GWYNEDD COUNTY COUNCIL

YSGOL BABANOD COED MAWR, BRON Y DRE, BANGOR, LL57 4TL

GEOTECHNICAL, GROUND PERMEABILITY AND CONTAMINATION INVESTIGATION REPORT

REPORT No. E1321.GGCI.R1

FEBRUARY 2021

Client :	**GWYNEDD COUNTY COUNCIL**
Project Title :	**YSGOL BABANOD COED MAWR, BRON Y DRE, BANGOR, LL57 4TL**
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e–geo Solutions Ltd
Glasgow House
High Street
St.Asaph
LL17 0RD
Tel 01745 828494

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Prepared by:	Huw Littler-Jones		
Checked by:	J.O.L.J		
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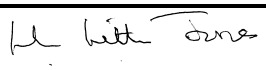
Signed:			

1. INTRODUCTION.

1.1 Background and Terms of Reference

1.1.1 In December 2020 e-geo Solutions Ltd were commissioned by Gwynedd County Council to undertake a combined geotechnical, ground permeability and ground contamination investigation at a former school site known as Ysgol Babanod Coed Mawr, Bron Y De, in Bangor. The objective of the investigation was to determine the ground conditions at the site, the ground permeability and the geotechnical properties of the ground strata, and to assess the site with respect to potential contamination.

1.1.2 This report presents the findings of intrusive investigations with in-situ geotechnical tests, permeability tests and the chemical analysis of soil samples.

1.1.3 The site is presently a disused school building surrounded by a tarmac surfaced yards, and grass covered playing areas. It is proposed to redevelop the site with residential properties and the findings of the intrusive investigation have been assessed against this proposed end use.

1.1.4 The report has been prepared by e-geo Solutions Ltd for the sole use of the Client, for the purposes described and no extended duty of care applies to other parties. Any other party using this report for any purpose whatsoever do so at their own risk and any duty care to that party is specifically excluded.

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1.2 Report Contents

1.2.1 The report includes sections on:-

- Present site description, profile and setting.
- The scope of the investigation, testing and analysis and its justification.
- The geological and hydro-geological conditions encountered in shallow boreholes and trial pits.
- The results of in-situ geotechnical tests in the boreholes
- The results of ground permeability tests
- Chemical analysis results and an assessment of contamination
- Comments on foundation design and development considerations

2. SITE LOCATION, DESCRIPTION AND PROFILE.

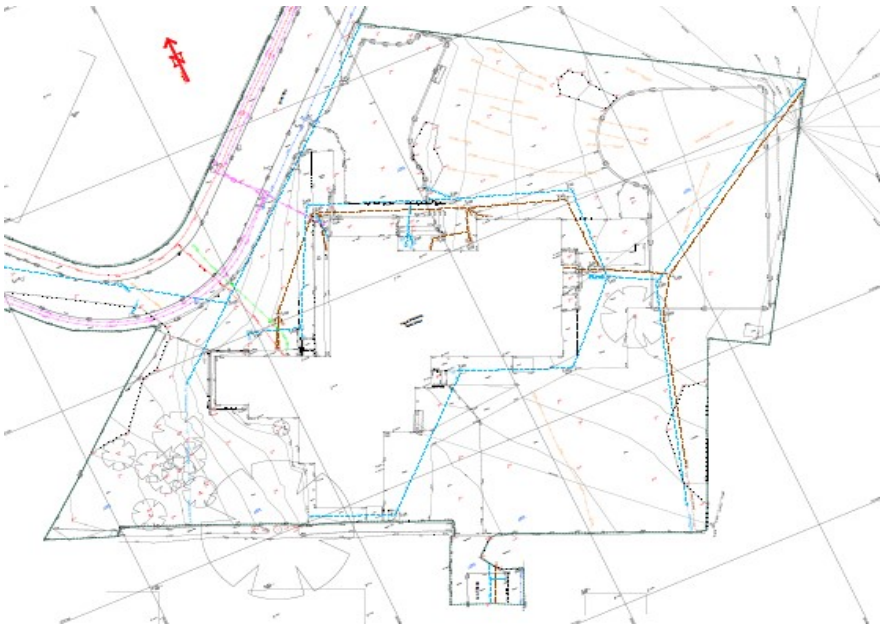
2.1 Site Location

2.1.1 The site is located to the south west of Bangor, just off Ffordd Coed Mawr, on a housing estate called Bron Y De as shown on Figure 1. It is centred at Grid Reference SH 56646 70770.

Figure 1 – Site Location

2.1.2 The extent of the site and the study area boundaries is shown on Figure 2.

Figure 2 – Site Extent



2.2 Site Description and Topography

2.2.1 The area for investigation (site) presently comprises a former school building surrounded on all sides by either a tarmac surfaced school yard/playing area or grass playing areas. The site has a slight gradient from the north west to the south east and is at a similar elevation to the surrounding ground. The only structure on the site is the single storey school building which occupies around half of the site. An aerial photograph of the site area is shown as Figure 3.

Figure 3 -Aerial Photograph

2.3 Site Profile

2.3.1 A desk-based study of the site has been undertaken. Full details of the site history with historical Ordnance Survey maps are presented in Appendix 1. Details of the geological and environmental setting are presented in Appendix 2. A summary of the findings and site profile are presented below:

Profile Item	YSGOL BABANOD COED MAWR, BRON Y DRE, BANGOR, LL57 4TL
Site Status:	The site comprises a former school building surrounded on all sides by either a tarmac surfaced school yard/playing area or grass playing areas. The site has a slight gradient from the north west to the south east and is at a similar elevation to the surrounding ground.
Site History: (Historical OS Maps presented in Appendix 1)	**1889**: The site is farmland and surrounded by farmland. There is a single track running through the middle of this site that leads to Coed Mawr farm which is west of the site. **1900**: The site is as in 1889. (Unchanged) **1966**: The site itself has not changed with only a few small outbuildings on the north side of the site. The land around has changed considerably with houses now surrounding the site from the north west around to the south east. There is a large farmland area to the south west where Coed Mawr farm still stands. **1972**: The site has now changed to house Ysgol Babanod Coed Mawr. The surrounding land has not changed, however more houses have been built to the south west. **2003**: The site is as in 1972.
Services:	There are no known main services within the site but there are local water and sewer services.

Geology: (Geological maps and data are presented in Appendix 2)	Information from the British Geological Survey Map indicates that drift (soil) deposits at the site comprise Glacial Till deposits of Diamicton age. The Glacial Till deposits extends for at least 100m in all directions but is likely to be relatively shallow. The bedrock comprises sandstone and conglomerate of the Minffordd Formation. There is no record of any made ground within the site. The site is not classed as agricultural land. There are no surface working features within 1000m of the site. The nearest BritPit is Cae-mab-Adda, a ceased sandstone pit, located 417m south of the site. The nearest non-coal mining feature is a Mineral Vein under the site; however, it is a Class B meaning difficult ground conditions are unlikely or localised and are at a level where they need not be considered. There is a very low risk of shrinkage and swelling clay at the site. There is a negligible risk of ground dissolution of soluble rocks below the site. There is a negligible risk of compressible deposits below the site. There is a very low risk of collapsible deposits below the site. There is a very low risk of running sand at the site. There is a very low/low risk of landslides.
Radon :	The site is not in a radon affected area with less than 1% of properties above the action level. No radon protection measures are required.
Ground Permeability :	The soils will be of low permeability. The bedrock will be of medium permeability with permeability governed predominantly by well-connected fractures.
Hydrogeology: (Environmental data is presented in Appendix 3)	The superficial deposits are classed as a Secondary Undifferentiated aquifer. In general, these layers have previously been designated as both minor and no-naquifer in different locations due to the variable characteristics of the rock type. The bedrock at depth is classed as a secondary A aquifer. This is defined as geology capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers. There are no Groundwater Abstraction Licence or Surface Water Abstraction Licence points within 500m of the site.
Hydrology:	The nearest ground water feature is an unnamed inland river not influenced by the tide, which is 54m south west.
Sensitive Land Uses:	The nearest designated Sites of Special Scientific Interest is Eithinog nature Reserve 450m west.
Landfills:	There are no Environment Agency registered landfill sites and Local Authority landfill sites or historic landfill within 500m.
Historical Industrial Sites:	The nearest land use with a potentially contaminative use is the Electricity Sub Station 77 north east of the site.
Pollution Incidents:	There are no Environment Agency pollution incidents which originate at the site.
Potential Contamination:	The sites only known previous use was as farmland, before it became a school. There is a very low to negligible risk of a contamination source on the site.

3. GROUND INVESTIGATION WORKS.

3.1 Previous Investigations

3.1.1 There are no known previous investigations of the ground at the site.

3.2 Scope of Work – Exploratory Holes

3.2.1 A geotechnical, permeability and ground contamination investigation were undertaken to provide information on the ground conditions at the site. The works were carried out by e-geo Solutions Ltd with the field work element undertaken on 18th and 22nd December 2020. The investigation was designed, supervised and administered by e-geo Solutions Ltd and undertaken in accordance with BS5930 (1999) – code of Practice for Site Investigations (Amendment 1).

3.2.2 The main scope of work involved:

- The excavation of 5 Nr trial pits to allow strata description, soil sampling and permeability tests. Trial pit records are presented in Appendix 3.
- The construction of 6 Nr window sample boreholes with dynamic cone penetrometer tests with continuous SPTs to determine soil density and strength. The results of DCP tests giving SPT N values are presented in Appendix 4.
- The examination of ground strata by a geo-environmental engineer and the careful description of soil types. Detailed descriptions of the ground strata are presented on the trial pit records in Appendix 3.
- Undertaking permeability tests in two trial pits (TP1, TP2). The results are presented in Appendix 5.
- Collection of 4 Nr. ground samples from near the ground surface for chemical analysis

3.3 Scope of Work – Testing and Analysis

3.3.1 A total of 5 Nr. ground samples were collected from the trial pits and submitted for chemical analysis at an accredited analytical laboratory. The analytical results are presented in Appendix 5. Samples were tested for:

Suite	Chemical Determinants	No. of Samples
Suite 1	pH, arsenic, cadmium, chromium (total and hexavalent), lead, mercury, selenium, copper, nickel, zinc, cyanide (total), sulphide, sulphur, sulphate. PAH (speciated)	WS1-1.0, WS2-0.75, WS3-0.7, WS5-0.5
Suite 2	Soluble SO4	WS1-1.0, WS1-2.0, WS2-0.75, WS3-0.7, WS5-0.5
Suite 3	Asbestos screen	WS2-0.75, WS3-0.7, WS5-0.5
Suite 4	EPH	WS1-1.0, WS3-0.7, WS5-0.5

3.4 Trial Hole Locations

3.4.1 Window sample boreholes and trial pit locations are indicated on Figure 4 below.

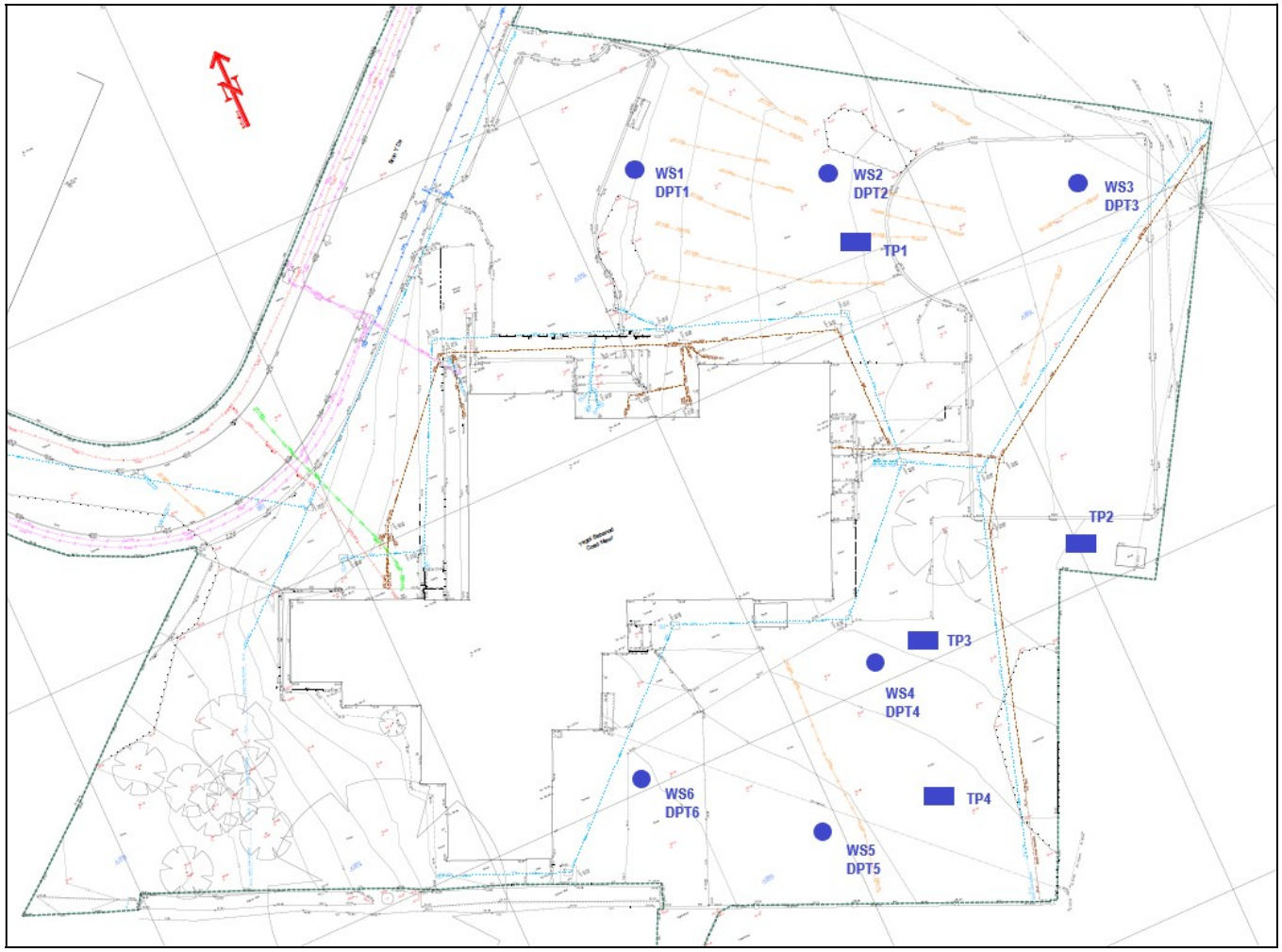


Figure 4 – Window Sample Boreholes (WS1 to WS6) and Trial Pit Locations (TP1 to TP4)

4. GROUND CONDITIONS AND GEOLOGY.

4.1 General

4.1.1 Details of the ground strata and depths are presented on the trial pit records in Appendix 3 and window sample boreholes in Appendix 4. A summary of the findings is presented below.

4.1.2 The results of in-situ standard penetration tests (SPTs) undertaken with a dynamic cone are presented in Appendix 4.

4.2 Stratigraphy

4.2.1 The strata and depths encountered during the investigation was:

Stratum	Description	Depth to base m range (average)
TOPSOIL	Dark brown clayey TOPSOIL with roots (10mm)	0.20
CLAY 1	Soft to firm and firm light brown and light grey slightly gravely silty CLAY	1.00
CLAY 2	Firm dark brown gravely slightly silty CLAY. Gravel is fine to coarse subangular of various lithologies. Rare cobble content	1.80
Gravely CLAY	Very stiff dark grey very gravely CLAY. (difficult to excavate)	TP4 only

4.3 Groundwater

4.3.1 Groundwater seepages were recorded in trial pits TP1 at 1.50m and TP2 at 1.20m.

4.4 Contamination Observations

4.4.1 During the examination of the ground strata no obvious indications of contamination were noted. There was no indication of hydrocarbons, vapours or unusual odours.

4.5 Geotechnical Properties

4.5.1 The results of Dynamic probe tests are presented in Appendix 4. The following SPT N values were obtained in the various strata.

Stratum	Description	Depth (m)	SPT 'N' value
CLAY 1	Soft to firm and firm light brown and light grey slightly gravely silty CLAY	0.20 0.50 0.80	1,3,9,1,1,2, 1,7,1,2,2,3, 6,9,7,7,6,10,
CLAY 2	Firm dark brown gravely slightly silty CLAY. Gravel is fine to coarse subangular of various lithologies. Rare cobble content	1.10 1.40 1.70 2.00 2.30 2.60 2.90 3.20 3.50 3.80 4.10	9,14,16,27,51,21, 24,24,29,36,63,31, 24,29,13,13,38,33, 22,13,16,13,19,27, 17,9,26,17,14,38, 15,9,47,17,22,28, 12,12,16,21,21, 6,16,13,36,29, 13,10,15,36,36, 15,17,15,30,34, 19,18,15,24,19

4.5.2 The results of the insitu SPTs indicate N values in the CLAY 1 to a depth of typically 1.00m are in the range 1 to 10 with an average of 7.5 at 0.80 to 1.10m bgl. This gives approximate allowable bearing pressure of 70kN/m2. Within CLAY 2 at a depth of 1.10m the average SPT N value is 17.4

which gives an equivalent shear strength of 87kN/m2 and an allowable bearing capacity of 180kN/m2. At a depth of 1.70m bgl the SPT N values range from 13 to 38 with an average of 25. This gives an allowable bearing pressure of 233 kN/m2 at a depth of 1.70m bgl.

4.6 Permeability Test Results

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4.6.1 The results of the permeability tests are presented on the Field Test Results sheets in Appendix 5.

4.7 Soil Infiltration Rate Calculations

4.7.1 The Soil Infiltration Rate (f) is based on the method described in the BRE Digest and is calculated from the time taken for the water level to fall from 75% to 25% of the actual water depth in the trial hole.

4.7.2 The Soil Infiltration Rate (f) is calculated by the equation:

f = Vp75 – 25/ ap50 x tp75 -25
Where - Vp75 -25 is the storage volume in the hole from 75% to 25% effective depth,
ap50 is the internal surface area of the hole to 50% effective depth plus the base area,
tp75 – 25 the time taken for water to fall from 75% to 25% effective depth.

4.7.3 In TP1 the following results were obtained:

Test TP1

The permeability test failed. The water level dropped only 30mm in 180minutes and was 290mm above the 75% full mark (test start) when the test was terminated.

4.7.4 In TP2 the following results were obtained:

Test TP2

The permeability test failed. The water level dropped only 20mm in 120minutes and was 350mm above the 75% full mark (test start) when the test was terminated.

4.7.5 In TP3 the following results were obtained:

Test TP3

The permeability test failed. The water level dropped only 130mm in 185minutes and was 180mm above the 75% full mark (test start) when the test was terminated.

5. CONTAMINATION ASSESSMENT

5.1 General

5.1.1 The results of the chemical analysis of soils samples are presented in Appendix 6. An assessment of the results of the analysis of samples has been undertaken to determine the presence and extent of any ground contamination. The assessment of contamination undertaken is a 'Tier 1 Generic Risk Assessment' which requires the comparison of contaminant concentrations to a set of generic Tier 1 Screening Values (TSV) risk-based screening concentrations.

5.1.2 Contaminant concentrations below the TSVs are considered not to warrant further risk assessment. It should be noted that exceeding the TSVs does not necessarily mean there is a risk, and the site should be remediated.

5.2 Soils Reference Values

5.2.1 TSVs for soil derived to be protective of human health are defined for standard end use situations in accordance with UK CLR framework. The values chosen are dependant on the site use or proposed development. The site is to be developed with residential housing (with no plant uptake). The TSVs selected to assess soils in relation to human health over the whole site are therefore 'residential with no plant uptake'.

5.2.2 The applicable TSVs for assessment of the analytical results are based on the following guideline criteria: CLEA 2009) Soil Guideline Values (SGVs) for 'residential and no plant uptake' end-use. (where available), LQM CIEH Generic Assessment Criteria – 2nd Edition 2009, Welsh Assembly Government C4SL.

5.3 Soils Analysis Assessment

5.3.1 Comparison of the analytical results for metals and non-metals using maximum concentrations as a means of assessment with the Tier 1 TSVs for 'residential use with plant uptake' indicates that the shallow ground strata do not contain any significant concentrations of contaminants above available respective trigger concentrations.

5.3.2 Concentrations of cadmium and chromium were significantly below the guideline concentrations or below detection limits.

5.3.3 Concentrations of arsenic were below the guideline concentration.

5.3.4 Concentrations of selenium, mercury were below the guideline concentrations.

5.3.5 Concentrations of copper, nickel, zinc were significantly below the guideline concentrations.

5.3.6 Concentrations of lead were significantly below the guideline concentrations with the exception of sample WS5 at 0.50 with a concentration of 446mg/kg against the guideline of 200mg/kg. However the average of all results at 134mg/kg was below the guideline concentration.

5.3.7 No elevated concentrations of sulphate or sulphur were found in the ground. Phenol and cyanide concentrations were generally below the detection limits.

5.3.8 No elevated concentrations of total hydrocarbons and polyaromatic hydrocarbons were found.

5.3.9 No elevated concentrations of soluble sulphate were detected.

5.3.10 No asbestos was detected.

6 DEVELOPMENT CONSIDERATIONS.

6.1 Foundations

6.1.1 The ground conditions encountered across the site are uniform with a layer of soft to firm and firm light brown and light grey slightly gravely silty CLAY found to a depth of 1.00m and underlain by a firm dark brown gravely slightly silty CLAY with rare cobbles.

6.1.2 Standard strip foundations placed within the dark brown gravely slightly silty CLAY (CLAY 2) at a standard depth of 1.20m should be designed for an allowable bearing capacity of 180kN/m2.

6.2 Floor Slabs

6.2.1 Floor slabs can be ground bearing depending on the final site levels.

6.3 Earthworks

6.3.2 The natural ground strata of clay can be easily excavated with normal groundworks excavation plant.

6.3.3 No significant groundwater inflows were recorded in the trial pits or boreholes and groundwater control should not be an issue.

6.4 Concrete

6.4.1 The results of laboratory pH and sulphate content indicate that ACEC Class AC1 and sulphate class DS-1 conditions prevail at the site, in accordance with BRE Special Digest 1 ‘Concrete in Aggressive Ground 2005’

6.5 Surface-Water Soakaways

6.5.1 The clay strata is not suitable for surface water soakaways and had very poor or no permeability.

6.6 Ground Contamination

6.6.1 The shallow ground strata do not contain any significant concentrations of contaminants above available respective trigger concentrations and there are no contamination risks.

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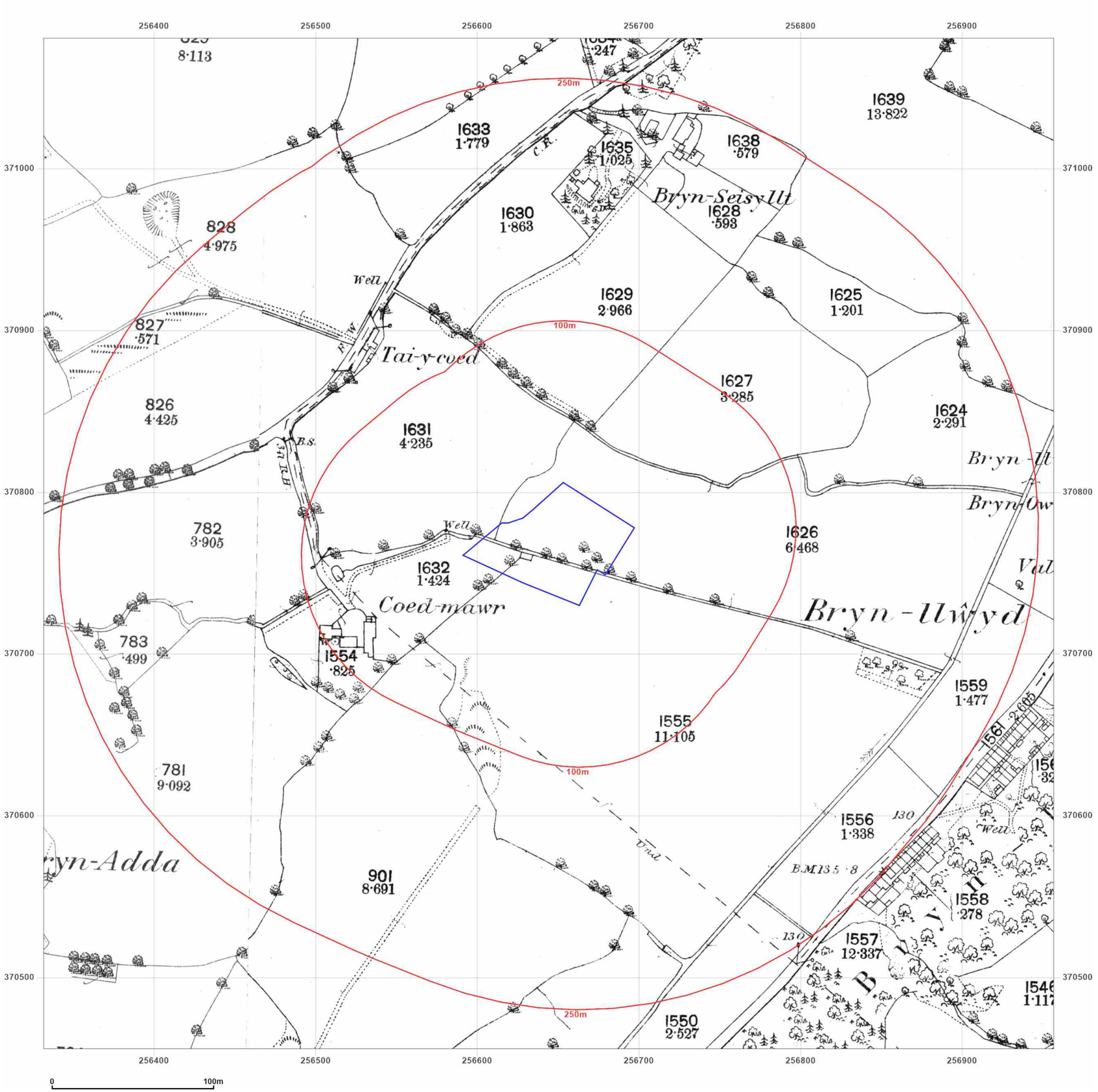
Appendix 1 - Historical OS Maps



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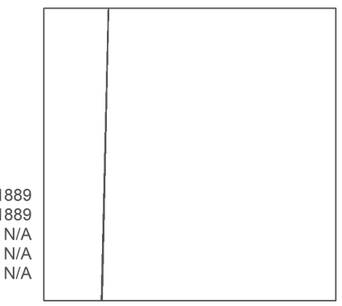

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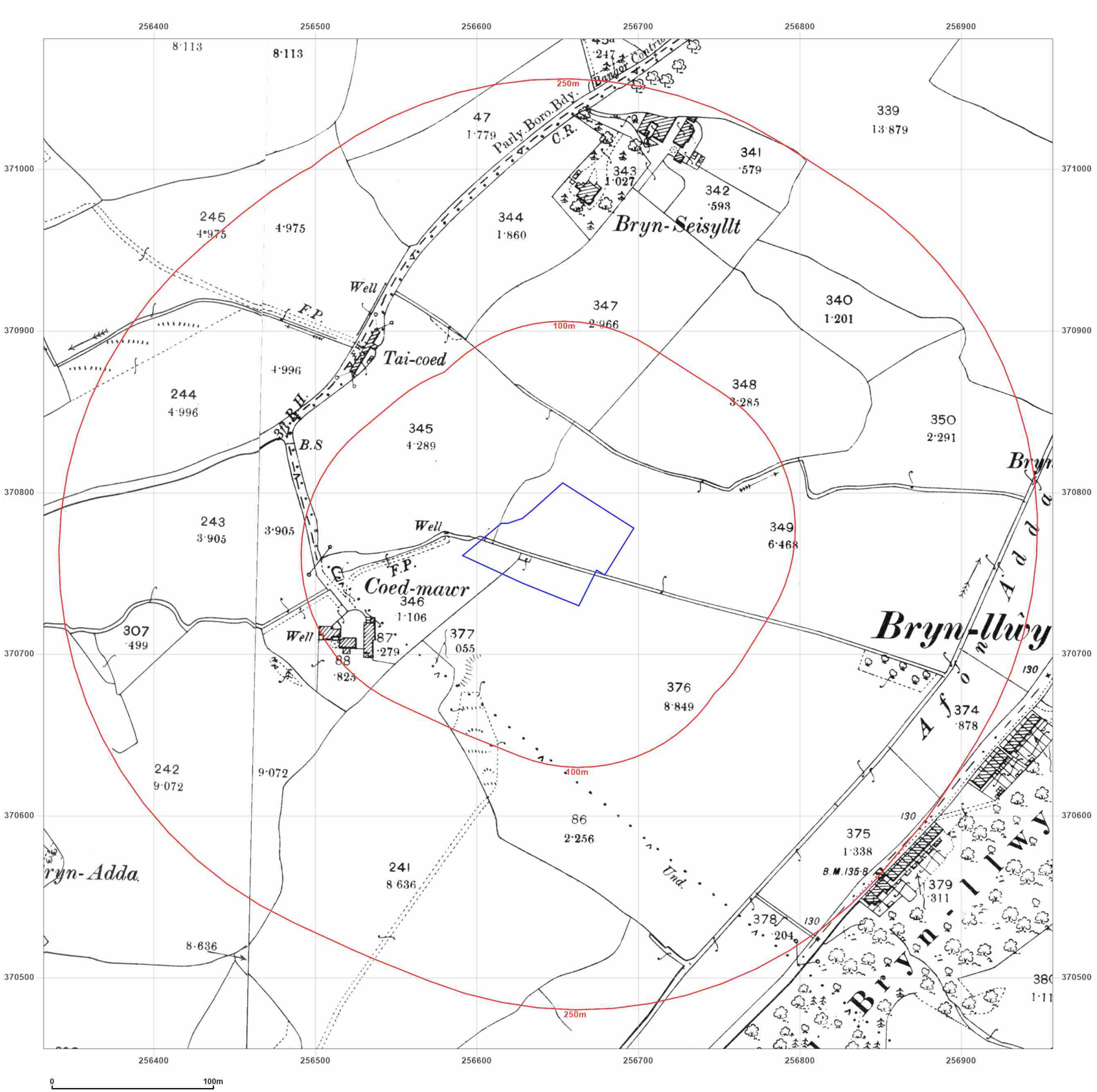

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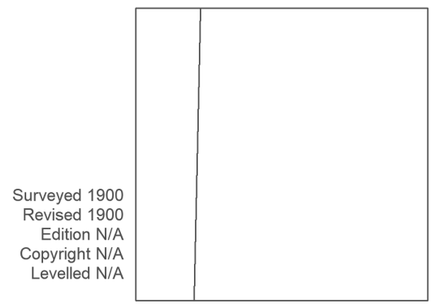

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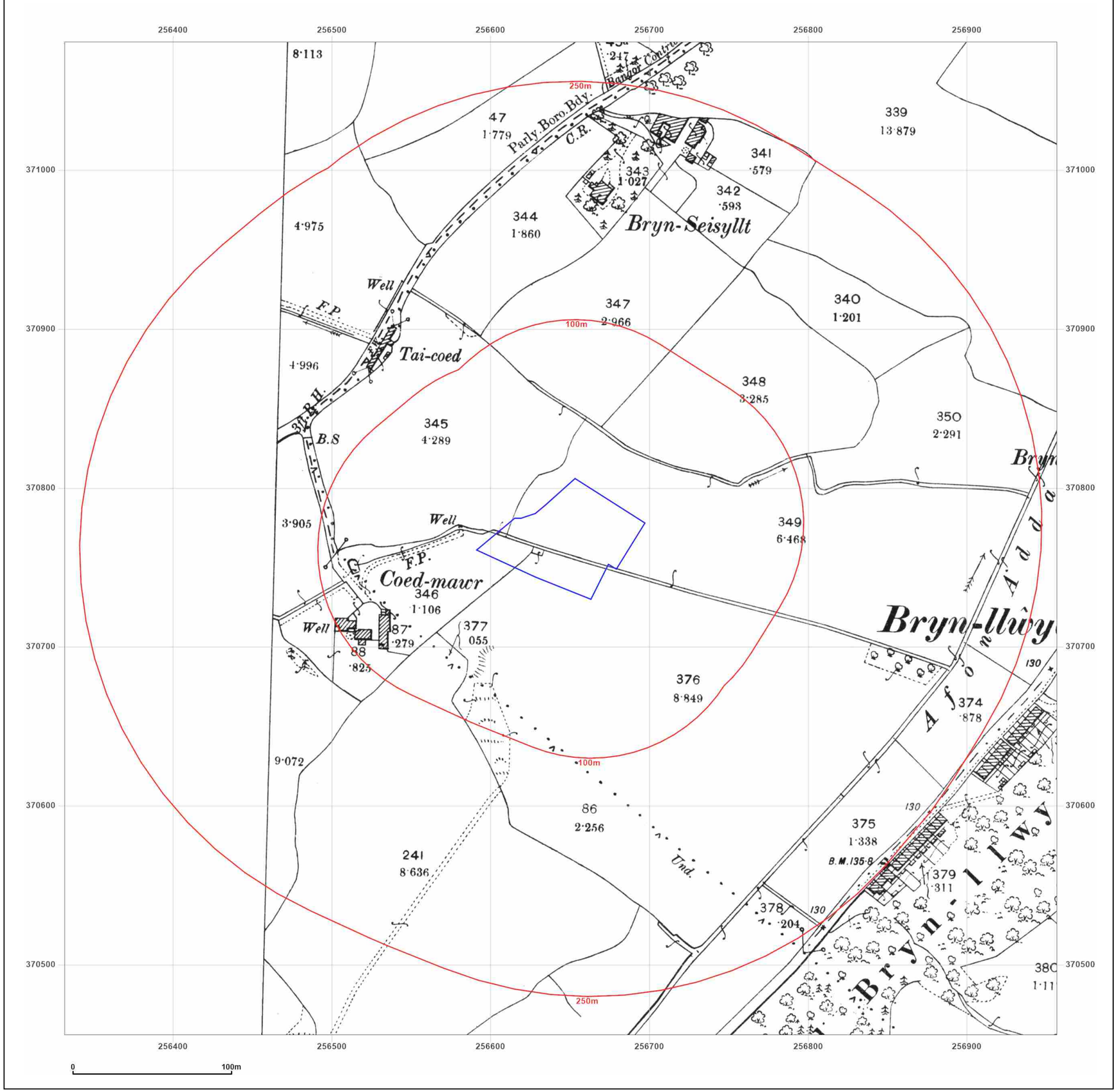

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BANGOR, LL57 4TL

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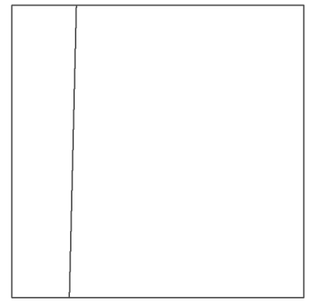

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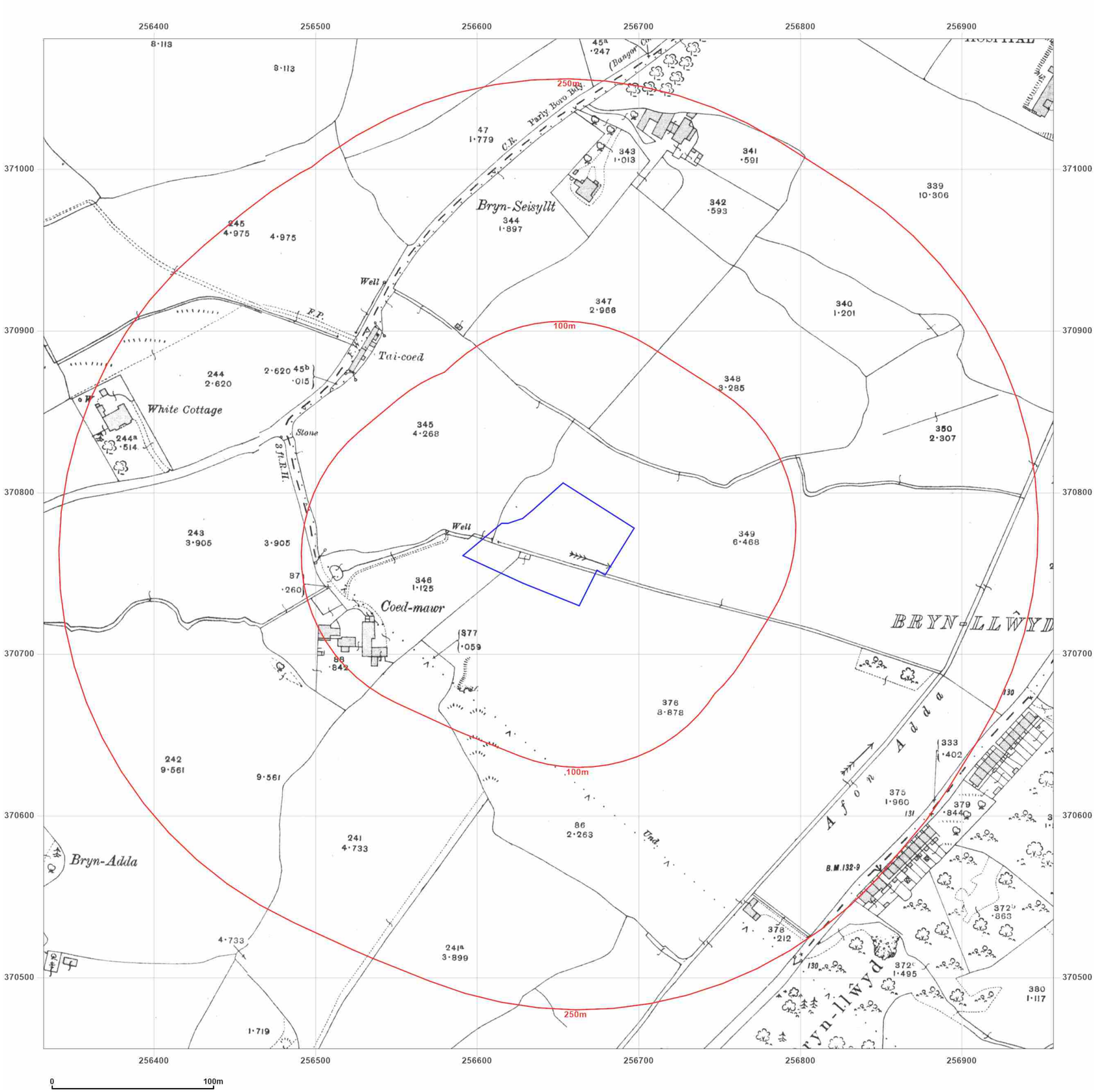

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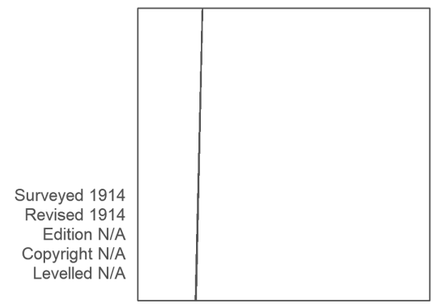

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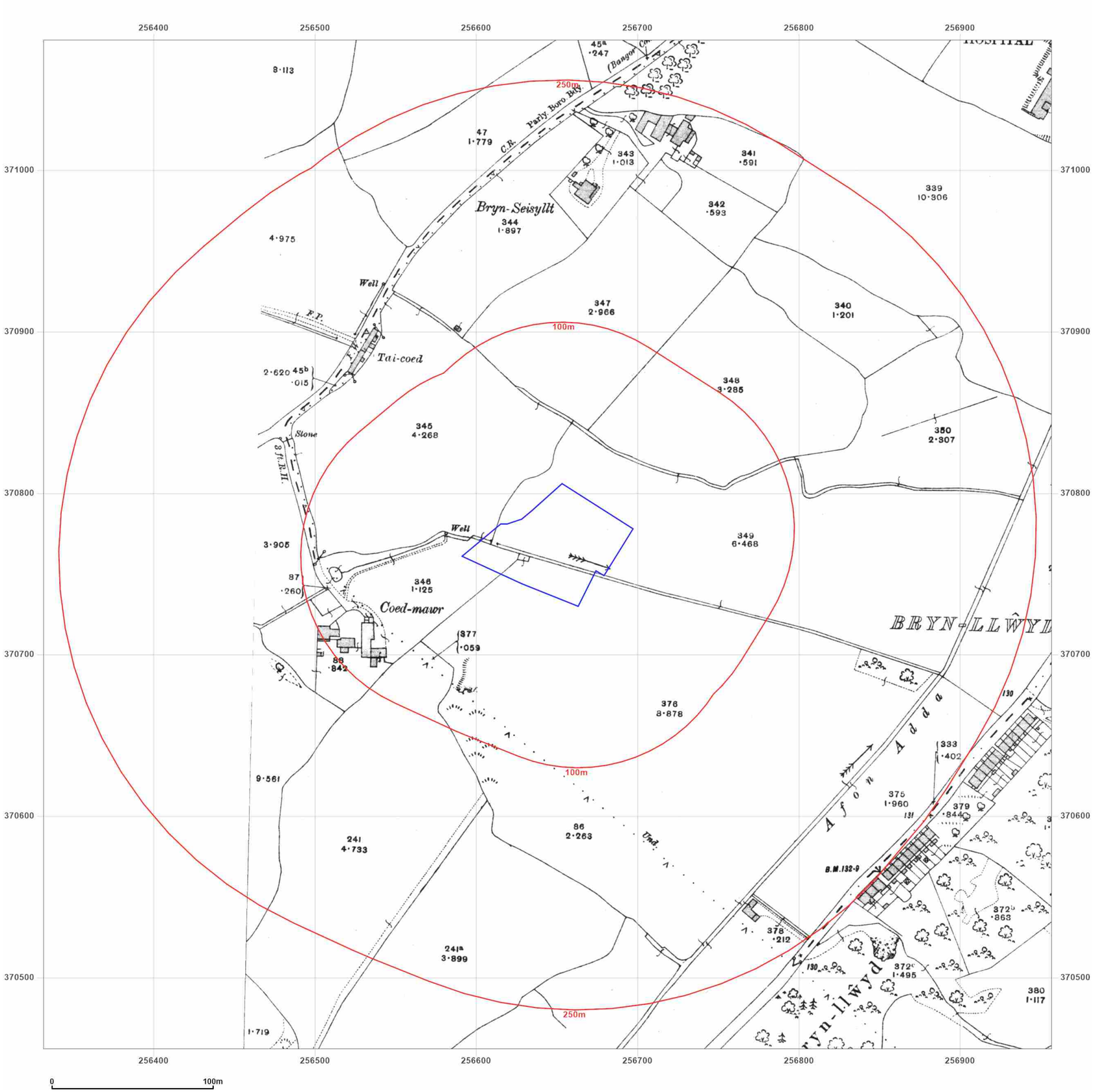

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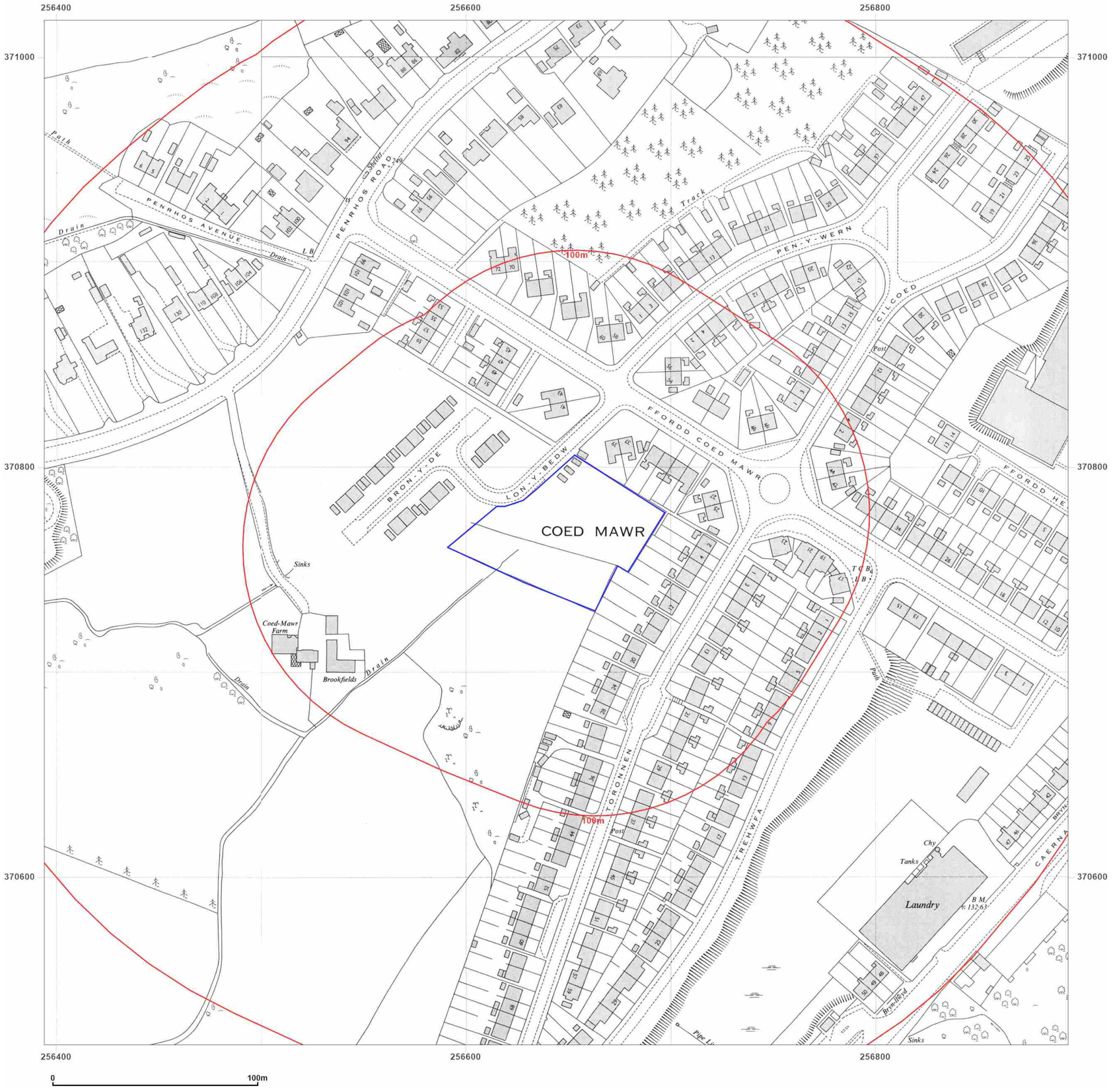

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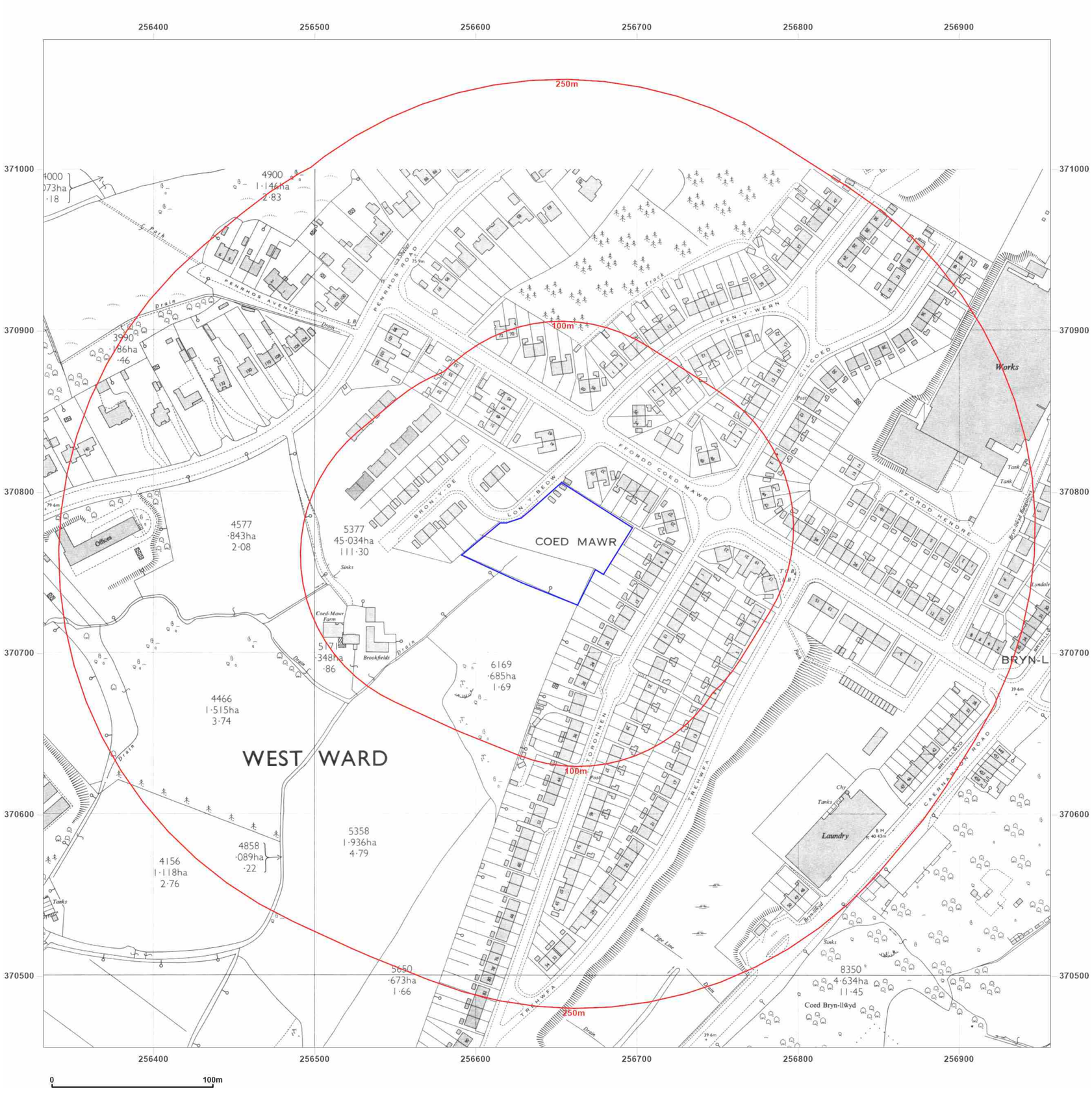

Groundsure INSIGHTS

Site Details:

COED MAWR INFANTS SCHOOL, BRON Y DE, BANGOR, LL57 4TL

Client Ref: E1321
Report Ref: HMD-165-7527262
Grid Ref: 256644, 370768

Map Name: National Grid

Map date: **1969**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1966
Revised 1969
Edition N/A
Copyright 1970
Levelled 1955

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Groundsure INSIGHTS

Site Details:

COED MAWR INFANTS SCHOOL, BRON Y DE, BANGOR, LL57 4TL

Client Ref: E1321
Report Ref: HMD-165-7527262
Grid Ref: 256644, 370768

Map Name: National Grid

Map date: **1970**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
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Groundsure INSIGHTS

Site Details:

COED MAWR INFANTS SCHOOL, BRON Y DE, BANGOR, LL57 4TL

Client Ref: E1321
Report Ref: HMD-165-7527262
Grid Ref: 256644, 370768

Map Name: National Grid

Map date: **1972-1977**

Scale: 1:1,250

Printed at: 1:2,000

N
W E
S

Surveyed 1965
Revised 1976
Edition N/A
Copyright 1977
Levelled 1975

Surveyed 1966
Revised 1972
Edition N/A
Copyright 1972
Levelled 1955

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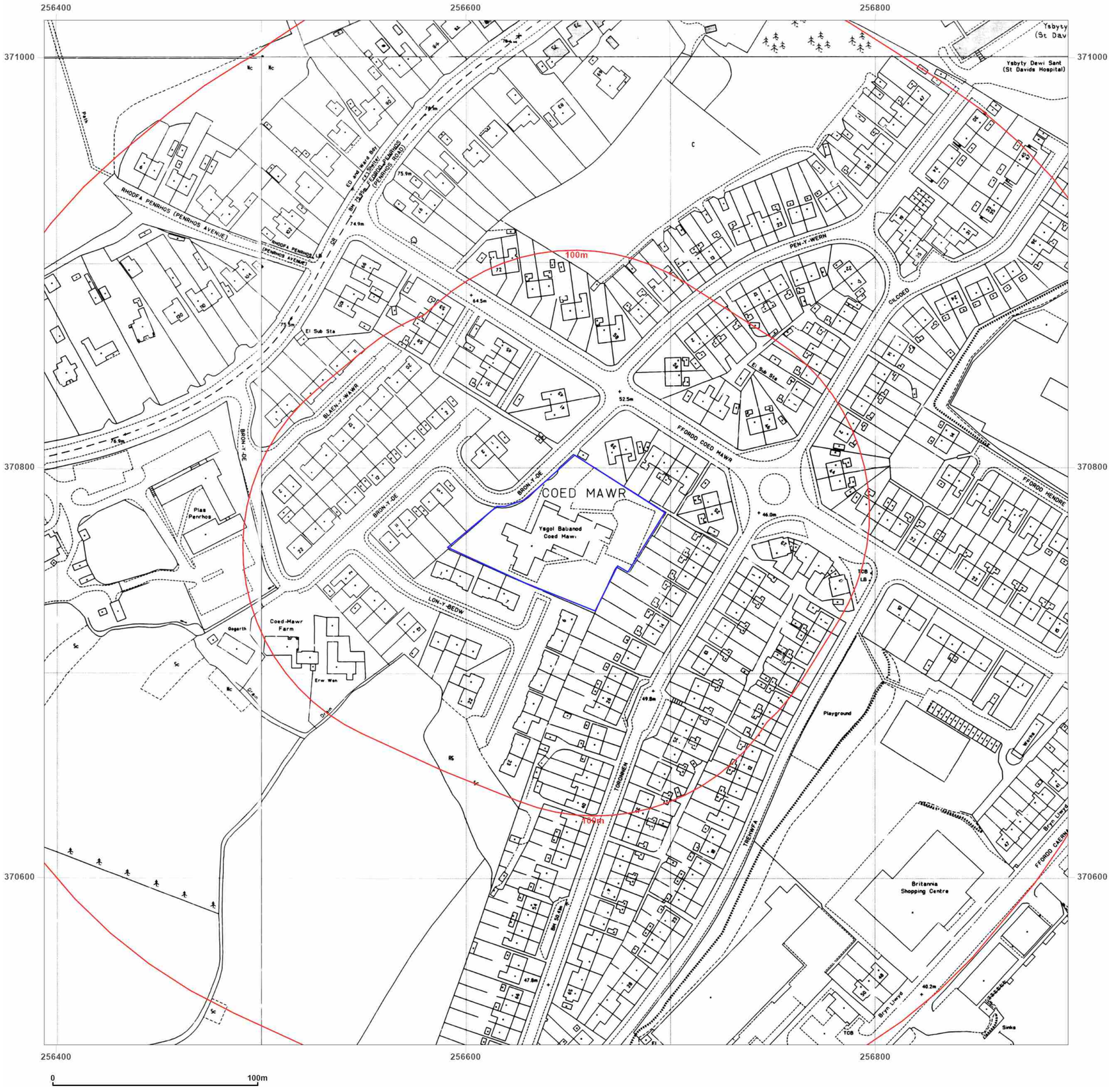

Groundsure INSIGHTS

Site Details:

COED MAWR INFANTS SCHOOL, BRON Y DE, BANGOR, LL57 4TL

Client Ref: E1321
Report Ref: HMD-165-7527262
Grid Ref: 256644, 370768

Map Name: National Grid

Map date: **1989-1993**

Scale: 1:1,250

Printed at: 1:2,000

N
W E
S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

Surveyed 1975
Revised 1989
Edition N/A
Copyright 1989
Levelled 1975

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Revised N/A
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Production date: 29 January 2021

Map legend available at:
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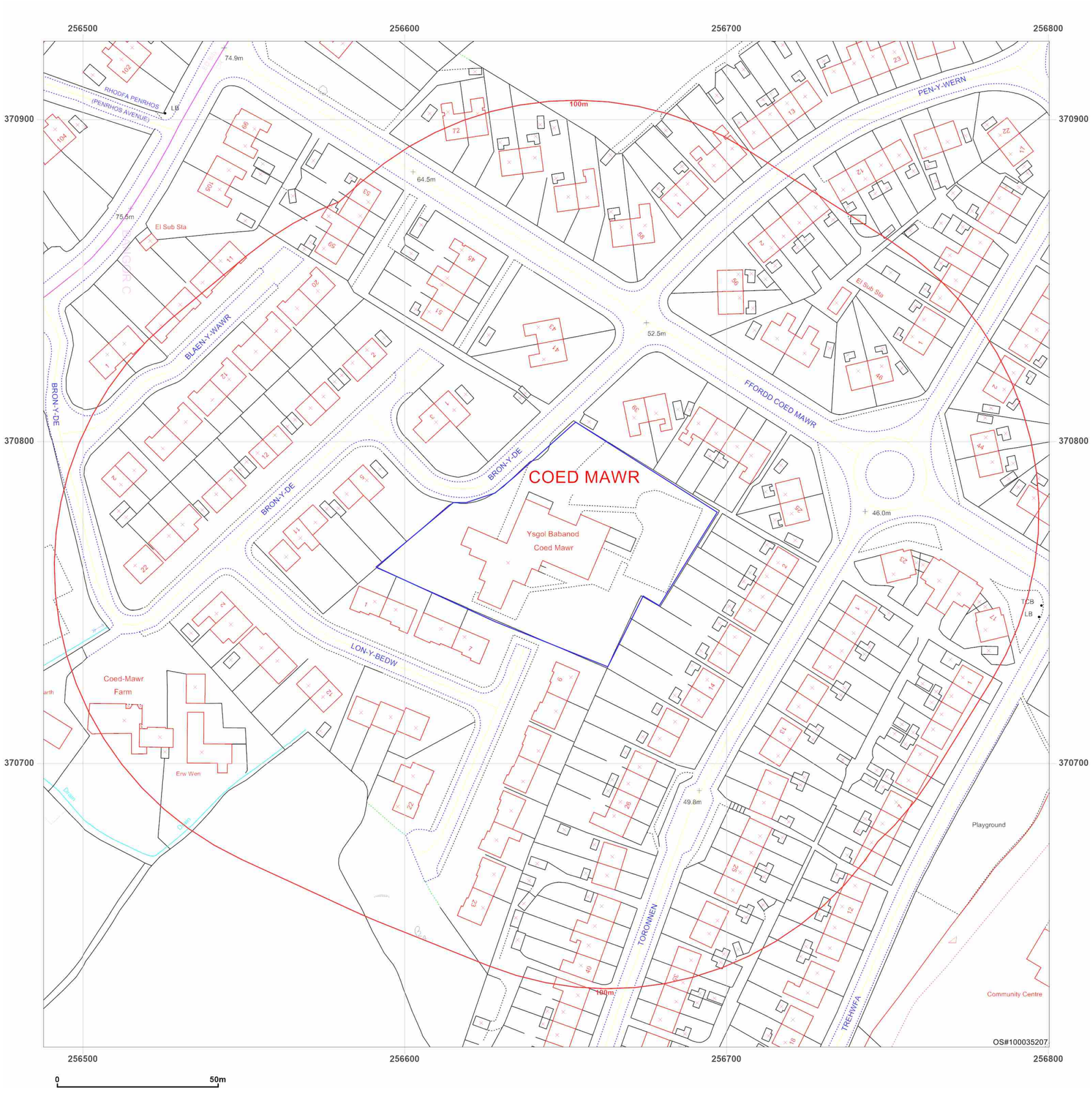


Groundsure INSIGHTS

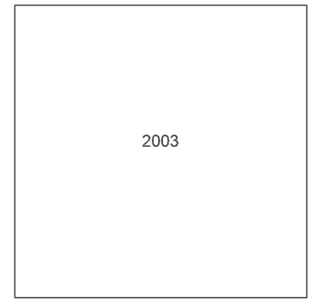
Site Details:

COED MAWR INFANTS SCHOOL, BRON Y DE, BANGOR, LL57 4TL

Client Ref: E1321
Report Ref: HMD-165-7527262
Grid Ref: 256644, 370768

Map Name: LandLine
Map date: **2003**
Scale: 1:1,250
Printed at: 1:1,250

N
W E
S



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