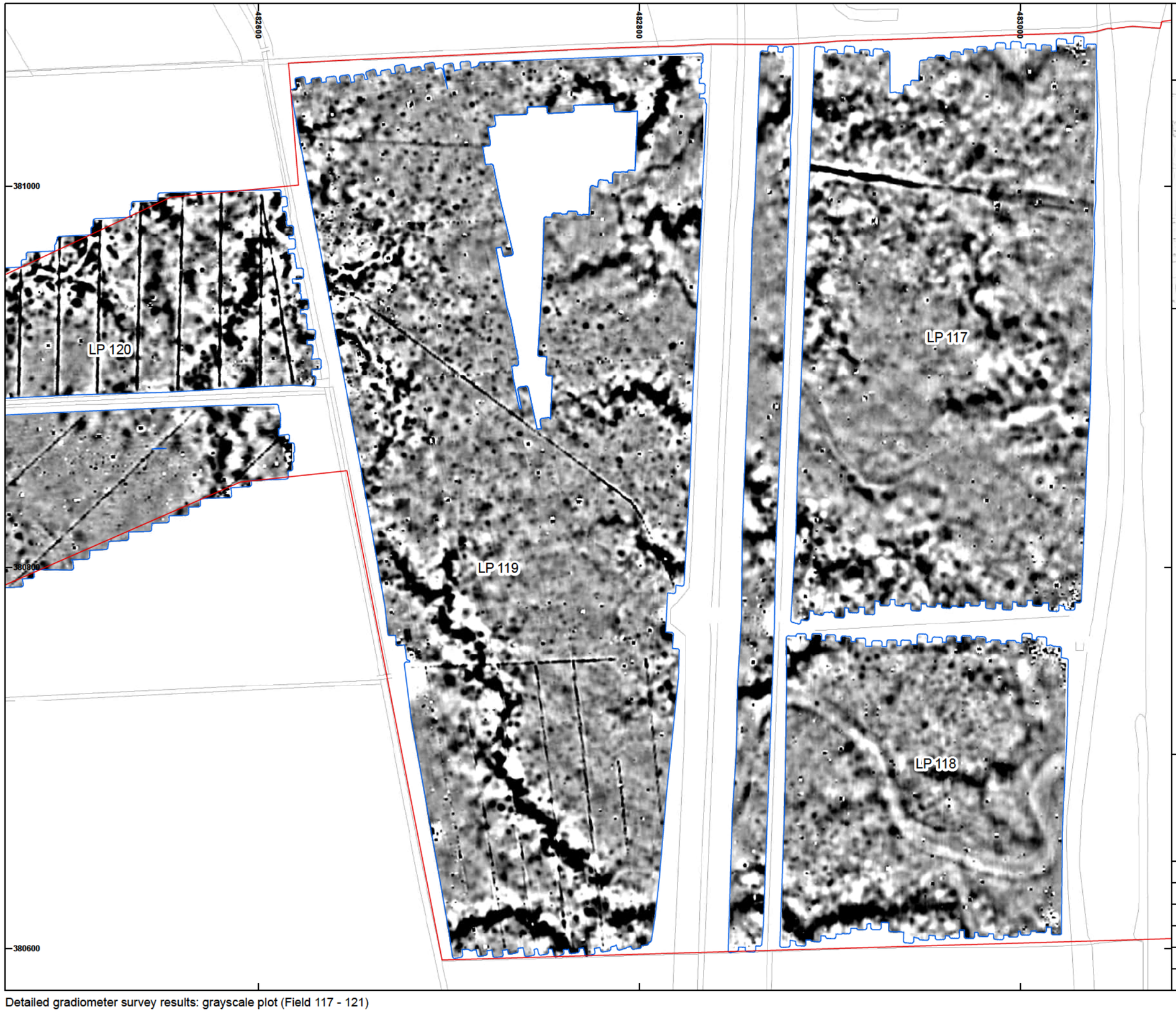
Detailed gradiometer survey results: grayscale plot (Field 116)

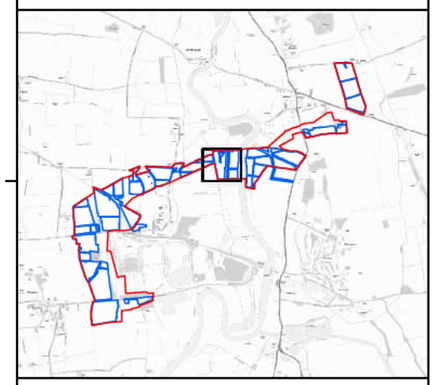
Figure 22



Detailed gradiometer survey results: interpretation (Field 116)

Figure 23





Site Boundary

Detailed survey extents

-2 nT

3 nT

0

100 m

Coordinate system: OSGB36

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
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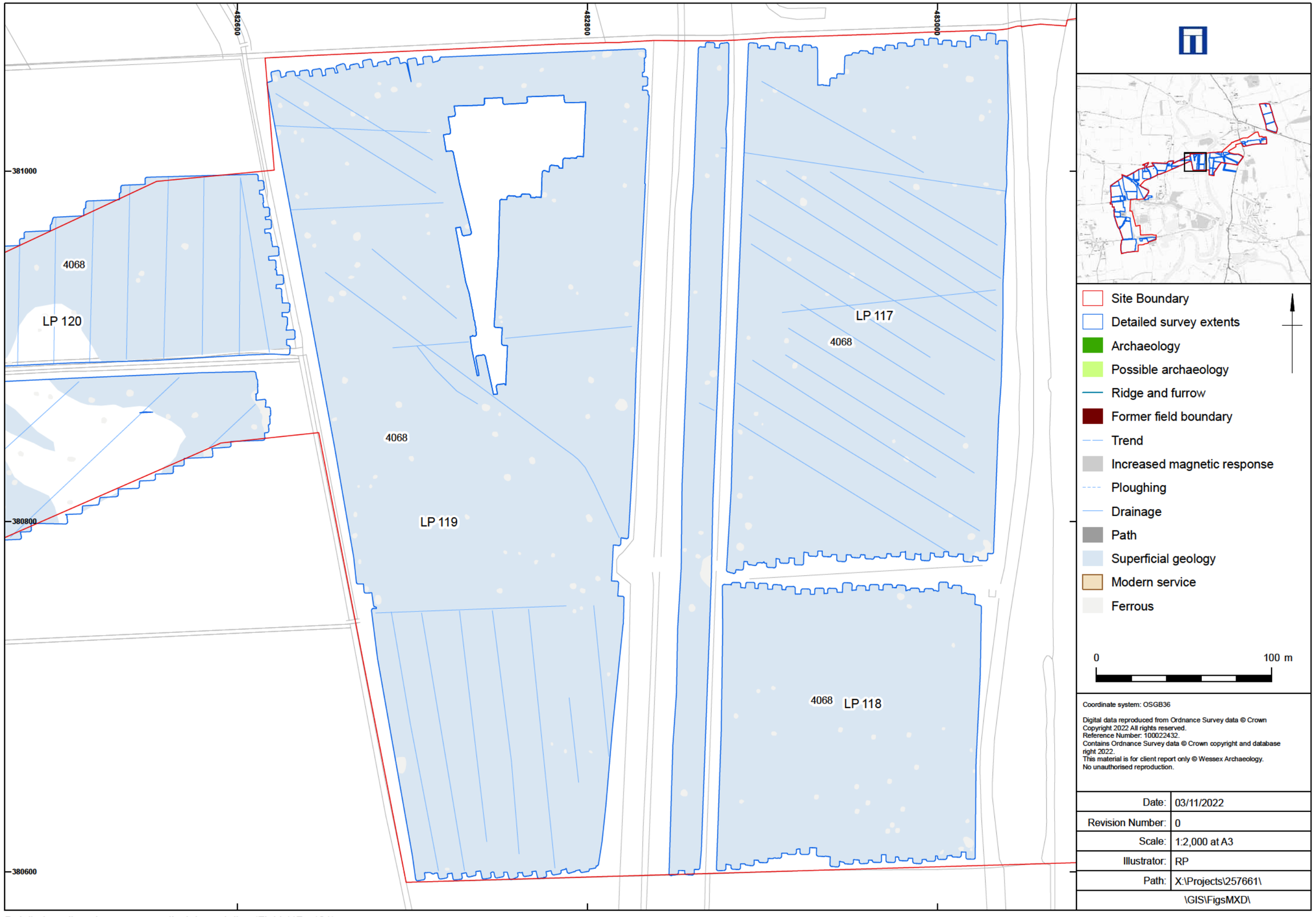
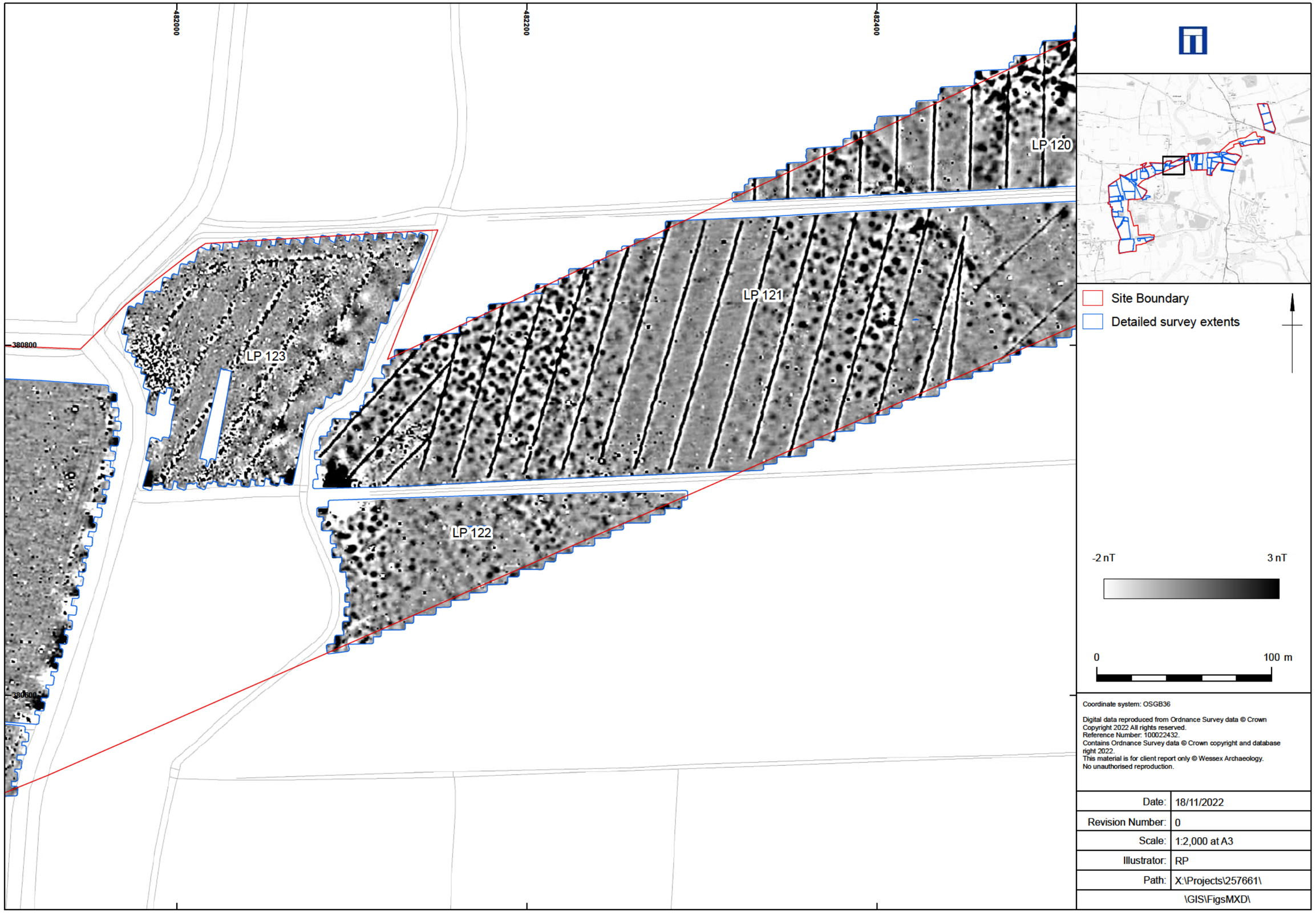
Detailed gradiometer survey results: grayscale plot (Field 117 - 121)

Figure 24



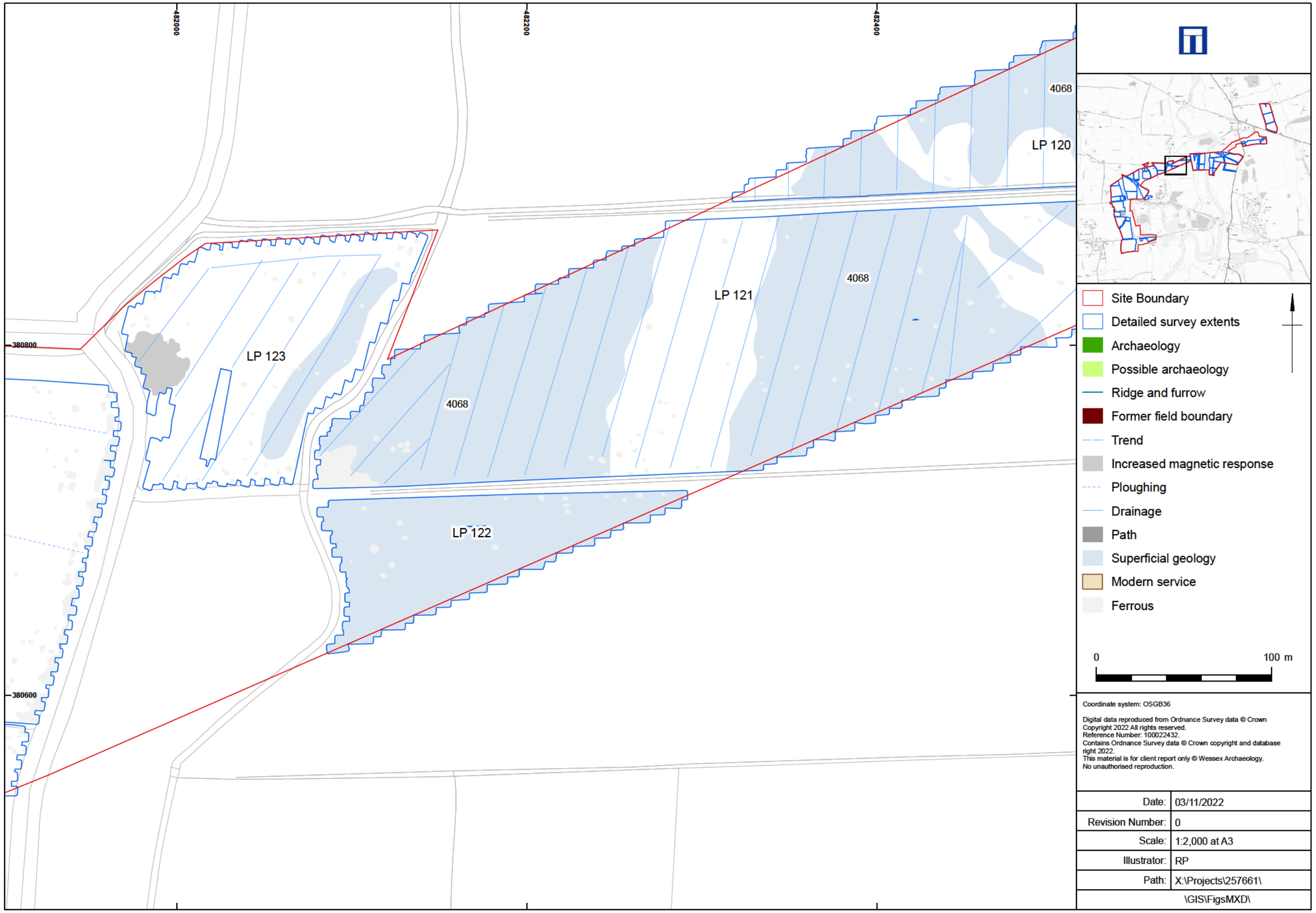
Detailed gradiometer survey results: interpretation (Field 117 - 121)

Figure 25



Detailed gradiometer survey results: grayscale plot (Fields 119 - 123)

Figure 26



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Revision Number:	0
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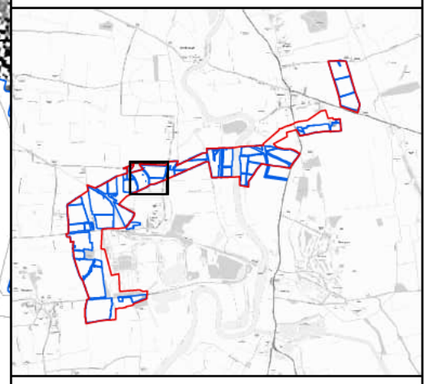
Detailed gradiometer survey results: interpretation (Fields 119 - 123)

Figure 27

481400
481600
481800
380800
380600
380400
LP 125
LP 126
LP 155



Site Boundary
Detailed survey extents

-2 nT
3 nT

0
100 m

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
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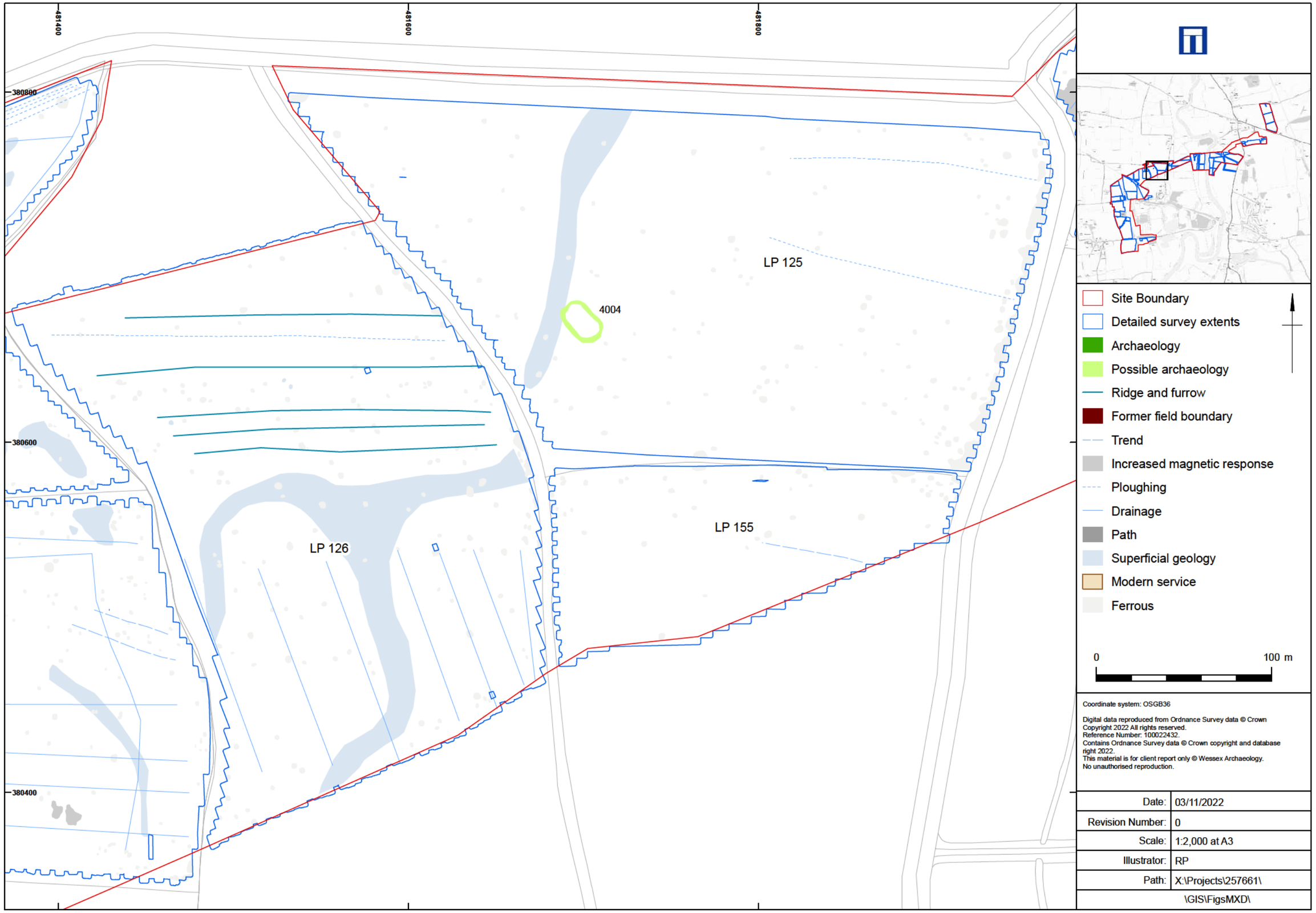
Detailed gradiometer survey results: grayscale plot (Field 125 - 128, 155)

Figure 28



Coordinate system: OSGB36

Date:	03/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

Detailed gradiometer survey results: interpretation (Field 125 - 128, 155)

Figure 29

480800
481000
481200
481400
380600
380400
LP 127
LP 128
LP 131
LP 132

Site Boundary
Detailed survey extents

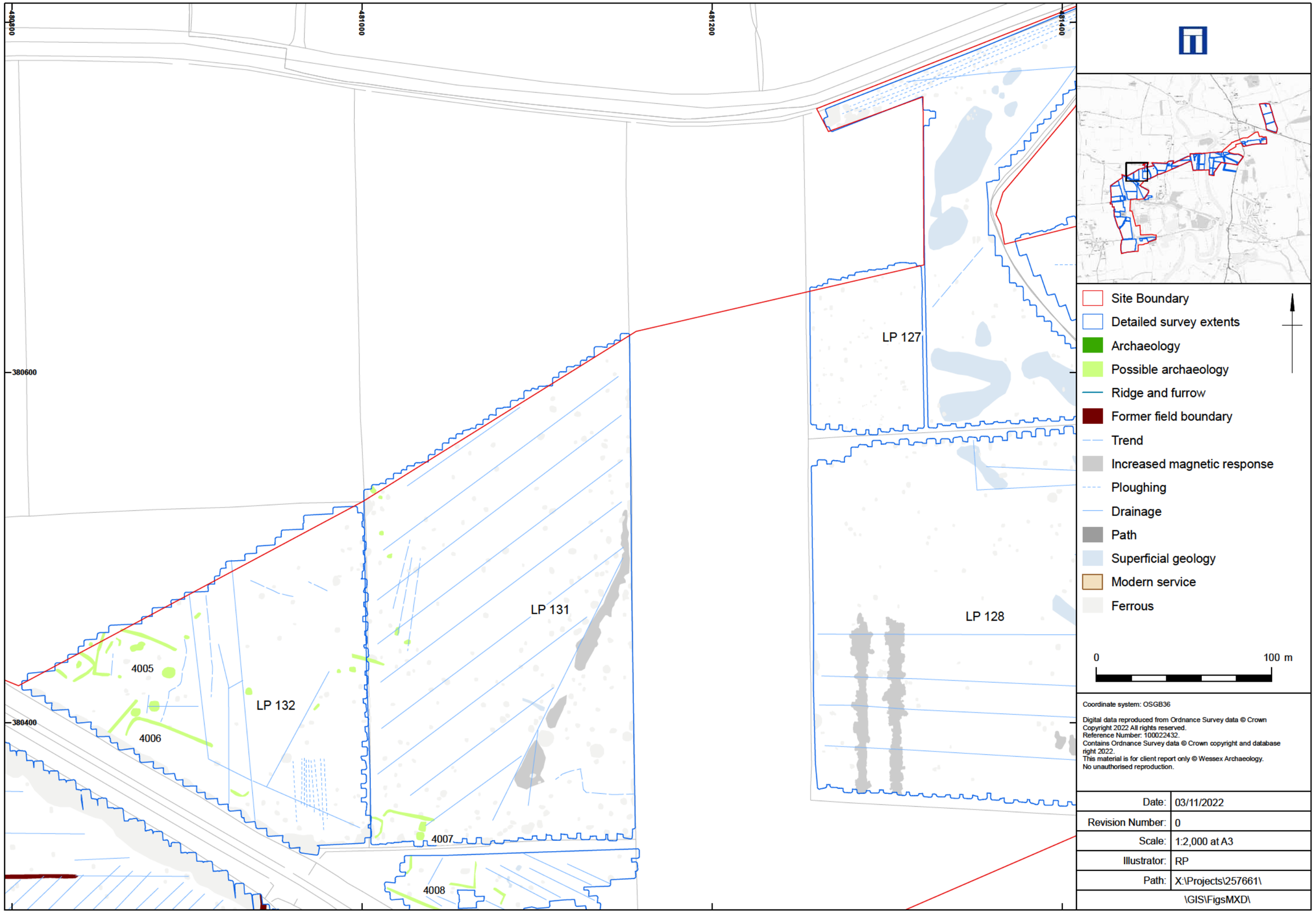
-2 nT
3 nT

0
100 m

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

Detailed gradiometer survey results: grayscale plot (Fields 127 - 133)

Figure 30



Detailed gradiometer survey results: interpretation (Fields 127 - 133)

Figure 31

480400

480600

480800

380400

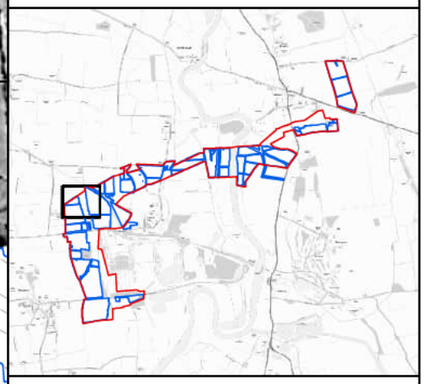
380200

380000

LP 137

LP 138

LP 136



Site Boundary

Detailed survey extents

-2 nT

3 nT

0

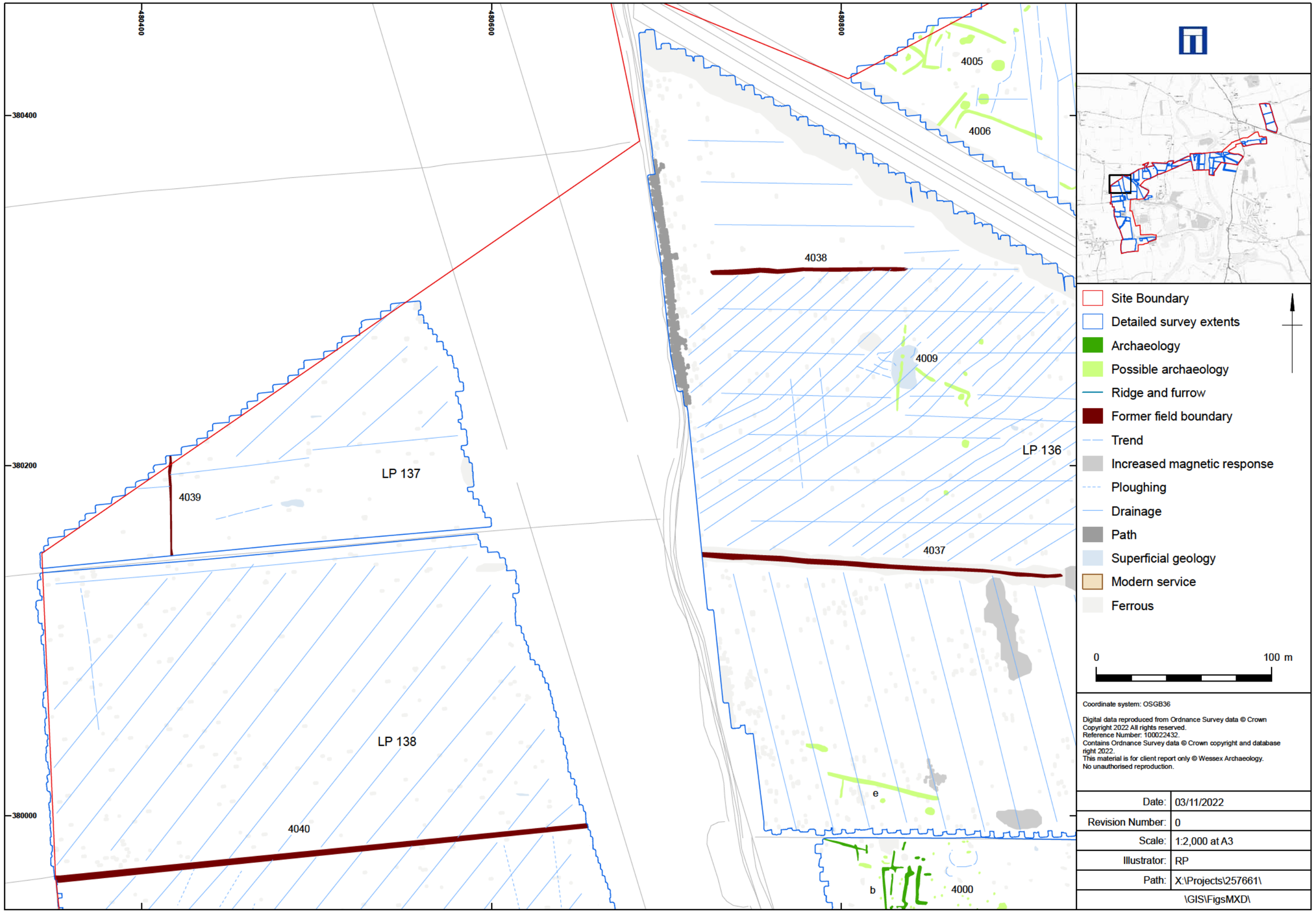
100 m

Coordinate system: OSGB36

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

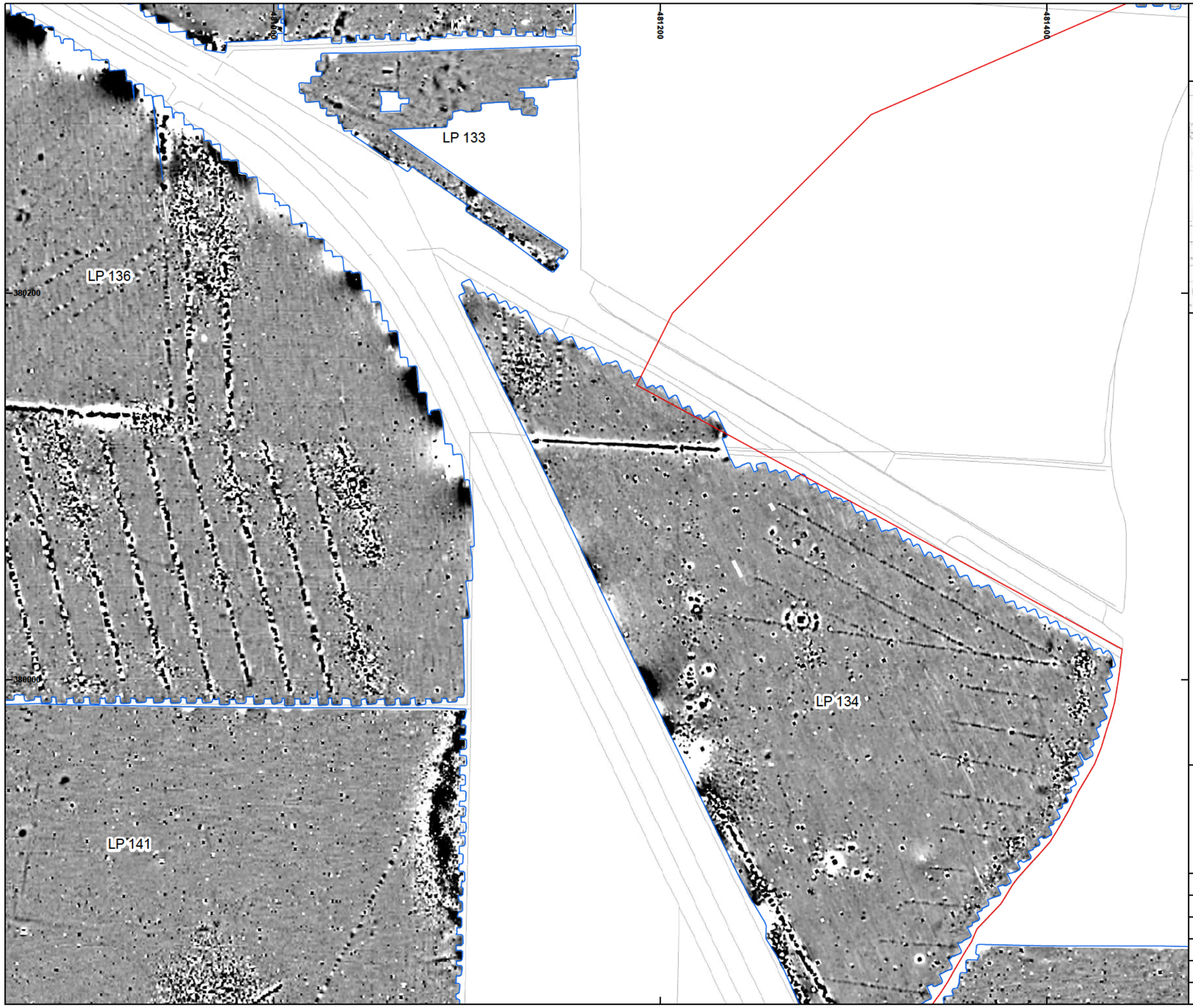
Detailed gradiometer survey results: grayscale plot (Fields 136 - 138)

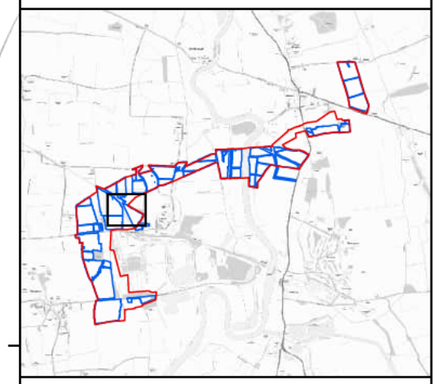
Figure 32



Detailed gradiometer survey results: interpretation (Fields 136 - 138)

Figure 33





Site Boundary
Detailed survey extents

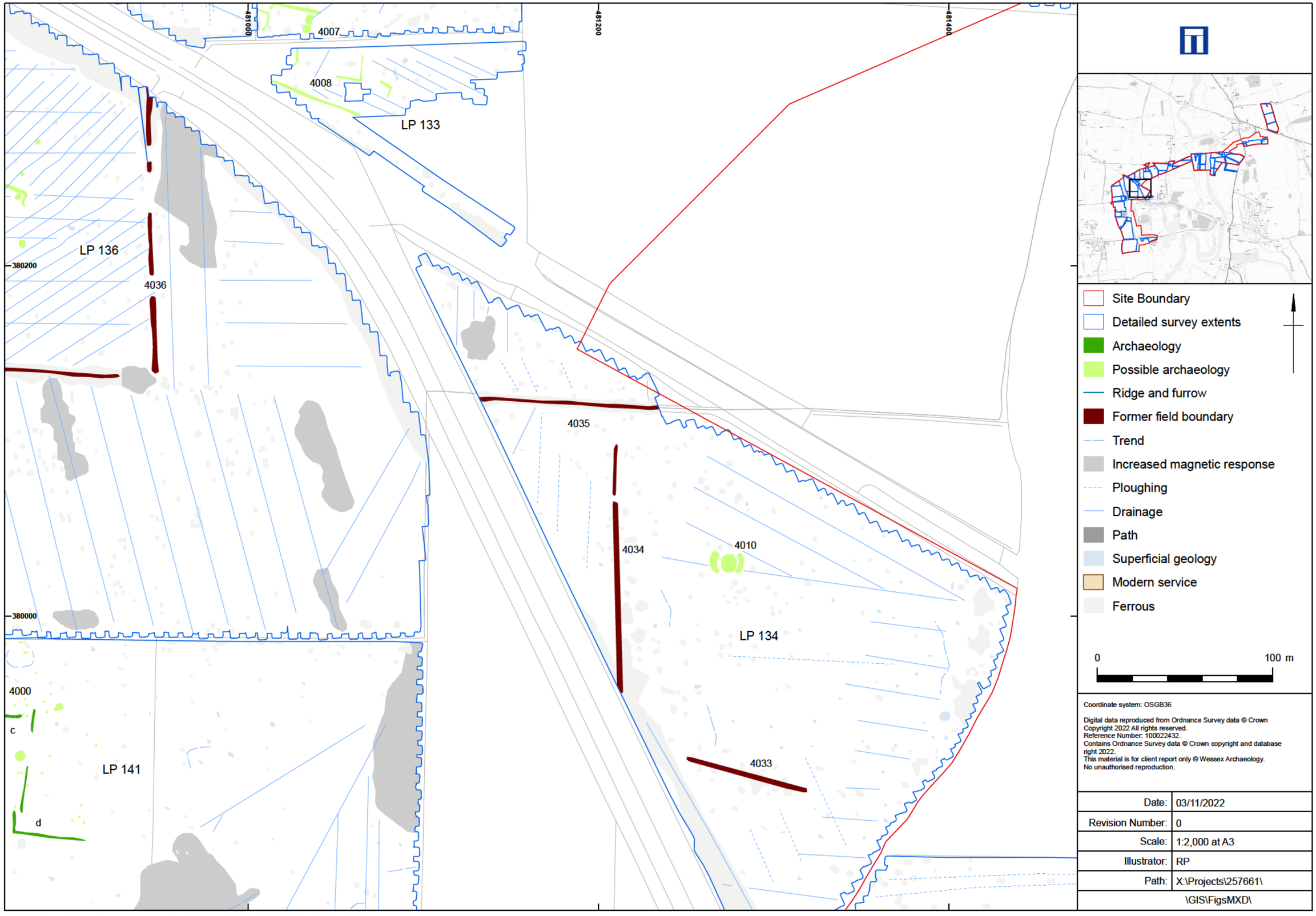
-2 nT 3 nT

0 100 m

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

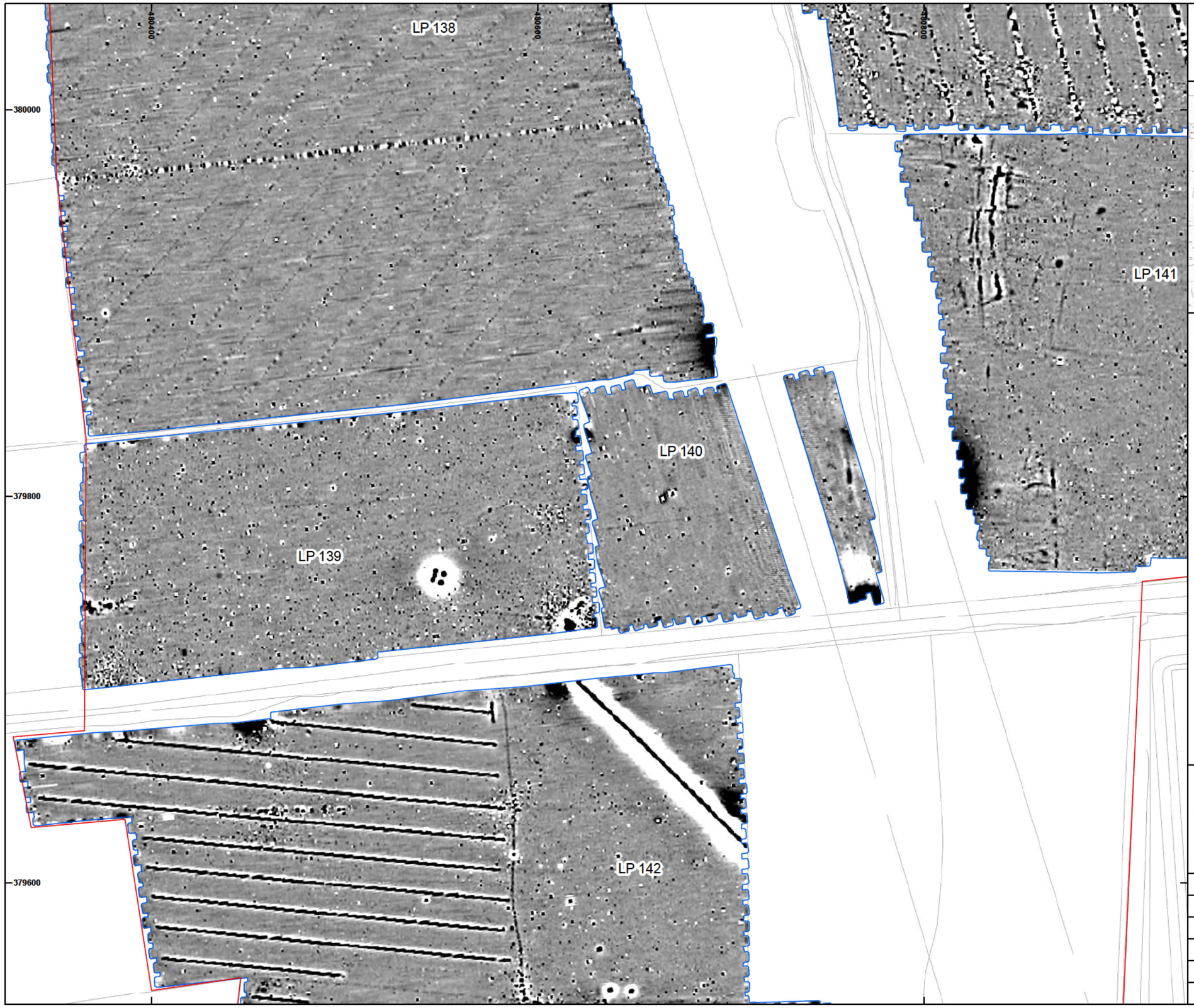
Detailed gradiometer survey results: grayscale plot (Fields133 - 136, 141)

Figure 34



Detailed gradiometer survey results: interpretation (Fields133 - 136, 141)

Figure 35

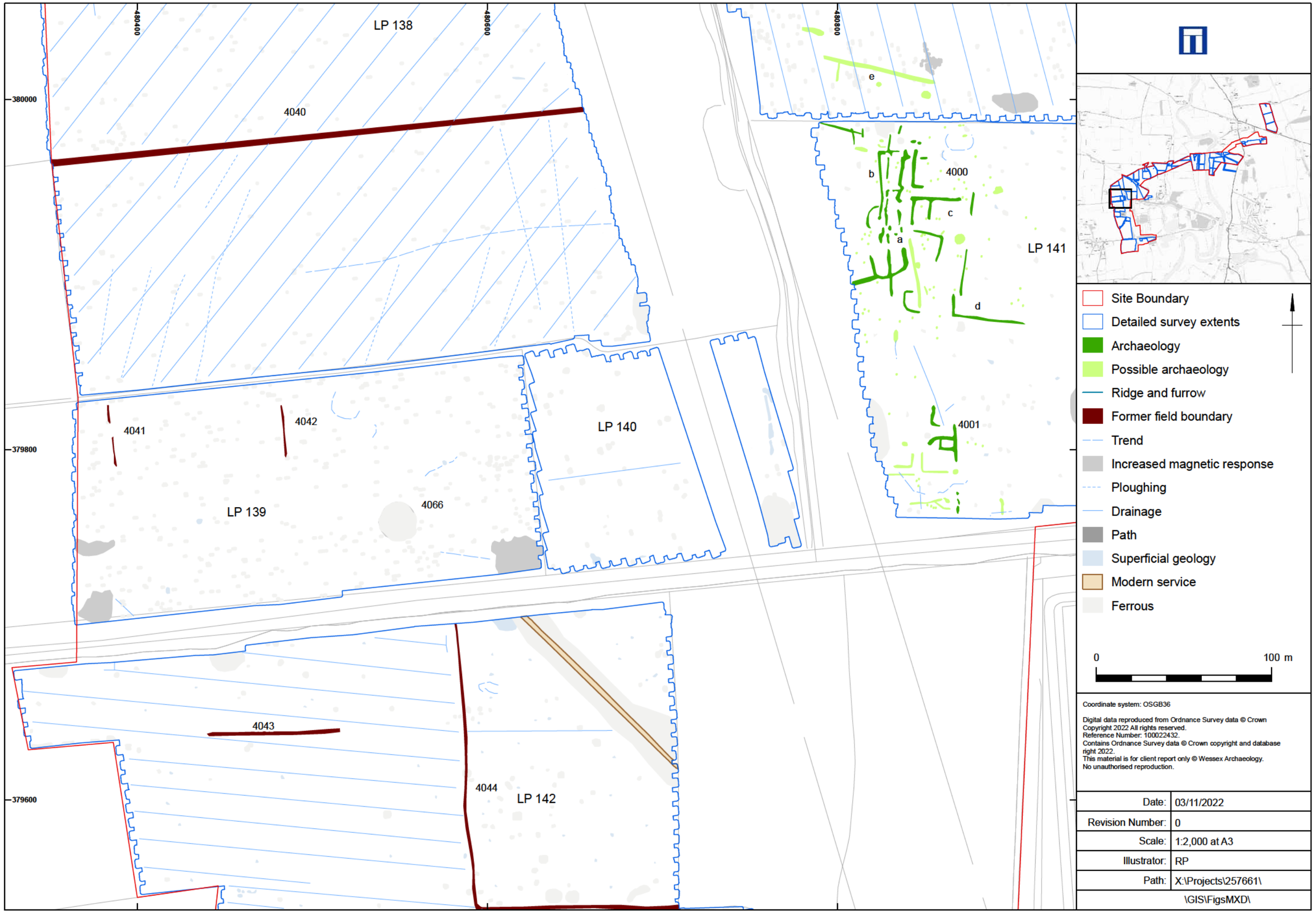


Coordinate system: OSGB36

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

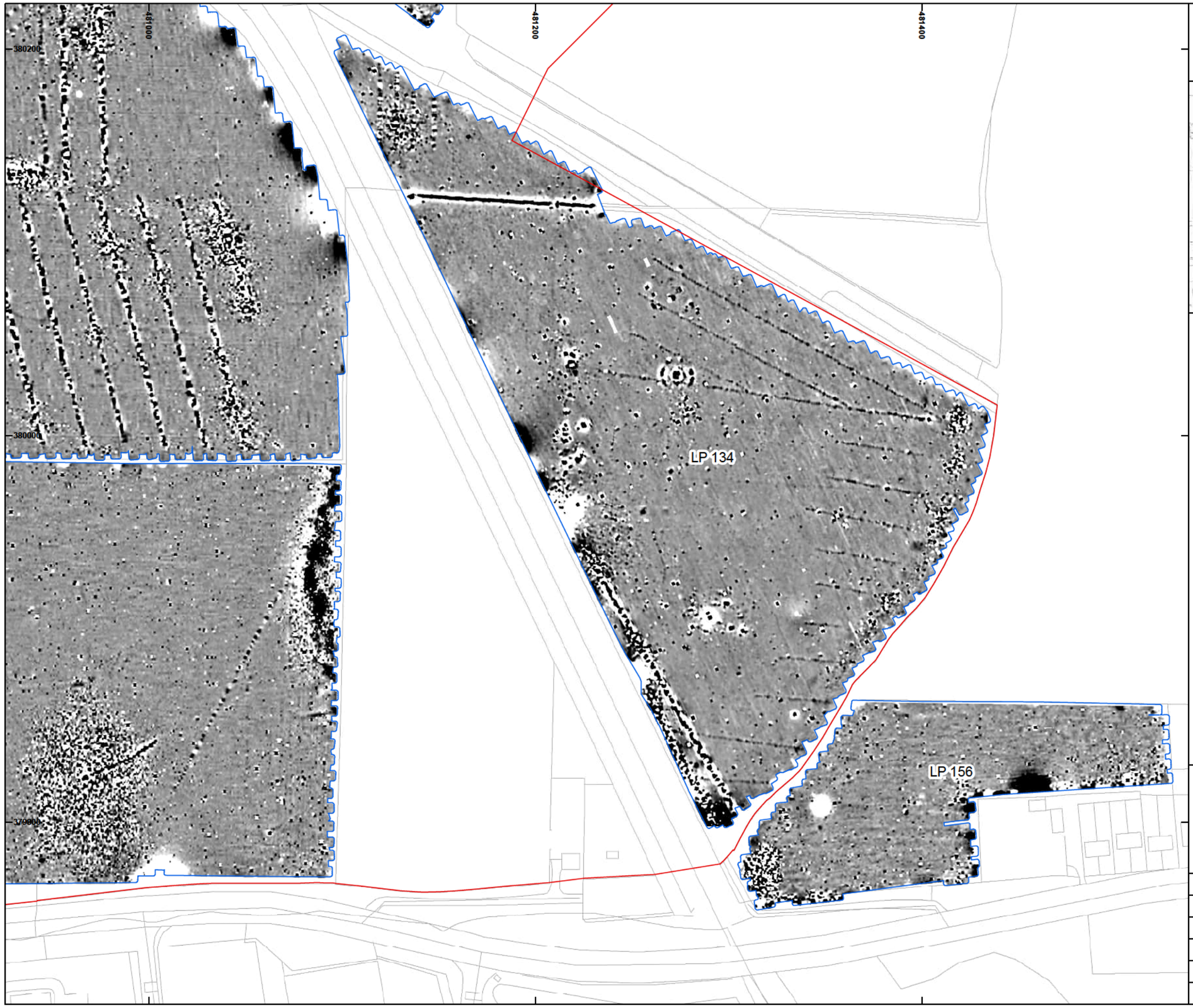
Detailed gradiometer survey results: grayscale plot (Fields 138 - 142)

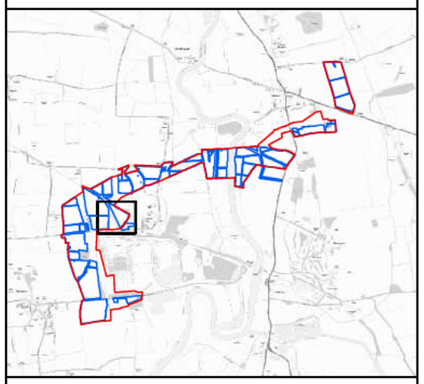
Figure 36



Detailed gradiometer survey results: interpretation (Fields 138 - 142)

Figure 37





Site Boundary

Detailed survey extents

-2 nT

3 nT

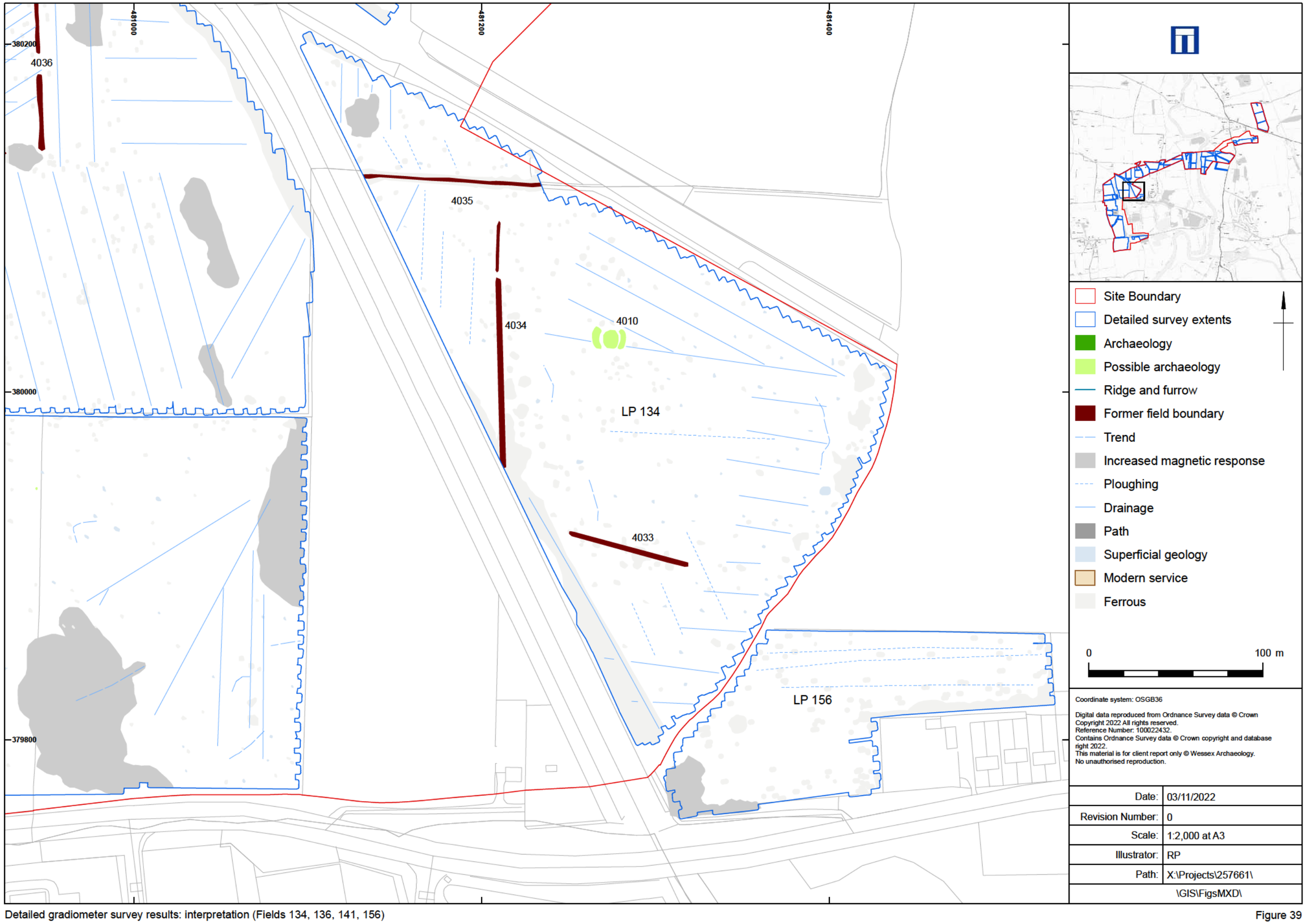
0

100 m

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

Detailed gradiometer survey results: grayscale plot (Fields 134, 136, 141, 156)

Figure 38

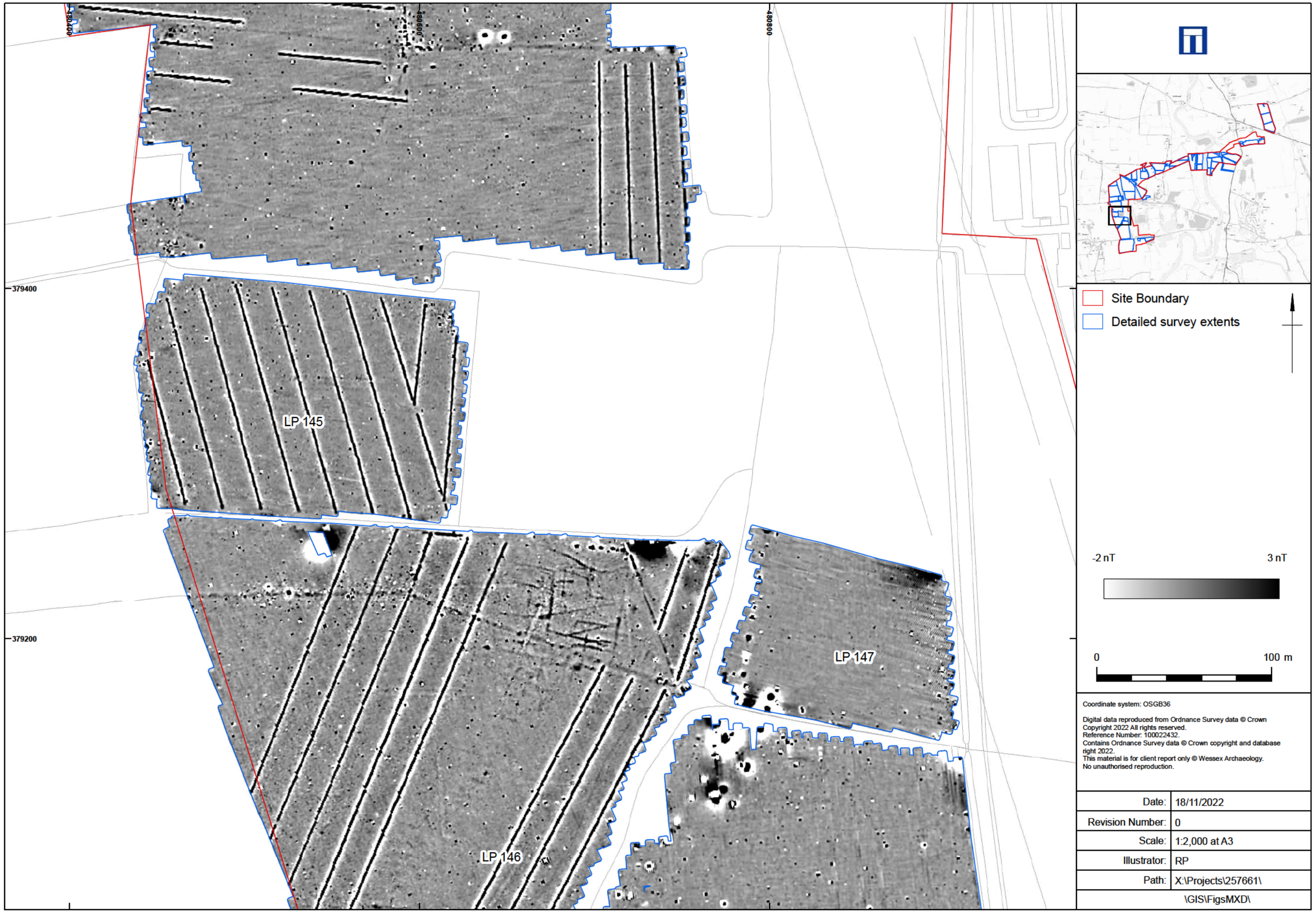


Coordinate system: OSGB36

Date:	03/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

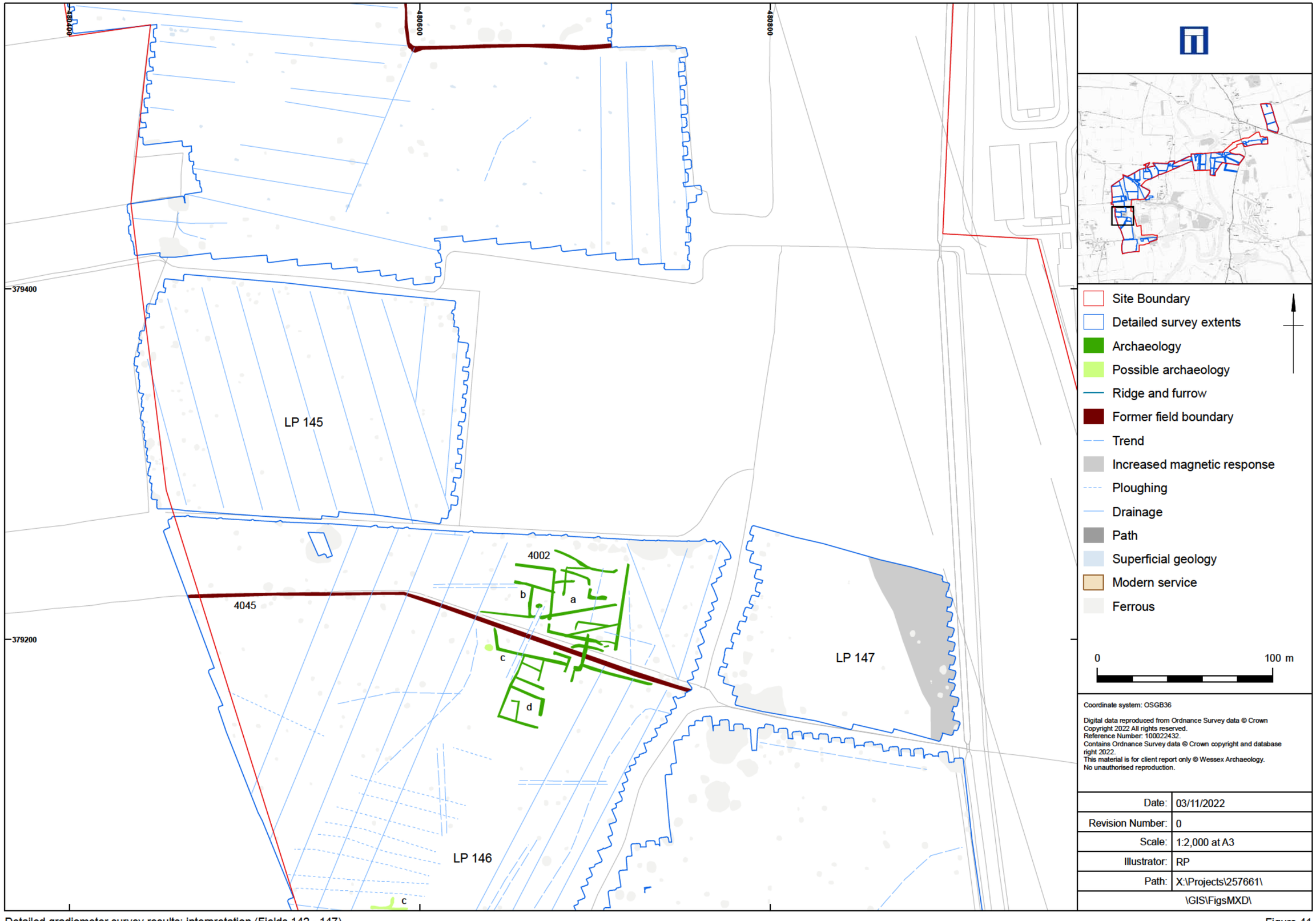
Detailed gradiometer survey results: interpretation (Fields 134, 136, 141, 156)

Figure 39



Detailed gradiometer survey results: grayscale plot (Fields 142 - 147)

Figure 40



Detailed gradiometer survey results: interpretation (Fields 142 - 147)

Figure 41

LP 146

LP 149

480600

480800

481000

379000

378800

378600

Site Boundary

Detailed survey extents

-2 nT

3 nT

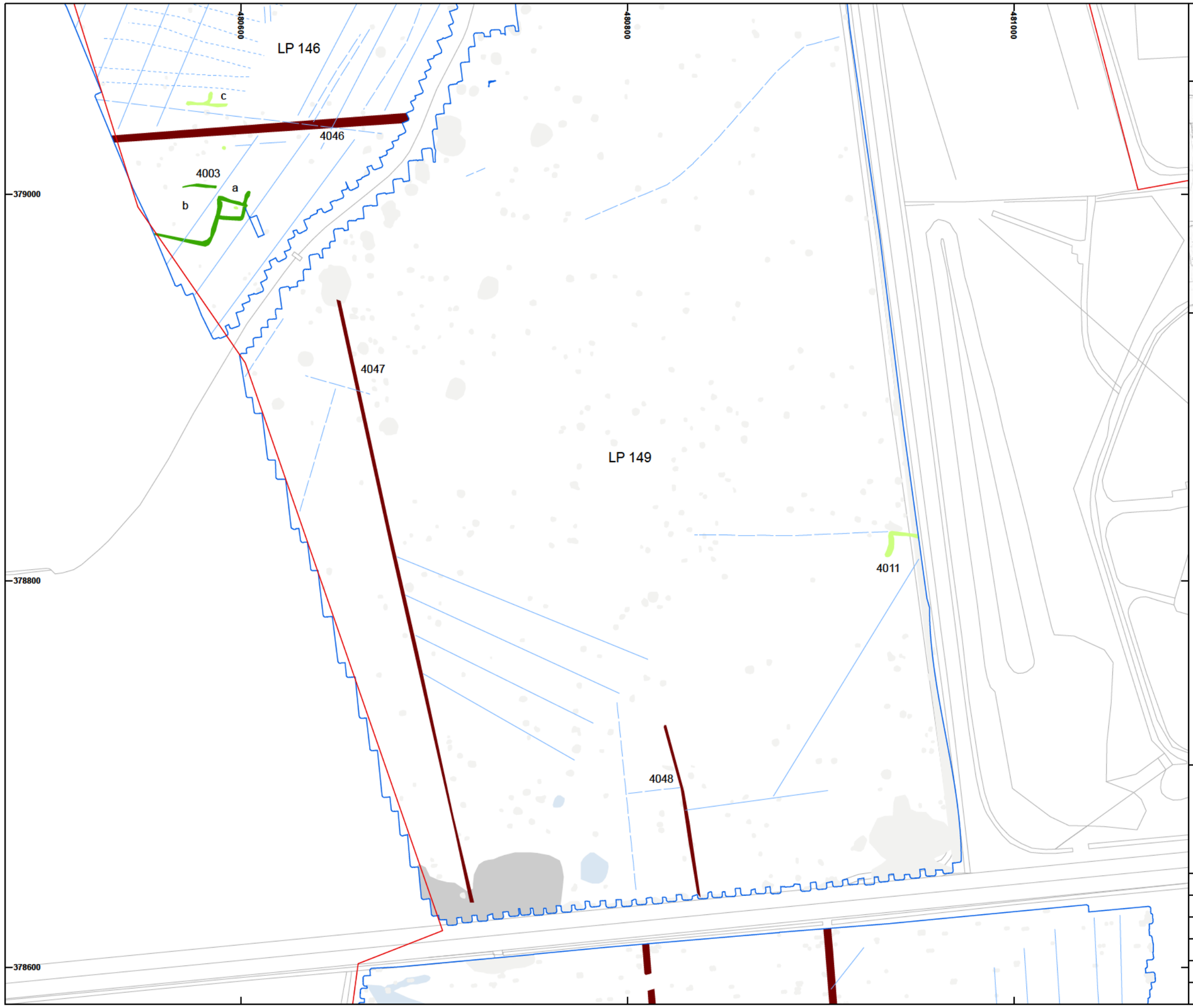
0

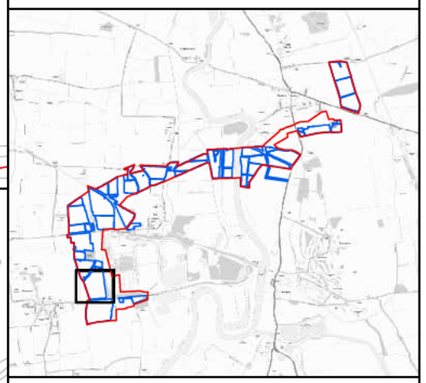
100 m

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

Detailed gradiometer survey results: grayscale plot (Fields 146, 149)

Figure 42





Site Boundary
Detailed survey extents
Archaeology
Possible archaeology
Ridge and furrow
Former field boundary
Trend
Increased magnetic response
Ploughing
Drainage
Path
Superficial geology
Modern service
Ferrous

0 100 m

Coordinate system: OSGB36

Date:	03/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

Detailed gradiometer survey results: interpretation (Fields 146, 149)

Figure 43

480600

480800

481000

378600

LP 152

LP 151

378400

378200

Site Boundary

Detailed survey extents

-2 nT

3 nT

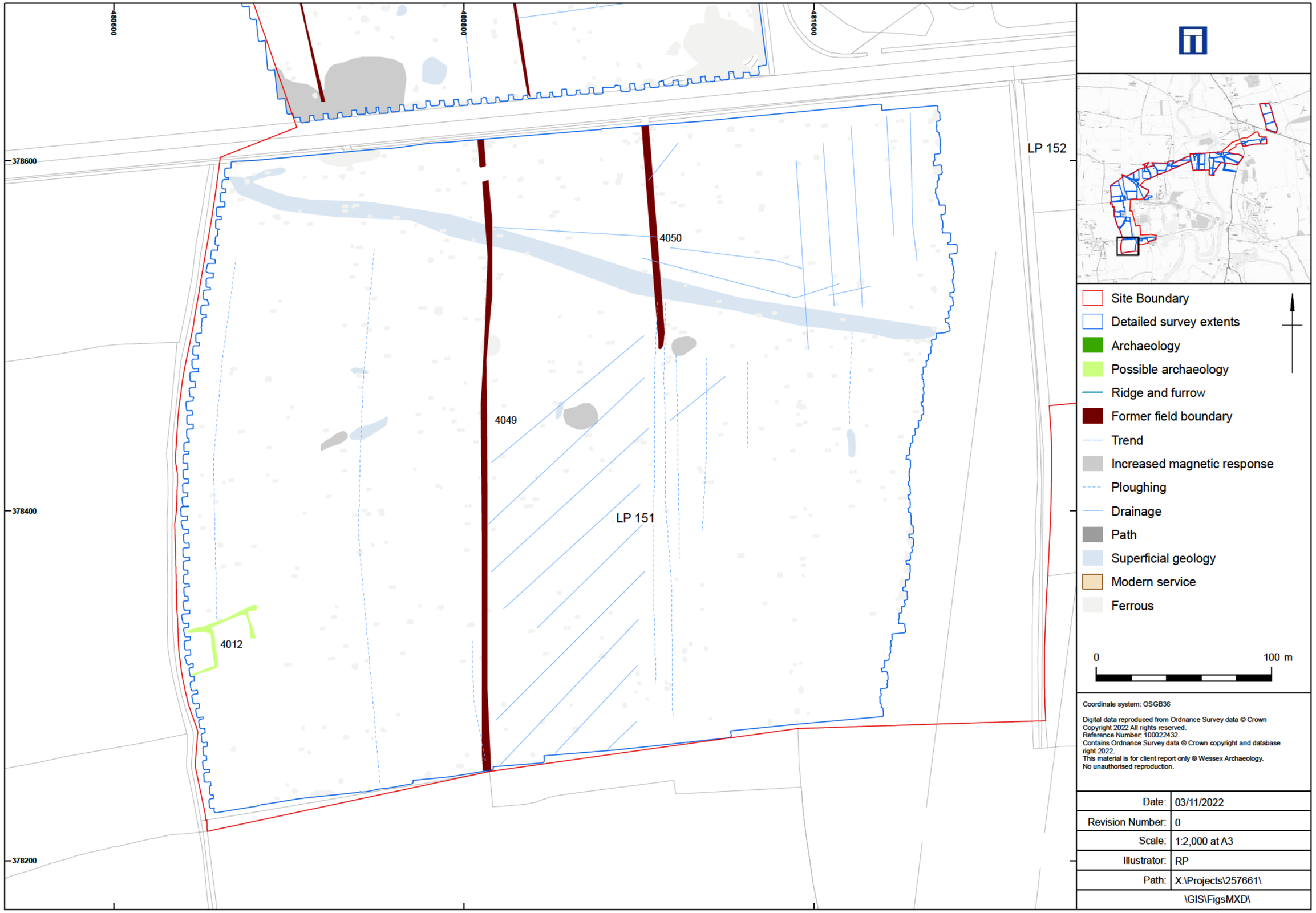
0

100 m

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

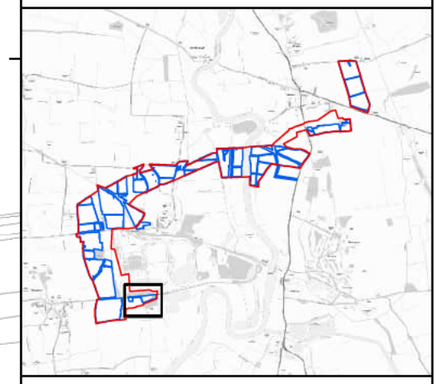
Detailed gradiometer survey results: grayscale plot (Field 151)

Figure 44



Detailed gradiometer survey results: interpretation (Field 151)

Figure 45



Site Boundary

Detailed survey extents

-2 nT

3 nT

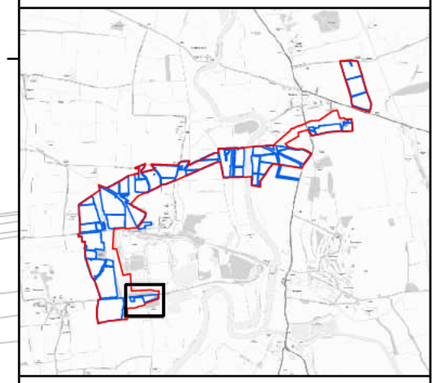
0

100 m

Date:	18/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
	\GIS\FigsMXD\

Detailed gradiometer survey results: grayscale plot (Fields 152, 154)

Figure 46



Site Boundary
Detailed survey extents
Archaeology
Possible archaeology
Ridge and furrow
Former field boundary
Trend
Increased magnetic response
Ploughing
Drainage
Path
Superficial geology
Modern service
Ferrous

0 100 m

Date:	03/11/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	RP
Path:	X:\Projects\257661\
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Detailed gradiometer survey results: interpretation (Fields 152, 154)

Figure 47

wessex archaeology

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