



OUR PICTURESQUE LANDSCAPE

HERITAGE LOTTERY BID – HABITAT STUDY

CADWYN CLWYD
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Cadwyn Clwyd

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EXECUTIVE SUMMARY

A Habitat Study has been prepared for the Our Picturesque Landscape Partnership, a Heritage Lottery Fund Landscape Partnership Bid which centres on the Dee Valley and the Pontcysyllte Aqueduct and Canal World Heritage Site, within the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty. The objectives of the Habitat Study were to map the key habitats within the project area, drawing from existing Phase 1 data held by Natural Resources Wales (NRW); to identify and map areas of habitat in the broad categories of ffridd, limestone grassland, hedges, water courses, heathland and woodland; to identify areas of weakness in terms of connectivity; to work with the project steering group to identify 'Pilot Habitat Improvement Projects', particularly relating to ffridd; to agree with the partners a number of key projects, including works on the key views in the Dee Valley; and to develop fully costed plans for the Landscape Conservation Action Plan, clearly splitting between the two geographical areas of Denbighshire and Wrexham.

Key habitats within the study area were mapped using the Phase 1 Habitat Survey data collected by the Countryside Council for Wales (CCW) between 1979 and 1997, which is available in GIS format from NRW (formerly CCW). A limitation of the Phase 1 data is that they may be significantly out of date through habitat change since the survey was carried out. Another limitation is that linear features such as hedgerows and other field boundaries were not mapped. The key habitats woodland, limestone grassland and water courses were taken directly from the CCW Phase 1 mapping data. Habitats were verified in certain areas using a combination of ground-truthing and examination of aerial photographs.

Hedgerows were mapped from aerial photography; where possible, a distinction was made between intact hedge, defunct hedge and hedge with trees. Hedgerow data has not been ground-truthed and therefore is a preliminary baseline dataset only, and would therefore require field survey to confirm its accuracy.

One of the key habitats of the project is ffridd, which has been proposed as a new priority habitat for Wales. Ffridd (also referred to as Coedcae) is an important habitat type that occurs within the marginal land between the uplands and the lowlands, and contains elements of habitat types which would occur in upland and lowland areas. It can be found between enclosed lowlands and moorland, on the summits of enclosed hills and on steep valley sides. It therefore comprises mainly marginal land which has been subject to fluctuating management intensity. Ffridd does not have a corresponding Phase 1 habitat code, as it is a highly complex mosaic of heterogeneous habitats, such as heath, bracken, grassland and scrub; it is therefore less straightforward to map than other habitat types. The main approach used to identify ffridd in the habitat study was to use the method of Distance Analysis in a GIS model. Firstly, a list of Phase 1 habitat types associated with ffridd (i.e. ffridd indicator habitats) was prepared based on the descriptions of the habitat prepared by the Wales Biodiversity Partnership, and agreed with the project partners. The study area was then set to a grid with 2x2 metre grid cells, and the 'distance to nearest indicator habitat' was calculated for each grid cell. Through this method, a 'heat map' was generated, with colours ranging from red indicating high potential for ffridd, green indicating medium potential and blue indicating low potential. Another method used to identify areas of ffridd was to pull out areas of the CCW Phase 1 data that were assigned two or more habitat codes,

indicating a mosaic of habitats which may correspond to ffridd. The combined viewing of these two layers in a Geographic Information System (GIS), along with other data relating to land classification, habitats and topography, enabled the identification of ffridd. A combination of ground truthing, examination of aerial photography and consultation with project partners was used to confirm areas of ffridd.

An examination of ecological connectivity was also carried out as part of the habitat study. The main source of information used in order to assess gaps in habitat connectivity was the outputs of work on connectivity modelling carried out by Countryside Council for Wales (CCW), which is available for heathland, broadleaved woodland and unimproved grassland. These datasets were examined in a GIS alongside other datasets, including the CCW Phase 1 data, to examine weaknesses in connectivity and what barriers to movement are present.

For ffridd, it was considered more appropriate to consider ecological connectivity within these areas rather than between them; a ffridd area with a complex mosaic of habitats such as heath, scrub, bracken, woodland and semi-natural grassland would therefore be considered to have good ecological connectivity and would support a range of wildlife at various stages of their life cycles.

When examining woodland connectivity, the hedgerow network as mapped during the Habitat Study was overlain on the woodland connectivity layers, as hedgerows can act as ‘ecological corridors’ for woodland species and thus improve the permeability of the landscape for woodland species.

The outputs of the habitat mapping exercise were a series of maps showing the distribution of key habitats within the study area. Woodland was found to be the most widespread and extensive of the key habitats within the study area, covering a total area 1290ha, comprising conifer plantation, semi-natural broadleaved woodland, broadleaved plantation and mixed plantation.

The next most extensive habitat was ffridd, covering an area of approximately 1208ha, concentrated around the central and northern parts of the study area. The best examples of ffridd (i.e. those with the most heterogeneous mix of ffridd ‘indicator habitats’ occur within the central part of the study area. A total of 32 individual areas were classified as ffridd, and a series of maps were produced for these areas, showing the Phase 1 habitat composition of each.

Heathland covers a total area of 935ha within the study area, with the majority comprising the Phase 1 habitat type D.1.1 Acid Dry Dwarf Shrub Heath with some areas comprising D.5 Dry Heath/Acid Grassland mosaic.

Calcareous grassland within the study area is limited to a relatively small area in the north east of the study area, comprising a total area of 163.4ha. Most of the calcareous grassland within the study area lies within the Berwyn and South Clwyd Mountains SAC, and all of it lies within Denbighshire.

A series of maps were produced showing habitat connectivity, mainly derived from the CCW ecological connectivity mapping dataset. These maps were examined in order to identify gaps in connectivity, and were used to target areas for ‘Habitat Improvement Projects’ within the study area.

Fully costed ‘Habitat Improvement Plans’ were developed for each of the key habitats for the project. These plans are intended for use by the project partners to focus ecological management work within the study area, and may be used to apply for funding for such work.

The overall estimated cost for delivery of the Habitat Improvement Projects is **£1,475,650** excluding VAT. It is important to note that this budget is based on very rough estimates of costings for management proposals, and each Habitat Improvement Plan will require detailed analysis of costings once further survey work and negotiations with landowners has been carried out.

It is also of note that all of the costings have been based on delivery of management proposals by contractors; if volunteer groups were to be used for delivery of management proposals (such as heather/bracken cutting, tree planting), labour costs could be significantly reduced.

1 INTRODUCTION

1.1 Background to the Our Picturesque Landscape Project Area of Outstanding Natural Beauty (AONB) and the Heritage Lottery Bid

TACP (UK) Ltd. were commissioned by the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty (AONB) on behalf of the Our Picturesque Landscape Partnership Scheme to undertake a habitat survey of the Our Picturesque Landscape project area in the Dee Valley.

The Clwydian Range and Dee Valley AONB covers an area of 390 square kilometres, from Prestatyn Hillside in the north and extending south as far as Moel Fferna, which is the highest point in the AONB at 630 metres.

Our Picturesque Landscape is a Heritage Lottery Fund Landscape Partnership Bid which centres on the Dee Valley and the Pontcysyllte Aqueduct and Canal World Heritage Site, within the Clwydian Range and Dee Valley AONB. The study area comprises an area of 75 square kilometres, with Corwen as its westernmost limit, Chirk at its eastern extent, and Cynr-y-Brain, the highest point in the study area, at its northern extent (see Figure 1.1). The study area lies mostly within Denbighshire, but a small area in the south-east of the study area lies within Wrexham.

The aims of the Our Picturesque Landscape are to:

- Protect the natural and historic heritage features through conservation and access management
- Reinststate the iconic and defining views of the picturesque movement
- Interpret the heritage significance of the picturesque landscape to people
- Engage with target audiences to share and increase awareness and understanding of the special qualities of the landscape.
- Connect and reconnect local communities with the landscape

1.2 Objectives and Outcomes of the Habitat Study

The objectives and desired outcomes of the Habitat Study are as follows:

a) To map the key habitats within the project area, drawing from existing Phase One data compiled by the Countryside Council for Wales (CCW), which was surveyed between 1979 and 1997 (Jones et al., 2003; JNCC, 2007).

b) Using the Phase One data, to identify and map areas of habitat in the following broad categories:

- Fridd
- Limestone Grassland
- Hedges

- Water Courses
- Heathland
- Woodland

c) Identify areas of weakness in terms of connectivity.

d) Work with the project steering group to identify ‘Pilot Habitat Improvement Projects’, particularly relating to Ffridd.

1.3 Ffridd – A Proposed New Priority Habitat for Wales

One of the key habitats for the project is ffridd, which has been proposed as a new priority habitat for Wales (Wales Biodiversity Partnership, 2012). Ffridd (also referred to as Coedcae) is an important habitat type that occurs within marginal land between the uplands and the lowlands. It contains components of both upland and lowland habitats, is vital for a range of important species and is also an important component of the Welsh cultural and historical landscape. Ffridd can be found between enclosed lowlands and moorland, on the summits of enclosed hills and on steep valley sides. It therefore comprises mainly marginal land which has been subject to fluctuating management intensity.

In 2012, the Wales Biodiversity Partnership produced a paper outlining a proposal to amend Wales’ Priority Species and Habitats List: Section 42 of the Natural Environment and Rural Communities (NERC) Act 2006 to include Ffridd (Wales Biodiversity Partnership, 2012). The inclusion of Ffridd within the Section 42 list of habitats was met with approval during a meeting of the WBP Steering Group in 2012 (Wales Biodiversity Partnership, 2012). The proposal was given further consideration by the steering group following the meeting, and CCW’s Directors Team opinion was also taken into account. The inclusion of ffridd as a S42 habitat was discussed further at a meeting in February 2013. Though it was generally considered that ffridd warranted inclusion within the S42 list due to its importance for biodiversity within a Welsh context, some concerns were raised regarding the wider implications, particularly with regard to the lack of a tight definition of the habitat, and uncertainty over which broad habitat type it would sit under. The decision that was reached during this meeting was that the majority of attendees endorsed the proposal to include ffridd within the S42 list, and that, following further work by CCW around the definition of ffridd, the Welsh Government would take the proposed amendment to the Minister for official approval and action. It is currently unclear as to whether this action was carried out, and it is of note that ffridd has not been included within the Section 7 list of habitats under the Environment (Wales) Act, 2016, which replaces the Section 42 list.

2 METHODS

2.1 Mapping of Key Habitats

2.1.1 Use of Existing Habitat Data

Key habitats within the study area were mapped using the Phase 1 Habitat Survey data collected by the Countryside Council for Wales (CCW) between 1979 and 1997 (Jones et al., 2003; JNCC, 2007), which is available in GIS format. During the CCW survey, trained surveyors recorded habitats in the field onto large-scale Ordnance Survey maps, according to the standard Phase 1 habitat classification and survey procedures set out in the Handbook for Phase 1 habitat survey (Joint Nature Conservation Committee, 2003). Habitat patches as small as either 0.1 ha or 0.25 ha were recorded, although smaller patches were also frequently mapped.

A limitation of the Phase 1 data is that they may be significantly out of date through habitat change; work has been carried out to update this dataset using remote-sensing technology (Lucas *et al.*, 2011) but this dataset is currently unavailable.

The key habitats heathland, woodland, limestone grassland and water courses were taken directly from the CCW Phase 1 mapping data. Habitats were verified in certain areas using a combination of ground-truthing and examination of aerial photographs.

2.1.2 Ffridd Mapping

Ffridd is a highly complex mosaic of heterogeneous habitats, such as heath, bracken, grassland and scrub, and does not have a corresponding Phase 1 code; it is therefore less straightforward to map ffridd than the other key habitats of the project.

The definition produced within the proposal document produced by the Wales Biodiversity Partnership in 2012 (WBP, 2012) was the main source of information used to define ffridd within the Our Picturesque Landscape Habitat Study. This description is included as **Appendix A** to this report.

The draft definition document lists the following criteria for classifying habitats as ffridd:

‘Land referable to the Section 42 ffridd habitat will:

- 1) *Cover an area greater than 5 ha;*
- 2) *Occur as a transitional zone of marginal land:*
 - i) *between the enclosed lowlands and mountain and moor or;*
 - ii) *on steep valley sides e.g. between urban areas and moorland/enclosed upland or;*
 - iii) *on the summits of enclosed hills;*
- 3) *Primarily support semi-natural habitats (semi-natural grassland, heath, mire, scrub, woodland, bracken or open water) but may contain small areas of improved agricultural land or conifer.*

In addition, ffridd habitat in good condition will:

- 1) *Consist of mosaics of two or more types of habitat from the following: semi-natural grassland, broadleaved woodland, scattered scrub and trees, dense scrub, hedgerows, dense and scattered bracken, non-ruderal tall herb and fern, upland species-rich ledges, heath, mire, open water, rock exposure or arable,*

or;

Support species particularly dependent on the Welsh ffridd landscape.'

As a complex of heterogeneous habitats, ffridd may contain habitats such as semi-natural grassland (particularly acid and marshy grasslands), bracken, woodland and scrub. Ffridd may also contain areas of highly managed habitats such as improved grassland and conifer plantation, but large tracts of these habitats would not be considered as ffridd but would be classified in their own regard.

In consultation with the Our Picturesque Landscape project partners, a list of Phase 1 habitats occurring within the study area were considered as components of Ffridd, as shown in **Table 2.1**.

Table 2.1. Phase 1 habitats which occur as components of ffridd within the study area (as agreed with Our Picturesque Landscape project partners)

Phase 1 Code	Name
A.1.1.1	Semi-natural broadleaved woodland
A.2.1	Dense scrub
A.1.2.2	Conifer plantation
B.1.1	Unimproved acid grassland
B.1.2	Semi-improved acid grassland
B.2.2	Unimproved neutral grassland
B.3.1	Unimproved calcareous grassland
B.3.2	Semi-improved calcareous grassland
B.4	Improved grassland
B.5	Marsh/marshy grassland
C.1.1	Dense bracken
D.1.1	Dry dwarf shrub heath
D.5	Dry heath/acid grassland mosaic
E.1.6.1	Blanket bog
E.2.1	Acid/neutral flush
F.1	Swamp
G.1	Open water
I.1.1.1	Inland cliff
I.1.2.1	Acid/neutral scree
I.1.4.1	Other exposure (acid/neutral)
I.2.1	Quarry

Two methods were used to identify ffridd habitat:

1. Distance analysis
 - a. Phase 1 habitats which indicate the presence of Ffridd were selected.
 - b. For each habitat type, the distance to the nearest indicator habitat was calculated for every 2x2 metre grid cell in the study area.
 - c. This resulted in a series of grids with values representing distance to the nearest area of the respective habitat type.
 - d. These were then summed to generate a final grid – low values indicate relatively close proximity to indicator habitats and therefore, a greater likelihood of Ffridd.
2. Mosaic habitats:
 - a. In order to pull out mosaic habitats, the phase 1 habitat survey data was interrogated to identify where two or more habitat types were recorded.
 - b. This was symbolised such that, the greater number of different habitat types recorded indicate a greater likelihood of Ffridd being present.

The combined viewing of these two layers in a GIS, along with other data relating to land classification, habitats and topography, enabled the identification of Ffridd habitats. The results of this mapping exercise are outlined in Section 3.

2.1.3 Hedgerow Mapping

Linear features, such as hedgerows and other field boundaries, were not mapped in the CCW Phase 1 survey, and there are no other spatial datasets that have this information. For this habitat study, hedgerows were mapped mainly from aerial photography. Where possible, distinction was made between Intact Hedge (J.2.1), Defunct Hedge (J.2.2) and Hedge and Trees (J.2.3), as these could be made out from aerials; the length of shadows indicating whether hedges have tall trees).

Some ground-truthing of hedgerows was carried out by the Our Picturesque Landscape project partners and this is ongoing. Hedgerow data will be updated by the project partners on completion of this exercise.

2.2 Identifying Areas of Weakness in Terms of Connectivity

The main source of information used in order to assess gaps in habitat connectivity was the GIS outputs of work on connectivity modelling carried out by Countryside Council for Wales (CCW). The purpose of this modelling exercise was to attempt to understand how typical species associated with particular habitats might move between areas of habitat and how ‘permeable’ the landscape is to species.

A general account of the work on ecological connectivity mapping carried out by CCW is given in Latham *et al.* (2013). As each species has different levels of mobility when it comes to moving through different habitats, the production of a general ecological connectivity map to cover all wildlife has

limitations (Latham *et al.*, 2013). The approach taken in the CCW modelling exercise, described in Watts *et al.* (2005) was to create an artificial ‘focal species’, with characteristics of mobility assigned to this focal species as being representative of a broad group of species associated with the habitat type in question, for example ‘woodland specialists’.

The modelling exercise maps ecological networks at three separate levels: Core, Focal and Local networks. Core networks are modelled for focal species that require large areas of habitat and have poor powers of dispersal. Focal networks are modelled for focal species requiring small areas of habitat and the have moderately good powers of dispersal. Local networks are modelled for species that can survive in small blocks of habitat and that have limited powers of dispersal.

Habitat networks were mapped using a technique called ‘least-cost modelling’. The term ‘cost’ refers to the ecological cost (or effort) of a species moving through the landscape, and thus can be considered as the inverse of ‘permeability’. In modelling the ecological connectivity of a particular habitat, such as heathland, all other habitats are assigned an ‘ecological cost’. This is based on their similarity to the target habitat and hence how easily a focal species may be able to move through them. For example, the ‘focal species’ of a heathland would not be able to move easily through a woodland, but it would be able to move relatively easily through a blanket bog habitat.

The mapping is available for broadleaved woodland, heathland, unimproved grassland, fens and bogs. Only the woodland and heathland layers were used in this study. The unimproved grassland layer was considered to be too generic to apply to calcareous grassland, a target habitat for the study. In the CCW model, the heathland connectivity layer was separated into upland and lowland categories using the Phase 1 upland boundary which is based on the upper limit of agricultural enclosure, typically around 300m in altitude (Latham *et al.*, 2013). For this study, the upland and lowland layers have been combined into one layer for heathland.

Taken together, the Core, Focal and Local Networks give a good indication of ecological connectivity within the landscape and can be used in various ways to inform biodiversity action and habitat improvement projects. These networks aid in the interpretation of the significance of habitat patches within the landscape and the functional relationships between them. As such, they provide a general guide to the location of gaps in connectivity, but require interpretation and do not provide specific prescriptions of where to create new areas of habitat. This would have to be assessed on a case-by-case basis, considering other factors such as abiotic conditions (e.g. soils, topography, drainage), landowner approval etc.

2.3 Developing Pilot Habitat Improvement Projects and Key Projects for the Landscape Conservation Action Plan

Following the mapping of habitats and analysis of key habitat connectivity within the study area, a series of ‘Pilot Habitat Improvement Projects’ were developed. These were developed using an ArcGIS online map which was shared with the project partners for their comment. The Pilot Habitat Improvement areas were identified through an assessment of ecological connectivity and condition assessment, particularly for Ffridd. A GIS layer was developed for these areas, with information attached to it on condition assessment and ecological connectivity.

A series of Habitat Improvement Projects were then developed, which outline the aims, specific management objectives, priority areas and desired outcomes of the habitat improvement projects. The potential costs of delivering these proposals were also considered. It is important to note, however, that these factors have all been estimated, and that each of the delivery plans would require detailed assessment of their viability prior to their implementation; it was beyond the scope of the current study to embark upon detailed management proposals and costings. It is intended that this is the first step towards the development of detailed project delivery plans for the Our Picturesque Landscape Study Area.

3 DESCRIPTION OF KEY HABITATS WITHIN THE STUDY AREA

A map showing all Phase 1 habitats within the study area is presented in **Appendix B**, along with a list of all these habitats and their coverage within the study area.

The key habitats for the Our Picturesque Landscape project area are described below, in the context of the study area.

3.1 Ffridd



Image 1. Ffridd on Velvet Hill

3.1.1 Ffridd Distribution and Total Area

The ‘heatmap’ produced under the ffridd model is shown in **Figure 3.1**. Areas confirmed as ffridd through ground-truthing and examination of aerial photography are shown in **Figure 3.2**. The total area classified as ffridd within the study area is 1208ha, concentrated around the central and northern parts of the study area. The best examples of ffridd (i.e. those with the most heterogenous mix of ffridd ‘indicator habitats’) occur within the central part of the study area.

3.1.2 Vegetation Composition

Habitat and vegetation composition varies significantly between and within the 32 areas classified as ffridd within the study area. The most common Phase 1 habitats within ffridd areas are C.1.1 continuous bracken, D.1.1 dry dwarf shrub heath (acid), B.1.1 unimproved acid grassland and B.1.2 semi-improved acid grassland. Semi-natural broadleaved woodland (A.1.1.1) and dense/continuous scrub (A.2.1) are also found within some areas.

3.1.3 Condition and Management

The draft definition states that ffridd habitat in good condition will consist of mosaics of two or more types of habitat from the following: semi-natural grassland, broadleaved woodland, scattered scrub and trees, dense scrub, hedgerows, dense and scattered bracken, non-ruderal tall herb and fern, upland species-rich ledges, heath, mire, open water, rock exposure or arable.

The following Ffridd Areas have been identified as having a high degree of habitat heterogeneity and are therefore considered to be good examples:

- Ffridd Area 5: Velvet Hill
- Ffridd Area 6: Fron Fawr
- Ffridd Area 7: Llantysilio
- Ffridd Area 9: Ty-uchaf
- Ffridd Area 14: Ty Canol
- Ffridd Area 17: Castell Dinas Brau
- Ffridd Area 19: Panorama Walk
- Ffridd Area 26: Croes yr Esgob

Ground-truthing was carried out at Velvet Hill and Fron Fawr, and the habitat composition in these areas was found to be relatively the same as that mapped in the CCW Phase 1 survey.

Detailed habitat maps of all Ffridd Areas are provided in **Appendix C**.

3.2 Calcareous (Limestone) Grassland



Image 2. Calcareous grassland and limestone exposure at St. Offa's Dyke Path

3.2.1 Distribution and Total Area

The distribution of Calcareous Grassland within the study area is shown on **Figure 3.3**. This habitat is limited to a relatively small area in the north east of the study area, comprising a total area of 163.4ha, of which 159.2ha has been classified as unimproved calcareous grassland (Phase 1 code B.3.1) and 4.2ha of which has been classified as semi-improved calcareous grassland (B.3.2). Most of the calcareous grassland within the study area lies within the Berwyn and South Clwyd Mountains SAC.

Information on the vegetation composition, management and condition of calcareous grassland within the study area has been gleaned from the Core Management Plan for the Berwyn & South Clwyd Mountains SAC & Berwyn SAC (CCW, 2008).

3.2.2 Vegetation Composition and Condition

Very little information is available on the vegetation composition of calcareous grassland within the study area, and it was beyond the scope of the current study to carry out detailed botanical surveys to determine vegetation composition. However, the Natura 2000 Standard Data Form for the Berwyn and South Clwyd Mountains SAC (JNCC, 2016) state that calcareous grassland within the study area corresponds to the EU Annex I habitat Semi-natural dry grasslands and scrubland facies: on calcareous substrates (Festuco-Brometalia)(EU Habitat Code: 6210).

3.2.3 Current Management

Some areas of Calcareous Grassland within the study area were surveyed in the field, and notes were made of the condition of this habitat. It was found that, in general, this habitat is in poor condition, as it is subject to intensive grazing by sheep.

The Core Management Plan for the Berwyn and South Clwydian Mountains SAC confirms this assessment. A monitoring programme undertaken in 2005 by CCW's SAC monitoring officer revealed that most monitoring plots were in an unfavourable condition, as demonstrated by the presence of nettles and thistles, species which are indicative of overgrazing (CCW, 2008).

It was recommended within the Core Management Plan that, to improve the condition of calcareous grassland within the SAC, the stocking density of this feature should be set at a level which the habitat can support and which would not have a detrimental impact on the condition of the habitat. It was recommended that stocking densities should therefore not exceed 0.4 live stock units (lsu)/ha (CCW, 2008). It was also recommended that problem species such as nettles and thistles should be controlled by cutting or selective herbicide application (CCW, 2008).

3.3 Heathland



Image 3. Heathland at Moel-y-Faen

3.3.1 Heathland Distribution and Total Area

The distribution of heathland within the study area is found in **Figure 3.4**. Heathland within the study area is mainly concentrated in the north of the study area, much of this area lying within the Berwyn and South Clwyd Mountains SAC, which contains the largest stands of upland heath in Wales. There are also some patches of heathland in the south of the study area. Heathland covers a total area of 935.4ha within the study area, with the majority comprising the Phase 1 habitat type D.1.1 Acid Dry Dwarf Shrub Heath, with an area of 891.6ha, and the remaining 43.8ha comprising D.5 Dry Heath/Acid Grassland Mosaic.

3.3.2 Vegetation Composition

Most of the heathland within the study area comprises dry dwarf shrub heath (acid). In places, this forms a mosaic with acid grassland. The dry heath consists mainly of NVC type H12 *Calluna vulgaris-Vaccinium myrtillus* heath, with frequent crowberry *Empetrum nigrum* and occasional cowberry *Vaccinium vitis-idaea* (CCW, 2008a).

3.3.3 Condition and Current Management

Monitoring carried out in 2005 found that heathland within the Berwyn and South Clwydian Mountains SAC is unfavourable, with poor species diversity. Habitat fragmentation, caused by reversion to grassland after years of overgrazing, was also found to be a problem (Gray, 2005 as referenced in CCW, 2008a).

Many areas of heathland within the Berwyn and South Clwydian Mountains are subject to management to create a diverse age structure, which aims to benefit upland bird species and other wildlife, and spread grazing pressure over the heath (CCW, 2008a). Heather management involves burning and mowing of 0.1-1ha strips of heath on a 15-year rotation.

Due to the problems associated with overgrazing, the Core Management Plan within the Berwyn and South Clwydian Mountains SAC recommends that reductions in stocking densities should be implemented to ensure sustainable grazing in the future. It is recommended that stocking densities should be limited to 0.33 ewes/ha/yr (0.05LSU/ha/yr) for maintenance of existing habitat conditions, and to 0.1 ewes/ha/yr (0.015LSU/ha/yr) for heathland restoration (CCW, 2008a).

Within the OPL Study Area, undergrazing of heathland is a bigger issue, with localised areas of overgrazing in grasslands at Eglwyseg linked to a lack of grazing higher up on heathlands (David Shiel pers. comm. 8th April 2017).

3.4 Woodland



Image 4. Broadleaved plantation woodland at Dergoed

3.4.1 Woodland Distribution and Total Area

Woodland is widespread within the study area, covering a total area of 1290ha. **Figure 3.5** shows the distribution of woodland within the study area. Conifer plantation is the most extensive, covering a total area of 641.6ha. Semi-natural broadleaved woodland is the next most widespread woodland type, covering a total area of 359ha. Mixed plantation woodland covers an area of 180.4ha and broadleaved plantation covers an area of 74.42ha.

3.4.2 Woodland Composition

Information on woodland composition was gleaned from the dominant species codes that are included with the CCW Phase 1 data, and some ground-truthing.

Many of the broadleaved plantation woodlands are dominated by oak (*Quercus* spp.), birch (*Betula* spp.) or ash (*Fraxinus excelsior*) or comprise a mixture of two or more of these species. Other tree and shrub species commonly found in semi-natural broadleaved woodlands in the study area include alder (*Alnus glutinosa*), sycamore (*Acer pseudoplatanus*), hazel (*Corylus avellana*), field maple (*Acer campestre*), hawthorn (*Crataegus monogyna*) and rowan (*Sorbus aucuparia*).

The species composition of broadleaved plantation woodland within the study area is quite varied, but dominant species include birch, oak, poplar (*Populus* spp.), beech (*Fagus sylvatica*), ash (*Fraxinus excelsior*), willow (*Salix* spp.) and larch (*Larix* spp.).

Conifer plantations within the study area generally comprise mainly spruce (*Picea* spp.) with some larch and pine (*Pinus* spp.).

Mixed broadleaved/conifer plantation woodlands comprise various mixtures of species including oak, ash, sycamore, spruce, larch, beech, poplar and pine.

3.4.3 Condition and Management

Very little existing information is available on woodland condition and management within the study area, and it was beyond the scope of the study to carry out detailed field surveys in this regard. Further field survey work would be required to assess the current condition of woodland within the study area and management practices currently in place.

3.5 Hedgerows



Image 5. Hedgerow network within the study area

3.5.1 Hedgerow Distribution within the Study Area

The hedgerow network within the study area, as mapped through aerial photography, is shown in **Figure 3.6**. The hedgerow network is quite strong throughout most of the study area, but there are areas where there are significant gaps. In the northern and eastern part of the study area, this is attributable to the fact that these are in the uplands and comprise large stands of heathland and other habitats, where hedgerows would not be expected to occur. Other gaps in the hedgerow network within the south-central part of the study area are on hills with ‘ffridd’ habitat, and would therefore also not be expected to have good hedgerow networks.

The western part of the study area comprises large fields comprising improved grassland, and it is likely that in these areas hedgerows have been removed as part of agricultural improvement works. The same applies to the south-eastern corner of the study area, where there are large areas of improved grassland and conifer plantation.

3.5.2 Hedgerow Composition

No information is available on the vegetation composition of hedgerows within the study area; work is currently being carried out by the project partners to gather such information.

3.5.3 Condition and Management

No information is available on the current condition and management hedgerows within the study area; work is currently being carried out by the project partners to gather such information.

3.6 Watercourses within the Study Area



Image 6. Llangollen Canal

3.6.1 Watercourse Distribution within the Study Area

Watercourses within the study area are shown on **Figure 3.7**. The two main watercourses within the Study Area are the River Dee, which meanders through the Study Area in an easterly direction, and the Llangollen Canal, which runs to the north of the River Dee. Several small streams and tributaries feed into these watercourses.

3.6.2 Description

The River Dee has been designated as a Special Area of Conservation (SAC), the River Dee and Bala Lake SAC, due to the presence of the EU Habitats Directive Annex I habitat ‘Water courses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation’, and the Annex II species Atlantic salmon (*Salmo salar*) and floating water plantain (*Luronium natans*).

The River Dee and several of its tributaries are also designated as Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act 1981. The main River Dee / Afon Dyfrdwy is notified as a SSSI for a range of riparian habitat types from eutrophic to mesotrophic, which support protected

aquatic species including floating water plantain, Atlantic salmon (*Salmo salar*), bullhead (*Cottus gobio*), river lamprey (*Lampetra fluviatilis*), sea lamprey (*Petromyzon marinus*), brook lamprey (*Lampetra planeri*), club tailed dragonfly (*Gomphus vulgatissimus*) and otter (*Lutra lutra*). Some sections of the river have also been designated for geological features (Jacobs, 2013).

The Llangollen Canal is a navigable watercourse which links Llangollen with Hurleston in south Cheshire. An eleven-mile stretch of the canal between Llantysilio in the west and Gledrid Bridge in the east has been declared a UNESCO World Heritage Site.

3.6.3 Current Condition and Management

Information on the current condition of the River Dee has been gleaned from the Core Management Plan for the River Dee and Bala Lake SAC and a management report on restoration of the River Dee / Afon Dyfrdwy SSSI (Jacobs, 2013).

The majority of features within the River Dee and Bala Lake SAC have been classified as being at 'Unfavourable' status at the time of the latest assessment (CCW, 2008b). The River Dee SSSI (and most of its tributaries that are also designated as SSSIs) have been assessed as being in unfavourable condition, due to historical and current pressures (Jacobs, 2013). Assessments of the ecological status of the River Dee carried out under the Water Framework Directive (WFD) have identified water pollution as a problem for the designated features within the river (Jacobs, 2013).

Jacobs (2013) identified a number of pressures on habitat suitability on the River Dee, namely:

- *'Absence of tree cover and grass lined bank tops*
- *Poaching from livestock*
- *Bank protection*
- *Embankments*
- *Channel realignment*
- *Major and minor weirs.'*

Five management measures for riparian habitat restoration were identified by Jacobs (2013), namely:

- *'Riparian zone management*
- *Bank protection removal*
- *Unmanaged and managed embankment retreat*
- *Channel realignment*
- *Removal or modification of weirs'*

3.6.4 Dee Invasive Non-Native Species Project

The Dee Invasive Non-Native Species (DINNS) Project, a catchment-wide initiative, is the main driving force behind control of invasive non-native species (INNS) in the Dee Valley. This project aims to coordinate the monitoring and control of INNS within the Dee catchment and to raise awareness of non-native species and biosecurity (<http://www.dinns.org.uk>). The main plants INNS identified as problem species within the Dee catchment are Japanese knotweed (*Fallopia japonica*), Himalayan balsam (*Impatiens glandulifera*), giant hogweed (*Heracleum mantegazzianum*), New Zealand pygmyweed (*Crassula helmsii*), rhododendron (*Rhododendron ponticum*), water fern (*Azolla filiculoides*), parrot's feather (*Myriophyllum aquaticum*), floating pennywort (*Hydrocotyle ranunculoides*), and American skunk cabbage (*Lysichiton americanus*). Animal species known to be a problem are American mink (*Mustela vison*), Chinese mitten crab (*Eriocheir sinensis*) and American signal crayfish (*Pacifastacus leniusculus*).

4 ECOLOGICAL CONNECTIVITY OF KEY HABITATS WITHIN THE STUDY AREA

4.1 Ffridd

As ffridd is generally confined to steep slopes and the tops of enclosed hills, ecological connectivity between these areas is always going to be poor (as these are, by their very nature, isolated). However, as the best examples of ffridd are considered to be those with a high degree of heterogeneity, it is more appropriate to consider ecological connectivity within these areas rather than between them. A ffridd area with a complex mosaic of habitats such as heath, scrub, bracken, woodland and semi-natural grassland would therefore be considered to have good ecological connectivity and would support a range of wildlife at various stages of their life cycles.

The individual habitat maps of each of the Ffridd Areas identified within this study (see **Appendix C**) show the degree of habitat heterogeneity, and therefore the degree of ecological connectivity, within them. The following areas of ffridd were found to have complex mosaics of habitats and therefore considered to have a high degree of ecological connectivity:

- Ffridd Area 5: Velvet Hill
- Ffridd Area 6: Fron Fawr
- Ffridd Area 7: Llantysilio
- Ffridd Area 9: Ty-uchaf
- Ffridd Area 14: Ty Canol
- Ffridd Area 17: Castell Dinas Brau
- Ffridd Area 19: Panorama Walk
- Ffridd Area 26: Croes yr Esgob

The other areas of ffridd identified in this study contain several of the indicator habitats of ffridd, but rather than comprising complex mosaics of these habitats, they generally consist of large continuous stands of habitats. These areas would therefore have a lower degree of ecological connectivity, i.e. species would not be able to move easily within these areas for their various requirements at different stages of their life cycles.

4.2 Calcareous Grassland

As can be seen from **Figure 3.3**, calcareous grassland is limited to a relatively small area in the north-eastern section of the Study Area. However, the distribution of calcareous grassland largely depends on underlying substrates and so its limited distribution is unsurprising. Two areas have been identified where ecological permeability is being hindered by habitats such as dense bracken and improved

grassland, which present barriers to movement for ‘focal species’ of calcareous grassland, as shown on **Figure 4.1**. These areas are proposed for management to enhance their permeability to calcareous grassland species and are discussed further in **Section 5**.

4.3 Heathland

The NRW Connectivity mapping shows that connectivity networks are generally strong in the north of the study area (see **Figure 4.2**). In the middle and southern parts of the study area, heathland connectivity networks are weaker; this is mainly attributable to the fact that heathland in these areas is confined to steep slopes and the tops of hills, with urban areas and improved grassland in the lowland areas in between. In certain areas, conifer plantations also present a barrier to movement.

4.4 Woodland and Hedgerow Network

The NRW woodland connectivity mapping (see **Figure 4.3**) shows that woodland core, focal and local networks are generally quite strong in the central and northern parts of the study area, but quite poor in the west.

The connectivity model produced by CCW did not consider linear features such as hedgerows, which can act as dispersal corridors for woodland species, thereby improving connectivity between woodland blocks. **Figure 4.4** shows the hedgerow network within the Study Area overlain on to the CCW Connectivity layers. It can be seen that in some areas that are shown as having poor connectivity under the CCW model, strong hedgerow networks suggest that ecological connectivity may be stronger than the model suggests, particularly in the west of the Study Area.

Large gaps in woodland connectivity in the northern part of the study area are attributable to the fact that this area comprises mostly heathland. It would not be desirable to create woodland habitat in these areas, as heathland is an ecologically valuable habitat itself and a key habitat of the project.

4.5 Watercourses

Watercourses were not considered within the NRW connectivity mapping exercise. The approach taken in this study was to use OS mapping data and aerial photography to examine linkages between the main watercourses and any areas where ‘gaps’ in connectivity could be identified.

There are several existing linkages between the river and the canal (such as at Pentrefelin and Pontcysyllte), but in general it was found that connectivity between the watercourses could be improved. Areas identified as having potential for improving Watercourse Connectivity are shown in **Figure 4.5**.

5 HABITAT IMPROVEMENT PROJECTS AND PLANS

Costed Habitat Improvement Plans for each of the key habitats within the study area are provided in **Tables 5.1-5.5**. These plans outline the aims, specific management objectives, priority areas and desired outcomes of the habitat improvement projects.

Estimated overall budgets and a breakdown of costings for delivering these proposals are also provided. Costings are based on the estimated areas requiring management, with rates mainly based on the SPON'S External Works and Landscape Price Book (AECOM, 2016) and prices for required materials such as seeds and acidifying materials specified where required. It is important to note, however, that these factors have all been estimated, and that each of the delivery plans would require detailed assessment of their viability prior to their implementation; it was beyond the scope of the current study to embark upon detailed management proposals and costings. It is intended that this is the first step towards the development of detailed project delivery plans for the Our Picturesque Landscape Study Area.

All costings are based on the assumption that management proposals will be carried out by contractors; if volunteer groups were to be utilised for the delivery of management proposals, costs would be significantly reduced. All prices are exclusive of VAT but include a 15% profit which is standard for contractors.

For each management plan, management proposals and estimated budgets are distinguished for Denbighshire and Wrexham.

Table 5.1. Ffridd Enhancement Plan

Project Title: Ffridd Enhancement	
Budget	<p>It is estimated that this project would require £555,650 overall. Based on the areas of ffridd within each county, the budget split is estimated as follows:</p> <p>Denbighshire budget: £527,800 Wrexham budget: £27,850</p> <p>Details of costings are provided below.</p>
Location	<p>The distribution of Ffridd within the Study area is shown in Figure 3.2. A total of 32 areas have been classified as Ffridd, of which 30 lie within the Denbighshire county boundary and two (Areas 28 & 29) lie within Wrexham.</p>
Description and Current Condition	<p>A total of 32 areas were identified as Ffridd through the model created for the project, confirmed by examination of habitat composition through CCW Phase 1 survey data and aerial photographs, and through consultation with the Our Picturesque Landscape project partners. Some were confirmed through ground truthing. A series of maps has been produced which show the locations of these areas and their CCW Phase 1 habitat composition.</p> <p>The best examples of Ffridd occur in the central part of the study area, on Velvet Hill (Ffridd Area 5), Fron Fawr (Ffridd Area 6), Llantysilio (Ffridd Area 7), Ty-uchaf (Ffridd Area 9), Ty Canol (Ffridd Area 14), Castell Dinas Brau (Ffridd Area 17), Panorama</p>

Project Title: Ffridd Enhancement	
	Walk (Ffridd Area 19) and Croes yr Esgob (Ffridd Area 26); all of these areas have quite a heterogeneous mixture of Phase 1 habitat types associated with ffridd.
Plan Description	<p>All the 32 areas identified as ffridd during this mapping exercise have been assessed for their habitat complexity through examination of CCW Phase 1 survey data and aerial photography. Some areas were assessed through field survey. For each of the 32 ffridd areas identified, recommendations are given for their sensitive management in order to enhance their value for wildlife (see Appendix C).</p> <p>Each area has been classified as being of ‘High’, ‘Medium’ or ‘Low’ priority for management, depending on the perceived value of each area and the potential benefits of management. These priorities may be altered at a later stage, depending on further condition assessment of these areas, and whether landowners would be amenable to implementing management measures.</p>
Aims	<ul style="list-style-type: none"> ➤ To conserve good examples of ffridd within the study area. ➤ To manage poorer examples of ffridd (i.e. those with less habitat and structural diversity and those that are under- or overgrazed) to enhance their value for wildlife. ➤ To enhance public awareness of the value of ffridd as a uniquely Welsh habitat which is valuable to a range of wildlife and is of huge cultural and historical significance.
Specific management objectives	<p>Management measures recommended for these areas are quite variable, and include the following:</p> <ul style="list-style-type: none"> • Implementation of appropriate grazing strategies to promote structural and habitat diversity. • Removal of bracken through cutting or rolling, in places where dense bracken forms continuous, extensive stands. Chemical control methods could also be used, though this would have to be considered carefully in terms of potential pollution impacts. Any direct bracken control methods would have to be followed up with other management measures such as the implementation of appropriate grazing systems, to ensure long-term benefits. • Planting of native, broadleaved trees or shrubs. <p>For all areas, further field survey work would be required in order to assess the condition of each area and to develop suitable management measures. Consultations with landowners will also be required.</p>
Priority Areas	<p>Of the 32 Ffridd areas identified, those which are considered highest priority for management are those where several of the ‘indicator habitats’ for ffridd are present, but where these comprise large extensive stands rather than complex mosaics of habitats. These include the following:</p> <ul style="list-style-type: none"> • Ffridd Area 19: Panorama Walk

Project Title: Ffridd Enhancement	
	<ul style="list-style-type: none"> • Ffridd Area 22: Pen-y-coed • Ffridd Area 23: Allt y Gwernant • Ffridd Area 25: Ty'n-wern • Ffridd Area 31: Gwernant Wood <p>Details of proposed management measures for each of these areas are provided in Appendix C.</p> <p>It is of note that the following areas, considered as being the best examples of ffridd within the study area, are not considered to be high priority for habitat enhancement measures (as they are currently in relatively good condition), but should be considered very high priority for conservation:</p> <ul style="list-style-type: none"> • Ffridd Area 5: Velvet Hill • Ffridd Area 6: Fron Fawr • Ffridd Area 7: Llantysilio • Ffridd Area 9: Ty-uchaf • Ffridd Area 14: Ty Canol • Ffridd Area 17: Castell Dinas Brau • Ffridd Area 19: Panorama Walk • Ffridd Area 26: Croes yr Esgob <p>Further field survey work in all Ffridd Areas may change priorities for management.</p>
Key Stakeholders	<ul style="list-style-type: none"> ➢ Landowners ➢ The Clwydian Range and Dee Valley AONB ➢ Denbighshire County Council ➢ Wrexham County Borough Council ➢ Natural Resources Wales ➢ Cadw ➢ The Friend of the Clwydian Range and Dee Valley ➢ The National Trust
Costings	<p>Estimated costs for each management proposal:</p> <p><u>Fieldwork:</u></p> <p>It is proposed to carry out field surveys of all areas identified as ffridd in this study. The total area of ffridd is 1,208ha. The average fieldwork rate for Phase 1 habitat survey in Wales was found to be 2.5km²/day (JNCC, 2010). However, the ffridd areas are on rough terrain and are spread widely throughout the study area, so a more realistic estimate for rate of fieldwork would be comparable to upland areas such as the Yorkshire Moors, which had an average fieldwork rate of 0.8km²/day, or 80ha/day. It would therefore take approximately 15 days to survey 1,208ha of ffridd. At an ecologist's daily rate of £350/day, the total amount for this element of work would be £5,250.</p>

Project Title: Ffridd Enhancement

Bracken control:

The total area of bracken within ffridd areas is 390ha. In order to increase structural diversity within ffridd areas, it is proposed to carry out patchy cutting, rolling or chemical control of roughly 10% of bracken (spread throughout all areas of ffridd). This would amount to roughly 39ha.

Estimates of costs for carrying out bracken management are taken from AECON (2016), with an industry standard 15% profit added.

Bracken control over 39ha by machine:

SPON'S rate is £21/100m², i.e. £2,100/ha. £2,100*39= £81,900 plus contractor's profit of 15% (£12,285). Comes to £94,185 – round up to **£95,000**.

Bracken control over 39ha by hand:

SPON'S rate is £71/100m², i.e. £7,100/ha. £7,100*39= £276,900 plus contractor's profit of 15% (£41,535). Comes to £318,435 in total – round up to **£320,000**.

For the overall budget estimate, the hand clearance rate of £320,000 has been used, as this is likely to be the more appropriate technique over most areas of ffridd, because ffridd often occurs on steep slopes which would be inaccessible to machinery.

Planting of native broadleaf trees:

Total area of native broadleaf woodland within ffridd areas is currently 72ha. Propose to increase woodland cover within ffridd by roughly 10%, i.e. 7.2ha.

It is estimated that tree planting costs £32,000/ha, and so the total cost for 7.2ha comes to **£230,400**

Overall cost:

Work Element	Estimated Cost (£)
Site Surveys	5,250
Patchy cutting of 39ha of bracken by hand	320,000
Planting of native broadleaf trees	230,400
Overall cost (£)	555,650

Budget allocation between Denbighshire and Wrexham:

Project Title: Ffridd Enhancement	
	<p>As approximately 95% of ffridd within the study area occurs within Denbighshire, 95% of the budget for ffridd management should be allocated to this county, with the remaining 5% allocated to Wrexham.</p> <p>Denbighshire budget: £527,800 Wrexham budget: £27,850</p>
Risk Appraisal	The implementation of management measures as outlined above will depend on how amenable landowners are to working with the project partners in order to protect and enhance areas of ffridd within the study area.
Delivery Roles and Responsibilities	The Our Picturesque Landscape project partners will appoint a ‘Habitat and Wildlife Conservation Officer’, who will take the lead on additional field survey work, as well as the coordination and implementation of management measures for ffridd enhancement.

Table 5.2. Calcareous Grassland Enhancement Plan

Project Title: Calcareous Grassland Enhancement	
Budget	<p>It is estimated that this project would cost approximately £25,000 overall to deliver. As all calcareous grassland lies within Denbighshire, this budget allocation would be entirely for Denbighshire.</p> <p>Details of costings are provided below.</p>
Location	The distribution of calcareous grassland within the study area is shown on Figure 3.3 . This habitat is limited to a relatively small area in the north east of the study area, comprising a total area of 163.4ha. Of this 159.2ha has been classified as unimproved acid grassland (Phase 1 code B.1.1) and 4.2ha as semi-improved acid grassland (B.1.2). Most of the calcareous grassland within the study area lies within the Berwyn and South Clwyd Mountains SAC.
Description and Current Condition	<p><u>Vegetation Composition:</u> Very little information is available on the vegetation composition of calcareous grassland within the study area, and it was beyond the scope of the current study to carry out detailed botanical surveys to determine vegetation composition. However, the Natura 2000 Standard Data Form for the Berwyn and South Clwyd Mountains SAC states that calcareous grassland within the study area corresponds to the EU Annex I habitat ‘Semi-natural dry grasslands and scrubland facies: on calcareous substrates (<i>Festuco-Brometalia</i>)’ (EU Habitat Code: 6210).</p> <p><u>Condition and Management</u> Some areas of calcareous grassland within the study area were surveyed in the field, and notes were made of the condition of this habitat. It was found that, in general, this habitat is in poor condition as it is subject to intensive grazing by sheep. The Core Management Plan for the Berwyn and South Clwydian Mountains SAC confirms this assessment; a monitoring programme undertaken in 2005 by CCW’s</p>

Project Title: Calcareous Grassland Enhancement	
	<p>SAC monitoring officer revealed that most monitoring plots were in an unfavourable condition, as demonstrated by the presence of nettles and thistles, species which are indicative of overgrazing (CCW, 2008).</p> <p>It was recommended within the Core Management Plan that, to improve the condition of calcareous grassland within the SAC, the stocking density of this feature should be set at a level which the habitat can support and which would not have a detrimental impact on the condition of the habitat. It was recommended that stocking densities should therefore not exceed 0.4 livestock units (lsu)/ha (CCW, 2008). It was also recommended that problem species such as nettles and thistles should be controlled by cutting or selective herbicide application (CCW, 2008).</p> <p><u>Connectivity:</u></p> <p>As can be seen from Figure 3.3, calcareous grassland is limited to a relatively small area in the north-eastern section of the Study Area. However, the distribution of calcareous grassland largely depends on underlying substrates and so its limited distribution is unsurprising.</p> <p>Two areas have been identified where there are gaps in connectivity between areas of calcareous grassland within the Study Area. The Phase 1 map for the Study Area indicates that in Management Area 1, this weakness in connectivity is caused by extensive areas of bracken which present a barrier to movement of species between areas of calcareous grassland. In Management Area 2, a large area of improved grassland may be contributing to weakness in connectivity.</p>
Plan Description	<ul style="list-style-type: none"> ➤ Field survey work to assess the condition of calcareous grassland throughout the site. ➤ Working with landowners to develop measures to improve the condition of calcareous grassland (for example, by reducing grazing pressure). ➤ Development of management measures within Management Areas 1 and 2, to improve calcareous grassland connectivity within the Study Area.
Aims	<ul style="list-style-type: none"> ➤ Improve the condition of calcareous grassland through the implementation of suitable management measures. ➤ Improve calcareous grassland connectivity by clearing bracken and reducing intensity of grassland management in areas of weak connectivity.
Specific management objectives	<ul style="list-style-type: none"> ➤ <u>Management Area 1:</u> <ul style="list-style-type: none"> • Clear bracken (approximately 6ha). • Introduce grazing to keep bracken down. • Consideration of seeding and/or plug planting with species associated with calcareous grassland. ➤ <u>Management Area 2:</u> Reduce intensity of grassland management by: <ul style="list-style-type: none"> • Reducing fertiliser application. • Adjusting stocking densities. • Consideration of seeding and/or plug planting with species associated with calcareous grassland.

Project Title: Calcareous Grassland Enhancement	
	<ul style="list-style-type: none"> ➤ Work with landowners throughout the entire area of calcareous grassland in order to develop management measures to improve the condition of calcareous grassland, mainly by adjusting stocking densities to reduce grazing pressure.
Priority Areas	<ul style="list-style-type: none"> ➤ Priority areas for improving connectivity are Management Areas 1 and 2 as discussed above. Of these two, Management Area 1 would be the easier and more beneficial area to manage, so this has highest priority. ➤ Priority areas for improving the general condition of calcareous grassland will depend on further survey work, and how amenable landowners are to working with the project partners to develop management measures for enhancement of calcareous grassland.
Key Stakeholders	<ul style="list-style-type: none"> ➤ Landowners ➤ The Clwydian Range and Dee Valley AONB ➤ Denbighshire County Council ➤ Natural Resources Wales ➤ Cadw ➤ The Friend of the Clwydian Range and Dee Valley ➤ The National Trust
Costings	<p><u>Management Area 1:</u> Clear 6.3ha of bracken to improve connectivity between areas of calcareous grassland on either side. Can be cleared by machine at £2,100/ha = £13,230</p> <p><u>Management Area 2:</u> Work with landowner to reinstate calcareous grassland. May require financial incentive – estimate £10,000.</p> <p>Overall budget rounded up to £25,000.</p>
Risk Appraisal	The delivery of this plan will depend upon how amenable landowners are to working with the project partners to develop and implement management measures for the enhancement of calcareous grassland.
Delivery Roles and Responsibilities	The Our Picturesque Landscape project partners will appoint a ‘Habitat and Wildlife Conservation Officer’, who will take the lead on additional field survey work, as well as the coordination and implementation of management measures for heathland enhancement.

Table 5.3. Heathland Enhancement Plan

Project Title: Enhancement of Heathland	
Budget	<p>It is estimated that this project would cost approximately £165,000 overall to deliver. As all heathland within the study area lies within Denbighshire, this budget allocation would be entirely for Denbighshire.</p> <p>Detailed costings are provided below.</p>
Location	<p>Heathland within the study area is mainly concentrated in the north of the study area, much of this area lying within the Berwyn and South Clwyd Mountains SAC, which contains the largest stands of upland heath in Wales. There are also some patches of heathland in the south of the study area.</p> <p>The distribution of heath within the study area is found in Figure 3.4. All areas of heath within the study area lie within the Denbighshire county boundary.</p>
Description and Current Condition	<p><u>Vegetation Composition:</u> Most of the heathland within the study area comprises Dry dwarf shrub heath (acid). In places, this forms a mosaic with acid grassland. The dry heath consists mainly of NVC type H12 <i>Calluna vulgaris</i>-<i>Vaccinium myrtillus</i> heath, with frequent crowberry <i>Empetrum nigrum</i> and occasional cowberry <i>Vaccinium vitis-idaea</i> (CCW, 2008).</p> <p><u>Current Condition:</u> Within the OPL Study Area, many areas of heathland are under grazed, with localised areas of over grazing in grasslands at Eglwyseg linked to a lack of grazing higher up on heathlands (David Shiel pers. comm. 8th April 2017).</p> <p><u>Connectivity:</u> The NRW Connectivity mapping shows that connectivity networks are generally strong in the north of the study area. In the middle and southern parts of the study area, heathland connectivity networks are weaker; this is mainly attributable to the fact that heathland in these areas is confined to steep slopes and the tops of hills, with urban areas and improved grassland in the lowland areas in between. In certain areas, conifer plantations present a barrier to movement.</p>
Plan Description	<p>It is proposed to carry out management measures in order to attempt to improve heathland connectivity at key locations throughout the Study Area. A total of seven 'Heathland Enhancement Areas' have been identified, based on the fact that these currently have poor heathland connectivity under the CCW Connectivity model. These are shown in Appendix D, with comments provided on each.</p>
Aims	<ul style="list-style-type: none"> ➤ To improve heathland connectivity networks within the study area. ➤ To improve the general condition of heathland within the study area.
Specific management objectives	<ul style="list-style-type: none"> ➤ Clearing of some areas of conifer plantation, or creation of woodland 'rides' to improve permeability. ➤ To manage areas of improved grassland in order to create more semi-natural habitat, which would be more permeable to heathland 'focal

Project Title: Enhancement of Heathland	
	<p>species' (typical species associated with this habitat type). Consideration could be given to the following management measures to restore heathland (based on measures discussed in Walker <i>et al.</i> (2004)):</p> <ul style="list-style-type: none"> • Reduction of nutrient input through reduced fertiliser application and removal of cuttings; • Adjusting stocking densities to reduce grazing pressure; • Soil acidification through the application of acidifying materials such as elemental sulphur (S), or a combination of low rates of sulphur combined with bracken litter, as suggested by Owens <i>et al.</i> (1999). • Mechanical disturbance, e.g. stripping topsoil. • Heather re-establishment through seeding or plug-planting; seed could be sourced from areas of existing heathland where cutting is being carried out.
Priority Areas	<ul style="list-style-type: none"> ➤ Within Heathland Improvement Areas 1 (Berwyn), 2 (Oernant), 3 (Tan-y-bwlch) and 7 (Ty'n Celyn Wood), clearing areas of conifer plantation or creating woodland 'rides' to improve permeability for heathland 'focal species'. ➤ Within Heathland Improvement Areas 4 (Pentredwr), 5 (Dinbren-uchaf) and 6 (Tan-y-Castell), to manage grassland less intensively, or preferably to create heathland in these areas, in order to improve permeability for heathland 'focal species'.
Key Stakeholders	<ul style="list-style-type: none"> ➤ Landowners ➤ The Clwydian Range and Dee Valley AONB ➤ Denbighshire County Council ➤ Natural Resources Wales ➤ Cadw ➤ The Friends of the Clwydian Range and Dee Valley ➤ The National Trust
Costings	<p>Felling of woodland/clearing woodland rides:</p> <p>This management proposal would be carried out under agreement with landowners/NRW. As this is a commercial exercise with profit to be made from the sale of timber, there would be no associated costs.</p> <p>Heathland creation to improve connectivity:</p> <p>Within Heathland Improvement Areas 4 (Pentredawr), 5 (Dinbren-uchaf) and 6 (Tan-y-castell), a total area of 67ha of improved grassland could be converted to heathland in order to improve heathland connectivity within the study area. It is assumed that roughly 25% of this area may be suitable for conversion to heathland (depending on landowners, local conditions etc.), i.e. 16.75ha.</p>

Project Title: Enhancement of Heathland

Heather seed:

This area would have to be seeded with heather in order to convert it to heathland. According to www.wildflowersuk.com, heather seed costs £8 for 10gms, and a sowing rate of 1gm/m² is recommended. The cost of heather seed therefore works out at £8,000/ha. To seed an area of 16.75ha would cost **£134,000**.

Note: costs could be reduced if seed is sourced from heather management areas within the study area.

Costs associated with heather seeding:

According to SPON'S, plant cost for seed spreading per is £0.52/100m², or £52.00/ha. Over an area of 16.75ha, the total cost would be £871. With 15% contractor's profit, this would come to roughly **£1,000**.

Land preparation – soil acidification materials

Areas being seeded with heather would benefit from site preparation to increase the acidity of receiving soils. Owens et al. (1999) suggest that the most efficient and environmentally-friendly method of soil acidification is to apply low rates of elemental sulphur (2tonnes/hectare) in addition to the spreading of bracken litter.

The website www.agrigem.co.uk gives a price of £864/tonne for granulated elemental sulphur when buying in bulk (£21.60 incl. tax for a 40kg bag). With an application rate of 2t/ha, this would come to £1,728/ha and applying this over an area of 16.75ha would therefore cost **£28,944**.

Bracken litter could be taken from areas being managed through bracken cutting (see Ffridd Habitat Improvement Plan), and so there would be no added cost for this material.

Costs associated with soil acidification:

According to SPON'S, plant cost for pre-seeding fertiliser's by machine is £0.19/100m², i.e. £19/ha. Over an area of 16.75ha, the total cost would be £318.25. With 15% contractor's profit, this would come to roughly **£366**.

Overall cost:

Work Element	Material	Labour/Plant	Estimated Cost (£)
Felling of woodland/clearing woodland rides			0
Heather seeding	134,000	1,000	135,000
Soil Preparation (acidification)	28,944	366	29310
Overall cost (£)			164,310

Project Title: Enhancement of Heathland	
	Overall budget estimate is rounded up to £165,000 . As all Heathland Improvement Areas lie within Denbighshire, the entire budget is allocated to Denbighshire.
Risk Appraisal	<p>The delivery of this plan will depend on the agreement of landowners to manage grasslands less intensively, and will require negotiations with them to develop management proposals, with incentives provided for appropriate management.</p> <p>The proposals to fell patches of woodland and/or create woodland rides may not be feasible, and will require consultation with NRW to discuss these possibilities.</p>
Delivery Roles and Responsibilities	The Our Picturesque Landscape project partners will appoint a ‘Habitat and Wildlife Conservation Officer’, who will take the lead on additional field survey work, as well as the coordination and implementation of management measures for calcareous grassland enhancement.

Table 5.4. Woodland Enhancement Plan

Project Title: Enhancement of Woodland	
Budget	<p>The overall budget is estimated at £700,000, <u>if being carried out by contractors</u>.</p> <p>Based on the areas of woodland within each county (approximately 85% of broadleaved woodland occurs within Denbighshire and 15% within Wrexham), the budget split is estimated as follows:</p> <p>Denbighshire: £595,000 Wrexham: £105,000</p> <p>Detailed costings are provided below.</p>
Location	Woodland is widespread within the study area, covering a total area of 1290ha. Figure 3.5 shows the distribution of woodland within the study area.
Description and Current Condition	<p><u>Woodland Composition</u></p> <p>Conifer plantation is the most extensive, covering a total area of 641.6ha. Semi-natural broadleaved woodland is the next most widespread woodland type, covering a total area of 359ha. Mixed plantation woodland covers an area of 180.4ha and broadleaved plantation covers an area of 74.42ha. Many of the broadleaved plantation woodlands are dominated by oak, birch or ash or comprise a mixture of two or more of these species. Other tree and shrub species commonly found in semi-natural broadleaved woodlands in the study area include alder, sycamore, hazel, field maple, hawthorn and rowan.</p> <p><u>Connectivity</u></p> <p>The NRW woodland connectivity mapping (see Figure 4.3) shows that woodland core, focal and local networks are generally quite strong in the central and northern parts of the study area, but quite poor in the west.</p>

Project Title: Enhancement of Woodland	
	<p>The connectivity model produced by CCW did not take into account linear features such as hedgerows, that can act as dispersal corridors for woodland species, thereby improving connectivity between woodland blocks. Figure 4.4 shows the hedgerow network within the Study Area overlain on to the CCW Connectivity layers; it can be seen that in some areas that are shown as having poor connectivity under the CCW model, strong hedgerow networks suggest that ecological connectivity may be stronger than the model suggests, particularly in the west of the Study Area.</p> <p>Large gaps in woodland connectivity in the northern part of the study area are attributable to the fact that this area comprises mostly heathland; it would not be desirable to create woodland habitat in these areas, as heathland is an ecologically valuable habitat of itself and a key habitat of the project.</p>
Plan Description	<p>It is proposed to improve woodland connectivity by carrying out woodland and hedgerow planting at key locations throughout the Study Area. A total of 32 ‘Woodland Enhancement Areas’ have been identified, based on the fact that these areas currently have poor woodland connectivity under the CCW Connectivity model. These areas are shown in Appendix E, with comments provided on each.</p>
Aims	<ul style="list-style-type: none"> ➤ To improve woodland connectivity within the Study Area. ➤ To increase the amount of broadleaved woodland within the Study Area by 5%, or 21.67ha.
Specific management objectives	<ul style="list-style-type: none"> ➤ Planting of native tree and shrub species in areas proposed for woodland creation over an area of roughly 21.67ha. ➤ Creation of new hedges and management of existing hedges to promote biodiversity and woodland connectivity.
Priority Areas	<p>Proposed woodland enhancement areas are provided in Appendix E. Each of these has been assigned a priority of High, Medium or Low for management. These may be revised accordingly based on factors such as landowner receptiveness.</p>
Key Stakeholders	<ul style="list-style-type: none"> ➤ Landowners ➤ The Clwydian Range and Dee Valley AONB ➤ Denbighshire County Council ➤ Wrexham County Borough Council ➤ Natural Resources Wales ➤ Cadw ➤ The Friend of the Clwydian Range and Dee Valley ➤ The National Trust
Costings	<p><u>Woodland planting:</u></p> <p>Clear light vegetation from planting area and remove to dump on site; dig planting holes; plant whips with roots well spread out; backfill with excavated topsoil; including one 38 × 38 mm treated softwood stake, two tree ties and mesh guard 1.20 m high; planting matrix 1.5 × 1.5 m; allow for beating up once at 10% of original planting, cleaning and weeding round whips once, applying fertilizer once at 35 gm/m²; using the following mix of whips, bare rooted</p>

Project Title: Enhancement of Woodland	
	<p>Rate = £ 320/ 100m² or therefore £ 32,000/ ha.</p> <p>If proposing to plant an area of 21.67ha, the overall cost would be roughly £700,000, <u>if being carried out by contractors.</u></p> <p>However, this cost may be reduced significantly through use of volunteer groups for tree planting. Saplings cost between 20p and £2, depending on species, so at a planting rate of 2250 whips/ha the cost of saplings would be between £450 and £4,500/ha, or £9,750 and £97,515 for an area of 21.67ha.</p>
Risk Appraisal	The delivery of this plan will depend upon how amenable landowners are to working with the project partners to develop and implement planting plans for woodland and hedgerow creation.
Delivery Roles and Responsibilities	The Our Picturesque Landscape project partners will appoint a ‘Habitat and Wildlife Conservation Officer’, who will take the lead on additional field survey work, as well as the coordination and implementation of management measures for enhancing woodland and hedgerow connectivity within the Study Area.

Table 5.5. Watercourse Enhancement Plan

Project Title: Enhancement of Watercourses	
Budget	<p>It is estimated that this project would cost approximately £30,000 overall to deliver. As all the proposed Watercourse Improvement Areas lie within Denbighshire, this budget allocation would be entirely for Denbighshire.</p> <p>Detailed costings are provided below.</p>
Location	The two main watercourses within the Study Area are the River Dee, which meanders through the Study Area in an easterly direction, and the Llangollen Canal, which runs to the north of the River Dee.
Description and Current Condition	<p>The River Dee has been designated as a Special Area of Conservation (SAC), the River Dee and Bala Lake SAC, due to the presence of the EU Habitats Directive Annex I habitat ‘Water courses of plain to montane levels with the Ranunculus fluitantis and Callitriche-Batrachion vegetation’, and the Annex II species Atlantic salmon (<i>Salmo salar</i>) and floating water plantain (<i>Luronium natans</i>). The River Dee and several of its tributaries are also designated as Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act 1981.</p> <p>The majority of features within the River Dee and Bala Lake SAC and SSSI have been assessed as being in Unfavourable Condition, caused by a number of historical and current problems. A restoration project is currently being undertaken for the River Dee (Jacobs, 2013).</p> <p>The Llangollen Canal is a navigable watercourse which links Llangollen with Hurleston in south Cheshire. An eleven-mile stretch of the canal between Llantysilio</p>

Project Title: Enhancement of Watercourses	
	<p>in the west and Gledrid Bridge in the east has been declared a UNESCO World Heritage Site.</p> <p>There are a number of Invasive Non-Native Species (INNS) within the Dee Catchment, including American mink, American signal crayfish, Japanese knotweed, Himalayan balsam and giant hogweed.</p>
Plan Description	<p>This plan involves enhancing ecological connectivity between the two main waterbodies within the Study Area, the River Dee and the Llangollen Canal, by creating new linkages or ‘stepping stones’ for riparian species that use the watercourses.</p> <p>The first step in the plan involves carrying out ground truthing of areas identified during the study area as ‘target areas’ for enhancing watercourse connectivity. These areas will be assessed for their suitability for management, based on their current ecological value, abiotic conditions (topography, hydrology etc) and landowner receptiveness.</p>
Aims	<ul style="list-style-type: none"> ➤ To enhance ecological connectivity between the River Dee and the Llangollen Canal. ➤ To increase public awareness of the value of the watercourses within the Study Area. ➤ To work with NRW on the Restoration Plan for the River Dee. ➤ To work with the Dee Invasive Non-native Species (DINNS) Project (http://www.dinns.org.uk) in monitoring and controlling INNS within the Dee Catchment and to raise awareness of biosecurity within the area.
Specific management objectives	<ul style="list-style-type: none"> ➤ Creation of new linkages or ‘stepping stones’ between the river and the canal. ➤ Linkages may be new channels that would directly link the two watercourses, or ponds and other wetland features that would act as ‘stepping stones’. ➤ Stakeholder engagement and possible use of volunteer groups to carry out management and increase public awareness.
Priority Areas	<p>Four ‘Watercourse Improvement Areas’, all within the Denbighshire County boundary, have been identified that would be suitable for enhancing connectivity between the River Dee and the Llangollen Canal:</p> <ul style="list-style-type: none"> • Area 1: Bron Heulog • Area 2: Bryn-Howel Farm • Area 3: Llyn Farm • Area 4: Cycylltau Bridge <p>These areas have been identified through a desktop exercise only, and have not been ground-truthed. Further work will be required to assess the suitability of these areas for management measures.</p>

Project Title: Enhancement of Watercourses									
Key Stakeholders	<ul style="list-style-type: none"> ➤ Natural Resources Wales ➤ The Canal and River Trust ➤ The Clwydian Range and Dee Valley AONB ➤ The Dee Invasive Non-Native Species Project ➤ Denbighshire County Council ➤ Wrexham County Borough Council ➤ Cadw ➤ The Friends of the Clwydian Range and Dee Valley ➤ The National Trust 								
Costings	<p>Four areas have been identified that may be suitable to improve connectivity between the River Dee and the Llangollen Canal. In order to improve connectivity, it is proposed to construct new waterbodies in these areas. Waterbodies may be new open channels or ditches, or constructed ponds.</p> <p>Assuming that two of these areas would be suitable for construction of waterbodies, the following costs may be incurred:</p> <ul style="list-style-type: none"> • Construction of 500m² pond, lined with imported puddling clay; natural edging with vegetation meeting the water: £24,500. With a contractor's profit of 15%, this would come to £28,175. • Excavate and form ditch and bank with 45 sides in light to medium soils; 1.5m wide x 1.2m deep: £1,875 per 100m. Average distance between canal and river within Watercourse Improvement Areas is 110m, therefore this would cost 2062.50. With a contractor's profit of 15%, this would come to £2,372. <p>Overall cost:</p> <table border="1"> <thead> <tr> <th>Work Element</th><th>Estimated Cost (£)</th></tr> </thead> <tbody> <tr> <td>Construction of 500m² pond</td><td>28,175</td></tr> <tr> <td>Excavation of ditch of 110m length</td><td>1,875</td></tr> <tr> <td>Overall cost (£)</td><td>30,050</td></tr> </tbody> </table> <p>All costs are from AECON (2016) and include materials, labour, plant hire etc.</p>	Work Element	Estimated Cost (£)	Construction of 500m ² pond	28,175	Excavation of ditch of 110m length	1,875	Overall cost (£)	30,050
Work Element	Estimated Cost (£)								
Construction of 500m ² pond	28,175								
Excavation of ditch of 110m length	1,875								
Overall cost (£)	30,050								
Risk Appraisal	The delivery of this plan depends on whether the areas identified are suitable for the implementation of management measures, in terms of local conditions and whether landowners would be amenable to engaging with the project partners to deliver management proposals.								
Delivery Roles and Responsibilities	The Our Picturesque Landscape project partners will appoint a 'Habitat and Wildlife Conservation Officer', who will take the lead on additional field survey work, as well as the coordination and implementation of management measures for enhancing watercourse connectivity within the Study Area.								

6 TOTAL COST FOR DELIVERY

The overall estimated cost for delivery of the Habitat Improvement Projects is **£1,475,650** excluding VAT as outlined in **Table 8.1** below. It is important to note that these fees are very rough estimates, and each Habitat Improvement Plan will require detailed analysis of costings once further survey work and negotiations with landowners has been carried out.

It is also of note that all of the costings have been based on delivery of management proposals by contractors; if volunteer groups were to be used for delivery of management proposals such as heather/bracken cutting, tree planting, labour costs could be significantly reduced.

Table 6.1. Total Cost for Delivery of Habitat Improvement Projects

Habitat Improvement Plan	Estimated Cost (£)
Enhancement of Ffridd	555,650
Enhancement of Calcareous Grassland	25,000
Enhancement of Heathland	165,000
Enhancement of Woodland	700,000
Enhancement of Watercourses	30,000
Total Estimated Fee for Delivery of Plans	1,475,650

Note: Costings for delivery of management proposals are mainly based on costs provided in AECON (2016) and are exclusive of VAT.

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8 FIGURES

APPENDICES

APPENDIX A

Definitions of Ffridd Habitat (from the Wales Biodiversity Partnership)

APPENDIX B

Habitat Map and Full List of Habitats within the Study Area

APPENDIX C

Ffridd Habitat Maps

APPENDIX D

Heathland Improvement Areas

APPENDIX E

Woodland Enhancement Areas