A4226 FIVE MILE LANE
PROPOSED ROAD SAFETY IMPROVEMENT WORKS

INTERIM SCHEME ASSESSMENT REPORT

ADDENDUMS

January 2011

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PROPOSED ROAD SAFETY IMPROVEMENT SCHEME

A4226 FIVE MILE LANE

VALE OF GLAMORGAN

INTERIM SCHEME ASSESSMENT REPORT ADDENDUMS

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17 Addendum – Results and Recommendations

17.1 Introduction

17.1.1 The following chapter concludes the above assessment and the key issues raised and actions recorded during consultation with Statutory Environmental Bodies. Further studies, to feed into the Stage 2 alignments and assessment, were agreed during consultation; these studies are set out in the chapters 18 and 19.

17.2 Summary Conclusions of above ISAR Assessment

17.2.1 The assessment of effects of five potential route alignments against the combined social topic and the environmental topics can be summarised:

The most significant effects and constraints would potentially be linked to:

- biodiversity through the SSSI Barry Woodlands, especially offline routes;
- buried archaeology (further surveys are required to assess extents and value);
- effects on landscape character, and hence SLA designation, through loss of elements and alteration to character due to engineering design;
- water environment, for example the Whitton-mawr spring (Ford Brook source), Waycock and groundwater monitoring boreholes; and
- land use viability, extent of land-take over good quality soils or severance of agricultural holdings.

Noise and Air Quality

17.2.2 There is little to differentiate between the route options for Noise and Air Quality. The Orange route on average just emerges with the best score for noise and vibration whilst the Purple is preferable for air quality.

Landscape

17.2.3 The worst-case scenario assessment, whether that would occur on a winters day in year one of operation or during construction, predicts that the Purple option is the most favourable and the least are the Orange and Red routes. The Purple would cause the least adverse effect in the short term primarily due to the lower design speeds and exclusion of roundabouts and

associated side roads. The best improvement through mitigation, from Moderate Adverse to Neutral/Slight adverse, is the Blue option as it is most sympathetic to existing large scale landform at key points and offers opportunities for sympathetic mitigation through grading out embankments/cuttings and through strategic planting.

17.2.4 Potentially significant adverse effects on the visual amenity of the sparse population would occur in the short term. The Blue option provides the best opportunities for improvement through time and mitigation.

17.2.5 Adverse effects could be further reduced and beneficial effects could be maximised through maintaining a close relationship between vertical alignment, landform and topography wherever practicable and where this does not conflict with visual amenity or other issues. Reducing land-take required for roundabouts would also serve to improve the road alignment's score under this topic. Specifically in Sector 3 minimising effects correlates to minimising removal of high category woodland and following an offline alignment. Within Sector 5 minimising loss of standard oaks and high category woodland down the valley side would improve effects on landscape character. However steep embankments between the woodlands to achieve this would have adverse effects on visual amenity but could be mitigated through woodland planting in the long term. Within the vicinity of Sutton Farm differing treatment to the west and east cuttings serve to minimise adverse effects; to the west of the carriageway deep cuttings and roadside hedgerows minimise adverse effects on visual amenity; and to the east, grading out cuttings minimises effects on landscape character and opens up views for vehicle travellers. Across the valley floor and floodplain reducing land-take of roundabouts would minimise adverse effect on landscape character. Minimising loss of SSSI woodland on the north facing valley side would improve performance of any option.

Vehicle Travellers

17.2.6 All options are considered to improve upon the existing condition in terms of improved experience and reduced driver stress.

Biodiversity

17.2.7 All proposed route options under consideration would result in the loss of improved grassland and arable habitats of limited ecological interest although breaching/removal of hedgerow

networks and some loss of woodland habitat (within the Barry Woodlands SSSI) at the southern end of the scheme would also arise. Selection and design of the Preferred Route should therefore seek to avoid (where possible) or minimise the amount of hedgerow/woodland displaced or removed with appropriate mitigation provided where possible. For protected species, the route alignment options could potentially affect reptiles, birds, bats, aquatic invertebrates and the riverine habitats of the River Waycock.

17.2.8 Based on consideration of the likely impacts, no single route alignment would be particularly favourable and the Preferred Route taken forward in subsequent stages of assessment is likely to comprise a combination of different options, each of which minimises ecological impacts within a particular Sector. In terms of ecology and nature conservation, this route would potentially adopt the following arrangement:

Sector 3: Blue Route with Junction arrangement as for Orange Route;

Sector 4: Blue Route;

Sector 5: Blue Route;

Sector 6: Red or Orange Routes

17.2.9 For all route alignment options, the greatest ecological impact would be associated with the loss of established habitats necessary to accommodate the scheme and disturbance to species during construction and associated increases in noise, lighting and pollution risk.

17.2.10 In addition to conserving road-side hedgerows in Sectors 3 & 4, minimising potential impacts through Sectors 5 & 6 is a key consideration for route selection. Within Sector 5, all the route alignments would result in hedgerow breaches east of the existing A4226 with the Blue Route also requiring removal of a species-rich hedgerow south of Northcliff cottage and affecting a number of mature Oaks to the west of Lidmore Wood. These trees, in addition to the western edge of Lidmore Wood could also be impacted by the Orange and Red alignments and, although Purple and Green alignments would avoid these trees and the woodland, they would likely impact upon the mature Oak and Ash immediately adjacent to the A4226.

Soils and Land Use

17.2.11 Prior to consultation with landowners absolute appraisal of impact on landholdings is difficult to judge as viability and size of landholdings are unknown at this stage. Alignments that maintain sufficiently large fields between the existing Five Mile Lane and the new route to ensure their

viable productivity may be preferred, provided that access throughout the holding can be maintained. Whilst the Orange route appears to be favoured in this respect all routes have an overall predicted impact of slight adverse. This is also the case for land quality based on current soil quality data that will be verified in the field for upcoming assessment stages.

17.2.12 Decrease in junction land-take would improve the performance of those options that utilise large roundabouts.

Heritage

17.2.13 The assessment was based on desktop studies and a field walkover. At this stage of the assessment, utilising DMRB's simple methodology, results should be treated with caution when comparing scheme options. From data available at the time of appraisal the options appeared to effect the Heritage resource similarly with the Blue, Purple and Green routes being appraised as Moderate Adverse overall effect. The Orange and Red scoring slightly better with a potential Moderate Slight and Slight Moderate adverse effect respectively.

17.2.14 During the assessment geophysical survey focused on the land in the vicinity of Whitton Lodge (the Romano-British farmstead). A number of linear ditch-like anomalies were detected, the distribution almost entirely concentrated immediately south of the Romano-British farmstead. One such response corresponds directly to cropmark evidence for the enclosure ditch, others show a broad correlation and some are hitherto undetected. Overall, the pattern of anomalies suggests a series of settlement enclosures from multiple phases, including the Romano-British period, or continuous modification.

17.2.15 As agreed in consultation with GGAT further geophysical surveys are recommended extending northwards of Whitton Lodge to determine the potential for important archaeology and provide an indication of preferred routes to take through to Stage 2. This results of both surveys are outlined in Chapter 16.

Water Environment

17.2.16 The five route alignment options are predicted to have similar effects on the water environment. The main potential impacts of the new highway are likely to be effects on the sources of the main rivers in the study area, including the Waycock, Ford Brook and Moulton

Brook. Ffynnon Whitton Mawr is at the source of the Ford Brook which requires further investigation of potential impacts on this hydrological feature with regard to potential effect on interruption and contamination of water flows and aquifer levels.

17.2.17 The next stage of assessment will provide a more detailed appraisal and understanding of feasible mitigation measures that could potentially deliver betterment of the existing situation.

17.2.18 A geotechnical investigation will provide more details regarding geological structure, groundwater levels, and possible interception locations. Prior to a planning application being submitted a Flood Consequence Assessment (in accordance with planning guidance) and Flood Defence Consent based on the specific details of the River Waycock crossing will be sought.

Social Impacts

17.2.19 All routes would conceivably improve perceptions of personal safety through improving viewing distances and width of road to include a shoulder on which to stop a vehicle. There would be no significant impacts on permeability of footpaths; cycle routes and bridleways. Offline routes would reduce traffic volumes on the local distributor road (bypassed sections of the existing Five Mile Lane), potentially enabling increased promotion and use of the existing route by pedestrians, equestrians and cyclists, so improving physical fitness. The online option provides fewer opportunities to better the existing situation for social aspects.

Disruption Due To Construction

17.2.20 During construction, effects on receptors may include dust, noise, cultural heritage, increased disturbance to species from construction vehicles and associated increases in noise, lighting and pollution risk due to site activities and or loss of habitat to accommodate the scheme. Other temporary, construction phase effects could include effects on the visual amenity of the population and on landscape character, silt contamination, pollution of water courses or groundwater, and disturbance to farming activities and livestock.

17.2.21 Significant effects and specific mitigation measures will be considered in more detail at Stage 2 and effects minimised through Environmental Protection Plans, Construction Environmental Management Plans and Detailed Construction Method Statements.

Policies and Plans

17.2.22 At this stage, potential impacts have been considered and identified against current UDP policies primarily associated with landscape, nature conservation and cultural heritage issues. The forthcoming LDP will be consulted as it emerges to assess impacts at later stages of assessment upon planning policies.

17.3 Statutory Environmental Body Consultation

17.3.1 Summarised below are the key issues raised and actions recorded during the consultation with Statutory Environmental Bodies.

Noise and Air Quality

17.3.2 Junction arrangements that improve the free flow of traffic would be beneficial in terms of noise and air emissions. Effects on noise and air quality of the potential alignments are generally considered not to be a significant issue. The 'sensitive' locations near any of the existing or proposed routes are unlikely to trigger any concern with regard to road traffic emissions when compared with criteria within DEFRA guidance Part IV of the Environment Act 1995 2002 Part III Local Air Quality Management Technical Guidance LAQM.TG(09).

17.3.3 Assessment results and consultation conclude that significant impacts with regard to noise are unlikely although the existing roundabout at Waycock Cross is congested at times so any increase or alteration of this junction should examine the impact of traffic flow as this may alter the noise climate for the closest residents. Low noise surface treatments would be explored if impacts require mitigation.

17.3.4 Baseline structural and ambient noise surveys could be carried out once public consultation is underway to determine effects on Whitton Lodge whose proximity to the proposed road may need to be assessed in detail.

Landscape

17.3.5 The whole corridor lies within a Special Landscape Area (SLA). Proposals need to demonstrate retention of defining landscape character and enhancement where possible.

17.3.6 The landscape officer stated that the main incongruities in the landscape are the proposed roundabout junctions which appear more urban in character than rural. The roundabouts extents, whilst shown as worst case at this stage, should be minimised as far as practicable. Staggered left-right turns may be acceptable solutions, subject to modelling and detailed design.

Biodiversity

17.3.7 The most significant effect on biodiversity of the assessed route alignments would be due to direct losses of nationally designated SSSI Barry woodlands. Prior to stage 2 further surveys, engineering design and assessment will aim to find feasible and acceptable routes through the woodland to take through to Stage 2. Consultation with CCW and the Vale of Glamorgan Council aims to gain agreement in principle to ensure the authority's responsibilities to conserve and enhance the site and an improved alignment in terms of safety may be achieved.

17.3.8 Along the length of the corridor mitigation ought to aim for maintaining and improving connectivity between habitats, for example maintaining tree canopy connectivity across the road within the SSSI woodland.

17.3.9 There may be a potential impact on cSINC woodland sites which could be mitigated through no net loss, which could include introduction of woodland management as well as new planting as appropriate.

17.3.10 During consultation the presence of breeding (or displaying) Skylark was noted in an arable field within Sector 3. Displaying (not breeding) Lapwing have been noted in the area of Sector 4. Additional surveys will be carried out prior to Stage 2 to inform the assessment of route alignments and any appropriate mitigation measures.

17.3.11 The routes taken forward to Stage 2 should seek to avoid Sutton and Lidmore Woods and the standard oaks within adjacent fields as they have potential to house bat roosts. Bat survey of individual trees would be required in the season before planning application submission. Other protected species surveys (e.g. Dormouse, Great Crested Newt) would also need to be replicated and all ecological reporting updated in the season prior to submission of the application based on targeted survey for the preferred scheme alignment.

17.3.12 Off-line options offer opportunity to increase hedgerow/grassland resource in the long term. On-line options at best would be neutral in the long term due to extensive loss of roadside hedgerows.

Soils and Land Use

17.3.13 Current assessment of effects on soils is based on large scale ALC maps which may differ from actual soil quality as confirmed at Sycamore Cross where Grade 2 within the ALC mapping has been assessed in the field as Grade 3a. Detailed effects are to be assessed once a defined footprint of the preferred route(s) and soil sampling has confirmed soil quality. The general principle of minimum land take and clear justification is to be followed to minimise loss of higher valued land (Grade 3a and above). Farm severance will be addressed in more detail in upcoming assessment stages.

Heritage

17.3.14 Within the study area there are potential areas where archaeology are considered to be most likely. A known Roman road travels east west through Sector 1 and there could be waterlogged archaeology within the valley floor in Sector 6. There is less potential for archaeology in Sector 5 due to the sloping nature of the ground but archaeological constraints appear to be most likely and critical within Sectors 3 and 4.

17.3.15 In consultation with GGAT further surveys and evaluation was agreed to investigate the baseline archaeological resource:

1. Further geophysical surveys to encompass Whitton Mawr, the land to the north of existing survey extents in order to determine the potential for nationally important buried Roman archaeology.
2. During a future stage of assessment a survey should be carried out along affected parts of the A48 which is in the vicinity of a Roman Road.
3. There may be a need for archaeological evaluation (trial excavation/lidar surveys) to confirm results of the geophysical surveys in places or to examine the archaeological potential of other areas, along a preferred route.

17.3.16 The results of these surveys could affect road alignments and junction configuration in determining the value and extents of buried archaeology.

17.3.17 Mitigation by preservation in situ may not always be feasible for example where human remains are located as these are susceptible to crushing. Mitigation by record may be the only option which could require extensive archaeological excavation.

17.3.18 Cadw's Regional Inspector of Ancient Monuments considers that, as there are no offline routes affecting character area 010 of the Llancarfan registered historic landscape, and as such there is no need for the preparation of an ASIDOHL2 or for Cadw to raise any concerns over potential impacts on the registered historic landscape.

17.3.19 Geophysics may be undertaken for the Roman Road at Sycamore Cross once the junction arrangement has been modelled at/after Stage 2.

Water Environment

17.3.20 A Flood Consequences Assessment (FCA) should be undertaken to assess the risk and consequences on flooding as a result of the preferred route prior to a planning application. The proposal must ensure there is no increase in risk of flooding for events up to and including the 0.1% extreme flood events in accordance with the requirements of the Welsh Assembly Government, Technical Advice Note 15 – Development and Flood Risk.

17.3.21 The final route would have to consider in detail the impact of the route on local water features, particularly the Ffynnon Whitton Mawr source. Assessment of effects on groundwater should ensure the EAW's groundwater monitoring boreholes can remain operational and not impacted upon.

17.3.22 Pollution prevention documents within the Environmental Protection Plan, Construction Environmental Management Plan and Detailed Construction Method Statements, would need to be submitted prior to the start of any works and should include:

- Details of any imports or exports of waste;
- Methods for managing surface water during construction including preventing suspended solids contaminating any watercourses/water bodies;
- Accident management plan including spill procedures; and
- Details on the location of material stores required during development.

17.3.23 The EAW welcome the intention to utilise SUDS and note the proximity of an alignment to an historic landfill that may be producing landfill gas that would be surveyed at Stage 3 as appropriate. EAW also point to the fact that an abstraction license may be required if any water is to be abstracted form either surface or ground water.

17.3.24 In order to minimise effects on fisheries the EAW offers the following advice:

- Any works within watercourse channels can only take place between 15th May and 15th October to ensure least disturbance to migrating and spawning salmonid fish;
- If an area of watercourse is to be drained down then a fish rescue must be carried out by suitably competent people;
- All equipment and footwear used in a watercourse must be disinfected to prevent the spread of crayfish plague; and
- Ideally clear-spanning bridges or over-sized arches, the abutments for which lie outside the river channel. If this is not possible then over-sized culverts (ideally boxed-culverts) shall be used, sufficiently large to incorporate the banks of the channel. The invert should be 150mm below the natural bed of the watercourse.

17.3.25 Flood Defence Consent will be required under the Water Resources Act 1991. Also under the Water Resources Act 1991 (as amended by the Environment Act 1995) discharge consent will be required if discharging effluent into inland freshwater, coastal water or estuaries, groundwater or land.

17.3.26 Design assumptions for the floodplain crossing are to include a soffit level of 1metre minimum above 1 in 100 year flood level and no structures within the channel. EA can provide names of specialist consultants to do FCA.

17.3.27 The EAW also cited potential conditions that they may attach to a future planning approval which are generally specific standard conditions.

Social Impacts

17.3.28 Public Rights of Way officer agreed that effects on Public Rights of Way are not a major issue. Impacts of all of the proposed options appear straight-forward to mitigate. Opportunities for PROW enhancement through use of redundant carriageway and new routes are to be considered at the detailed design stage.

17.4 Recommendations

17.4.1 Set out below are recommendations for further studies and amendments to route options that reduce risk ensuring feasible options are appraised at Stage 2, opportunities are maximised and constraints and adverse effects minimised:

1. further consideration of alignment through the SSSI woodland through detailed surveys iterative design options;
2. further geophysical surveys, carried out after harvest, to determine the routes taken through to Stage 2 within Sector 3 and 4;
3. reduction of displacement or removal of hedgerows, woodland and important standard trees generally or considering reduced footprints to reduce loss;
4. explore potential to reduce land-take of junctions or reduce land-take generally where this does not lead to other adverse environmental effects;
5. in the vicinity of Sutton Farm, proposed deep cutting and roadside hedgerow to the west of the carriageway and grading out the cuttings to the east to open up views for vehicle travellers whilst minimising effects on landscape character;
6. consider opportunities to maintain a close relationship between vertical alignment, landform and topography wherever practicable and where this does not conflict with visual amenity or other issues;
7. liaise with EAW regarding the presence of and potential impact on groundwater monitoring boreholes and Fynnon Whitton Mawr and other aspects of the water environment to define Stage 2 brief and requirements for monitoring; and
8. to reduce effects on biodiversity consider an amalgamation of the Blue route (with Orange junction arrangement in Sector 3 and re-alignment to avoid the species rich hedgerow and Oaks in Sector 5) and Orange/Red route through Sector 6.

18 Addendum – SSSI Study

18.1 Introduction

18.1.1 The following report updates and supplements the surveys and assessment of potential effects on the Barry Woodlands Site of Special Scientific Interest (SSSI), as reported in the Interim Scheme Assessment Report[11] (ISAR). Consultation with Countryside Council of Wales (CCW) and the Vale of Glamorgan Council's Ecologist raised concern at the potential adverse impact of the proposed alignments on the Barry Woodlands SSSI; statutory consultees are likely to raise formal objection during the planning application process if the proposed route has unacceptable adverse effects on the SSSI. It was collectively agreed that further engineering design, surveys and assessment would be required to inform further detailed discussions with statutory consultees in determining feasible and viable solutions to be taken forward to Stage 2 assessment.

18.1.2 The following study investigates potential effects on the biodiversity and landscape of the SSSI of a number of alignments and road standards through the woodland following targeted biodiversity and landscape surveys and detailed engineering design. The report considers the opportunities for mitigation and enhancement.

18.1.3 The woodlands were surveyed, mapped and sampled in accordance with standard National Vegetation Classification (NVC) methodology (Rodwell 1997) to determine the community type. Effects are assessed under the WelTAG and DMRB criteria to enable comparison with the ISAR results. Further detail relating to survey methodology is included within Section 2.1. An assessment of potential woodland loss in terms of landscape character and visual amenity for each alignment and road standard under consideration is reported in section 3.

Engineering Design

18.1.4 Countryside Council of Wales and the council's in house ecologist raised concerns over the potential loss and fragmentation of SSSI woodland through online or offline safety improvement

[11] *A4226 Five Mile Lane Proposed Road Safety Improvement Works* Interim Scheme Assessment Report

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works. The Statutory Environmental Bodies recognised the opportunity for potential enhancements to the quality, management, extents and linkages of the habitat resource.

18.1.5 Safety improvements for the stretch of road between the Waycock Cross roundabout and the Waycock Valley floor aims to improve upon the existing situation through:

- Improving the vertical and horizontal alignments to recognised standard;
- Creating a safer environment beyond the carriageway;
- Widening the carriageway; and
- Reduce the contrast between light and dark (and dry and damp road surface) as you enter and leave the woodland.

18.1.6 The online and offline improvements considered within the ISAR were designed to accommodate a traffic speed of 60 miles per hour and considered a variety of junction designs including roundabouts (recommended within highway guidelines) and smaller footprint, but less desirable, junctions such as ghost islands/dedicated right turn lanes and T-junctions. Taking on board results and recommendations of the ISAR assessment process, this study analyses the effect on the woodland of reduced standard alignments (from 60mph to 40mph between Waycock Cross roundabout and the River Waycock) as well as variations on the offline route already assessed in the ISAR. To improve the environmental performance of the route options the design speed has been reduced to 40mph and road gradients have been maximised within the guideline limits whilst promoting a safer turning into the Barry College access.

18.1.7 The routes are as follows:

Reference	Description		ISAR reference
1	Offline	Two lanes plus climbing lane	Blue
2	Offline	Two lanes plus dedicated right hand turn lane to Barry College	Blue (reduced width)
3	Online	Two lanes plus climbing lane Widening to the east of existing carriageway	N/A
4	Online	Two lanes plus climbing lane Widening to the west of existing carriageway	N/A
5	Online	Two lanes plus dedicated right hand turn lane Widening to the east of existing carriageway	N/A
6	Online	Two lanes plus dedicated right hand turn lane Widening to the west of existing carriageway	N/A

18.1.8 Travelling form Waycock Cross roundabout in a northerly direction the stream to the east of the carriageway, carrying surface water from the road and surrounding area to the Waycock River, would require culverting or realignment (and have cost implications) if widening to the east was implemented.

18.1.9 The advantage of an offline route would be that the existing road could remain open during construction and act as a local distributor road during operation carrying local traffic, pedestrians, equestrians and cyclists.

18.2 Biodiversity

18.2.1 In order to inform the route selection process and supplement the information contained within the ISAR a targeted survey to establish the community type and relative ecological interest within the two SSSI woodland blocks was undertaken in June 2010.

National Vegetation Survey

Methodology

18.2.2 Initially each woodland was walked in a semi-structured way to assess how many significantly different woodland communities were present; these were determined visually in terms of species composition and vegetation structure. This initial approach enabled similar stands - vegetation units that have distinctive floristic and structural properties - to be identified and subsequently sampled together.

18.2.3 Each of the different stands of woodland vegetation was then mapped (boundaries should be taken as indicative) and sampled in accordance with standard National Vegetation Classification (NVC) methodology (Rodwell 1997). Five quadrats were sampled per stand taking care to avoid areas of atypical vegetation e.g. tracks and scrub edges. Each woodland quadrat in fact represents three sub-quadrats within different scales of vegetation (Table 2.1), with quadrat size based on standard NVC methodology for woodland survey (Rodwell 1997). The location of sampled quadrats (Nos. 1 – 15) is shown on the figures in Volume 2.

Table 2.1 Woodland NVC sample (quadrat) sizes

Scale of vegetation	Quadrat size (m)
Canopy trees	50 x 50
Shrub understorey	10 x 10
Field layer/woodland floor	4 x 4

18.2.4 The frequency and above-ground cover of each vascular plant species and, for field layers, every moss or liverwort present in each quadrat was recorded and the data were subsequently combined into a floristic table for each sampled stand. MATCH software was then used to analyse each floristic table and produce a co-efficient of similarity against published NVC communities/sub-communities. As a rule of thumb, the higher the co-efficient, the better the match against published type. Surveyor experience and detailed vegetation descriptions provided within the *British Plant Communities* series (Woodlands and Scrub, Volume 1 1991) were then used to confirm the classification of each stand in terms of the NVC. It should be noted that as a tool for vegetation description, the NVC in general has limitations, especially with respect to plant communities arising from, or influenced by significant levels of human disturbance - for example brownfield sites.

NVC Survey Results

18.2.5 The survey and subsequent analysis of data indicated that both of the woodlands surveyed were matched against the W8 *Fraxinus excelsior – Acer campestre – Mercurialis perennis* (Ash – Field Maple – Dog's Mercury) woodland community. Within the survey corridor alongside the existing carriageway, there was very little difference between the two woodland blocks (i.e. eastern and western blocks), with both matched against the relatively species poor W8d Ivy sub-community of the Ash-maple-dog's mercury woodland. This tends to be the least diverse of the Ash-maple (W8) woodland sub-communities and is indicative of loss of diversity caused by long-term lack of woodland management operations e.g. cutting and coppicing.

18.2.6 Within the western woodland block, localised areas supported indicator species of a (historically) more diverse woodland, including some of the species referred to in the SSSI citation (Appendix 18.3) such as Herb Paris *Paris quadrifolia*, Greater Butterfly Orchid *Platanthera chlorantha* and Woodruff *Galium odoratum*.

18.2.7 In the eastern woodland block, small populations of Goldilocks Buttercup *Ranunculus auricomus* and Greater Butterfly-orchid were seen near the road although the woodland community and ground flora overall was species-poor and comparable with the western woodland block.

18.2.8 The W8d sub-community type was applicable over both woodland blocks although one area at the southern edge of the western woodland block (see Figures) was slightly more diverse and had affinities with the W8e Herb-Robert *Geranium robertianum*) sub-community which is more species-rich than W8d. However, the differences were not considered sufficiently marked so as to effect the overall classification to the W8d sub-community.

18.2.9 The location of surveyed quadrats and woodland community types is illustrated on the Figures with more detailed habitat descriptions and floristic tables used for the MATCH analysis provided in Appendices 18.1 & 18.2 respectively.

Assessment Of Impacts

18.2.10 The ISAR had indicated that the off-line alignment (Blue Route) would result in a Severe Adverse impact on biodiversity in the short term, reducing to Moderate Adverse in the long term with the adoption of mitigation measures (e.g. woodland management plan, new planting). Each of the on-line options were assessed as having a Moderate Adverse impact in the short term, reducing to Slight Adverse over the long term.

18.2.11 Whilst the ISAR assessments were based on consideration of all the habitat features within the southern part of the scheme (Sector 6 in the ISAR), the severity of the impact was strongly influenced by the extent of SSSI loss under each alignment. Further design of the scheme – considering both on-line and off-line options has provided a quantitative estimate of the impact on the SSSI units as shown in Table 2.2. The indicated percentages are based on a total area of 125,000m^2 (12.5ha.) for the two woodland blocks with the route alignment options arranged from 'worst case' – Option 1 Blue Route - to that which minimises the footprint of the scheme – Option 6. This effectively translates to a loss of approximately 9% of the woodland under the Blue Route, compared to 5% under Option 6.

18.2.12 A further consideration relating to the impact of the on and off-line alignments is that the latter would lead to increased fragmentation of the woodland habitat, as the scheme would effectively introduce a new road corridor through the woodland. Each of the on-line options would

increase the footprint of the existing carriageway, which would avoid or minimise the potential risk of increased fragmentation.

18.2.13 The relative uniformity of the woodland community within both woodland blocks does not indicate that widening on the eastern or western side would be preferable for the on-line solutions, although the western side did support a greater number of woodland indicator species in the ground flora. For the on-line alignments, 3 & 5 would predominantly involve widening to the east of the existing carriageway, with alignments 4 & 6 involving widening to the west.

Table 2.2 Approximate extent of woodland loss under each alignment based on a total area of 125,000m² (12.5Ha).

Alignment	Approximate area of woodland lost			A (m²)	B (m²)	Fragments habitat
1 (Blue)	11,060 m²	1.1Ha	8.8%	0	0	Yes
2	9,940 m²	0.9Ha	8.0%	1,120	1,120	Yes
3	7,560 m²	0.7Ha	6.0%	2,380	3,500	No - Widens existing carriageway gap
4	7,540 m²	0.7Ha	6.0%	20	3,520	No - Widens existing carriageway gap
5	6,680 m²	0.6Ha	5.3%	860	4,380	No - Widens existing carriageway gap
6	6,430 m²	0.6Ha	5.1%	250	4,630	No - Widens existing carriageway gap

A = difference in woodland area loss between the alignment and the option above (the next worst performing option)

E.g. Alignment 5 loss of woodland value A (m²) = 7,540 – 6,680 = 860

B = difference in woodland area loss between the alignment and the worst performing option

E.g. Alignment 5 loss of woodland value B (m²) = 11,060 – 6,680 = 4,380

18.2.14 All of the route alignments would result in some loss of woodland habitat – ranging from 9% in the worst case (i.e. Alignment 1 – Blue) to 5% with on-line widening. In order to maintain consistency and permit comparison with the ISAR, the assessment criteria have been based on guidance within the Design Manual for Roads and Bridges (DMRB) and WelTAG and have not

been amended or updated – for a further description of the assessment methodology, see Section 1.4 of the ISAR.

Off-line Options (Routes 1 & 2)

18.2.15 Both these alignments would result in habitat loss away from the existing road corridor and would be likely to increase habitat fragmentation resulting in an impact of Major magnitude on a High Value receptor and an overall Severe Adverse impact on the woodland in the short term and in the absence of mitigation/compensation measures.

On-line Options (3 & 5)

18.2.16 On-line widening, with most of the works footprint to the east of the existing carriageway would result in a loss of between 5% and 6% of the woodland within the two blocks. This would represent an impact of Moderate magnitude on a High value receptor and an overall Moderate Adverse impact in the short term and in the absence of mitigation/compensation measures. The presence of the stream corridor on the eastern side of the carriageway, is a further consideration for these alignments as it is likely that culverting and/or localised diversions would be required at a cost to the scheme.

On-line Options (4 & 6)

18.2.17 As described for the previous on-line options, widening the existing carriageway to the west would result in a loss of between 5% and 6% of the woodland habitat. The overall impact would be comparable (Moderate Adverse) although widening to the west would avoid or minimise additional effects on the stream corridor.

18.2.18 A further consideration for the impact assessment of off-line *versus* on-line options based on the assessment criteria published by the Institute of Ecology and Environmental Management - IEEM (2006) is of potential benefit (in terms of decision making) in supplementing the assessment under DMRB/WelTAG. The IEEM criteria are based around the principle of establishing the ecological 'significance' of an impact – this is defined as an effect (adverse or beneficial) on the integrity of a defined site or ecosystem(s) and/or the conservation status of habitats or species within a given geographical area. In this context, integrity is defined as the:

> *'Coherence of a site's ecological structure and function across its whole area that allows it to sustain the habitat, complex of habitats and/or levels of populations'.*

18.2.19 Using this (IEEM) measure of 'significance' the off-line solutions would be likely to result in a significant adverse impact – i.e. would affect the integrity of the woodland – whereas the on-line widening would be unlikely to result in a significant impact, particularly with the adoption of appropriate mitigation and/or compensation measures (see Section 4.0) .

18.3 Landscape

18.3.1 The following section considers each route alignment on the woodland in terms of the potential effects on visual amenity and landscape character. The assessment follows best practice guidance. The assessment methodology can be found in Appendix 18.4.

Visual Amenity

18.3.2 Potential adverse effects on visual receptors are limited by the screening qualities of the woodland. Receptors are likely to be restricted to The Welsh Hawking Centre and adjacent dwellings, farm workers and vehicle travellers. The receptor group composed of visitors to the Welsh Hawking Centre (Medium sensitivity) would be affected during the open season and during the hours of business, as they arrive and leave the attraction. From within the centre views of the new routes are unlikely. Residents in the two adjacent dwellings (High sensitivity) would similarly have views of the new alignments as they arrive and leave and potentially from second story windows that address the road. Farm workers are of Medium sensitivity and would obtain intermittent views of the new alignments from the valley floor. The most numerous receptors would be of Low sensitivity (vehicle travellers).

18.3.3 Views to the existing woodland edges (edges both addressing the road and fields within the valley bottom) are composed of a well formed canopy and shrub layer/woodland edge. The character of the woodland alters beyond these edges; lack of management has created dense stands of tall trees with narrow canopies. Both the offline and online improvements would create new edges exposing the internal nature of the woodland altering visual character in the short term until new planting establishes and existing canopies, and any new planting, grow into the new conditions.

18.3.4 Views of the woodland from the south (Waycock Cross) correlate to the SSSI woodland boundary. To the west of the carriageway non designated woodland continues to the south beyond the SSSI boundary, effectively concealing views of the southern edge of the designation.

18.3.5 The magnitude of change experienced would vary between alignments. Visitors to The Welsh Hawking Centre would perceive a widening of the road resulting from the online options. Opposite the Welsh Hawking Centre's entrance the distance to the furthest point of the carriageway would increase from approximately 7.5 to 30 metres away.

18.3.6 The offline options at this point are located further into the woodland and further away from the Welsh Hawking Centre (70 metres to far edge of carriageway). The existing retained woodland (width of approximately 45 metres at that point) would effectively filter and screen the new alignment until it emerges from the woodland in the Waycock Valley bottom. For more information on effects beyond the extents of the SSSI please refer to the ISAR[12].

18.3.7 Vehicle travellers would also perceive the online routes as a widening of the existing road. The offline alignments would be seen in the context of the existing alignment but with the addition of a new route corridor through the woodland. The effects of the offline route during operation year 1 would be most adverse as the canopy, woodland edge, shrub layer and grasses establish and grow into the space created by the new road.

18.3.8 Changes in visibility through the seasons are not considered to make a significant difference to magnitude of change experienced by visual receptors in this area where canopies are generally above eye level.

Landscape Character

18.3.9 The SSSI designation contributes to the sensitivity and value of the ecology of the woodland but not significantly to landscape. Within the following landscape assessment the Special Landscape Area (SLA) is considered to add value to the woodland. During the previous assessment stage (ISAR) the entire woodland was evaluated as being of high value to landscape character. The extended surveys undertaken for this study added a further level of detail by mapping areas within the woodland of differing capacity to accommodate the change proposed. Please refer to the Figures in Volume 2.

[12] *A4226 Five Mile Lane Proposed Road Safety Improvement Works* Interim Scheme Assessment Report February 2010 Soltys Brewster Consulting

18.3.10 The woodland to the east of the carriageway could be considered of higher value than that to the west. The mature Oak trees immediately to the east are of better quality, are older and have well-formed crowns than the predominant Ash woodland to the west, so enhancing how the woodland is experienced and valued. Generally the remainder of the woodland is characterised by dense tall trees with narrow sparse crowns. Due to lack of management in recent decades, resources for diverse shrub and herb layers have been reduced (see Appendix 18.1).

18.3.11 The magnitude of change would decrease from the short term to the long term as new planting establishes and the new edges of the existing woodland spreads into its new conditions. As character and potential mitigation measures are similar for all alignments, differences in magnitude of change are primarily related to the area of woodland removed and number of new woodland edges created to accommodate the scheme.

18.3.12 Loss of woodland would only be apparent to the limited receptors discussed above, thus increasing the capacity of the woodland to accept a change in character. Sections of existing carriageway not utilised as a local distributor road have the potential to be 'grubbed up' and utilised for new woodland planting so reducing long term effects. The capacity of the majority of the woodland is High and the minority Medium to accept the type of change proposed.

Assessment Of Significance

18.3.13 The tables below set out the derivation of significance for effects on visual amenity for the worst case scenario of during operation Year 1 and once potential mitigation has established in operation year 15.

Table 3.1 Significance of Effect on Visual Amenity Operation Year 1

Alignment	Sensitivity of Receptor	Magnitude of Effect	Significance of Effect
1 and 2 (Offline routes)	Low (VT)	High	Moderate
	Medium (WHC)	Low	Slight
	Medium (FW)	Medium	Moderate
	High (R)	Low	Moderate
3, 4. 5 and 6 (Online routes)	Low (VT)	Medium	Slight
	Medium (WHC)	Low	Slight
	Medium (FW)	Low	Slight
	High (R)	Low	Moderate

Table 3.2 Significance of Effect on Visual Amenity Operation Year 15

Alignment	Sensitivity of Receptor	Magnitude of Effect	Significance of Effect
1 and 2 (Offline routes)	Low (VT)	Low	Slight-Neutral
	Medium (WHC)	Negligible	Slight-Neutral
	Medium (FW)	Low	Slight
	High (R)	Negligible	Slight
3, 4. 5 and 6 (Online routes)	Low (VT)	Negligible	Slight-Neutral
	Medium (WHC)	Negligible	Slight-Neutral
	Medium (FW)	Negligible	Slight-Neutral
	High (R)	Negligible	Slight

18.3.14 The tables below sets out the derivation of significance for effects on landscape character for the worst case scenario of during operation Year 1 and once mitigation has established in operation year 15.

Table 3.3 Significance of Effect on Landscape Character Operation Year 1

Alignment	Landscape Capacity	Magnitude of Effect	Significance of Effect
Offline routes (1 and 2)	Moderate	Medium	Moderate
	High	Medium	Slight
Online routes (3, 4, 5 and 6)	Moderate	Low	Slight
	High	Low	Slight-Neutral

Table 3.4 Significance of Effect on Landscape Character Operation Year 15

Alignment	Landscape Capacity	Magnitude of Effect	Significance of Effect
Offline routes (1 and 2)	Moderate	Low	Slight
	High	Low	Slight-Neutral
Online routes (3, 4, 5 and 6)	Moderate	Negligible	Slight-Neutral
	High	Negligible	Slight-Neutral

18.4 Potential Mitigation Measures

18.4.1 In determining the requirement and scale of mitigation considered for each alignment, the following key principles have been applied:

- Avoidance of the most sensitive areas through identification and adoption of best route option;
- Minimising the development footprint as far as practicable where avoidance of impacts is not possible;
- Timing of construction works to avoid or reduce disturbance to wildlife (e.g. maintenance and vegetation control activities outside nesting periods);
- On-site habitat enhancement within the scheme corridor or adjacent land;
- Sympathetic design and installation of hard structures, such as bridges and tunnels, and increase permeability through installation of nest/roost sites for wildlife; and
- Appropriate management of retained habitats/features.

Avoidance

18.4.2 The online routes take into account the recommendations of the ISAR stage by achieving good fit with existing topography through maximising gradients and utilising the existing break in the woodland blocks where the road currently runs.

Minimising development footprint

18.4.3 Apart from alignment 1 the alignments being assessed in this study have reduced footprints than those appraised in the ISAR. This has been achieved through a reduced design speed of 40mph to achieve better fit with the existing topography and reduced carriageway width for alignments 2, 5 and 6 (substituted the climbing lane along whole length for local widening to permit a dedicated right turn in to Barry College.)

Timing of site preparation/clearance works

18.4.4 In order to minimise the potential for disturbance and to ensure compliance with the relevant legislation (e.g. Wildlife and Countryside Act 1981), site preparation and vegetation clearance should be undertaken over the winter period (October – February). This would avoid the bird nesting season (typically this runs from March – August inclusive), and coincide with reduced levels of activity by species such as foraging/commuting bats. Disturbance of wildlife in general

in retained areas of woodland would also be minimised by timing of works over winter – i.e. activity levels in general much reduced compared to the Spring – Autumn period.

Habitat Compensation or Enhancement

18.4.5 Compensation for habitat loss at least to an equivalent area (0.5ha) would be a minimal requirement and could incorporate new planting using species known to occur within the woodlands. This planting could be provided to enhance existing scrub/hedgerow connections between SSSI woodland blocks to the east (1no. location) and west (2 no. locations). As part of the compensation/enhancement measure, consideration of re-use of existing top-soil, from within the scheme footprint, should be considered. The woodland soil may contain a seed-bank that could supplement any new planting proposed.

18.4.6 Replanting new embankments and cuttings at points along the route would aim to achieve a closed canopy across the carriageway. The proposed trees would be protected by crash barriers according to DMRB TD19 and Passive Safety UK Guidelines for Specification and Use of Passively Safe Street Furniture on the UK Road Network.

Structures Design

18.4.7 Dependant on option taken forward as preferred route and associated impact on canopy connections across the road, consideration of mitigation measures such as a 'green bridge' may be appropriate allowing faunal species to cross the road at canopy height.

Habitat Management

18.4.8 Adoption of a woodland management plan to re-instate appropriate management to the retained woodland blocks either side of the A4226 should also be considered, with the details of management actions and duration of the plan to be agreed with CCW and the Vale of Glamorgan ecologist.

18.5 Conclusions/Recommendations

Biodiversity

18.5.1 The results of the NVC survey have identified that the woodland blocks to the east and west of the existing carriageway were broadly similar in character and condition, particularly within a corridor extending 50 m either side of the A4226. Both woodlands were considered a match to the relatively species-poor W8d Ivy sub community of Ash – Field Maple – Dog's Mercury woodland. Ground flora within both woodlands was limited and only localised areas supported species indicative of a more diverse fauna that may have been present under the historical management of the woodland.

18.5.2 All of the route alignment options under consideration would result in some loss of woodland habitat – varying between 9% for off-line options and 5% for on-line widening. These percentages relate to the area of the two woodland blocks surveyed although in terms of the total extent of the Barry Woodlands SSSI would equate to a loss of between 0.9% and 0.5% (SSSI citation states total extent of 120.7ha). Although the comparison between on and off-line alignments in terms of area loss is not particularly marked, in functional terms, the off-line options would be likely to increase fragmentation of the habitat and could potentially lead to secondary effects (e.g. increased disturbance of retained areas) as a result of constructing a new road corridor through woodland.

18.5.3 In terms of biodiversity, adoption of the on-line solution would be preferable both in terms of minimising area loss and confining the works footprint to an existing road corridor, where any potential for secondary impacts would be reduced (e.g. faunal species would be habituated to the presence of the existing road). Amongst the on-line options, either Nos. 4 or 6 would be preferable as these would also minimise the potential impact of the stream corridor east of the existing carriageway.

18.5.4 The loss of woodland habitat would be unavoidable under any safety improvement options and mitigation at the design stage should be considered to reduce the scheme footprint to the minimal required level – taking into account highway safety parameters. This has been implemented to an extent through the identification of on-line solutions and detailed design could further refine the adopted Preferred Route. Compensation for habitat loss at least to an

equivalent area (0.5ha) would be a minimal requirement and could incorporate new planting using species known to occur within the woodlands. This planting could be provided to enhance existing scrub/hedgerow connections between SSSI woodland blocks to the east (1no. location) and west (2 no. locations). Adoption of a woodland management plan to re-instate appropriate management to the retained woodland blocks either side of the A4226 should also be considered, with the details of management actions and duration of the plan to be agreed with CCW and the Vale of Glamorgan ecologist.

18.5.5 In the long term, adoption of the mitigation and compensation measures has the potential to ensure no net loss of woodland habitat overall and to increase the intrinsic biodiversity interest within the two woodland blocks affected by the scheme. In the absence of any future management, it is likely that the intrinsic interest in these woodlands, particularly that associated with the ground flora, would continue to decline.

18.6 Landscape

18.6.1 As summarised by factors above the alignments would not have a significant adverse effect on the woodland in terms of landscape character or visual amenity in the short or long term.

19 Addendum – Geophysics Surveys

GSB Prospection

GEOPHYSICAL SURVEY REPORT
2010/13

A4226 Five Mile Lane Improvements
Barry

Client:

AC archaeology

on behalf of

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Specialising in Shallow and Archaeological Geophysics

19.1 GSB Survey No. 2010/13

A4226 Five Mile Lane Improvements

NGR	Approximate centre ST 080 713
Location	Approximately 3km northwest of Barry and 1km east of Walterston, the site is either side of the A4226 and is bounded to the north by the road from Walterston to Dyffryn and the A48/A4232 junction
Unitary Authority	Vale of Glamorgan County Borough
Community Councils	Wenvoe, Llancarfan
Topography	Flat
Current land-use	Area 1 – pasture: Areas 2 and 3 - young crop
Soils	Ston Easton 571a association well drained fine silty over clayey soils on limestone. Some shallow calcareous soils. (SSEW 1983)
Geology	Jurassic and Carboniferous limestone
Archaeology	Previously excavated Romano-British farmstead with associated features identified by cropmarks (AC 2010)
Study Area	c.5ha
Survey Methods	Fluxgate gradiometer detailed survey

Aims

To locate and characterise any anomalies of possible archaeological interest within the application area. The work forms part of a wider archaeological assessment being carried out by **AC archaeology** on behalf of **Soltys Brewster Consulting**.

Summary of Results*

Numerous ditches were detected, predominantly south of the Romano-British farmstead. Several enclosures, possibly of at least two phases, appear to be represented. A number of weaker linear responses, trends and small pit-like anomalies were also revealed, some of which may be of archaeological interest due to their alignment and proximity to the known remains. A former quarry west of the A4226 manifested itself as an area of magnetic disturbance.

Project Information

Project Co-ordinator: J Tanner BSc MSc PIfA
Project Assistants: J Anderson, G Attwood
Date of Fieldwork: 23rd – 25th February 2010
Date of Report: 5th March 2010

***It is essential that this summary is read in conjunction with the detailed results of the survey.**

19.2 Survey Specifications

Method

The survey grid was set out and tied in to the Ordnance Survey (OS) grid using a Topcon RTK GPS system. A copy of the geo-referenced results in AutoCAD format is included on the Archive CD.

Technique	Traverse Separation	Reading Interval	Instrument
Magnetometer - Scanning	-	-	-
Magnetometer – Detailed	1m	0.25	Bartington Grad 601-2
Resistance – Twin Probe	-	-	-
Ground Penetrating Radar (GPR)	-	-	-

Data Processing

	Magnetic	Resistance	GPR
Zero Mean Traverse	Y	-	-

Step Correction	Y	-	-
Interpolate	Y	-	-
Filter	N	-	-

General Considerations

Conditions for survey were acceptable; the survey areas were unobstructed apart from some equestrian hurdles in Area 1. The short grass and young crop generally presented no difficulty in walking at a steady pace with the instruments. Minor stepping errors due to zones of heavy and waterlogged soil have been corrected by processing, minimising any detrimental effect on data quality.

Smaller scale ferrous anomalies ("iron spikes") are present, their form best illustrated in the XY trace plots. These responses are characteristic of small pieces of ferrous debris in the topsoil and are commonly assigned a modern origin. While the most prominent of these are highlighted on the interpretation diagram, they are not discussed in the text below unless considered relevant.

Ferrous responses adjacent to the boundaries are due to fencing and gates.

19.3 Results of Survey

Magnetic Survey

Area 1

A linear anomaly [1] is strong, well-defined, ditch-like in form, and is adjacent to a Romano-British farmstead and it is therefore classified as *Archaeology*: it may comprise part of an enclosure extending beyond the survey area. A short and intermittent linear anomaly [2] is parallel to [1] but is less well-defined and has been assigned to the category *Uncertain.*

Two weaker linear anomalies [3] might be regarded as strong trends, but are at right-angles to each other and parallel to anomaly [1]. This, together with the proximity of known archaeology, has led to their categorization as *?Archaeology*.

Other linear anomalies [4] and [5] were detected and although relatively weak and ill-defined in comparison to [1], and in no convincing alignment, they are strong for trends. Similarly, several pit-like anomalies may be natural soil effects but given the context, archaeological origins for the pits and linears are as likely as agricultural or natural causes. These linear and pit-like anomalies are therefore classed as *Uncertain.*

A number of weak trends are visible in the dataset, and are possibly a result of natural or agricultural effects, but the presence of the adjacent known archaeology and the anomalies detected in Area 2 (see below) suggest that archaeological origins cannot be dismissed.

Area 2

Numerous strong and well-defined linear anomalies were detected in Area 2. Response [6], although intermittent in its eastern section, appears to correspond with a cropmark forming an enclosure around the Romano-British farmstead (AC 2010). A north-south linear response [7] also correlates with the cropmark evidence. These features are therefore interpreted as ditches and are classified as *Archaeology*.

A number of short linear anomalies, broadly orientated north-south, were detected within the enclosure ditch [6]. It is not clear what the group of responses

[8] represent but those denoted [9], although intermittent, appear to be parallel to the enclosure ditch, suggesting perhaps a double-ditched enclosure. These anomalies do not correlate directly with the cropmark evidence and are therefore assigned to the category *?Archaeology*.

Well-defined linear responses [10] to [14] are ditch-like in form and appear to represent enclosure or boundary ditches. Although the alignments and orientations are not precise, a broad correlation with some of the transcribed cropmarks (AC 2010) can be seen. Anomalies [13] and [14] appear to lack corresponding cropmarks but are strong, clear and form a cohesive pattern with other features. Responses [10] to [14] are therefore categorized as *Archaeology*.

Linear anomalies at [15] and [16] are weaker and rather less well-defined but are orientated with the stronger responses: anomaly [15] appears to be an extension of [11] and together [11], [15] and [16] may form an enclosure. Anomalies [15 and [16] are therefore classed as *?Archaeology*.

Whilst the linear anomalies do not overlap, the pattern hints at multiple or continuous phases of activity, enclosures perhaps being extended or modified. If anomaly [10] represents part of an enclosure, it appears not to be contemporary with either of the postulated enclosures formed by linear [13] or by anomalies [11-15-16].

The numerous trends visible in the data may be a result of relatively recent agricultural practices or pedological effects. A trend appears to be an extension of anomaly [12] and another is parallel to linear [16], but generally there is no obvious pattern. The nature of the site however indicates that archaeological origins cannot be ruled out. A similar argument applies to a number of small pit-like anomalies, which are therefore classed as *Uncertain*.

Area 3

An area of magnetic disturbance towards the north of Area 3 corresponds to the position of a former quarry (Old Maps 2010).

Two pit-like anomalies have been classed as *Uncertain* as they are small, weak and isolated but in the context of the site an archaeological origin cannot be ignored.

A few weak trends were detected, probably resulting from natural causes or possibly ploughing.

Conclusions to survey

A number of linear ditch-like anomalies were detected, the distribution almost entirely concentrated in Area 2 immediately south of the Romano-British farmstead. One such response corresponds directly to cropmark evidence for the enclosure ditch, others show a broad correlation and some are hitherto undetected. Overall, the pattern of anomalies suggests a series of enclosures from multiple phases or continuous modification.

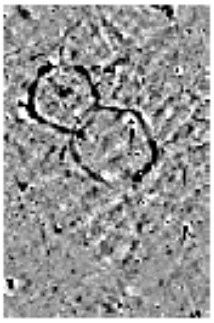
Throughout the dataset small pit-like anomalies are visible. Numerous weak trends were also detected, and where they do not form obvious patterns or share alignment with linear anomalies, a natural, agricultural or modern origin seems likely, although given the context archaeological origins cannot be wholly dismissed.

An area of magnetic disturbance is due to the presence of a former quarry.

GSB Prospection

GEOPHYSICAL SURVEY REPORT
2010/64

A4226 Five Mile Lane Improvements: North of Whitton Cross, Vale of Glamorgan



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Specialising in Shallow and Archaeological Geophysics

19.4 GSB Survey No. 2010/64

A4226 Five Mile Lane Improvements: North of Whitton Cross

NGR	ST 078 718 (approximate centre)
Location	Approximately 3km northwest of Barry and 1km east of Walterton. The site is to the east of the A4226
Unitary Authority	Vale of Glamorgan County Borough
Community Council	St Nicholas and Bonvilston
Topography	Flat
Current land-use	Southern field: arable, freshly sown; Northern field: pasture
Soils	Denchworth (712b) association: Slowly permeable seasonally waterlogged clayey soils with similar fine loamy over clayey soils (*Soils of England and Wales. Sheet 2, Wales*. Soil Survey of England and Wales. 1983)
Geology	Jurassic and cretaceous clay
Archaeology	A Roman villa lies to the south the crossroads. Geophysical survey for the first phase of this scheme (GSB 2010) identified numerous ditches presumably associated with the villa
Study Area	16ha
Survey Methods	Detailed fluxgate gradiometry

Aims

To locate and characterise any anomalies of possible archaeological interest within the application area. The work forms part of a wider archaeological assessment being carried out by **AC archaeology** on behalf of **Soltys Brewster Consulting**.

Summary of Results*

The survey has identified a number of anomalies of clear interest and several other responses which have archaeological potential. Dominating the results are two ring ditches, roughly in the centre of the southern field investigated, and a third much smaller ring in the northern field. The latter appears isolated, whilst the two rings appear to be associated with a complex of archaeological features. There is a marked increase in the magnetic levels in the southern half of the field (perhaps due to ploughing?) and there appear to be several ditch and pit type anomalies of possible archaeological interest. To the northwest of the two ring ditches there are several responses which show a rectilinear pattern which could indicate Romano-British features, though the results are confused by presumed ploughing effects. Others anomalies are more difficult to interpret and an *Uncertain* classification has been used simply because the magnetic responses are not as clearly defined as the other 'known' archaeological features. They are equally as likely to be natural or agricultural in origin.

Project Information

Project Co-ordinator: G Attwood MSc

Project Assistants: D Shiel & E Wood

Date of Fieldwork: 4th – 8th October 2010

Date of Report: 19th October 2010

***It is essential that this summary is read in conjunction with the detailed results of the survey.**

19.5 Survey Specifications

Method

All survey grid positioning was carried out using Hi-per Pro RTK differential GPS equipment. The geophysical survey areas are geo-referenced relative to the Ordnance Survey National Grid by tying in to local detail and corrected to the OS mapping. These tie-ins are presented in Figure T1. Please refer to this diagram when re-establishing the grid or positioning trenches.

Technique	Traverse Separation	Reading Interval	Instrument	Survey Size
Magnetometer – Detailed	1m	0.25	Bartington Grad 601-2	16ha

Data Processing

Data Set	Zero Mean Traverse	Step Correction	Interpolate	Filter
Magnetic	Y	Y	Y	N

General Considerations

Conditions for survey were ideal – the fields had been recently ploughed, harrowed and rolled or comprised pasture; they were level with no obstructions.

19.6 Results of Survey

Magnetic Survey

The present survey work was carried out in two fields east of the A4226 and immediately north of an earlier survey (GSB 2010), which investigated areas around a known Roman villa complex. The results of this latest survey will be discussed as a whole.

The strongest, ferrous type responses (A) coincide with a large pipeline that crosses the survey area; there appears to be a second, smaller pipeline (B). There are several drain-like anomalies which have been highlighted, though they do not form a consistent pattern; as such the interpretation is slightly perplexing. Ferrous noise around the edge of the survey is caused by modern boundaries and a very strong response (C) is caused by a cattle feeder. An old boundary marked on the 1940s map (see Figure 1) is not apparent in the data but another boundary shown on the 1878 map has resulted in an erratic line of anomalies (D). The latter boundary is visible as a clear depression in the field which drains into a nearby pond.

Smaller scale ferrous anomalies ("iron spikes") are present throughout, their form best illustrated in the XY trace plots. These responses are characteristic of small pieces of ferrous debris in the topsoil and are commonly assigned a modern origin. While the most prominent of these are highlighted on the interpretation diagram, they are not discussed in the text below unless considered relevant.

Archaeologically, the clearest anomalies are those at (E) and (F). The results indicate two ring ditches measuring approximately 28m and 35m in diameter respectively. While one ring must be later than the other, it is not possible to establish the chronological relationship on the basis of the magnetic results alone. Ring (E) appears to have some central features and there are hints of an anomaly shadow in the interior; there is no obvious break in the ditch. Other anomalies suggest pits or short ditch lengths, appended to the ring. There are also features within ring (F) though offset from the central area and there is a break, or entrance, in the south-east quadrant.

Both rings lie south of a presumed old ditch boundary (G), in a ‘zone’ containing numerous pit, curvilinear and linear type anomalies / trends. The alignment of many of the trends is approximately north-south. Given that these trends appear to stop at (G), it seems likely that past ploughing is

responsible for many of the responses; they reflect either agricultural activity, or are due to erosion of buried archaeological deposits. It is possible that the slightly stronger and better-defined rectilinear anomalies (H) could indicate Romano-British activity, though this interpretation is tentative; the results aren't as clear as in the earlier survey around the known villa building (GSB 2010). Many of the responses near (I) are interpreted as *Uncertain* because of their more amorphous nature. It is also unclear whether the numerous arcs / curvilinear trends are archaeological; such an interpretation seems unlikely. The reason why some linear anomalies (like J) appear to terminate as they do is also unclear.

North of postulated former boundary (G) ploughing trends follow a northwest-southeast direction and there is a marked decrease in the number of well-defined magnetic responses. The only exception is the ring ditch (K) in the northern field. This is approximately 11m in diameter with an entrance on the south-east. The apparent lack of any other archaeological type responses in the results is slightly perplexing. They may be too small to be detected or, in the case of larger features, are likely to have been ploughed out.

Conclusions to survey

The survey has successfully mapped a number of features of archaeological interest; the most striking are two ring ditches in the southern field and a third, smaller example in the northern field. There are several other responses which appear archaeological in origin, especially in the vicinity of the two rings; elsewhere some anomalies may be indicative of Romano-British features, due to their rectilinear form, but this may simply be a ploughing effect.

Many anomalies have been classified as *Uncertain* simply because although they have some archaeological potential, the strength and nature of the magnetic anomalies are not as well defined; hence a natural or agricultural response is equally likely.

19.7 Assessment of effects of route alignments

A significant group of anomalies on Whitton Mawr could include further evidence for settlement or, possibly funerary, that may be of national importance. A further anomaly to the north may also be of significance.

Inevitably, the Red route, which involves the smallest land-take in the vicinity of this area of archaeological importance, would be the preferred route, based on existing data. The Orange route would be slightly less desirable, followed by the Purple, with the Green and Blue routes as least desirable.

20 Addendum - WelTAG Assessment Scores

20.1 Methodology

20.1.1 To relate the totals and averages of each alignment back to the WelTAG 7 point scale, the total scores of the residual impact are divided by 11 (the number of assessment topics) to provide an average numerical score which may then be translated back into the 7 point scale:

Description	Numerical range of scores	**WelTAG 7 point scale**
Large beneficial	2.5 – 3	**+ + +**
Moderate beneficial	1.5 – 2.49	**+ +**
Slight beneficial	0.5 – 1.49	**+**
Neutral	0 – 0.49 - (0 – 0.49)	**0**
Slight adverse	- (0.5 – 1.49)	**-**
Moderate adverse	- (1.5 – 2.49)	**- -**
Severe adverse	- (2.5 – 3)	**- - -**

Residual Impact = Mitigated Impacts

NB mitigation has not been agreed at this stage, is not integral to scheme and may not be carried forward.

NB These scores should not be used in isolation as a conclusion to the ISAR assessment.

20.2 ISAR Scores

TOTAL SCORES (including mitigation)

FOR EACH ALIGNMENT AS IDENTIFIED DURING ISAR ASSESSMENT STAGE

	Summary of Effect on 7 Point Scale (ISAR)				
Appraisal Criteria	**Blue Option**	**Purple**	**Red**	**Orange**	**Green**
Traffic Noise and Vibration	+	+	+	+ +	+
Local Air Quality	+ / + +	+ +	0 / +	0 / +	0
Landscape	0	0	0	0	-
Vehicle Travellers	+ + / + + +	+	+	+ / + +	+ / + +
Biodiversity	- / +	-	-	0	0
Soils, Agriculture and Land Use	-	-	-	-	-
Heritage	- -	- -	- / - -	- / - -	- -
Water Environment	-	-	-	-	-
Social Impacts	+	+	0	+	+
Planning Policy	0 / -	0 / -	0 / -	0 / -	0 / -
Transport Planning Objective	+ +	+	+	+ / + +	+
TOTAL AVERAGE (Numerical)	0.3	0	-0.1	0.2	-0
TOTAL AVERAGE (seven point scale)	0 / +	0	0 / -	0 / +	0

20.3 ISAR Ranking

20.3.1 Based on the ISAR assessment (excluding further studies completed after consultation) the ranking for the alignments based on environmental performance are (from least adverse impact/most beneficial impact to greatest adverse impact/least beneficial impact):

1. Blue alignment
2. Orange alignment
3. Purple is the next best performing option (assessed against an alternative junction strategy with less land take)
4. Green alignment
5. Red alignment

20.3.2 In consultation with the Statutory Environmental Bodies it was agreed the environmental performance could be improved by:

- Minimising effects on SSSI – please refer to SSSI study and ranking set out below.
- Reduction in footprint where this does not have a secondary effect that is more adverse than that being mitigated.
- Topographical and landform design to maintain existing character where this does not have a secondary effect that is more adverse than that being mitigated.

20.4 Ranking of Alignments through the SSSI woodland

20.4.1 A detailed engineering and assessment through the SSSI was undertaken aiming to reduce adverse effects on the woodland. The engineering design aimed to reduce land take through reducing the design speed and considering alternative access arrangements for the Welsh Hawking Centre, for both an online and offline alignment.

20.4.2 Through the SSSI only the ranking for the alignments based on environmental performance are (from least adverse impact/most beneficial impact to greatest adverse impact/least beneficial impact):

Rank	Reference	Description		ISAR Reference
1	Alignment 6	Online	Two lanes plus dedicated right hand turn lane Widening to the west of existing carriageway	N/A
2	Alignment 4	Online	Two lanes plus climbing lane Widening to the west of existing carriageway	N/A
3	Alignment 5	Online	Two lanes plus dedicated right hand turn lane Widening to the east of existing carriageway	N/A
4	Alignment 3	Online	Two lanes plus climbing lane Widening to the east of existing carriageway	N/A
5	Alignment 2	Offline	Two lanes plus dedicated right hand turn lane to Barry College	Blue
6	Alignment 1	Offline	Two lanes plus climbing lane	Blue

20.4.3 Alignments 3 - 6 are similar to the online ISAR routes (Red, Orange, Green and Purple) although their land take footprints are reduced through better fit with the topography. Alignment 1 is the Blue ISAR route and Alignment 2 is a reduced land take Blue route by utilising a dedicated right hand turn as opposed to the climbing lane seen in Alignment 1/ Blue route. Alignments 5 and 3 propose to widen the carriageway over the existing road and to its east which would require culverting the existing stream.

20.5 Ranking of Alignments through the Geophysics Survey sites

20.5.1 On the assumption that the geophysical survey anomalies provide a reasonable assessment of the true archaeological potential of the area around Whitton Mawr, then the following ranking of alternative routes would apply:

Rank	Reference	Comment
1	Red route	Involves least new land take in sensitive area. Some impact on localised deposits anticipated
2	Orange route	Has some impact on the southern area around the villa site, but avoids principal features to the north. Roundabout sited away from principal features
3	Purple Route	Impact on northernmost site of significance. Roundabout sited away from principal features
4	Green route	Impact on northernmost site of significance. Roundabout close to and on principal features in central area
5	Blue route	Impact on northernmost site of significance, some impact on central area. Roundabout sited away from principal features. Has most extensive impact on villa site and associated features to the south.

20.5.2 The Geophysics surveys have informed the baseline archaeological resource which alters the overall Heritage assessment and therefore the initial assessment scores outlined above:

	Summary of Effect on 7 Point Scale (including geophysics results)				
	Blue Option	**Purple**	**Red**	**Orange**	**Green**
Heritage	**---**	**--/---**	**-**	**--**	**---**
TOTAL AVERAGE (Numerical)	**0.2**	**0**	**-0.1**	**0.2**	**-0.2**
TOTAL AVERAGE (seven point scale)	**0 / +**	**0**	**0 / -**	**0 / +**	**0 / -**

20.5.3 All the alignments have been assessed as more adverse in light of the geophysics surveys, apart from the Red which has improved from Slight Moderate adverse to Slight adverse.

20.5.4 Therefore the revised ranking for the alignments based on environmental performance are (from least adverse impact/most beneficial impact to greatest adverse impact/least beneficial impact):

1= Blue and Orange alignments

3 Purple alignment (assessed against an alternative junction strategy with less land take)

4 Red alignment

5 Green alignment

21 ISAR Conclusions

21.0.1 The follow up studies add detail to the ISAR results and recommendations covered in Chapter 14 in the following ways:

1. Developing engineering alignments that follow the reduced design speed and standard through the SSSI as assessed in the study will reduce adverse impacts on the biodiversity of the woodland. The least adverse alignment being either alignment 4 or 6, both of which are online with widening to the west of the existing carriageway.
2. Developing engineering alignments through sectors 3 and 4 that avoid potential areas of buried archaeological value would potentially reduce adverse effects on this receptor. Further site investigations have been recommended as part of the next assessment stage, to confirm the significance, or otherwise of archaeological deposits below the preferred route.

21.0.2 Therefore, based on existing data, the environmental performance of the best ranked ISAR alignments (Blue and Orange) could be further improved by avoiding the potential buried archaeology as far as practicable. For example exploring an amalgamation between the Orange and Purple routes with a junction arrangement that is similar to the Blue junction location or a mainly online route such as the Red alignment. Site investigations at the next assessment stage should confirm the significance, or otherwise, of archaeological deposits in the area.

21.0.3 The adverse effects on the biodiversity of the SSSI woodland would potentially be reduced for all ISAR alignments if a reduced design speed/standard were adopted through the woodland area, such as those assessed in the SSSI study. The most beneficial alignment to adopt would either be 4 or 6.

21.0.4 Other recommendations raised at the interim consultation workshop and during assessment, remain a consideration in order to reduce risk, to ensure feasible options are appraised at Stage 2, to minimise constraints and adverse effects and maximise opportunities and beneficial effects are:

1. reduction of displacement or removal of hedgerows, woodland and important standard trees generally or considering reduced footprints to reduce loss;

2. explore potential to reduce land-take of junctions or reduce land-take generally where this does not lead to other adverse environmental effects;
3. in the vicinity of Sutton Farm, proposed deep cutting and roadside hedgerow to the west of the carriageway and grading out the cuttings to the east to open up views for vehicle travellers whilst minimising effects on landscape character;
4. consider opportunities to maintain a close relationship between vertical alignment, landform and topography wherever practicable and where this does not conflict with visual amenity or other issues; and
5. liaise with EAW regarding the presence of and potential impact on groundwater monitoring boreholes and Fynnon Whitton Mawr and other aspects of the water environment to define Stage 2 brief and requirements for monitoring.

22 Addendum Appendices

Appendix 18.1 **Habitat Descriptions**

Appendix 18.2 **NVC Floristic Tables**

Appendix 18.3 **SSSI Citation**

Appendix 18.4 **Landscape Methodology**

Appendix 19.1 **Geophysics Technical Information Instrumentation, Display Options, Data Processing, Tie-in Techniques and Information, Terms Commonly Used in Interpretation of Results**

Appendix 18.1 Habitat Descriptions

1. Woodland 1 – west of A4226 Waycock Road

Quadrat data: see NVC Floristic Table 1, Quadrat Nos. 1 - 5

Woodland within 50m of the road lay on slightly sloping or near-level ground below the remainder of the wood, which covered the north-east and north-west facing slopes of a low hill. The area overlies slowly-permeable Jurassic and Cretaceous clay soils of the Denchworth Association and the ground was damp but not waterlogged. There was a local system of old wood banks at the northern corner of the wood.

This part of the wood was structurally well-developed, with a clear canopy, understorey and field layer. The current vegetation appeared to have been derived from a working woodland that had been managed as coppice-with-standards, with traditional management probably ceasing 60-70 years ago (there were very few Ash *Fraxinus excelsior* or Pedunculate oak *Quercus robur* standards that appeared to be any older than this). The current condition of the vegetation suggested that there has been little or no management in this part of the wood in recent decades. The canopy was approximately 15 – 20 m high and dominated by Ash trees, which formed a near-closed cover and cast deep shade on the woodland floor (Plate 1). The only other frequent canopy trees were Silver Birch *Betula pendula*, Pedunculate oak and Downy Birch *Betula pubescens*. In a few places the canopy was lower and other species (Goat Willow *Salix caprea,* Wych Elm *Ulmus glabra* and Field Maple *Acer campestre*) formed a reduced canopy.

Below, outgrown Hazel *Corylus avellana* coppice stools were abundant, along with mature bushes of Hawthorn *Crataegus monogyna* and Field Maple. Bramble *Rubus fruticosus* agg. formed a semi-continuous low tangle below and, typically of the W8 community, calcicolous shrubs such as Guelder-rose *Viburnum opulus*, Dogwood *Cornus sanguinea* and Spindle *Euonymus europaeus* were scattered throughout the understorey.

Plate 1. Ivy-dominated W8 woodland with abundant old Hazel coppice near A4226.

The woodland floor was deeply shaded, with abundant fallen and decomposing dead wood. Common Ivy *Hedera helix* formed extensive carpets across the ground, and only other shade-tolerant species were regular associates - Enchanter's-nightshade *Circaea lutetiana* was constant, along with mats of pleurocarpous woodland mosses such as *Eurhynchium striatum* and *Kindbergia praelonga*. Both understorey and field layer supported saplings of the main canopy trees above.

Remnants of what was probably once a diverse woodland ground flora were still occasionally present; a good-sized population (estimated 100+ plants) of Herb-Paris *Paris quadrifolia* (Plate 2) was found 15 – 20 m from the road, and there were occasional Bluebell *Hyacinthoides non-scripta*, Dog's Mercury *Mercurialis perennis*, Greater Butterfly-orchid *Platanthera chlorantha* and Woodruff *Galium odoratum*. Ferns were no more than occasional throughout and included Male-fern *Dryopteris filix-mas*, Broad Buckler-fern *D. dilatata* and Borrer's Male-fern *D. borreri*. Living trees and fallen wood also supported good populations of characteristic common bryophytes such as the mosses *Isothecium myosuroides*, *Brachythecium rutabulum* and *Hypnum cupressiforme* and the liverworts *Metzgeria furcata* and *Frullania dilatata*.

Plate 2. Flowering/fruiting Herb-Paris in deep shade

In one place near the southern end of this woodland section there was evidence of past disturbance, indicated by a few large heaps of wooded spoil and an abundance of Elder *Sambucus nigra* in the understorey.

Analysis of the data collected from this part of the wood indicated a relatively good fit with the W8d community. This tends to be the least diverse of the Ash-maple (W8) woodland sub-communities and is indicative of loss of diversity caused by long-term lack of woodland management operations e.g. cutting and coppicing.

2. Woodland 1 – west of A4226 Waycock Road: remainder of wood

Quadrat data: see NVC Floristic Table 2, Quadrat Nos. 6 - 10

The majority of this block of mature woodland lay on the north-east and north-west facing slopes of a low hill. It overlies slowly-permeable Jurassic and Cretaceous clay soils of the Denchworth Association and the ground was damp but not waterlogged. There was what appeared to be a regular series of parallel drains on the lower part of the woodland with a north-west aspect, draining down toward the River Waycock.

Generally the wood was structurally well-developed, with a clear canopy, understorey and field layer. The current vegetation appeared to have been derived from a working woodland that had been managed as coppice-with-standards, with traditional management probably ceasing 60-70 years ago (there were very few Ash *Fraxinus excelsior* or Pedunculate oak *Quercus robur* standards that appeared to be older than this). The current condition of the vegetation suggested that there has been little or no management in this part of the wood in recent decades. However, a number of paths and signs present in parts of the wood suggest that illegal off-road motorcycling has been/continues to be a problem. The canopy was approximately 15 – 20 m high and dominated by Ash trees, which formed a near-closed cover and cast deep shade on the woodland floor. Silver Birch, Downy Birch, Pedunculate oak, Sycamore *Acer pseudoplatanus* and Goat Willow were all relatively frequent associates of the Ash and in places, especially upslope, were locally abundant.

Below, outgrown Hazel *Corylus avellana* coppice stools were abundant, as were mature bushes of Hawthorn *Crataegus monogyna* and Field Maple. Bramble *Rubus fruticosus* agg. formed a semi-continuous low tangle below and typically of the W8 community, calcicolous shrubs such as Wild Privet *Ligustrum vulgare*, Dogwood *Cornus sanguinea* and Spindle *Euonymus europaeus* were scattered throughout.

The field layer was variable although carpets of Common Ivy were more or less constant, especially at the northern end of the wood where the woodland floor was deeply shaded and where only Enchanter's-nightshade and Male-fern were frequent associates (Plate 3). Upslope, where a prominent wood-bank formed the woodland boundary, more light was able to reach the woodland floor and consequently the field layer was locally diverse. These areas supported a sparse cover of woodland indicators including Broad-leaved Helleborine *Epipactis helleborine*, Bluebell, Wood Speedwell *Veronica montana*, Sanicle *Sanicula europaea*, Hairy-brome *Bromopsis ramosa*, Stinking Iris *Iris foetidissima*, Herb-Paris, Primrose *Primula vulgaris*, Greater Butterfly-orchid, Dog's Mercury and Wood Sedge *Carex sylvatica*. Across the woodland floor there were carpets of characteristic woodland mosses especially

Eurhynchium striatum and *Thamnobryum alopecurum*. Ferns were relatively frequent and a number of species were present, including Soft Shield-fern *Polystichum setiferum*, Hart's-tongue *Asplenium scolopendrium*, Male-fern and Broad Buckler-fern.

Plate 3. Woodland upslope from the road.

A few small seepage lines were also present and these tended to be characterised by vigorous patches of Remote Sedge *Carex remota*, Rough Meadow-grass *Poa trivialis* and a number of common wetland herbs and grasses.

Living trees and fallen wood supported good populations of characteristic common bryophytes such as the mosses *Isothecium myosuroides*, *Brachythecium rutabulum* and *Hypnum cupressiforme* and the liverworts *Metzgeria furcata* and *Frullania dilatata*.

Analysis of the data collected from this part of the wood indicated a relatively good fit with the W8d community. Several small patches of woodland uphill appeared to have some affinities with the W8e (Herb-Robert *Geranium robertianum*) sub-community which is more species-rich than W8d but the differences were not felt to be marked enough to be significant.

3. Woodland 2 – east of A4226 Waycock Road

Quadrat data: see NVC Floristic Table 3, Quadrat Nos 11 - 15

This Ash-maple woodland was in many respects a mirror image of the woodland on the other side of the A4226, with similar soils, species composition, structure and apparent management. The road edge and a deeply incised small stream marked the lowest point of the surveyed area, which lay on a gentle west-facing slope.

There were a few subtle differences in species; Downy Birch appeared to be more frequent in the canopy, and although the age of most of the trees seemed to be 60-70 years, some of the oaks near the road appeared to be older, perhaps in the order of 100+ years. In the understorey, abundant old Hazel stools mixed with locally frequent Holly *Ilex aquifolium* and most of the same shrubs as before. Many of the Ash trees appeared to have been coppiced when young and there were also a few old Ash stools.

Field-rose was abundant in the field layer and mixed with Bramble to form a low arching tangle across much of the woodland floor (Plate 4). As in the woodland across the road, the field layer was quite species-poor and dominated by a carpet of Common Ivy, typically accompanied by low cover of Enchanter's-nightshade and False Brome *Brachypodium sylvaticum*. Woodruff and Wood Sedge were also relatively frequent and small populations of Goldilocks Buttercup *Ranunculus auricomus* and Greater Butterfly-orchid were seen near the road.

Moving uphill and further away from the road, the woodland interior was similar but more mosses (*Thamnobryum alopecurum* and *Eurhynchium striatum*) were present on the woodland floor. The wet clay banks of the roadside stream provided good habitat for other bryophytes including the mosses *Thuidium tamariscinum* and *Fissidens taxifolius* along with the thalloid liverwort *Pellia* cf. *endiviifolia*.

Analysis of the data collected from the 50 m of woodland closest to the road indicated a reasonably good fit with the W8d community, although Hawthorn and Dog's Mercury were less constant than expected. Other species including Downy Birch, Field Maple and Ash saplings were over-represented in the community. However, the community did not show any conclusive affinities with any other sub-community of W8.

Plate 4. Low Bramble was frequent near the road.

Appendix 18.2 NVC Floristic Tables

Table 1: W8d *Fraxinus excelsior – Acer campestre – Mercurialis perennis* woodland; *Hedera helix* sub-community

Quadrat numbers: 1-5

Species	Common name	Frequency	Range of cover values
Canopy			
Fraxinus excelsior	Ash	V	7-9
Betula pendula	Silver Birch	IV	3-7
Quercus robur	Pedunculate Oak	IV	1-5
Betula pubescens	Downy Birch	III	3
Hedera helix	Common Ivy	III	2-3
Acer campestre	Field Maple	II	2
Salix caprea	Goat Willow	II	1-2
Quercus petraea	Sessile Oak	I	1
Ulmus glabra	Wych Elm	I	1
Shrub understorey			
Corylus avellana	Hazel	V	5-7
Crataegus monogyna	Hawthorn	V	4-6
Acer campestre	Field Maple	IV	5-6
Fraxinus excelsior	Ash	III	1-3
Cornus sanguinea	Dogwood	II	2-4
Euonymus europaeus	Spindle	II	1-4
Malus sylvestris	Crab Apple	II	1
Quercus robur	Pedunculate Oak	II	1
Ilex aquifolium	Holly	I	1
Lonicera periclymenum	Honeysuckle	I	1
Rosa arvensis	Field-rose	I	2
Field layer			
Circaea lutetiana	Enchanter's-nightshade	V	2-7
Eurhynchium striatum	A moss	V	3-7
Hedera helix	Common Ivy	V	7-10

Species	Common name	Frequency	Range of cover values
Rubus fruticosus agg.	Bramble	V	1-6
Fraxinus excelsior	Ash	III	2
Kindbergia praelonga	A moss	III	3-4
Arum maculatum	Lords-and-Ladies	II	1
Dryopteris filix-mas	Male-fern	II	1
Galium odoratum	Woodruff	II	1-2
Geum urbanum	Wood Avens	II	1
Thuidium tamariscinum	A moss	II	3
Acer campestre	Field Maple	I	1
Brachythecium rutabulum	A moss	I	3
Carex sylvatica	Wood Sedge	I	1
Dryopteris dilatata	Broad Buckler-fern	I	1
Galium aparine	Cleavers	I	1
Glechoma hederacea	Ground-ivy	I	1
Thamnobryum alopecurum	A moss	I	3
Veronica montana	Wood Speedwell	I	1
Bare ground/litter		-	-
MATCH co-efficient of similarity to W8d			**63.0**
Possible affinities to other NVC communities/sub-communities			None
Total number of species found in stand			**33**

Table 2: W8d *Fraxinus excelsior – Acer campestre – Mercurialis perennis* woodland; *Hedera helix* sub-community

Quadrat numbers: 6-10

Species	Common name	Frequency	Range of cover values
Canopy			
Fraxinus excelsior	Ash	V	7-9
Quercus robur	Pedunculate Oak	V	1-5
Betula pendula	Silver Birch	IV	3-7
Betula pubescens	Downy Birch	IV	1-4
Clematis vitalba	Traveller's-joy	II	1-2
Salix caprea	Goat Willow	II	1

Species	Common name	Frequency	Range of cover values
Acer campestre	Field Maple	I	1
Acer pseudoplatanus	Sycamore	I	1
Shrub understorey			
Acer campestre	Field Maple	V	3-6
Corylus avellana	Hazel	V	3-8
Crataegus monogyna	Hawthorn	IV	1-6
Fraxinus excelsior	Ash	III	3-4
Hedera helix	Common Ivy	III	2-4
Euonymus europaeus	Spindle	II	1-4
Lonicera periclymenum	Honeysuckle	II	1-4
Quercus robur	Pedunculate Oak	II	1-4
Sambucus nigra	Elder	II	1
Betula pendula	Silver Birch	I	4
Betula pubescens	Downy Birch	I	1
Cornus sanguinea	Dogwood	I	3
Rosa arvensis	Field-rose	I	3
Salix caprea	Goat Willow	I	6
Field layer			
Fraxinus excelsior	Ash	V	1-3
Circaea lutetiana	Enchanter's-nightshade	IV	4-5
Dryopteris filix-mas	Male-fern	IV	1-4
Eurhynchium striatum	A moss	IV	3-4
Galium aparine	Cleavers	IV	1-3
Polystichum setiferum	Soft Shield-fern	IV	1-4
Rubus fruticosus agg.	Bramble	IV	1-5
Dryopteris dilatata	Broad Buckler-fern	III	1-4
Geranium robertianum	Herb-Robert	III	1-4
Hedera helix	Common Ivy	III	8-9
Kindbergia praelonga	A moss	III	3
Brachypodium sylvaticum	False Brome	II	1-2
Cornus sanguinea	Dogwood	II	2-3
Geum urbanum	Wood Avens	II	1-2

Species	Common name	Frequency	Range of cover values
Lonicera periclymenum	Honeysuckle	II	1
Poa trivialis	Rough Meadow-grass	II	2-5
Thamnobryum alopecurum	A moss	II	3
Acer campestre	Field Maple	I	1
Arum maculatum	Lords-and-Ladies	I	1
Asplenium scolopendrium	Hart's-tongue	I	4
Brachythecium rutabulum	A moss	I	3
Bromopsis ramosa	Hairy-brome	I	2
Cardamine flexuosa	Wavy Bitter-cress	I	1
Carex pendula	Pendulous Sedge	I	1
Carex sylvatica	Wood Sedge	I	1
Deschampsia cespitosa	Tufted Hair-grass	I	1
Epipactis helleborine	Broad-leaved Helleborine	I	1
Galium palustre	Common Marsh-bedstraw	I	2
Heracleum sphondylium	Hogweed	I	1
Hyacinthoides non-scripta	Bluebell	I	3
Juncus effusus	Soft-rush	I	1
Mercurialis perennis	Dog's Mercury	I	6
Plagiomnium undulatum	A moss	I	3
Platanthera chlorantha	Greater Butterfly-orchid	I	1
Ranunculus repens	Creeping Buttercup	I	2
Sanicula europaea	Sanicle	I	4
Silene dioica	Red Campion	I	1
Tamus communis	Black Bryony	I	1
Vicia sepium	Bush Vetch	I	1
Bare ground/litter		-	-
MATCH co-efficient of similarity to W8d			**60.3**
Possible affinities to other NVC communities/sub-communities			W8e
Total number of species found in stand			**50**

Table 3: W8d *Fraxinus excelsior – Acer campestre – Mercurialis perennis* woodland; *Hedera helix* sub-community

Quadrat numbers: 11-15

Species	Common name	Frequency	Range of cover values
Canopy			
Betula pubescens	Downy Birch	V	4-5
Fraxinus excelsior	Ash	V	8-9
Quercus robur	Pedunculate Oak	V	4-5
Betula pendula	Silver Birch	II	3-5
Shrub understorey			
Acer campestre	Field Maple	V	1-7
Corylus avellana	Hazel	V	6-9
Euonymus europaeus	Spindle	V	1-4
Fraxinus excelsior	Ash	V	1-3
Rosa arvensis	Field-rose	V	1-4
Hedera helix	Common Ivy	IV	2-4
Crataegus monogyna	Hawthorn	III	1-5
Quercus robur	Pedunculate Oak	II	4
Fagus sylvatica	Beech	I	1
Ilex aquifolium	Holly	I	1
Tamus communis	Black Bryony	I	1
Field layer			
Eurhynchium striatum	A moss	V	1-5
Fraxinus excelsior	Ash	V	1-4
Hedera helix	Common Ivy	V	7-9
Rubus fruticosus agg.	Bramble	V	4-6
Circaea lutetiana	Enchanter's-nightshade	IV	1-3
Carex sylvatica	Wood Sedge	III	1-4
Galium odoratum	Woodruff	III	1-4
Geum urbanum	Wood Avens	III	1-2
Lonicera periclymenum	Honeysuckle	III	1-4
Acer campestre	Field Maple	II	1-3

Species	Common name	Frequency	Range of cover values
Arum maculatum	Lords-and-Ladies	II	1-2
Euonymus europaeus	Spindle	II	1-2
Kindbergia praelonga	A moss	II	3
Tamus communis	Black Bryony	II	1
Dryopteris dilatata	Broad Buckler-fern	I	1
Filipendula ulmaria	Meadowsweet	I	1
Hypnum cupressiforme	A moss	I	3
Isothecium myosuroides	A moss	I	3
Mercurialis perennis	Dog's Mercury	I	1
Ranunculus auricomus	Goldilocks Buttercup	I	3
Thamnobryum alopecurum	A moss	I	3
Veronica montana	Wood Speedwell	I	1
Vicia sepium	Bush Vetch	I	2
Viola species	A violet	I	1
Bare ground/litter		II	4-6
MATCH co-efficient of similarity to W8d			**55.7**
Possible affinities to other NVC communities/sub-communities			None
Total number of species found in stand			**32**

Appendix 18.3 SSSI Citation

CYNGOR CEFN GWLAD CYMRU

COUNTRYSIDE COUNCIL FOR WALES

SITE OF SPECIAL SCIENTIFIC INTEREST: CITATION

VALE OF GLAMORGAN	**COEDYDD Y BARRI/BARRY WOODLANDS**
Local Planning Authority:	Vale of Glamorgan Council
Date of Notification:	4 April 2007
National Grid Reference:	ST 087690 and ST 127707
OS Maps:	1:50,000 Sheet number: 171
	1:10,000 Sheet number: SO 00 SW
Site Area:	120.7 ha

Description:

Coedydd Y Barri/Barry Woodlands is of special interest for its semi-natural broadleaved woodland.

The site comprises a series of fourteen separate woodland blocks, some of which are connected by hedgerows. They are in two groups, about 3 km apart, centred on Pencoedtre Wood and Middleton Wood, on the northern and western outskirts of Barry, in the Vale of Glamorgan. Most of the woodlands are on gently sloping ground at an altitude of between 30m and 70m and associated with clayey, often waterlogged, moderately base rich lowland soils that in Wales are almost entirely restricted to the Vale of Glamorgan. Long-established woodland on this particular soil-type gives rise to ash-dominated woodland that supports a rich ground flora. This series of woodlands is the best example of this habitat in Wales.

The individual woodlands vary in the combination of species of tree present, depending on their management in the past. Generally, ash *Fraxinus excelsior* is the dominant species, but pedunculate oak *Quercus robur* and beech *Fagus sylvatica* are also present. Other tree species include hornbeam *Carpinus betulus*, sycamore *Acer pseudoplatanus* and downy birch *Betula pubescens*. Some of the woods have been subject to replanting in the past.

Beneath the woodland canopy, a shrub layer consists of species such as hazel *Corylus avellana*, field maple *Acer campestre*, hawthorn *Crataegus monogyna*, wych elm *Ulmus glabra*, spindle *Euonymus europaeus* and crab apple *Malus sylvestris*. Occasionally, wild privet *Ligustrum vulgare*, wayfaring tree *Viburnum lantana*, wild cherry *Prunus avium* and holly *Ilex aquifolium* can also be found. Climbing species such as field-rose *Rosa arvensis* and honeysuckle *Lonicera periclymenum* use these shrubs and trees for support. Where there is a gap in the woodland canopy, downy birch, field maple, ash and other tree and shrub saplings occur, competing to fill the space created by fallen or dying trees.

The ground flora of these woodlands is of particular interest as it is especially rich, even in areas replanted with non-native trees.

Typically, this includes woodland species such as dog's mercury *Mercurialis perennis*, yellow archangel *Lamiastrum galeobdolon*, enchanter's-nightshade *Circaea lutetiana* , lesser celandine *Ranunculus ficaria*, soft shield-fern *Polystichum setiferum*, bluebell *Hyacinthoides non-scripta*, primrose *Primula vulgaris*, wood anemone *Anemone nemorosa* and woodruff *Galium odoratum*. Coedydd Y Barri/Barry Woodlands is notable for the large number of rare woodland plants that can be found amongst the ground flora. These include greater butterfly-orchid *Platanthera chlorantha*, thin-spiked wood-sedge *Carex strigosa*, wood millet *Milium effusum*, early purple-orchid *Orchis mascula*, twayblade *Listera ovata*, herb-paris *Paris quadrifolia*, goldilocks buttercup *Ranunculus auricomus* and sanicle *Sanicula europaea*. In total, about 150 species of vascular plants have been recorded here, making this group of woodlands one of the most species-rich of any type found in Wales.

Flushes, streams and small humid ravines add to the ecological diversity of the woodlands. There are also two areas of wooded swamp, associated with up-welling of lime-rich water, which support beds of great horsetail *Equisetum telmateia*.

Remarks:

This is a new site. The majority of the woods that make up Coedydd Y Barri/Barry Woodlands SSSI are included in the provisional Inventory of Ancient Woodland for Glamorgan. Parts of the SSSI are leased by the Forestry Commission.

Appendix 18.4 Landscape Methodology

LANDSCAPE CHARACTER

Effects on landscape character would be derived from physical changes to the landscape that may cause changes in character and how the landscape is experienced and valued. The landscape classification and evaluation is the baseline against which the effect of the proposed scheme is assessed.

Assessment of the significance of effects on landscape character is the result of a combination of magnitude of change and the capacity of the landscape to accommodate or accept the change that is predicted to occur.

In applying the criteria, the potential beneficial as well as adverse effects of the scheme have been taken into account. Assessment of magnitude is based on factors including geographical extent, prominence, degree of alteration/intrusion and perceived change, reversibility, duration and potential mitigation. In assessing how the alignments would affect the existing landscape the following factors are considered:

- The extent to which the road would be visible in the landscape;
- The character of the landscape and its capacity to accept changes of the type and scale proposed;
- The extent to which effects can be mitigated and the road can be integrated into the landscape.

The following criteria have been used to define magnitude:

- **High Magnitude**: The scheme or specific effect will result in substantial loss or major alteration to key elements of the landscape resource to the extent that there is a fundamental change to landscape character.
- **Medium Magnitude**: The scheme or specific effect will result in loss or alteration to key elements of the landscape resource to the extent that there is a partial change to landscape character.
- **Low Magnitude**: The scheme or specific effect will result in minor loss or alteration to key elements of the landscape resource to the extent that there may be some slight perception of change to landscape character.
- **Negligible Magnitude**: The scheme or specific effect will result in very minor loss or alteration to key elements of the landscape resource and there would be no fundamental change to landscape character.

Landscape capacity refers to the degree to which a particular landscape character area (LCA) or type is able to accommodate change of a specific type without significant effects in its character, or overall change of landscape character type.

Consequently, capacity is based on the type of development proposed, a consideration of sensitivity, landscape value (quality, situation and rarity) attached to the landscape and visibility from within the LCA. For the purposes of this landscape character assessment the following criteria have been adopted for assessing capacity.

- **Low Capacity**: A landscape of high value, sensitive to this form of development, or where views of the road scheme may be visible from a large proportion of the character area. As a consequence significant effects on landscape character or quality are likely.
- **Moderate Capacity**: A landscape that has medium sensitivity to the type and form of development proposed and any change caused by the proposed development would be unlikely to have a significant effect on landscape character or quality that could not be mitigated against.
- **High Capacity**: A landscape of low value, not sensitive to this type of development, unlikely to be within a designated landscape and contain few other constraints imposed by landscape character elements. Or where dominant views from within the LCA of the proposed road scheme are unlikely. As a result development of the type proposed is very unlikely to have a significant effect on landscape character or quality.

As stated above, the relationship and combinations of magnitude and capacity determine the significance of landscape effects. Significance increases in line with the capacity of the landscape character area (LCA) and the magnitude of effect. Differentiation is made between the sensitivity of particular receptors based upon their value within the landscape. A greater landscape capacity or a smaller magnitude of landscape effect moderates and/or lessens the significance of effect. The table below sets out the derivation of significance for effects on landscape character.

Table 18.1 Significance of Effect on Landscape Character

Magnitude of Effect on Landscape Character	Landscape Capacity		
	Low	**Moderate**	**High**
High	Substantial*	High-Moderate*	Moderate
Medium	High-Moderate*	Moderate	Slight
Low	Moderate	Slight	Slight-Neutral
Negligible	Slight	Slight-Neutral	Slight-Neutral

Note: *Substantial and High-Moderate is considered significant in terms of the EIA Regulations and as such has been asterisked.*

VISUAL AMENITY

Effects on visual amenity relate to changes in the composition of views and people's responses to these changes which have been assessed at locations frequented by members of the public. Relevant considerations for the visual effect analysis included:

- The magnitude of the change to the visual quality that would be caused by the proposed road alignments including length of road visible, the roads potential prominence, the distance between road and receptor, and the context of the view;
- The receptor location, number of people within each potential receptor group and the nature of these receptor groups and their sensitivities (e.g. will people view the site during work or leisure activities, whilst in transit, etc.); and
- The existing visual character and quality of the view (including whether it is subject to landscape designations, the presence of positive or negative visual detractors, etc.).

The level of significance of effect upon visual amenity is determined by correlating the magnitude of effect with the sensitivity of receptors. When considering the potential visibility of the scheme, the following features are taken into account:

- the level of the road relative to the existing ground level (including mounds, bunds, cuttings, false cuttings);
- the main carriageway, side roads, junctions, lighting and structures;
- traffic on the road (screened traffic is by a barrier (for example a cutting or woodland) of over 4 metre deep/tall, whereas 'not fully screened' refers to the fact that larger vehicles would be visible but smaller cars are not);
- visibility of the scheme through the seasons; and
- loss of landscape elements.

The magnitude of effect on visual amenity is based upon the following criteria:

- **High Magnitude**: Where the scheme will result in a significant or dominant and immediately apparent feature of the view that affects and changes the overall character of the view and to which other features become subordinate.
- **Medium Magnitude**: Where the scheme forms a visible and recognisable new element within the overall view and is readily noticed by the viewer without changing the overall nature of the view.
- **Low Magnitude**: The scheme will constitute a minor component of the wider view, which might be missed by the casual observer. Awareness of the development will not have a marked effect on the overall quality of the view.

- **Negligible Magnitude**: The presence of the proposed road scheme has no effect on the perception of the landscape**.**

Receptor type is a key factor in determining sensitivity, although other factors listed can influence the sensitivity of the given receptor to visual change.

- **High Sensitivity**: Residents with views towards the route alignments or people undertaking recreation where the landscape within which the road is seen is the primary reason for attraction (e.g. walkers, hikers, riders, scenic route users). Receptors are more likely to be within a recognised designated landscape and could be attracted to visit more frequently, or stay for longer by virtue of the view.
- **Medium Sensitivity**: Outdoor workers (farm workers etc.) and people undertaking recreational pursuits where the landscape within which the scheme is seen is not the primary reason for attraction (e.g. golfers, water based activities, theme and adventure parks, historic sites, parks and gardens, minor road users). This category normally includes residents with indirect views towards the development but for the purposes of this study the worst-case scenario is recorded i.e. all residents are high sensitivity. Receptors are less likely to be within a recognised designated landscape and could be attracted to visit more frequently, or stay for longer by virtue of the facilities and features of the particular attraction.
- **Low Sensitivity**: People travelling through the landscape (by car, train, bus etc.). Users of indoor workplaces and indoor community facilities. Receptors are unlikely to be within a recognised designated landscape and are most likely to be present at a given viewpoint by virtue of some other need or necessity unrelated to the landscape.

Table 18.2 Significance of Effect on Visual Amenity

Magnitude of Visual Effect	**Sensitivity of Receptor**		
	High	**Medium**	**Low**
High	Substantial*	High-Moderate*	Moderate
Medium	High-Moderate*	Moderate	Slight
Low	Moderate	Slight	Slight-Neutral
Negligible	Slight	Slight-Neutral	Slight-Neutral

Note: *Substantial and High-Moderate is considered significant in terms of the EIA Regulations and as such has been asterisked.*

Appendix 19.1 Geophysics

Technical Information Instrumentation

Instrumentation

Fluxgate Gradiometer: Geoscan FM36/256 and Bartington *Grad*601-2

Both the Geoscan and Bartington instruments comprise two fluxgate sensors mounted vertically apart; the distance between the sensors on the former is 500mm, on the latter 1000mm. The gradiometers are carried by hand, with the bottom sensor approximately 100-300mm from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. The fluxgate gradiometer suppresses any diurnal or regional effects. Generally, features up to 1m deep may be detected by this method. Having two gradiometer units mounted laterally with a separation of 1000mm, the Bartington instrument can collect two lines of data per traverse.

Resistance Meter: Geoscan RM15

This instrument measures the electrical resistance of the earth, using a system of four electrodes (two current and two potential.) Depending on the arrangement of these electrodes an exact measurement of a specific volume of earth may be acquired. This resistance value may then be used to calculate the earth resistivity. The most common arrangement is the Twin Probe configuration which involves two pairs of electrodes (one current and one potential): one pair remain in a fixed position, whilst the other measures the resistance variations across a grid. The resistance is measured in ohms and, when calculated, resistivity is in ohm-metres. The resistance method as used for standard area survey employs a probe separation of 0.5m, which samples to a depth of approximately 0.75m. The nature of the overburden and underlying geology will cause variations in this depth.

GPR: Sensors & Software Noggin Smartcart

The Noggin system includes an onboard digital video logger (DVL III), 250 MHz or 500MHz antenna, an odometer wheel and battery. It is, therefore, a fully integrated system. The built-in software uses the integrated odometer to provide an accurate distance measurement to the response. The data are recorded in digital format and can be processed to produce depth slice maps, 2D sections or 3D cubes.

Display Options

XY Trace

This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane. The output may be either colour or black and white.

Greyscale

This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all

values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Relief Plot

This is a method of display that creates a three dimensional effect by directing an imaginary light source on a given data set. Particular elements of the results are highlighted depending on the angle of strike of the light source. This display method is particularly useful when applied to resistance data to highlight subtle changes in resistance that might otherwise be obscured.

3D Surface Plot

This is similar to the XY trace, but in 3 dimensions. Each data point of a survey is represented in its relative position on the *x* and *y* axes and the data value is represented in the *z* axis. This gives a digital terrain, or topographic effect.

Radargram

Radar data comprise a record of reflection intensity against the time taken for the emitted energy to travel from the transmitter down to the reflector and back to the receiver. The resultant plot is effectively a vertical section through the ground along the line of the traverse, with time (depth) on the vertical axis, displacement on the horizontal axis and reflection intensity as a grey or colour scale.

Time Slice

If a number of radargrams are collected over a grid, or in conjunction with GPS data, it is possible to reconstruct the entire dataset into a 3D volume. This can then be resampled to compile 'plan' maps of response strength at increasing time offsets (typically converted to show approximate depth), thus simplifying the visualisation of how anomalies vary beneath the surface across a survey area.

Volume Plot

Rather than looking at discrete slices of data from the 3D volume, it is possible to strip away all reflections with intensity below a user-defined threshold, leaving just the strongest anomalies. This serves to create a rendered 3D model of the most substantial subsurface deposits which can then be rotated or enlarged/reduced to either animate the display or view it from any perspective.

Data Processing

Zero Mean Traverse	This process which sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set. It is usually only applied to gradiometer data.
Step Correction	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors
Interpolation	When geophysical data are presented as a greyscale, each data point is represented as a small square. The resulting plot can sometimes have a 'blocky' appearance. The interpolation process calculates and inserts additional values between existing data points. The process can be carried out with points *along* a traverse (the *x* axis) and/or *between* traverses (the *y* axis) and results in a smoother greyscale image.
Despike	In resistance survey, spurious readings can occasionally occur, usually due to a poor contact of the probes with the surface. This process removes the spurious readings, replacing them with values calculated by taking the mean and standard deviation of surrounding data points. It is not usually applied to gradiometer data.
High Pass Filter	Carried out over the whole a resistance data-set, the filter removes low frequency, large scale spatial detail, such as that produced by broad geological changes. The result is to enhance the visibility of the smaller scale archaeological anomalies that are otherwise hidden within the broad 'background' change in resistance. It is not usually applied to gradiometer data.
GPR Filters	There are a wide range of GPR filters available and their application will vary from project to project. The most commonly used are: Dewow (removes low frequency, down-trace instrument noise); DC-Shift (re-establishes oscillation of the radar pulse around the zero point); Bandpass Filtering (suppresses frequencies outside of the antenna's peak bandwidth thus reducing noise); Background Removal (can remove ringing, instrument noise and minimize the near-surface 'coupling' effect); Migration (collapses hyperbolic tails back towards the reflection source).

Tie-in Techniques and Information

Tapes

A number of points on each survey grid are recorded by triangulating to at least two fixed points on the base map. If there is a lack of 'hard detail' in the mapping, some form of survey marker will be left *in-situ* for reference.

NOTE: When re-establishing the grid (for excavation or other post-survey work) only data from the supplied tie-in diagram should be used and NOT the report figures.

Electronic Distance Measurers (EDM) / Total Stations (TST)

This type of instrument measures the distance and angle to features with reference to a fixed point. Where possible the EDM will be set up over a point that can be re-established with relative ease, e.g. over map detail, a survey marker or at a point measureable by tapes. Distances and angles to permanent points of reference and/or map detail are recorded as well as at least two points per survey grid.

NOTE: When re-establishing the grid (for excavation or other post-survey work) only data from the supplied tie-in diagram should be used and NOT the report figures.

Global Positioning Systems (GPS)

Using a roving receiver unit, these systems record the longitude, latitude and altitude of a given point by triangulating between a network of satellites. For survey-grade measurements, the accuracy is refined by integrating data from a fixed base station or local reference network. In addition to grid points, elements of map detail are collected to assess the existing base-map accuracy and, in worst-case scenarios, use the data on a non-georeferenced map. If the supplied mapping is found to be inaccurate, it is sometimes necessary to shift the position of GPS points (keeping their relative positions fixed) within the site plan to correlate cartographic features with the 'real-world' co-ordinates; this should be considered when using GPS to re-establish an existing survey grid (see note below). It should be noted that the accuracy of any GPS-positioned point is dependent upon both the system and the satellite geometry at the time of survey. On projects where multiple contractors have used GPS, the possibility of compound errors between original survey grid creation, tie-in information and grid re-establishment should be borne in mind when positioning trenches over recorded anomalies.

NOTE: If re-establishing the grid with a GPS (for excavation or other post-survey work), use only the co-ordinates recorded on the tie-in diagram or, if supplied, the GPS data file included on the Archive CD; relative positions in the report diagrams may be correct but absolute co-ordinates can vary if discrepancies in the base mapping have been encountered.

Terms Commonly used in the Interpretation of Results

Magnetic

Archaeology	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological These anomalies, whilst considered anthropogenic, could be of any age.
? Archaeology	The interpretation of such anomalies is often tentative, with the anomalies exhibiting either weak signal strength or forming incomplete archaeological patterns. They may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Areas of Increased Magnetic Response	These responses show no visual indications on the ground surface and are considered to have some archaeological potential.
Industrial	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions e.g. palaeochannels or magnetic gravels.
? Natural	These are anomalies that are likely to be natural in origin i.e. geological or pedological.
Ridge and Furrow	These are regular and broad linear anomalies that are presumed to be the result of ancient cultivation. In some cases the response may be the result of modern activity.
Ploughing Trend	These are isolated or grouped linear responses. They are normally narrow and are presumed modern when aligned to current field boundaries or following present ploughing.
Uncertain Origin	Often, anomalies (both positive and negative) will be recorded which stand out from the background magnetic variation yet show little to suggest an exact origin. This may be because the characteristics and distribution of the responses straddle the categories of "*?Archaeology*" and "*?Natural*" or that they are simply of an unusual form.
Trend	This is usually an ill-defined, weak, isolated or obscured linear anomaly of unknown cause or date.
Areas of Magnetic Disturbance	These responses are commonly found in places where modern ferrous or fired materials are present e.g. brick rubble. They are presumed to be modern.
Ferrous Response	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.

Resistance

Archaeology	High or low res responses are clearly or very probably archaeological These anomalies, whilst considered anthropogenic, could be of any age.
? Archaeology	The interpretation of such anomalies is often tentative, with the anomalies exhibiting either weak signal strength or forming incomplete archaeological patterns. They may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions e.g. palaeochannels or magnetic gravels.
? Natural	These are anomalies that are likely to be natural in origin i.e. geological or pedological.
? Landscaping / topography	These are regular and broad linear anomalies that are presumed to be the result of ancient cultivation. In some cases the response may be the result of modern activity.
Vegetation	These are isolated or grouped linear responses. They are normally narrow and are presumed modern when aligned to current field boundaries or following present ploughing.
Trend	This is usually an ill-defined, weak, isolated or obscured linear anomaly of unknown cause or date.

GPR

Wall /Foundation/ /Vault /Culvert etc.	High amplitude anomaly definitions used when other evidence is available that supports a clear archaeological interpretation.
Archaeology	Anomalies whose form, nature and pattern indicate archaeology but where little or no supporting evidence exists. If a more precise archaeological interpretation is possible, for example the responses appear to respect known local archaeology, then this will be indicated in the accompanying text. As low amplitude responses are less obvious features it is unlikely that they would have a definitive categorisation.
? Archaeology	When the anomaly could be archaeologically significant, given its discrete nature, but where the distribution of the responses is not clearly archaeological. Interpretation of such anomalies is often tentative, exhibiting either little contrast or forming incomplete archaeological patterns.
Historic	Responses showing clear correlation with earlier map evidence.
?Historic	Responses relating to features not directly recorded on earlier maps but which appear to respect features that are. May form patterns suggestive of formal gardens, landscaping or footpaths.
Area of Anomalous Response	An area in which the response levels are very slightly elevated or diminished with respect to the 'background'. Where no obvious surface features or documentary evidence can explain this spread of altered reflectivity it is assumed to denote some kind of disturbance, though the origins could be of any age and either anthropogenic or natural. Possible explanations are changes in subsurface composition and groundwater 'ponding'.
Natural	Anomalies relating to natural sub-surface features as indicated by documentary sources, local knowledge or evidence on the surface.
?Natural	Responses forming patterns akin to subsoil/geological variations either attenuating or reflecting greater amounts of energy. An archaeological origin such as rubble spreads or robbed out remains cannot be dismissed.
Trend	An ill defined, weak or isolated linear anomaly of unknown cause or date.
Modern	Reflections that indicate features such as services, rebar or modern cellars correlating with available evidence (maps, communications with the client, alignment of drain covers etc.).
?Modern	Reflections appearing to indicate buried services but where there is no supporting evidence. Also applies to responses which form patterns, or are at a depth which suggests a modern origin. An archaeological source cannot be completely dismissed.
Surface	Responses clearly due to surface discontinuities, the effects of which may be seen to 'ring' down through radargrams and so incorrectly appearing in the deeper time-slices.

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