

**GREEN INFRASTRUCTURE STATEMENT (GIS) & NET BENEFIT
FOR BIODIVERSITY ENHANCEMENT SCHEME
WITH MANAGEMENT PLAN INCLUDED**

FOR

**NEW DRAINAGE SCHEME AT CYFARTHFA CASTLE,
MERTHYR TYDFILL, CF47 8RE**



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VALIDITY

Due to the dynamic nature of ecological conditions the results of the survey(s) and related conclusions and recommendations as contained within this report should only be considered valid for up to 12 months from the date the last survey was undertaken.

Any alterations to the site proposals may invalidate the recommendations contained within this report.

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1 Introduction

1.1 Survey Background, Aims & Objectives

- 1.1.1 Abricon Ltd. was commissioned by Merthyr Tydfil Council to undertake a Green Infrastructure Statement (GIS) and Net Benefit for Biodiversity Enhancement Scheme (NBBES) to describe how Green Infrastructure will be incorporated into the proposed development at “the site”, Cyfarthfa Castle Park, Brecon Road, Merthyr Tydfil, CF47 8RE.
- 1.1.2 A Preliminary Ecological Appraisal (PEA) of the site was carried out on the 9th October 2024 by Abricon (Abricon, 2024).
- 1.1.3 This report will include the following:
- A description of the baseline site with landscape plans.
 - A description of how Green Infrastructure has been incorporated into the planning proposals.
 - A scheme of enhancements to ensure a Net Benefit for Biodiversity.
 - An ecological management plan with responsibilities and funding addressed.
 - How the scheme has applied the step-wise approach (Avoid, Minimise, Mitigate/Restore, Compensate onsite, Compensate offsite).
 - Consideration of ecosystem resilience by using the DECCA (Diversity, Extent, Condition, Connectivity, Adaptability) framework.

1.2 Site Location and Description

- 1.2.1 The site is located at Cyfarthfa Castle Park, Brecon Road, Merthyr Tydfil, at National Grid Reference: SO 04143 07362.
- 1.2.2 The site is an area of ~2.3 hectares (ha) within the Cyfarthfa Park, and consists of mixed parkland habitat, formal gardens close to the Castle and a mixture of lawned areas. The full park is ~65ha and contains Cyfarthfa Park Lake, ~230 metres west of the site, and woodland which is located north, east and west of the castle.
- 1.2.3 The castle itself is a multi-roomed 19th century castle structure with pitched slate tiled roofs, flat roofs, towers and a basement/tunnel system.
- 1.2.4 Within the wider landscape, the site is surrounded by residential areas of Merthyr Tydfil and open fields (agricultural or grazing) with the Brecon Beacons National Park to the north of the site.

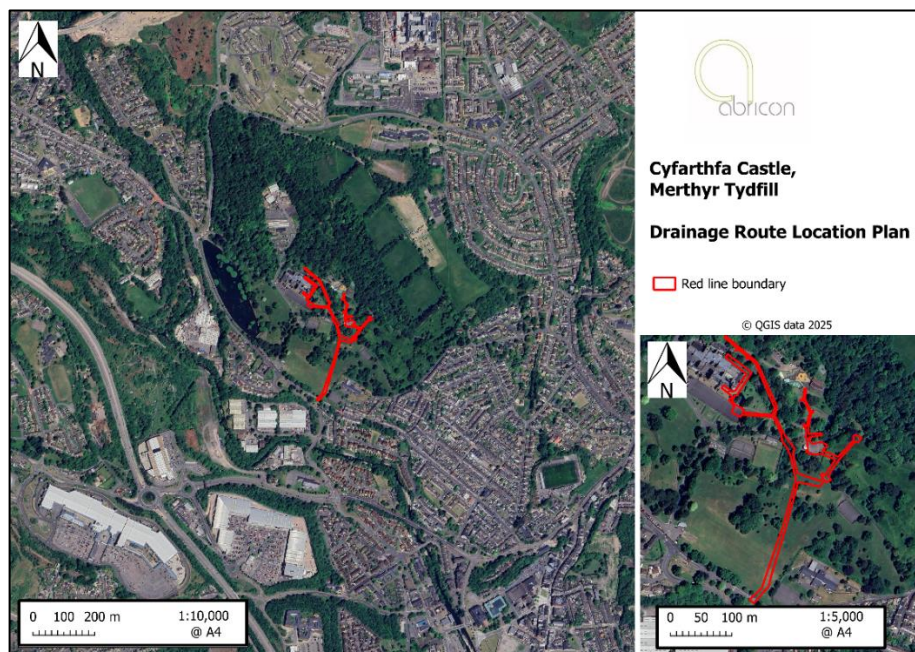


Figure 1 - Location of site – accessed 17/04/2025

Imagery ©2024 Google

1.3 Proposed Development

- 1.3.1 This report is prepared to accompany the planning application P/25/0087, submitted to Merthyr Tydfil Council. This is described as *'the repairs, replacement and installation of new drainage pipes, attenuation tank and manholes. This is to reduce the risk of flooding from surface water from the castle and surrounding area'*.
- 1.3.2 It is understood the drainage channel under current plans will be ~2m x 2m, and ~663m long within the red line boundary for the site. It will include a cut and fill exercise, in some areas to lower the track and in others to increase the levels to create appropriate gradient draining. The attenuation tank is planned to be 2m x 0.8m x 30m. The track construction will require the removal of some areas of hedgerows, trees, modified grassland, other neutral grassland and scrub.
- 1.3.3 Site plans are provided in Figure 3, 4, and 5 and Appendix A.

2 Green Infrastructure Statement (GIS) & Net Benefit for Biodiversity Enhancement Scheme

2.1 Green Infrastructure Statements (GIS)

2.1.1 Planning Policy Wales, Edition 12 details the following:

“A green infrastructure statement should be submitted with all planning applications. This will be proportionate to the scale and nature of the development proposed and will describe how green infrastructure has been incorporated into the proposal. In the case of minor development this will be a short description and should not be an onerous requirement for applicants. The green infrastructure statement will be an effective way of demonstrating positive multi-functional outcomes which are appropriate to the site in question and must be used for demonstrating how the step-wise approach has been applied”.

2.2 Biodiversity Enhancement Scheme

2.2.1 The Environment (Wales) Act 2016 requires all development to show a net benefit to biodiversity. This can be achieved by including biodiversity enhancement measures in development plans. A net benefit can only be achieved after avoiding damage, minimizing (mitigation) impacts and replacement (compensation).

2.2.2 The Green Infrastructure Statement must show that Green Infrastructure and biodiversity will be protected and enhanced by following the step-wise approach in order.

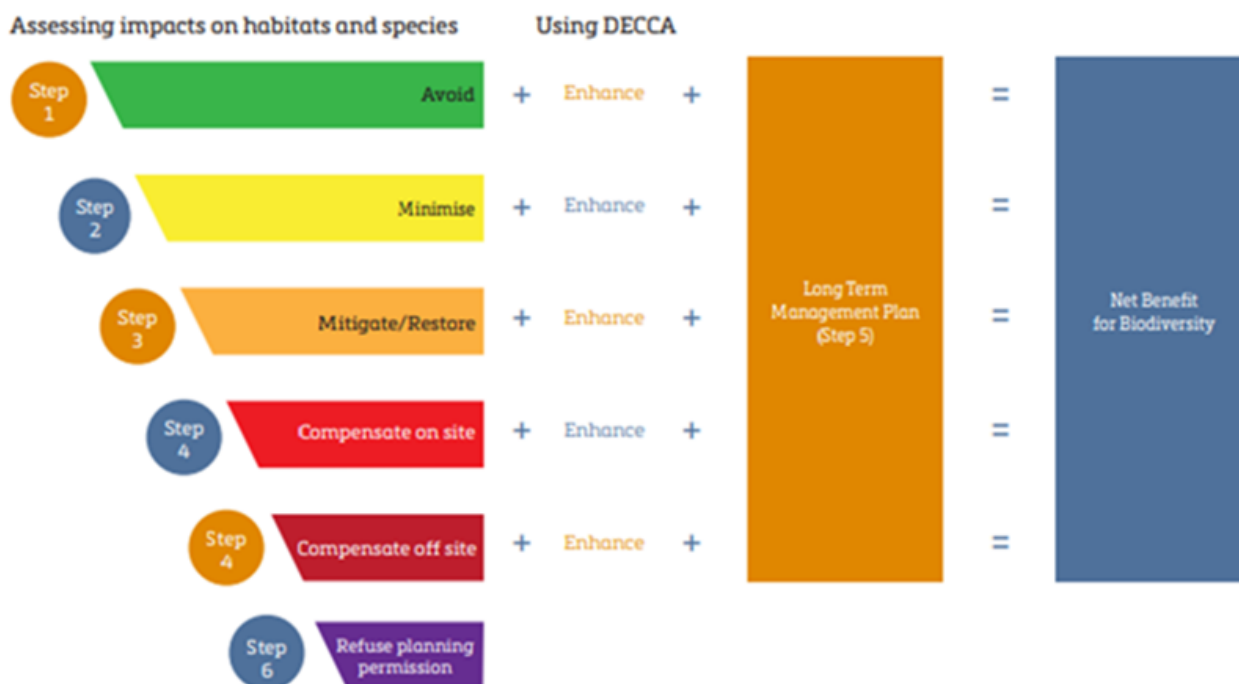


Figure 2 - Summary of the Step-Wise Approach

2.3 Net Benefit for Biodiversity Enhancement Scheme (NBBES)

2.3.1 Net Benefit for Biodiversity is the idea that development should leave biodiversity in a better state than before, through securing immediate and long term, measurable and demonstrable benefit, primarily on, or immediately adjacent to, the site.

3 Green Infrastructure (GI) Assessment

3.1 Existing Onsite Green Infrastructure (GI)

3.1.1 Details of the habitats, with photographs of the site can be found within the PEA (Abricon, 2025).

Table 1 - Existing Onsite Green Infrastructure (GI)

Habitat	Description	Has this GI already been removed?	Will this GI need to be removed or retained?
Modified Grassland g4	The southern extent of the site consisted predominantly of modified grassland (G1), with some scattered individual trees. The other areas of modified grassland are small 'islands' between the asphalt paths, and patchworks of ornamental shrubs and woodland (G3 – G10). All the modified grassland habitats are managed to a short sward. Species present include: ryegrass <i>Lolium perenne</i>, white clover <i>Trifolium repens</i>, common dandelion <i>Taraxacum officinale</i>, creeping buttercup <i>Ranunculus repens</i>, common daisy <i>Bellis perennis</i>, ribwort plantain <i>Plantago lanceolata</i> and smooth meadow grass <i>Poa pratensis</i>.	No	Grass will be removed when the trench for the drainage pipes, attenuation tank and manholes are created.
Other Neutral Grassland g3c	In the northeast extent of the site is an area of other neutral grassland (G2). Species present include: cats ear <i>Hypochaeris radicata</i>, dogs tail <i>Cynosurus cristatus</i>, black knapweed <i>Centaurea nigra</i>, cocksfoot <i>Dactylis glomerata</i>, creeping buttercup <i>Ranunculus repens</i>, Yorkshire fog <i>Holcus lanatus</i>, broad leaved dock <i>Rumex obtusifolius</i>, cow parsley <i>Anthriscus sylvestris</i>, great willow herb <i>Epilobium hirsutum</i>, common dandelion <i>Taraxacum officinale</i>, cranes-bill <i>Geranium</i> sp. and smooth meadow grass <i>Poa pratensis</i>. A small patch of Himalayan balsam <i>Impatiens glandulifera</i> (Schedule 9 species) is present in the northern corner.	No	Grass will be removed when the trench for the drainage pipes, attenuation tank and manholes are created. Patch of Himalayan balsam to be removed using specialist treatment/removal to avoid the spread of the Schedule 9 species.

Blackthorn Scrub h3a	Area containing blackthorn <i>Prunus spinosa</i> scrub (S1) is located in the western corner of G2 and bordered by a species rich hedgerow H1.	No	Scrub will be removed when the trench for the drainage pipes, attenuation tank and manholes are created.
Other Woodland; Mixed w1h	Other Woodland; mixed was found in small patches across the site. These areas contained mixed parkland ornamental species. Species present in these habitats include sycamore <i>Acer pseudoplatanus</i> , cedar <i>Cedrus sp.</i> , Cypress <i>Cupressus sp.</i> , spruce <i>Picea sp.</i> and oak <i>Quercus sp.</i> for example.	No	The planned works run through the woodland areas. No impacts expected on a habitat scale. Retained trees have the potential to be impacted during the construction phase of the development from vehicle movements, storage of materials and other construction activities. This will be included within a CEMP document.
Developed Land; Sealed Surface u1b	Hardstanding paths for staff and public to use between the various areas within the Cyfarthfa Castle Park. Also includes a bandstand structure.	No	Hardstanding will be removed when the trench for the drainage pipes, attenuation tank and manholes are created.
Non-Native and Ornamental Hedgerow h2b	The hedge around the edge of the sports court (H2) is a managed beech <i>Fagus sylvatica</i> hedge, ~1.8m height x 1.5m width.	No	A small section of this hedgerow will be lost as a result of the proposed new drainage route installation. Retained hedgerows have the potential to be impacted during the construction phase of the development from vehicle movements, storage of materials and other construction activities. This will be included within a CEMP document.
Species-rich Native Hedgerow with Trees h2a5 32	Hedgerow (H3) borders G2 and G5, connecting the northern woods to H1. Species and dimensions as H1 below, tree species present include predominantly lime trees <i>Tilia sp.</i>	No	One tree (labelled as T1321) at the northern end of H3 may be lost as a result of the proposed new drainage route installation. The retained sections have the potential to be impacted during the construction phase of the development from vehicle movements, storage of materials and other construction activities.

Species rich native hedgerow h2a5	A species rich native hedgerow (H1) runs along the west and south border of G2, ~1.5m high x 2m wide. Species include dogwood <i>Cornus sanguinea</i>, beech <i>Fagus sylvatica</i>, horse chestnut <i>Aesculus hippocastanum</i>, hornbeam <i>Carpinus betulus</i>, sycamore and hawthorn <i>Crataegus monogyna</i>.	No	A small section of this hedgerow will be lost as a result of the proposed new drainage route installation. Retained hedgerows have the potential to be impacted during the construction phase of the development from vehicle movements, storage of materials and other construction activities. This will be included within a CEMP document.
Line of Trees w 33	One treeline is present on site (TL1). This lines the perimeter of the sports court and runs alongside the beech hedge (H2). Present species are English oak <i>Quercus robur</i>, Cypress trees <i>Cupressus</i> sp., sycamore and spruce <i>Picea</i> gen.	No	Section of tree line TL1 (including loss of trees labelled as T1800, T1802, T1803, T1804, T1805 and T1806) will be lost as a result of the proposed new drainage route installation. Retained sections of the tree line have the potential to be impacted during the construction phase of the development from vehicle movements, storage of materials and other construction activities. This will be included within a CEMP document.
Scattered Trees g 32	Numerous individual trees were present across the site.	No	Two individual trees are proposed to be removed as lie in the path of the drainage route and attenuation tank, these are a Norway Maple (T1681) and Cherry Plum (T1259).

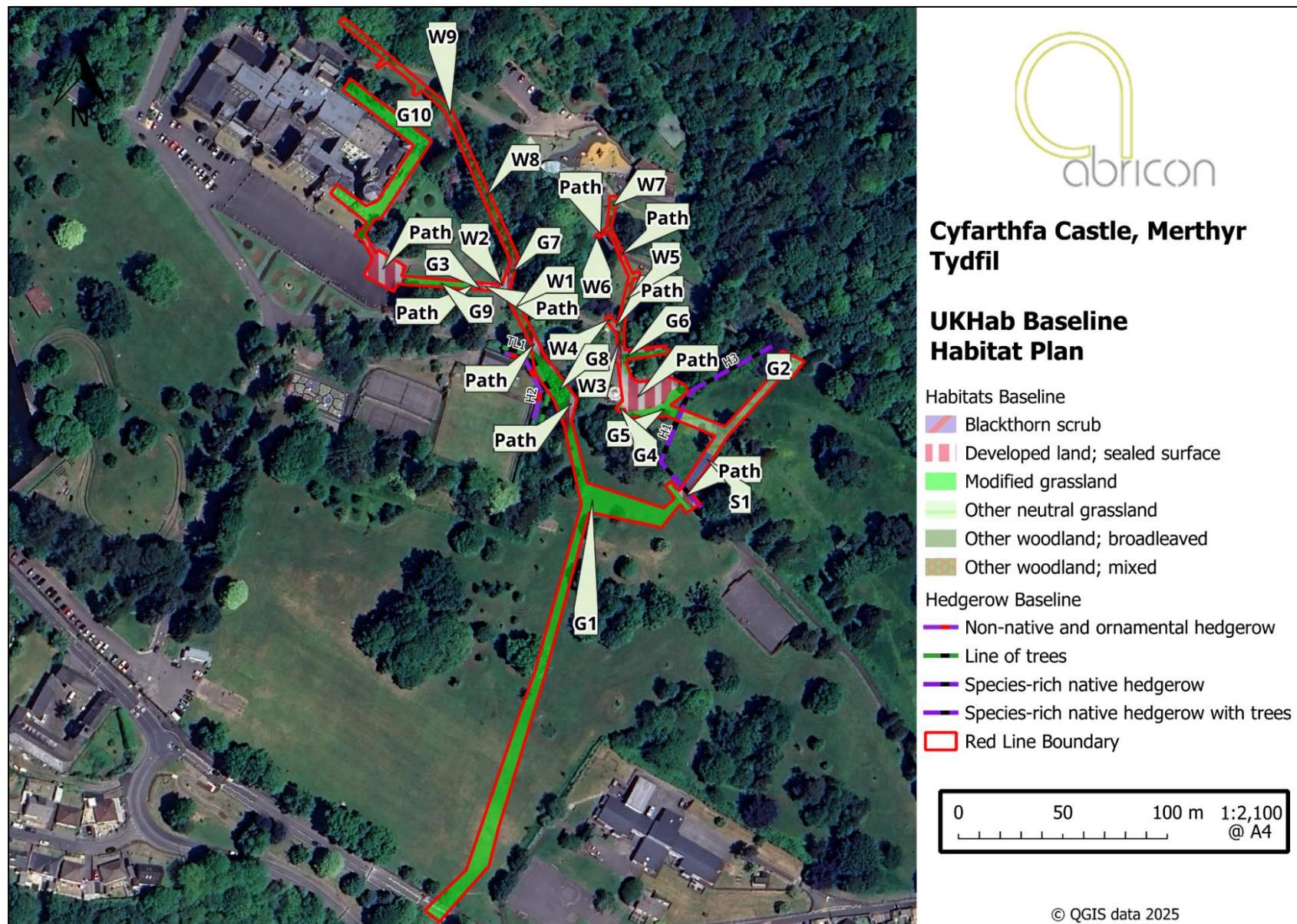


Figure 3 - UKHab Baseline Plan (No Trees)

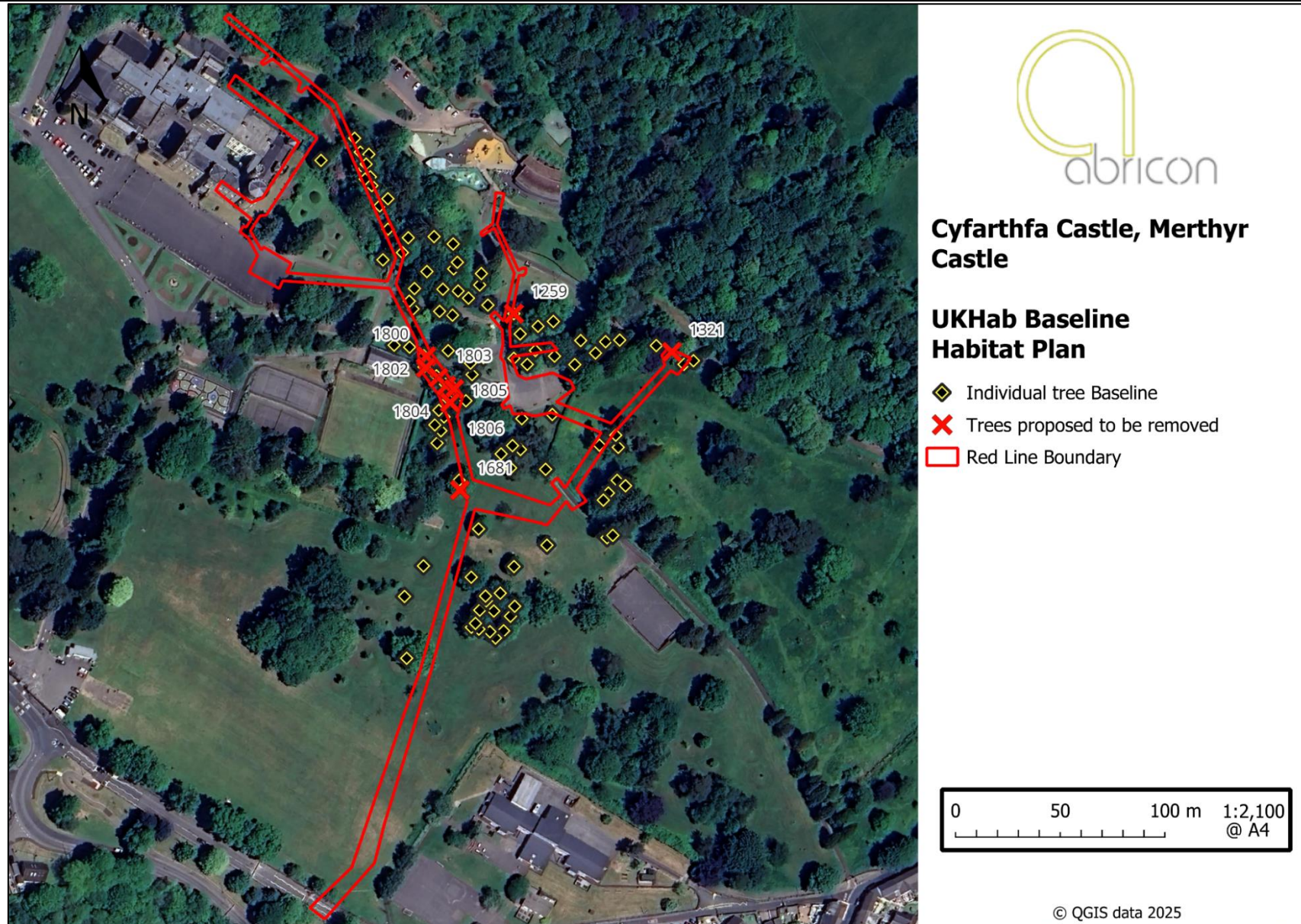


Figure 4 - Baseline Tree Plan

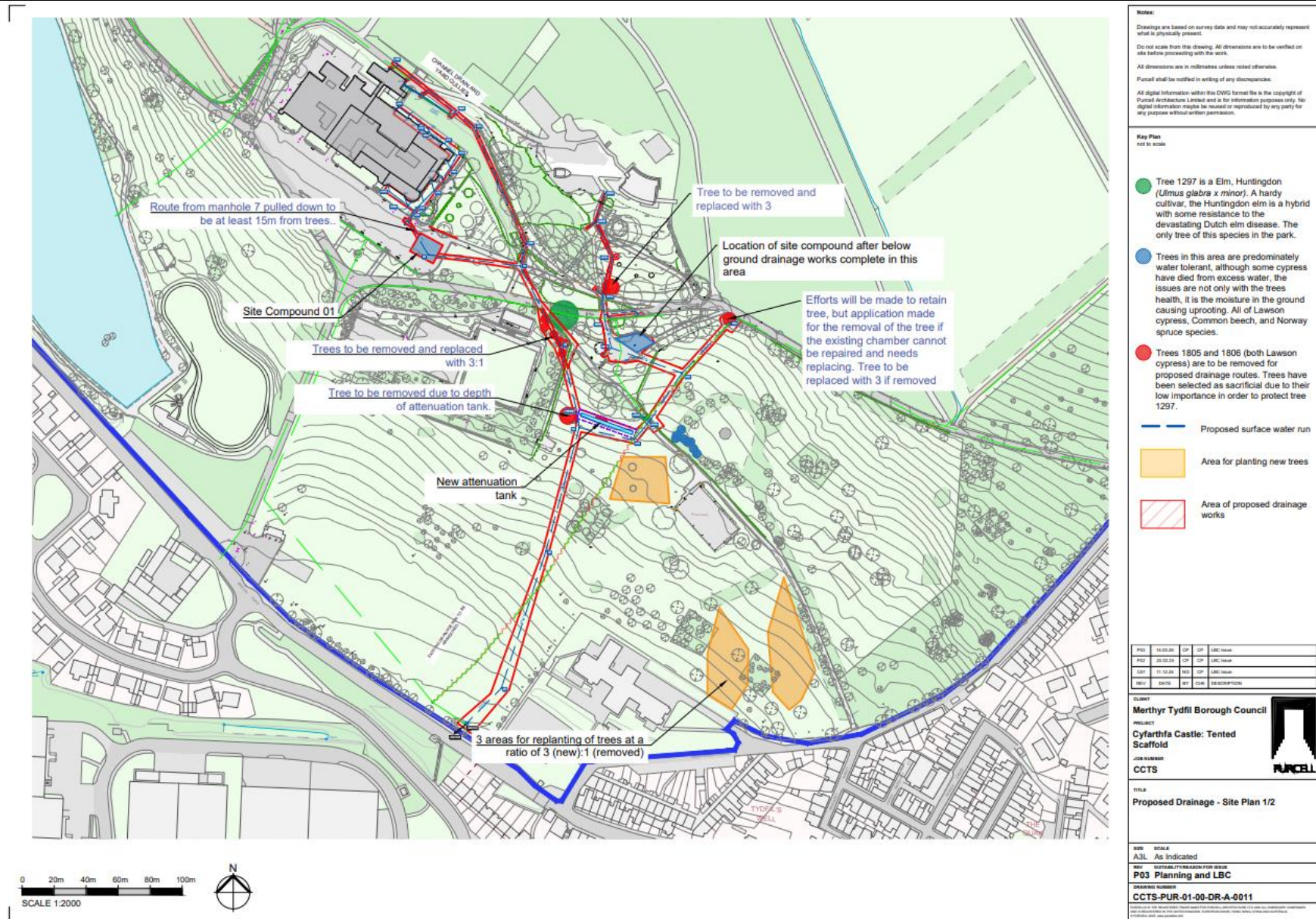


Figure 5 - Tree Loss Plan and Areas for Planting New Trees

3.2 Created Onsite Green Infrastructure (GI)

Table 2 - Created Green Infrastructure (GI)

Habitat	Description
Modified Grassland g4	Any areas of bare ground left within the modified grassland after development will be sown with a grassland mix such as Parkland Grass Seed (BL8) (or similar) to encourage regrowth in these areas.
Other Neutral Grassland g3c	For areas of lost grassland within G2, appropriate species rich neutral grassland seed mix should be selected to encourage regrowth in these areas. Suggested seed mix for G2 area include Emorsgate EM2 Standard General Purpose Meadow Mixture or Emorsgate EM10 Tussock Meadow Mixture (or similar).
Species Rich Native Hedgerow h2a5	It is recommended that rather than removal, translocation of the hedgerows is undertaken if possible. The translocated or newly planted hedgerow should be allowed 2m on site width to allow the hedgerow to mature with time. The hedgerows will be allowed to grow and then maintained at a minimum height of 3m. It should contain native mixed species (minimum of 7 native species throughout in order to achieve the species rich status), including fruiting species. Minimum heavy standard tree stock should be planted approximately every 20m along hedgerow length. An appropriate location has been suggested in Appendix B and will be confirmed prior to construction. The hedgerow should reach at least 20m long to replace the lost lengths of existing hedgerow. The hedgerow should be planted or filled in with native hedgerow species such as the following: • Field maple <i>Acer campestre</i> • English oak <i>Quercus robur</i> • Silver birch <i>Betula pendula</i> • Hazel <i>Corylus avellana</i> • Crab apple <i>Malus Sylvestris</i> • Hawthorn <i>Crataegus monogyna</i> • Blackthorn <i>Prunus spinosa</i> • Damson <i>Prunus domestica</i> subsp. <i>Insititia</i> • Wild cherry <i>Prunus avium</i> • Hornbeam <i>Carpinus betulus</i> • Spindle <i>Euonymus europaea</i> • Guelder rose <i>Viburnum opulus</i>

	Native flowering hedgerow species should also be included, such as honeysuckle <i>Lonicera periclymenum</i> , to attract moth species to the area, increasing the site's foraging appeal to rarer bats like horseshoes.	
Scattered Trees g 32	Any lost trees will be replaced in groups within the wider Cyfarthfa Castle Park grounds as per local tree replacement policy. This will include up to 27 trees (see Figure 5) including the following species:	
	Species	Quantity
	Japanese maple <i>Acer palmatum</i>	1
	Silver Maple <i>Acer saccharinum</i>	1
	Common alder <i>Alnus glutinosa</i>	1
	Silver birch <i>Betula pendula</i>	9
	European hornbeam <i>Carpinus betulus</i>	1
	Sweet Chestnut <i>Castanea sativa</i>	1
	Japanese cedar <i>Cryptomeria japonica</i>	1
	Maidenhair tree <i>Ginkgo biloba</i>	1
	Japanese red pine <i>Pinus densiflora</i>	1
	Japanese cherry <i>Cerasus serrulata</i>	3
	Sawtooth oak <i>Quercus acutissima</i>	1
	Black locust <i>Robinia pseudoacacia</i>	1
	Weeping willow <i>Salix × sepulcralis</i> 'Chrysocoma'	1
	Giant sequoia <i>Sequoiadendron giganteum</i>	3
	Weeping hemlock <i>Tsuga canadensis</i>	1
	These contain a mixture of native and non-native species to match the surrounding park's diverse mix of tree species.	

4 Net Benefit for Biodiversity

- 4.1.1 Recommended enhancements for species include the installation of bat and bird boxes, a reptile hibernacula and an insect tower.
- 4.1.2 Integrated box designs have not been used in this case as no building construction is planned. As such, surface-mounted boxes have been utilised. These must be self-cleaning designs and constructed from woodstone or woodcrete for reasons of longevity. Boxes should be positioned away from artificial light. These boxes/enhancement features should be erected, replaced if damaged/lost and maintained in perpetuity.

Table 3 - Enhancements for biodiversity

Type of enhancement	Location	Further information
A total of three bat boxes will be included onsite.	The bat boxes will be installed on suitable mature trees onsite or within the adjacent parkland. These will be situated facing a southerly direction, at least 3m from ground level and free from vegetation which may block the entrance to the box. Suggested locations are shown in Appendix B, however, locations should be chosen by a suitably experienced ecologist at installation.	These will be Schwegler 2F Bat Boxes (or similar woodcrete option), chosen for its suitability for crevice dwelling bat species such as brown long-eared bats <i>Plecotus auritus</i> and pipistrelles <i>Pipistrellus spp.</i> which have been identified onsite.
A total of three bird boxes will be included onsite.	The bird boxes will be installed on suitable mature trees onsite or within the adjacent parkland. These will be situated facing a northerly or easterly direction, at least 3m from ground level and free from vegetation which may block the entrance to the box. Suggested locations are shown in Appendix B, however, locations should be chosen by a suitably experienced ecologist at installation.	This will be a Woodstone Seville Nest Box 32mm (or similar woodcrete option), chosen for its suitable design for common bird species.
A reptile hibernacula will be created.	A habitat pile will be created in the area of Other Neutral Grassland. Suggested locations are shown in Appendix B, however, locations should be chosen by a suitably experienced ecologist at installation.	Materials like the rubble, logs or vegetation from the site clearance can be utilised for the hibernacula creation. The hibernacula will be as large as possible but a minimum of 1m wide x 1m long x 1m tall.
An insect tower will be included onsite.	An insect tower will be installed in the area of Other Neutral Grassland. This will be installed at least 2m high, in a sunny location in close proximity to plants and flowers, with the front ideally facing south. Suggested locations are shown in Appendix B, however, locations should be chosen by a suitably experienced ecologist at installation.	This will be National Trust Insect Towers (or similar design), chosen for the suitability for pollinators and bees.

5 Implementation, Management and Maintenance

5.1 Modified Grassland

- 5.1.1 Parkland Grass Seed (BL8) (or similar) has been recommended to quickly establish over larger areas such as the traditional parkland onsite.

Implementation

- 5.1.2 The best time to sow is when other grasses are growing. This ensures ground conditions are correct for germination. Early spring and late autumn sowings do not usually require irrigation. Landscape grass seeds sown in the summer months may require watering for successful germination and establishment. Winter sowings may take place on very free draining ground however, sowing at this time should be avoided on heavy clay and/or ground prone to waterlogging.
- 5.1.3 Split the total quantity of landscape grass seeds to be applied into two equal amounts. Apply the first half over the entire area either by hand or by using a broadcast spreader. Gently work most of the applied seeds into the loose tilth with a firm rake or harrow. Apply the remaining seed in the same way and again, rake or harrow most of them into the tilth.
- 5.1.4 Finally, lightly roll or tread over the surface to squeeze the seeds and tilth down into the seedbed. This method ensures the seeds are evenly spread, set at different depths and in good contact with the soil. All of the above helps to ensure the seeds are anchored firmly into position so as not to float away during heavy or persistent rainfall and to retain the correct moisture level for efficient germination.
- 5.1.5 The seedbed must maintain a good level of moisture to allow germination to take place. This is particularly important during sunny and/or breezy weather where the seedbed can dry out very quickly. Failure is most commonly caused by seeds drying out just as they begin to germinate.
- 5.1.6 Sown grassland should be fenced off to discourage people/dogs from walking on the grassland or machinery from compacting the area whilst it is establishing. This can be removed once seedlings have established.

Management and Maintenance

- 5.1.7 Once seedlings establish leaves 2 to 3 inches (50 to 75mm) long the first cut may be made at no more than one third of the overall leaf length. Do not scalp the grass on its first cut. As the seedlings establish and resulting turf matures the leaf length may be adjusted higher or lower.
- 5.1.8 Once established, the grassland shall continue to be maintained as per the surrounding park grassland for at least 25 years, or in perpetuity.

5.2 Other Neutral Grassland

- 5.2.1 Emorsgate EM2 Standard General Purpose Meadow Mixture or Emorsgate EM10 Tussock Meadow Mixture has been recommended to aid the growth of the grassland after the drainage route has been dug.

Implementation

- 5.2.2 Seed is best sown in the autumn or spring but can be sown at other times of the year if there is sufficient warmth and moisture. The seed must be surface sown and can be applied by machine or broadcast by hand. To get an even distribution and avoid running out, divide the seed into two or more parts and sow in overlapping sections. Do not incorporate or cover the seed, but firm in with a roll, or by treading, to give good soil/seed contact.
- 5.2.3 Sown grassland should be fenced off to discourage people/dogs from walking on the grassland or machinery from compacting the area whilst it is establishing. This can be removed once seedlings have established.

Management and Maintenance

- 5.2.4 Most of the sown meadow species are perennial and are slow to establish. Soon after sowing there will be a flush of annual weeds, arising from the soil seed bank. These weeds can look unsightly, but they will offer shelter to the sown seedlings, are great for bugs, and they will die before the year is out. So, resist cutting the annual weeds until mid to late summer, especially if the mixture contains yellow rattle, or has been sown with a nurse of cornfield annuals. Then cut, remove and compost or add to the habitat pile within G2. Early August is a good time. This will reveal the young meadow, which can then be kept short by grazing or mowing through to the end of March of the following year. Dig out any residual perennial weeds such as docks.
- 5.2.5 It is recommended the grassland should be managed around a main summer hay cut in combination with autumn and possibly spring mowing. Meadow grassland is not cut or grazed from spring through to late July/August to give the sown species an opportunity to flower. After flowering in July or August take a 'hay cut': cut back to c 50mm. Leave the 'hay' to dry and shed seed for 1-7 days then remove from site. Mow the re-growth through to late autumn/winter to c 50mm and again in spring if needed.
- 5.2.6 Once established, the grassland shall continue to be maintained as per the surrounding neutral grassland for at least 25 years, or in perpetuity.

5.3 Species Rich Hedgerow - Translocation

- 5.3.1 Hedgerow created from translocation or removed hedgerow sections.

Implementation

- 5.3.2 All hedgerow translocation tasks will be carried out under supervision of suitably experienced ecologist.
- 5.3.3 Hedgerow translocation is most successful when undertaken during the period October to late February. This allows the hedge to acclimatise to its new location before the summer. Translocations will not be undertaken during hot and dry or freezing conditions or during periods of prolonged heavy rain or during snow or frost. Hedgerow roots will be exposed for as little time as possible; they must never completely dry out.
- 5.3.4 The exact location of the receptor trench and adjacent fencing should be agreed and marked out in advance and fertiliser, water retention granules, watering equipment and topsoil (as detailed below) should be purchased and on site.
- 5.3.5 Prior to translocation the hedge will require cutting back to reduce its size. This makes it easier to move but more importantly reduces the strain on the roots in the year following translocation. The contractor should allow for cutting the hedge back to a height of approximately 30-60cm and reducing the side growth back to solid wood.
- 5.3.6 The receptor trench will be dug to a width of approximately 1.5-2m, although this will depend on the size of the translocated material. Similarly, the depth of the trench will inevitably vary but will require excavation to a depth of approximately 1m.
- 5.3.7 Substrate at the base of the trench will be loosened with an excavator bucket. To maximise the chances of successful establishment of the translocated hedgerow, slow-release fertilizer (N:P:K 20:4:10) can be applied to the trench base at a rate of 50g per metre. Similarly, broadleaf P4 water retention granules can be spread along the trench base at a rate of 30g per metre.
- 5.3.8 Short sections of hedge should be dug and transferred to the receptor trench in sequence. A chainsaw operative should be available to cut roots or stems rather than breaking them with the excavator (cleanly cut roots are less susceptible to fungal infection).
- 5.3.9 Translocated shrubs will then be placed in the receptor trench and set at the required ground level. Gaps between shrubs will then be backfilled with soil from the donor site, packing the lower soil layers between buckets to ensure good contact between roots and soil. Re-laid shrubs will be watered immediately after translocation. Topsoil levels should be topped up if any roots become exposed.

- 5.3.10 Where damage occurs during the translocation or where the new alignment is shorter (due to bunching up) than the original line of the hedgerow, additional planting will be required.

Management and monitoring

- 5.3.11 If weather conditions following translocation remain dry, the hedgerow should be watered on a daily basis until it rains. If dry weather persists during the first summer, the translocated plants will be well watered to prevent failures. Same principles apply as per new trees (see irrigation 5.5.6 – 5.5.9). The hedgerow should be inspected in the growing season following translocation to assess the percentage take of the plants (following heavy pruning and translocation, some plants can be very late producing leaves). New woody planting and the translocated hedge will be checked once per month for first 6 months after planting and then on an annual basis from years 1 to 25.
- 5.3.12 Long term management should be light trimming allowing the hedgerow to increase in size and thicken out each time whilst ensuring all the stems remain healthy. The hedgerow should not be constantly trimmed at the same height as this form of long-term management places a hedge under stress and can lead to a deterioration in condition.
- 5.3.13 Cutting will leave at least 10cm of the previous year's growth. Cutting incrementally, rather than trimming back to the same point, allows hedges to increase in height and width by several centimetres at each cut, encouraging a dense, healthy hedgerow and allowing last year's growth to fruit and flower.
- 5.3.14 Any failed planting will be identified during annual checks and failed plants will be replaced (as required) with new whips. Up to 5% failure rate for shrubs will be allowed, but if more than 5% failures occur then replacement planting of the same (or similar) species will be provided.
- 5.3.15 The translocated hedgerow will require trimming back after the first season's growth to encourage bushy growth, followed by annual cutting.
- 5.3.16 Once established, the hedgerow shall continue to be maintained with annual cutting for at least 25 years, or in perpetuity.

5.4 Species Rich Hedgerow – Creation

- 5.4.1 Hedgerow created from newly planted saplings.

Implementation

- 5.4.2 Planting of bare-rooted stock is to be carried out between November and March; however, pot grown plants can be planted throughout the year. Planting shall take place during frost free conditions when the site is not waterlogged.
- 5.4.3 All planting beds will be free from weeds and waste materials. The ground will be cultivated to full depth with the additional of slow-release fertiliser or well-rotted manure. All plants are to be thoroughly soaked immediately prior to planting.
- 5.4.4 All mixed native hedging material will be planted as bare-rooted transplants and are to be notch planted in a double staggered row at 45cm centres using 5 plants per linear metre.
- 5.4.5 Hedgerows will be planted as evenly as possible and protected by spiral rabbit guards.

Management and monitoring

- 5.4.6 Post-development cutting/trimming of the hedgerows should take place outside of the nesting bird season (between September and February).
- 5.4.7 New planting will be inspected at 6 and 12 months after planting and then on an annual basis from years 1 to 5. Any failed planting will be identified, and failed plants will be replaced (as required). Up to 5% failure rate for shrubs will be allowed, but if more than 5% failures occur then replacement planting of the same (or similar) species will be provided. Any shrubs which fail will be replaced on a like-for-like basis.
- 5.4.8 In the first spring, cut the newly planted whips down to 45-60cm. This hard pruning will encourage the whips to become thick and bushy.

- 5.4.9 If dry weather persists during the first summer, the whips will be well watered to prevent failures. Same principles apply as per new trees (see irrigation 5.5.6 – 5.5.9).
- 5.4.10 The whips will be lightly trimmed every second or third year, allowing the plants to increase in size each time. All hedgerows will be managed to a height of at least 3-4m and width of at least 2m, as this is considered to be particularly important for encouraging use by native British wildlife.
- 5.4.11 Removal of tree protection will be undertaken promptly once specimens have successfully established after at least three years. This is to prevent trunk distortion, damage and constriction which can be caused by tree guards and stakes and can lead to structural weakness in the trunks.
- 5.4.12 Monitoring will be carried out with the current regular maintenance of the park. Any failed planting will be identified, and failed saplings will be replaced (as required).
- 5.4.13 Once established, the hedgerow shall continue to be maintained with annual cutting for at least 25 years, or in perpetuity.

5.5 Scattered Trees

- 5.5.1 Trees planted in chosen areas of the wider park will comprise a mix of species, reflecting the diverse woods within the formal gardens.

Implementation

- 5.5.2 Any rubbish, concrete, metal, glass, decayed vegetation, and contaminated topsoil will be removed. If weed growth has developed, then any individuals should be manually pulled or dug out and herbicide should not be used. Gravel, fertilizers or other organic matter shall not be added. The soil at the bottom of the planting hole shall not be loosened or disturbed. Any earth-moving works will be carried out while soil and weather conditions are suitable i.e., not during or shortly after rainfall or during high winds. Where existing topsoil and subsoil are to be moved and re-used, the topsoil and subsoil will be kept separate and deposited within the planting beds in the same profile as the existing ground. Before the spreading of topsoil, the receiving area for trees and shrubs should be mixed and de-compacted to increase permeability. Any imported topsoil used will comply with BS 3882:2015 Specification for topsoil and requirements for use (BSI, 2015).
- 5.5.3 Recipients of young trees from the nursery will ensure that they have the resources, both human and mechanical, necessary to unload the lorry in a speedy and efficient manner. The landscape contractor will conduct a full quality check at the time of unloading to check that the plants are of good form and vigour, free from pest and disease, free from physical damage or deformity, with vigorous leading shoots moist fibrous root systems and stout root collars. All roots should not be circled, girdled or kinked, freeze or burn damage should be checked for. Plants with symmetrically distributed roots should be chosen. Any defects or breakages will be reported to the dispatching nursery immediately and replaced. Trees and shrubs that do not meet the specification or are otherwise unsatisfactory or damaged will be rejected and returned. The site of temporary storage will be isolated from areas where there is potential for contamination from other stored materials on neighbouring sites or damage from vehicles. Any temporarily stored plants shall have their roots kept cool and moist. The length of time that trees are held in temporary storage will be kept to a minimum. Any off-season material shall be heeled in to prevent freeze damage. Greenhouse material shall be hardened off prior to planting. While on-site, plants shall be protected from excess light, heat and desiccation. Containerized trees will be lowered intact from delivery by hand or using machinery. They will not be dropped onto the ground, as this can cause damage to their root system.
- 5.5.4 All bare root trees will be unloaded carefully and will have their root systems protected immediately after unloading, either by heeling in on-site in a temporary trench or by covering with a moisture-retentive, breathable material. Bare root trees delivered in co-extruded bags may be left in those bags until planting but will still need to be protected from sun, wind and severe frost. Any non-porous materials or wrappings will be removed at this stage. Heeled-in root systems will be kept moist at all times. The planting hole shall be backfilled by

unamended native soil. The soil surrounding the newly planted tree shall be covered with a specialist fabric layer to minimise weed growth (weed resistant membrane) The outer edges of the fabric should be anchored to the soil using pegs, nails or heavy wire staples. The new trees shall only be staked when necessary, stakes shall be loose and low and removed after one growing season. X shaped slits shall be cut where planting holes are formed. A soil berm should be mounded around the planting hole to increase water retention. To the top of the newly planted specimen, a 75mm-100mm thick layer of well-drained organic mulch should be added, which is to be smoothed with a plastic leaf rake. No phosphate containing fertilizer should be used on any planted trees or shrubs, instead fish meal or ammonium sulphate should be used.

- 5.5.5 Tree installation works are advised to be undertaken between July and September or November and February. Tree maintenance works should also avoid the season for nesting birds. All tree works should be carried out in accordance with current best practice guidelines and BS3998 – Tree Works. Only natural pruning method to be used. The use of an Arboricultural Association Approved Contractor or ISA Certified Arborist/Tree Worker suitably insured and experienced to carry out the tree works is recommended. All trees to be positioned on site to avoid conflict with services and supplied with root barriers as necessary to protect services and structure. If needed, use tree shelters or other barriers to keep out herbivores. Base & sides of pits to be well loosened. Standard and feathered tree pits to suit tree root system, with 300mm min soil around roots and 600mm deep pit (bottom of pit to be broken up to a depth of 150mm), filled with good quality topsoil. Standard nursery stock trees to be pit planted with double stub stake and fixed horizontal tie approx. one third clear stem height.

Irrigation

- 5.5.6 Water can be sourced externally (bought in by a bowser) or the site served by local mains water services.
- 5.5.7 Irrigation principals should be followed as outlined below. Except from Section 11.3 of the BS 8545:2014 BSI Tree guidance:
- The timing and frequency of irrigation should take into account the prevailing weather conditions, soil moisture release characteristics, and the response of the tree species to water deficits or periods of prolonged soil saturation.
 - Any given volume of soil has the capacity to hold a given volume of water. The water-holding capacity of the soil should be assessed and taken into account when determining irrigation needs.
 - In addition to water-holding capacity, the amount of water available to the tree should be assessed. Applying this to all newly planted trees is often impractical, but sample assessments should be made.
 - The frequency of irrigation is more important than the volume of water given at any one time. Increased water volumes cannot compensate for a lack of frequency. This should be accounted for in irrigation plans. Irrigation plans should also take into account the findings of the original site assessment and the subsequent species choice made
 - Monitoring is recommended if there are 10 consecutive days during the growing season at $\geq 25^{\circ}\text{C}$. Water should only be added if soil moisture probe/tensiometer values indicate that it would be appropriate to do so.
 - The frequency and extent of irrigation should take into account the prevailing weather conditions (e.g. prolonged dry periods or rainfall patterns).
 - If the use of irrigation tubes is proposed, it should be fully assessed in relation to the site constraints.
- 5.5.8 The BSI tree guidance states that in dry periods, trees probably need to be watered about twice each week with 20L of water adequate to keep an 800mm diameter root ball well irrigated, and that 40L of water or less thoroughly moistens a soil ball of 500mm to 600mm.
- 5.5.9 **The period over which irrigation is required is likely to be at least two full growing seasons,** depending on how successfully the planted trees establish on-site.

Management and Maintenance

- 5.5.10 Pruning and trimming of trees should be carried out outside of the bird breeding season (nesting season: March – August inclusive) in the months of September to February. Trees should be checked bi-annually for shape, form and size, and pruned as appropriate to the species. Any stakes, canes or ties found not fit for purpose will be adjusted, replaced or removed. After 2 years all stakes, canes and ties may be removed.
- 5.5.11 Areas around the new plants should be kept clear of weeds to allow the plants to establish themselves by weeding twice a year in the Spring and Autumn. This should be through digging or cutting away unwanted vegetation which will then be removed from the site. Weeding should not take place through the use of herbicides. Any litter or debris should be removed as soon as it is found.
- 5.5.12 No phosphate containing fertilizer should be used on any planted trees or shrubs, instead fish meal or ammonium sulphate should be used.
- 5.5.13 Annual monitoring will be carried out with the current regular maintenance of the park. Any failed planting will be identified, and failed trees will be replaced (as required). Up to 5% failure rate for specimens will be allowed, but if more than 5% failures occur then replacement planting of the same (or similar) species will be provided. Any trees which fail will be replaced on a like-for-like basis.
- 5.5.14 Once established, the trees shall continue to be maintained as per the surrounding trees within the parkland for at least 25 years, or in perpetuity.

5.6 Responsibilities and Funding

- 5.6.1 Merthyr Tydfil Council will fund the management and monitoring of work related to biodiversity mitigation and monitoring, as detailed within this document on site in perpetuity.
- 5.6.2 It shall be the responsibility of Merthyr Tydfil Council to ensure that the above tasks for site are carried out.

6 Lighting

- 6.1.1 Connectivity between habitats or Green Infrastructure elements can be negatively impacted by Artificial Light At Night (ALAN). However, construction will be undertaken during the working day and will therefore not require any lighting at nighttime. Additional lighting will not be installed as part of the development. There will be no increase in artificial lighting onsite either during or post development.

7 The Step-Wise Approach

- 7.1.1 Planning authorities must follow a step wise approach to maintain and enhance biodiversity, build resilient ecological networks and deliver net benefits for biodiversity by ensuring that any adverse environmental effects are firstly avoided, then minimized, mitigated, and as a last resort compensated for. Information regarding the step-wise approach are provided below.

Table 4 - the Step-Wise Approach

Avoid	The location and layout of the drainage route was chosen specifically to impact the least amount of trees and important habitats onsite. This has been designed to avoid tree 1297 which is a Huntingdon Elm <i>Ulmus glabra x minor</i> with some resistance to the devastating Dutch elm disease. As this is the only tree of this species in the park, this has been retained within the plans. Merthyr Tydfil Council Tree officer and ecologists were consulted throughout the process to ensure compliance and to create the least damaging location for the drainage route.
Minimise	The route has been chosen to minimise the impact on the species rich grassland with attenuation pond now located within the species poor grassland area instead.
Mitigate/Restore	Root protection zones have been created to mitigate the impact of the digging on tree roots. Any lost grassland will be restored, with seed mixes encouraging quicker and more diverse regrowth in these areas.
Compensate (onsite)	No on-site compensation will be possible due to restrictions about planting trees or shrubs on top of the new or repaired drainage.
Compensate (offsite)	Tree removal has occurred only where necessary, and all removed trees will be replaced by a 3:1 ratio. Replacement trees will be located within areas of the surrounding Cyfarthfa Park, in close proximity to the development area.

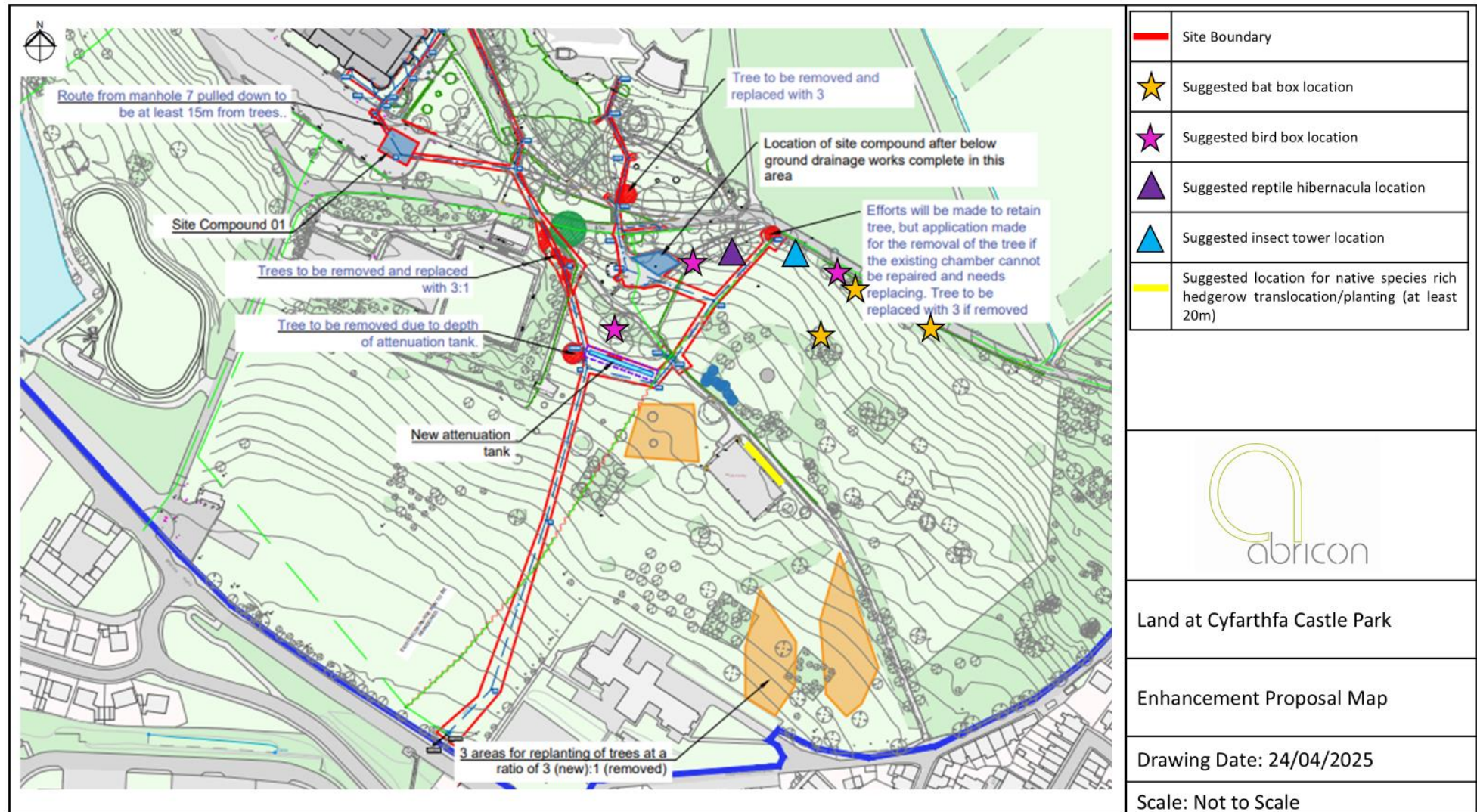
8 Conclusion

- 8.1.1 The proposed Green Infrastructure Strategy will accord with the principles set out by Merthyr Tydfil Council and has followed the step-wise approach. It will protect the habitats within and adjacent to the site, ensuring that they continue to support diverse habitats and species and has been designed to enhance the green infrastructure on the site in a way that increases resilience to the changing climate and provides protection for people and places.
- 8.1.2 It is assessed that the proposed development will result in an onsite Net Benefit for Biodiversity and an improvement in ecosystem resilience.

Appendix A – Plans and Drawings



Appendix B – Suggested Enhancement Location Map



Appendix C - Ecosystem resilience (the DECCA framework)

GI Element \ DECCA	Diversity	Extent	Condition	Connectivity	Adaptability
Modified Grassland	Grassland seed mix has been chosen to include a mixture of native grass species to increase diversity. Diversity is limited by the modified grassland habitat surrounding the site and the proposed management.	The grassland planted onsite comprises a small section of a wider parkland. This will be replanted, restoring the disturbed areas, ensuring fragmentation of the grassland does not occur.	The management and maintenance of the grassland habitat will ensure the success of the planting, with any failures replaced/replanted. Once established, the grassland will become a seamless area of the of the existing parkland which provides ecosystem services to the surrounding town and its population.	The habitat comprises a small section of the wider park which creates a green corridor and increases connectivity through the town of Merthyr Tydfil and into the surrounding landscape.	A greater species diversity will by its nature be more resilient to changes in climate or environment in future.
Other Grassland Neutral	Grassland seed mix has been chosen to include a diverse mixture of grass and flowering species (composed of 15% native wild flowers and 85% slow growing grasses) to increase diversity. The hibernacula and insect tower installed in this area will support reptiles and insects using the site.	The grassland planted onsite comprises a small section of a wider area of other neutral grassland within the parkland. This will be replanted, restoring the disturbed areas, ensuring fragmentation of the grassland does not occur.	The management and maintenance of the grassland habitat will ensure the success of the planting, with any failed patches replaced/replanted. Once established, the grassland will become a seamless area of the of the existing parkland which provides ecosystem services to the surrounding town and its population.	The habitat comprises a small section of the wider park which creates a green corridor and increases connectivity through the town of Merthyr Tydfil and into the surrounding landscape.	The greater species diversity encouraged in this area will by its nature be more resilient to changes in climate or environment in future. The management plan is created to be flexible and adaptable and can be reviewed in future if changes are necessary.
Species Rich Native Hedgerow/Translocated Hedgerow	The hedgerow will contain at least seven native species and will be	The proposed hedgerow will be created to replace the lost sections of	The management and maintenance of the hedgerow will ensure the	The hedgerow will be planted sensitively to increase connectivity	The greater species diversity encouraged in this hedgerow will by its

	planted with native flowering species also.	hedgerow. This will be at least 20m long to create useful commuting, foraging or nesting habitat and will be situated sensitively to encourage connectivity and not cause fragmentation of habitats.	success of the planting, with any failures replaced. Using translocation techniques encourages a shorter timeframe for the hedgerow to establish and reach good condition. Once established, the hedgerow will become a seamless area of the of the existing parkland which provides ecosystem services to the surrounding town and its population.	between habitats within the site, providing a commuting corridor for several species. This habitat will also comprise a small section of the wider park which creates a green corridor and increases connectivity through the town of Merthyr Tydfil and into the surrounding landscape.	nature be more resilient to changes in climate or environment in future. Using translocated specimens means the hedgerow species have already adapted to and grown within the local climate of the location and may have a better chance of success in future. The management plan is created to be flexible and adaptable and can be reviewed in future if changes are necessary.
Scattered Trees	A range of native and non-native tree species have been chosen to increase tree species diversity onsite in line with the existing trees within the formal gardens and parkland. The bat and bird boxes installed on existing trees onsite will encourage bat and bird species to roost/nest in this area.	The proposed trees will be planted to replace the felled trees. These will be replaced in a 3:1 ratio to compensate for this loss and maintain tree cover in the area.	The management and maintenance of the newly planted trees will ensure the success of the planting, with any failures replaced. Once established, the trees will become a seamless area of the of the existing parkland which provides ecosystem services to the surrounding town and its population.	The trees comprises a small section of the wider park which creates a green corridor and increases connectivity through the town of Merthyr Tydfil and into the surrounding landscape.	The greater species diversity set out in the tree planting plan will include non-native species that may have more resilience to a changing climate. The greater species diversity will also, by its nature, be more resilient to changes in climate or environment in future. The management plan is created to be flexible and adaptable and can be reviewed in future if changes are necessary.

Appendix D - References

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