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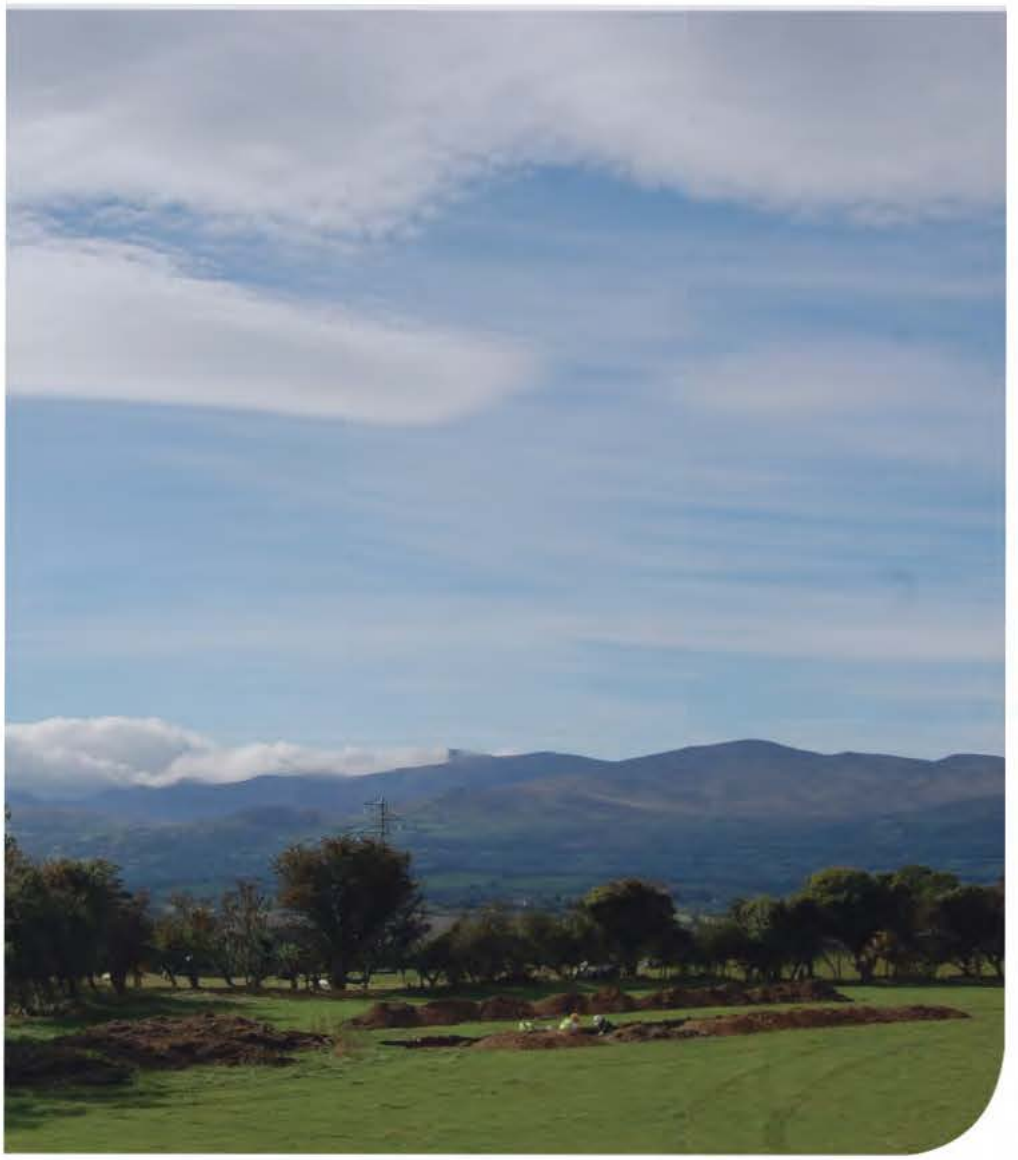
Coed Dolwyd Service Reservoir and Associated Pipework, Glan Conwy

Archaeological Evaluation & Mitigation



Ymddiriedolaeth Archaeolegol Gwynedd
Gwynedd Archaeological Trust

Coed Dolwyd Service Reservoir and Pipeline
Archaeological Evaluation and Mitigation

Produced for

COSTAIN

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COED DOLWYD SERVICE RESERVOIR AND ASSOCIATED PIPEWORK: ARCHAEOLOGICAL WORKS

Prepared for Dŵr Cymru, September 2011

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Summary

A programme of archaeological evaluation has been conducted in advance of the construction of a new service reservoir and pipeline, at Coed Dolwyd, Conwy. This phase of archaeological work included targeted trial trenching, predominantly at the proposed site of the reservoir and temporary compound, but also along the route of the pipeline. A total of 15 archaeological trial trenches were excavated across the site. These trenches targeted potential archaeological anomalies identified in the results of a programme of geophysical survey and by an archaeological assessment which comprised a desk-top survey and field search. This phase of evaluation identified no significant archaeological evidence. The majority of the potential sites may be attributed to geological activity, and those features that were demonstrated to be of an archaeological origin were all of a post-medieval date, and associated with field-drainage.

Five geotechnical ground Investigation trial pits were observed along the proposed pipeline route: no archaeological deposits or features of note were identified within the confines of any example, bar a redundant post-medieval ceramic field drain in STP 03. Colluvia up to 1.65m thick was recorded in STP 11, located at the western limit of the pipeline route, north of Llansanffraid Glan Conwy.

Three T-shaped archaeological trenches (Trenches 13 to 15) were targeted along the proposed pipeline route to target Gwynedd Archaeological Trust Assessment Report 957 Features 2, 4 and 6: archaeological activity was identified in Trenches 13 and 15. Trench 13 contained agricultural drainage indicative of land improvement and management; Trench 15 contained three distinct phases of archaeological activity: a rock cut linear, succeeded by the parallel running gullies and then intercutting pits. The presence of burnt clay within the subsoil horizon as well as the intercutting pits, suggests the presence of further localised activity indicative, possibly of kiln firing or other industrialised process. The date of the activity could not be determined during on-site works but charcoal was recovered for possible C^{14} dating. The archaeological activity in Trench 15 was concentrated in the northeastern end of one of the two spurs forming the T-shaped trench. No similar activity was identified within the remainder of the trench. This implies that the linear feature and gullies continue on an alignment parallel and to the northeast of the centreline of the pipeline; the pit clusters also appear to continue to the northeast of the centreline (the full extent of which could not be determined within the confines of the trench).

Recommendation is given for further evaluation and/or mitigation to examine the Trench 15 area and to mitigate the scheme as a whole: an archaeological watching brief during main works is recommended for the pipeline route and reservoir/compound site; whereas further evaluation and/or controlled stripping under archaeological control is recommended for a targeted area surrounding Trench 15.

1 INTRODUCTION

Gwynedd Archaeological Trust (GAT) was commissioned by Dŵr Cymru to complete a programme of archaeological evaluation including trial trenching and a watching brief at the location of the proposed Coed Dolwyd Service Reservoir and Associated Pipework Scheme.

The proposals include:

- A proposed reservoir site, *c.*690.0m east of Llansanffraid Glan Conwy (with neighboring temporary site compound during construction phase);

- A *c*.1.5km long pipeline route located north and east of Llansanffraid Glan Conwy.

Based on information within Dŵr Cymru drawing 0000_0007 (Rev. 10), the reservoir will be located at Site 11 and the temporary compound at Site 8c, both located within neighbouring fields located in close proximity to a local road (B5381) between Rhyd-Ifan Farm and Plas Isa Farm (centred on NGR **SH81657592**).

The proposed pipeline route runs from Site 11 (NGR **SH81497612**) to the A470 trunk road north of Llansanffraid (NGR **SH80367647**).

This phase is to be regarded as the **second phase** of a staged programme of archaeological works, preceded by an initial assessment phase (GAT Report **957**); the aim of which is to establish the archaeological significance of the site, to assess the impact of the development proposals on surviving monuments or remains and to help inform future decision making, design solutions and potential mitigation strategies

This phase of archaeological works included:

- Archaeological trial trenching at the reservoir (Dŵr Cymru Site 11) and the temporary compound (Dŵr Cymru Site 8c), targeting twelve locations (locations based on geophysical survey results – *Stratascan Ltd.* ref. **2958**)
- Archaeological trial trenching along the pipeline route at three targeted locations (locations based on GAT assessment report **957** findings/recommendations).
- Archaeological watching brief during the excavation of five geotechnical ground investigation (STP) trenches, completed by the Client along the pipeline route

1.1 Mitigation/Standards

A mitigation brief was not prepared for this phase work by **Gwynedd Archaeological Planning Services** (GAPS), but they have been informed of the results of the assessment, geophysical survey and evaluation.

The evaluation programme (reservoir and pipeline route) conformed to the guidelines specified in the *IFA Standard and Guidance for Archaeological Evaluation* (Institute of Field Archaeologists, 1994, rev. 2001 & 2008); the watching brief programme (pipeline route) conformed to the guidelines specified in the *IFA Standard and Guidance for Archaeological Watching Brief* (Institute of Field Archaeologists, 1994, rev. 2001 & 2008).

2 PROJECT BACKGROUND

GAT completed an archaeological assessment of the reservoir/compound and pipeline route in June 2011 (Smith and Evans, 2011. GAT Report **957**). A total of ten features were identified within the assessment area, of which six were thought to be 18th century or earlier in date, with prehistoric archaeological activity areas postulated at three locations: two areas along the pipeline route and one area within Site 8c. These areas were identified during the walkover survey and archive research by GAT.

The results are summarised below:

*Table 1. Potential archaeological activity identified along the proposed pipeline route (reproduced from GAT Report **957** with amendments)*

Feature Nu	Name	Location
1	Platform	SH 80377651
2	Terrace/former field bank	SH 80627653
3	Hedge bank	SH 80987636-SH 81067644
4	Area of potential for prehistoric activity	SH 81107640 C
5	Hedge bank	SH 81127647-SH 81187640
6	Area of potential for prehistoric activity	SH 81357620 C
7	Hedge bank	SH 81417605- SH 81557620
8	Area of potential for prehistoric activity	SH 81597592 C
9	Former Trackway	SH 80737664- SH 80787638
10	Hedge banks	SH 80967639- SH 81357658

Based on client feedback and discussions with GAPS, it was agreed that a **second phase** of works should be undertaken, initially within Sites 11 and 8c, followed by future phases based on the **second phase** results. The **second phase** programme was agreed by all parties to include a geophysical survey of Sites 11 and 8c, followed by targeted trial trenching based on the survey results.

The geophysical survey was completed by *Stratascan* in September 2011 (*Stratascan Ltd.* ref. **2958**; report reproduced as Appendix I). A magnetometer survey was completed using a Bartington Grad 601-2, which used two fluxgates mounted 1.0m vertically apart aligned to nullify the effects of the earth's magnetic field. Readings were taken at 0.25m centers along traverses 0.5m apart, which equated 7200 sampling points within a full 30m x 30m grid. The survey identified various linear anomalies within 11 and 8c (reproduced as Figure 1) that included two parallel linear anomalies running east-west, *c.*12.0m apart and up to 110.0m in length (classed as probable cut features of archaeological origin) and a 30.0m long linear feature aligned north south (also classed as probable cut feature of archaeological origin), both within Site 11. A series of disparate linears of various lengths were also identified in Sites 11 and 8c, all classed as *possible* cut features of archaeological origin, along with probable plough marks at the northern end of Site 8c and an in filled “pond” towards the centre of 8c. Magnetic variation was identified across 11 and 8c, indicative of geological and/or pedological activity; this tallied with the identification of shale and coarse sandstone geology by GAT during the walkover/assessment (GAT Assessment Report **957**: 5).

(Reproduced from GAT *Project Design for Archaeological Evaluation (G2192) Trial Trenching,* October 2011)

2.1 Topography/Geology

The development site lies on the east slopes of the northern end on the Conwy valley. The landscape is characterised by continuous undulations and hummocks, and for the most part consists of improved fields bordered by hedgerows.

The underlying geology of the area is Nantglyn Flag formations containing mudstone and silt stone (British Geological Survey, website, September 2011). The overlying soils tend to be typical brown earths of the Denbigh 1 type. These consist of well drained fine loamy and fine silty soils over rock. (Soil Survey of England and Wales, Sheet 02 Wales).

3 METHODOLOGY

3.1 Archaeological Trial Trenches - Reservoir/Site Compound

A detailed gradiometer survey of the proposed sites for the reservoir and temporary compound (Sites 11 and 8c) was carried out by *Stratascan* in September 2011 (Hadrall, September 2011; ref. **2958**). The survey identified seventeen anomalies which were deemed to be of a potential archaeological origin. These anomalies comprised:

- Four positive linear anomalies, interpreted as **probable** cut features of archaeological origin.
- Eleven positive linear anomalies interpreted as **possible** cut features of archaeological origin.
- One possible in-filled pond
- One area of closely spaced parallel linear anomalies, probably related to agricultural activity such as ploughing.

A total of twelve archaeological trial trenches were excavated across the two fields, with trenches 1 -5 located in Site 11, and trenches 6-12 located in Site 8c. Each trench targeted one or more geophysical survey anomaly, with some of the longer anomalies targeted several times along their length. The trenches were positioned at approximate right-angles to the anomalies in order to maximize the chance of locating them. Trenches 1 and 2 measured 2m (w) x 30m (l); the remaining 10 trenches measured 2m (w) x 20m (l).

- Trench 01 – 30.0m (l) x 2.0m (w): investigating two parallel linear anomalies running east-west, *c.*12.0m apart and up to 110.0m in length (classed as probable cut features of archaeological origin);

- Trench 02 – 30.0m (l) x 2.0m (w): investigating two parallel linear anomalies running east-west, *c.*12.0m apart and up to 110.0m in length (classed as probable cut features of archaeological origin) and a parallel 40.0m long linear feature of *possible* archaeological origin;

- Trench 03 – 20.0m (l) x 2.0m (w): investigating a 100.0m long linear feature of *possible* archaeological origin;

- Trench 04 – 20.0m (l) x 2.0m (w): investigating a 50.0m long linear feature of *probable* archaeological origin;

- Trench 05 – 20.0m (l) x 2.0m (w): investigating a 40.0m long linear feature of *possible* archaeological origin (this feature continues from Site 11 to Site 8c);

- Trench 06 – 20.0m (l) x 10.0m (w): investigating a 100.0m long linear feature of *possible* archaeological origin; this feature will also be investigated by Trench 12;

- Trench 07 - 20.0m (l) x 2.0m (w): investigating an irregular shaped 25.0m long linear feature of *possible* archaeological origin;

- Trench 08 – 20.0m (l) x 2.0m (w): investigating an irregular shaped 25.0m long linear feature of *possible* archaeological origin;

- Trench 09 – 20.0m (l) x 2.0m (w): investigating the “infilled pond”;

- Trench 10 – 20.0m (l) x 2.0m (w): investigating parallel linear anomalies identified as agricultural activity;

- Trench 11 – 20.0m (l) x 2.0m (w): investigating a 60.0m long linear feature of *possible* archaeological origin; this feature will also be investigated by Trench 12;

- Trench 12 – 20.0m (l) x 2.0m (w): investigating a 100.0m long linear feature of *possible* archaeological origin; this feature will also be investigated by Trench 06;

Each trench was located via digital survey, and excavated using an 8-tonne tracked excavator, fitted with a toothless ditching bucket (supplied by *William Hughes Civil Engineering Limited*). The excavation of each trench was monitored by an archaeological technician. The trenches were excavated down to the level of the glacial horizon, this tended to be at a depth of between 0.3m and 0.5m.

A written and photographic record of each trench was maintained, and all subsurface features were manually cleaned, excavated and recorded in order to determine their extent, function, date and relationship to adjacent features.

Following consultation and, where necessary inspections by Gwynedd Archaeological Planning Services (GAPS), the trenches were re-instated at the end of each day.

3.2 Archaeological Trial Trenches - Pipeline Route

GAT Report **957** highlighted ten features along the pipeline route, of these, Features **2**, **4** and **6** were identified as suitable for trail trenching at this phase. The remaining features are either not to be affected by the current design (Features **1**, **9** and **10**) or don’t appear to be affected until main works (Features **3**, **5**, and **7**).

All co-ordinates below are based on locations defined in GAT Report **957** and are to be treated as the centre points for the individual trenches.

- Trench 13 - Feature 2 - Terrace/former field bank (NGR SH80627653)

- Trench 14 – Feature 4 - Area of potential for prehistoric activity (NGR SH81107640)

- Trench 15 – Feature 6 - Area of potential for prehistoric activity (NGR SH81357620)

Each T-shaped trench measured 2 x 2.0m by 20.0m (80m^2) and was designed to cover the easement width and pipe route centreline as comprehensively as possible within the area of suspected archaeological activity.

3.3 Geotechnical Ground Investigation Trial Pits

Costain proposed 11 ground investigation trial pits (STP) along the route of the proposed pipeline (as located on Client Drawing **259-17_0000_0013_I2**). The function of the trial pits varied, some were used to assess the geology of the area others were used to locate

existing services, and in some instances a trial pit would serve both purposes. On discussion with the client and Gwynedd Archaeological Planning Services (GAPS; Jenny Emmett *pers comm.*), it was agreed that 5 of 11 the trial pits would be mitigated by archaeological watching brief; these were:

- STP 03 (NGR SH81097642) – GI and water pipe location
- STP 06 (NGR SH80427660) – GI and water pipe location
- STP 09 (NGR SH80297666) – GI only
- STP 10 (NGR SH80557653) – GI only
- STP 11 (NGR SH81357627) – GI only

The remaining test pits were not mitigated via archaeological watching brief as they were either targeting existing low and high pressure gas mains (STP 01, STP 02, STP 04 and STP 05) or were within an existing carriageway targeting water and/or telecoms services (STP 07 and STP 08).

The watching brief supervised the removal of the topsoil and subsoil horizons within each trial trench, down to the glacial horizon, in order to assess the existence of significant deposits or artefacts.

The trial trenches were excavated by *William Hughes Civil Engineering Limited* using a 1.5 tonne tracked excavator, fitted with a toothless ditching bucket, with hand-tools used when in close proximity to services. The trenches measured a maximum of 2.88m², and were excavated to depths ranging from 0.5m – 1.9m.

A written and photographic record of each trench was maintained, and all subsurface features were manually cleaned, excavated and recorded in order to determine their extent, function, date and relationship to adjacent features.

4 RESULTS

4.1 Archaeological Trial Trenches - Reservoir/Site Compound

Trench 1 – Figure 1/Plate 1

This trench targeted two parallel linear anomalies of a probable archaeological origin, running north-east/south-west. The trench measured 30.0m x 2.0m, and was orientated north-west/south-east; it was located on level ground, close to the middle of Site 11.

No archaeological explanations for the two targeted anomalies was identified, however a small linear feature, most likely a field drain, was identified running north-east/south-west across the north-western end of the trench. This feature was 0.5m wide and 0.1m deep, the cut had moderately sloping sides and a flat base, and it was filled by a firm mid grey-brown clay silt, containing moderately frequent sub-rounded cobbles and occasional small flecks of charcoal.

The non-archaeological deposits in this trench consisted of a fairly substantial topsoil, some 0.3m thick, of a soft, mid grey-brown, silt-clay, containing occasional sub-rounded cobbles. This overlay a subsoil of firm, mid-orange-brown silt clay, containing moderately frequent sub-angular cobbles (<0.05m diameter). The subsoil was some 0.2m thick.

There was a distinct change in the underlying geological deposits within this trench. The north-western end of the trench was characterised by a firm mid brown-grey silt-clay containing frequent flecks of mid orange silt and sub-angular cobbles, whilst 8m from the south-eastern end of the trench a deposit of weathered bed-rock rose up abruptly. This

deposit consisted of loose, well sorted, sub-angular silt stone cobbles (<0.1m) surrounded by a silt matrix. These distinct changes in the geology are likely to be the cause of the linear anomalies identified in the geophysics results.

Trench 2 – Figure 1/Plate 2

This trench targeted the north-eastern end of the two parallel linear anomalies targeted by trench 1, along with a third north-east/south-west running linear, identified as of possible archaeological origin. The trench measured 30.0m x 2.0m, and was orientated north-west/south-east; it was located on level ground, close to the eastern boundary of Site 11.

No archaeological explanation for any of the three targeted anomalies was identified.

The non-archaeological deposits in this trench consisted of a fairly substantial topsoil, some 0.2m thick, of a soft, mid grey-brown, silt-clay, containing occasional sub-angular cobbles. This overlay a subsoil of firm, mid-orange-brown silt clay, containing frequent sub-angular cobbles (<0.05m diameter). The subsoil was some 0.25m thick.

As in Trench 1 there was a distinct change in the underlying geological deposits within this trench. The north-western end of the trench was characterised by some 3m of friable mid brown-orange clay-silt containing moderately frequent sub-angular cobbles, this was then replaced by a deposit of weathered bed-rock, similar to that observed in Trench 1. Ridges of bed-rock, running approximately north/south were visible below the loose, well sorted, sub-angular silt stone cobbles. These distinct changes in the geology are likely to be the cause of the linear anomalies identified in the geophysics results.

Trench 3 – Figure 1/Plate 3

This trench targeted a single linear anomaly of possible archaeological origin, running north-east/south-west. The trench measured 20.0m x 2.0m, and was orientated north-west/south-east; it was located on level ground, close to the north-western boundary of Site 11.

The cause of the linear anomaly targeted by this trench was positively identified as a north-west/south-east running 0.07m wide asbestos pipe. This pipe is likely to have once carried water to Rhyd Ifan farm. The pipe was located 0.5m below the surface, and lay within a narrow trench, which was cut into the natural weathered bedrock and sealed by the subsoil.

The non-archaeological deposits in this trench consisted of a topsoil, some 0.15m thick, of a soft, dark brown, silt-clay, containing occasional sub-rounded gravel. This overlay a subsoil of firm, mid brown clay-silt, containing moderately frequent sub-angular gravel and occasional sub-angular cobbles (<0.07m diameter). The subsoil was some 0.2m thick.

As in trenches one and two there was a distinct change in the underlying geological deposits within this trench. The north-western end of the trench was characterised by a firm, mid orange sand-clay-silt containing moderately frequent sub-angular cobbles. At the mid way point of the trench, this was then replaced by a deposit of weathered bed-rock, similar to that observed in trenches one and two.

Trench 4 – Figure 1/Plate 4

This trench targeted a single linear anomaly of a probable archaeological origin, running north/south. The trench measured 20.0m x 2.0m, and was orientated north-west/south-east; it was located on moderately sloping ground, close to the southern boundary of Site 11.

The cause of the linear anomaly targeted by this trench was positively identified as a shallow linear feature running north/south. The cut was 0.6m in width and 0.15m in depth, it

had moderately sloping sides and a flat base. It was cut into the natural, and contained a single stony deposit. This feature has been interpreted as a hand-dug field drain.

The non-archaeological deposits in this trench consisted of a thin topsoil, some 0.1m thick, of a friable, dark brown, silt-clay, containing occasional sub-rounded gravel. This overlay a subsoil of firm, dark grey-brown silt-clay, containing moderately frequent sub-angular gravel and occasional sub-angular cobbles (<0.07m diameter). The subsoil was some 0.25m thick.

As in the other trenches in Site 11, there was a distinct change in the underlying geological deposits within this trench. The south-eastern end of the trench was characterised by a friable, mid orange silt-clay containing frequent sub-angular cobbles. At the mid way point of the trench, this was then replaced by a deposit of weathered bed-rock, similar to that observed in the other trenches in Site 11.

Trench 5 – Figure 1/Plate 5

This trench targeted the northern end of a long linear anomaly of possible archaeological origin, which appears to run south from Site 11 into Site 8c, where it turns to run in a south-easterly direction, before turning back south again (also targeted by Trenches 6, 7 and 12). The trench measured 20.0m x 2.0m, and was orientated north-west/south-east; it was located down the side of a small fairly steep rise, close to the southern boundary of Site 11.

No archaeological explanation for the targeted anomaly was identified.

The non-archaeological deposits in this trench consisted of a moderate topsoil, some 0.2m thick, of a soft, dark brown, silt-clay, containing occasional sub-rounded gravel. This overlay a subsoil of firm, mid brown silt-clay, containing moderately frequent sub-angular gravel and occasional sub-angular cobbles (<0.07m diameter). The subsoil was some 0.25m thick.

As in the other trenches in Site 11, there was a distinct change in the underlying geological deposits within this trench. The south-eastern end of The trench measured characterised by a firm, mid orange silt-clay containing frequent sub-angular cobbles. At the mid way point of the trench, this was then replaced by a deposit of weathered bed-rock, similar to that observed in the other trenches in Site 11. These distinct changes in the geology are likely to be the cause of the linear anomalies identified in the geophysics results.

Trench 6 – Figure 1/Plate 6

This trench targeted the middle of a long linear anomaly of possible archaeological origin, which appears to run south from Site 11 into Site 8c, where it turns to run in a south-easterly direction, before turning back south again (also targeted by Trenches 5, 7 and 12). The trench measured 20.0m x 2.0m, and was orientated north-west/south-east; it was located on a flat area at the northern end of Site 8c.

No archaeological explanation for the targeted anomaly was identified. However a small tree-bowl containing concentrated patches of charcoal was identified at the north-eastern end of the trench.

The non-archaeological deposits in this trench consisted of a shallow topsoil, some 0.1m thick, of a soft, mid brown, silt-clay, containing occasional sub-rounded cobbles(<0.1m). This overlay a subsoil of friable, mid grey sand-clay, containing moderately frequent sub-angular gravel and occasional sub-angular cobbles (<0.1m diameter). The subsoil was some 0.15m thick.

As in the trenches in Site 11, there was a distinct change in the underlying geological deposits within this trench. A band of weathered bed-rock (similar to that observed in Site

11) some 12.5m wide ran across the middle of the trench, whilst at either end, this was replaced by a firm, mid orange silt-clay containing frequent sub-angular cobbles. These distinct changes in the geology are likely to be the cause of the linear anomaly identified in the geophysics results. These distinct changes in the geology are likely to be the cause of the linear anomalies identified in the geophysics results.

Trench 7 – Figure 1/Plate 7

This trench targeted the southern end of a long linear anomaly of possible archaeological origin, which appears to run south from Site 11 into Site 8c, where it turns to run in a south-easterly direction, before turning back south again (also targeted by Trenches 5, 6 and 12). The trench measured 20.0m x 2.0m, and was orientated north-west/south-east; it was located on a moderate slope, towards the southern boundary of Site 11.

No archaeological explanation for the targeted anomaly was identified.

The non-archaeological deposits in this trench consisted of a shallow topsoil, some 0.1m thick, of a friable, dark grey, silt-clay, containing occasional sub-angular gravel. This overlay a subsoil of friable, light grey-brown silt-clay, containing moderately frequent sub-angular gravel and occasional sub-angular cobbles (<0.1m diameter). The subsoil was some 0.35m thick.

As in the other trenches in sites11 and 8c, there was a distinct change in the underlying geological deposits within this trench. The north-western end of the trench was characterised by a friable but firm, mid orange silt-clay containing frequent sub-angular cobbles. Some 5m from the south-eastern end of the trench this was then replaced by a deposit of weathered bed-rock, similar to that observed in the other trenches in Sites 11 and 8c. These distinct changes in the geology are likely to be the cause of the linear anomalies identified in the geophysics results.

Trench 8 - – Figure 1/Plate 8

This trench targeted a curvilinear feature of possible archaeological origin. The trench measured 20.0m x 2.0m, and was orientated north-west/south-east; it was located on a steep slope, close to the southern end of Site 11.

No archaeological explanation for the targeted anomaly was identified.

The non-archaeological deposits in this trench consisted of a shallow topsoil, some 0.12m thick, of a friable, light grey, sand-silt, containing occasional sub-angular gravel. This overlay a subsoil of friable, light brown-grey sand-clay, containing frequent sub-angular gravel and occasional sub-angular cobbles (<0.1m diameter). The subsoil was some 0.35m thick, and petered out towards the north-eastern end of the trench, as it rose towards the top of the slope.

As in the other trenches in Sites 11 and 8c, there was a distinct change in the underlying geological deposits within this trench. The north-western end of the trench, at the top of the slope, was characterised by a deposit of weathered bed-rock, similar to that observed in the other trenches in Sites 11 and 8c. At approximately the mid way point of the trench this was replaced by a friable, light orange silt-clay containing frequent sub-angular cobbles. Some 1.5m from the south-eastern end of the trench this silt-clay deposit changed became more compact, and changed to a light, mottled orange/ yellow shade. These distinct changes in the geology are likely to be the cause of the linear anomalies identified in the geophysics results.

Trench 9 – Figure 1/Plate 9

This trench targeted a possible in-filled pond. The trench measured 20.0m x 2.0m, and was orientated north-west/south-east; it was located on undulating ground, close to the eastern boundary of Site 11.

The clay deposits observed at the north-western end of the trench are consistent with the pond interpretation; however there was nothing to suggest that this was anything more than a natural feature.

The non-archaeological deposits in this trench consisted of a shallow topsoil, some 0.1m thick, of a fairly friable, light grey, silt clay, containing occasional sub-angular gravel. This overlay a subsoil of friable, light grey-brown, silt-clay, containing occasional sub-angular gravel and cobbles (<0.1m diameter). The subsoil was some 0.26m thick, and at the north-western overlay several bands of clay, a total of 0.25m thick. The interface between the clay deposits was diffuse, consistent with alluvial deposits associated with a pond.

The changes in the underlying geological deposits within this trench, were particularly marked and numerous. Two ridges of bedrock and weathered bedrock ran east-west across the trench, at the north-western end, and in the middle. These ridges were interspersed by deposits of compact mottled yellow-brown clay.

Trench 10 – Figure 1/Plate 10

This trench targeted an area of closely spaced parallel linear anomalies, interpreted as features probably related to agricultural activity such as ploughing. The trench measured 19.5m x 2.0m, and was orientated north-west/south-east; it was located on fairly flat ground, in the north-western corner of Site 11.

No archaeological explanation for the targeted anomaly was identified. However a small tree-bowl was identified towards the middle of the trench.

The non-archaeological deposits in this trench consisted of a shallow topsoil, some 0.1m thick, of a friable, mid brown, silt clay, containing occasional sub-angular cobbles. This overlay a subsoil of friable, light brown, silt-clay, containing frequent sub-angular gravel and cobbles (<0.1m diameter). The subsoil was some 0.18m thick.

As in the other trenches in sites11 and 8c, there were distinct changes in the underlying geological deposits within this trench. The north-western end of the trench was characterised by a deposit of weathered bed-rock, similar to that observed in the other trenches in Sites 11 and 8c. After some 2m this was replaced by a firm, light yellow-grey, silt-clay, containing occasional sub-angular cobbles. At approximately the mid way point of the trench this deposit changed to a firm, light grey-brown, silt-clay, containing frequent flecks of orange-brown silt-clay and moderately frequent sub angular cobbles. These distinct changes in the geology are likely to be the cause of the linear anomalies identified in the geophysics results.

Trench 11 – Figure 1/Plate 11

This trench targeted a linear feature, orientated north-east/south-west, of possible archaeological origin. The trench measured 19.0m x 2.0m, and was orientated north-west/south-east; it was located on a moderate slope, close to the western boundary of Site 11.

The cause of the linear anomaly targeted by this trench was positively identified as a fairly substantial linear feature running north-east/south-west across the trench, some 4.7m from the south-eastern end. The cut was 0.55m in width and 0.35m in depth, it had steeply

sloping sides and a flat base. It was cut into the natural, and contained a single stony deposit, surrounded by a silt-clay matrix. This feature has been interpreted as a hand-dug French drain.

The non-archaeological deposits in this trench consisted of a shallow topsoil, some 0.1m thick, of a soft, mid grey-brown, silt clay, containing occasional sub-rounded coarse gravel. This overlay a subsoil of firm, mid brown-grey, silt-clay, containing occasional sub-rounded cobbles (<0.1m diameter). The subsoil was some 0.2m thick.

As in the other trenches in sites11 and 8c, there were distinct changes in the underlying geological deposits within this trench. The north-western end of the trench was characterised by a deposit of weathered bed-rock, similar to that observed in the other trenches in Sites 11 and 8c. After some 4m this was replaced by a firm, mid orange-brown, silt-clay, containing moderately frequent sub-angular cobbles. At approximately the mid way point of the trench this deposit changed to a firm, mid brown-grey, silt-clay, with mottled orange patches.

Trench 12 – Figure 1/Plate 12

This trench targeted the middle of a long linear anomaly of possible archaeological origin, which appears to run south from Site 11 into Site 8c, where it turns to run in a south-easterly direction, before turning back south again (also targeted by Trenches 5, 6 and 7). This trench also targeted the north-eastern end of a linear feature, also investigated by trench 11; and the middle of third linear, running north/south, again identified as being of possible archaeological origin. The trench measured 20.0m x 2.0m, and was orientated north-west/south-east; it was located on a moderate slope, in the middle of Site 11.

As in Trenches 5, 6 and 7, no archaeological explanation for the long linear anomaly which runs down from Site 11into Site 8c was identified. Curiously, no archaeological explanation was identified for the linear which in Trench 11 was identified as a substantial French drain; it seems that the feature must have run out by this point. The third, north-south running anomaly proved to be a very substantial feature, of a similar construction to the French drain in Trench 11. The cut was 0.6m in width and 0.55m in depth, it had steeply sloping sides and a flat base. It was cut into the natural, and contained a single stony deposit, consisting of loose sub-angular cobbles graded slightly, with larger cobbles at the base, and surrounded by a silt-clay matrix.

The non-archaeological deposits in this trench consisted of a shallow topsoil, some 0.1m thick, of a friable, dark grey-brown, clay-silt, containing occasional sub-angular coarse gravel. This overlay a subsoil of friable, mid brown-grey, silt-clay, containing occasional sub-angular coarse gravel and cobbles (<0.06mdiameter). The subsoil was some 0.3m thick. A colluvial deposit, some 0.2m thick was observed running below the subsoil. This deposit was a compact, mid grey, silt clay containing frequent sub-angular cobbles (<0.1m diameter).

The changes in the underlying geological deposits within this trench, were particularly marked and numerous. The north-western end of the trench was characterised by a deposit of weathered bed-rock, similar to that observed in the other trenches in Sites 11 and 8c. After some 3.7m this was replaced by several friable but compact bands of silt-clay, containing moderately frequent sub-angular gravel and cobbles, with patches of bedrock showing through in places.

4.2 Archaeological Trial Trenches – Pipeline Route

Trench 13 – Figure 1/Plates 13 and 14

Trench 13 was located to target GAT Report **957** Feature 2: *Terrace/former field bank.*

The T-shaped trench measured 2 x 2.0m by 20.0m (80m^2) and was designed to cover the easement width and pipe route centreline as comprehensively as possible within the area of suspected archaeological activity.

The trench depth was relatively shallow: up to 0.40m; silt stone bedrock was identified at the western and southern ends of the trench areas, with Morainic Drift in all other areas. The topsoil measured 0.10m in depth and the subsoil (characterised as denuded topsoil) measured up to 0.30m in depth.

The terrace was not identified as a structural feature of archaeological origin but was interpreted as geological in origin, represented by the transition from rockhead to the drift geology within the local area.

Trench 14 – Figure 1/Plates 15 and 16

Trench 14 was located to target GAT Report **957** Feature 4: *Area of potential for prehistoric activity*.

The T-shaped trench measured 2 x 2.0m by 20.0m (80m^2) and was designed to cover the easement width and pipe route centreline as comprehensively as possible within the area of suspected archaeological activity.

No evidence for prehistoric archaeology was identified within the confines of the trench: three redundant stone-filled field drains were identified within the northwest-southeast portion of the trench; orientated generally north-south.

No bedrock was identified within the trench confines: the topsoil was shallow, up to 0.20m in depth, followed by 0.15m of subsoil (denuded topsoil, with evident waterlogging), atop glacial boulder clay.

Trench 15 – Figure 1; Figures 3 to 7/Plate 17 to Plate 24

Trench 15 was located to target GAT Report **957** Feature 6: *Area of potential for prehistoric activity*.

The T-shaped trench measured 2 x 2.0m by 20.0m (80m^2) and was designed to cover the easement width and pipe route centreline as comprehensively as possible within the area of suspected archaeological activity.

A linear feature, truncated by several smaller gullies and pits of a possible pre-historic date was identified within the northern end of the trench *c.*3.0m from the northeastern limit of the easement (Figure 03).

The feature measured *c.*2.0m wide, running off the edge of excavation to the north-west and south-east. The feature was cut into the bedrock (fractured, fine silt stone), which had moderately sloping sides and a flat base (Figure 06). The natural fault lines of the bedrock had informed the shape of the cut. The rock displayed evidence

of in situ burning in the base of south-eastern end of the cut, and was filled by two deposits.

Two slightly irregular gullies, a maximum of 0.7m wide, were cut into either side of the main feature, later in date, but apparently running parallel to it. The gullies contained fairly frequent sub-rounded cobbles (<0.3m diameter), along with lumps of charcoal and burnt clay, and very small fragments of burnt bone (Figures 3 and 5).

In turn the gullies were truncated by a total of five small sub-circular pits (Figures 3 and 4). These pits appeared to intercut each other slightly, indicating that they were not all contemporary, however exact relationships proved difficult to ascertain due to truncation. Again lumps of charcoal and burnt clay were evident within the fills of some of these pits. No obvious function for these pits was evident, they were small for waste pits, and there was no obvious evidence of them being post holes (e.g. in the form of packing or post pipes).

The entire area was covered by a patchy deposit, which contained frequent inclusions of burnt clay, similar to that observed in the earlier features. This burnt clay may represent remnants of daub from a structure, or a possible kiln or furnace lining. No clay was observed in situ. A couple of lumps of possible slag were also identified within this deposit.

The three distinct phases, the rock cut linear, the parallel running gullies and the intercutting pits indicate a fairly lengthy period of activity, and the large quantity of burnt clay suggests possible industrial processes.

4.3 Geotechnical Ground Investigation Trial Pits

STP03

This trial pit had the dual purpose of geotechnical ground investigation and locating a water pipe. The trial pit measured 3.8m x 0.6m, and had a maximum depth of 1.2m

The trial pit located a wide ceramic pipe, located 0.6m below the surface, lying within a trial pit cut into the natural boulder clay. The pipe was no longer in use. No archaeological deposits were observed.

The non-archaeological deposits in this trial pit consisted of a moderate topsoil, some 0.2m thick, of a friable, mid brown-grey, clay-silt, containing moderately frequent sub-angular coarse gravel. This overlay a subsoil of firm, mid grey-brown, silt-clay, containing moderately frequent sub-angular coarse gravel and occasional sub-angular cobbles (<0.06mdiameter). The subsoil was some 0.3m thick. The underlying geological deposit was a friable but firm mid brown-yellow silt-clay containing occasional sub-angular coarse gravel.

STP06

This trial pit had the dual purpose of geotechnical ground investigation and locating a water pipe. The trial pit measured 3.6m x 0.8m, and had a maximum depth of 1m. It was orientated east-north-east/west-south-west.

The trial pit located a 0.48m wide pipe, located 0.66m below the surface, lying within a 1m wide trial pit cut into the natural boulder clay. The pipe is still in use. No archaeological deposits were observed.

The non-archaeological deposits in this trial pit consisted of a shallow topsoil, some 0.1m thick, of a friable, mid grey-brown, sand-silt, containing moderately frequent sub-angular coarse gravel. This overlay a subsoil of firm but friable, mid grey-brown, sand-silt, containing moderately frequent sub-angular coarse gravel and occasional sub-angular cobbles (<0.06mdiameter). The subsoil was some 0.3m thick. The underlying geological deposit consisted of sub-angular, fine sandstone cobbles, surrounded by a friable, mid brown, sand-silt matrix.

STP09

This was a geotechnical ground investigation trial pit. The trial pit measured 2.0m x 0.6m, and had a maximum depth of 0.5m. It was orientated north-east/south-west.

No archaeological deposits were observed within this trial pit.

The non-archaeological deposits in this trial pit consisted of a shallow topsoil, some 0.1m thick, of a friable, mid grey-brown, clay-silt, containing moderately occasional sub-angular coarse gravel. This overlay a firm mid, grey-brown, clay-silt, containing moderately frequent gravel and sub-angular cobbles. The underlying geological deposit consisted of sub-angular, fine sandstone cobbles, surrounded by a friable, mid brown, sand-silt matrix.

STP10

This was a geotechnical ground investigation trial pit. The trial pit measured 2.0m x 0.6m, and had a maximum depth of 0.75m. It was orientated north/south.

No archaeological deposits were observed within this trial pit.

The non-archaeological deposits in this trial pit consisted of a substantial topsoil, some 0.3m thick, of a friable, mid brown, sand-clay-silt, containing moderately frequent sub-angular gravel and cobbles. This overlay directly a natural geological deposit friable, mid brown-yellow, sand-silt containing frequent sub angular cobbles of a fine silt-stone.

STP11

This was a geotechnical ground investigation trial pit. The trial pit measured 2.0m x 0.6m, and had a maximum depth of 1.9m. It was orientated north/south.

No archaeological deposits were observed within this trial pit.

The non-archaeological deposits in this trial pit consisted of a fairly substantial topsoil, some 0.25m thick, of a firm, dark grey-brown, silt-clay, containing occasional sub-angular gravel. This overlay a very thick colluvial deposit, some 1.65m thick, consisting of a firm mid yellow-brown, sand-silt-clay, containing moderately frequent sub-angular cobbles. A compact, mid yellow clay was visible at the very base of the trial pit.

5 CONCLUSIONS

5.1 Proposed Reservoir and Compound (Sites 11 and 8c)

The archaeological features within Sites 11 and 8c identified consisted of various types of simple agricultural drainage, used for redistributing ground and surface water. The larger stone filled drains tend to be referred to as French drains, as described and popularised by Henry French (1813-1885). The examples of French drain on this site appear to have been excavated by hand, rather than machine, and do not contain any form of pipe, simply deposits of graded stone. Despite being of a simple construction, these features, one of which in particular (q.v. Trench 12) was cut to a depth of over a meter below the surface

level, represent a significant attempt at land improvement. The absence of a pipe, and the hand dug nature of the cut indicate a pre-industrial date, of around the 18th century.

No evidence for GAT Report **957** Feature 8: *Area of potential for prehistoric activity* was identified within the evaluated areas.

5.2 Proposed Pipeline Route

Within the five observed geotechnical ground Investigation trial pits, no archaeological deposits or features of note were identified within the confines of any example, bar a redundant post-medieval ceramic field drain in STP 03. Colluvia up to 1.65m thick was recorded in STP 11, located at the western limit of the pipeline route, north of Llansanffraid Glan Conwy. Topsoil/Subsoil horizons varied from a 0.30m to 0.50m in depth.

Within the three archaeological evaluation trenches (Trenches 13 to 15), archaeological activity was identified in Trenches 13 and 15. Trench 13 contained agricultural drainage indicative of land improvement and management; Trench 15 contained three distinct phases of archaeological activity: a rock cut linear, succeeded by the parallel running gullies and then intercutting pits. The presence of burnt clay within the subsoil horizon as well as the intercutting pits, suggests the presence of further localised activity indicative, possibly of kiln firing or other industrialised process. The date of the activity could not be determined during on-site works but charcoal was recovered for possible C^{14} dating. The archaeological activity in Trench 15 was concentrated in the northeastern end of one of the two spurs forming the T-shaped trench (Figure 03). No similar activity was identified within the remainder of the trench. This implies that the linear feature and gullies continue on an alignment parallel and to the northeast of the centreline of the pipeline; the pit clusters also appear to continue to the northeast of the centreline (the full extent of which could not be determined within the confines of the trench).

6 RECOMMENDATIONS

Recommendation is given for further evaluation and/or mitigation to examine the Trench 15 area and to mitigate the scheme as a whole: an archaeological watching brief during main works is recommended for the pipeline route and reservoir/compound site; whereas further evaluation and/or controlled stripping under archaeological control is recommended for a targeted area surrounding Trench 15.

Following Institute for Archaeologists (IFA) guidelines (*Standard and Guidance for Archaeological Watching Brief (Institute for Archaeologists*, 1994, rev. 2001 & 2008), watching briefs are divided into four main categories:

- comprehensive (present during all ground disturbance)
- intensive (present during sensitive ground disturbance)
- intermittent (viewing the trenches after machining)
- partial (as and when seems appropriate).

Specific recommendations would be as follows:

6.1 Proposed Reservoir and Compound (Sites 11 and 8c)

A partial watching brief; to be undertaken during works, in response to the client/contractors programme and during initial site clearance. Attendance would be programmed accordingly.

Despite the universal cover attempted by the geophysics and the high % of trial trenching, there is still an inherent risk in "blank" areas (where the geophysics did not identify an anomaly and it was not evaluated) and this tactical approach should provide suitable mitigation.

6.2 Proposed Pipeline Route

NB. GAT Report **957** Features **3**, **5**, **7** and **10** (hedge banks) are to be mitigated during main works (photographic/written records)

At the location of Trench 15 (centred on NGR SH81357620) it is recommended that further evaluation and/or mitigation of a larger area within the easement is undertaken in advance of main works (or in tandem if a strategy of controlled strip is agreed). It is also recommended that the charcoal samples recovered from the identified features during the current evaluation are assessed for palaeoenvironmental potential, which could provide dating and/or phasing for the multi-phase activity within this location. The dating of these features could be completed prior to main works to inform the mitigation strategy.

The linear feature within Trench 15 is orientated on a similar alignment to the proposed pipe centreline, but several metres to the north and may continue for some distance within the easement route. The linear feature may not be directly impacted by the centreline trench, but the topsoil cover is thin in this area and the main works easement strip may expose the feature or the feature may be covered by only a shallow interface. If the easement is to be used as a laydown and traffic area, then the feature may not be protected; the pit cluster may also continue across the easement and the burnt clay rich deposit may indicate further localised activity within the easement area. It may be possible to utilise targeted geophysics within the localised area as an additional evaluation phase to determine the extent of the multiphase archaeological activity, particularly the alignment of the linear feature and gullies as well as the distribution of the pit cluster. However, the existence of burnt clay within the deposit above the pit cluster as well as within the pit cluster may give off a large thermoremnant anomaly signal that could mask the features beneath.

An intensive watching brief is recommended at the western end of the scheme where the thick colluvium identified in the client's trial pit STP 11 has the potential to mask underlying archaeology (which could not be identified through aerial photography, walkover survey or geophysics (colluvium too thick at over a metre depth)).

An intermittent watching brief is recommended for the remainder of the scheme (east of STP11 environs and excluding the Trench 15 environs), as with the reservoir/compound, completed in tandem with the client/contractor programme and maintained during easement strip and open trenching. For the easement strip and open trenching it is recommended that the contractor utilises a tracked excavator with a *toothless* bucket, at least as far as the glacial horizon; it is not recommended that bulldozer blades are used for the easement strip or the reservoir/compound clearance as this could negate the effectiveness of the archaeological watching brief.

7 SOURCES CONSULTED

Haddrell, S. 2011. COED DOLWYD SERVICE RESERVOIR AND ASSOCIATED PIPEWORK – Geophysical Survey: Preliminary Data.

Smith, G. and Evans, R. 2011GAT Report **957**: COED DOLWYD SERVICE RESERVOIR AND ASSOCIATED PIPEWORK – Archaeological Assessment

Standard and Guidance for Archaeological Watching Brief (Institute for Archaeologists, 1994, rev. 2001 & 2008)

Appendix I

STRATASCAN

Geophysical Survey Report

Llansanffriad Glan Conwy

for

Gwynedd Archaeological Trust

September 2011

Job ref. 2958

Simon Haddrell BEng(Hons) AMBCS PIFA

Document Title:	**Geophysical Survey Report Llansanffraid Glan Conwy**
Client:	**Gwynedd Archaeological Trust**
Stratascan Job No:	**2958**
Techniques:	**Detailed magnetic survey (gradiometry)**
National Grid Ref:	**SH 816 760**

Field Team:	**Richard Fleming, James Wilkinson and Jon Simpson**
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LIST OF FIGURES

1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over land at Llansanffraid Glan Conwy, and has identified a small number of cut features which are likely to be associated with archaeology. A significant amount of further positive features, providing weaker evidence for archaeology, has also been identified around the site. Some of these features may be associated with the local geology / pedology.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by Gwynedd Archaeological Trust.

2.2 Site location

The site is located to the east of Llansanffraid and to south west of Rhyd-Ifan at OS ref. SH 816 760.

2.3 Description of site

The survey area comprises approximately 4.2ha split across two pasture fields.

2.4 Geology and soils

The underlying geology is Nantglyn Flags formations containing mudstone and silt stone. No drift geology has been recorded. (British Geological Survey, website, September 2011).

The overlying soils are known as Denbigh 1 which are typical brown earths. These consist of well drained fine loamy and fine silty soils over rock. (Soil Survey of England and Wales, Sheet 02 Wales).

2.5 Site history and archaeological potential

Although not specific details were available to Stratascan there is a high potential for prehistoric activity within the survey area.

2.6 Survey objectives

The objective of the survey was to locate any features of possible archaeological significance in order that they may be assessed prior to development.

2.7 Survey methods

Detailed magnetic survey (gradiometry) was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in the Methodology section below.

3 METHODOLOGY

3.1 Date of fieldwork

The fieldwork was carried out over 4 consecutive days from 13th September 2011. Weather conditions during the survey were dry with sunny intervals.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 2 together with the referencing information. Grids were set out using a Leica Smart Rover RTK GPS.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. A SmartNet RTK GPS uses Ordnance Survey's network of over 100 fixed base stations to give an accuracy of around 0.01m.

3.3 Survey equipment and gradiometer configuration

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, can be accurately detected using an appropriate instrument.

The mapping of the anomaly in a systematic manner will allow an estimate of the type of material present beneath the surface. Strong magnetic anomalies will be generated by buried iron-based objects or by kilns or hearths. More subtle anomalies such as pits and

ditches can be seen if they contain more humic material which is normally rich in magnetic iron oxides when compared with the subsoil.

To illustrate this point, the cutting and subsequent silting or backfilling of a ditch may result in a larger volume of weakly magnetic material being accumulated in the trench compared to the undisturbed subsoil. A weak magnetic anomaly should therefore appear in plan along the line of the ditch.

The magnetic survey was carried out using a dual sensor Grad601-2 Magnetic Gradiometer manufactured by Bartington Instruments Ltd. The instrument consists of two fluxgates very accurately aligned to nullify the effects of the Earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background. The Grad601-2 consists of two high stability fluxgate gradiometers suspended on a single frame. Each gradiometer has a 1m separation between the sensing elements so enhancing the response to weak anomalies.

3.4 Sampling interval, depth of scan, resolution and data capture

3.4.1 Sampling interval

Readings were taken at 0.25m centres along traverses 0.5m apart. This equates to 7200 sampling points in a full 30m x 30m grid.

3.4.2 Depth of scan and resolution

The Grad 601-2 has a typical depth of penetration of 0.5m to 1.0m, though strongly magnetic objects may be visible at greater depths. The collection of data at 0.25m centres provides an optimum methodology for the task balancing cost and time with resolution.

3.4.3 Data capture

The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

3.5 Processing, presentation of results and interpretation

3.5.1 Processing

Processing is performed using specialist software known as *Geoplot 3.* This can emphasise various aspects contained within the data but which are often not easily seen in the raw data. Basic processing of the magnetic data involves 'flattening' the

background levels with respect to adjacent traverses and adjacent grids. 'Despiking' is also performed to remove the anomalies resulting from small iron objects often found on agricultural land. Once the basic processing has flattened the background it is then possible to carry out further processing which may include low pass filtering to reduce 'noise' in the data and hence emphasise the archaeological or man-made anomalies.

The following schedule shows the basic processing carried out on all processed gradiometer data used in this report:

1. *Destripe* (Removes striping effects caused by zero-point discrepancies between different sensors and walking directions)

2. *Destagger* (Removes zigzag effects caused by inconsistent walking speeds on sloping, uneven or overgrown terrain)

3.5.2 Presentation of results and interpretation

The presentation of the data for each site involves a print-out of the minimally processed data both as a greyscale plot (Figure 03) and a colour plot showing extreme magnetic values (Figure 04). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figure 05).

4 RESULTS

The following list of numbered anomalies refers to numerical labels on the interpretation plots (Figure 5).

Probable Archaeology

1. A number of positive linear anomalies are likely to represent infilled ditches, perhaps indicating former field / enclosure boundaries or possibly ceremonial functions. These features are limited to the north of the site.

Possible Archaeology

2. A number of positive linear anomalies, possibly associated with infilled ditches providing weak evidence of archaeological activity, are evident around the survey area.

3. Some amorphous positive anomalies may represent cut features such as pits or ditches but lack any distinctive form indicating a natural origin. However due to the potential for prehistoric activities these features may alternatively be of an archaeological origin.

4. A number of magnetic 'spikes' (strong focussed values with associated antipolar response) indicate ferrous metal objects. Although most of these are likely to be modern debris, some may be of archaeological interest. Particular attention may be paid to those found in association with other potentially archaeological anomalies.

Other Anomalies

5. Areas of magnetic disturbance are the result of substantial nearby ferrous metal objects such as fences and underground services. These effects can mask weaker archaeological anomalies but on this site have not affected a significant proportion of the area.

6. A positive area anomaly with an associated negative response, possibly caused by an infilled pond, is evident in the south of the field.

7. Four strong bipolar responses, associated with probable borehole caps, can be seen in the northern field.

5 CONCLUSION

The geophysical survey undertaken at Llansanfraid Glan Conwy is dominated by a large amount of moderately strong background variations associated with the local geology / pedology. Even with the background 'noise' the survey has identified a few probable and a number of possible archaeological cut features. Some of the possible cut features are amorphous and may be of a natural origin.

The survey has also identified a possible infilled pond, magnetic spikes, magnetic disturbance, borehole caps and modern agricultural marks.

6 REFERENCES

British Geological Survey, n.d., *website* (http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 2 Wales.*

APPENDIX A – Basic principles of magnetic survey

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

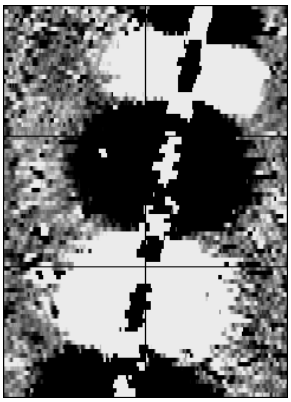
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically either 0.5 or 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.

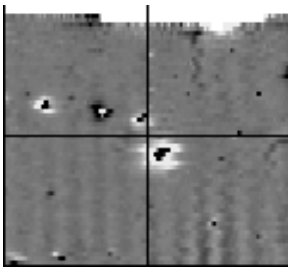
APPENDIX B – Glossary of magnetic anomalies

Bipolar



A bipolar anomaly is one that is composed of both a positive response and a negative response. It can be made up of any number of positive responses and negative responses. For example a pipeline consisting of alternating positive and negative anomalies is said to be bipolar. See also dipolar which has only one area of each polarity. The interpretation of the anomaly will depend on the magnitude of the magnetic field strength. A weak response may be caused by a clay field drain while a strong response will probably be caused by a metallic service.

Dipolar

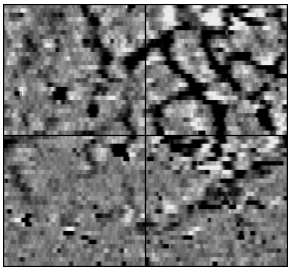


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very strong anomaly is likely to be caused by a ferrous object.

Positive anomaly with associated negative response

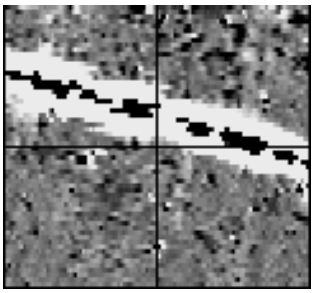
See bipolar and dipolar.

Positive linear



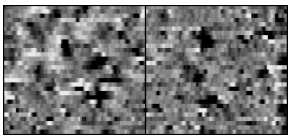
A linear response which is entirely positive in polarity. These are usually related to in-filled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity and some may even have a natural origin.

Positive linear anomaly with associated negative response



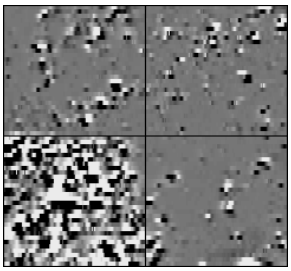
A positive linear anomaly which has a negative anomaly located adjacently. This will be caused by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field boundaries.

Positive point/area



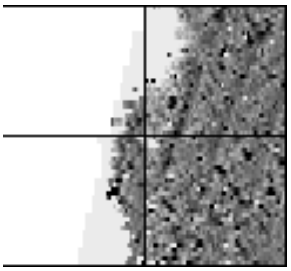
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by in-filled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally occurring depressions in the ground.

Magnetic debris



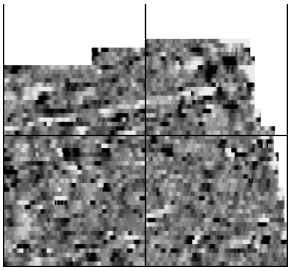
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low (+/-3nT) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly (+/-250nT) is more indicative of a spread of ferrous debris. Moderately strong anomalies may be the result of a spread of thermoremanent material such as bricks or ash.

Magnetic disturbance



Magnetic disturbance is high amplitude and can be composed of either a bipolar anomaly, or a single polarity response. It is essentially associated with magnetic interference from modern ferrous structures such as fencing, vehicles or buildings, and as a result is commonly found around the perimeter of a site near to boundary fences.

Negative linear

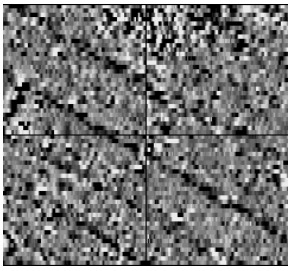


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative the background top soil is built up. See also ploughing activity.

Negative point/area

Opposite to positive point anomalies these responses may be caused by raised areas or earthen banks. These could be of an archaeological origin or may have a natural origin.

Ploughing activity



Ploughing activity can often be visualised by a series of parallel linear anomalies. These can be of either positive polarity or negative polarity depending on site specifics. It can be difficult to distinguish between ancient ploughing and more modern ploughing, clues such as the separation of each linear, straightness, strength of response and cross cutting relationships can be used to aid this, although none of these can be guaranteed to differentiate between different phases of activity.

Polarity

Term used to describe the measurement of the magnetic response. An anomaly can have a positive polarity (values above 0nT) and/or a negative polarity (values below 0nT).

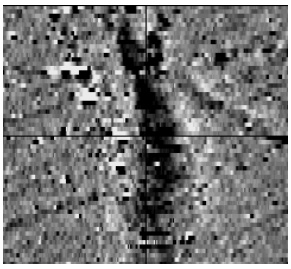
Strength of response

The amplitude of a magnetic response is an important factor in assigning an interpretation to a particular anomaly. For example a positive anomaly covering a $10m^2$ area may have values up to around 3000nT, in which case it is likely to be caused by modern magnetic interference. However, the same size and shaped anomaly but with values up to only 4nT may have a natural origin. Colour plots are used to show the amplitude of response.

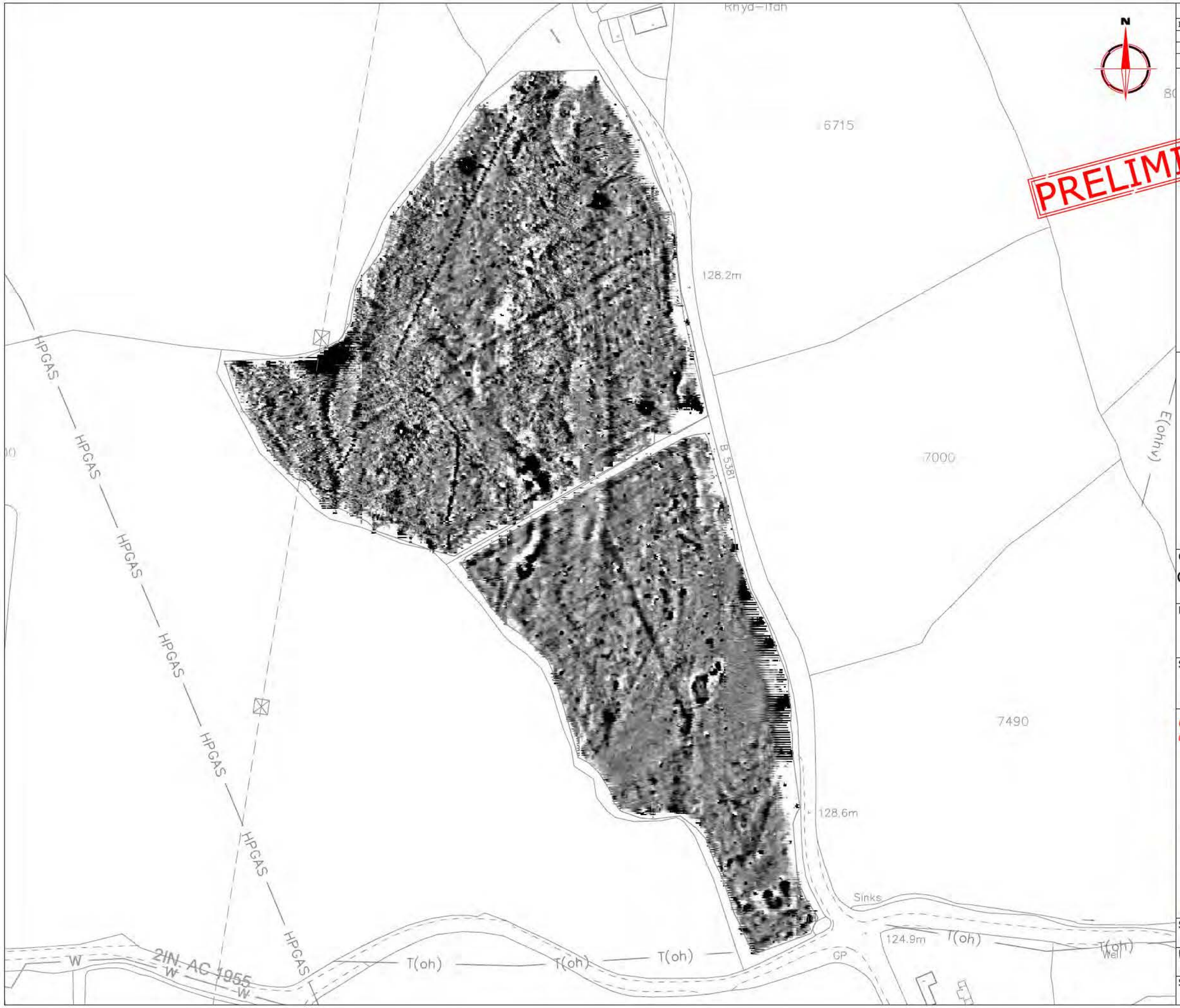
Thermoremanent response

A feature which has been subject to heat may result in it acquiring a magnetic field. This can be anything up to approximately +/-100 nT in value. These features include clay fired drains, brick, bonfires, kilns, hearths and even pottery. If the heat application has occurred in situ (e.g. a kiln) then the response is likely to be bipolar compared to if the heated objects have been disturbed and moved relative to each other, in which case they are more likely to take an irregular form and may display a debris style response (e.g. ash).

Weak background variations



Weakly magnetic wide scale variations within the data can sometimes be seen within sites. These usually have no specific structure but can often appear curvy and sinuous in form. They are likely to be the result of natural features, such as soil creep, dried up (or seasonal) streams. They can also be caused by changes in the underlying geology or soil type which may contain unpredictable distributions of magnetic minerals, and are usually apparent in several locations across a site.



PRELIMINARY

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +3nT (black)
Minimum -3nT (white)

-3nT +3nT

+3nT

-3nT

Client

GWYNEDD ARCHAEOLOGICAL TRUST

Project Title — Job No. 2958

GEOPHYSICAL SURVEY - LLANSANFFRAID GLAN

Subject

PLOT OF PROCESSED GRADIOMETER DATA

STRATASCAN™
GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING
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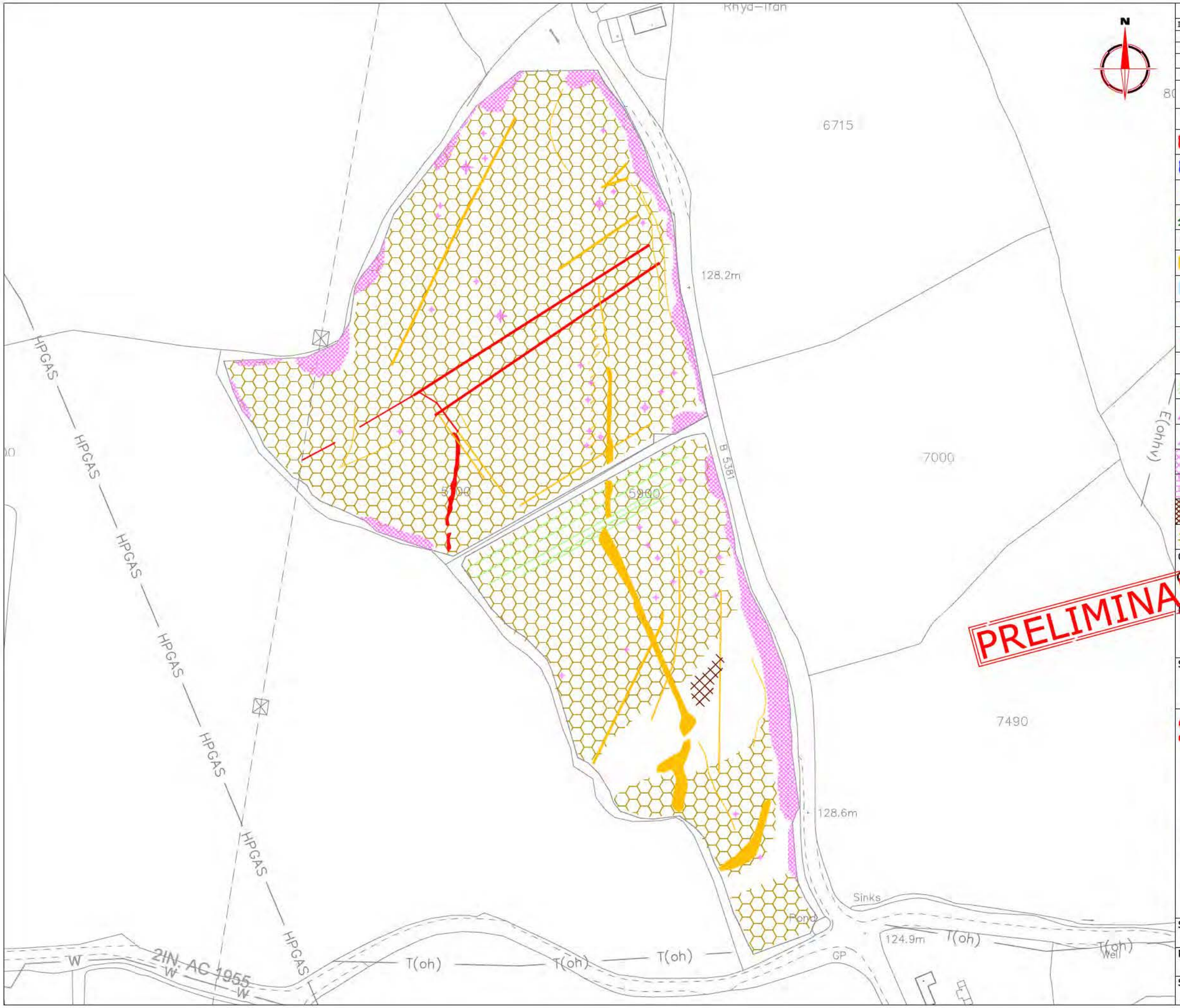
SUMO GROUP MEMBER

Scale 1:1500 — 0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	RAJS	01
Survey date	Drawn by	Figure No.
SEPT 11	SDH	A



PRELIMINARY

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

PROBABLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - probable cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - probable bank or earthwork of archaeological origin
- Moderate strength discrete anomaly - probable thermoremanent feature
- Widely spaced curving parallel linear anomalies - probably related to ridge-and-furrow

POSSIBLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - possible cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - possible bank or earthwork of archaeological origin
- Moderate strength discrete anomaly - possible thermoremanent feature
- Magnetic spike - probable ferrous object

OTHER ANOMALIES

- Closely spaced parallel linear anomalies - probably related to agricultural activity such as ploughing
- Linear anomaly - probably related to pipe, cable or other modern service
- Linear anomaly - possibly related to land drain
- Magnetic disturbance associated with nearby metal object such as service or field boundary
- Strong magnetic debris - possible disturbed or made ground
- Possible in-filled pond
- Area of amorphous magnetic variation - probable natural (e.g. geological or pedological) origin

Client
CWYNEDD ARCHAEOLOGICAL TRUST

Project Title — Job No. 2958
GEOPHYSICAL SURVEY - LLANSANFFRAID GLAN

Subject
ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES

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Scale 1:1500 — 0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	RAJS	01
Survey date	Drawn by	Figure No.
SEPT 11	SDH	B

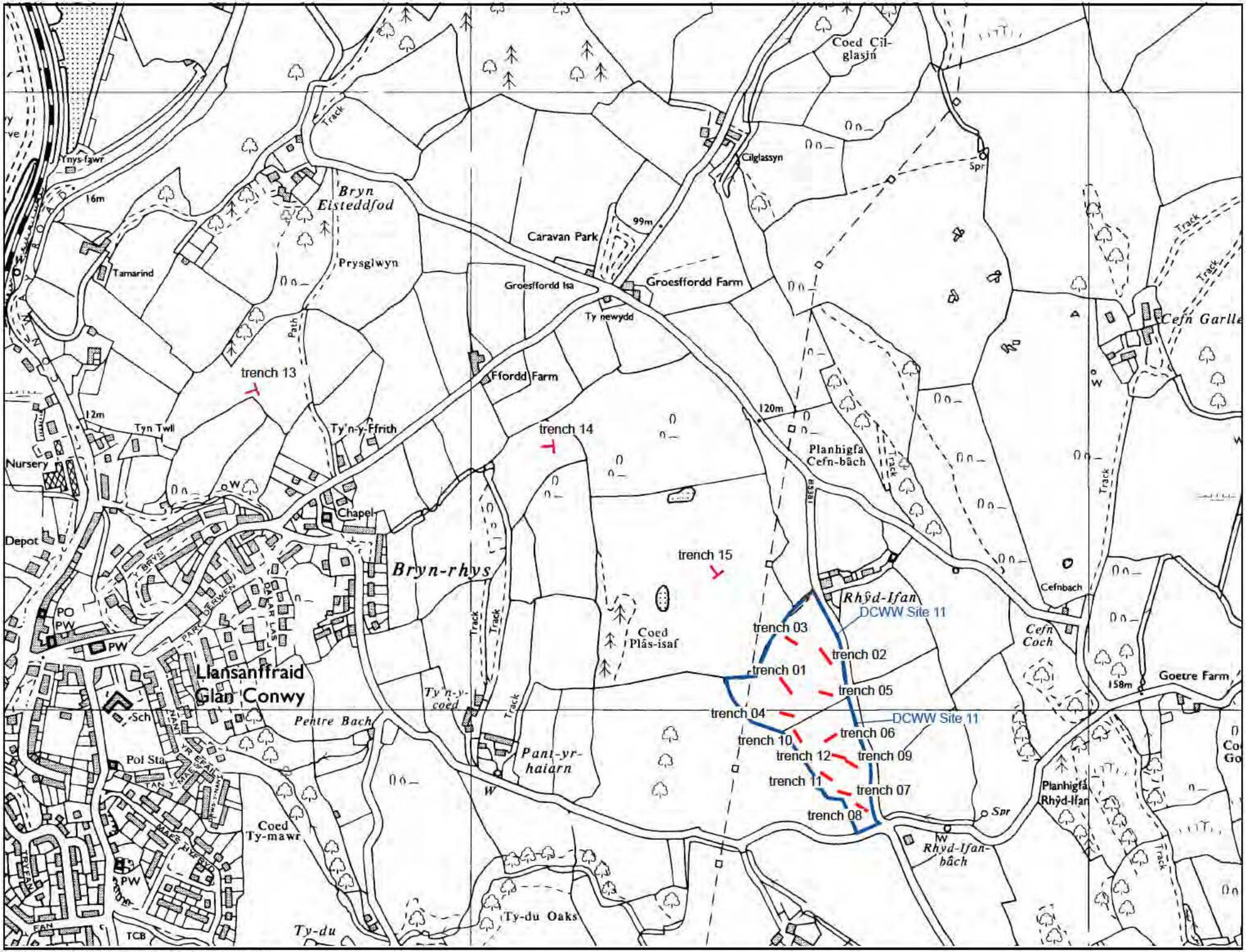
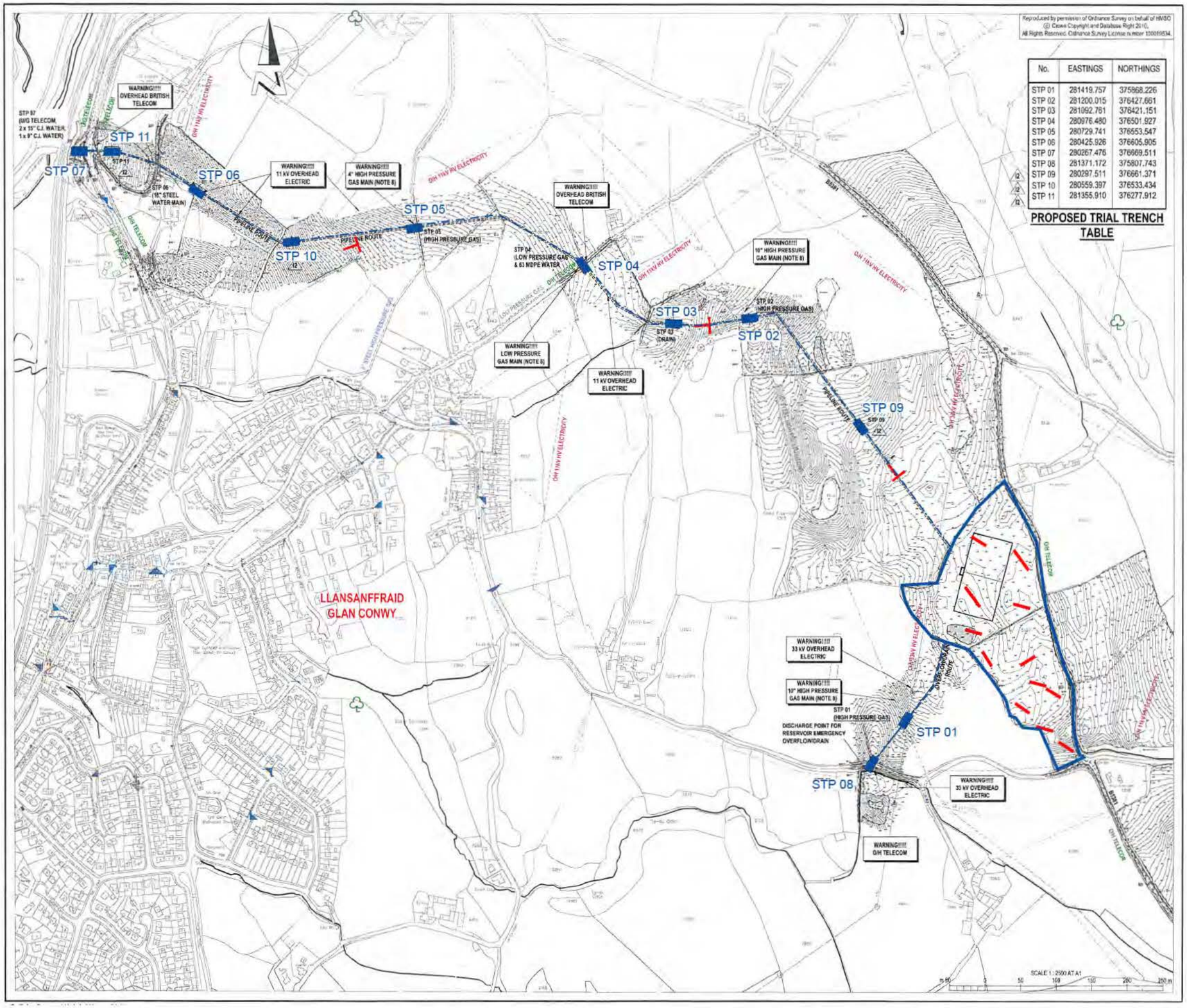


Figure 01: G2192 Location Map (1:5000@A4)



No.	EASTINGS	NORTHINGS
STP 01	281419.757	375868.226
STP 02	281200.015	376427.661
STP 03	281092.761	376421.151
STP 04	280976.480	376501.927
STP 05	280729.741	376553.547
STP 06	280425.926	376605.905
STP 07	280267.476	376669.511
STP 08	281371.172	375807.743
STP 09	280297.511	376661.371
STP 10	280559.397	376533.434
STP 11	281355.910	376277.912

PROPOSED TRIAL TRENCH TABLE

NOTES

1. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY. IF IN DOUBT - ASK.

2. DIMENSIONS ARE IN MILLIMETRES, UNLESS NOTED OTHERWISE.

3. LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM, UNLESS NOTED OTHERWISE.

4. ALL WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE SCOPE OF WORKS FOR GROUND INVESTIGATION AND ASSOCIATED SCHEDULES, PREPARED BY AECOM.

5. **THE POSITION AND NATURE OF THE BURIED SERVICES SHOWN ON THIS DRAWING ARE INDICATIVE ONLY. TRIAL PIT EXCAVATION SHALL BE CARRIED OUT IN A MANNER THAT WILL NOT DAMAGE ANY BURIED SERVICES.**

6. THE POSITION, LEVEL, SIZE, NATURE AND MATERIAL OF ALL BURIED SERVICES ENCOUNTERED SHALL BE RECORDED IN THE TRIAL PIT LOG.

7. TRIAL PITS SHALL BE EXCAVATED IN ACCORDANCE WITH THE REQUIREMENTS OF THE TRIAL PIT REQUEST SHEET.

8. **WALES AND WEST UTILITIES MUST BE CONSULTED BEFORE COMMENCING ANY EXCAVATION WORK WITHIN 10m OF ANY GAS PIPELINE. NO EXCAVATION WORK TO COMMENCE WITHIN 50m OF A HIGH PRESSURE GAS PIPELINE UNTIL IT HAS BEEN TRACED AND ITS ROUTE IDENTIFIED. MECHANICAL EXCAVATION IS NOT PERMITTED WITHIN 3m OF ANY GAS PIPELINE.**

9. WALES AND WEST UTILITIES REQUIRE A MINIMUM OF SEVEN DAYS NOTICE BEFORE EXCAVATION WORK COMMENCES NEAR ANY GAS PIPELINES.

SERVICES LEGEND

STP PROPOSED TRIAL PIT LOCATION

Rev.	Date	Drawn	Chkd.	Appd.	Description	H&S Box Updated
I2	05.08.11	IPT	STP	JHT	STP 09, 10, 11 ADDED	
I1	26.07.11	IPT	STP	JHT	STPS ADDED, ADDITION TO STP7	

Drawing Status: INFORMATION

Dŵr Cymru Welsh Water

COSTAIN

Job Title: COED DOLWYD NEW SRV PROVISION

A912.W.524

Drawing Title: UNDERGROUND SERVICES AND GROUND INVESTIGATION (PIPELINES)

AECOM
Vista, St. Davids Park, Ewloe, FLINTSHIRE, CH5 3DT
Tel: 01244 529700 Fax: 01244 529598
www.aecom.com

Consultants Job Number: 60216705.12.146S

Scale: 1:2500 AT A1 | Orig refer: IPT

Checked: STM | Approved: JHT | Date: 22.07.11

SET Scheme No.: 259-17 | Drawing no.: 0000_0013 | Rev: I2

Figure 02: General location of DCWW proposed pipeline route and reservoir. DCWW geotechnical/service test pits (STP) located (not to scale) along with GAT trial trenches. NOT TO SCALE; for reference only (Reproduction of Client Drawing 259-17 000_0013; for indvidual GAT trench numbers, cf. Figure 01).

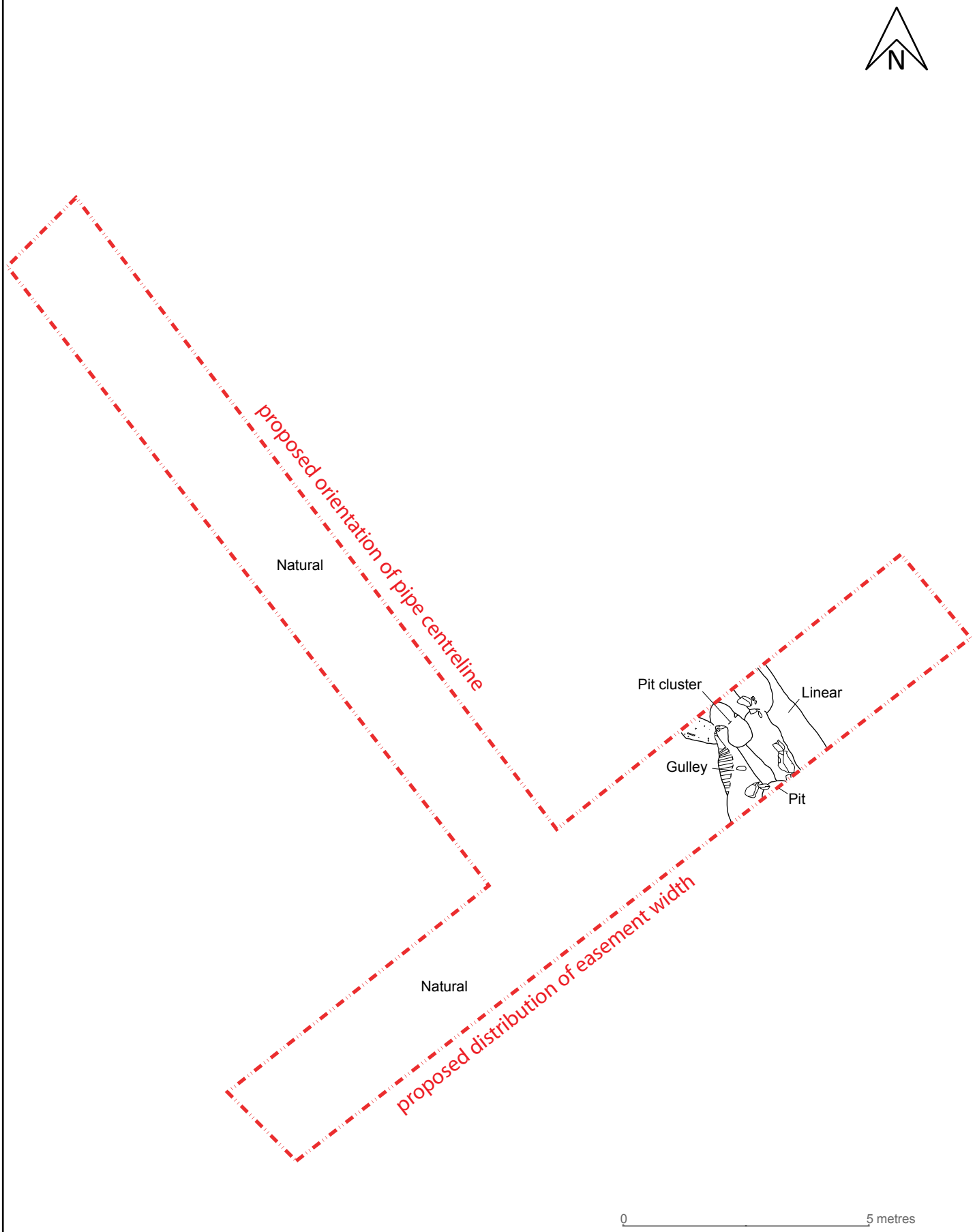


Figure 03: Trench 15 - Pre excavation detailing the distribution of features, for specific detail see **Figure 04**

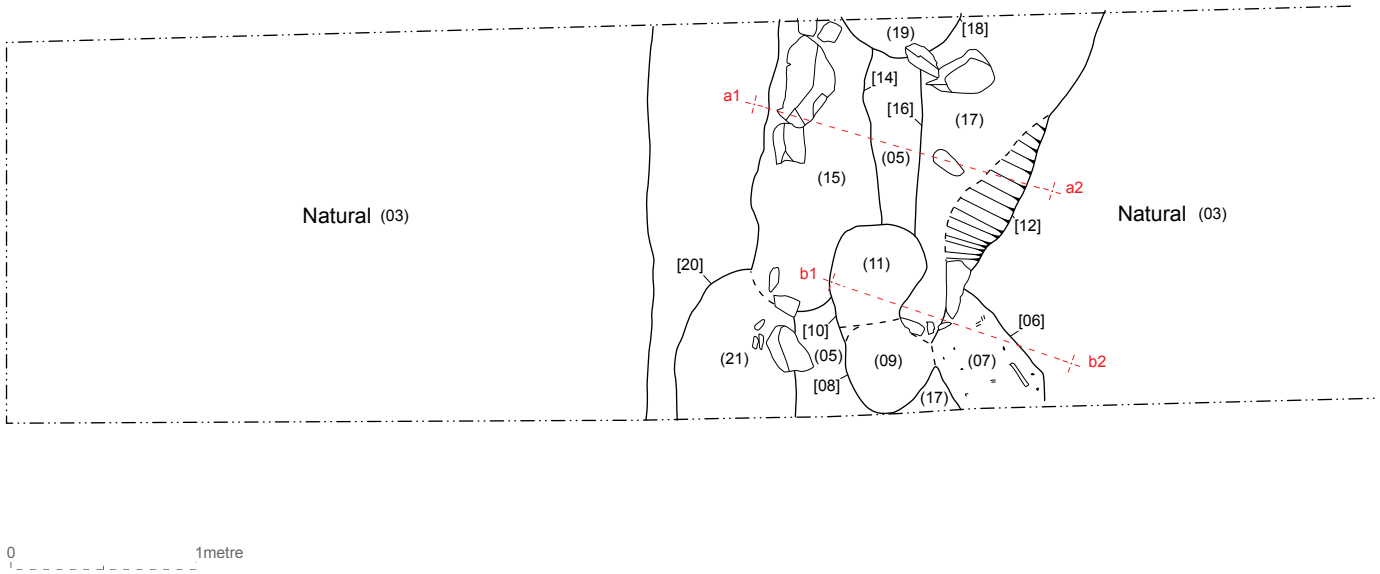


Figure 04: Trench 15 - Pre excavation plan detail detailing the distribution of features
(cf. Figure 03 for locaiton of features within trench and Figures 07 and 08 for assoc. sections).

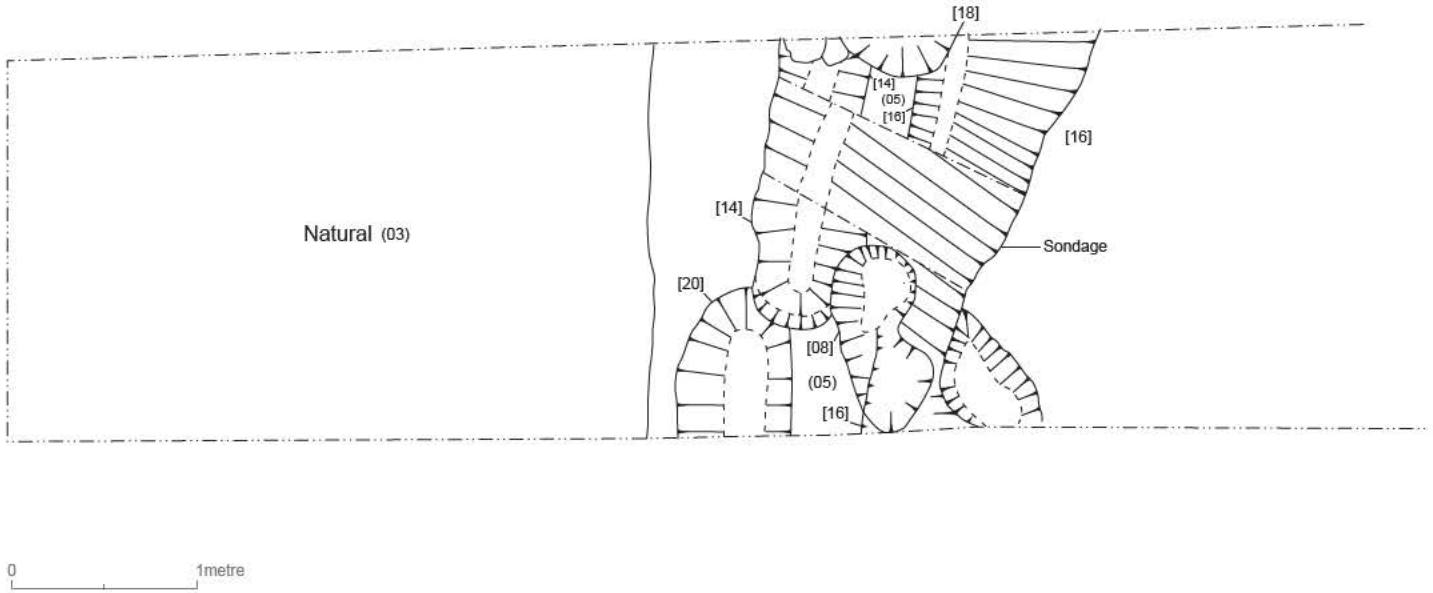


Figure 05: Trench 15 - Plan during excavation of multiphase activity detailing excavation of pit clusters and sondage through gullies/linear feature (cf. Figure 03 for locaiton of features within trench and Figures 07 and 08 for assoc. sections).

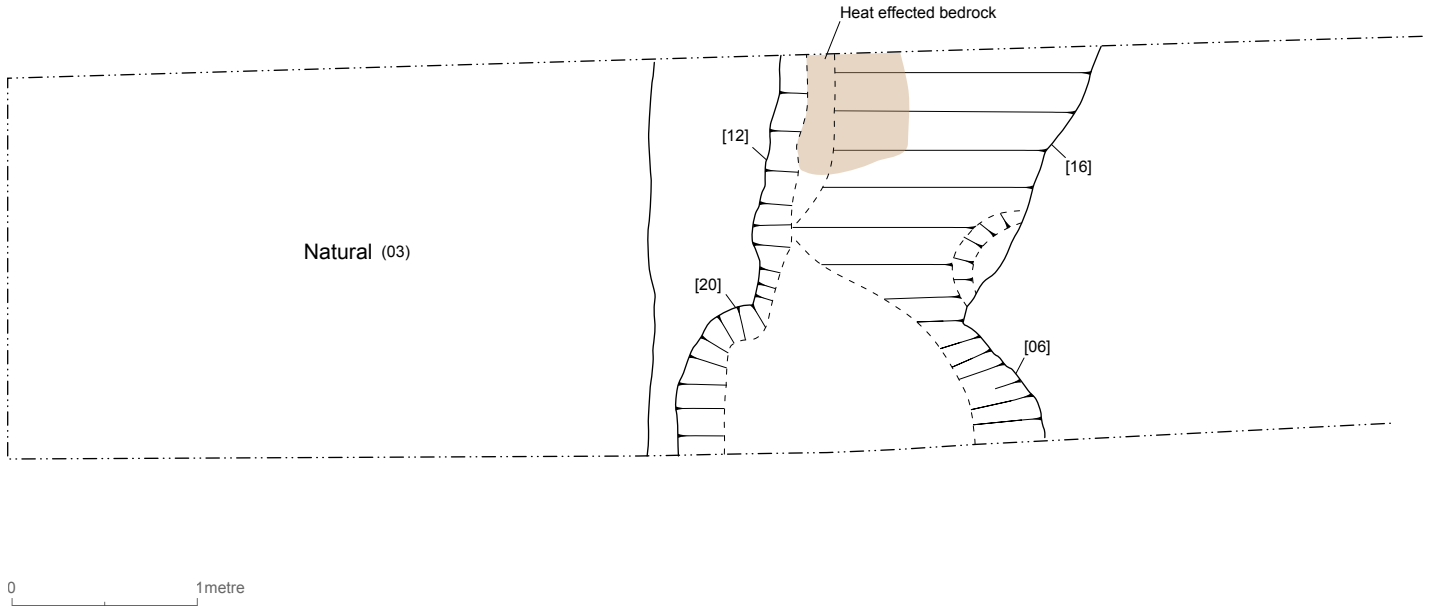


Figure 06: Trench 15 - Post excavation plan of mulitphase activity
(cf. Figure 03 for locaiton of features within trench and Figures 07 and 08 for assoc. sections).

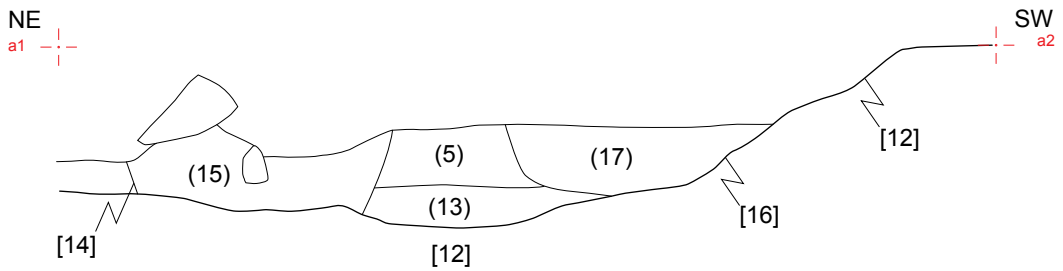


Figure 07: Trench 15 - North west facing section of features 12, 14 & 16

0 50cm

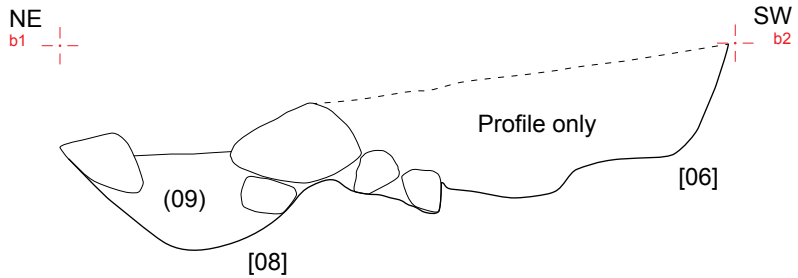


Figure 08: Trench 15 - North west facing section of features 08 & 06

0 50cm

Plate 1 Post-ex shot of Trench 1

Plate 2 Post-ex shot of Trench 2

Plate 3 Post-ex shot of Trench 3

Plate 4 Post-ex shot of Trench 4

Plate 5 Post-ex shot of Trench 5

Plate 6 Post-ex shot of Trench 6

Plate 7 Post-ex shot of Trench 7

Plate 8 Post-ex shot of Trench 8

Plate 9 Post-ex shot of Trench 9

Plate 10 Post-ex shot of Trench 10

Plate 11 Post-ex shot of Trench 11

Plate 12 Post-ex shot of Trench 12

Plate 13 Post-ex shot of Trench 13a

Plate 14 Post-ex shot of Trench 13b

Plate 15 Post-ex shot of Trench 14

Plate 16 Post-ex shot of Trench 14

Plate 17 - Trench 15 general shot

Plate 18 - Trench 15 general shot

Plate 19: Trench 15 - detailed shot of linear feature/gully prior to cleaning and excavation

Plate 20: Trench 15 - detailed shot of linear feature/gully prior during cleaning and excavation; note pit cluster in foreground

Plate 21: Trench 15 - detailed shot of linear feature/gully area during excavation of the later pit cluster

Plate 22: Trench 15 - detailed shot of gully fill during excavation and fully excavated pit cluster

Plate 23: Trench 15 - detailed shot of linear feature after excavation; this feature had utilised an existing fissure in the bedrock, which was then expanded. The date of the feature was not determined during the excavation; samples for possible C14 dating were recovered from all main features including the pit cluster.

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