Cardiff University Ecosystem Resilience and Biodiversity Action Plan (ERBAP) 2021-2023

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Abbreviations

BAP	Biodiversity action plan
BRED	Biodiversity and Resilience Ecosystems Duty
CBD	Convention on Biological Diversity
CL BAP	Cardiff Local Biodiversity Action Plan
CWCW	Cardiff Wildlife and Cardiff Wildflower
DECCA	Diversity, Extent, Condition, Connectivity and Adaptability
ECO	Environmental Compliance Officer
EMS	Environmental Management Systems
ERBAP	Cardiff University Ecosystem Resilience and Biodiversity Action Plan
GI	Green infrastructure
HPIB	Habitats of Principal Importance for Biodiversity
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
LNP	Local Nature Partnership
MOOC	Massive Open Online Course
NGOs	Non-governmental organisations
NRAP	Nature Recovery Action Plan
NRW	Natural Resource Wales
PHEW	Positive, Health, Environment and Wellbeing Fortnight
SDGs	Sustainable Development Goals
WG	Welsh Government

Chapter 1: Background

Biodiversity and resilience narrative

The United Nations' Convention on Biological Diversity (CBD), which was opened for signatures at the 1992 Rio Earth Summit, recognized the need for international action to halt biodiversity loss. Over 25 years later, The Global Assessment Report of the UN's Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) warned that if we want to halt biodiversity loss, slow the deterioration of nature and meet biodiversity, climate and sustainable development goals by 2030, *"business as usual" will not work and will instead drive societies and economies to more risks.* According to the report, the biomass of wild mammals has fallen by 82%, natural ecosystems have lost about half of their area and a million species are at risk of extinction.

As a signatory of the Environmental Association of Universities and Colleges (EAUC) SDG Accord, Cardiff University is committed to embedding the UN's Sustainable Development Goals (SDGs) throughout the institution. The SDG's were adopted in 2015 and set out a series of 17 goals which outline urgent actions needed to achieve sustainable development by 2030. Of these goals, the most relevant to Cardiff University's Biodiversity Action Plan are:

- SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.
- SDG 13: Take urgent action to combat climate change and its impacts.
- SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

At a national level, biodiversity has been addressed through the UK Biodiversity Action Plan (BAP)[1]. BAPs followed the Articles of the CBD and included *assessments* of the state of a given biodiversity component (including accurately documenting it), identifying *critical actions* needed to improve the state of that biodiversity, over a short, medium and long timescale, *implementing* those plans and finally *monitoring* the outcomes and applying remedial actions needed. Welsh legislation confirms Wales' legal commitment to biodiversity conservation. Section 6 of the Environment (Wales) Act 2016 introduced an "enhanced biodiversity and resilience of ecosystems duty (the S6 duty)" for public authorities, which requires that they "seek to maintain and enhance biodiversity so far as consistent with the proper exercise of their functions and in so doing promote the resilience of ecosystems". To comply with the S6 duty public authorities "should embed the consideration of biodiversity and ecosystems into their early thinking and business planning… as well as their day to day activities". Cardiff University submitted its preliminary Section 6 report to Welsh Government on 20th December 2019[2] the link to the report is contained within Appendix 1.

Further, one of the seven goals of the Well-being of Future Generations (Wales) Act, 2015 is to strive for a resilient Wales: *"A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change."* Both the Environment (Wales) Act and the Well-Being of Future Generations Act frame biodiversity with respects to its contribution to achieving ecosystem resilience. Natural Resources Wales (NRW), the environmental body of Welsh Government, has developed a framework for evaluating ecosystem resilience based on five attributes, referred to as **DECCA: Diversity, Extent, Condition, Connectivity and Adaptability**. In recognition that the Welsh policy context recognizes the importance of ecosystem resilience and biodiversity as a vital component of resilience, we refer to our plan as the **Cardiff University Ecosystem Resilience and Biodiversity Action Plan (ERBAP)**. This is because in addition to biodiversity, we consider the connectivity, condition and extent of the terrestrial ecosystems across Cardiff University's estate. A brief description of NRW's attributes for considering resilience follows.

Diversity. Diversity matters at different levels and scales, from genes to species and from habitats to landscapes. It supports the complexity of ecosystem functions and the cascades of interactions that deliver services and benefits[3]. If diversity is lost, systems may deteriorate and ultimately collapse. The function of individual components of a system are also susceptible to disturbance; diversity provides redundancy of functions and enhances the capacity of the system as a whole to adapt to future change[4]. It is important to note that diversity must also be 'appropriate'; some ecosystems, e.g. peat bogs, may have relatively low diversity, but, nonetheless, the particular range of species and habitats they contain are critical for their functioning.

[1]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69203/pb12772-conbiouk-071004.pdf

[2] https://www.cardiff.ac.uk/public-information/policies-and-procedures/health-safety-and-environment/_nocache

[3] Ceulemans, R., U. Gaedke, T. Klauschies, and C. Guill. 2019. The effects of functional diversity on biomass production, variability, and resilience of ecosystem functions in a tritrophic system. *Scientific reports*, *9*(1):1-16.

[4] Byrnes, J. E., L. Gamfeldt, F. Isbell, J. S. Lefcheck, J. N. Griffin, A. Hector, B. J. Cardinale, D. U. Hooper, L. E. Dee, and J. E. Duffy. 2014. Investigating the relationship between biodiversity and ecosystem multifunctionality: challenges and solutions. *Methods in Ecology and Evolution*, 5(2):111-124.

Extent. The greater the extent of a habitat or species, the more able it will be to contain the effects of disturbance. For example, a larger area of habitat can support larger populations, which are less likely to go extinct (and potentially also have a wider genetic diversity conferring greater adaptive capacity) and are less affected by detrimental edge effects. Many species have a minimum size of habitat required to support a population, below which they may become extinct[5]. Size also influences ecological processes, for example, a raised bog large enough to support its own hydrological system is likely to be more resilient than smaller bogs.

Condition. Condition is a broad term that interacts with the other attributes. We employ it here to make a link to how a system is managed, what inputs are applied, what is taken from it, and how it is influenced by the management of the surrounding land. An ecosystem in poor condition will be 'stressed' and have reduced capacity to resist, recover or adapt to new disturbances, or to deliver ecosystem services effectively. Condition can be thought of in terms of broad ecosystem components relating to biodiversity, air, water and land. Resilience assessments therefore consider the condition of sites, including soil, air and water quality, and the impacts of major land/sea uses and industries.

Connectivity. Connectivity among habitats allows the movement within and between ecosystems of flora and fauna, nutrients, abiotic material and energy. Connecting of two or more habitat patches enables an exchange of genetic material, nutrients, goods, culture, knowledge, etc. therefore their local condition improves. Connectivity allows ecosystems to function and recover from disturbance, but it is reduced through habitat loss and fragmentation, creation of barriers, and erosion of the 'permeability' that allows movement across the landscape. In certain situations, connectivity may have negative aspects, for example, if it risks facilitating the spread of diseases, fire, or invasive non-native species[6].

Adaptability. Adaptability differs from the other attributes because it is part of the *definition* of resilience rather than an attribute that *supports* it. However, its inclusion in the Environment (Wales) Act is important because it emphasises one of the most important features of resilience: dynamism and the ability to adapt to change. This is especially relevant for climate change, which is now regarded as inevitable and during which we cannot expect to maintain the *status quo*. Instead we need to think in terms of changing species distributions, composition of ecological communities, and ecosystem functions and processes. This is where the elements of diversity, extent, condition and connectivity start to link and provide the basis for adaptation to happen. For example, maintaining diversity hotspots and connectivity between them can facilitate species' range shift[7].

[5] Harte, J., A. B. Smith, and D. Storch. 2009. Biodiversity scales from plots to biomes with a universal species–area curve. *Ecology letters*, 12(8):789-797.

[6] Gilarranz, L. J., B. Rayfield, G. Liñán-Cembrano, J. Bascompte, and A. Gonzalez. 2017. Effects of network modularity on the spread of perturbation impact in experimental metapopulations. *Science*, 357:199–201.

[7] Thomas C. D., P. K. Gillingham, R. B. Bradbury, D. B. Roy, B. J. Anderson, J. M. Baxter, N. A. D. Bourn, H. Q. P. Crick, R. A. Findon, R. Fox, J. A. Hodgson, A. R. Holt, M. D. Morecroft, N. J. O'Hanlon, T. H. Oliver, J. W. Pearce-Higgins, D. A. Procter, J. A. Thomas, K. J. Walker, C. A. Walmsley, R. J. Wilson, and J. K. Hill. 2012 protected areas facilitate species' range expansion. *Proceedings of the National Academy of Sciences of the United States of America*, 109 (35):14,063-14,068.

The adaptability of habitat patches is an outcome of their resilience. The overall adaptability of ecosystems invites specific consideration of the adaptive cycles which many ecosystems undergo – understanding that ecosystems are not static entities and will change over time. The key question is whether ecosystems will adapt and change in the desired direction given future environmental, and socioeconomic changes and demands such as climate change. Such challenges need to be addressed by active management of habitats across the University's estate, including direct habitat interventions and Systemic Design.

In addition to the NRW attributes of ecosystem resilience, the Environment Act sets out nine simple principles of sustainable management of natural resources to underpin natural resources management. Cardiff University seeks to integrate these ways of workings within the governance structure of the ERBAP. These principles are[8]:

Adaptability: plan, monitor, review and change our work as we gain a better understanding through our improved evidence. This will be done through the **annual audit** as well as the regular periods of revision of the ERBAP.

Scale dependence: take decisions and actions at the right level, from global to local. We need to work together to identify the most appropriate scale for delivering the environmental and wider, cultural, social and economic priorities and opportunities that our evidence highlights. The ERBAP creates a centralized plan of action to guide professional services and research actions involving on-the-ground decisions. To scale up actions, Cardiff University is working with other partners across the Cardiff city-region to join up our green spaces and create a more comprehensive ecological network across the city.

Working together: ensure all stakeholders can play a role in conserving and sustainably managing our natural resources through engagement in, codesigning and cocreating projects, providing evidence, and cooperating and collaborating at the local, regional and national level. The ERBAP Steering Group includes stakeholders from the University's professional services community, the student body and academics, engaging with other government bodies, including Cardiff City Council (a representative which sits on our ERBAP Steering Group) and NRW (South Central Area Statements team), as well as NGOs, other Universities in the Cardiff city-region and local communities.

Engaging with the public: ensure transparency and that local communities have an opportunity to have their say on how our natural resources should be managed. The ERBAP Steering Group plans to initiate public engagement through the organization of a workshop and other public outreach events, targeting NGOs, students and the public. Cardiff university also engages communities through citizen science projects (e.g. the Spotabee App) and will encourage participation in both monitoring and managing existing habitats.

Gaining evidence: improve our evidence base in order to increase our understanding of our natural resources, how they function and the benefits that they provide. This evidence will help us all to better

[8] Cited from https://gov.wales/sites/default/files/publications/2019-05/environment-wales-act-2016-sustainable-management-natural-resources.pdf

understand the steps that we can take to manage our estate more sustainably. A full range of evidence will be needed, not only environmental, but also, cultural, social and economic, gathered from experts, stakeholders and local communities. The ERBAP will be supported by evidence routinely collected through undergraduate courses, research projects and citizen science.

Understanding the benefits: increase our understanding of the value of our natural resources and how they support each other so that we and future generations continue to receive economic, social, cultural and environmental benefits whilst reducing our environmental impact. These objectives will be carried out through engagement of academics, future professionals and citizens, via dissemination, outreach and education.

Long term approach: the impacts of our decisions and actions need to be considered not only for their effect in the short term but also over the long-term, in accordance with the Well-being of Future Generations Act. Therefore, decisions need to be taken with long-term as well short-term benefits in mind, need to be reflexive and to evolve as conditions change. Strengthening resilience is a time-consuming process and needs to be critically evaluated at 5-year intervals or more.

Prevention: take steps to prevent significant damage of our ecosystems. The ERBAP seeks to both restore and protect our green spaces and the benefits they provide to society. To mitigate events such as accidental damage, unforeseen consequences of management actions, future scenarios will be evaluated, and contingency plans developed to prevent major negative consequences for the University's green estate.

Resilience: ensure that our decisions consider the resilience of our ecosystems and their ability to provide their benefits in the long term. This is at the heart of the ERBAP and why we consider not just the number of species we conserve, but also the extent, condition, connectivity and adaptability of their habitat. As such we need to acknowledge the specific environment that Cardiff's urban setting provides, how that varies across the University's estate and the role of social and cultural processes in forming this matrix.

With the Environment Act, the Wellbeing of Future Generations Act and the Planning Act, we in principle have a broader integrated framework for ecosystem resilience, which incorporates the application of biodiversity policy and management. This framework can be placed in the context of Natural Resource Planning and the development of 'Area Statements' by NRW for placing ecosystem resilience and biodiversity policy in a local context, and discussions have recently been ongoing with stakeholders, including Cardiff University staff, in terms of what the statements should look like. At the same time, a number of working groups have been set up to help with ideas for delivery of WG's Environment Act, including relevant ones on *Ecosystem Resilience and Restoration* and *Urban Green Infrastructure*.

While society faces a biodiversity crisis, we also face a climate emergency, which has been acknowledged by the University's Declaration of November 2019 and current work to develop our route to net zero by 2030. However, we cannot address climate change without also considering conserving and increasing biodiversity. The ERBAP seeks opportunities to conserve and promote the diversity of species on the University's estate, which can also dovetail with actions to reduce carbon

emissions and increase carbon sequestration. Within the urban environment, the conservation of biodiversity is particularly important because wildlife areas may suffer from pollution and fragmentation, so efforts should encompass the protection of remaining sites of interest for biodiversity, enhancement of sites of potential value, and the creation of new habitats. The IPBES report highlights some policy tools, options and exemplary actions in ***urban areas***, such as the promotion of nature-based solutions; increasing access to urban services and a healthy urban environment for low-income communities; improving access to green spaces; sustainable production and consumption; and ecological connectivity within urban spaces, particularly with native species. With the ERBAP, we seek to address these concerns, and by doing so, to join the rank of UK universities who have also dedicated themselves to working to halt biodiversity loss.

Cardiff University staff have worked over the last several years to improve the number of pollinators within the Cardiff urban region by installing beehives on the roof of several university buildings. However, pollinators and other wildlife require access to suitable habitat and diverse forage throughout the year in order to prosper. The ERBAP seeks to take a joined-up approach to work across University sites, with professional services, academic researchers, students, and with Cardiff City Council and other actors to create a corridor of quality green spaces across the Cardiff city region. The ERBAP will identify a series of principles to guide landscape maintenance practices and will incorporate this into the tender process. As the ERBAP develops, further locations and principles will be included in maintenance practices. Principles will include leaving designated and design spaces for wildflower meadows, reducing and eliminating the use of herbicides, surveying the tree population and using digital tools to inform species and location selection for future tree plantings, and timing of hedge clipping to consider nesting species.

Given the above, the development of the ERBAP is timely and will map onto best practice, as well as supporting Cardiff University's Environmental Sustainability Enabling Strategy[9] to achieve its underpinning goals. Many universities in the UK already have BAPs, and as such we are somewhat behind the curve. However, we have examined how these are framed within the context of each University's local environment and have developed the ERBAP by taking some of the best elements of these plans. In addition, we need to ensure that the ERBAP is consistent with Cardiff City Council's 2019 Green Infrastructure and Biodiversity and Resilience of Ecosystems Duty Action Plans[10] and that of other relevant land holders, so that we ensure we manage the University's estate in a manner consistent with council aspiration and to maintain green infrastructure in a way that enhances biodiversity and connectivity, leveraging synergistic improvements for biodiversity city-wide.

Aims

Cardiff University's ERBAP has the following general aims.

1. **Characterise**. The ERBAP will first characterise the **level and distribution** of biological diversity, measured both within species (abundance, demographic resilience, genetic diversity) and among species (community-level biodiversity for all major groups of indigenous

[9] https://www.cardiff.ac.uk/__data/assets/pdf_file/0006/1197555/SustainableStrat.pdf
[10] cardiff.moderngov.co.uk/documents/s34305/Cabinet%2026%20Sept%202019%20Biodiversity%20BRED%20App.pdf

plants and animals). The ERBAP will also characterise current status of biodiversity related **ecosystem services** across the University's estate, including levels of connectivity, green infrastructure functionality (carbon sequestration, sustainable drainage, urban cooling, air quality remediation), pollination services and cultural value. These biodiversity characteristics will first be evaluated using intensive surveys and data analysis during Year 1 of the ERBAP (2021-2022) to fully capture the annual cycle of the ecosystems within the University's Estate. Characterisation will be carried out by staff, students and local citizen volunteers and will follow Welsh legislation's DECCA (Diversity, Extent, Condition, Connectedness, Adaptability) framework. A full report will be provided at the end of Year 1.

2. **Manage**. The ERBAP will then use the data collected in Year 1 to establish the most effective management strategies for maintenance, restoration and enhancement of the University's green estate by:
    a. **Mitigation**. First, practices that negatively impact on the Estate's biodiversity and related ecosystem services will be changed and/or mitigated by ameliorative measures relevant to those practices. This will require an inventory of those practices and their consequences for the University's Green Estate during Year 1.
    b. **Restoration**. Identification of strategic habitats and functions shown in Year 1 to be in unsatisfactory condition will be targeted for restoration and/or enhancement during the period of the BAP, including a phased restoration plan around the University's Estate focusing on enhancing biodiversity under the DECCA framework.
    c. **Enhancement**. We will evaluate the University's green estate with an aim to enhance its biodiversity performance, regardless of its current status, following the DECCA framework (which includes connectivity within the Estate and with local green infrastructure). Enhancements will be phased and will involve habitat modification, including planting, removal of weeds, enhancement of native biodiversity using infrastructure and installations such as refugia, connectivity measures and introduction of new biodiversity enhancing management practices. Overall, we aim to restore and enhance the functionality and biodiversity of 30% of the University's green estate by 2023, and to have completed the process across the entire estate by 2030.
3. **Monitor**. The ERBAP will institute a rolling monitoring program that will evaluate changes and the impact of management practices on biodiversity and ecosystem services by engagement with academic and professional services staff, by educational opportunities afforded to students across all colleges and by engagement with local volunteers. Monitoring activities will be as inclusive as possible to create a 'living laboratory', thereby embedding the activities of the BAP within the University's day-to-day life and activities.
4. **Promote, Engage and Mobilise**. The ERBAP will focus on the promotion of biodiversity and the ecosystems services it produces with staff and students, including involving them in the activities described above. The ERBAP will also enhance engagement with local authorities and stakeholders with a view to making the University's green estate a focus for community activities of educational and well-being relevance. This will be realised by using the University's green estate as a focus for community interaction through co-design, co-creation, exhibitions, installations, hard landscaping and e-learning.

State-of-the-Art: Cardiff University's biodiversity and estate

Species

At Cardiff University we have to date identified eighteen species (or species groups) of wildlife and wildflower as our priorities for conservation action (Table 1). The list includes all of the Species of Principal Importance for Biodiversity (SPIBs - under Section 7 of the Environment (Wales) Act 2016)[11] which currently occur at Cardiff University, as well as the Priority Species identified in the Cardiff Local Biodiversity Action Plan, 2008 (CL BAP)[12].

In addition to this, the list also includes some species chosen by the Cardiff University Community for special attention. In January-February 2019 the Cardiff Wildlife & Cardiff Wildflowers staff group ran a consultation on Yammer about the possibility of developing a 'Wildlife & Wildflower Plan' for Cardiff University. The consultation documents were read by 308 members of staff and attracted 167 contributions. The contributors identified ten species (or species groups) of wildlife and wildflower as community priorities for conservation action at Cardiff University.

Also included in the list are several sensitive groups identified from records as present on university grounds, warranting their prioritisation in ongoing management plans. These records were made by members of the Biodiversity Action Plan Working Group and, as described in detail below, by assimilation of recent historical records of the extant flora and fauna through iRecord. The conservation of these groups is largely achievable in parallel with existing aims relating to the other priority species.

We acknowledge that for some of the species on the following list (e.g. black redstart, tree sparrow) it may not be possible to improve numbers, as their absence relates to ecological factors that extend beyond Cardiff University's ability to influence. However, there are many other species on the list (e.g. finches, warblers, raptors, other thrushes) that are known and commonly visit the site and the numbers of which we expect to enhance through targeted actions.

Table 1. Species and species groups identified to date as priorities for conservation action and management.

[11] https://www.biodiversitywales.org.uk/Environment-Wales-Act
[12] https://www.outdoorcardiff.com/wp-content/uploads/Cardiff-LBAP-2008.pdf

Cardiff University Priority Species						
#	Common name	Species name	Species of Principal Importance for Biodiversity	Cardiff Local Biodiversity Action Plan	Cardiff University Wildlife & Wildflower Plan	Status at Cardiff University in 2020
1	Slow worm	*Anguis fragilis*	yes	yes	yes	Present at one site
2	Common pipistrelle	*Pipistrellus pipistrellus*	yes	yes	yes	Use at least three sites
3	Newts	*Lissotriton vulgaris; L. helveticus; Triturus cristatus*	yes	yes	yes	Not recorded
4	Black-headed gull	*Larus ridibundus*	yes	yes	no	Present at one site
5	Herring gull	*Larus argentatus* subsp. *argentatus*	yes	yes	no	Present at several sites
6	House sparrow	*Passer domesticus*	yes	no	no	Present at several sites
7	Cinnabar moth	*Tyria jacobeae*	no	yes	no	Breeds at two sites
8	Hedgehog	*Erinaceus europaeus*	yes	no	yes	Uses at least three sites, may breed
9	Swift	*Apus apus*	no	no	yes	Breeds at one site
10	Tawny owl	*Strix aluco*	no	no	yes	Uses one site
11	Garden birds	Incl. *Prunella modularis, Turdus philomelos, Sturnus vulgaris,*	yes	no	yes	Present at most sites
12	Pollinators	Incl. *Spilosoma lutea, Malacosoma neustria*	no	no	yes	Present at most sites
13	Bluebell	*Hyacinthoides non-scripta*	no	no	yes	Present at four sites
14	Welsh daffodil	*Narcissus pseudonarcissus*	no	no	yes	Not recorded
15	Soil fauna/flora	Incl. Acari, Trichoniscidae, various Coleoptera, Chilopoda, Fungi	no	no	no	Present at all sites
16	Veteran trees	Incl. *Quercus spp.*, *Fagus sylvatica*, *Fraxinus excelsior*	yes	no	no	Present at several sites
17	Saproxylic fauna/flora	Incl. Lucanidae, Syrphidae, Fungi	no	no	no	Present at some sites
18	Moths	Var. Lepidoptera	no	no	no	Present at all sites

Habitats

As well as our priority species (or species groups) we have also identified five priority habitats (Table 2). The first four of these are all Habitats of Principal Importance for Biodiversity under the Environment (Wales) Act 2016 (HPIBs) as well as Priority Habitats under the 2008 Cardiff Local

Biodiversity Action Plan (CL BAP) and were independently also chosen as priorities by the Cardiff University Community in the 2019 Wildlife & Wildflower Plan. The fifth, veteran trees, was selected given its provision of several key microhabitats on which a large contingent of EU red-listed species, mostly saproxylic beetles, depend; several similar beetles have been recorded on university grounds, very likely depending on the existing provision of these microhabitats.

Table 2. Habitats identified to date as priorities for conservation action and management.

Cardiff University Priority Habitats					
#	Common name	Habitat of Principal Importance for Biodiversity	Cardiff Local Biodiversity Action Plan	Cardiff University Wildlife & Wildflower Plan	Status at Cardiff University in 2020
1	Lowland neutral grassland meadow	yes	yes	yes	Currently c.2,475m^2 across eight sites. All converted from improved grassland, but with some remnant and several colonising species.
2	Ponds	yes	yes	yes	Currently only one mini-pond across all sites, but another pond was historically present.
3	Lowland mixed deciduous woodland	yes	yes	yes	Around 9,000m^2 across three sites.
4	Hedgerow	yes	yes	yes	Over 3km present across several sites.
5	Veteran trees	yes	no	no	At least three sites containing veteran trees.

Our priority species and habitats are spread across the University campus. In Table 3 we indicate the diversity and extent of our key sites with some comments on condition and connectivity where known. The species are not shown at site level in order to protect their location. It is worth noting that these values and statements are approximate and will require further survey during the ERBAP's first stage (characterise). The grey lines in Table 3 state the aspirations for each site: these may be subject to change based on the outcome of data collected in Year 1. Characterization of each site will then to be used to establish the most effective management strategies for maintenance, restoration and enhancement of the University's green estate, and the aspirations may be revised at that time.

Table 3. Key sites for biodiversity across Cardiff University's estate, including DECCA commentary. Determination of species poor or species rich status was determined based on training from National Trust[13]. In the training document, key 2a states: "Species poor areas are dominated by ryegrass and usually have poor biodiversity. Semi-improved areas have less ryegrass and a few species. Species rich

[13] http://www.magnificentmeadows.org.uk/assets/pdfs/How_to_identify_different_types_of_grassland.pdf

areas have 15+ vascular plants, or more than 30% flowering plant coverage present and little ryegrass."

Cardiff University Sites Site	**Meadow**	**Ponds**	**Woodland**	**Hedgerow**	**Priority Species**
Sports Fields	1,030m^2 Species Poor	mini		870m Connected	10
Sports Fields 2023 Aspiration	*530m^2 Species Poor*	*mini*		*870m Connected*	*7*[14]
University Hall	68m^2 *Species Poor*	previously	8,200m^2 Connected	580m Connected	6
University Hall 2023 Aspiration	*418m^2 Semi-Improved*	*yes*	*8,200m^2 Connected*	*580m Connected*	*10*
Redwood	c538m^2 Not surveyed				5
Redwood 2023 Aspiration	*c538m^2 Species Rich*	*yes*		*yes*	*7*
Talybont North	420m^2 Species Rich		300m^2 Connected	610m Connected	5
Talybont North 2023 Aspiration	*420m^2 Species Rich*		*300m^2 Connected*	*610m Connected*	*5*
Talybont South	85m^2 Species Poor			450m Connected	5
Talybont South 2023 Aspiration	*85m^2 Species Rich*			*450m Connected*	*5*
Cartwright Court	216m^2 Species Poor		350m^2 Connected	370m Connected	5
Cartwright Court 2023 Aspiration	*216m^2 Species Rich*		*350m^2 Connected*	*370m Connected*	*5*
Bute Building	no				3
Bute Building 2023 Aspiration	*500m^2 Species Rich*			*yes*	*5*
Trevithick Building	0			yes	0
Trevithick Building 2023 Aspiration	*400m^2* Species Rich			*yes*	*5*
Cubric	No			yes	2
Cubric 2023 Aspiration	*250m^2 Species Rich*			*yes*	*5*
Main Building				300m Connected	3
Main Building 2023 Aspiration				300m Connected	3
Hadyn Ellis	70m^2 Semi-Improved				3
Hadyn Ellis 2023 Aspiration	*70m^2 Semi-Improved*				*3*
Remembrance Garden					3

[14] The Sports Fields is due to undergo major redevelopment in 2021. Our hope is to retain much of the biodiversity.

Remembrance Garden 2023 Aspiration					*3*
5-7 Corbett Road				50m Not connected	2
5-7 Corbett Road 2023 Aspiration				*50m* *Not connected*	*2*
Senghennyd Court	76m^2 Species Rich				2
Senghennyd Court 2023 Aspiration	*76m^2* *Species Rich*				*2*
Roy Jenkins					2
Roy Jenkins 2023 Aspiration					*2*
Gordon Hall				80m Not connected	1
Gordon Hall 2023 Aspiration				*80m* *Not connected*	*1*

Although much work has already been done to identify areas of biodiversity importance and to map areas of important green infrastructure across the University's estate, it is recognised that the ERBAP need to build on this work. Further work is needed to **characterise** both the faunal and floral diversity present across the University's estate by surveying sites in detail throughout the year. The ERBAP will implement these surveys during 2021, deploying Professional Services staff, Academic staff and students in a systematic way. Quarterly surveys will be carried out for all green infrastructure sites identified around the University in 2019 by the Dean and colleagues, not only those identified above. The surveys will be carried out as described in the ERBAP section below.

Local context and activities

Cardiff City Council

Cardiff University is based largely within the city centre, in diverse locations featuring a wide variety of built infrastructure, green spaces and usage patterns by University staff and students and the public. This makes green infrastructure management challenging and highly context specific. In the context of DECCA, it also means that the University's patches of green estate cannot be seen in isolation, either in its own right, or within this context of the green estate which is present adjacent and close to the University, management of much of which is the responsibility of Cardiff City Council. The Council recently produced a new Green Infrastructure (GI) and a Biodiversity and Resilience Ecosystems Duty (BRED) Forward Plan (2019)[15] and the University's ERBAP is very much contextualised by these documents. The GI Plan has the aim to produce "*multi-functional, connected green spaces that make the best use of land - at the same time providing green open space for all, helping wildlife to flourish, and delivering a wide range of economic, health and community benefits*." The BRED Action Plan is positioned to "*deliver the objectives of the Green Infrastructure Plan as well as those of the Nature Recovery Action Plan (2015*)."

The overall vision of these plans is that *'Cardiff's distinctive natural heritage will provide a network of Green Infrastructure which will be protected, enhanced, developed and managed to ensure that its integrity and connectivity is sustained for the economic, social and environmental benefit of the City and the Region.*' It is clear that Cardiff University's estate, especially that located within the Cathays Park site and surroundings is therefore of extreme importance for Cardiff City Council to achieve this

[15]https://cardiff.moderngov.co.uk/documents/s34305/Cabinet%2026%20Sept%202019%20Biodiversity%20BRED%20App.pdf

vision and as such we must work in close collaboration with the Council to ensure our ERBAP activities are consistent with this vision and with direct management activities carried out by the council. At the same time, Cardiff University employs >6,600 staff and has >33,000 students, all of whom are, at some time or other, users of the city's green infrastructure and facilities, and who stand to benefit substantially by a joined-up approach to green space and biodiversity management in their surroundings.

Cardiff City Council's GI Plan is framed explicitly within the concept of resilience identified in the Well-being of Future Generations Act, and this is a major reason why the University's ERBAP is also framed in this way. Among other policy drivers, the Council's Plan also acknowledges the role of Natural Resources Wales' Area Statements activity, which are intended to help facilitate the sustainable management of Wales' natural resources. Cardiff City Council and all of Cardiff University's estate are situated within the South-Central Area Statement boundary[16]. Its six main objectives include *protection and enhancement of Cardiff's ecosystems to ensure that they continue to support diverse habitats and species, allowing them to adapt to change* (Objective 1). This includes the following activities:

1. Mapping of ecosystems, and preparation and implementation of management plans for specific ecosystems;
2. Delivery of city-wide and cross-boundary initiatives including projects to support removal of invasive species, increased planting of pollinators and protection of endangered habitats and species;
3. Ensuring ecosystems are resilient, in terms of their extent, diversity, connectivity and condition (DECCA)
4. Provision of ecosystem corridors in new and existing developments
5. Ongoing work with volunteers to improve local biodiversity
6. Monitoring and recording of species and habitats
7. Provision of information and training for volunteers and local people.

The other objectives include: management of green infrastructure to enhance climate resilience and provides protection to people and places (including flood management, provision of shade and other microhabitats, sustainable urban drainage and monitoring climate change impacts on green infrastructure); supporting the local economy and tourism, providing benefits for physical and mental health by improving, promoting and creating connected, multi-functional green infrastructure; enabling citizens to participate in learning, training and volunteering to foster social inclusion and equality and improve life chances; to enhance Cardiff sense of place – Cardiff is already known as one of Europe's greenest cities and the GI Plan seeks to enhance this heritage.

The BRED Action Plan aims to bring the general activities in the GI Plan to bear on the objectives of Welsh Government's Nature Recovery Action Plan (NRAP), which include "*Safeguarding species and habitats of principal importance and improving their management*"; "Increasing the resilience of our natural environment by restoring degraded habitats and creating habitats"; "Tackling key pressures on species and habitats" and "improving evidence, understanding and monitoring". A large number of activities are envisaged as part of a "Greening the City" plan, which is embedded in the GI Delivery Plan 2019-2022. Although many of these are site-specific, they include general objectives to map GI-based ecosystem services, development of a Green Lane network plan, installation of wildlife explorer trails across the parks system, installation of interpretation boards, and development of park management plans. Overall, there is an aim to increase tree canopy cover from 19% to 25% by 2030,

[16] https://naturalresources.wales/about-us/area-statements/south-central-wales-area-statement/introduction-to-south-central-area-statement/?lang=en

form a Local Nature Partnership (now formed, see below), and produce a local Nature Recovery Action and a Pollinator Plan for the city.

It can be seen that the above objectives map very well with the objectives of the University's ERBAP. However, to ensure ERBAP activities are consistent with Cardiff City Council's GI and BRED Plans in both a spatial and temporal manner, specific joined up thinking and activities are required. Direct co-working opportunities need to be identified, resourced, managed and monitored. To enable these activities to be identified and developed, a member of Cardiff City Council currently sits on the ERBAP Committee (Cardiff Council, Conservation Officer) and a member of the University sits on the Cardiff Local Nature Partnership (LNP) steering committee (Dean of Environmental Sustainability). The LNP steering committee comprises representatives from local government, NRW, a variety of NGOs, Cardiff Civic Society and actors such as the University. Collaboration is at an early stage, but we are already engaged in discussions around, for example, the design and management of green space south of the University's Main Building and the potential deployment opportunities for Cardiff University students in LNP activities for projects and as volunteering posts.

Natural Resources Wales
NRW's South Central Area Statement works at a wider spatial scale and has, among its main objectives, the aim to build resilient ecosystems, connect people with nature, improve health and improve air quality. The team is aware of the development of the University's ERBAP. Under the Building Resilient Ecosystems theme, urban ecosystems are a priority and working through Local Nature Partnerships, Public Authorities and Public Service Boards, the Area Statements team will provide advice to stakeholders with developing their evidence base, understanding ecological networks at a wider spatial scale for synergistic planning and will develop resilience based area plans.

Pharmabees
The award winning Pharmabees project traces its roots back to Dr Jenny Hawkins, a former student of the School of Pharmacy who in 2015 completed a PhD entitled 'Apothecary Bee's, using the bee as a tool for drug discovery'. Jenny discovered a 'super honey' from Tywyn in North Wales which killed hospital superbugs and determined that this activity was due to specific plants the bees visited during foraging. To recreate super honey, beehives were installed on the roof of the Pharmacy (Redwood) Building and Tywyn plants were planted to provide the 'super' food for the bees[17].

Using the experience from the Redwood Building, Pharmabees engaged with the wider University resulting in the installation of hives and bug boxes on more University buildings. A collaboration with the charity Buglife resulted in planting of a wildlife meadow at the Redwood Building which developed into a memorial garden (in commemoration of Prof Chris McGuigan) with a grass free lawn. In 2016 this gained a Green Flag Community Award, which has been awarded annually since as the site has developed.

Pharmabees is also closely aligned with two of the "Flagship" projects; Caer Heritage who plan to install an apothecary garden at their site and Grangetown Community Project who have installed a pollinator friendly community garden and are in the process of seeding a wildflower meadow. These collaborations continue to evolve.

In 2018, in collaboration with the Student Union Wildlife and Conservation Society (WildSoc) gained funding from Grow Wild to establish 10 pollinator friendly areas across the estate. The newly created gardens cover the whole of the Cardiff University site, with planting on the Sports Fields; the Health Park Campus; the Queen's Building Site; the Cathays site and the new Maindy Road site. The project

[17] https://youtu.be/tQctVn4QQQU

culminated with a talk from the prestigious academic Professor David Goulson who is one of the foremost bumblebee researchers. The project engaged in the region of 500 people from within and around Cardiff University. There are now 10 areas that can be further developed over the next few years with the involvement of staff and student societies.

Interest came from beyond the university campus, resulting in engagement on biodiversity, antibiotics and antibiotic resistance with 12 secondary schools, 30 primary schools as well as six community projects in South Wales and overseas. This enabled the development of structured evidence-based engagement with schools, campus and community. The team has evidenced increases in knowledge and understanding which highlight positive behavioural and value changes relating to biodiversity, bees, the environment, science and wellbeing. To engage with communities on the importance of this work, a website was created highlighting how university research is having a real-world impact and how the public can contribute[18]. The website hosts a link to spin-out the citizen science project 'spot-a-bee' in which the public use mobile phones to upload images of bees and plants onto google maps to build a map of bee friendly plants in Cardiff. So far there have been over 5000 entries, with some from as far as California and Angola. Pharmabees is looking to link the apps output with national databases and to use the data as a planning tool to identify urban areas which are in need to plants and to monitor the impact of climate changes on flora and fauna. Further engagement with schools and university students is planned.

The Pharmabees project is now recognised as part of the University's Environmental Sustainability Strategy. Over 1,000m^2 of pollinator friendly, carbon-sequestering plants have been planted at the university. The University was also awarded Bee Friendly Status by the Welsh Assembly Government. In 2017 the project received a number of national awards which included sustainability awards from the Guardian and Sustain Wales. The project has engaged with a diverse range of organizations such as community gardens, schools, industry, health boards, Welsh Assembly Government and the Women's Institute.

The project has also enhanced links with partner organizations from across South Wales to enrich the biodiversity of green spaces beyond the confines of the University and to encourage more engagement and pollinators across the region. They co-created bee-friendly, plant-rich environments to make the University and Cardiff a better place to work and live. In addition to this, they are currently running a wildflower seed mix project in three areas of Cardiff in which they are asking the public to grow our experimental mix of wildflower seeds at home and record the insects that visit them. The wildflower seed mix will also be used to create a wildflower meadow at a Grangetown site. Local residents and schools will monitor growth and insect visits.

These developments led to the co-creation of wellbeing space with health boards. Wellbeing space at Llandough Hospital was recently cited as an example of good practice by the Auditor General for Wales. A project at Ystrad Mynach hospital looks to measure the impact of spending time in green spaces on personal wellbeing. Increased engagement with Welsh Government led to Pharmabees curating a conference on behalf of the Welsh Assembly Government Pollinator Action Group entitled 'Bee Well Cardiff, Joining the Dots'.

Cardiff University Meadow Areas

Over the last five years, nine meadow areas have been created on campus by the Cardiff University Grounds Maintenance Team (SPORT) and Pharmabees in collaboration with Residences, Estates, and WildSoc. The seeds used were provided by Buglife's Urban Buzz project and the Kew Gardens Community Gardens project. The meadows are all on neutral soil and all were planted with exclusively

[18] https://www.cardiff.ac.uk/pharmabees

native and archaeophyte species. The predominant species planted were ox-eye daisy, wild carrot, yarrow, salad burnet, knapweed, meadow buttercups, bird's foot trefoil and red and white clover. Some meadows have established or recruited less common plants, including tufted vetch, perforate St John's wort, yellow rattle, wild arum, lesser celandine, common centaury, fox-and-cubs, musk mallow, and lady's and hedge bedstraw.

In addition to this, 4,300 native bluebells were planted across five sites to provide a seed bank for the future (previously the native bluebell was extinct on campus). These meadow areas were all previously lawn areas (improved or semi-improved grasslands) and are now being managed as meadows as part of Cardiff University's grounds contract. Fifty viper's bugloss plants were cultivated from seed and introduced in 2019 based on guidance from Pharmabees pollen research. These have become established on at least two sites.

The Cardiff Wildlife and Cardiff Wildflower (CWCW) Staff Group

The Cardiff Wildlife and Cardiff Wildflower (CWCW) Staff Group is part of Cardiff University's private Yammer network, which is open to all members of staff at Cardiff University. The group was created in 2018 and currently has around 400 members (310 of whom have been active on the group within the last year). The purpose of the group is to share knowledge and enthusiasm about Cardiff University's biodiversity, and local environmental projects. There is an average of one post a week, usually photographs or videos of wild animals and plants taken on the University grounds, or other local initiatives, petitions and offers.

In January 2019, to celebrate the CWCW Staff Group reaching 250 members, the group ran a survey to select priority species and habitats for Cardiff University to work towards protecting (see Table 1 above). The results of this survey were developed into a Cardiff University Wildlife and Wildflower Plan, which was one of the starting documents presented to the ERBAP Steering Group at the start of its tenure.

Governance and decision making

The ERBAP is currently managed by a Steering Committee, which has been constituted since August 2019. This committee and its remit arose from the University's Environmental Sustainability Enabling Strategy 2018-2023, which included a priority "*To enhance the biodiversity of our campus by promoting pollinator planting across our green spaces*" as part of the goal of Underpinning a Resilient University. Four biodiversity Objectives were outlined under this priority:

1. Linking with the Well-being strategy to develop a community garden and food growing space;
2. Expanding the Welsh Government Pollinator friendly initiative across University buildings;
3. Building partnerships with our neighbours to develop biodiversity corridors across the city;
4. Continuing creation of wildflower/bee friendly planting around University campuses.

The Committee is currently comprised of members of Academic Staff: Prof Michael Bruford (Dean for Environmental Sustainability as Chair), Prof Steve Ormerod (BIOSI), Prof Les Baillie (PHRMY), Dr Angelina Sanderson-Bellamy (PLACE/BIOSI), Dr Marie Davidova (ARCHI); postgraduate students: Jordan Cuff and Maximilian Tercel (BIOSI); Student Union Ethical and Environmental Officer: Julia Komar; Professional Services Staff: Justine Jenkins (PHRMY as secretary), Katrina Henderson (SSWEL), Lee Raye (CSERV), Andrew Thompson (ESTAT), Chris James (ESTAT); and a representative of Cardiff City Council: Nicola Hutchinson (Conservation Officer). Currently the group reports on an *ad hoc* basis to the Environmental Management Systems (EMS) Steering Group, a subcommittee of the Health Safety and Environment Committee of the University but has not yet been formally constituted within the University's committee reporting structure, nor have general principles regarding membership been established. The ERBAP team has been meeting approximately monthly to discuss the

development of the ERBAP itself, relevant activities in and around the University's estate, partnership activities, resourcing and infrastructure.

It is suggested that the ERBAP Committee **formally reports to the EMS Steering Group** when it sits and that as part of the ERBAP, the Committee **formally reviews membership**, including **criteria**, **balance** (currently there are no formal undergraduate student members, or members of the local community) and **how decisions are formally taken** (currently via *ad hoc* consensus) prior to submission to the EMS Committee for approval. These governance issues are important as the ERBAP will require resourcing from the University and external funders to implement its recommendations.

Chapter 2: Actions

Production of the Ecosystem Resilience and Biodiversity Action Plan

This ERBAP has been produced collaboratively by members of the Steering Committee, for discussion, modification and ultimately recommendation by the University Executive Board and Council. It is recognised that a period of consultation will be required by the University and Stakeholders to assess the actions recommended. The timescale of the current ERBAP follows the current University Way Forward period (i.e. from 2021 to 2023), although some of the recommendations extend beyond the current Way Forward document period, until 2030, to align with the University's Climate Emergency Declaration, the UN's Sustainable Development Goals and the Council's tree canopy cover target.

Appointment of a Biodiversity Officer

A central recommendation of the ERBAP is the appointment of a Biodiversity Officer for the University. The role and job description are described below. We suggest a mid-Grade 5 (Spinal point 25: £38,704 in year one) Professional Services position, costed for 3 years in the attached spreadsheet (here at 28/35 hours). Role criteria are detailed in the attached job specification. The responsibilities of the role would be to:

- Oversee habitat improvements delivered as part of the University's ERBAP.
- Lead the maintenance of Cardiff University's existing high-value biodiversity areas.
- Take responsibility for the monitoring of priority species on Cardiff University sites and ensure species data are digitised in a suitable database for future researchers and reported to the South East Wales Biodiversity Records Centre.
- Maintain detailed records of all biodiversity projects including GIS maps, project proposals, risk assessments and photographs.
- Produce management plans as required to support biodiversity-friendly management of sites.
- Act as a first point of call for biodiversity queries / projects.
- Run volunteer planting & monitoring events on campus for volunteer students and staff.
- Help to apply for project funding and environmental prizes.
- Keep in contact with the environmental site portering, and grounds maintenance teams.
- Liaise with the press office to share important news and photographs and support external communication.
- Liaise with partners at Cardiff City Council, the Local Nature Partnership and Natural Resources Wales and support engagement with stakeholders and the wider community.

Resourcing strategy

It is recognised that implementing the ERBAP will require additional resources of a direct financial, human and infrastructural nature. Therefore, a resourcing strategy is required to implement the ERBAP. In additional to internal resources that may come directly from those provided to the Estates

department (e.g. for ground management and enhancement), educational and volunteering activities (via students and staff) and from School activities, the University is eligible for external funding to help enhance the green infrastructure, enable local stakeholder engagement via citizen groups, schools and as members of the Local Nature Partnership. The funding already attracted by the Pharmabees project is testament to availability of external resources if sound projects and programmes are developed. External funding applications are already in development by members of the ERBAP committee from academic and other sources, and currently external funding opportunities are being identified, monitored on a monthly basis and prioritised for application. However, the success of this approach is contingent on the time and availability of members of the committee and others to develop proposals. The appointment of a Biodiversity Officer would significantly enhance this activity and enable external funds to be leveraged more efficiently to reduce future costs of the ERBAP and even generate research income.

Chapter 3: Action Plan

Species and Community Biodiversity Plan

The ERBAP's central Aims are described above but summarised here.

1. Characterise the level and distribution of biological diversity, measured both within and among species and the current status of biodiversity related ecosystem services across the University's estate. These will first be evaluated by intensive surveys and analysis during Year 1 of the ERBAP (2021-2022).
2. The data collected in Year 1 will be used to establish the most effective management strategies for maintenance, restoration and enhancement of the University's green estate by mitigation.
3. Strategic habitats and functions identified in Year 1 to be in unsatisfactory condition will be targeted for restoration and/or enhancement, including a phased restoration plan around the University's Estate focusing on enhancing biodiversity under the DECCA framework.
4. We will evaluate the University's green estate with an aim to enhance its biodiversity performance, regardless of its current status. We aim to restore and enhance the functionality and biodiversity of 30% of the University's green estate by 2023, and to have completed the process across the entire estate by 2030.
5. A rolling monitoring program will be implemented to evaluate changes and the impact of management practices on biodiversity and ecosystem services. Monitoring activities will be as inclusive as possible to create a 'living laboratory', thereby embedding the activities of the ERBAP within the University's day-to-day life and activities.
6. The ERBAP will focus on the promotion of biodiversity and the ecosystems services it produces with staff and students, local authorities and stakeholders. It will use the University's green estate as a focus for community interaction.

Review of other Biodiversity Action Plans

We first carried out a review of the available BAPs across the Russell Group, Welsh Universities and local authorities to establish the scope of these documents and to benchmark best practice across relevant sectors. In the Russell Group, BAPs have been produced by Bristol, Durham, Exeter, Glasgow, Leeds, Liverpool, Newcastle, Nottingham, Oxford, Sheffield, Southampton, UCL, Warwick and York. Particular attention was paid to GW4 universities Bristol and Exeter. For Welsh HEIs, BAPs have been produced by Aberystwyth, Bangor, Swansea, South Wales and Wrexham-Glyndwr. BAPs have also

been produced by Cardiff City Council (superseded by the GI and BRED plans described above), Bristol Council and we also examined Bridgend's Plan. We identified the key elements of these plans with special reference to the HEI sector (Table 4) and mapped these onto Institutional plans to see what aspects are commonly included and to identify Best Practice.

Table 4. Key elements of Higher Educational Institution Biodiversity Action Plans

	Russell Group (with plans)	Welsh HEIs (with plans)
Legislative Framework	8	1
Global narrative	3	2
Local (including University) narrative	5	3
Environmental Association of Universities and Colleges (EAUC) policy	1	0
Survey of competitors	1	0
Estates Plan		
Management1	9	1
Mitigation2	2	1
Restoration3	1	0
Monitoring4	5	3
Green Infrastructure / connectivity / spatial plan	4	0
Maps including habitats	7	4
Environmental Management Systems 14001 compliance	1	2
EcoCampus Bronze, Silver, Gold, and Platinum Awards (Cardiff University currently holds the platinum award)	0	1
Green Impact	7	2
Building Research Establishment Environmental Assessment Method (BREAAM)	1	0
Green Flag	2	1
Edible campus	1	0
Institutional decisions and governance	1	0
Biodiversity Officer / coordinator	1	0
Funding strategy	2	0
Annual survey / bioblitz	1	0
Species Plans	3	1
Publication of a biodiversity report	2	0
Awareness raising / communications	3	1
Action Plan (timebound)	7	2
Local Partnerships	5	0
Education Plan (including Teaching and outreach)	1	0
Student body involvement	4	0
Staff involvement (volunteering)	4	0
Healthy living (mindfulness, gardens)	1	0

Best Practice

Relatively comprehensive documents have been produced by **Exeter (Penryn campus**, this is, however, a very estates-driven report), **Glasgow** (possibly the most comprehensive which combines most potential facets of what a University BAP could include), **Leeds** (a very academic document, and has almost no estates component), **Nottingham** (solely estates driven, to the extent that academics and students have not been involved at all), **Sheffield** (also very estates-driven), **Swansea** (quite

comprehensive, but perhaps more academically driven) and **UCL** (very estates-driven). This document therefore aims to take the best elements of these Plans to produce a comprehensive ERBAP based on best practices.

One aim of the ERBAP is to conserve the Priority Species at Cardiff University through proper management of our Priority Habitats (especially where the priority species are known to occur, Table 5). The plan also aims to put into place monitoring procedures for our priority habitats and species. The ERBAP will also institute a comprehensive characterisation program to revisit all sites and habitats on the University's green estate.

Table 5. Threats facing priority species

Threats facing our Priority Species			
Priority Species	**International Threats according to IUCN**	**National Threats**	**Local Threats (those relevant to Cardiff University populations have asterisks*)**
Slow worm	Agricultural intensification, residential development, fires, forestry.	Loss of habitat, predation	Roadkill, loss of field margins, hedgerows, meadows*, rough grassland*, residential development*, human disturbance*, predation*
Newts	Pollution of water, loss of ponds, introduction of fish	Habitat loss, intensification of farming	Predation*, loss of ponds*
Tawny owl	Loss of woodland, pesticide use, traffic, powerlines	Vole population	Loss of woodland*, use of pesticides*, traffic*, powerlines*, presence of voles*
Black headed gull	Disease, oil spills, pollution	Predation	Disease*, predation*, pollution
Herring gull	Disease, oil spills, pollution, wind farms	Decrease in waste food available, predation	Disease*, decrease in waste food*, predation*, pollution
Swift	Residential development, re-roofing or demolition	Refurbishment of buildings	Building renovation*, disturbance*, demolition*, international factors
Garden birds	Loss of invertebrates, intensification of agriculture, loss of hedgerows, scrub and grassland, soil drainage, pesticides, climate change	Agricultural intensification (loss of food), use of pesticide	Loss of wildflowers*, use of pesticides (esp. slug pellets)*, intensification of agriculture, pollution*, climate change*

Pollinators	Intensification of agriculture, pesticide use, loss of wildflowers, invasive species, disease, climate change	Land use intensification, loss of habitat, disease, use of pesticides, climate change	Use of pesticides*, disease*, climate change*, loss of habitat*, intensified land use
Hedgehog	None	Habitat loss, intensification of agriculture, prey availability, road kill, predation	Agricultural and residential development*, road kill*, bonfires
Pipistrelle	Persecution, disturbance, building renovation	Refurbishment of buildings, disturbance	Climate change*, residential development/ renovation*, roads*, disturbance*
Bluebell	-	Destruction of woodland, collection in wild, hybridisation with Spanish bluebells	Destruction of woodland*, change in management*, regular mowing*, trampling*, collection*, introduction of Spanish bluebells*
Welsh daffodil	-	Agricultural intensification, poor management	Agricultural intensification, poor management*
Soil fauna/flora	Habitat quality erosion, agricultural intensification, land use change	Habitat quality erosion, agricultural intensification, land use change	Agricultural intensification, use of pesticides*, pollution*, land use change*
Veteran trees	Deforestation, agricultural intensification	Deforestation, agricultural intensification	Agricultural intensification, destruction of woodland*, change in management*
Saproxylic fauna/flora	Habitat loss, land use change, over management	Habitat loss, land use change, over management	Agricultural intensification, destruction of woodland*, change in management*, reduced habitat connectivity*
Moths	Climate change, deforestation, agricultural intensification, habitat loss, land use change	Climate change, deforestation, agricultural intensification, habitat loss, land use change	Deforestation, agricultural intensification, light pollution, habitat loss, land use change

Monitoring Strategy

An ideal monitoring strategy has been devised to account for the broadest feasible taxonomic range of flora and fauna. Efforts will be made to implement as many of these strategies as necessary to fully characterise the biodiversity of Cardiff University under the constraints of the available expertise, material, labour and permissions (i.e. licenses). Monitoring will account for temporal and spatial

variation in diversity across all university grounds. Material will need to be collected regularly, preserved and subsequently identified for characterisation of extant invertebrate fauna, whereas vertebrates, plants and fungi can be surveyed and recorded without collection. Surveys of groups requiring highly specialist taxonomic knowledge will be restricted by the availability of relevant expertise for the necessary identifications. For longevity, these surveys can be incorporated into teaching practices in the School of Biosciences and any other relevant university schools where possible. The surveys will comprise various techniques employed at regular intervals depending on the labour and potential ecological disruption associated with each:

Microhabitats:

- Visual surveys of sites have already been initially conducted and can be updated as management reform continues.

Invertebrates:

- **Ground-running invertebrates** – Pitfall traps (buried cups with mesh covering and lid to prevent rodent entry and rainfall) and vacuum sampling will be carried out for ground-running diurnal and nocturnal invertebrates.
- **Flying invertebrates** – Sticky/Malaise/Interception traps will be employed as appropriate depending on footfall, access and habitat structure. Charismatic fauna such as butterflies will be photographed and initiatives such as the Big Butterfly Count encouraged on university grounds.
- **Light-attracted nocturnal species** – Light trapping is already being conducted across Cardiff by Cardiff University staff and students and will be implemented on university grounds.

Vertebrates:

- **Mammals** – Camera traps and Longworth traps will be used, subject to appropriate licenses, expertise and presence of shrew holes.
- **Bats** – Bat detectors/stationary bat detectors will be used, particularly in sites thought to contain bats.
- **Birds** – Dawn chorus surveys for songbirds and visual surveys for larger birds including gulls, particularly herring gulls, will be employed.
- **Hedgehogs/small mammals** – Footprint tunnel surveys and torching (in line with hedgehog friendly campus accreditation) will be used, subject to appropriate licenses.
- **Reptiles** – Refugia surveys are already being carried out on the most appropriate sites and will be sustained, with additional surveys considered where suitable habitat arises.
- **Amphibians** – No ponds are currently present, but once established, torching, spawn counts/searches and bottle traps will be used, subject to appropriate licensing (although no Greater Crested Newts have been recorded so far on university grounds).

Flora/Fungi:

- **Wildflowers** – Full site surveys have been previously conducted. Visual/photo surveys with additional full site surveys will be carried out.
- **Ground vegetation** – Visual/photo surveys will be carried out.
- **Trees** – Visual/photo surveys will build upon the current extent of cataloguing, which has already characterised a large contingent of the floral biodiversity.
- **Fungi** – Visual/photo surveys will be carried out.

To supplement these surveys, historical records across university grounds have been and will continually be collected from the widely used natural recording site/app iRecord, using the "activity" functionality. These records have been compiled for all Cardiff University grounds, with several species included in these records contributing to the development of the priority species list for future management above. "Bioblitz" activities will be encouraged to increase the rate of recording on university grounds, particularly by groups and individuals with expert knowledge of specialist taxonomic groups.

The following section presents the specific plan for each of the identified priority species for conservation and enhancement.

Species Targets

Slow worms

1. Initial characterisation study.
2. By the start of 2021 we will have set up a staff-run slow worm monitoring program.
3. By the end of 2021, we will have set up a cat-deterrent system (e.g. a proximity buzzer), to ensure that cats do not decimate the slow worm population.
4. By the end of 2022 we will have erected a warning sign on each site where this species is present to prevent disturbance.
5. By the end of 2023, we will have created an environmental assessment and mitigation protocol, to be followed if the university needs to develop any environmentally sensitive areas based on urban prototype testing.
6. By 2023 we will have converted an additional 1,000m^2 into meadowland. This will be half done by 2022.

Newts

1. Initial characterisation study
2. By the end of 2020 we will have renovated the pond at University Hall and created an amphibian and reptile hibernaculum nearby.
3. By the end of 2023 we will have created a large central university wildlife pond by main building. The pond will be designed to exclude fish and provide shelter for amphibians. This will be supported by a transdisciplinary co-created design, that can be achieved through stakeholder engagement and via undergraduate and master programs.

Tawny owls

1. By the end of 2021 we will have put in place a Dusk Survey program to check for the presence of owls across Cardiff University.
2. By the end of 2022 on every site where tawny owls are detected, we will have put in place a harm reduction program including warning signs in car parks and collision prevention schemes around power lines.
3. By 2023 we will have created one mile of additional hedgerow and/or rough grassland to encourage small mammals and birds. This will be half done by 2022.

Gulls

1. By the end of 2021 we will have put in place a gull surveying program. This will include four yearly visits to sites with gulls, looking for any signs of disease and predation, and counting the number of nests.

Swifts

1. By the end of 2022 we will have created a swift-friendly site policy to ensure that swifts are not disturbed during their nesting season.
2. By the end of 2022 we will have erected a warning sign on each site where this species is present to prevent disturbance. Design for habitat amelioration will commence.
3. By the end of 2023, we will have created an environmental assessment and mitigation protocol, to be followed if the university needs to develop any environmentally sensitive areas. We will have increased habitat opportunities for swifts with specific interventions and will have developed specific designs. This will be achieved through integration of students and citizen science where possible.

Garden birds

1. Initial characterisation study – what species do we have, where and when do they visit? Which one's breed? (e.g. garden warblers, blackcaps, willow warblers, raptors), which ones overwinter (e.g. blackcaps, chiffchaffs)?
2. By 2023 we will have converted an additional 1,000m^2 of green estate managed grassland into meadow.
3. By the end of 2021 we will have banned the use of insecticides and slug pellets in all outdoor environments.

Pollinators

1. Initial characterisation study.
2. By the end of 2021 we will have banned the use of insecticides and slug pellets in all outdoor environments.
3. By the end of 2021 we will have restricted the use of selective pesticides to sports surfaces only.
4. By the end of 2022 we will have stopped using glyphosate products in knapsacks, we will only be using weed wipers, stem injection and no-mix solutions. We will also increase habitats and edible landscapes for pollinators in the area by 50%.
5. By 2023 we will have converted an additional 1,000m^2 into meadowland.

Hedgehogs

1. Initial characterisation study.
2. By the end of 2021 we will have banned the use of insecticides and slug pellets in all outdoor environments.
3. By the end of 2021 we will have enrolled on the Hedgehog Friendly Campus Scheme and have put in place a Dusk Survey program to check for the presence of hedgehogs across Cardiff University.
4. By the end of 2022 we will have put up warning signs in the car parks of sites known to be used by hedgehogs. We will also increase habitats and edible landscape in the area using urban interventions.
5. By the end of 2023, we will have created an environmental assessment and mitigation protocol, to be followed if the university needs to develop any environmentally sensitive areas.
6. By 2023 we will have created one mile of additional hedgerow and/or rough grassland to encourage small mammals and birds. This will be half done by 2022.

Pipistrelles

1. Initial survey using acoustic methods (specially to see where and whether we have soprano and/or alto pipistrelles, which are separate species).
2. By the end of 2022 we will have created a bat-friendly site policy to ensure that they are not disturbed during their breeding season.

3. By the end of 2021 we will have put in place a Dusk Survey program to check for the presence of pipistrelles across Cardiff University.
4. By the end of 2022 we will have erected a warning sign on each site where this species is present to prevent disturbance and increase their habitat through urban interventions.
5. By 2023 our Estates and Campus Facilities operations will be carbon neutral (see Environmental Sustainability Enabling strategy).
6. By the end of 2023, we will have created an environmental assessment and mitigation protocol, to be followed if the university needs to develop any environmentally sensitive areas.

Bluebells

1. Initial characterisation study, including identification of any potential hybrids.
2. By the end of 2023 we will have removed all the Spanish bluebells at Cardiff University, and banned their use.
3. By the end of 2022 we will have erected a warning sign on each site where this species is present to prevent disturbance.
4. By the end of 2023, we will have created an environmental assessment and mitigation protocol, to be followed if the university needs to develop any environmentally sensitive areas. We will support their habitat through community seed bombing events at desired areas.
5. By 2023 we will have introduced bluebells to every site with woodland areas at Cardiff University.

Welsh daffodils

1. By the end of 2023 we will have erected a warning sign on each site where this species is present to prevent disturbance.
2. By the end of 2023 we will have banned the planting of horticultural daffodils and replaced all horticultural daffodils with wild Welsh daffodils. We will organise public events to gauge the opinions of the public about both growing on site as well as in their front garden. This will support connectivity across the city.
3. By the end of 2023, we will have created an environmental assessment and mitigation protocol, to be followed if the university needs to develop any environmentally sensitive areas.
4. By 2023 we will have converted an additional 1,000m^2 into meadowland. This will be half done by 2022.

Soil fauna/flora

1. By the end of 2021 we will have banned the use of insecticides and slug pellets in all outdoor environments.
2. By the end of 2021 we will have restricted the use of selective pesticides to sports surfaces only.
3. By the end of 2022 we will have stopped using glyphosate products in knapsacks, we will only be using weed wipers, stem injection and no-mix solutions. We will also increase habitats and edible landscapes for pollinators in the area by 50%.
4. By 2023 we will have converted an additional 1,000m^2 into meadowland. This will be half done by 2022.

Veteran trees

1. Existing old-growth trees will be maintained as long as they are deemed structurally safe to remain. (policy already in place)

2. Existing trees will be allowed to mature. Thorough assessments will be carried out regarding the structural safety of trees, with trees affected by fungal decay, hollowing or even death not inherently resulting in their removal unless they pose a risk to human safety (policy already in place)

Saproxylic fauna/flora

1. An initial survey of the extant saproxylic fauna will be carried out in 2021
2. By the end of 2021 we will have banned the use of insecticides and slug pellets in all outdoor environments.
3. By the end of 2021 we will have restricted the use of selective pesticides to sports surfaces only.
4. By the end of 2022 we will have stopped using glyphosate products in knapsacks, we will only be using weed wipers, stem injection and no-mix solutions. We will also increase habitats and edible landscapes for pollinators in the area by 50%.

Moths

1. Initial characterisation study using moth traps in 2021
2. By the end of 2021 we will have banned the use of insecticides and slug pellets in all outdoor environments.
3. By the end of 2021 we will have restricted the use of selective pesticides to sports surfaces only.
4. By the end of 2022 we will have stopped using glyphosate products in knapsacks, we will only be using weed wipers, stem injection and no-mix solutions.
5. By 2023 our Estates and Campus Facilities operations will be carbon neutral (see Environmental Sustainability Enabling strategy).
6. By 2023 we will have converted an additional 1,000m^2 into meadowland. This should have increased habitats and edible landscapes for pollinators around the university by over 50%.

Table 6. Summary of Targets
Feasibility of all targets depends on appointment of a Biodiversity Officer

Summary of Targets	
Date	**Targets**
By Sept 2021	Initial surveys and characterisation studies completed, and results submitted on iRecord. Insecticides and slug pellets banned. Selective herbicides restricted to sports surfaces. Staff slow worm monitoring program set up. Pond at University Hall renovated.
By Dec 2021	First general biodiversity survey completed across all sites. Dusk survey set up for tawny owls, bats and hedgehogs, possibly using a static audio recorder to help monitor sites. Enrol and start on Hedgehog Friendly Campus Scheme. Gull survey set up. Site policies in place for swifts and bats. Anti-cat systems in place for slow worms. Warning signs set up on roads for hedgehogs, tawny owls. Do not disturb signs for bluebells, Welsh daffodils, swifts, bats, slow worms. Projects on supporting prototype habitats across the campus starts. Start of public engagement.

By Dec 2022	Glyphosate products restricted. All Spanish bluebells removed. All horticultural daffodils removed and replaced with native Welsh daffodils. Planting of additional horticultural daffodils and bluebells banned. Creation of 500m^2 of meadow for pollinators, songbirds, Welsh daffodils. Creation of 500m of hedgerow/rough grassland for hedgehogs, tawny owls. Developing prototype habitats across the campus, engaging public. Start of systemic interventions.
By Dec 2023	Environmental assessment and mitigation protocol for developing environmentally sensitive sites. We will have created a new wildlife pond near main building. Monitoring of prototypical habitats. Creation of new that are informed by the former ones. Citizen science monitoring, token, DIY, AR apps. Restoration and enhancement of the functionality and biodiversity of 30% of the University's green estate. Creation of 1,000m^2 of meadow for pollinators, songbirds, Welsh daffodils. Creation of 1km of hedgerow/rough grassland for hedgehogs, tawny owls. Bluebells introduced to every site with woodland. Cross-species flourishing community.
By Dec 2030	Complete restoration and enhancement of the functionality and biodiversity of the University's green estate.

Table 7. Capital costs

Biodiversity Action Plan capital costs over 3 years – Species & Habitats			
Project	**Possible Site**	**Item and cost – all prices are estimates**	**Total**
Meadow project	University Hall Bute Building Trevithick Building Cubric Building	100% wildflower seed (3kg) (£390) Interpretation boards x2 (£500)	£890
Pond project	University Hall Redwood Building	Renovations to Uni Hall pond (£350) Creation of a new wildlife pond (£1,000)	£1,350
Hedge project	May include Sports Fields Cartwright Court *Final sites tbc based on survey & demand*	Hedgerow trees & shrubs (x500) (£1,000)	£1,000
Dusk survey	Undisclosed bat, tawny owl, hedgehog & swift sites x5	Static bat detector (£780) Wildlife cameras x3 (£450)	£1,230
Slow worm project	Undisclosed slow worm site	Solar powered cat-repeller/scarer (x2) (£40) Interpretation board for site (£250) New refugia (x3) (£25)	£315
Swift project	Undisclosed swift site	Signs for site x 3 (£100) Interpretation board for site (£250)	£350

Hedgehog project	Undisclosed hedgehog sites x3	Road signs for sites (x6) (£200) Interpretation boards (x3) (£750)	£950
Bat project	Undisclosed bat sites x3	Road signs for sites (x6) (£200) Interpretation board for sites (x3) (£750)	£950
Bluebell project	Undisclosed shady meadow areas around campus x5	Bluebell bulbs (x4,000) (£800) Signs for sites (x6) (£200)	£1,000
Welsh daffodil project	Existing horticultural daffodil plantings around campus & bright meadows (x c.10)	Bulbs (x1,000) (£960) Signs for sites (x3) (£100)	£1,060
Total			£9,095

Engagement and Mobilisation Plan

There are a number of communities with which the ERBAP Steering committee will seek to engage, with further details below:

1. Professional Services
2. Academic staff
3. University students
4. Cardiff communities and community groups
5. Local government
6. Environmental NGOs

BAP activities will be embedded within the behavioural change programme, Green Impact. This will encourage building teams from across the University to engage with awareness raising and undertake a range of activities to support the BAP. Activities will be embedded into the staff and student Sustainability week run in March annually and also into the staff Positive, Health, Environment and Wellbeing (PHEW) fortnight run annually in July. The Environmental Compliance Officer (ECO) network will be used for disseminating information out to local areas.

One of the aims of the characterisation programme in year one will be to produce a booklet of "*The Wildlife and Wildflowers of Cardiff University*". This booklet will list the 100 most common species found in the different priority habitats of Cardiff University. It will be a basic field guide and include photographs of all 100 species in their Cardiff habitat. These booklets can be sold in the Students' Union and at other locations around campus. They will help raise awareness about Cardiff University's wildlife and wildflowers. The money raised will be put exclusively towards funding for biodiversity projects (e.g. meadow, woodland, hedgerow or pond creation; bird, bug, bat or hedgehog boxes) at Cardiff University.

During Fresher's Week 2021, and each subsequent year, we will run a guided tour of the wildlife and wildflowers of Cardiff University. This will help raise awareness and goodwill towards the biodiversity of Cardiff, especially amongst students who have recently moved to Cardiff. During the tour we can advertise and sell the *Wildlife and Wildflowers of Cardiff University* booklets to raise money for additional conservation projects. We will look to run similar events during PHEW as well as staff induction activities. We will look to engage with staff in each of the Schools at Cardiff University through lunchtime seminars in order to create space for new ideas for and broader collaboration on future ERBAP activities.

The Student's Union (SU) will be actively involved with BAP activities. The SU will execute the Planting Project next to the Cathays Railway Station and aims to create a Student Volunteering Group that will help with BAP Projects across campus. The progress of the Group's work and BAP activities will be posted on SU social media throughout the academic year. During Go Green Week in the SU (February/March 2021) there will be a strong emphasis on biodiversity, for the purpose of raising awareness as well as promoting student engagement with BAP activities.

Regular meetings will be held with relevant organisations (e.g. Buglife, Plantlife), community groups (e.g. Greening Cathays) and local authorities (i.e. Cardiff Council) to discuss progress of the BAP and its context in wider Cardiff biodiversity. This will provide an opportunity to monitor Cardiff University's alignment with local biodiversity aims to ensure a cohesive approach to biodiversity enhancement in the city and orchestrate a greater degree of connectedness between arising and existing habitats. Pharmabee activities, detailed already above, have already engaged extensively across Cardiff communities (neighbourhoods, schools and hospitals) to add more quality green spaces that contribute to biodiversity. The ERBAP can create synergies with Pharmabees to enhance community engagement. Additionally, through the Dean's participation in the LNP and Cardiff Council's Conservation Officer's role in the ERBAP Steering committee, engagement with local government is facilitated.

Mobilisation of the various communities identified above will occur through our engagement plan. Communities and NGOs will be invited to codesign projects, activities and workshops, such as seed bombing, gardening workshops, bioblitz, concerts, healthy food and cosmetics festivals, etc. In this way, we seek to elicit and include ideas from our communities and to collaborate in bringing those ideas to life.

The University and Cardiff communities will be further mobilised through the promotion of phone apps to employ citizen science approaches to measuring and monitoring biodiversity on the University campus and throughout Cardiff city. A further idea to engage community stakeholders is through the use of a token economy where participants can earn tokens for volunteering in ERBAP activities and exchange the tokens for sustainable products. This kind of reward system can be implemented over the ERBAP period 2021-2023 for time volunteered, but it can also be promoted in particular for events such as Sustainability week and PHEW and implemented as a competition between schools, buildings or teams or for project outputs, such as DIY habitats and edible landscapes extensions. Recognition and awards could be made to different categories such as "Species champions" for those who log the most sightings of priority species each month.

The ERBAP Steering committee, with particular support from the Biodiversity Officer, could partner with the National Museum Wales to engage with museum visitors through both displays and specific events during the year. This same approach can be used with Bute Park and many of our local environmental NGOs, such as Bug's Life, Wildlife Trust and community gardening groups. In January 2021 the ERBAP Steering committee will agree a calendar of events for 2021 through engagement with our University and external partners and stakeholders.

Table 8. Budget for the engagement and mobilisation plan

Engagement and Mobilisation Plan costs	Costs
Workshop activities (hospitality @ £300/workshop *2 workshops) and materials (£100/workshop *2 workshops)*3 years	£2400
Sustainable Products to exchange for tokens (5 tokens/product, each product @£5*50*3 years	£750
Biodiversity Writing contest (4 awards @ £50/award/year*3 years)	£600
Total cost	**£3750**

Education Plan

The university will integrate the ERBAP into its curriculum across the schools and colleges. This will be performed through 'living laboratories' through real life student's projects. Therefore, e.g. architectural students will work on extending habitats for identified species of importance, whilst music students will be analysing the sounds of bumblebees. Outputs from these kinds of student projects can be presented through public events to inspire and promote further engagement. In addition, the plan proposes a new postgraduate master in systemic design. This program will be fully transdisciplinary, developing collaborative and codesigned studio-based projects with students of various background. The projects will use the university campuses as a living laboratory for extending habitats and edible landscape for the above-mentioned species, integrating social, technical and environmental systems through holistic approach.

Each course offered by the university has to integrate biodiversity in relation to its content; this can be complemented by incorporating some surveying activity or interventionist projects into curriculum. This means that the curricula must become non-anthropocentric, inclusive to other species. This covers e.g. non-human computer interactions, sounds of other species, non-human psychology, communities, habitats, agriculture and medicine. Surveys of taxonomically specialist groups will also be incorporated into teaching practices in BIOSI and other relevant schools where possible.

Survey and interventionist activities could be conducted in a multi-disciplinary setting, for example through regularly held bioblitz, with students from different schools working together to achieve learning objectives. In addition to bioblitz activities, multi-discipline, cross-school student, post-graduate, and staff collaborations will be supported through ERBAP sponsored project competitions, such as designing a bug hotel, with submitted projects being evaluated and the winning project team being awarded during Sustainability week. Further annual competitions will be sponsored by ERBAP, include an annual competition for Cardiff University students, Cardiff primary and secondary students and Cardiff community members to submit an essay about the value of priority species for Cardiff. A winning essay will be selected from each participant category and announced and published during Sustainability Week. Each prize winner will be awarded £50.

Over the last year, the Dean of Environmental Sustainability has been conducting an audit of all the courses offered at Cardiff University that contain topics of environmental sustainability. Once complete, this information will be used by the ERBAP Steering committee to work together with identified sustainability education champions across the campus, including Academics and the Dean of Postgraduate Education (PSE) in Architecture as well as the Sustainable Places Research Institute and the School of Earth and Ocean Sciences to develop curriculum on ecosystem resilience and biodiversity that can be implemented as introductory material for year 1 students across all colleges, which will look to be adapted into a Massive Open Online Course (MOOC). The module material will

be designed so that there is one module adapted for each college, tailored towards the disciplines within the college, but also including elements of ERBAP in each module.

In addition to this, environmental sustainability material will be included in staff and student induction activities.

Table 9. Timeline of Education activities

Activity	**Completion:**
Audit of courses with environmental sustainability content	January 2021
Introduce a mandatory environmental sustainability induction online training course for staff and students	December 2020
Implementing Knowledge Gap Prize	First prize to be awarded during Sustainability Week March 2021
Implementing introductory environmental sustainability MOOC	Sept 2022
Opening of Master in Systemic Design	October 2022
Evaluation of introductory course	January 2023

Appendix 2: Cardiff University Preliminary Section 6 Report

https://www.cardiff.ac.uk/public-information/policies-and-procedures/health-safety-and-environment