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PWLLHELI TO BLAENAU FFESTINIOG

Report on Archaeogeophysical Survey of Proposed Gas Pipeline 2009

Part 1: Report and Inventory of Findings

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Pwllheli to Blaenau Ffestiniog

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Summary

This report describes the findings from a magnetometer survey carried out to test for evidence of archaeological features or remains along the route of a proposed gas pipeline between Pwllheli and Blaenau Ffestiniog, in Gwynedd, North Wales. Fieldwork for the survey was done in July-August 2009. The survey covered all surveyable sections of the route which were accessible at that time.

The survey located a limited number of findings of potential archaeological concern, alongside various magnetic anomalies of probably non-archaeological or natural origin. The results also identified extensive sections of the route for which there can only be a very low probability that any substantial concentrations of archaeological features may be present.

Findings which may provide targets for further investigation at a later stage of the archaeological evaluation (in addition to numerous former ditches, boundaries and drains) include possible burnt mounds (fields 3/6 and 3/21); ditch-like features which could (rather uncertainly) suggest enclosures (e.g. 3/24, 6/1, 6/23, 15/23); former quarry pits (9/3, 17/14-17/17), and a former structure (14/14).

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Contents

Introduction and background	3
The Proposed Route	4
Survey methodology	5
Results	6
Conclusions	11
Appendix 1 (inventory of selected findings)	13
Appendix 2 (list of unsurveyed areas)	+16

Illustrations

A3 plans at the following scales are included in Part 2 of this report:

Figures K1 – K4	Key plans showing location of survey areas in relation to 1:2000 figure outlines (figures 1-61), and OS grid.	1:25000
Figures 1 - 48	Survey location plans with grey scale plots of magnetometer data (alongside interpretative plans also showing magnetic susceptibility data).	1:2000
Figures A1 – A9	Data archive: graphical plots of magnetometer survey data.	1:1250

Plans are arranged in sequence along the pipeline from west to east.

Pwllheli to Blaenau Ffestiniog

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Introduction and Background

This report describes the findings from a geophysical survey carried out in July and August 2009 as part of the archaeological assessment of a proposed gas pipeline route. The survey was commissioned by RSK Environment Ltd, and forms part of an environmental evaluation being undertaken on behalf of Multitech and Wales and West Utilities.

The route between Pwllheli and Blaenau Ffestiniog, Gwynedd, has a total length of c. 37.3km. (This total includes side branches, but excludes street works, and sections of the existing pipe which will not be replaced as part of this project.) A number of fields (as listed in Appendix 2 to this report) could not be entered during this phase of fieldwork because of crops or access issues. Magnetometer data was collected wherever possible along the remainder of the route (with the exception of limited areas of bog, woodland, etc as noted on the survey plans.)

The geophysical survey was carried out following the preparation of a Desk-Based Assessment [DBA] of the route, and a Walkover survey, both undertaken by RSK Ltd. The DBA [1] provides a full account and inventory of previously recorded archaeological findings within a 1km wide study area centred on the proposed pipe alignment. It also includes descriptions of the topography and landscape history. Some of this information was summarised in a Specification document prepared in advance of the geophysical survey [2]. The specification also includes notes on the geology along the route (and its potential effects on the quality of magnetic response), as well as the survey methodology. Some of the comments on these topics in the following paragraphs are therefore reproduced from the specification.

The first version of this report (dated 28 September 2009) was circulated following completion of the fieldwork. A second version (revised to take account of curatorial comments) is dated 13 January 2010. A note on the revision is included in the section on presentation and reporting (below).

The proposed works involve the replacement of an existing 4" pipeline with a 6" pipeline. Parts of the pipeline have already been replaced during the A497 widening scheme and these areas are not affected by the current proposal. The 6" pipeline will be laid within a 20m working corridor (the 'working width'). Topsoil will be stripped from approximately 14m within the working width to allow for a running track and for the pipeline stringing.

The geophysical survey therefore covered a corridor of 21m width centred on the pipeline centre line, as shown on current route maps. (The survey followed a route as set out in plans supplied to us dated 18.5.09.) A survey of this width covers the full working width which will be required for pipeline construction, and should also provide a full record of the

magnetic response within a strip of ground equivalent to the area which will be subject to magnetic interference from the pipe once it is laid.

The Proposed Route

Topography and Geology

The proposed route runs east from Pwllheli along the Lleyn coast and inland of Criccieth to Porthmadog. It then crosses Traeth Mawr (the reclaimed former Afon Glaslyn estuary) to Penrhyndeudraeth, and enters the Afon Dwyryd valley. It follows the river for the length of the Vale of Ffestiniog, and there is then a final upland section to Blaenau Ffestiniog.

The western section of the route (Pwllheli to Criccieth) has an underlying bedrock of Ordovician formations (including Llandeilo and Llanvirm) interrupted by a localised igneous extrusion of Rhyolitic tuff to the east of Pwllheli. Magnetometer surveys carried out on sites with comparable Ordovician bedrock in Pembrokeshire have successfully detected archaeological features, although geological magnetic effects were also detected. The response on the present route is likely to be modified by the widespread presence of overlying boulder clay and morainic drift, which occurs over much of the western part of the route (to the west of Porthmadog).

The findings from a geophysical survey carried out by Stratascan on the route of the A497 road improvement in 2004 [3] indicate that the boulder clay should provide satisfactory conditions for a magnetometer survey. The A497 survey followed a route close to the proposed pipeline, and detected a number of features of potential archaeological significance, including a ring ditch (later confirmed by excavation). Both the road and pipe routes intersect the Rhyolitic extrusion near Pwllheli, but there was no strong magnetic interference in the data plots of the 2004 road survey. The possible presence of sand hills in this area also does not appear to have noticeably influenced the magnetic response.

The Cambrian bedrock that is encountered for much of the route between Criccieth and Blaenau Ffestiniog is very localised to this area, and so no directly comparable survey data was available to us to indicate the nature of the magnetic response to be expected. This part of the route is generally free of drift deposits, which raises the possibility that any magnetic rocks which are present at the ground surface will be more strongly detected by the survey than in the western part of the route. (The actual findings were that the strength of geological magnetic effects in this part of the route was broadly similar to the western section.) The pipeline route crosses the alluvial soils of Traeth Mawr, and in part follows the reclaimed Dwyryd valley floor. Alluvial or re-deposited soils in the vicinity of magnetic bedrock should usually be magnetically responsive. The route intersects a granite outcrop to the south of Blaenau Ffestiniog. This gave rise to some moderate, but not exceptionally strong, magnetic effects, as seen also in previous surveys done in the vicinity of Cornish granite (and in Charnwood Forest).

Archaeology

The archaeological potential of the study area for this project was reviewed in detail in the Archaeological Desk Based Assessment by RSK [1]. The DBA suggests that the known archaeological findings from the western part of the route could indicate a possibility of further findings. Extensive Bronze Age remains were discovered during archaeological

fieldwork (including the geophysical survey as mentioned above), which was undertaken on the route of the A497 road improvements. These included the ring ditch as noted in the 2004 geophysical survey (which was also identified as cropmark), and which was confirmed on excavation to be a Bronze Age barrow. There was little evidence from the road evaluation for later Iron Age or Romano-British sites, although there is evidence in the wider study area for activity of these periods.

Cropmark evidence for archaeological findings from the pipeline route is very limited, given the general lack of arable land, and so the possibility of further findings remains open. Other types of sites or features that may be detectable could include medieval and later farmsteads and settlements, as well as former boundaries or enclosures. Findings in these categories have been identified in the DBA from map regression. It is also possible in the upland parts of the route that the survey could identify ground disturbances associated with former quarrying, or other post-industrial revolution activities.

Survey Methodology

The survey was carried out following the methodology as described in the Specification for the project, as issued by RSK in July 2009 [2].

The procedure employed for the survey is based on recorded magnetometer coverage of a continuous sample strip along the route, supplemented by magnetic susceptibility readings. This method provides detailed direct evidence for the presence of any detectable archaeological sites or features which intersect the route, and has been used successfully as part of the archaeological assessment process on numerous previous pipeline projects.

A full magnetometer survey will meet the recommendations for an investigation of this kind as set out in the revised English Heritage geophysical guidelines document (*Geophysical Survey in Archaeological Field Evaluation*, English Heritage, 2008), as well as the Institute of Field Archaeologists' Code of Conduct (2006).

The current EH guidelines document replaces the 1995 version, and places increased emphasis on the desirability of detailed magnetometer surveying, in preference to limited sampling procedures. Recorded magnetometer surveying provides a more complete representation of archaeological and other findings than is available by other techniques, and also offers more reliable evidence for their absence from unproductive areas. It also offers the maximum likelihood of distinguishing archaeological from natural magnetic effects.

Fieldwork Procedure

The proposed pipeline works involve the replacement of an existing 4" pipeline with a 6" pipe. Parts of the pipeline have already been replaced during the A497 widening scheme and these areas are not affected by the current proposal. The 6" pipeline will be laid within a 20m working corridor (the 'working width'). Topsoil will be stripped from approximately 14m within the working width to allow for a running track and for the pipeline stringing.

The geophysical survey therefore covered a corridor of 21m width centred on the pipeline centre line, as shown on current route maps. (The survey followed a route as set out in plans supplied to us dated 18.5.09.) A survey of this width covers the full working width which will be required for pipeline construction, and should also provide a full record of the magnetic response within a strip of ground equivalent to the area which will be subject to magnetic interference from the pipe once it is laid.

The survey was carried out using Bartington 1m fluxgate magnetometers, with readings plotted at 25cm intervals along transects 1m apart. The results are presented as grey scale plots on figures 1 – 48 (at 1:2000 scale), and as graphical or x-y trace plots in the data archive (figures A1 to A9), which is also included in Part 2 of this report. Part 2 of the report also includes four initial key maps (figures K1-K4) which show the locations of the 1:2000 figures.

Magnetic susceptibility readings form a useful component of the survey. They provide evidence of local magnetic conditions, as determined by geology and soil type, and therefore inform the interpretation of the magnetometer survey. It is rarely possible, however, particularly in an extensive survey across a varying geological background, to identify archaeological findings directly from the susceptibility data. A magnetometer survey provides direct evidence for the existence and location of subsurface archaeological features, whereas their presence can only be inferred indirectly from susceptibility readings, which are also affected by numerous non-archaeological variables. We therefore collected susceptibility readings only along the centre line of the route. This was done using Bartington susceptibility meters with a field detector loop.

The survey was positioned in each field by reference to OS co-ordinates measured from the digital mapping supplied by the client, and located with a sub-1m accuracy differential GPS system.

Presentation and reporting

The survey plots show the readings after standard processing operations including adjustments to the line spacing to correct for variations in the instrument zero setting, and numerical smoothing to reduce background noise levels.

The grey scale plots are reproduced at 1:2000 scale on the survey location plans, which show the position of the 21m wide survey strips in relation to (DXF) background mapping and the pipe route (blue line). The OS coordinates of detected features can be read directly from digital copies of the Autocad plans.

The magnetic susceptibility readings are presented in the form of a graph of readings superimposed on the 1:2000 scale interpretation plans. Results from sections of the route where the readings were particularly high are plotted at a reduced vertical scale. These plots are shown in blue rather than grey.

The interpretation of the magnetometer survey which is shown in the lower half of each survey plan in Part 2 includes a selection of magnetic anomalies, but not all the features indicated are archaeologically significant. The interpretation as marked is intended to be schematic and illustrative, and not to reproduce the detail of the grey scale plots. Features are indicated by coloured outlines, or occasionally by broken lines. Broken lines are used to permit a simplified representation of complex features, or to represent features which are too fragmented to form a satisfactory outline.

In some magnetically responsive or active areas of the survey only an indicative selection of disturbances is marked. In all cases the interpretation is selective; anomalies which are

strong or narrow in profile, asymmetrical, or which have a prominent negative peak are likely to be caused by buried stones, bricks or iron objects, and have been excluded as far as possible.

Colour coding has been used to try and distinguish different effects. Magnetic anomalies of possible archaeological, or at least non-geological origin are outlined in red, with potential geological, or recent, disturbances in an orange/brown. (Possible cultivation effects are shown in green, and pipes or drains in blue.) This division is not absolute or guaranteed, and features other than those outlined in red may still need further investigation establish their archaeological relevance. Magnetic anomalies of (probably) non-archaeological origin have been subdivided (in the revised version of this report) into two further categories. Disturbances which appear to be of recent (rather than geological) origin are outlined in a dark brown, and any remaining ambiguous features are marked as uncertain / unknown (in a light green/brown). The colours used in this interpretation are deliberately not wholly dissimilar from each other in recognition of the imprecision of these categories.

One difficulty in classifying magnetic anomalies (as well as in trying to identify those of archaeological concern) is that interpretation may depend on context as well as on intrinsic anomaly characteristics. Areas of strong magnetic activity are often geological, but may indicate modern debris or infilling. Scale and distribution may be deciding qualities rather than anomaly strength. Alternatively, a comparably disturbed area which is located near to a stream could indicate a possible burnt mound (and so be of archaeological interest).

Parallel linear markings have (in previous surveys on comparable bedrock) sometimes been found to be geological, but they may also be cultivation effects. Scale, extent and alignment may therefore be relevant to the classification. A isolated band of disturbed readings may be recent or natural, but could also indicate modern infilling of an old boundary ditch. Alignment in relation to other boundaries may therefore determine the interpretation.

The difficulty of reaching a consistent interpretation when a magnetic disturbance may be caused by the interaction of different factors can be seen by comparing (for example) fields 6/13, 6/17 and 6/44. All contain parallel linear features against a background of high magnetic susceptibility readings (indicating a strongly magnetic near-surface bedrock). In 6/13 the linear features are intermittent and appear to be associated with other geological disturbances, but in 6/17 they are smaller in scale and closely spaced, as well as parallel with field boundaries. It is possible therefore that in this strongly magnetic context very slight or superficial cultivation effects have been detected (although the reason they are detectable is because of the geological background). The features are therefore marked in green. In 6/44 the linear features are less regular than in 6/17, and not associated with such strong nearby geological effects as in 6/13, and so are marked as unknown. The magnetic disturbances in each case probably have much in common, in spite of these marginal distinctions, and in any case have a minimal bearing on the archaeological potential of the fields in question.

Individual small magnetic anomalies (perhaps with a rounded rather than narrow profile in the x-y plot) may be naturally magnetic stones buried in the topsoil, or may be silted pits of potential archaeological interest. Context and grouping will influence the categorization of otherwise comparable features.

We hope that the interpretation we have imposed on the survey reflects both the unusually

varied magnetic response from the terrain, as well as the fact that only a small proportion of the magnetic activity can be archaeologically significant.

The grey scale plots are reproduced at 1:2000 scale on the survey location plans, which show the position of the 21m wide survey strips in relation to (DXF) background mapping and the pipe route (blue line). The OS coordinates of detected features can be read directly from digital copies of the Autocad plans.

The magnetic susceptibility readings are presented in the form of a graph of readings superimposed on the 1:2000 scale interpretation plans. Results from sections of the route where the readings were particularly high are plotted at a reduced vertical scale. These plots are shown in blue rather than grey.

Results

The survey findings are described below from west to east along the route. The field or plot numbers (in which fields are counted from road crossings) follow the numbering scheme notified to us by the client.

The potentially more significant findings from the survey are itemized in the inventory which follows as an appendix at the end of the report. A more general discussion of the results follows below. This is divided for convenience into five sections, corresponding approximately to the subdivisions as used for the topographic description of the route in the DBA.

1. *Aberech to Llanystumdwy [Figures K1 and 1-10]*

The present course of the River Erch is here located partly on reclaimed intertidal land, but much of the pipeline is slightly inland, and probably therefore on a bedrock of Silurian Tuff, which is present also in figure 5. The otherwise prevalent Ordovician bedrock is covered by boulder clay from figure 3 onwards, although the route may encroach in places on to reclaimed sand dunes.

Fields 0/1 to 0/4 have not yet been surveyed because they were under a cereal crop during the fieldwork period. The presence of a circular cropmark (RSK site 511 as listed in the DBA) a little to the south of the route suggests that the route itself lies outside the area of reclaimed coastline (although it is mentioned in the DBA that the cropmark could be caused by a modern drain).

Fields 0/5 to 0/7 are boggy, and there are drainage channels between 0/8 and 0/9. Magnetic anomalies visible in these fields are of a strength and size commonly seen near watercourses, and probably relate to natural variations in the depth of silting. Strong anomalies near an electricity pole in 0/9 may be recent.

In field 0/10 there is part of a weak and indistinct, but apparently circular feature some 10m

in width. This is near to a weak linear feature perhaps representing a former boundary. There is another such linear feature (which aligns more closely with an extant boundary) in 0/11. Weak linear markings in 1/1 and 1/2 are possibly a cultivation effect. Strong magnetic anomalies in 2/1 are near watercourses, and probably natural (but are in a possible location for a burnt mound).

There are no interpretable findings in 2/3, although the field is near (c. 100m NE from) an IA/RB occupation site (RSK 539). The route then follows a road until fields 3/1-3/2 (figure 4). These fields have not yet been surveyed because of a hay crop. [Field 3/1 lies across the road to the east of RSK site 411 (probable medieval house platforms). Field 3/2 is immediately south of RSK site 550 (a possible prehistoric enclosure and field system).]

The magnetic response in field 3/3 and part of field 3/5 (figure 5) is dominated by an existing pipe. (This recurs at intervals. We assume it is the existing gas pipe, which the new pipe is to replace.) Elsewhere in 3/5-3/6 there are strong magnetic disturbances which correspond to high magnetic susceptibility readings. This is probably an effect of the Silurian Tuff outcrop, which is centred on these fields.

Previously recorded finds in this area include an excavated burnt mound to the south of 3/3 (RSK 535) and a farmstead south of the route in 3/5 (RSK 591). Burnt mounds are difficult to identify from survey data in the presence of other magnetic disturbances (because of their irregular and variable composition), but it remains a possibility that the unusually strong magnetic anomalies (near to a stream) towards the west of field 3/6 could represent a burnt mound, although the effect could also be geological. Earthworks which perhaps represent a medieval settlement are visible towards the south of field 3/6 (RSK 417), but presumably do not intersect the survey.

Field 3/9 contains pipes, and weak linear markings parallel to the eastern field boundary. These could be cultivation effects (but see discussion of field 3/25 below). Disturbances in 3/10 and 3/12 could be partly natural (given the very high susceptibility values in 3/10), but there is also a line of magnetic anomalies which appears to represent the clay tiles of a land drain (in blue). The curving feature in 3/12 is made up of strong magnetic disturbances (as seen in the graphical plot; figure A1), and lacks the coherent profile to be expected from a silted ditch. A depression perhaps representing an old pond is listed to the north of the route in 3/10 (RSK 525), but does not appear to encroach on the survey.

There are linear features perhaps representing former boundaries in 3/14. (The cropmark ring ditch which was detected in the A497 geophysical survey [3] and subsequently excavated was located a short distance to the west of field 3/14 [RSK 159].)

The irregularity of the strong magnetic disturbances in 3/16 and 3/17 suggests they are geological (or perhaps the recent filling of a pond or pit). Fields containing maize crops have not yet been surveyed (3/15 and 3/19 to 3/20). These latter may contain the site of former cottages (RSK 570). Field 3/21 contains irregular magnetic disturbances near to a bog (as well as a modern pipe). It could therefore be a (rather uncertain) site for a burnt mound (as in 3/6).

A pipe intersects the survey in 3/24, but there are other disturbances towards the west of the field. Some may be geological, but there are linear features suggesting ditches or fragments

of enclosures (if they are not also natural). Linear markings in 3/25 may be cultivation effects, but such patterns could alternatively be caused by a striated shallow bedrock immediately below the ploughsoil. This was found to be the case for some comparable findings in Pembrokeshire surveys. Comparable linear markings are seen at a number of subsequent locations in the survey (see e.g. 4/4-4/5, 5/3, 6/11-6/13, 6/16-6-23, 6/30, 6/41-6/45, 6/50). These all occur either on Ordovician bedrock (as with the geological markings seen in Pembrokeshire), or on the Upper Cambrian between Criccieth and Porthmadog.

A clear double linear feature (in red) in 3/25 could be a ditch or boundary. There are additional possible linear features in 3/26. These do not follow a narrow parallel pattern as seen in 3/25. Magnetic findings in 3/27 – 3/28 may be largely natural, although there appear to be land drains in 3/28. The Aberkin medieval township (RSK 166) is located some 200m to the south of 3/26.

2. *Llanystumdwy to Porthmadog [Figures K2 and 11-23]*

The route here follows a course inland of Criccieth, and across mainly pasture and hay fields towards Porthmadog. The bedrock is mainly Upper Cambrian with no boulder clay. There are reclaimed tidal flats between Wern Manor and Porthmadog (figures 21-23). The absence of drift material means geological magnetic effects are sometimes strongly apparent.

There are wooded or overgrown areas in 3/29 and part of 3/30. Disturbances in 4/2 to 4/6 appear to be largely natural, although the linear effects (seen particularly in 4/4) could relate either to cultivation or geology (as noted for 3/25 above). A possibility remains that a particularly distinct linear feature in 4/3 could be a silted ditch. The linear markings in fields 4/4 and 4/5 are relatively small in scale and align with field boundaries. This perhaps leaves open the possibility that they are caused by ploughing. Uneven ground was recorded in 4/5 in the walkover survey (RSK 574).

There is continuing magnetic activity of a mainly geological character in subsequent fields, including some (probably natural) linear features in 5/3. These correspond to a distinct peak in the susceptibility response, as do other such disturbances (e.g. 3/6, 3/25, 5/6, 6/5, 6/6, 6/11, 6/13, 6/16, 6/17, 6/28, 6/38, 6/42, 6/44, 6/50). This is consistent with the assumption in each case that the magnetic anomalies relate to shallow rock outcrops. The linear features as mentioned above in 4/4-4/5 are an exception to this pattern (with relatively low susceptibility). This could support the possibility that they are a cultivation effect.

Field 5/4 contains a visible earthwork (perhaps a former boundary) seen in the walkover (RSK 576). Upstanding (rather than silted) earthwork features are often not detected in surveys.

Field 6/1 contains intersecting but indistinct linear features. These are perhaps more likely to be natural than to represent a corner of an enclosure (although the moderate susceptibility response does not decide the question). A pattern of strong disturbances in 6/5 is clearly geological. (Some visible rock outcrops were noted in subsequent fields during the fieldwork.)

Fields 6/17-6/19 contain narrow linear markings (as in 3/25, 4/4-4/5), some of which terminate at other (differently oriented) ditch-like features. Such effects could again be caused by cultivation, although the very high susceptibility readings in this case suggest they are natural.

An enclosed Roman settlement is recorded in the DBA some 200m to the north of 6/24 (RSK 197). A faint possibility therefore remains that linear features (as seen in 6/23) could represent associated enclosure ditches, but the presence of such findings elsewhere suggests they are more likely to be natural.

One finding which differs slightly from the numerous magnetic anomalies caused by outcrops of magnetic bedrock is on a side branch to the pipeline in field 6/29b, where a broad curving magnetic anomaly could represent a former channel of the adjacent stream. Strong disturbances near to another ditch between 6/29c and 6/29d could (perhaps) indicate a possible site for a burnt mound.

A Roman road is recorded in the vicinity of field 6/33 (RSK 201), but roads rarely give rise to detectable magnetic anomalies. Some of the strong disturbances in 6/47 represent metal sheets placed on the ground for a reptile survey (but others are probably geological).

A distinct linear feature in 6/52 lies close to the western edge of the reclaimed Afon Glaslyn tidal flats which extend west from Tremadoc, and so could perhaps be a former drainage ditch (but it is also near to probably geological disturbances). Other possible former ditches are seen within the reclaimed area in fields 6/53-6/54. An area of strong magnetic activity at the west end of 7/2 differs in scale and texture from much of the geological activity mentioned above. It could perhaps be an area of modern infilling.

3. *Porthmadog to Penrhyndeudraeth [Figures K3 and 24-29]*

The pipeline route resumes to the east of Porthmadog and crosses the reclaimed Traeth Mawr immediately to the south of the railway embankment. It then continues to the north of Minffordd, and through the built-up area of Penrhyndeudraeth (where only a few plots of land were suitable for survey coverage).

The data plots show an area of disturbed response adjacent to a pipe in field 7/7. This could perhaps indicate debris relating to construction or reclamation works. There are alignments of disturbed readings corresponding to a visible rubble bank in 7/8, and some localized and possibly recent strong magnetic anomalies in 7/9. Weak linear markings in 7/9-7/10 may relate (again) to variations in the depth of silt deposition on waterlogged ground. There are more metal sheets for the reptile survey in 7/11. High readings in 7/13 appear in part to be caused by a pipe, but there could also be a geological effect, given the nearby presence of a granite quarry (RSK 229).

There are intermittent strong magnetic anomalies in subsequent fields, and particularly 9/3, 9/6, 10/1, and then all fields to 11/11. Some of these areas are near to buildings, and could contain recent disturbances, but most must be geological. The particularly intense disturbances in 9/3 (near to the former workhouse) could indicate backfilling of former

quarry workings, as are recorded in this area (RSK 241 and 513).

4. *Penrhyndeudraeth to Ffestiniog [Figures K3-4 and 30-41]*

This section of the route is located mainly on drained meadows alongside the Afon Dwyrdd.

The concentrated magnetic disturbances NE of the pond in 11/11 and 12/1 may well be caused by modern infilling or debris rather than geology. The proposed route from 11/11 onwards follows the existing pipe, which is visible in the survey plots to field 13/12.

Narrow raised linear features are recorded in the vicinity of field 12/2 (RSK 578). These may be plough furrows, and are not clearly visible in the survey.

The magnetic anomalies seen in a number of fields including 13/8, 13/13-13/14, 13/26, 13/28, 14/1, 14/8 are of the relatively broad and weak variety often seen on waterlogged ground, or near watercourses (as in 0/8, 0/9, 2/1, 7/9-7/10). We again assume such features are caused by variations in the depth of silt deposits.

The survey in 13/26, 13/28, 13/34, 14/11, 14/12 is intersected by rather fragmented linear disturbances, which could be trenches or ditches containing variable fill. These are indicated in red, but could relate to land drainage. There is a more distinct possible ditch-like feature in 13/29. Intermittent but regular narrow magnetic anomalies as seen in 13/36 are characteristic of clay drainage tiles (as in 3/10).

A line of relatively weak disturbances in the centre of 14/4 could be a former boundary rather than a drain. A line of disturbances in the center of 14/13 corresponds to a visible bank. The small-scale disturbances towards the east of 14/14 could be caused by a rubble scatter. Their location corresponds to a former building (RSK 564). A possible ditch was detected in 14/19. A pipe is again visible in 14/20-14/21, 15/6, 15/10. Areas of increased magnetic activity in 14/19-14/20 and 15/10 could be geological. There could be a small rubble scatter in 15/14.

5. *Ffestiniog to Blaenau Ffestiniog [Figures K4 and 42-48]*

The route here leaves the Afon Drwyd valley and turns north towards Blaenau Ffestiniog. This final section is on a granite bedrock with a boulder clay drift deposit.

There are strong geological magnetic anomalies in 15/22. Relatively weak features in 15/23 could perhaps represent ditches. These features are located about 100m south of the recorded position of a hut circle settlement and enclosure (RSK 329), and to the north of the Ffestiniog medieval township (RSK 320). Undulating magnetic anomalies in 15/21, 15/22, 16/2 suggest a magnetic bedrock buried at moderate depth (rather than exposed immediately below the topsoil). An existing (gas ?) pipe was detected in 16/5, 16/8-17/2. An early iron smelting site is recorded in the vicinity of field 16/7 (RSK 451), but the nearby section of the route is in woodland, and was not surveyed. Settlement remains are recorded nearby to

the east of the route (RSK 464, 465, 468), but do not appear to encroach on the survey. Additional hut circles (RSK 434) are recorded near 17/10, which is also woodland.

A cluster of small magnetic anomalies in 17/19 could be of archaeological relevance, but they could also be recent. These findings are some 200m north of the previously mentioned hut circle site (RSK 434), and a similar distance to the west from an Iron Age enclosure (RSK 452).

The very concentrated magnetic disturbances in 17/14-17/17 could perhaps be geological, but more probably represent the modern filling of former quarry workings. Various quarry and mine workings are recorded nearby in the DBA (RSK 428, 430, 482).

Conclusions

The survey appears to have provided a detailed and varied response to a range of subsurface features and disturbances, although many of the magnetic anomalies are of geological origin, and only a limited number are likely to be of archaeological concern.

The findings from the western part of the route (Pwllheli to Porthmadog) include various possible ditches and former boundaries, but there are no clearly defined ditched enclosures (comparable to the cropmark ring ditch detected in the A497 survey) in the areas surveyed to date. A possible small circular feature in field 0/10 is ill defined and could be wholly conjectural.

There are areas containing parallel linear markings of a kind which could be caused by cultivation (including modern ploughing), although in some cases the near surface bedrock gives rise to similar effects.

Groups of magnetic anomalies in boggy ground in 3/6 and 3/21 are in suitable locations to suggest the possibility of burnt mounds (as, perhaps, are disturbances in 2/1 and 6/29c). Ditched enclosures (of irregular plan) could perhaps have been (partially) detected in 3/24 and 6/1 (and even more doubtfully in 6/23). Former ditches or drains were detected clearly on reclaimed ground in 6/52.

Findings east of Porthmadog include a probable infilled quarry pit in Penrhyndeudraeth (9/3), and others in Blaenau Ffestiniog (17/14-17/17), together with various ditches, drains and former boundaries along the Afon Drwyd valley. A spread of debris relating to a former building (RSK 564) was seen in 14/14. There are possible ditches and perhaps other features near to a hut group (RSK 329) in 15/23. One group of small pit-like features was seen in an area containing numerous nearby ancient occupation remains near Blaenau Ffestiniog (17/19).

Report by:

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01865 200864

28 September 2009
Revised 13 January 2010

Fieldwork for this survey was carried out by P. Cottrell, assisted by F. Prince, C. Oatley and D. Doyle.

References

- [1] Pwllheli to Blaenau Ffestiniog Pipeline. Archaeological Desk-Based Assessment and Field Reconnaissance Survey. Prepared by RSK Group plc for Multitech and Wales and West Utilities. Project No. P41119; April 2009.
- [2] Pwllheli to Blaenau Ffestiniog Pipeline. Specification for Archaeological Geophysical Survey. Prepared by RSK Group plc for Multitech and Wales and West Utilities. Rev 02 July 2009.
- [3] Geophysical Survey Report Aberech to Llanystumdwy: Stratascan ref. 1899, August 2004.

Pwllheli to Blaenau Ffestiniog: Geophysical Survey

Appendix 1: Inventory of Selected Findings

This list notes the more significant findings from the magnetometer survey of this pipeline route. The grading (1-4) given alongside each entry refers to the reliability of the geophysical evidence rather than the archaeological significance of the findings.

- Grade 1: Distinct magnetic anomalies of probable archaeological origin.
- Grade 2: Magnetic anomalies possibly including natural or recent disturbances, but which could in part be archaeologically significant.
- Grade 3: Weak or isolated features; not necessarily archaeologically significant.
- Grade 4: Magnetic anomalies of probably non-archaeological origin.

This summary list includes only selected magnetic findings, particularly those which may be of potential archaeological interest, or which may require further investigation for their significance to be established. Magnetic disturbances which may be mentioned in the text or indicated on plans are not necessarily included if they appear to be of natural or non-archaeological origin.

Plot number

Grade

1. Aberech to Llanystumdwy

0/10	Part of weak apparently circular feature; c. 10m width.	2-3
0/10	Linear feature: former boundary ?	2
0/11	Indistinct linear feature: former boundary ?	2-3
2/1	Strong magnetic anomalies near bog: probably natural, but perhaps a burnt mound ?	2
3/6	Two areas of strong magnetic disturbances near spring and watercourses at W of field: possible locations for burnt mounds ?	2
3/14	Weak ditch-like linear features: former boundaries ?	2

3/21	Irregular magnetic disturbances in boggy ground: possible location for burnt mound ?	2
3/24	Indistinct linear and other features at W of field: enclosures (or natural ?)	2-3
3/25, 3/26, 3/28	Possible former ditches or boundaries (in red), together with cultivation effects and drains.	1-2

2. *Llanystumdwy to Porthmadog*

4/3 2	Linear feature: possible ditch.	
4/4-4/5	Narrow linear markings: perhaps cultivation.	3
5/3	Parallel linear markings: perhaps geological.	3-4
6/1	Linear features meet at acute angle. Probably too weak/ill defined to represent a corner of an enclosure.	3
6/17-6/19	Narrow linear markings (as in 4/4-4/5). Scale and separation could indicate cultivation, but high susceptibility readings suggest probably geological.	3-4
6/23	Linear markings in field to south of Roman settlement (RSK 197). - Probably natural.	3
6/29b	Curving magnetic anomaly near to stream: silted former channel ?	3-4
6/29c-6/29d	Strong disturbances near ditch: recent, or burnt mound ?	2-3
6/52	Broad linear magnetic anomaly near W limit of reclaimed area: former ditches/drain (or natural ?).	2-3
6/53-6/54	Additional former ditches or drains on reclaimed land.	2
7/2	Magnetic disturbance at W of field: perhaps recent debris/infilling.	3-4

3. *Porthmadog to Penrhyndeudraeth*

9/3	Unusually concentrated magnetic disturbances could indicate backfilling of former quarry pit.	3-4
-----	---	-----

4. *Penrhyndeudraeth to Ffestiniog*

13/26-13/28 + 13/34, 14/11, 14/12

Various former boundaries or banks/trenches (similar to visible former boundary in 14/13). 2-3

13/29 Possible Distinct ditch-like linear feature. 1-2

13/36 Three parallel land drains. 3

14/4 Possible former boundary. 2

14/13 Former boundary (as indicated by visible bank).
1

14/14 Magnetic disturbances (of strength and density consistent with rubble spread). Corresponds to location of former structure (RSK 564). 1

14/19 Probable ditch. 1

15/14 Cluster of magnetic anomalies could be rubble scatter or similar. 2-3

5. *Ffestiniog to Blaenau Ffestiniog*

15/23 Possible ditches near to hut group and enclosure (RSK 329). 1-2

17/14-17/17 Very concentrated magnetic disturbances: infilled quarry workings ? 3-4

17/19 Group of small (pit-like ?) magnetic anomalies. 2

Pwllheli to Blaenau Ffestiniog: Geophysical Survey

Appendix 2: List of remaining unsurveyed fields

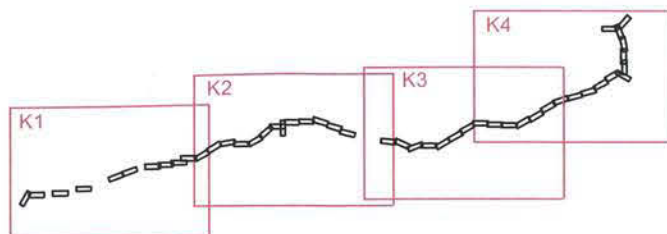
The list of remaining surveyable areas which were not surveyed as part of the fieldwork carried out in July-August 2009 is as follows. Other sections of the route which have not been surveyed are variously wooded, boggy or overgrown, as noted on the survey plans (figures 1-48). [Sections 1-7 of the route as listed below are indicated on the key maps (K1-K4) in green. Re-routes are shown approximately in blue.]

1. First four fields at west end of route (0/1 to 0/4); cereal crop. (530m total length)
2. Two fields in ownership plot 017 (fields 3/1-3/2) - hay/silage not yet cut (310m)
3. Three fields in ownership 023 (fields 3/15 and 3/19 – 3/20) - maize crop (400m)
4. Three fields in ownership 045 (fields 6/34 – 6/36)- access problem. (210m)
5. One field in ownership 062 (un-numbered field before 10/1: small paddock in Penrhyndeudraeth) - route no longer crosses this field according to farmer (and according to modified line: see note on re-routes below). (50m)
6. Ownership 084 (two sections of river bank owned by angling club: fields 13/20 and 13/25) - access issues - but this is low lying riverside land which is regularly flooded, and not really worth surveying. (120m)
7. Two fields in ownership 107 (fields 15/28 – 15/29) - access problem + grass/silage not yet cut. (290m)

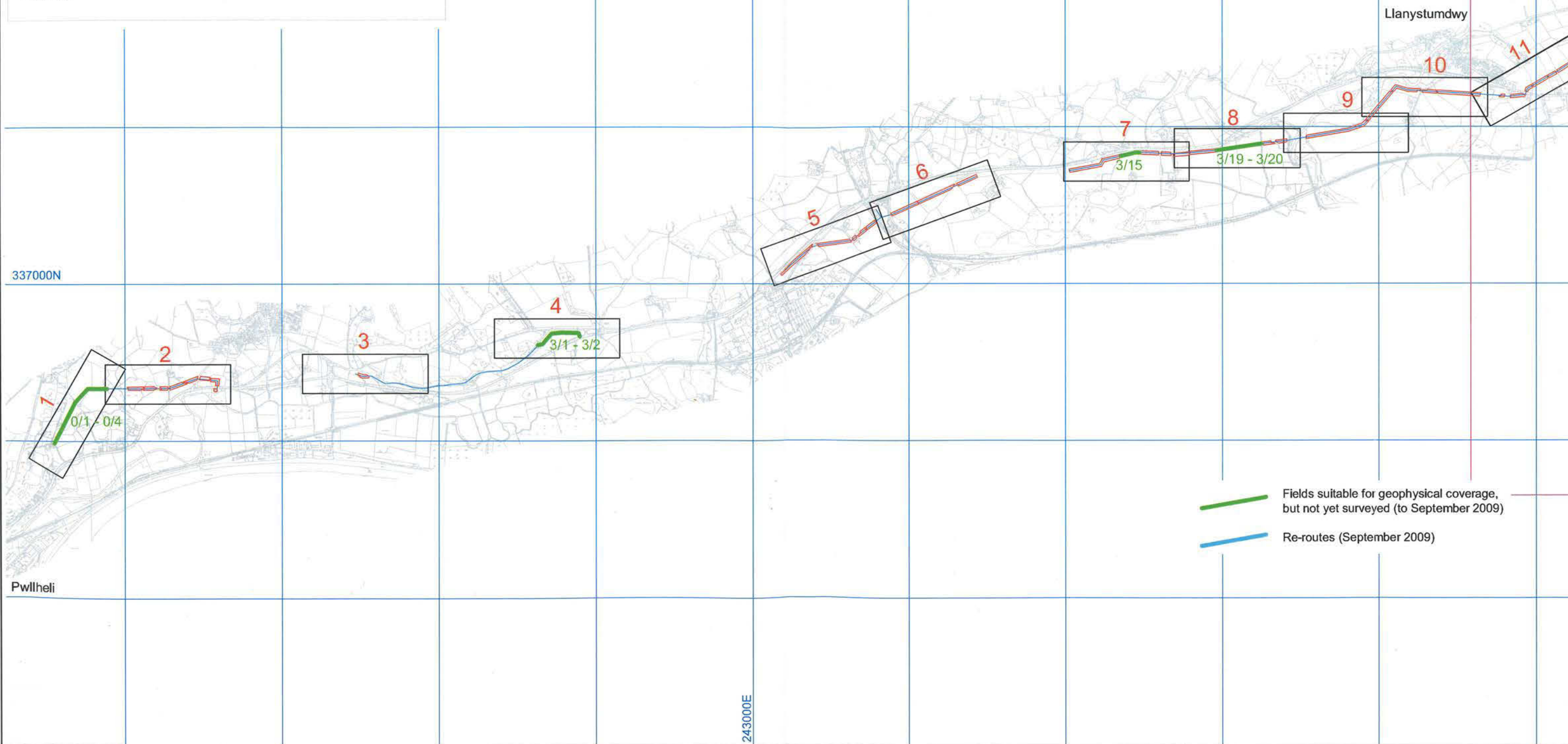
The route followed during the geophysical survey was defined by a dxf line dated 18.5.09. A slightly modified route was forwarded to us on 17.9.09. The main variations from the previous line appear to be as follows:

- i Field 10/1: item 5 in above list is now by-passed.
- ii Fields 11/4 - 12/1: c. 1.1km of route now follows road.
- iii Fields 14/9 - 14/15: c. 1.3km of route has moved approximately 60m to the south of the previously surveyed line.

The total remaining length of route which might be considered for future investigation could include items 1-4 and item 7 above (total length 1740m), and re-route iii (length c. 1.3km). The additional coverage required would if so be approximately 3km.



1:400000



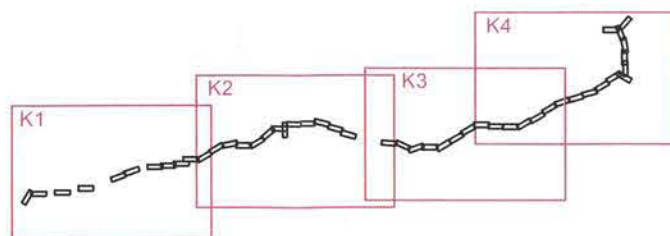
Fields suitable for geophysical coverage,
but not yet surveyed (to September 2009)

Re-routes (September 2009)

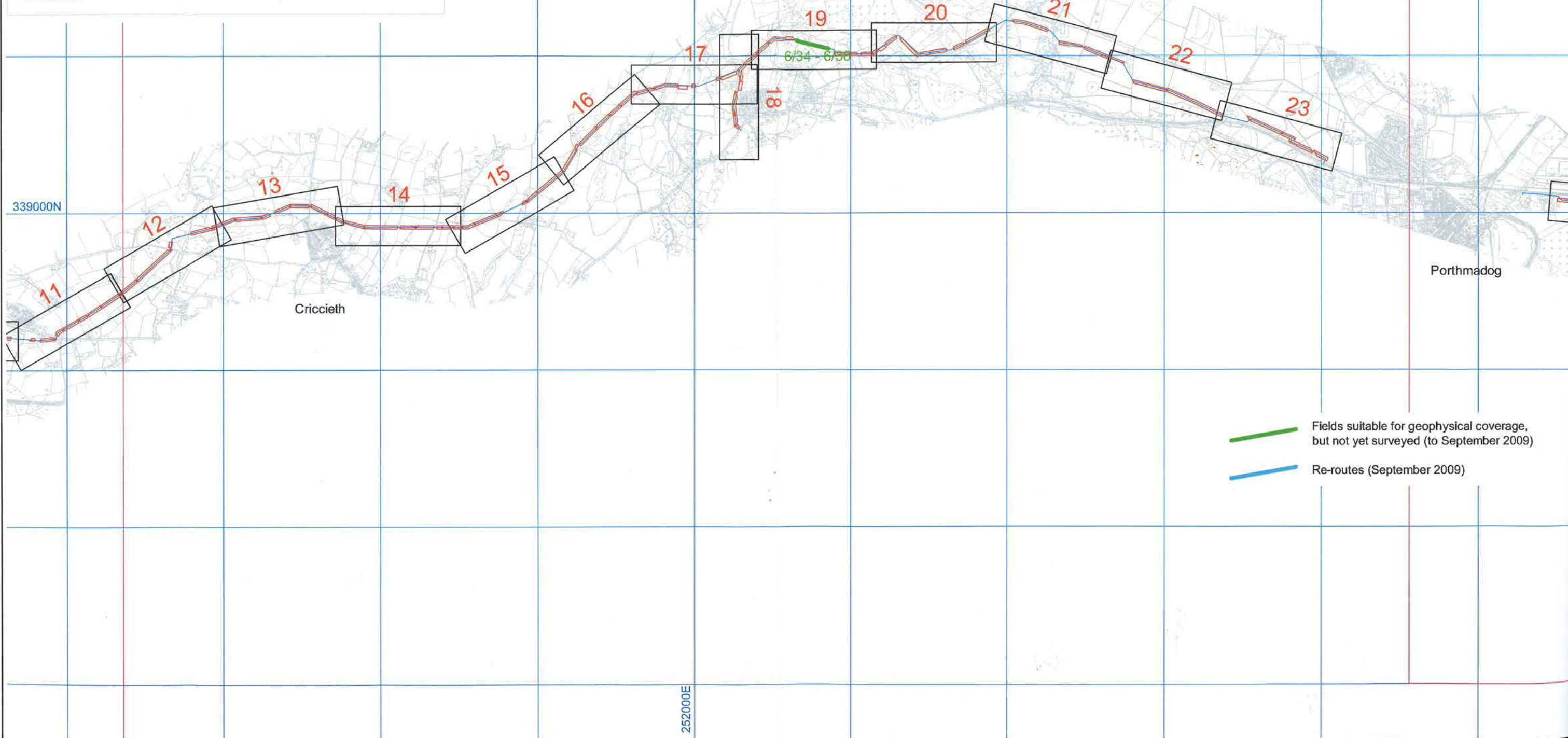
Pwllheli

Llanystumdwy

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1:400000



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for: RSK Environment Ltd

1:25000

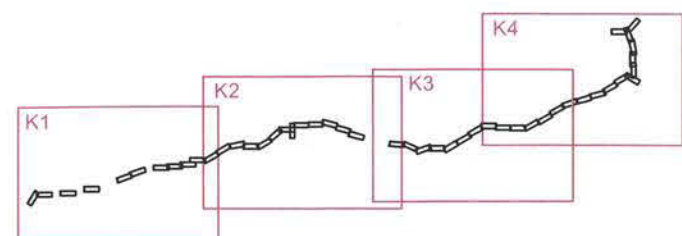


1:2000 survey plots
pipeline route

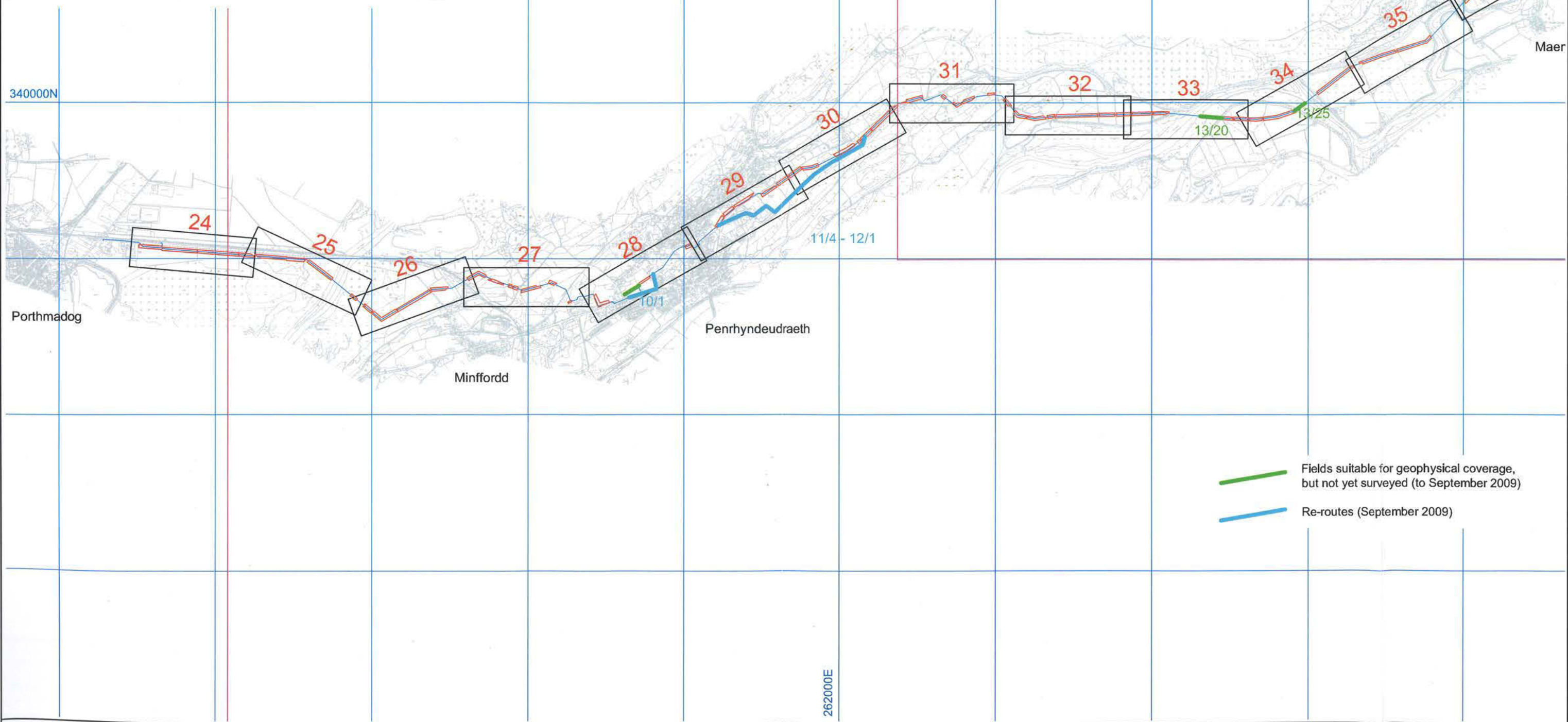
PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009
Figure K2: Location of survey plans 11-23

22

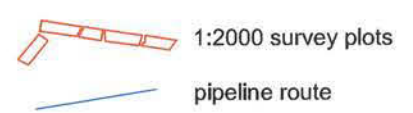
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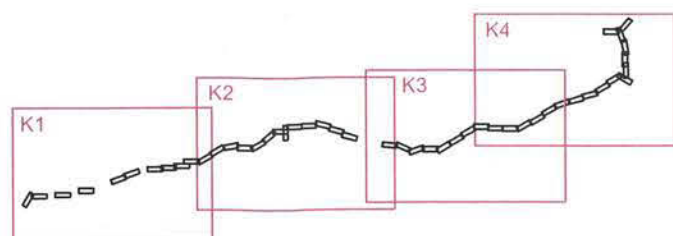


RSK GROUP PLC
Surveyed by: Bartlett-Clark Consultancy 01865 200864
for: RSK Environment Ltd

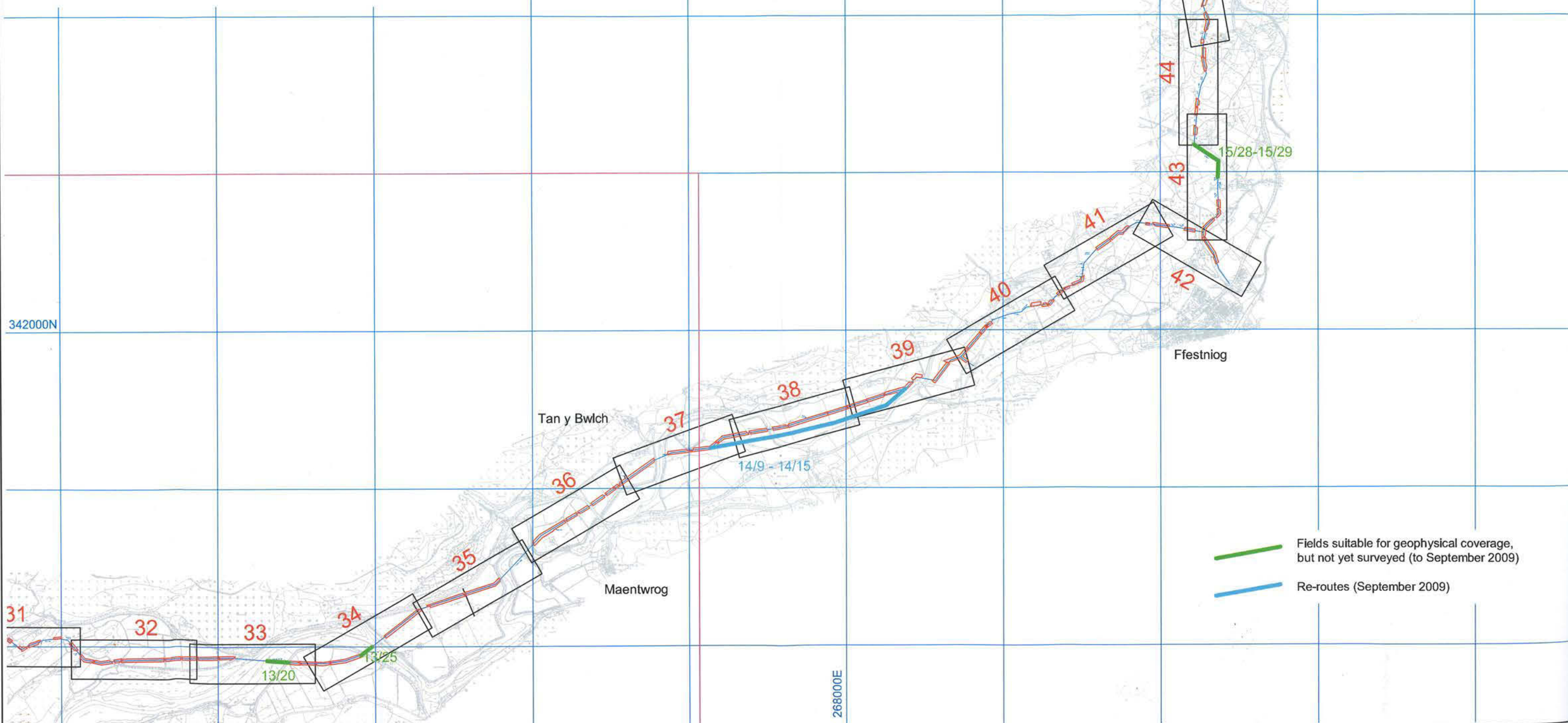


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Geophysical Survey 2009
Figure K3: Location of survey plans 24-35

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1:400000



Fields suitable for geophysical coverage, but not yet surveyed (to September 2009)

Re-routes (September 2009)



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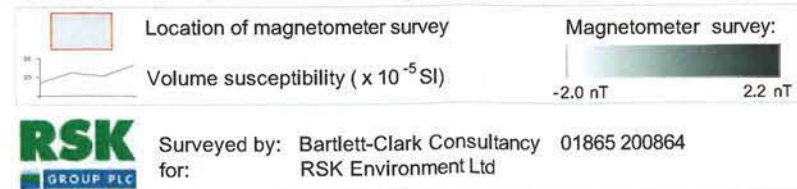
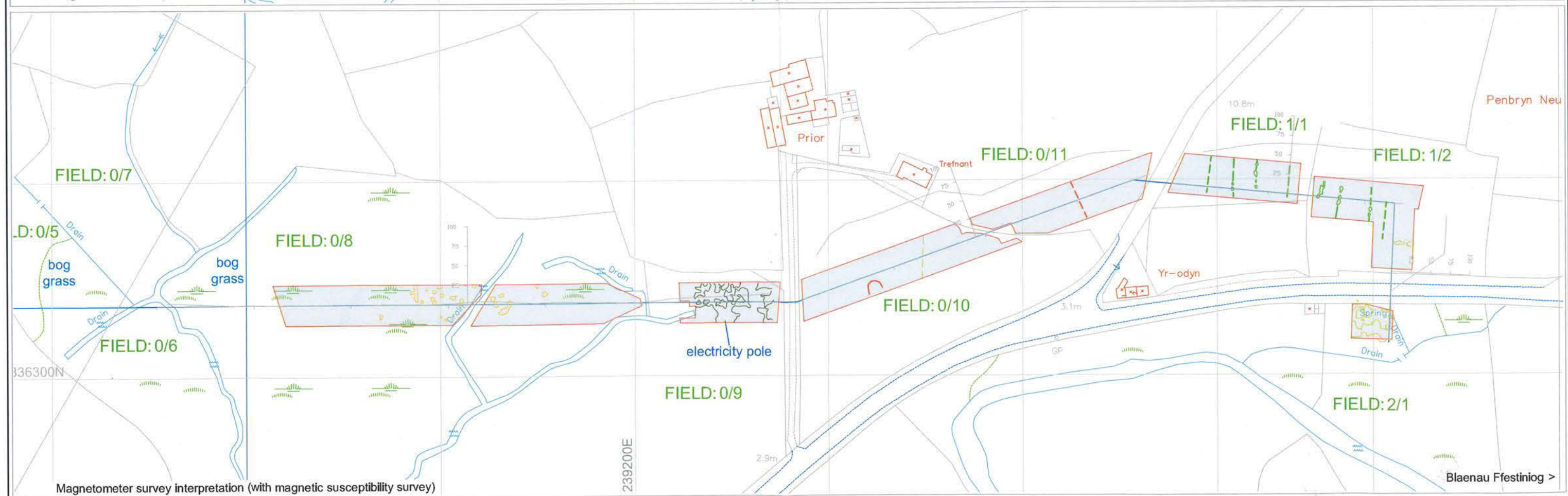
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1:2000 survey plots

pipeline route

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Proposed Gas Pipeline
Geophysical Survey 2009
Figure K4: Location of survey plans 33-48



Magnetic anomalies: interpretation

possibly archaeological

mainly geological

probably recent

uncertain / unknown

cultivation

pipe

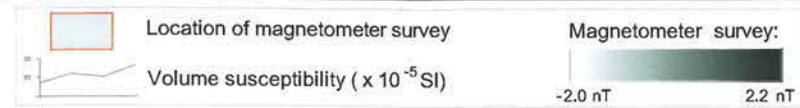
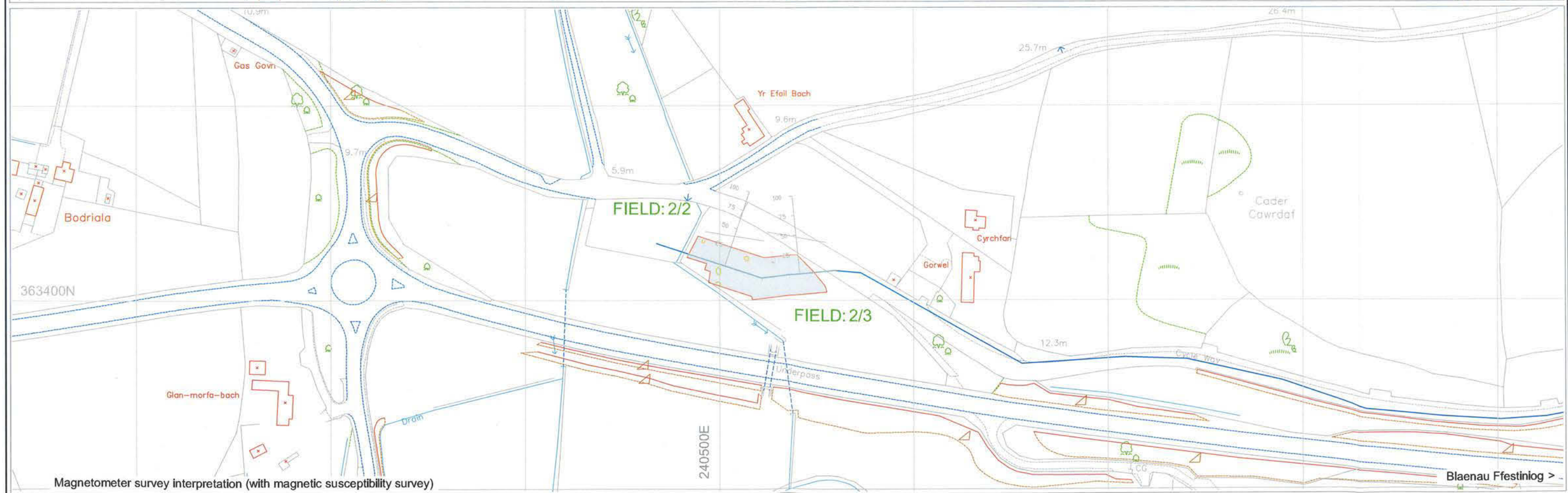
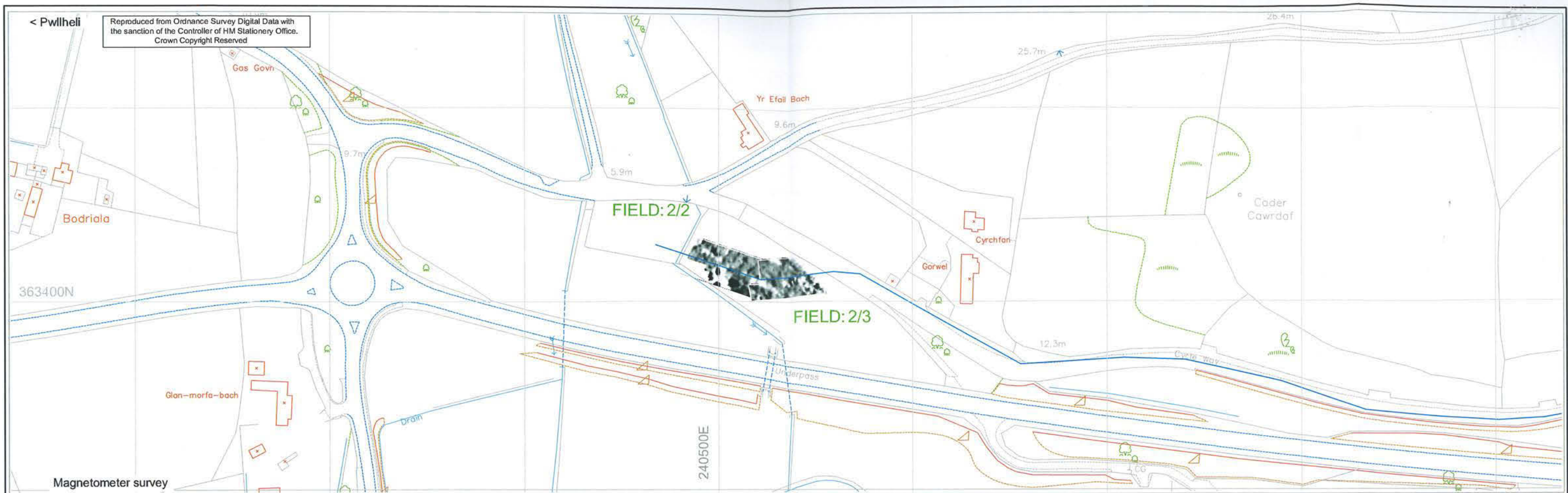
land drains ?

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Figure 2: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



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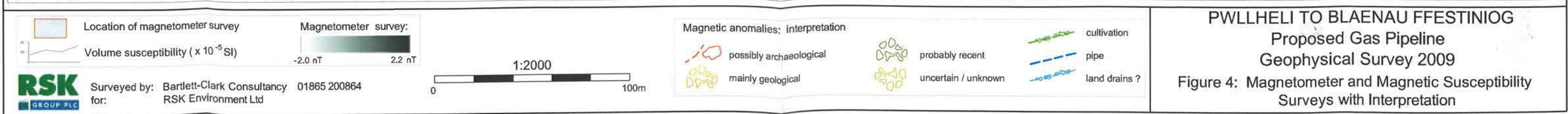
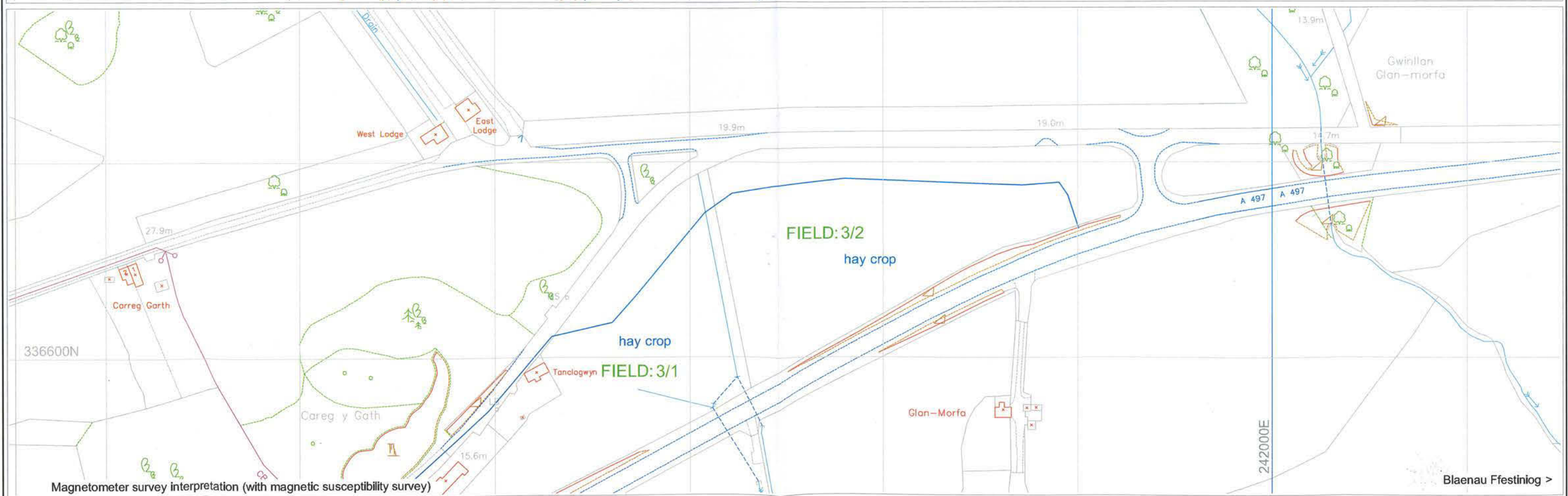
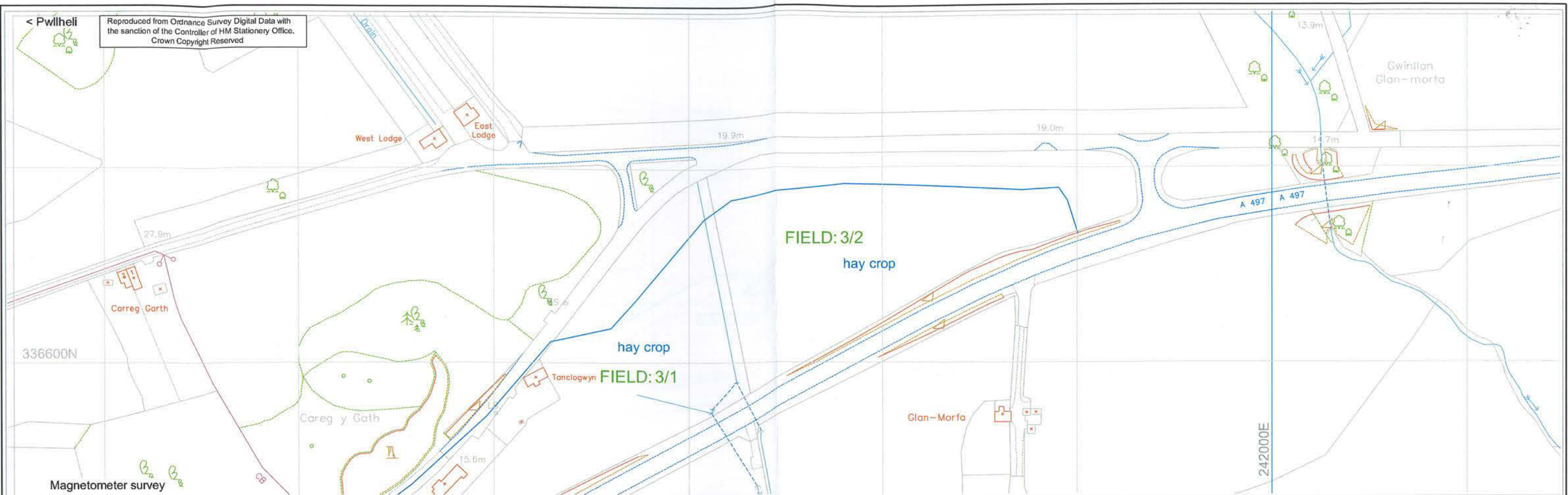
Magnetic anomalies: interpretation

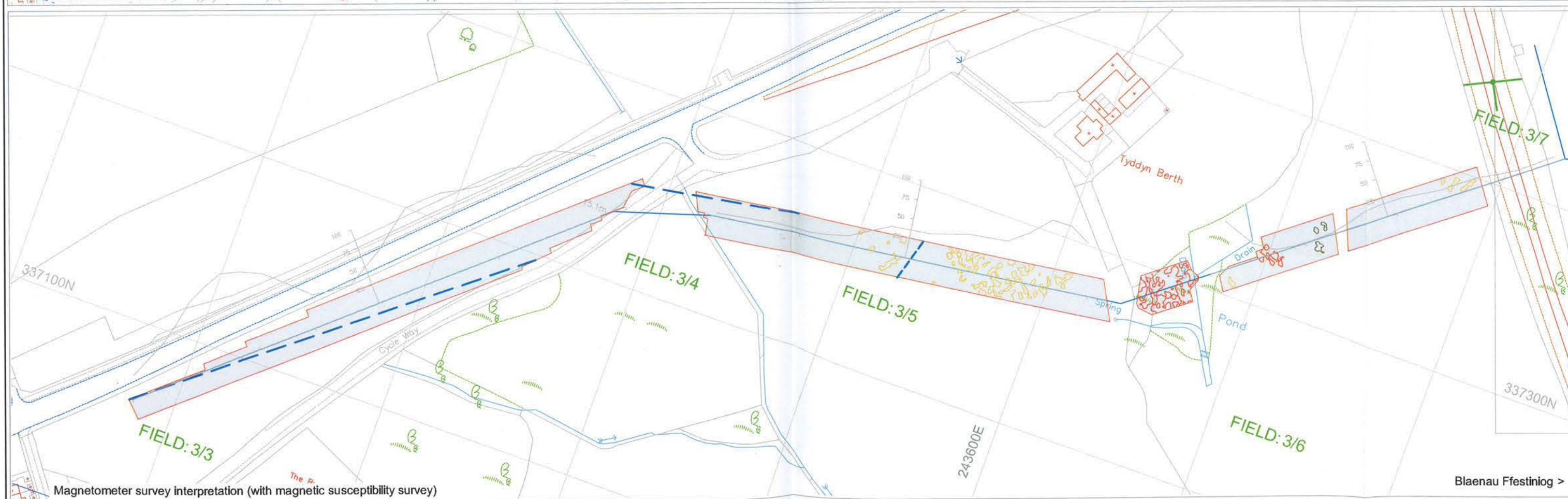
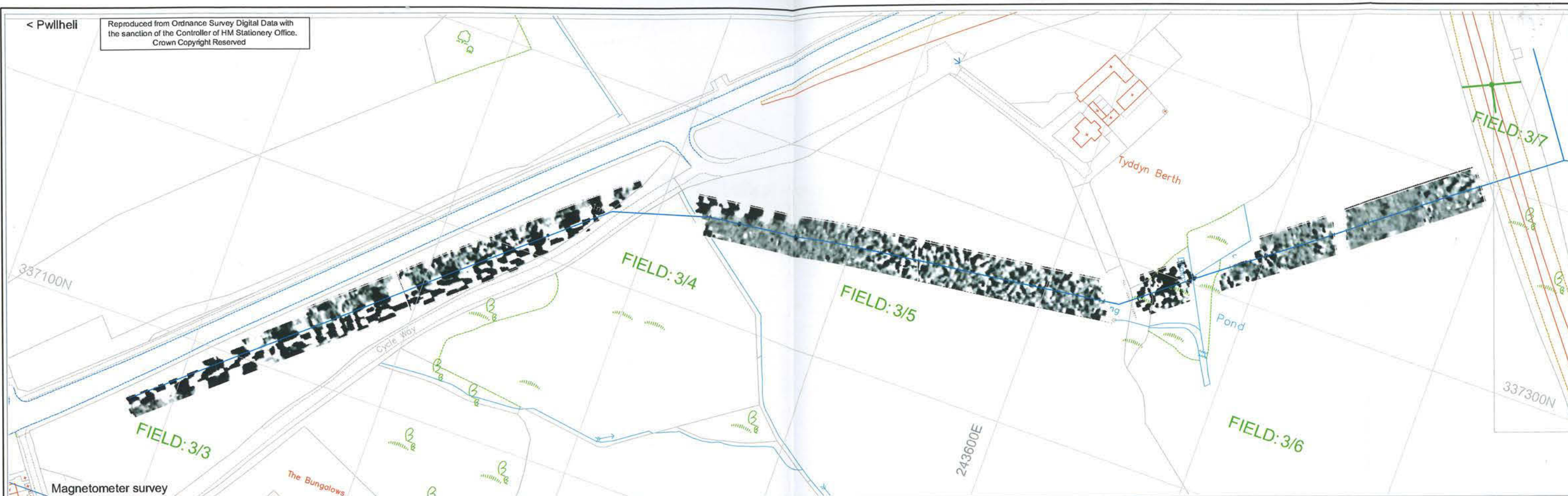


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Geophysical Survey 2009

Figure 3: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation





Location of magnetometer survey
Volume susceptibility (x 10⁻⁵ SI)
Magnetometer survey:
-2.4 nT 2.6 nT



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for: RSK Environment Ltd

1:2000
0 100m

Magnetic anomalies: Interpretation

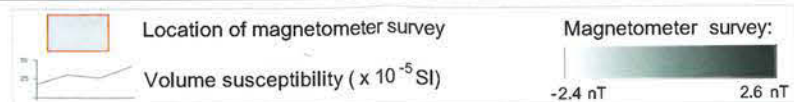
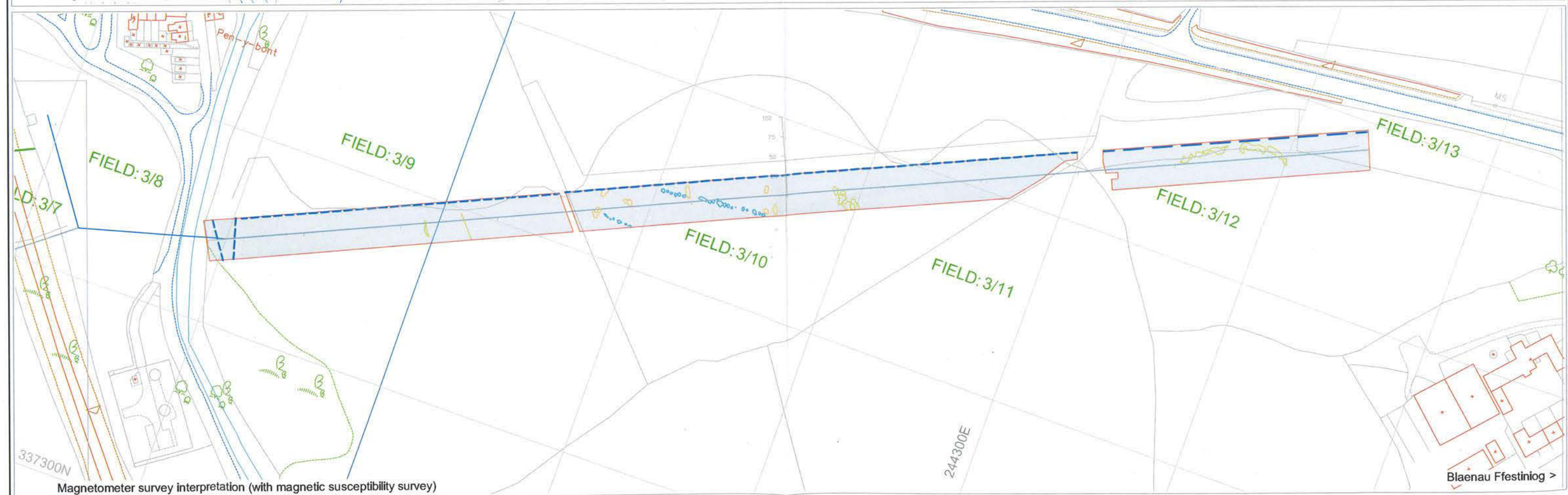
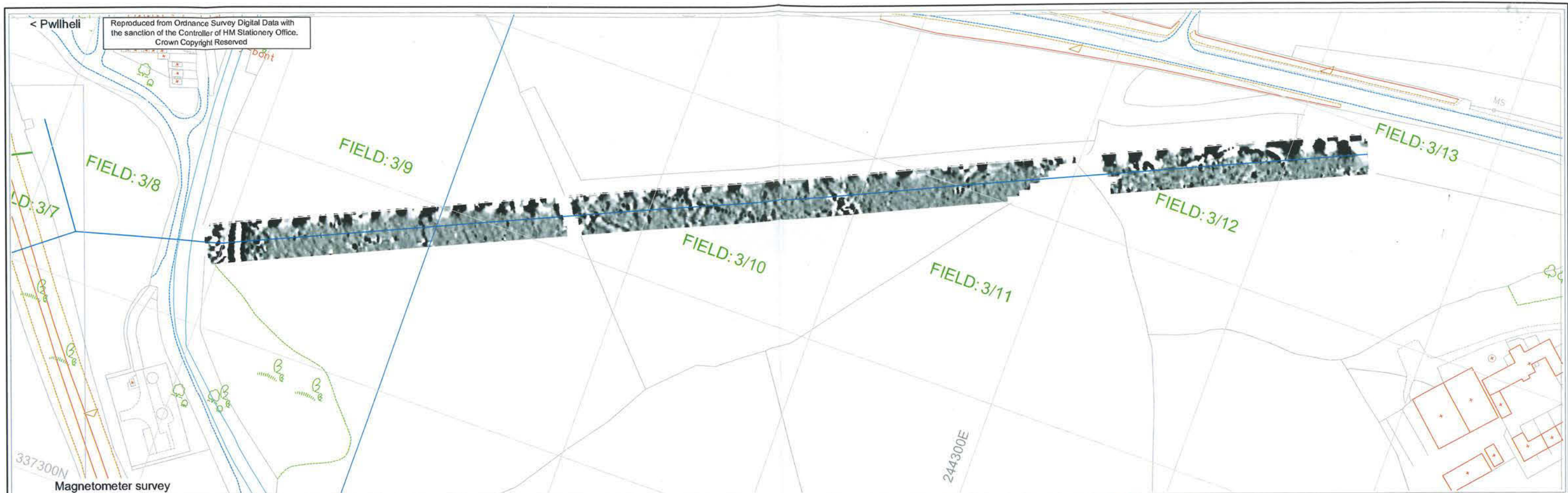
possibly archaeological
mainly geological

probably recent
uncertain / unknown

cultivation
pipe
land drains ?

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Geophysical Survey 2009

Figure 5: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



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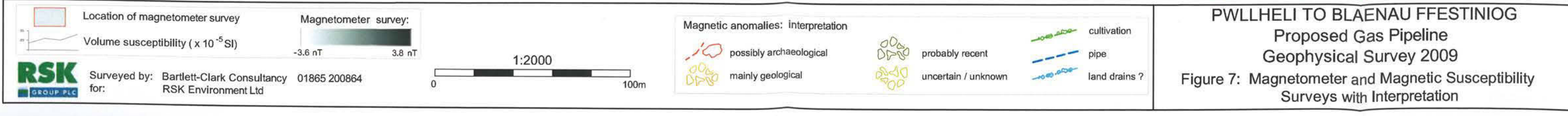
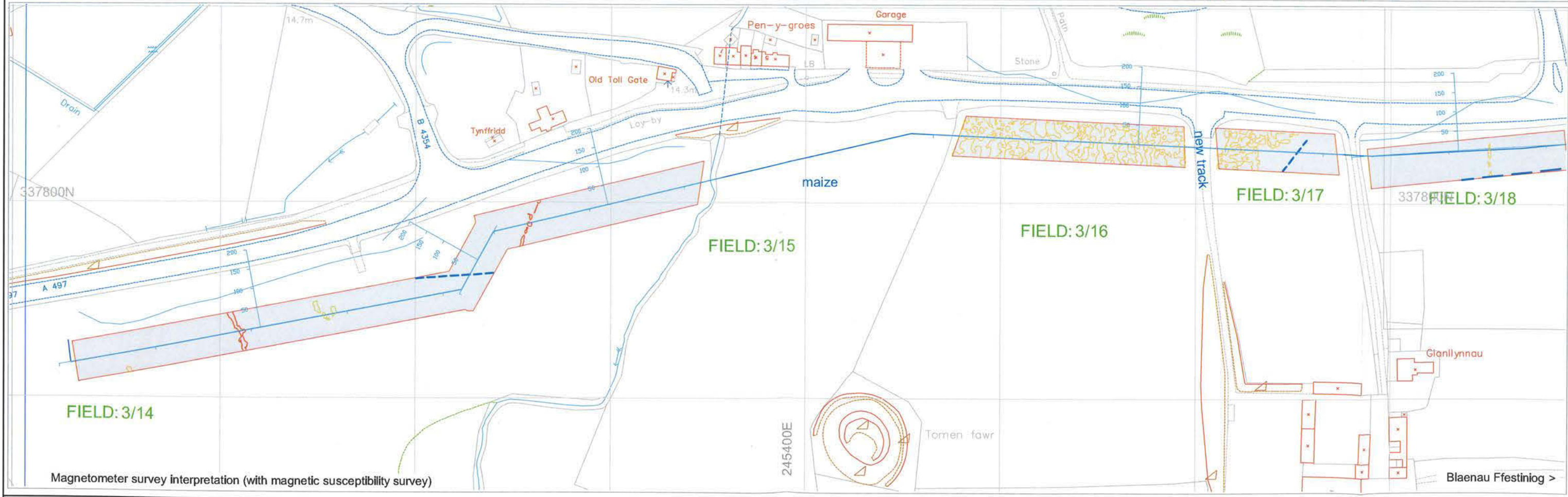
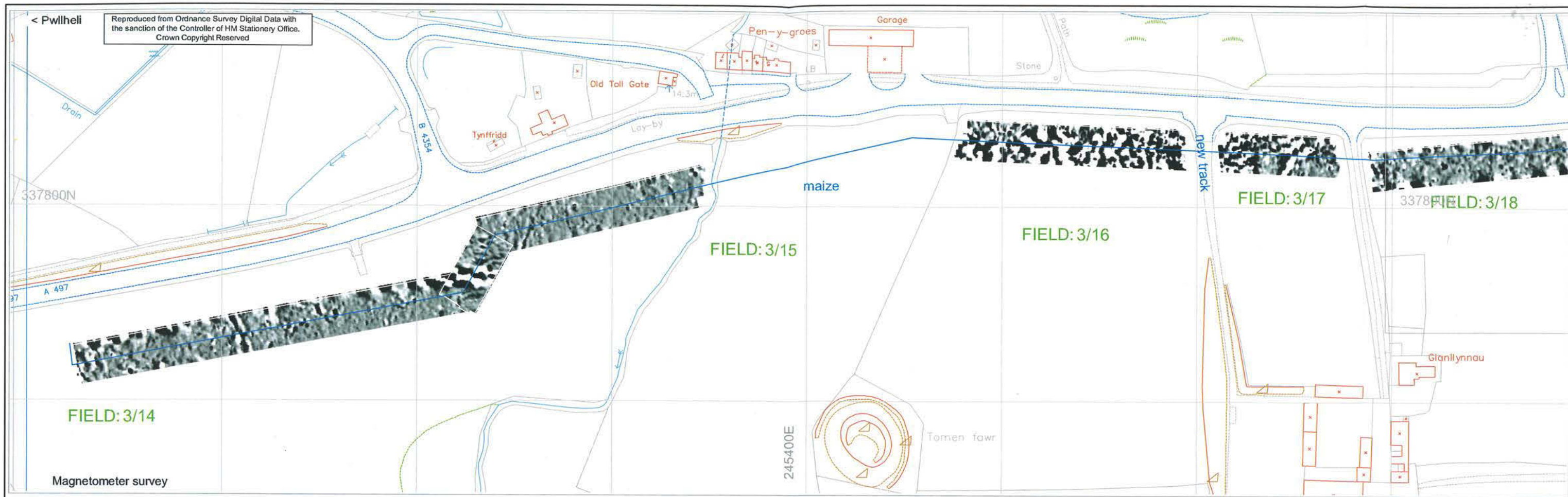
Surveyed by: Bartlett-Clark Consultancy 01865 200864
for: RSK Environment Ltd

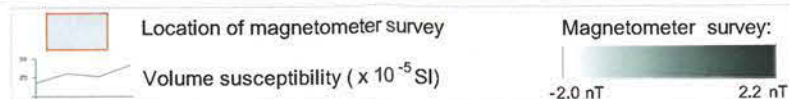
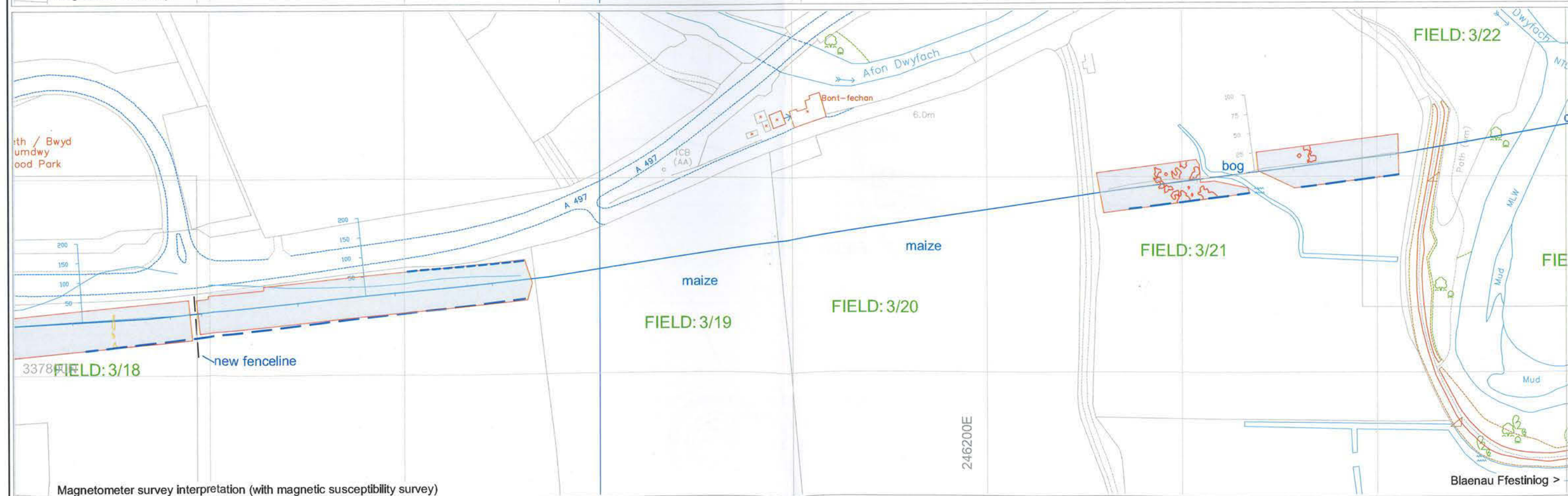
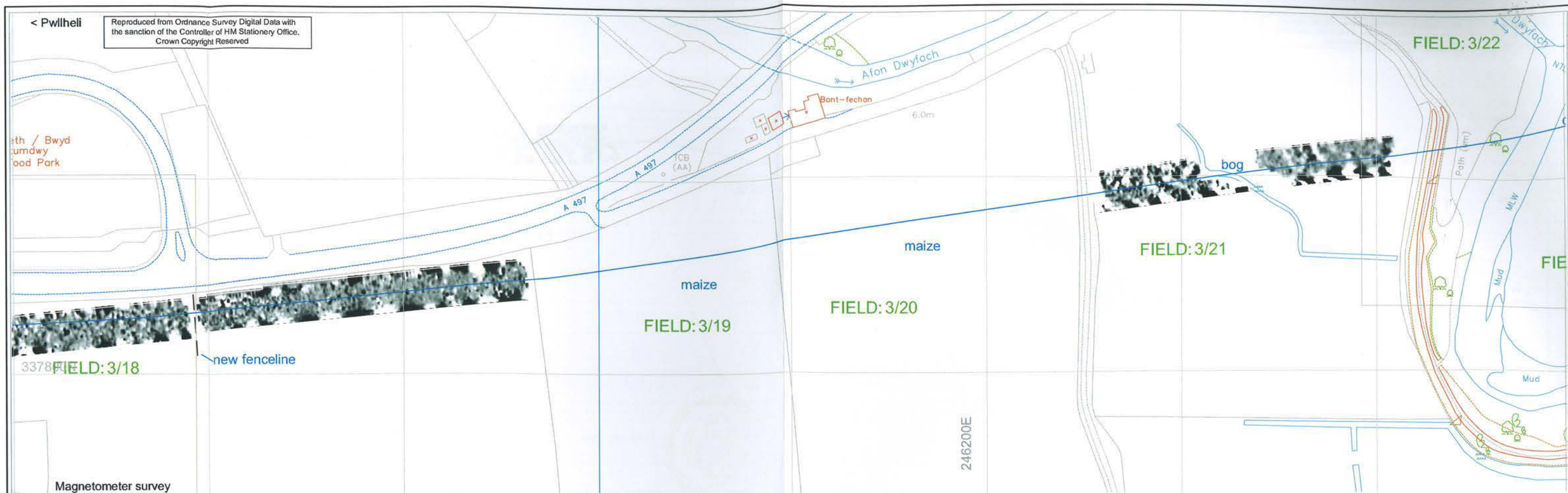


Magnetic anomalies: interpretation



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Proposed Gas Pipeline
Geophysical Survey 2009
Figure 6: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation





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 for: RSK Environment Ltd



Magnetic anomalies: interpretation

possibly archaeological
 mainly geological

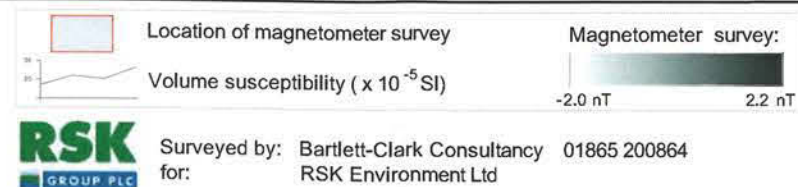
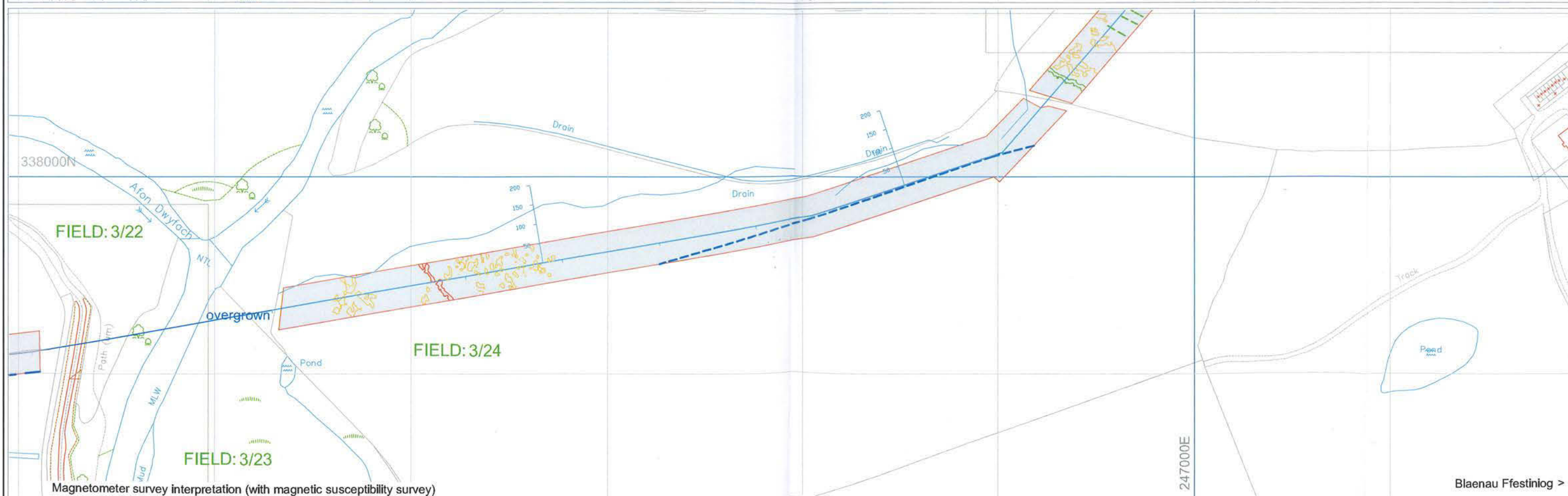
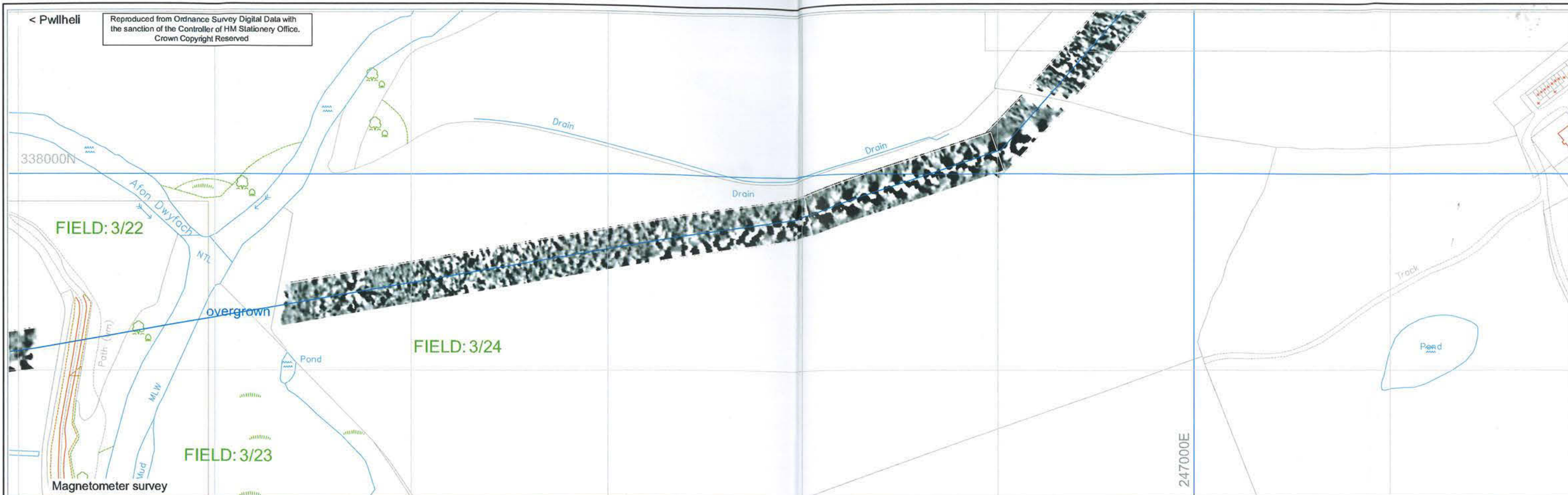
probably recent
 uncertain / unknown

cultivation
 pipe
 land drains ?

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Proposed Gas Pipeline
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Figure 8: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



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Proposed Gas Pipeline
Geophysical Survey 2009
Figure 9: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation

< Pwllheli

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FIELD: 3/26

FIELD: 3/28

338200N

manure pile

FIELD: 3/27

FIELD: 3/29
overgrowth

FIELD: 3/25

Magnetometer survey

Aberkin

338100E

FIELD: 3/26

FIELD: 3/28

338200N

manure pile

FIELD: 3/27

FIELD: 3/29
overgrowth

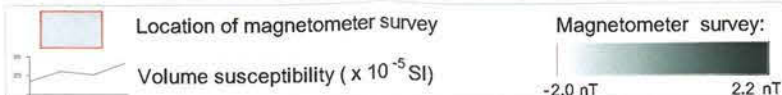
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Aberkin

338100E

Blaenau Ffestiniog >

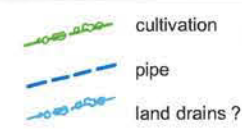
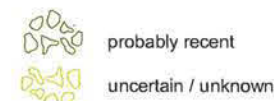
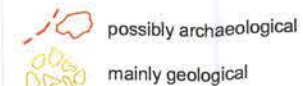
Magnetometer survey interpretation (with magnetic susceptibility survey)



Surveyed by: Bartlett-Clark Consultancy 01865 200864
for: RSK Environment Ltd



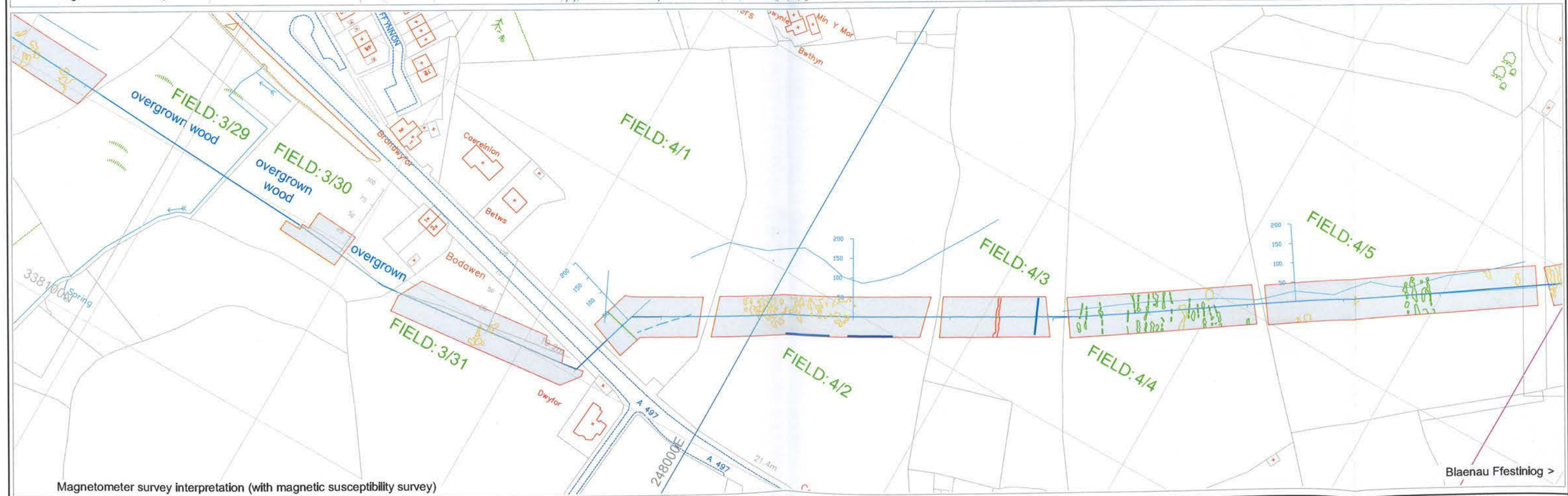
Magnetic anomalies: interpretation



PWLLHELI TO BLAENAU FFESTINIOG

Proposed Gas Pipeline
Geophysical Survey 2009

Figure 10: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



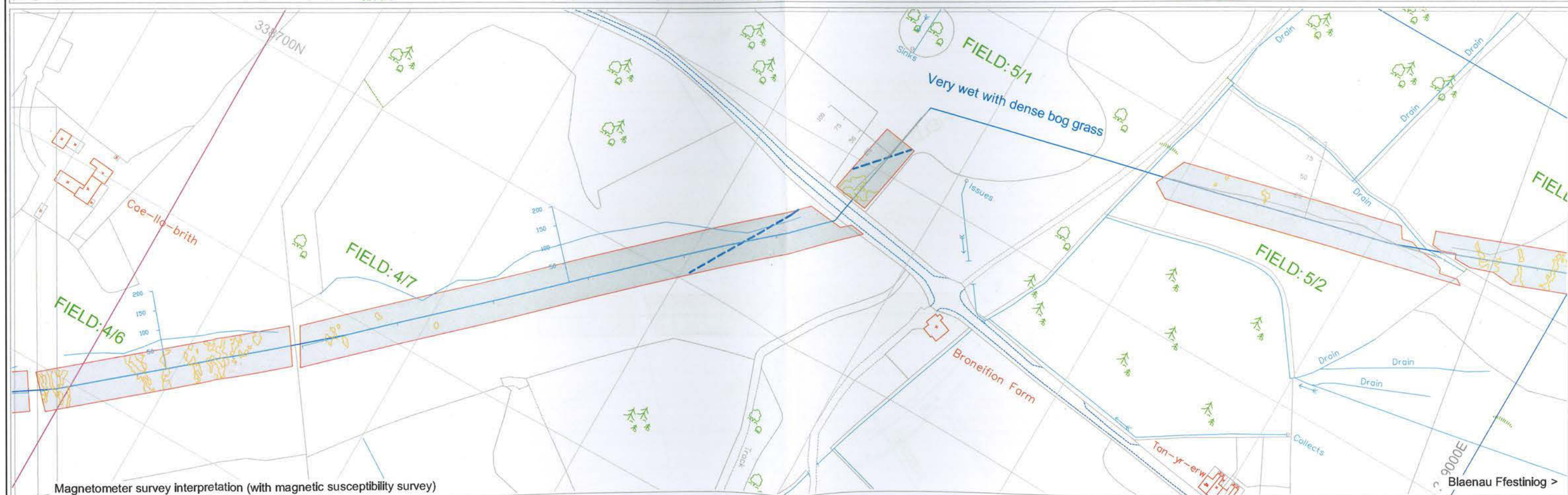
PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009
Figure 11: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation

< Pwllheli

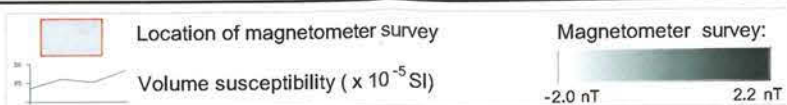
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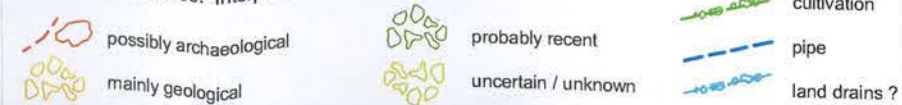
Magnetometer survey



Magnetometer survey interpretation (with magnetic susceptibility survey)



Magnetic anomalies: interpretation



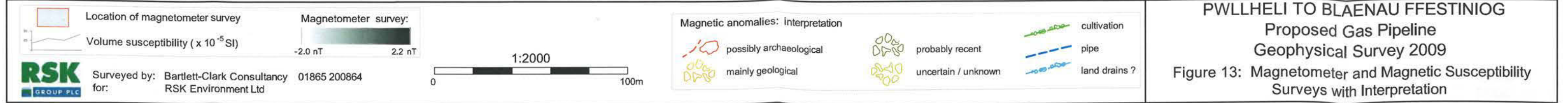
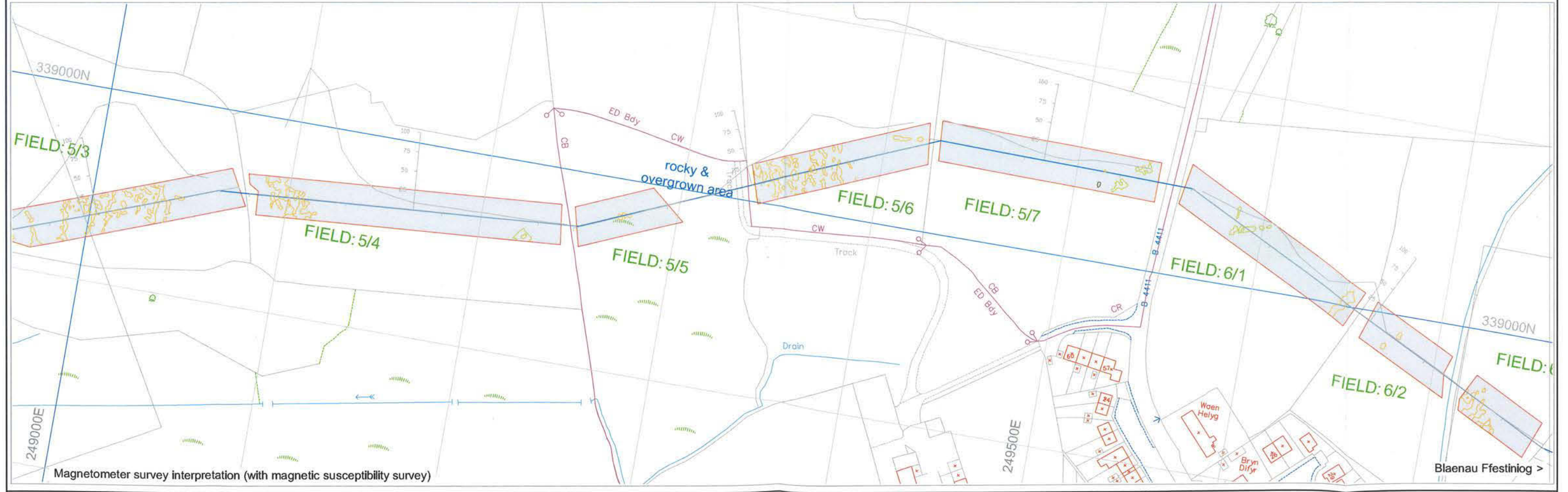
PWLLHELI TO BLAENAU FFESTINIOG

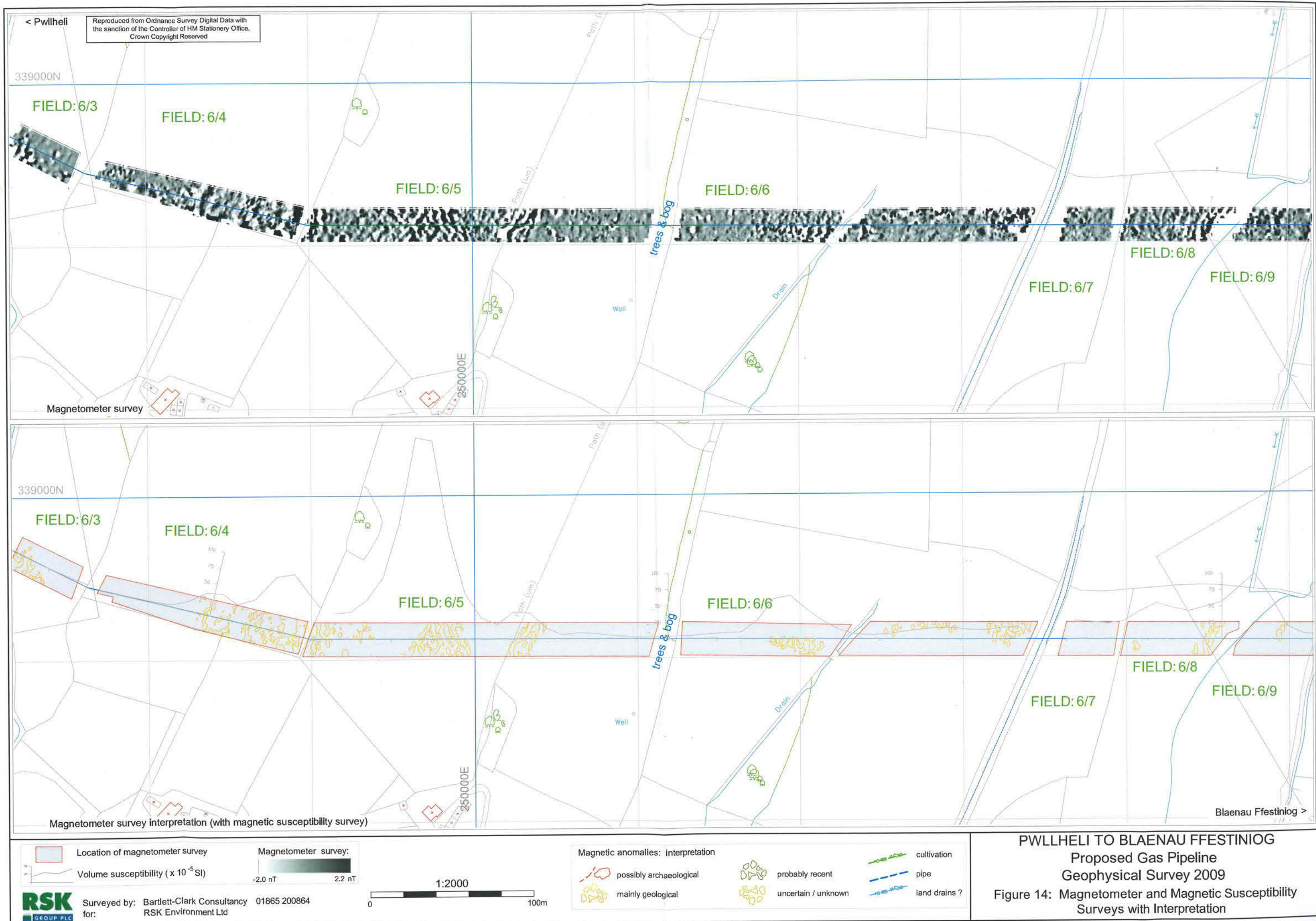
Proposed Gas Pipeline
Geophysical Survey 2009

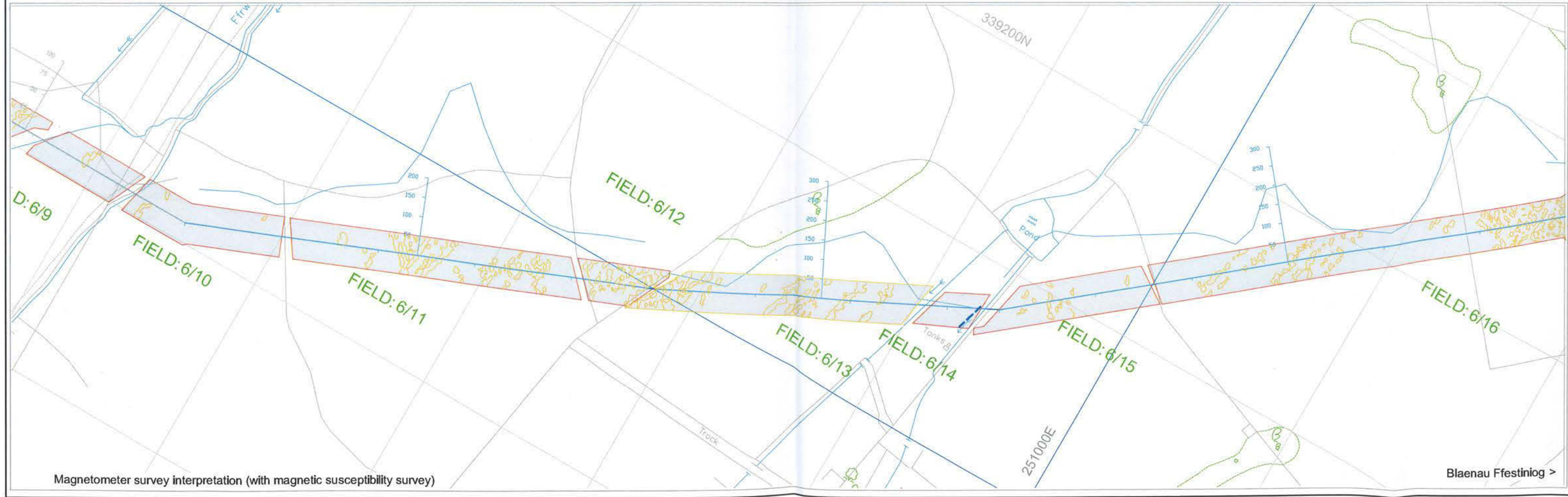
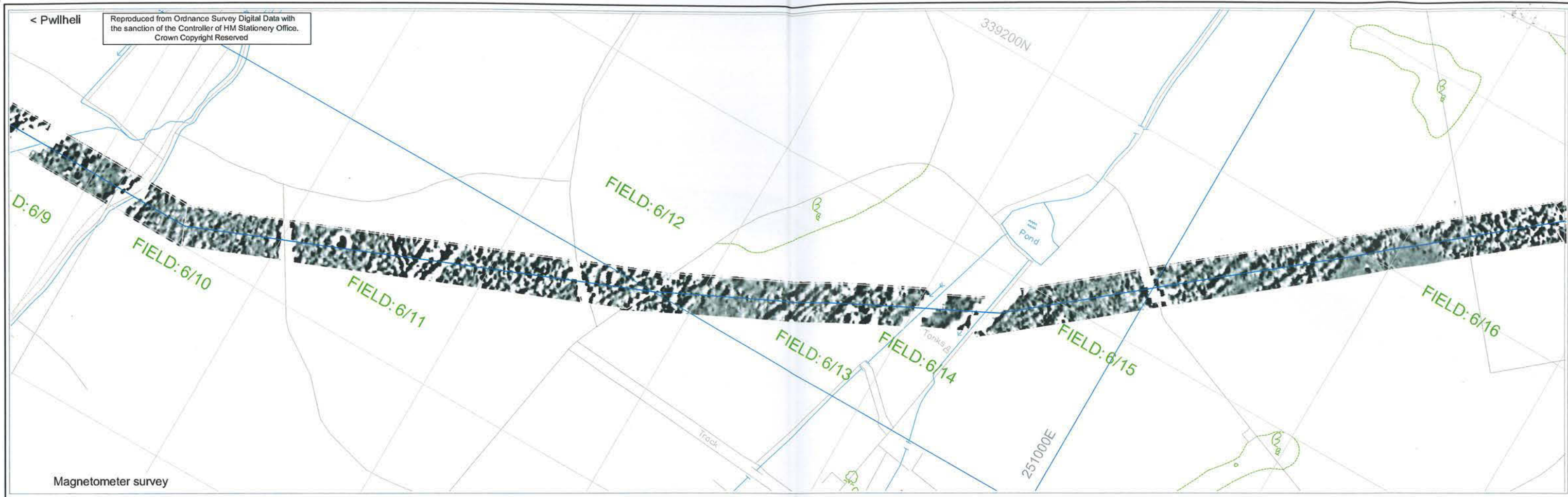
Figure 12: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



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for: RSK Environment Ltd







Location of magnetometer survey

Volume susceptibility ($\times 10^{-5}$ SI)

Magnetometer survey: -2.0 nT 2.2 nT

1:2000

0 100m

Magnetic anomalies: Interpretation

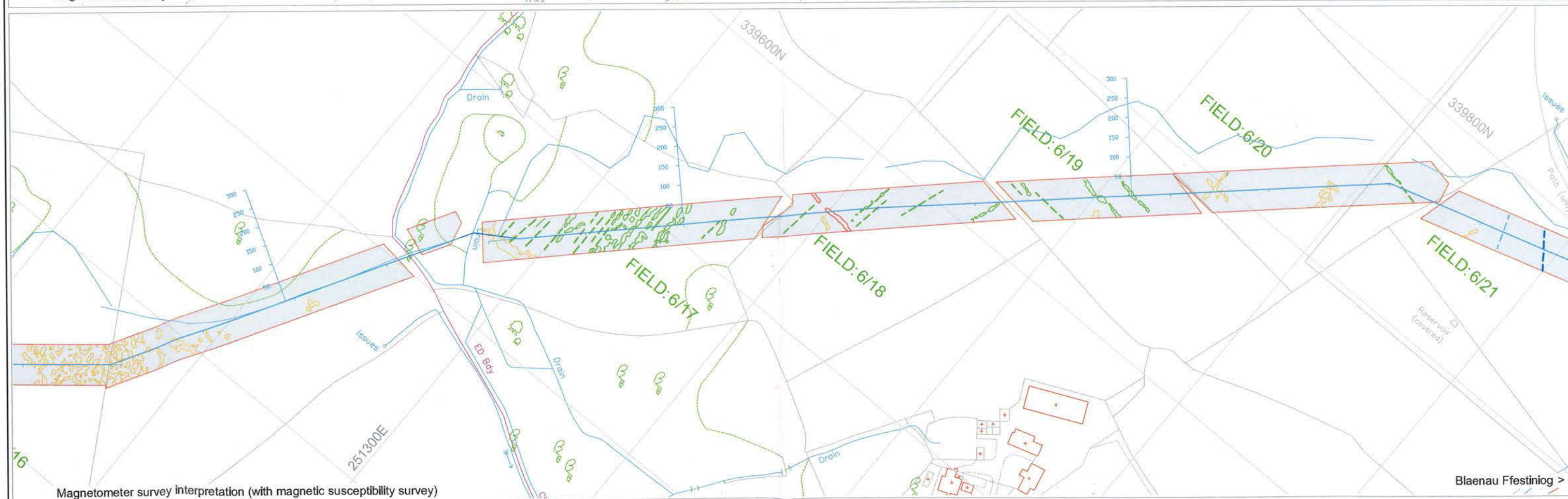
- possibly archaeological
- mainly geological
- probably recent
- uncertain / unknown
- cultivation
- pipe
- land drains?

PWLLHELI TO BLAENAU FFESTINIOG

Proposed Gas Pipeline

Geophysical Survey 2009

Figure 15: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



Location of magnetometer survey
Volume susceptibility ($\times 10^{-5}$ SI)
Magnetometer survey:
-2.0 nT 2.2 nT



Surveyed by: Bartlett-Clark Consultancy 01865 200864
for: RSK Environment Ltd

1:2000
0 100m

Magnetic anomalies: interpretation

possibly archaeological
mainly geological

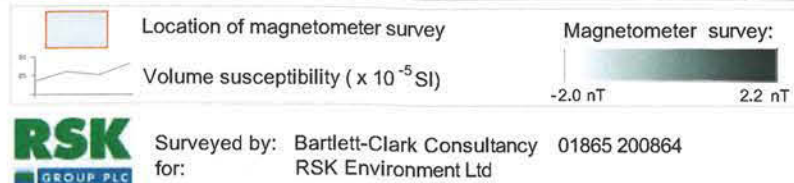
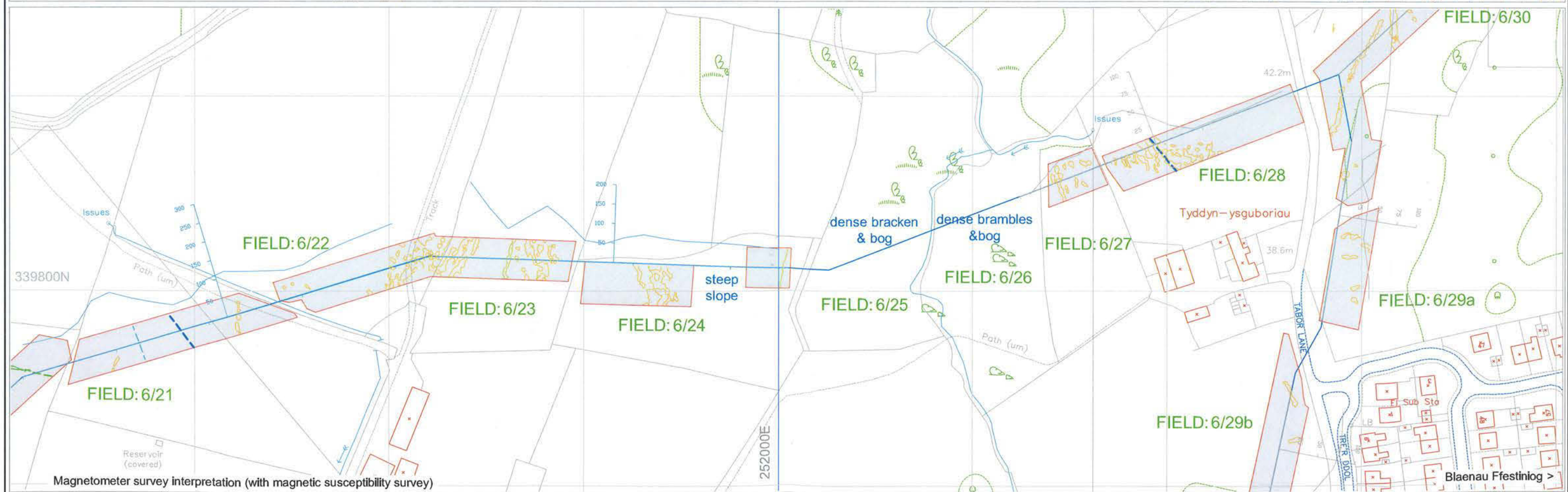
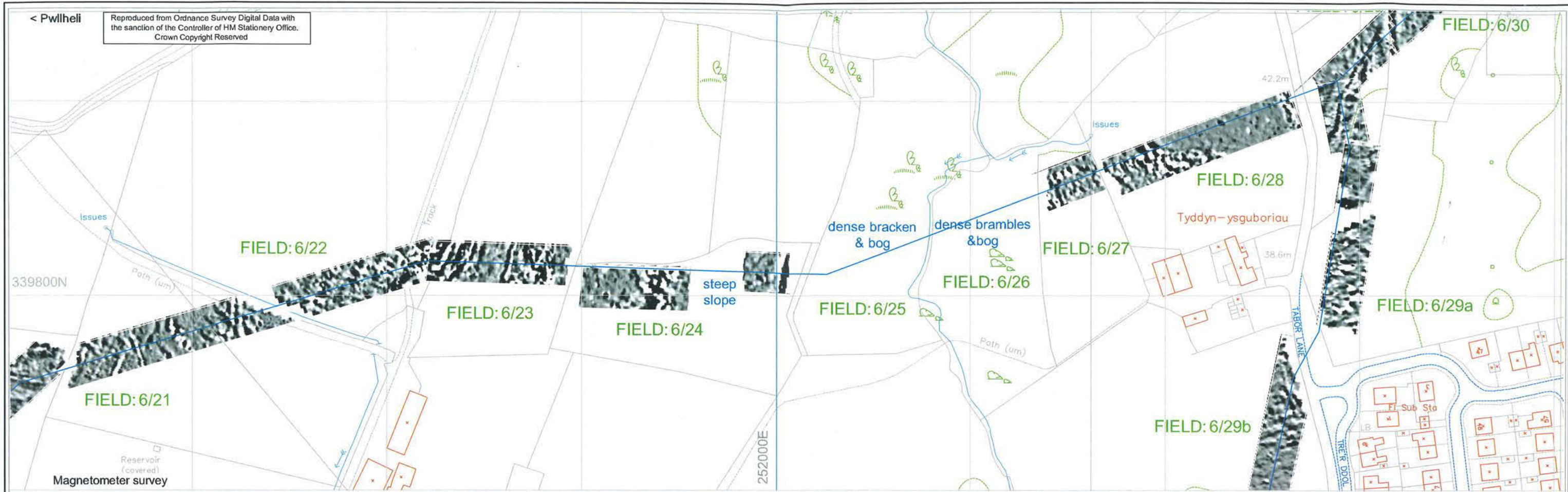
probably recent
uncertain / unknown

cultivation
pipe
land drains ?

PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009

Figure 16: Magnetometer and Magnetic Susceptibility Surveys with Interpretation

40



Magnetic anomalies: Interpretation

possibly archaeological

mainly geological

probably recent

uncertain / unknown

cultivation

pipe

land drains ?

PWLLHELI TO BLAENAU FFESTINIOG

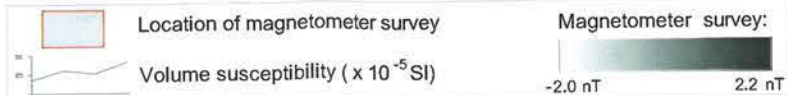
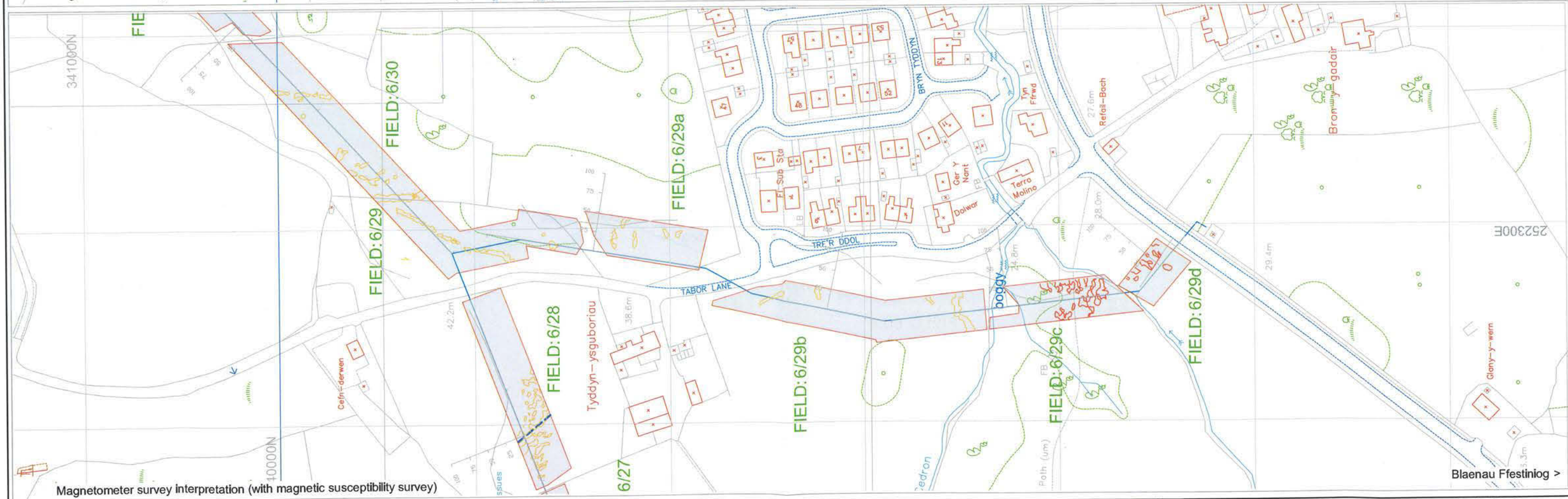
Proposed Gas Pipeline

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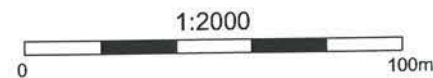
Figure 17: Magnetometer and Magnetic Susceptibility Surveys with Interpretation

< Pwllheli

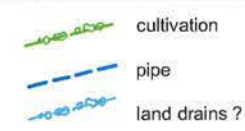
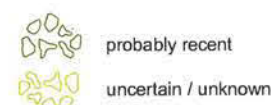
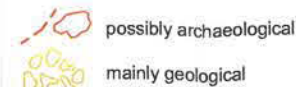
Reproduced from Ordnance Survey Digital Data with the sanction of the Controller of HM Stationery Office. Crown Copyright Reserved



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for: RSK Environment Ltd



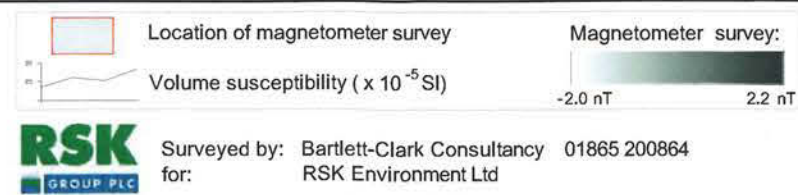
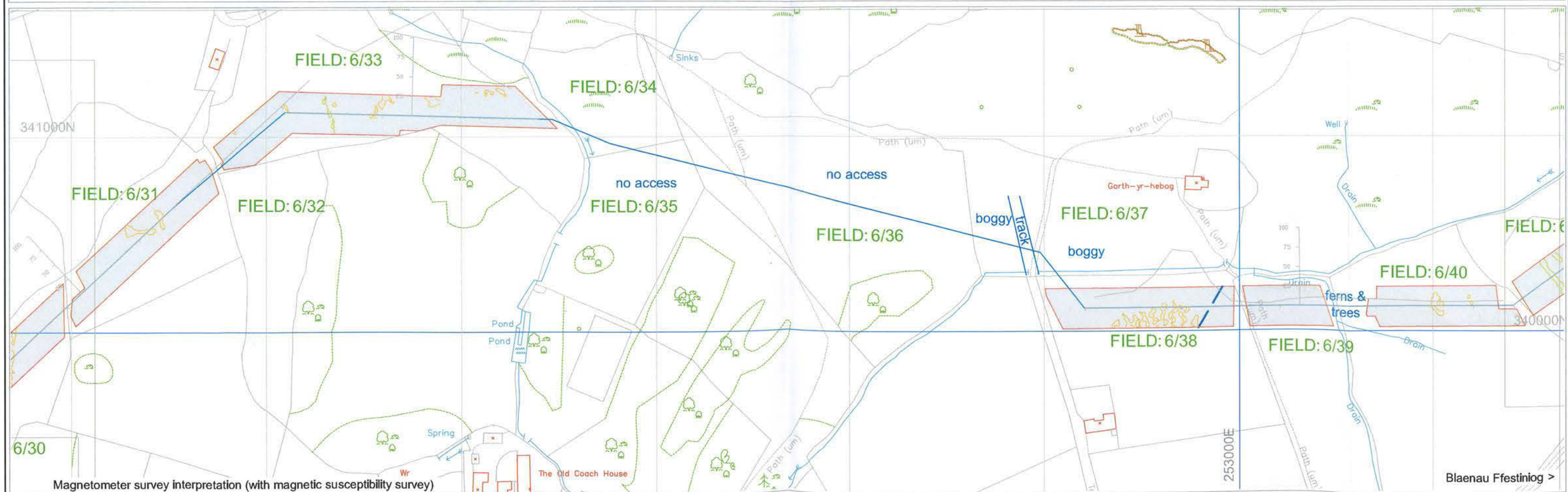
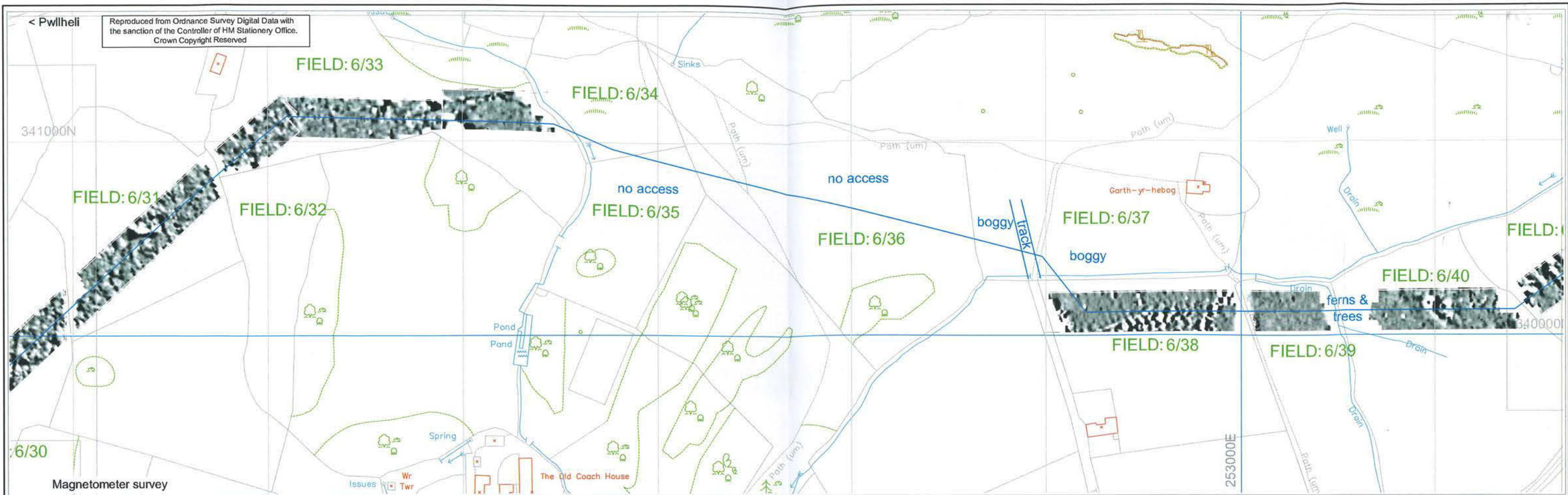
Magnetic anomalies; interpretation



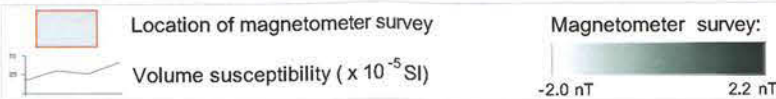
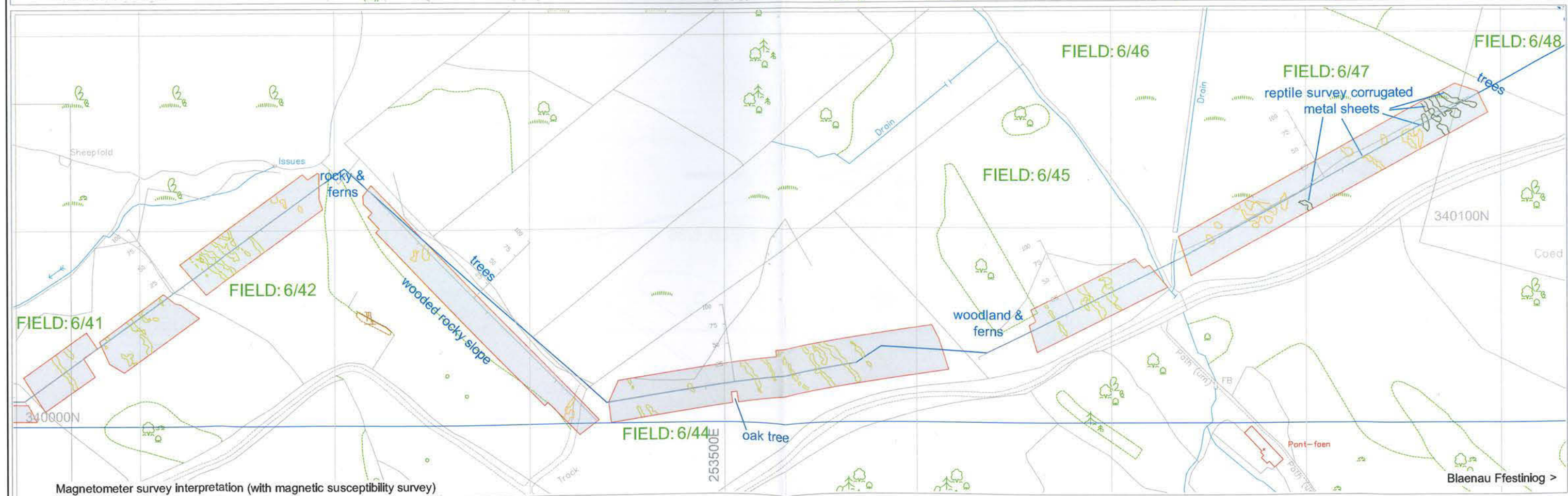
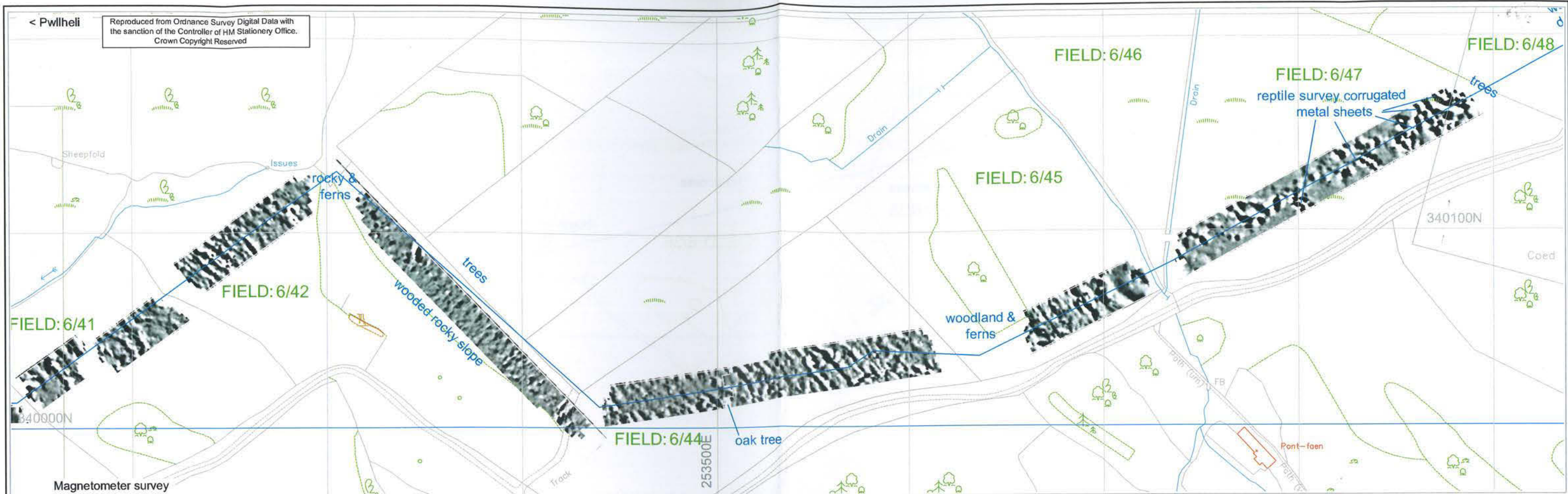
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Proposed Gas Pipeline
Geophysical Survey 2009

Figure 18: Magnetometer and Magnetic Susceptibility Surveys with Interpretation

42

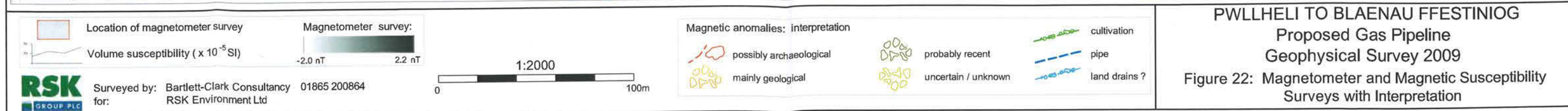
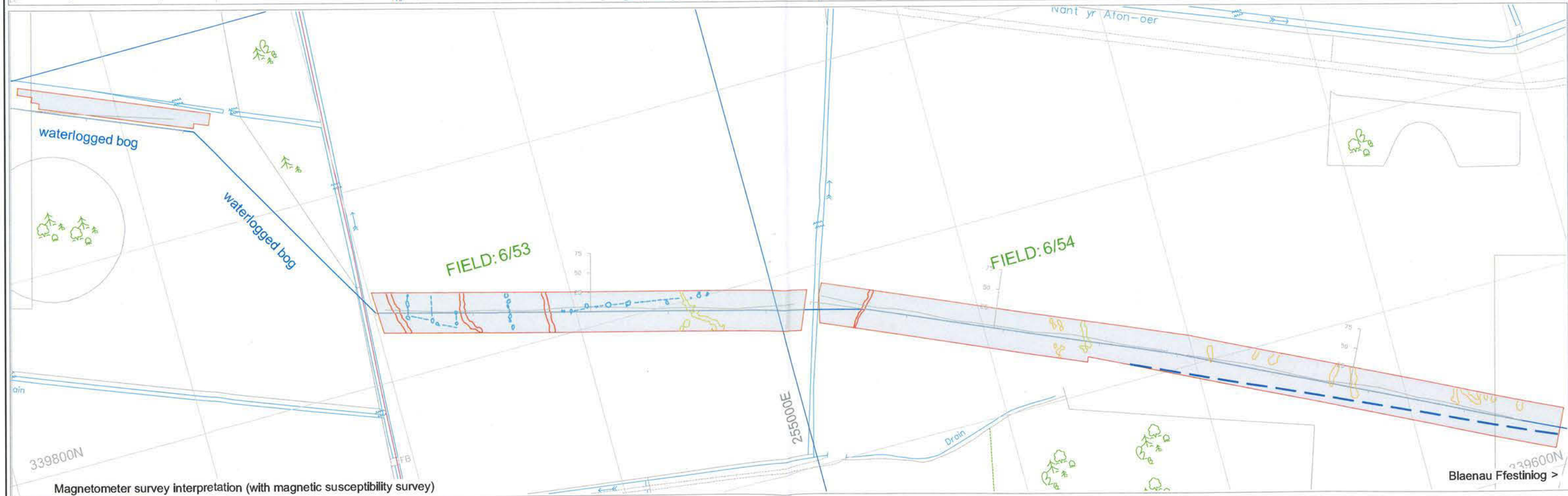


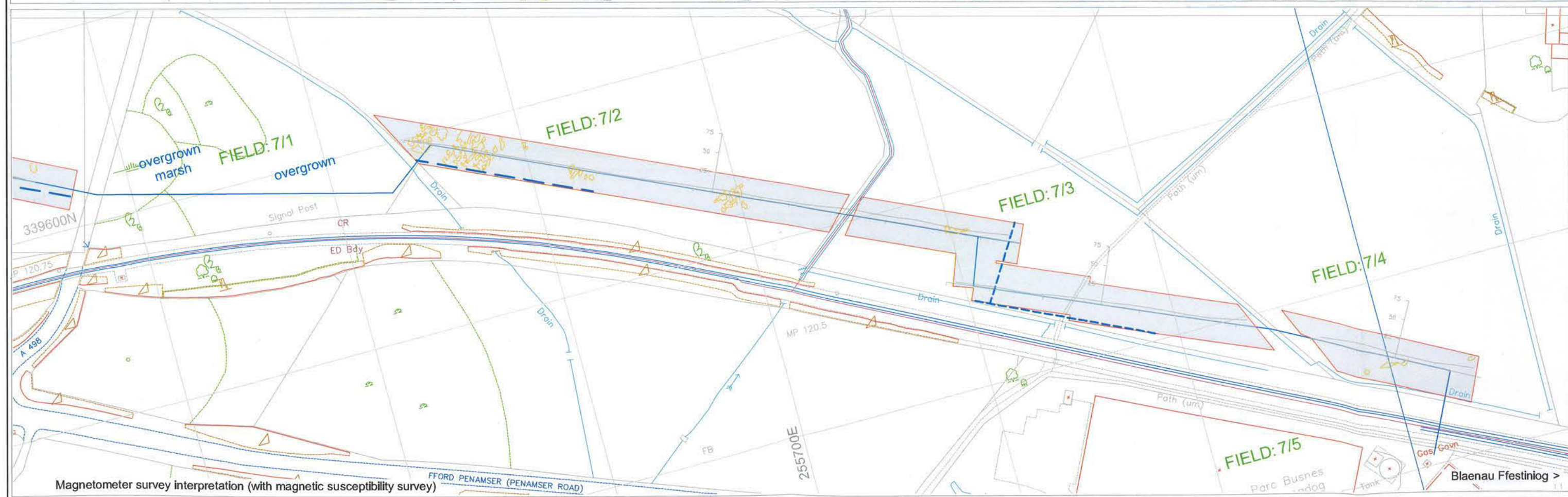
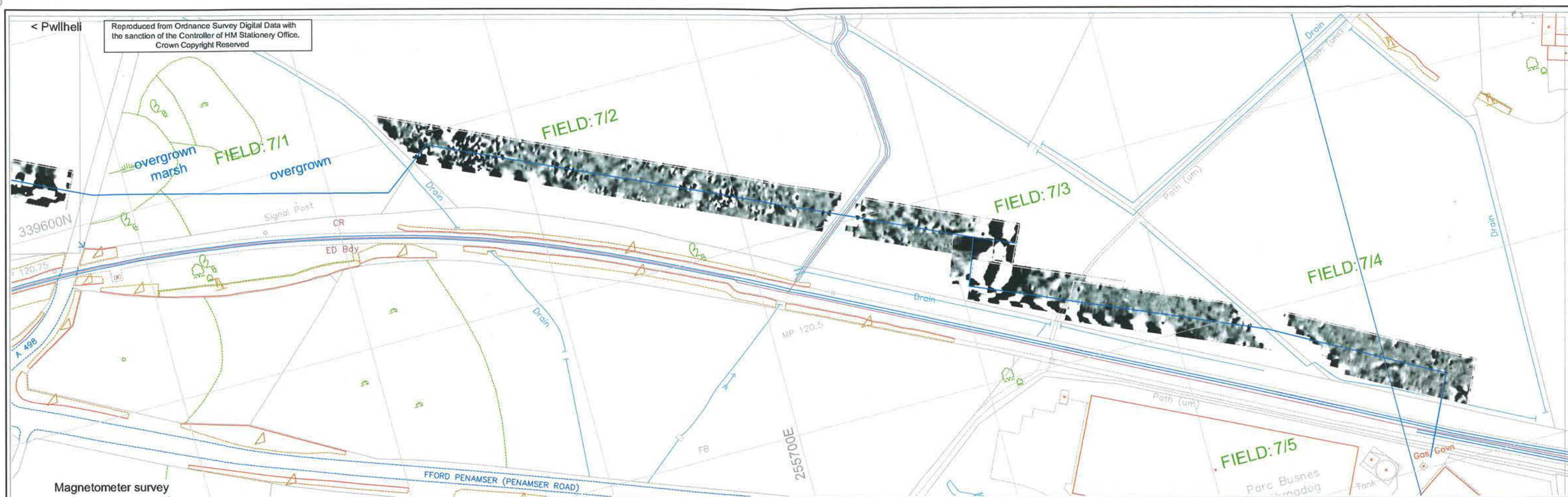
PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009
Figure 19: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation





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Proposed Gas Pipeline
Geophysical Survey 2009
Figure 21: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation





Location of magnetometer survey

Volume susceptibility ($\times 10^{-5}$ SI)

Magnetometer survey:

-2.0 nT 2.2 nT

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for: RSK Environment Ltd

1:2000

0 100m

Magnetic anomalies: interpretation

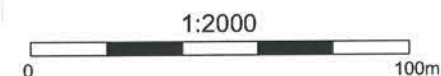
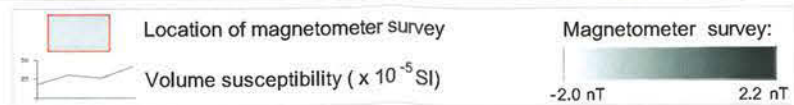
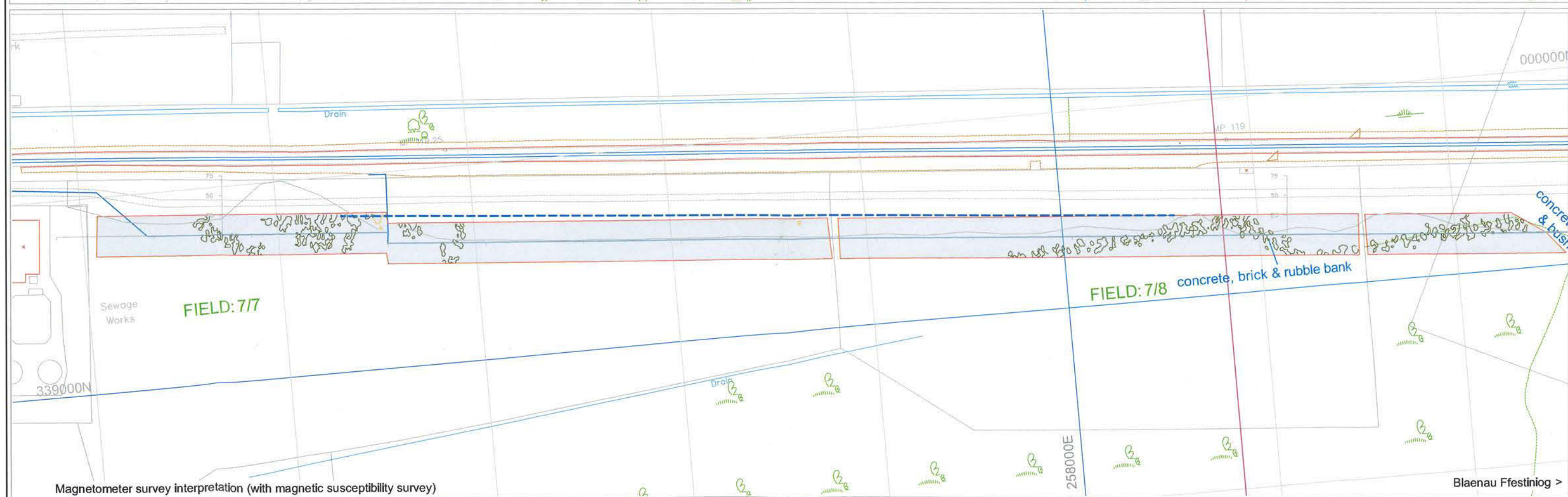
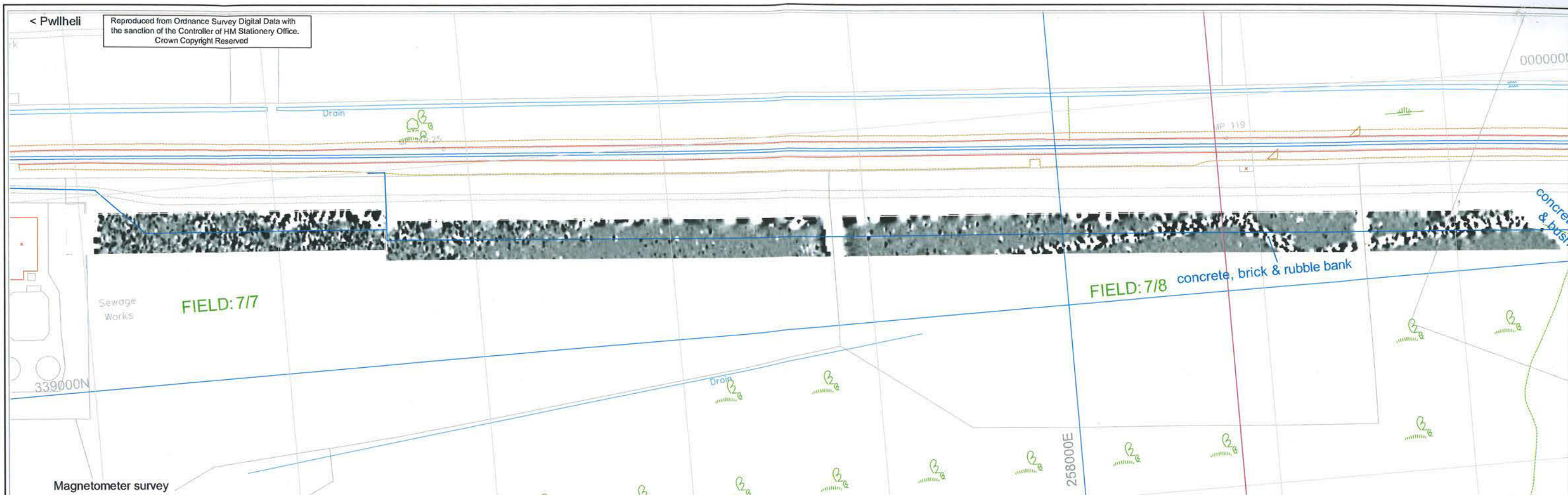
possibly archaeological	probably recent	cultivation
mainly geological	uncertain / unknown	pipe
		land drains ?

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Proposed Gas Pipeline

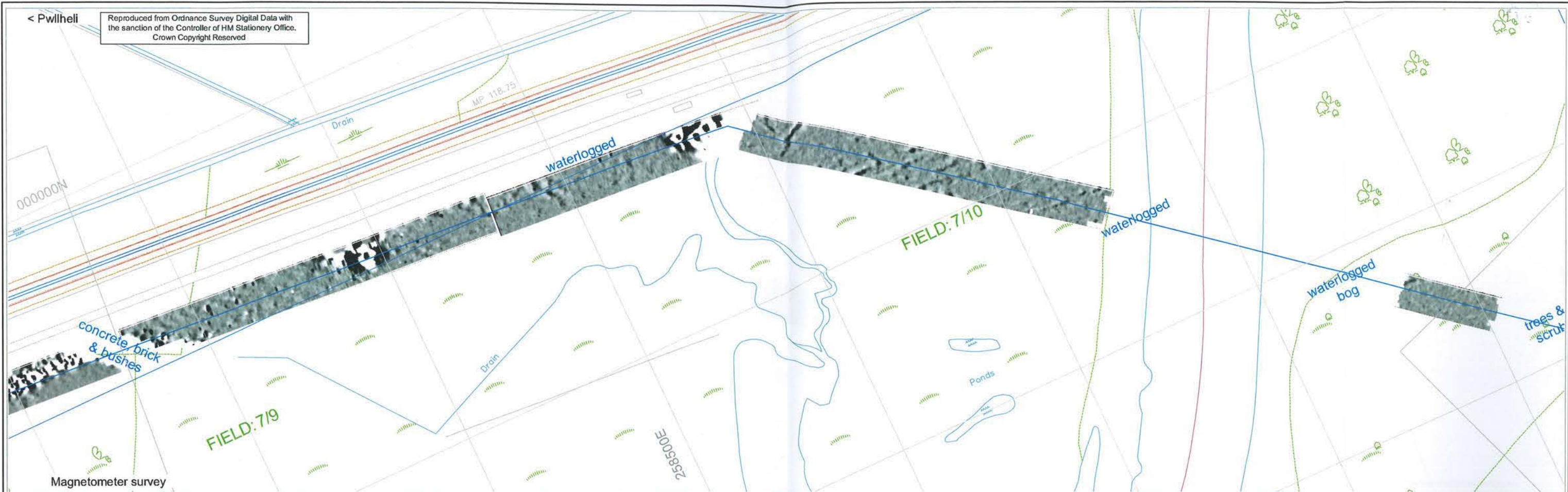
Geophysical Survey 2009

Figure 23: Magnetometer and Magnetic Susceptibility Surveys with Interpretation

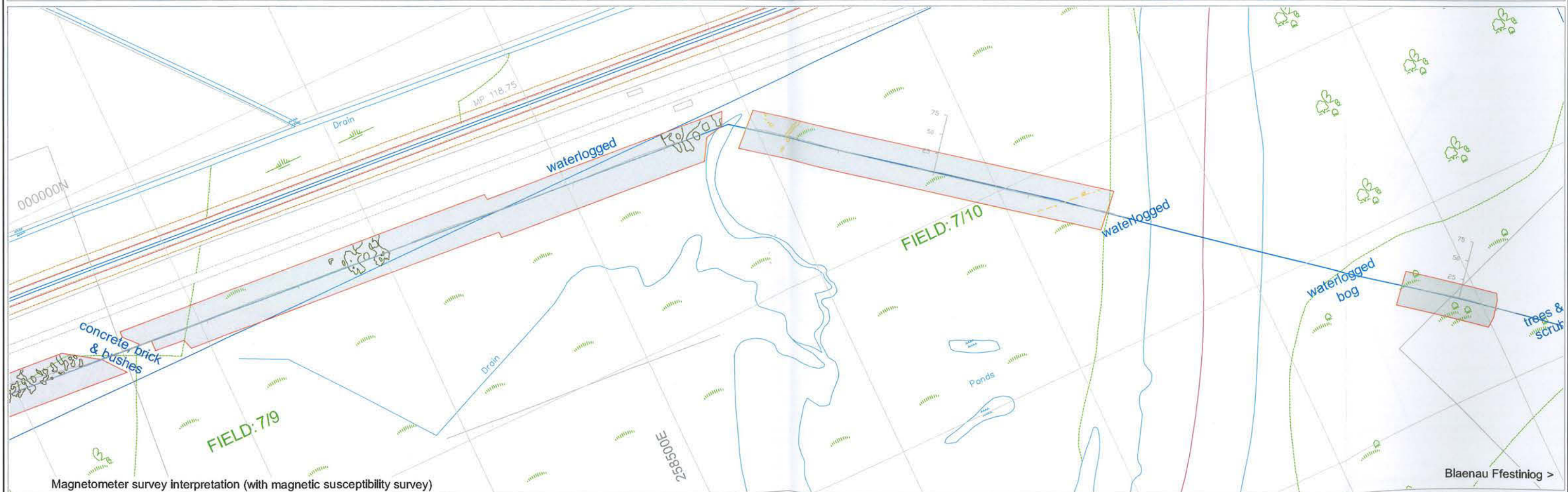


Magnetic anomalies: interpretation

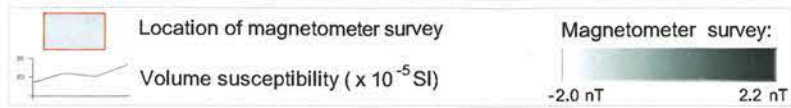




Magnetometer survey



Magnetometer survey interpretation (with magnetic susceptibility survey)



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 for: RSK Environment Ltd

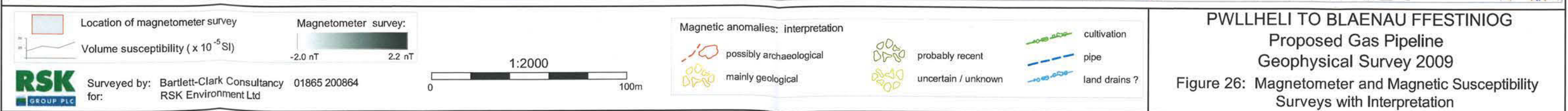
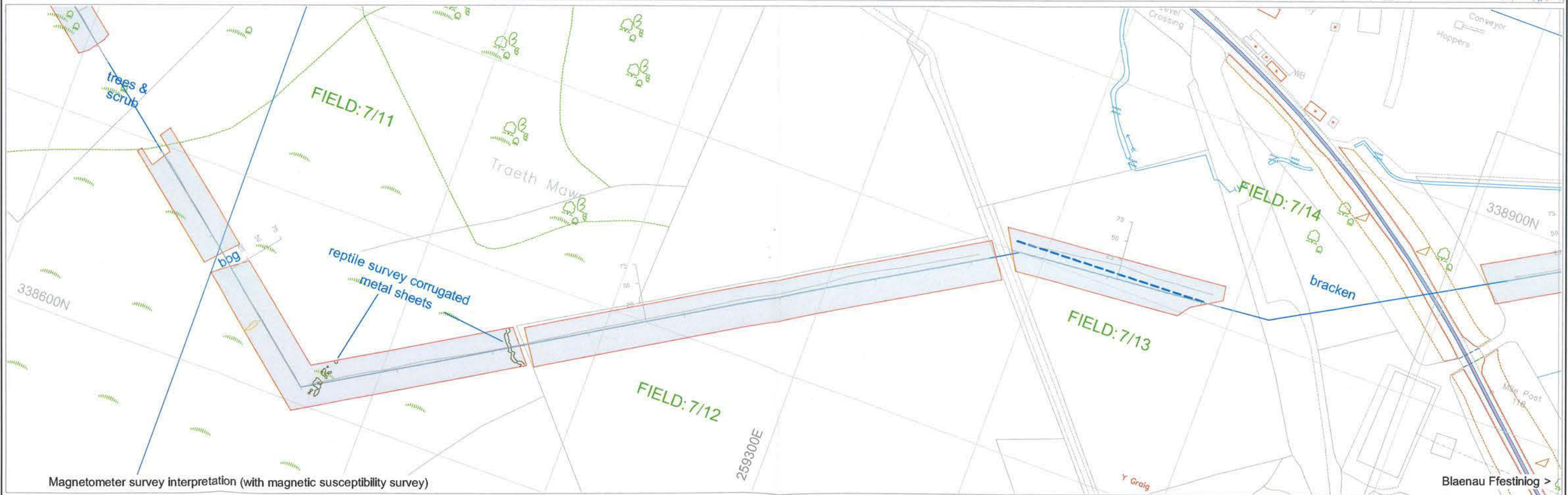
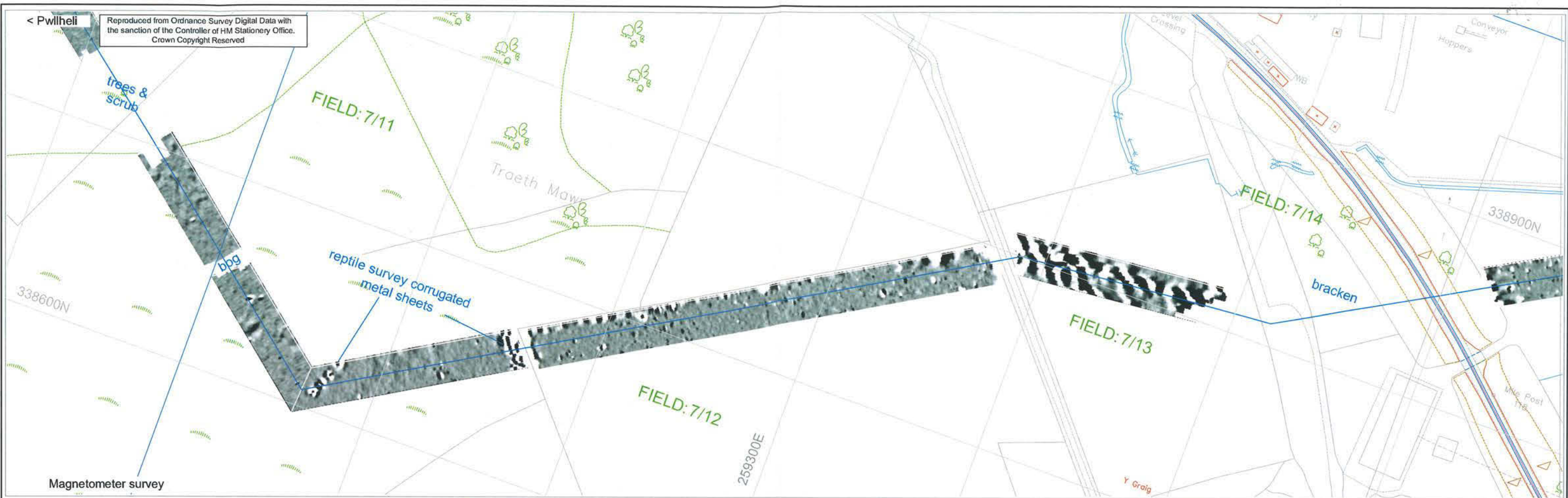
Magnetic anomalies: Interpretation

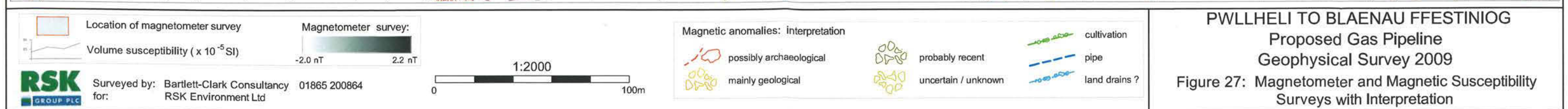
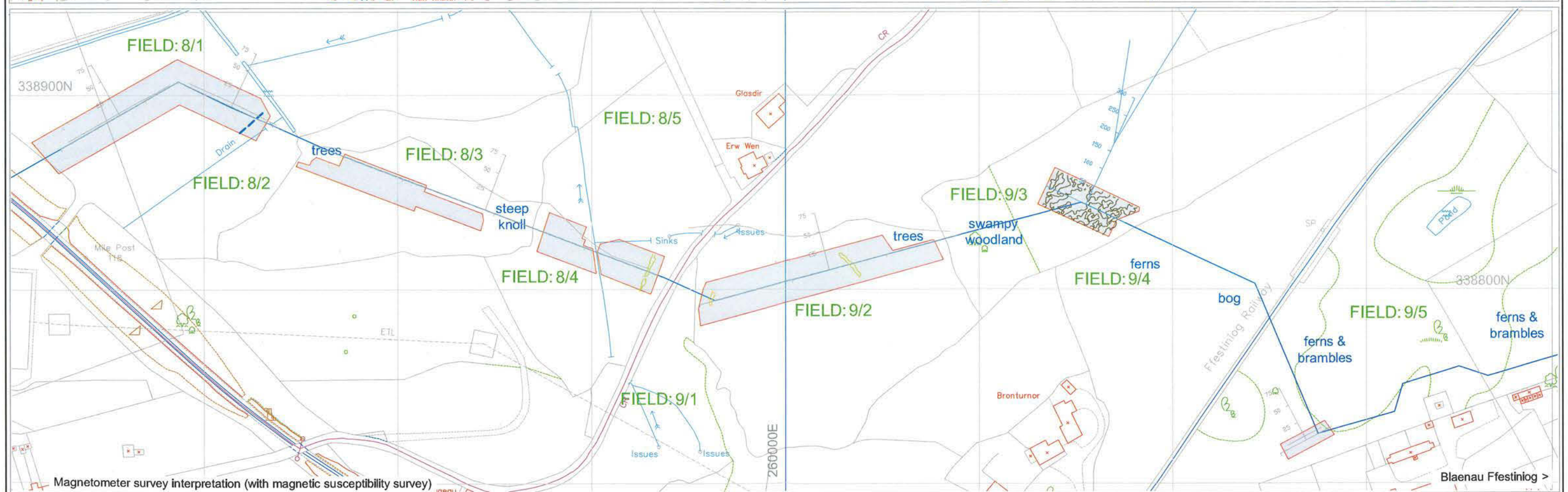
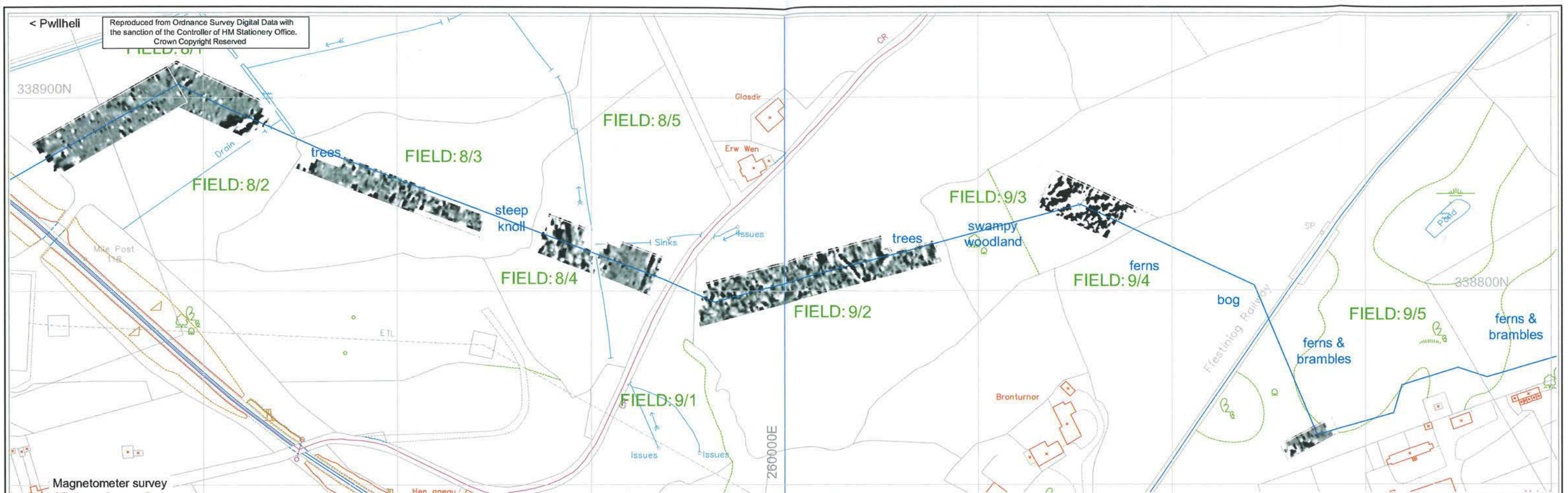
- possibly archaeological (red outline)
- mainly geological (yellow outline)
- probably recent (green outline)
- uncertain / unknown (blue outline)
- cultivation (green wavy line)
- pipe (blue dashed line)
- land drains? (blue solid line)

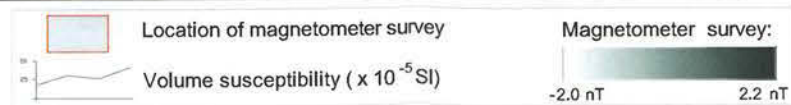
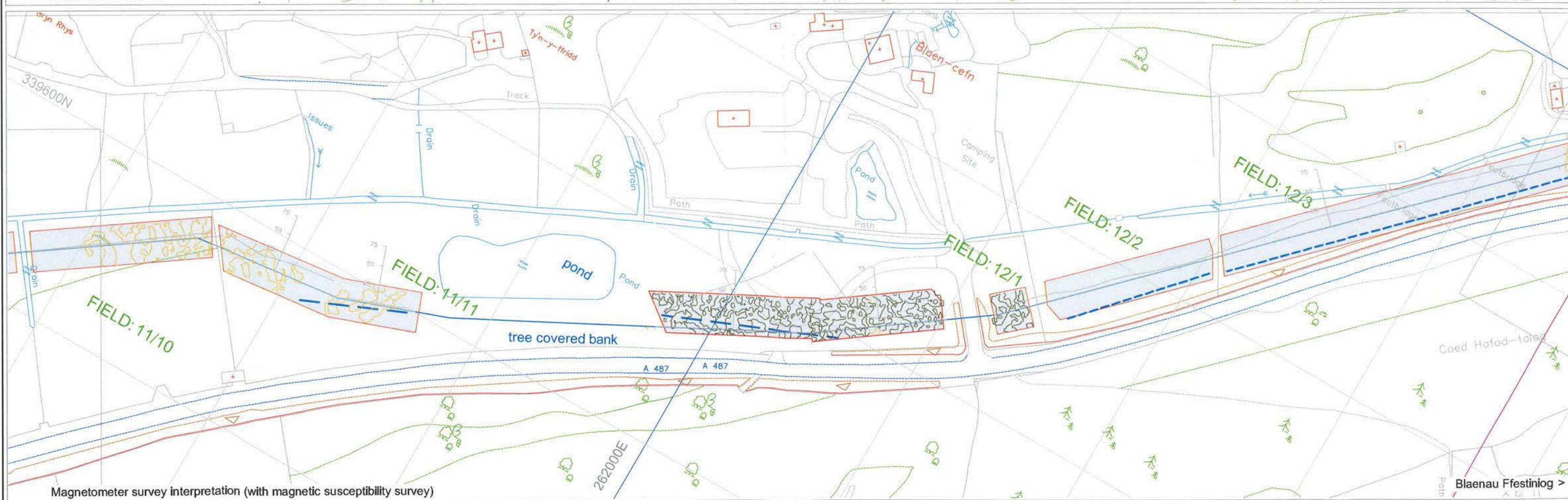
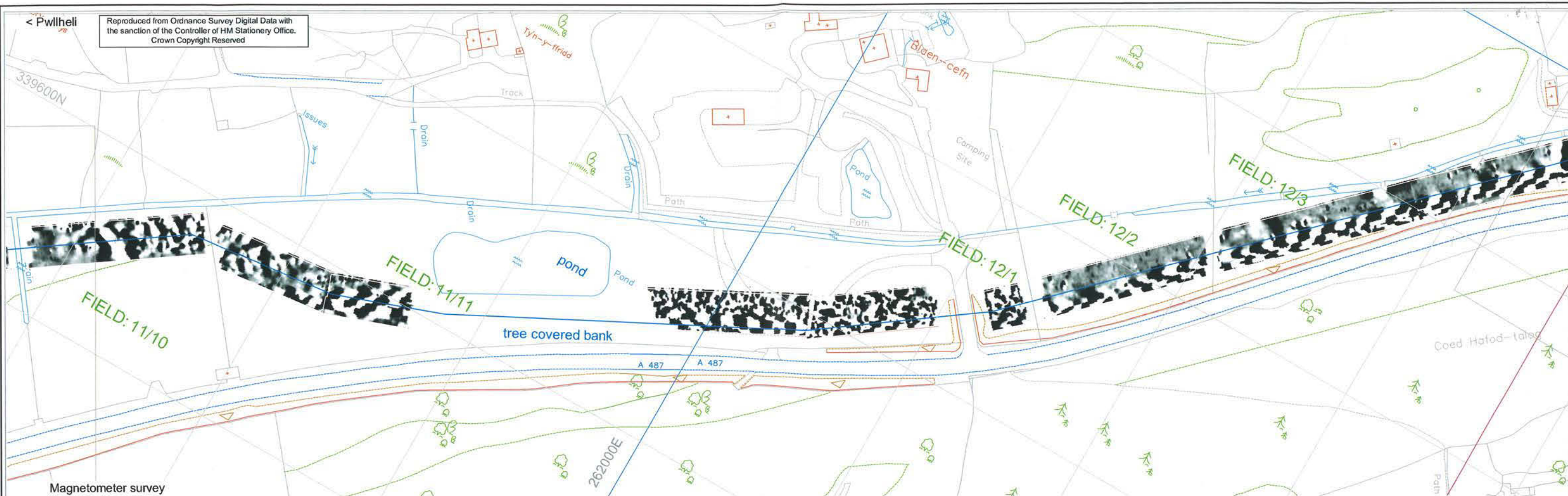
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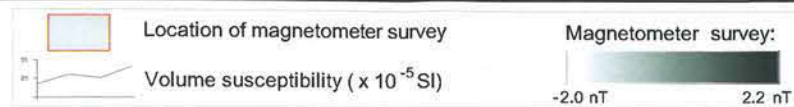
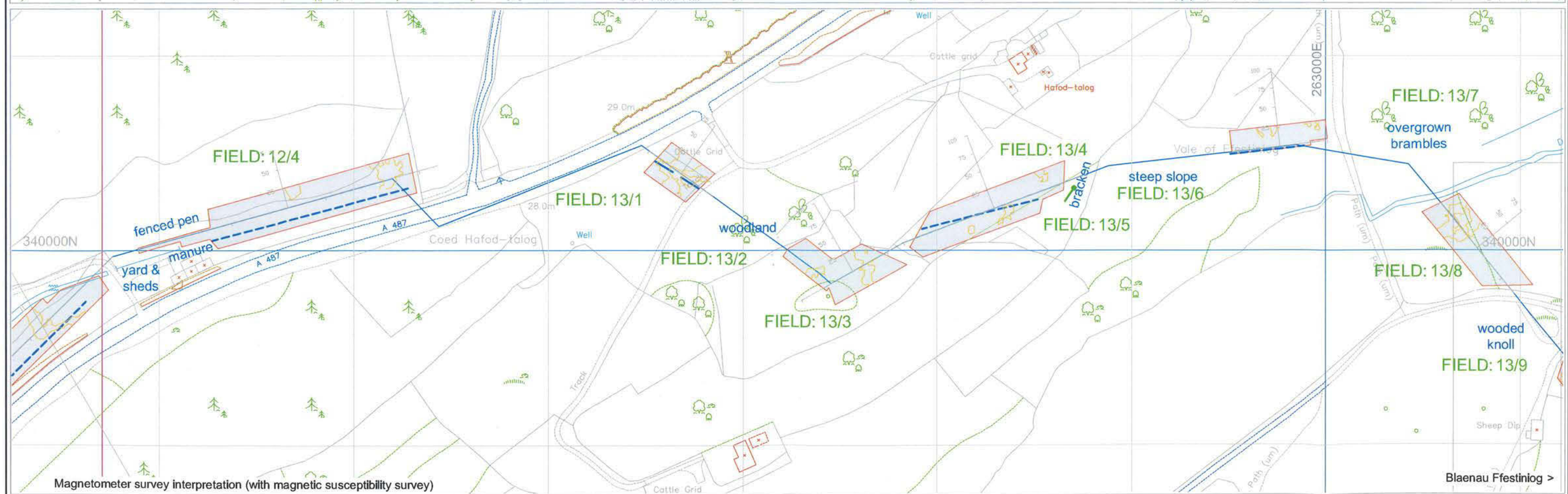
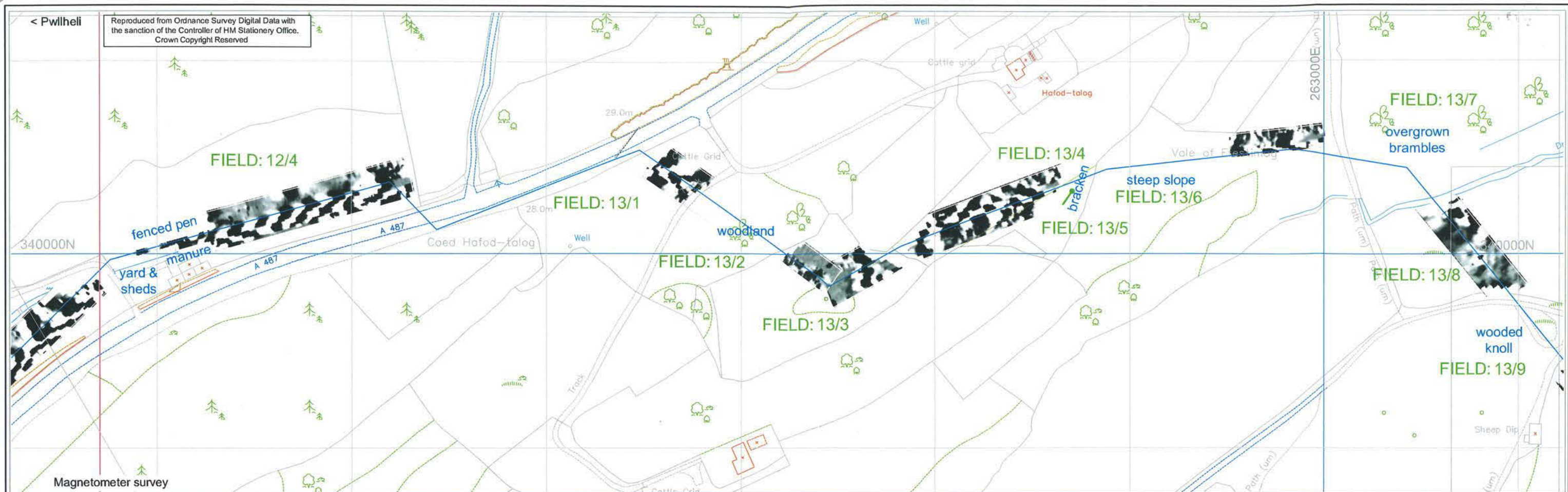
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Figure 25: Magnetometer and Magnetic Susceptibility Surveys with Interpretation





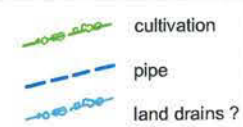
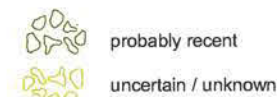
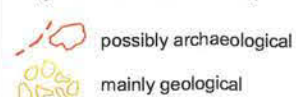




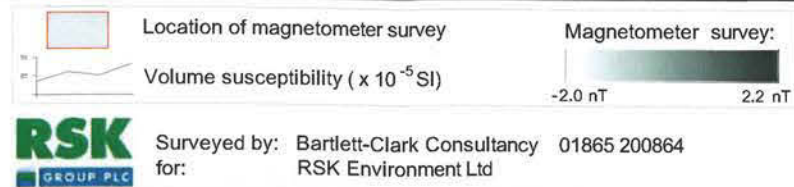
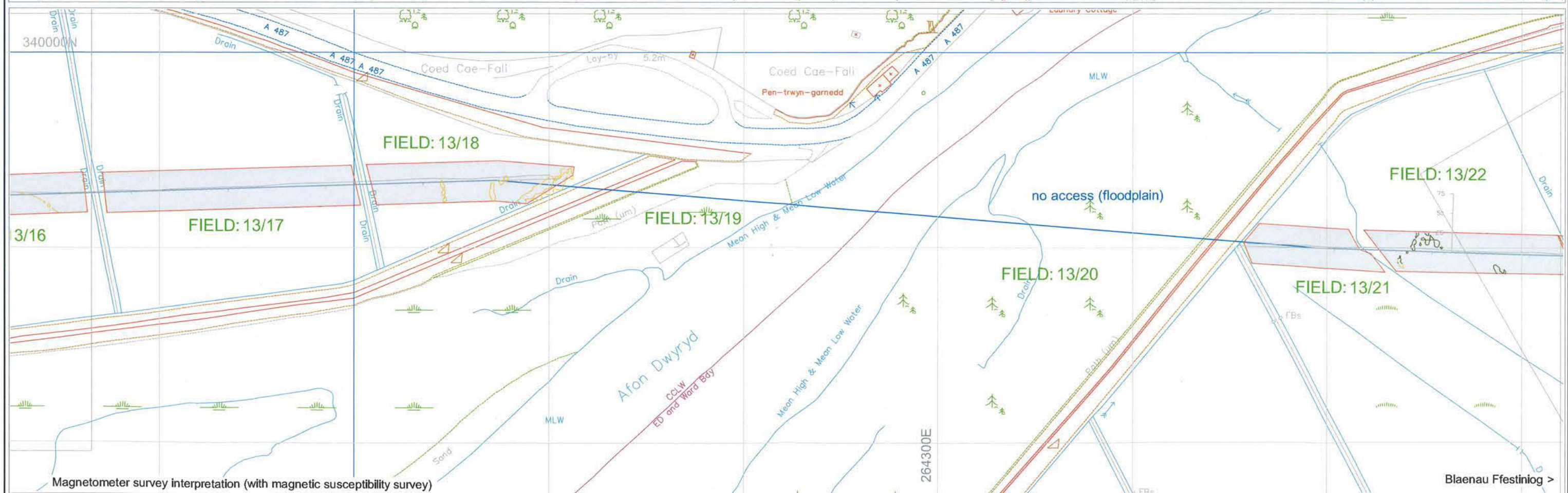
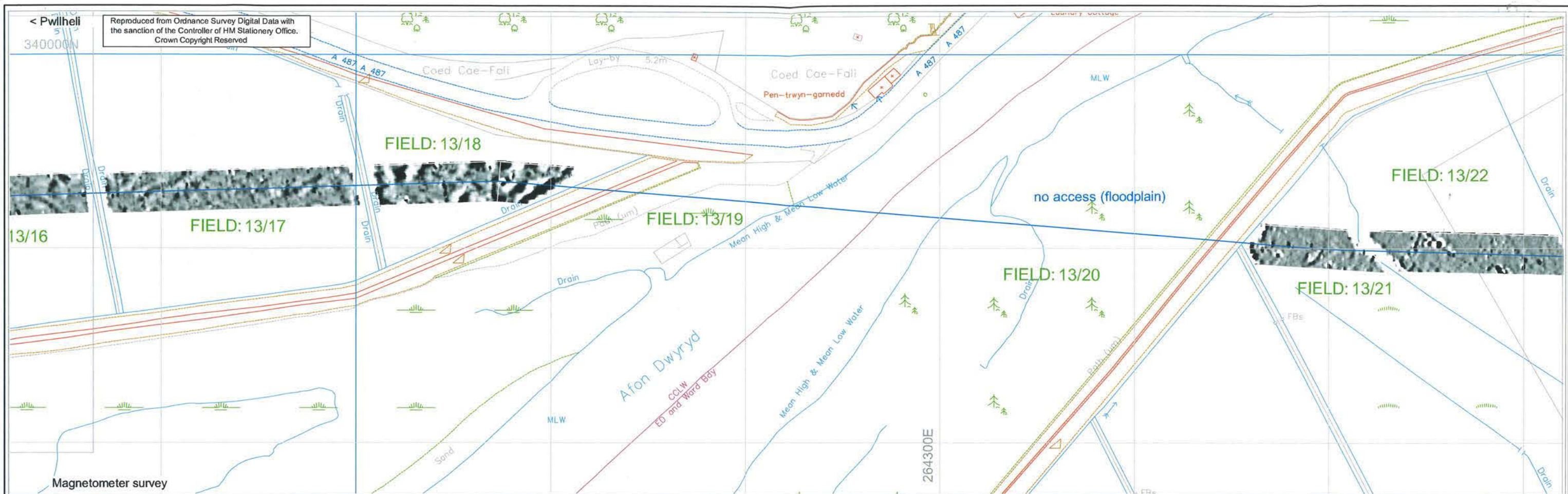
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for: RSK Environment Ltd



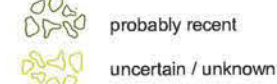
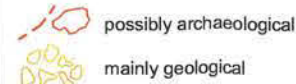
Magnetic anomalies: Interpretation



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Proposed Gas Pipeline
Geophysical Survey 2009
Figure 31: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation



Magnetic anomalies: interpretation

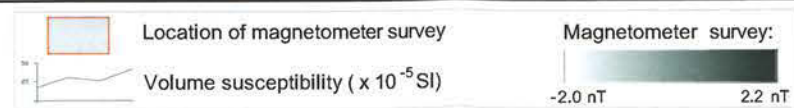
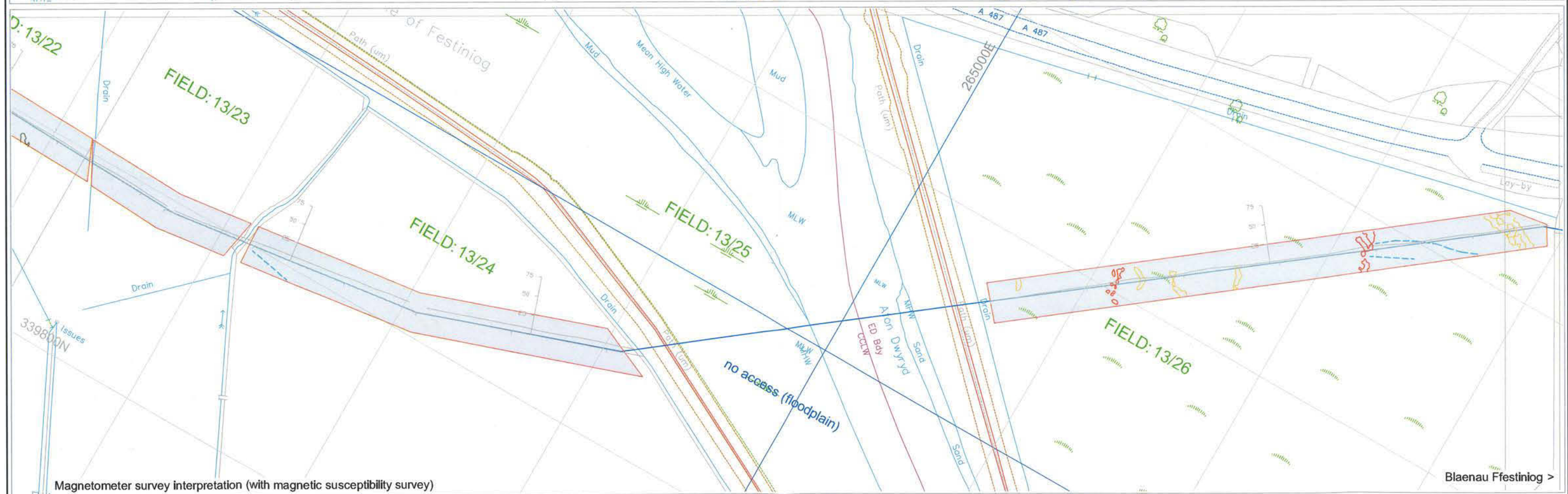
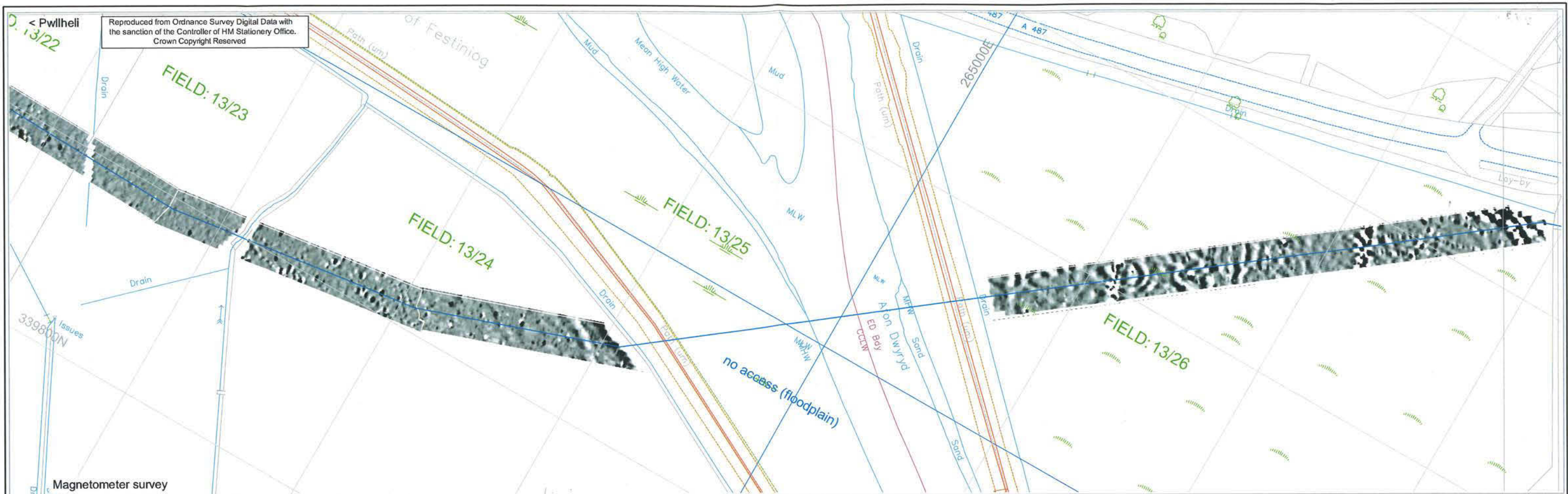


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Figure 33: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



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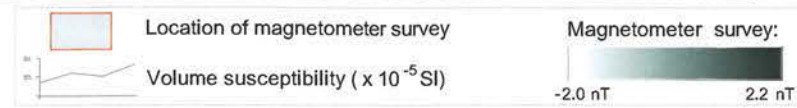
Magnetic anomalies: interpretation



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Figure 34: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation



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for: RSK Environment Ltd



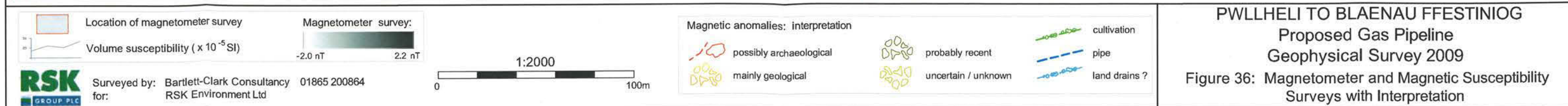
Magnetic anomalies: interpretation

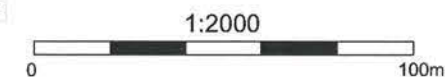
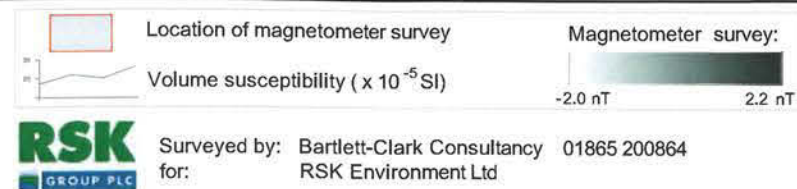
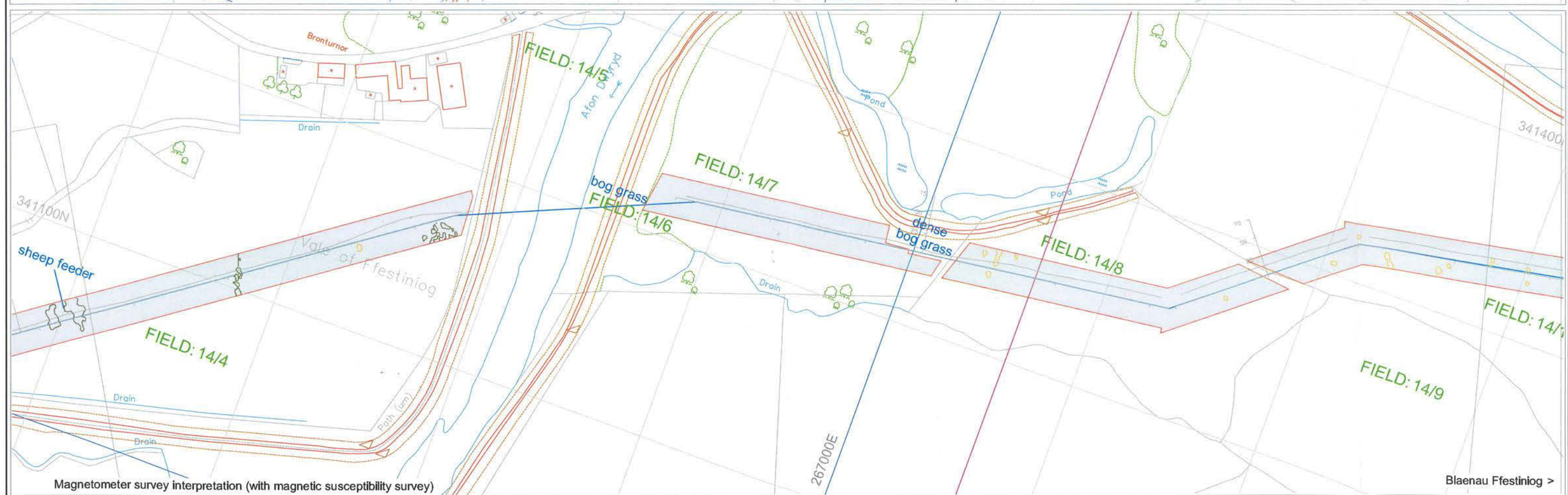
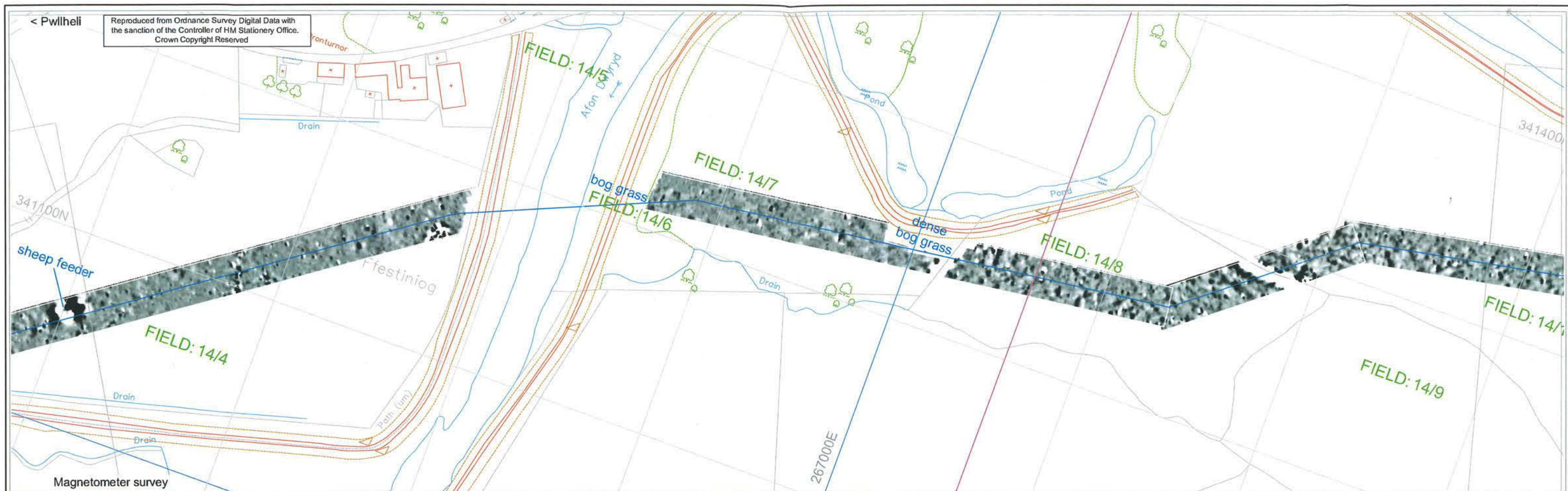


PWLLHELI TO BLAENAU FFESTINIOG

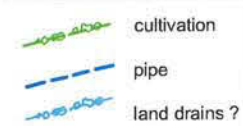
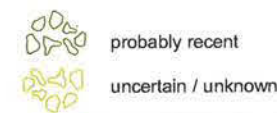
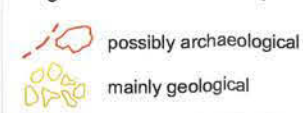
Proposed Gas Pipeline
Geophysical Survey 2009

Figure 35: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation





Magnetic anomalies: interpretation

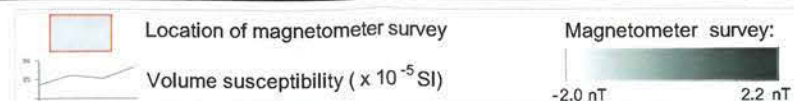
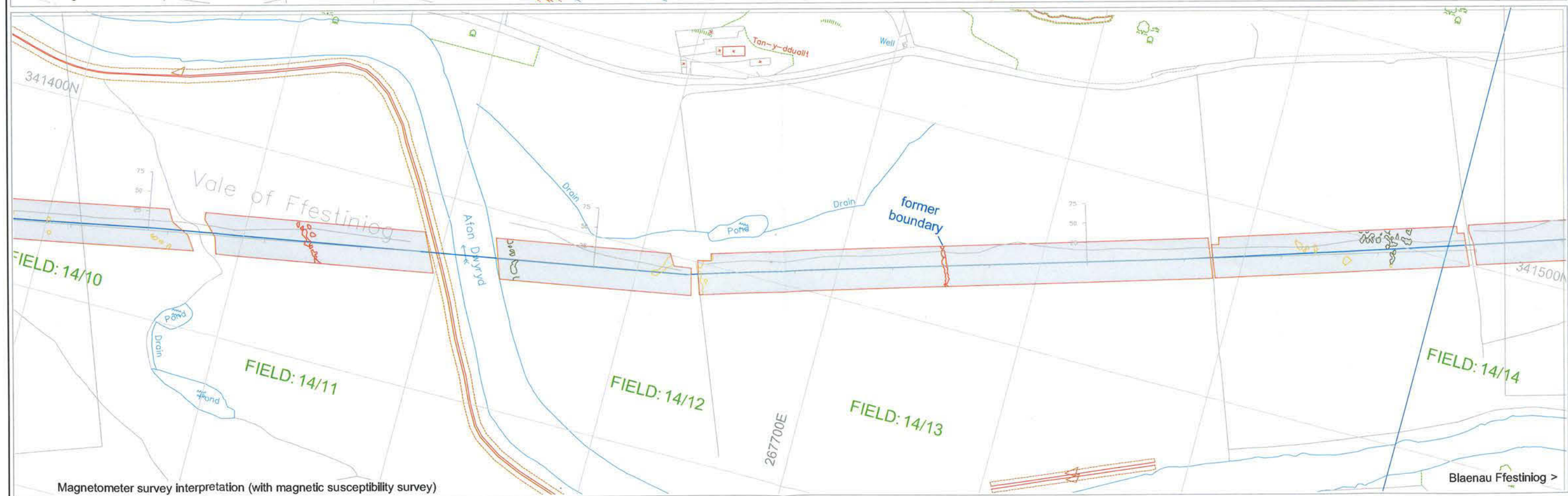
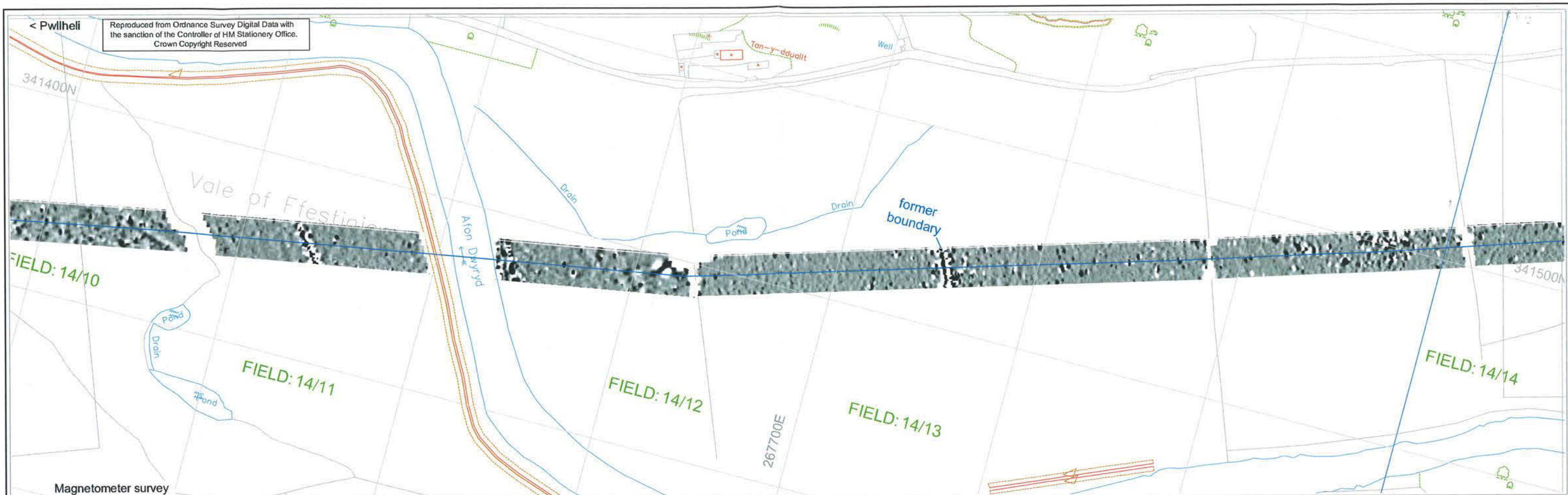


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Proposed Gas Pipeline

Geophysical Survey 2009

Figure 37: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



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for: RSK Environment Ltd



Magnetic anomalies: interpretation

possibly archaeological

mainly geological

probably recent

uncertain / unknown

cultivation

pipe

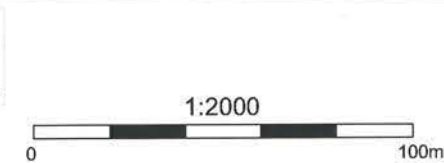
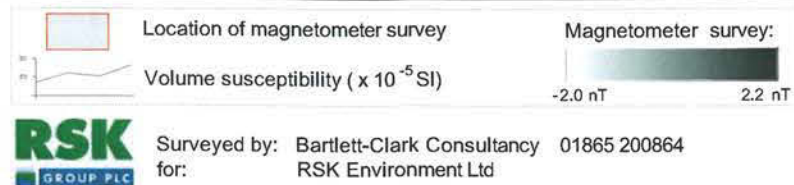
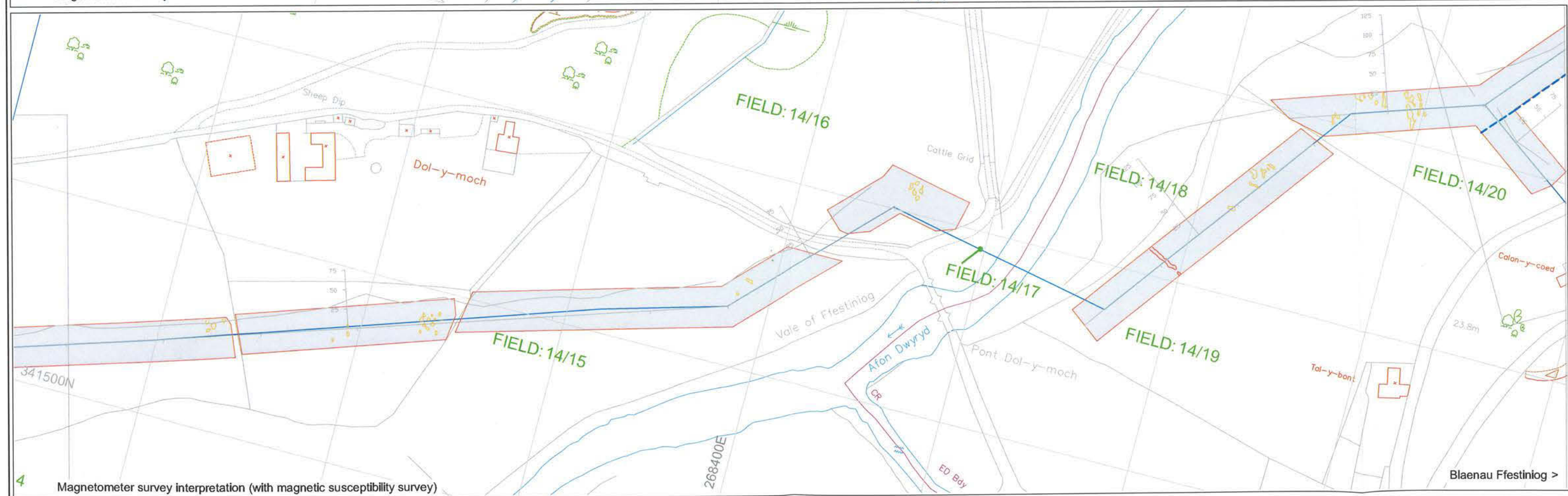
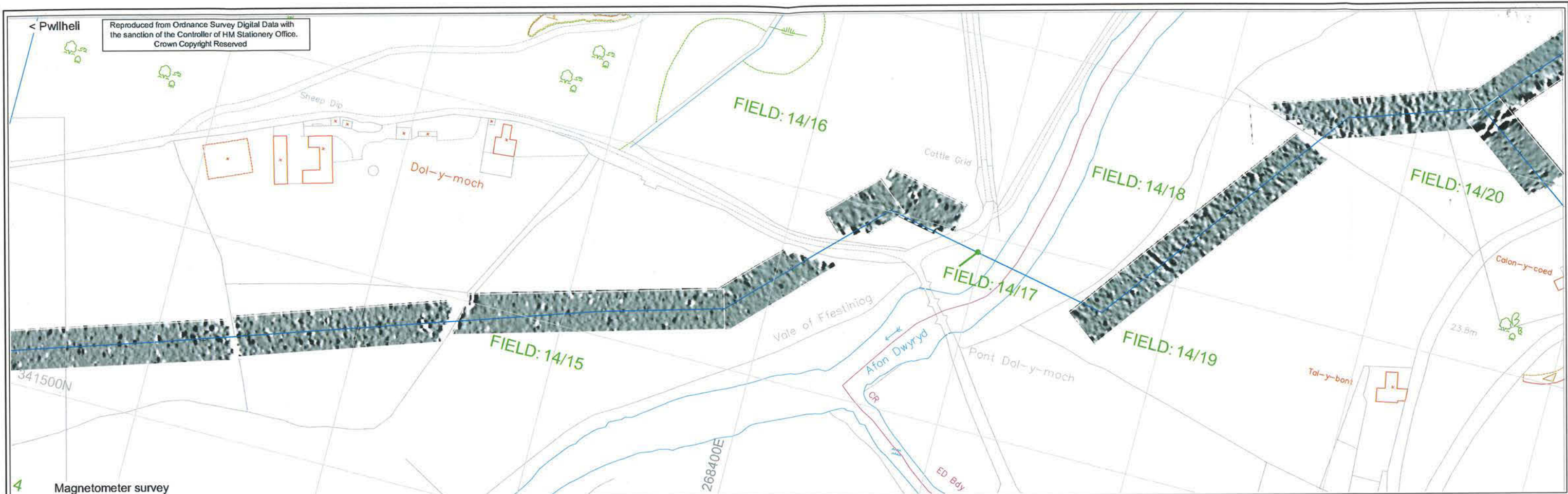
land drains ?

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Proposed Gas Pipeline

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Figure 38: Magnetometer and Magnetic Susceptibility Surveys with Interpretation

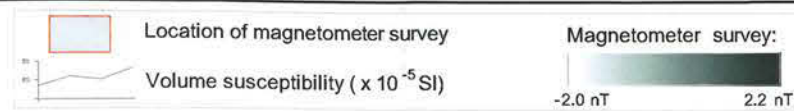
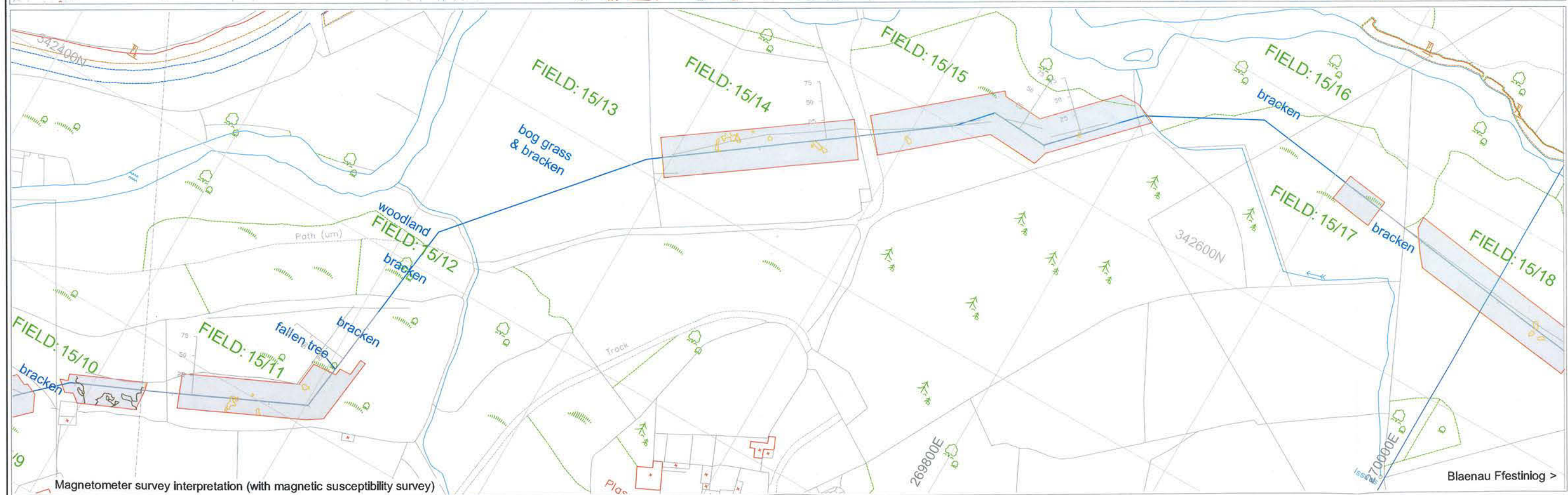


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Figure 39: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



RSK GROUP PLC

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for: RSK Environment Ltd



Magnetic anomalies: interpretation

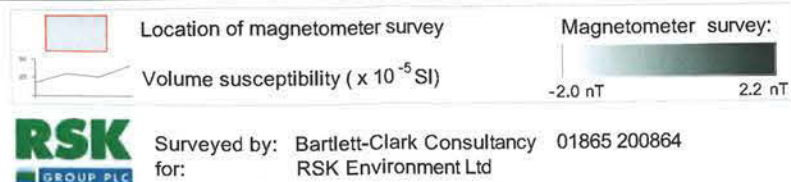
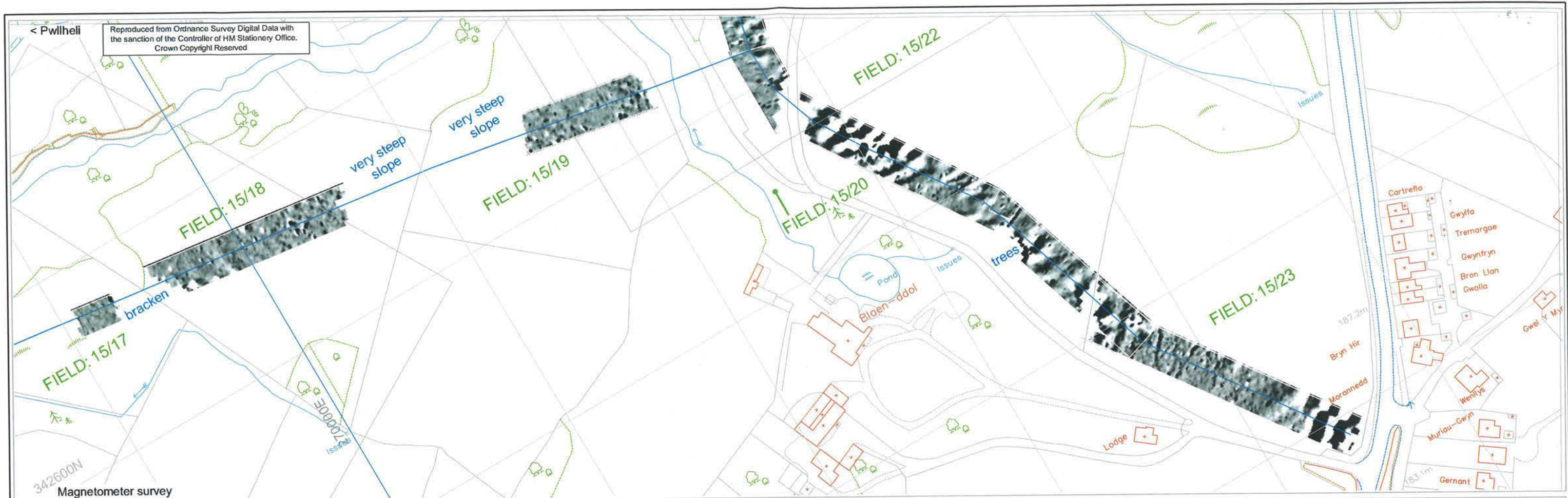


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Geophysical Survey 2009

Figure 41: Magnetometer and Magnetic Susceptibility
Surveys with Interpretation

Blaenau Ffestiniog >



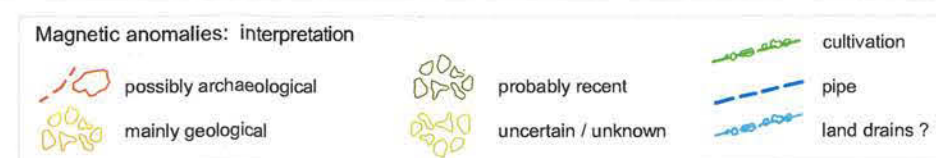
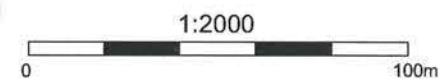
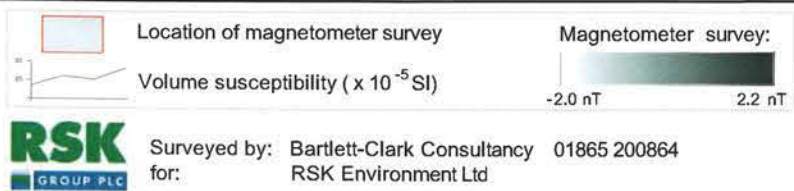
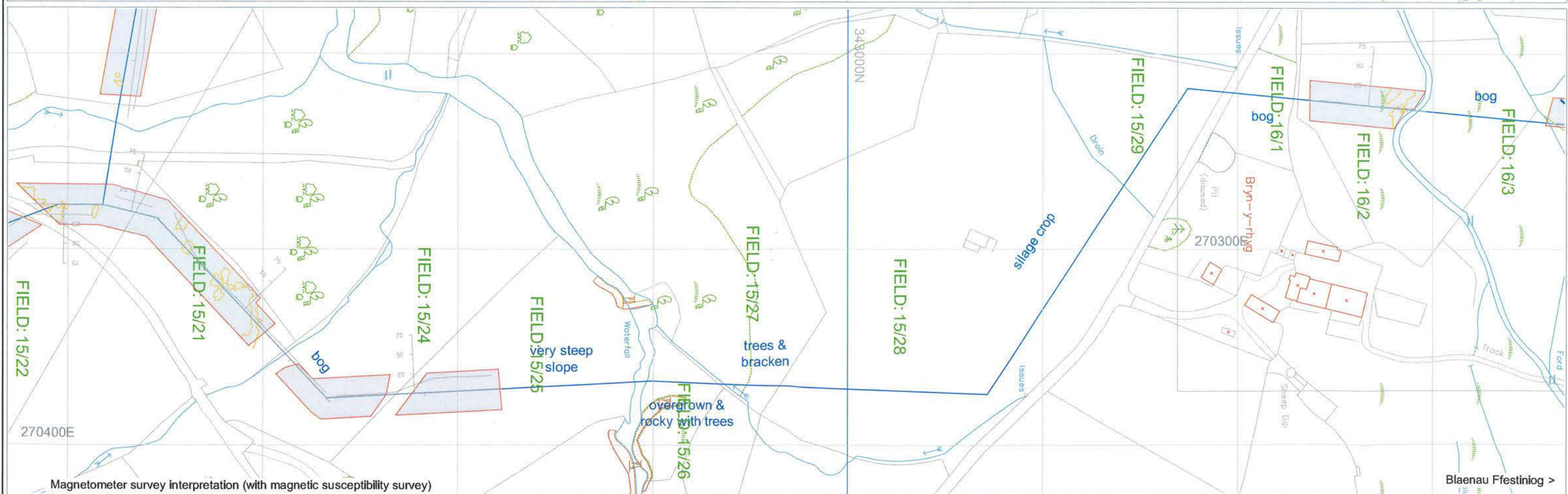
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Proposed Gas Pipeline

Geophysical Survey 2009

Figure 42: Magnetometer and Magnetic Susceptibility Surveys with Interpretation

64

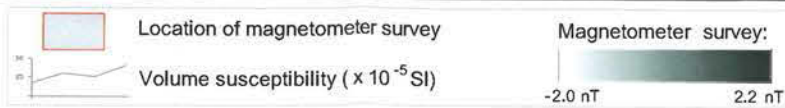
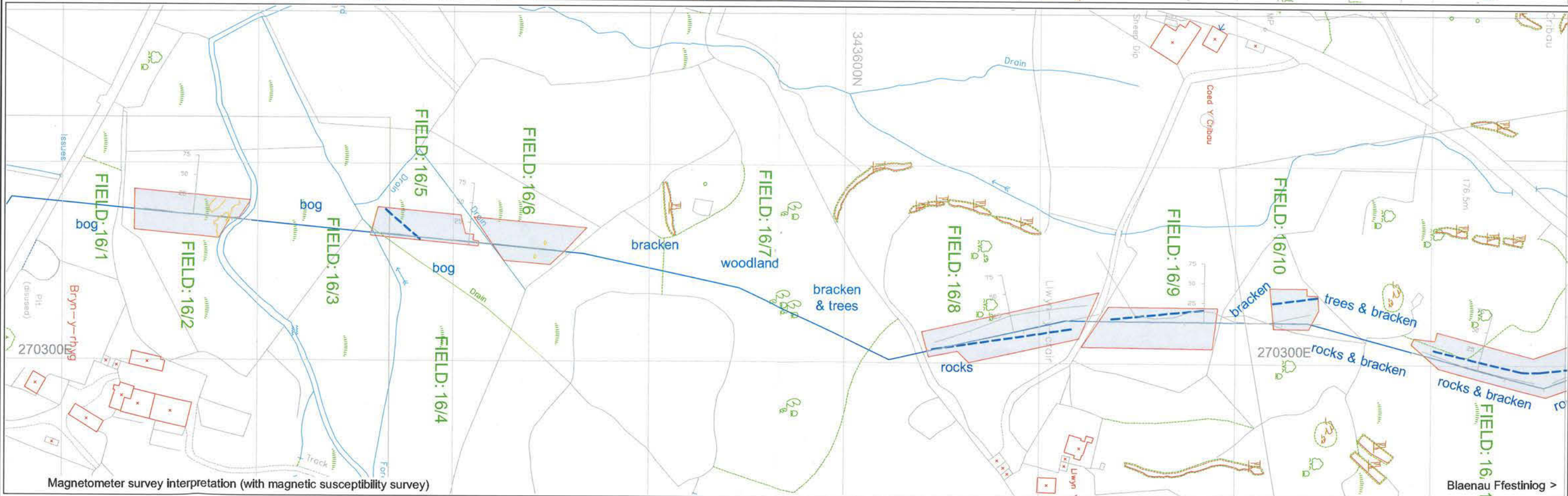
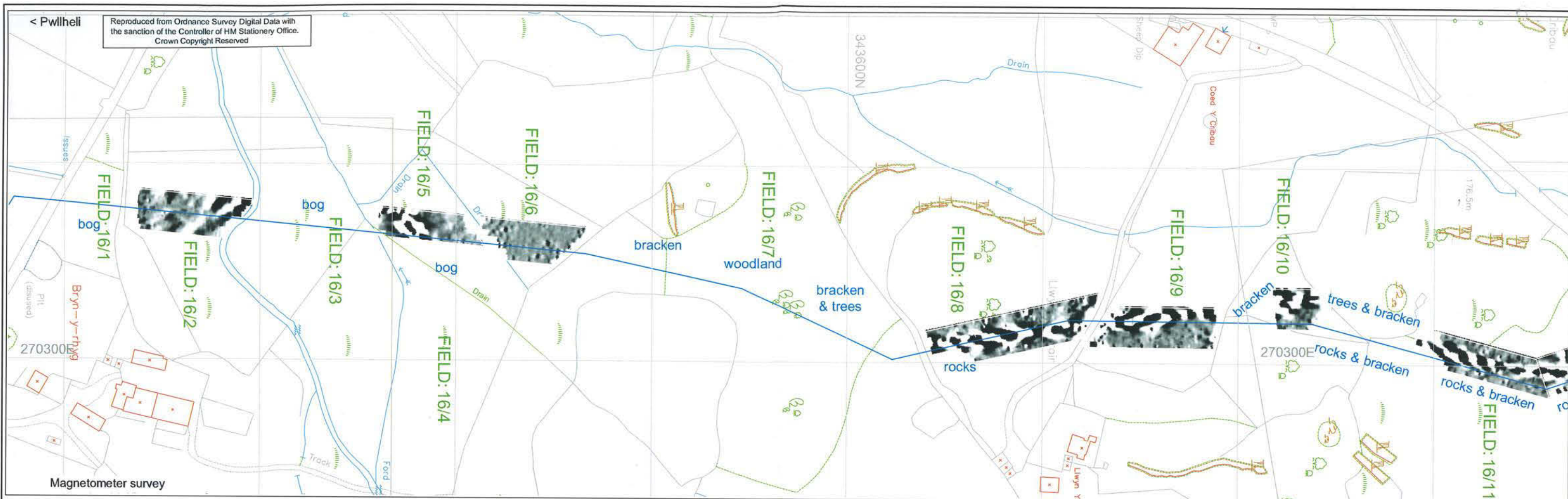


PWLLHELI TO BLAENAU FFEISTINIOG

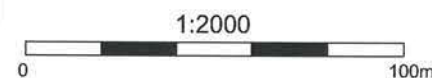
Proposed Gas Pipeline

Geophysical Survey 2009

Figure 43: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



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 Surveyed by: Bartlett-Clark Consultancy 01865 200864
 for: RSK Environment Ltd



Magnetic anomalies: interpretation

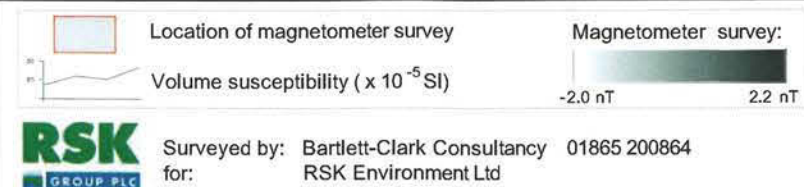
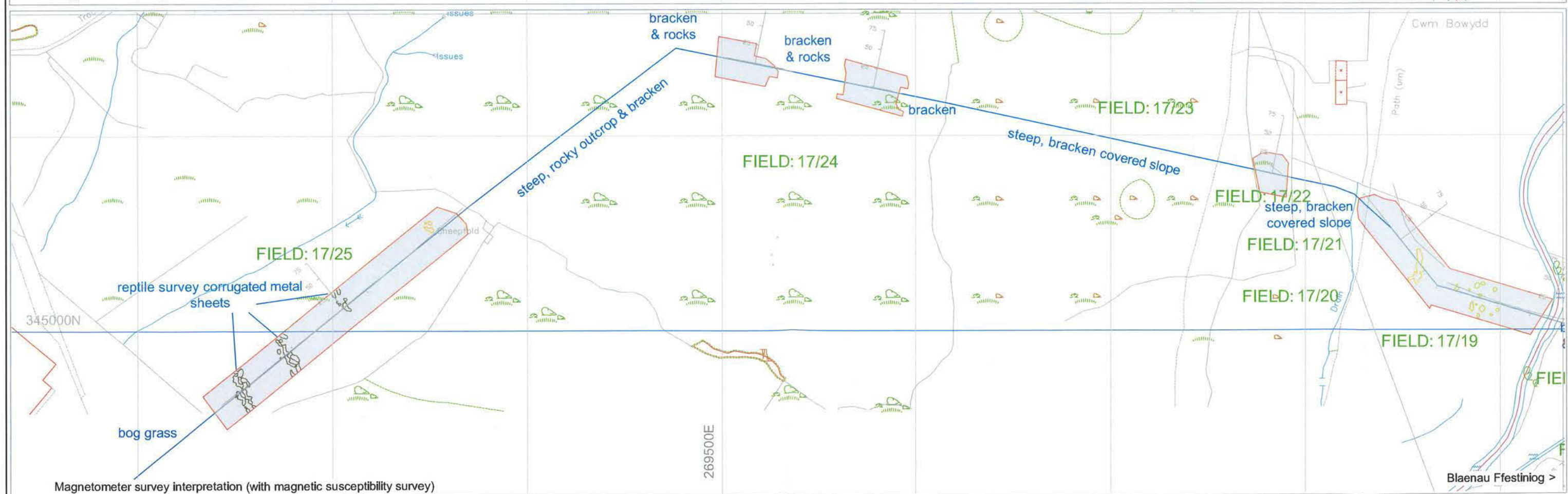
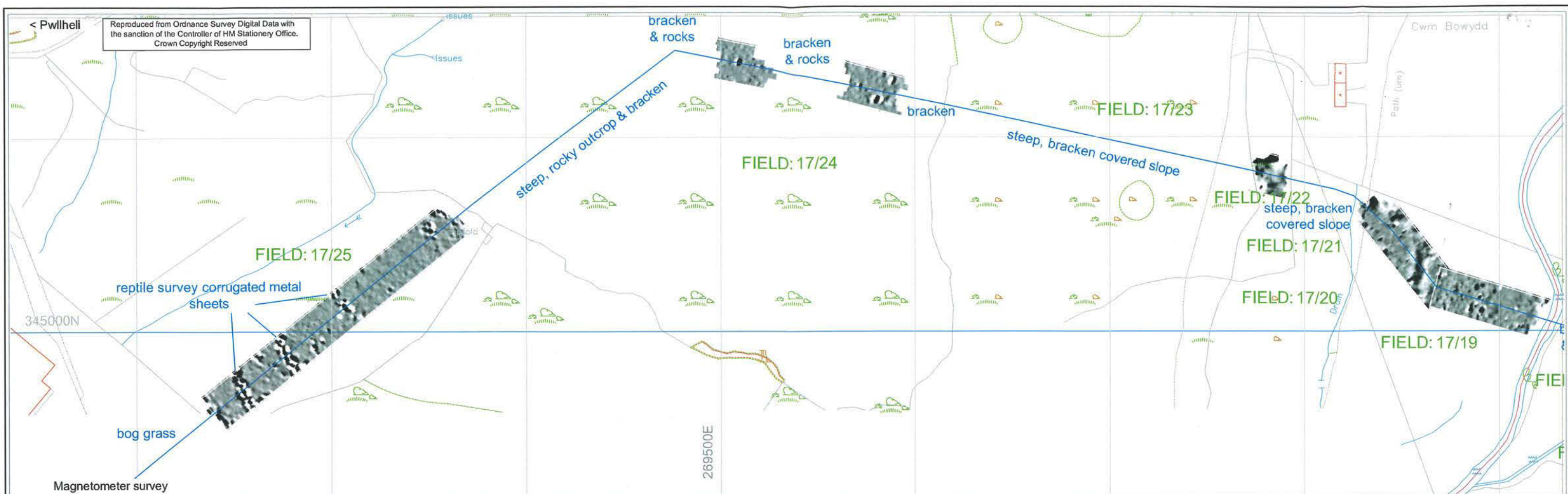
- possibly archaeological
- mainly geological
- probably recent
- uncertain / unknown
- cultivation
- pipe
- land drains ?

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Proposed Gas Pipeline
 Geophysical Survey 2009

Figure 44: Magnetometer and Magnetic Susceptibility Surveys with Interpretation

Blaenau Ffestiniog >



Magnetic anomalies: interpretation

possibly archaeological

mainly geological

probably recent

uncertain / unknown

cultivation

pipe

land drains ?

PWLLHELI TO BLAENAU FFESTINIOG

Proposed Gas Pipeline

Geophysical Survey 2009

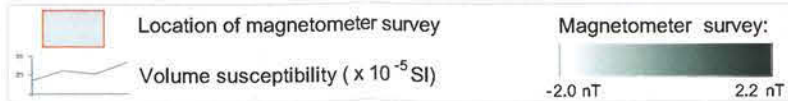
Figure 47: Magnetometer and Magnetic Susceptibility Surveys with Interpretation



Magnetometer survey



Magnetometer survey interpretation (with magnetic susceptibility survey)



Magnetic anomalies: interpretation



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Figure 48: Magnetometer and Magnetic Susceptibility Surveys with Interpretation

← Pwllheli

60 nT (unless otherwise stated)

Cereal crop fields

0/1

0/2

0/3

0/4

40 nT

40 nT

40 nT

0/8

0/8

0/9

0/10

80 nT

80 nT

1/1

1/2

1/2

2/1

2/3

2/3

0/11

Hay crop fields

3/11

3/2

3/3

3/6

3/6

3/6

3/5

80 nT

3/10

3/10

3/9

3/12

50 nT

3/14

3/14

3/14

Blaenau Ffestiniog →

25/2 Field numbers (rdx/field)

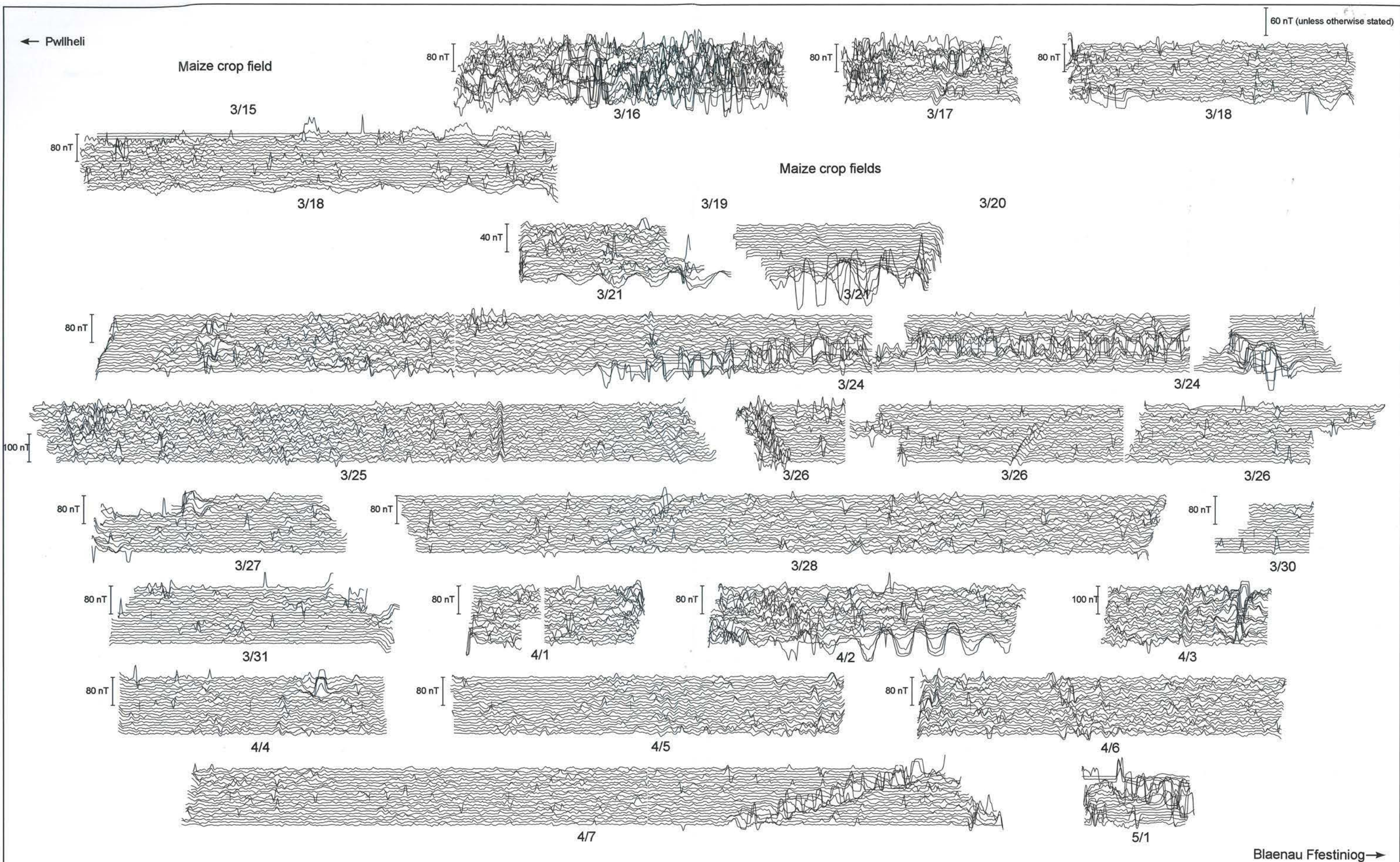
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0 60m



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PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009
Magnetometer Survey Data Archive: Figure A1



25/2 Field numbers (rdx/field)



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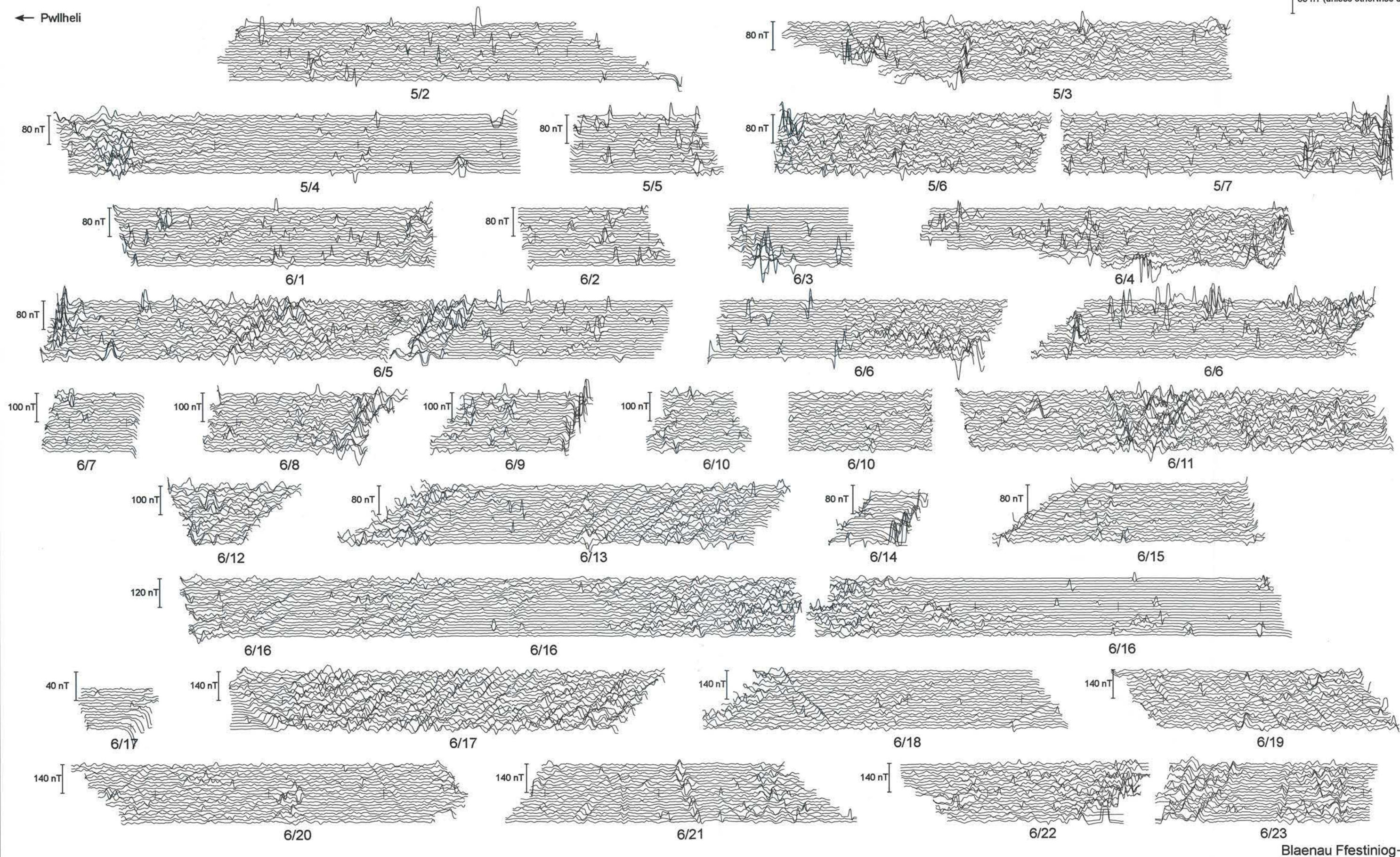
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PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009

Magnetometer Survey Data Archive: Figure A2

← Pwllheli

60 nT (unless otherwise stated)



25/2 Field numbers (rdx/field)

1:1250

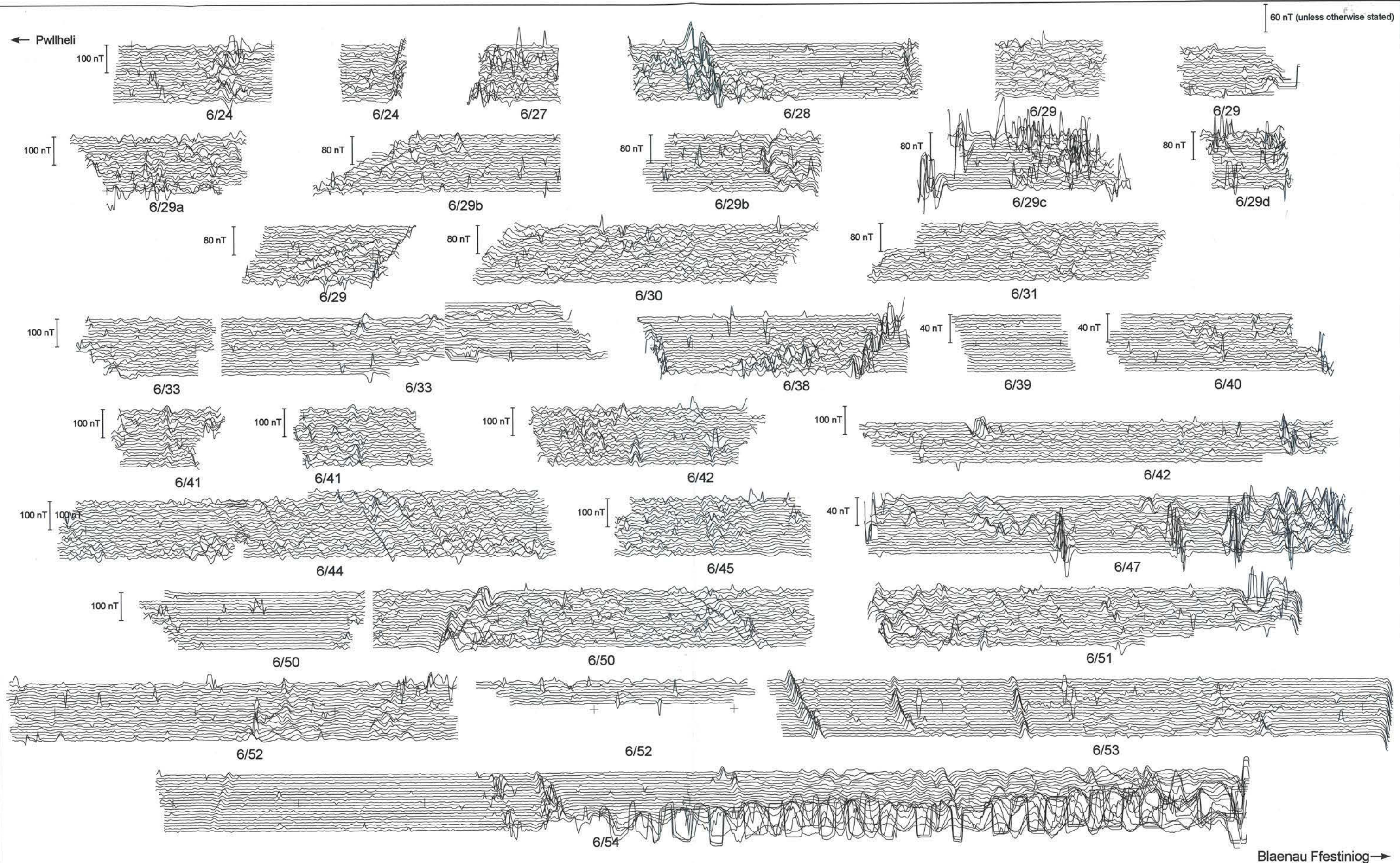
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PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009

Magnetometer Survey Data Archive: Figure A



25/2 Field numbers (rdx/field)



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1:1250

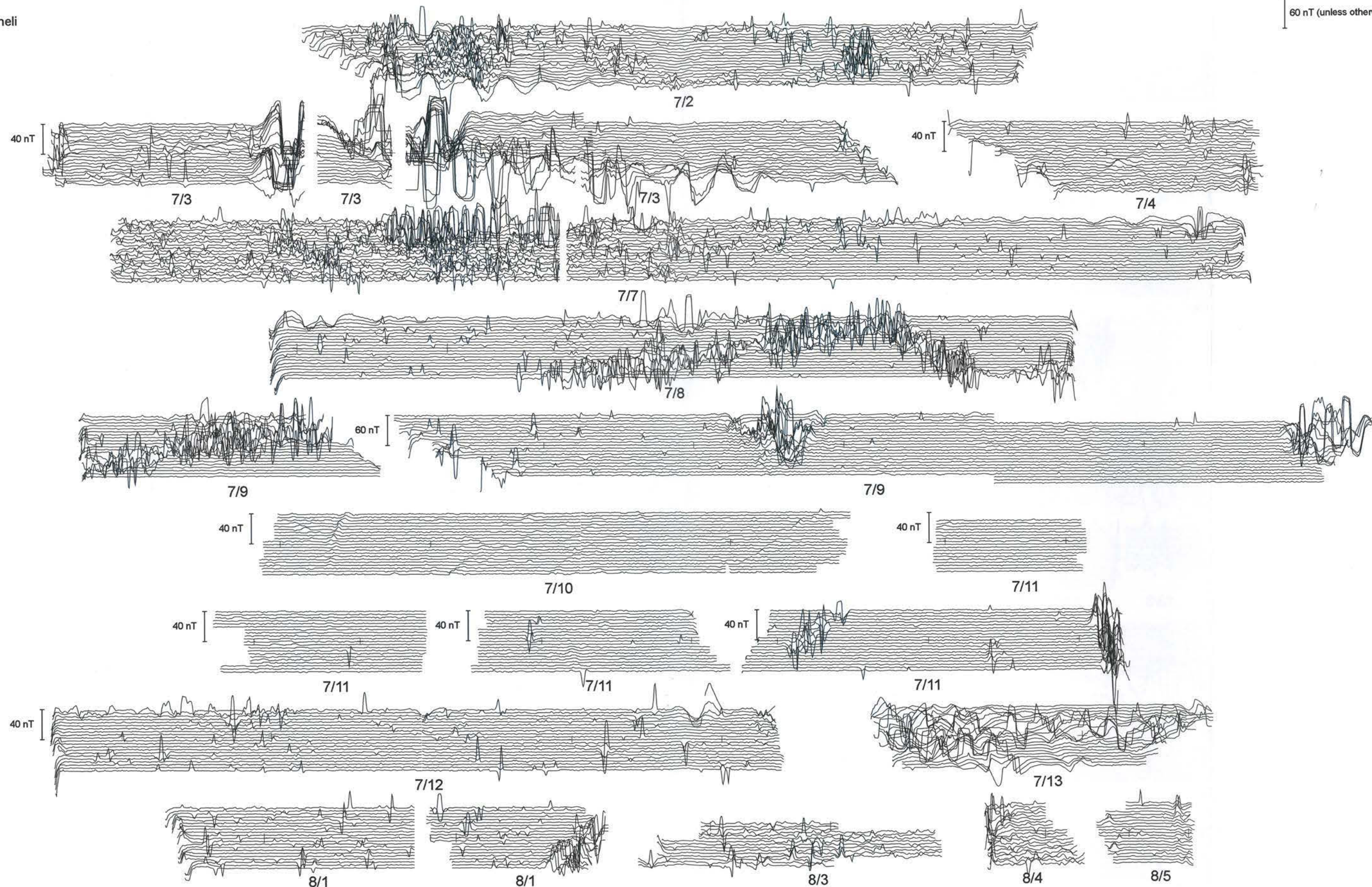
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PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009

Magnetometer Survey Data Archive: Figure A4

← Pwllheli

60 nT (unless otherwise stated)



Blaenau Festiniog →

25/2 Field numbers (rdx/field)

1:1250



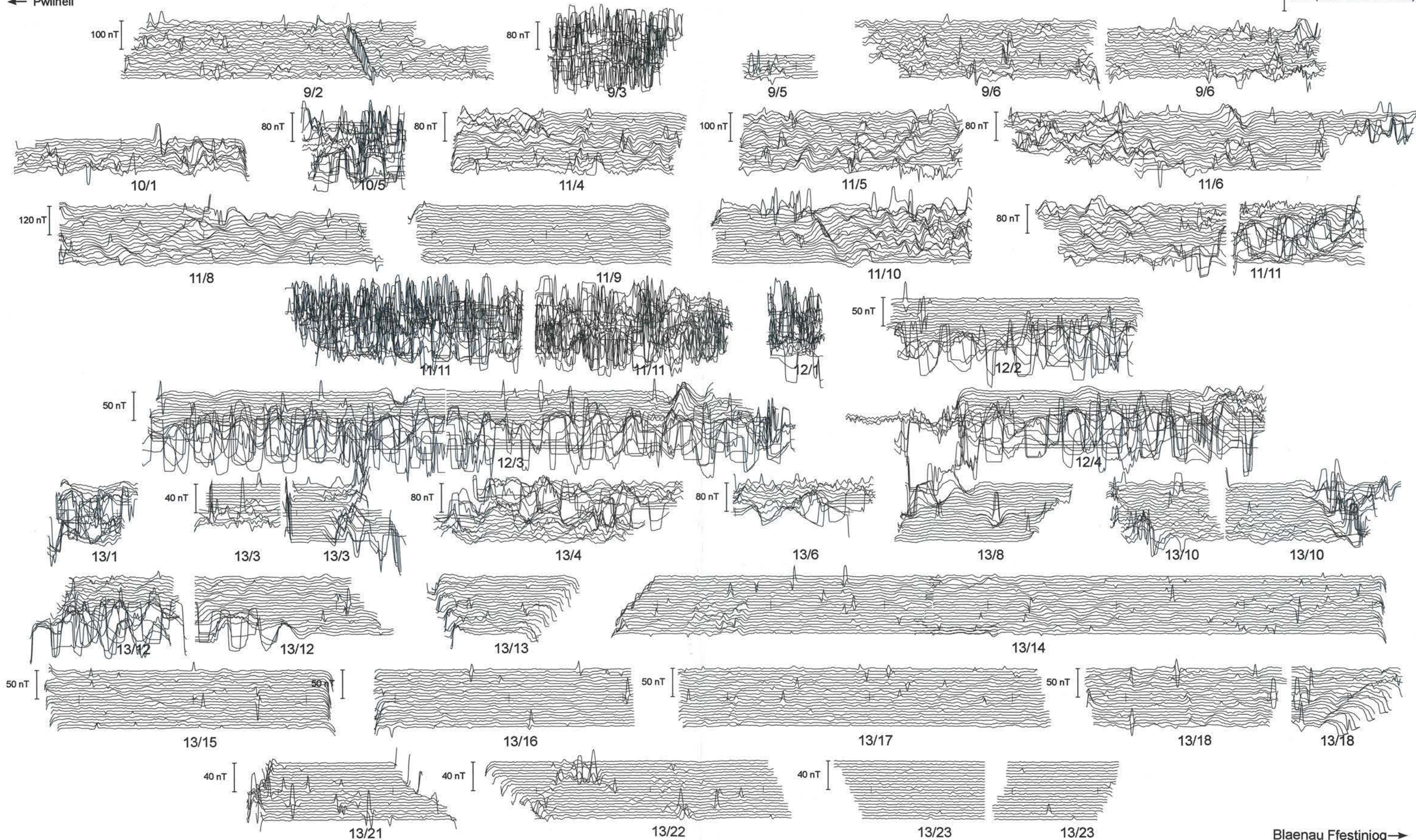
Surveyed by: Bartlett-Clark Consultancy (01865 200864)
for: RSK Environment Ltd.

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Proposed Gas Pipeline
Geophysical Survey 2009

Magnetometer Survey Data Archive: Figure A5

← Pwllheli

60 nT (unless otherwise stated)



Blaenau Ffestiniog →

25/2 Field numbers (rdx/field)

1:1250



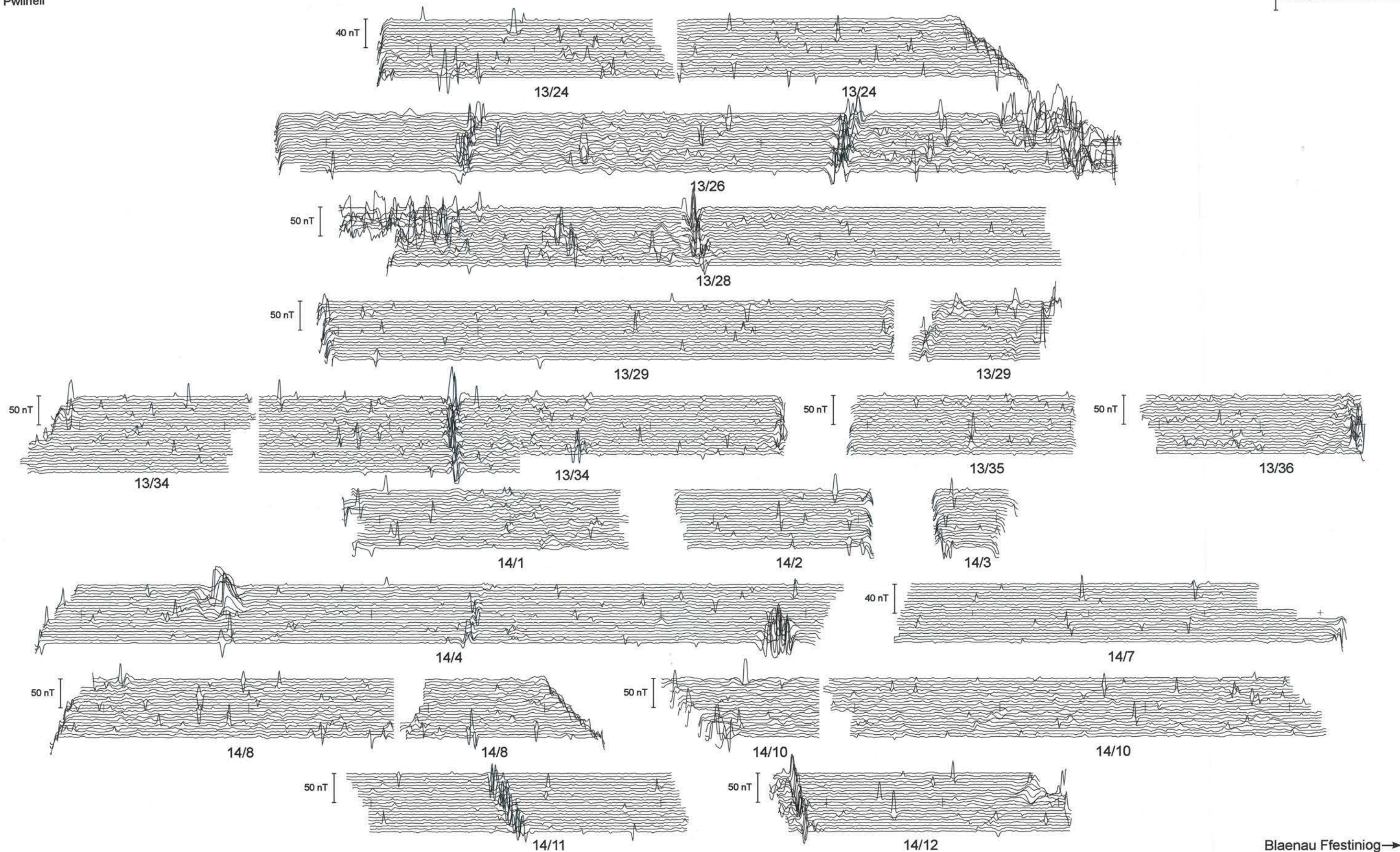
Surveyed by: Bartlett-Clark Consultancy (01865 200864)
for: RSK Environment Ltd.

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Proposed Gas Pipeline
Geophysical Survey 2009

Magnetometer Survey Data Archive: Figure A6

← Pwllheli

60 nT (unless otherwise stated)



Blaenau Ffestiniog →

25/2 Field numbers (rdx/field)

1:1250

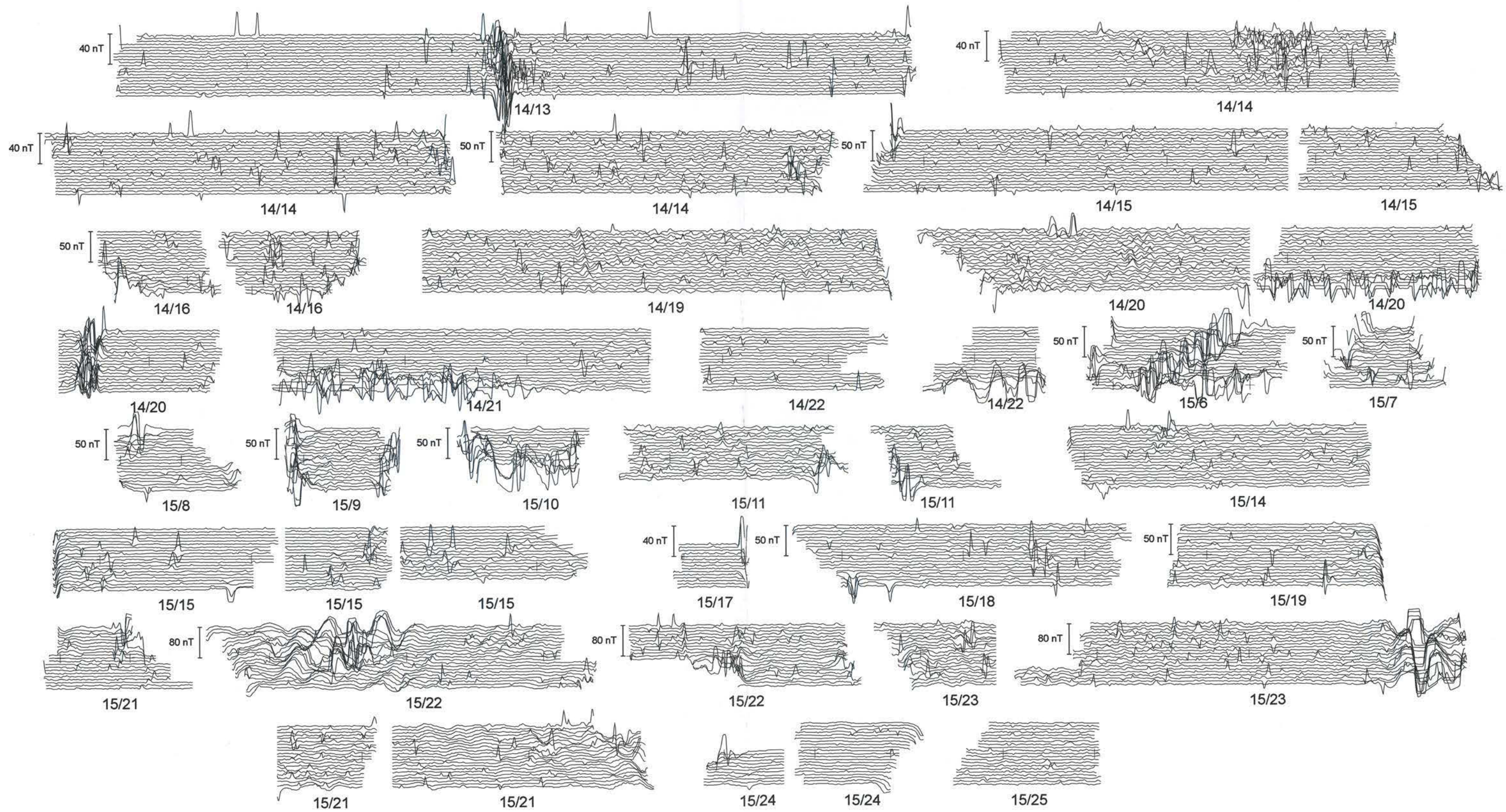


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PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009
Magnetometer Survey Data Archive: Figure A

← Pwllheli

60 nT (unless otherwise stated)



Blaenau Ffestiniog →

25/2 Field numbers (rdx/field)

1:1250

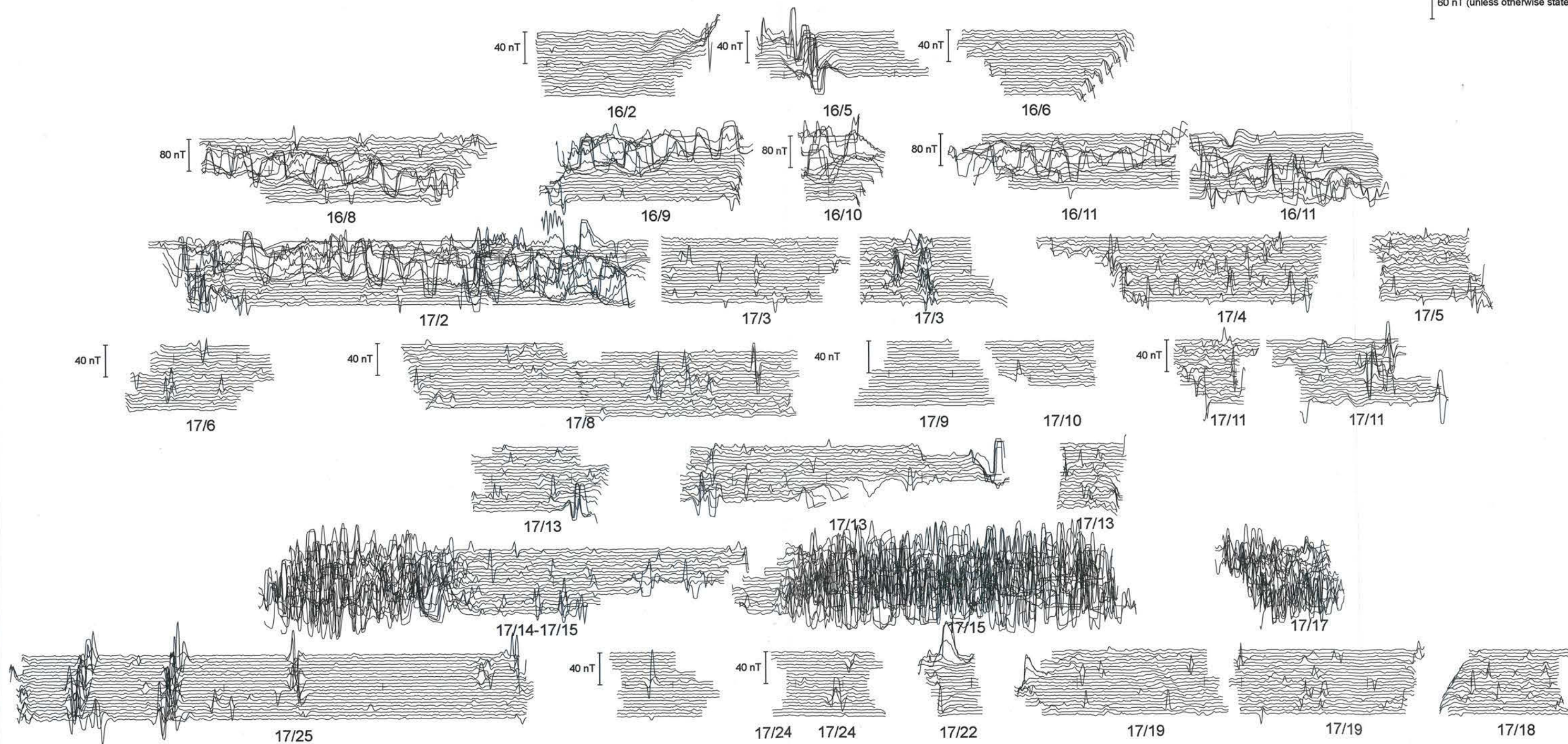


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PWLLHELI TO BLAENAU FFESTINIOG
Proposed Gas Pipeline
Geophysical Survey 2009
Magnetometer Survey Data Archive: Figure A8

← Pwllheli

60 nT (unless otherwise stated)



Blaenau Ffestiniog →

25/2 Field numbers (rdx/field)

1:1250

0 60m



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Magnetometer Survey Data Archive: Figure A9

