



# NATURAL CAPITAL LABORATORY

**YEAR 1 REPORT**

## Quality information

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# Introduction

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## Context

On 1 April 2019, AECOM and conservation charity the Lifescape Project launched an ambitious, pro-bono research project called the ‘**Natural Capital Laboratory**’ (NCL). The project centres around **rewilding** a 100 acre piece of land in Scotland and working with the landowners to restore the habitats on site, support species reintroductions, and encourage people to connect with the environment. Alongside the rewilding process, the NCL was set up as a testbed to experiment with new techniques to quantify, measure, and communicate environmental and social change from the rewilding process. The NCL involves three main workstreams:

- **Data and Technology** – in order to understand the changes on site, the NCL is being used as a platform for designing and testing innovative new approaches for measuring environmental and social change. Examples include using drones, AI, and remote sensing technologies to capture, process, and interpret aerial imagery, map habitats, and assess their condition; and quantifying flows of ecosystem services through the use of thermal imaging cameras, camera traps, robotic rovers, heart rate monitors, and air quality sensors.
- **Capitals Accounting** – at the core of the NCL will be a set of natural, social, human, intellectual, manufactured, and financial capital accounts built around the [Corporate Natural Capital Accounting](#) framework. These accounts will provide a structured means of organising the data collected on the site and will be used to monitor change over time to provide a clear evidence base from which the impacts of rewilding may be evaluated.
- **Engagement** – as the data is collected and the accounts are populated, engaging ways of communicating the findings of the NCL are being developed such as virtual reality and interactive digital platforms. These techniques aim to demonstrate the environmental and social benefits of rewilding to a wider audience than is possible through traditional technical reports.

The first year of the NCL ran from 1 April 2019 to 31 March 2020 and a specific theme was explored during each quarter of this period. These themes included:

- **Natural Capital** – baseline survey work and production of a natural capital account and digital accounting framework.
- **Net Gain** – exploration of how biodiversity could be incorporated into an accounting framework.
- **Remote Sensing** – development of an approach to map and monitor habitats using remote sensing.
- **Social Capital** – development of a structured accounting framework to monitor change in social capital.

This report provides an overview of the activities undertaken in the first year of the NCL and presents the key findings. At the end of the report is an outline plan for Year 2 of the project. It is accompanied by a Digital Natural Capital Accounting platform which can be accessed [here](#) as well as individual reports covering the details of each of the site visits. These are available upon request.

While the first year has been led by AECOM and the Lifescape Project working alongside the landowners, the aim is to set up an open, collaborative platform where organisations can work together to tackle the world’s environmental challenges. If you would like to find out more about the NCL or any details of the methodologies developed, or you would like to get involved in collaborating on the NCL, you can get in touch with:

[chris.x.white@aecom.com](mailto:chris.x.white@aecom.com) and [adam.eagle@lifescapeproject.org](mailto:adam.eagle@lifescapeproject.org).

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# Activities Undertaken

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## Overview

This section provides an overview of the activities undertaken in Year 1 of the NCL.

## Activities

A total of four formal site visits were undertaken in April, May, August, and November. This included 23 people from a range of organisations including AECOM, Crosscut Forestry, Lifescape Project, the landowners, as well as a number of independent volunteers. Several activities were undertaken during these visits which are summarised under the following themes: biodiversity, technology, and social engagement.

### Biodiversity

- Site walkover to identify key habitats and species
- Phase 1 habitat survey
- National Vegetation Classification (NVC) survey
- Collection of moss samples
- Camera trap surveys
- Thermal imaging survey
- Breeding bird survey
- Invertebrate (butterfly and dragonfly) survey
- Bat survey
- Red squirrel population surveys (including visual surveys and feeding transects)
- Moth trapping
- Initial tree planting project (420 trees)

### Technology

- Identification of key visualisation locations to be used as a basis for a virtual reality production to highlight the ecosystems on site and how they are likely to change over the next 100 years
- Photos of vegetation at the visualisation locations
- 360-degree imaging of visualisation locations for development of virtual reality production
- Walkover of the site to locate suitable take-off and landing zones for UAV flights
- UAV video flythrough of predefined flight paths across the site (aligned with the visualisation

locations)

- UAV aerial photographic survey of site defined by the site boundary for processing an orthomosaic aerial map and photogrammetry-derived 3D model
- Aerial images of the visualisation locations as based on GPS locations
- Remote sensing maps and ground truthing of remote sensing outputs

## **Social engagement**

- Ground-based photography and videography of the site
- Audio recordings of site including general audio baseline (running water, bird song, wind etc.)
- Interviews of participants in the NCL project
- Survey of visitor blood pressure, pulse rate, sleep quality, step count, and subjective wellbeing
- Initial meeting with members of the local community
- Painting workshop for site visitors

## **Outputs**

The key outputs from these activities include:

- Year 1 report including a natural and social capital account, net gain baseline assessment, and remote sensing maps of habitat extent and condition, together with an online Digital Natural Capital Account and 'proof of concept' virtual reality experience
- Maps of the site terrain, species density, and habitat coverage
- Videos of drone footage, 3D modelling, and camera trap recordings
- Reports covering the 5-year plan for the site, details from the site visits, water quality and aquatic ecology baseline reports, and a Masters dissertation on approaches to integrating biodiversity into natural capital accounting
- Communications outputs including a flyer, infographic, a web page, and a poster presentation
- An extensive photo gallery of the site
- 20 articles in the online and print media covering the NCL
- Presentations at 25 events in London, Glasgow, Birmingham, Leeds, Paris, the Lake District, Peterborough, and Plymouth about the project, as well as several online webinars
- 7 articles written by the team about the NCL in various publications
- An internal network of over 65 people working on the project at various points
- An external network of over 95 people who have been engaged at some point to discuss the project from the business, NGO, academic, government, and local community sectors
- Carbon offsets to cover all travel to the site as part of the NCL

# Key Findings

## Overview

This section provides a summary of the key findings from Year 1 of the NCL across the four key themes:

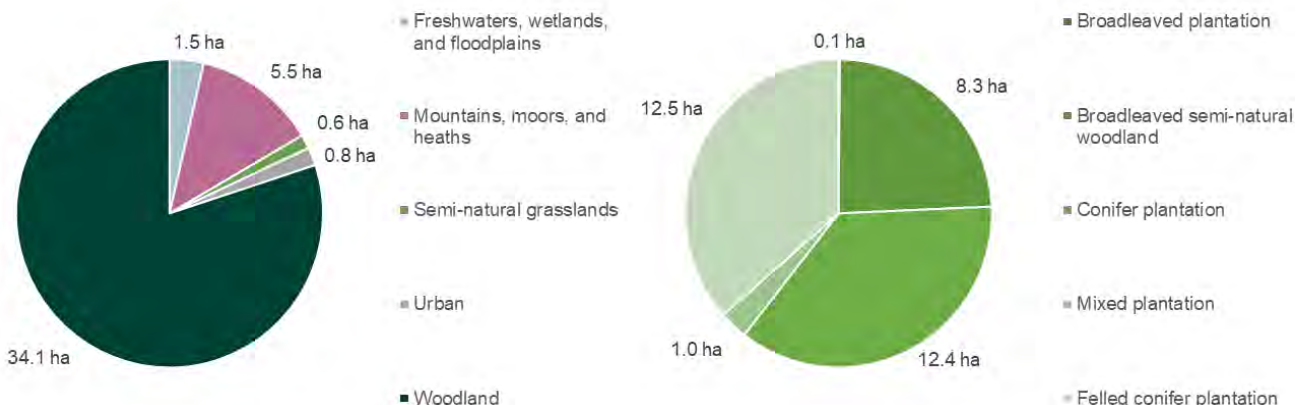
- Natural capital
- Net gain
- Remote sensing
- Social capital

## Natural capital

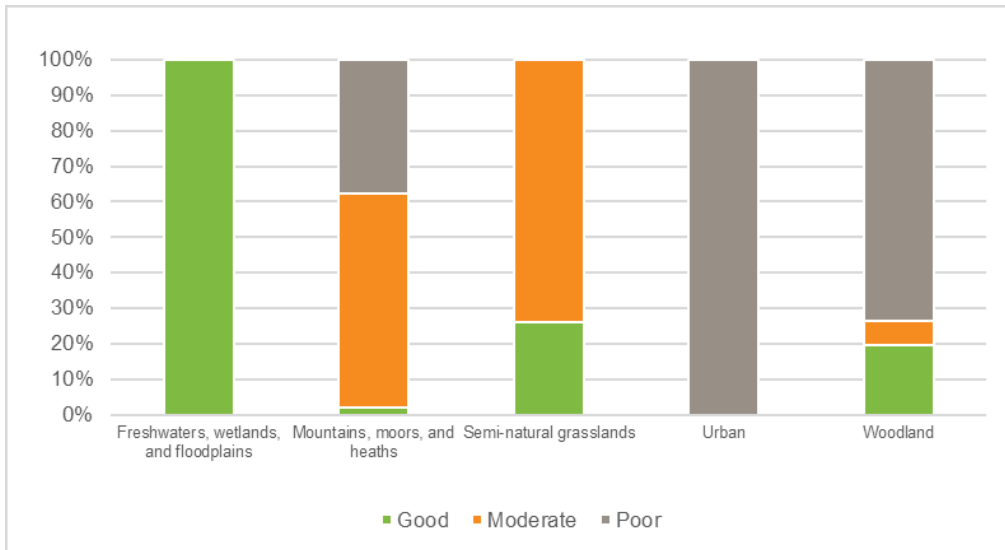
The aim of the natural capital accounting workstream in Year 1 was to establish a baseline natural capital account for the site before significant change takes place. The idea was to draw on the approaches and values available within the literature to put together the account. Then, over the coming years, to identify areas where the data is limited or the models could be further developed, and pilot new approaches for improving the techniques involved.

A summary of the baseline natural capital account is set out in the diagrams and tables that follow. Further details are available in Appendix A. Alongside this, a Digital Natural Capital Accounting platform has been developed to provide a more engaging way of presenting this information. This is available [here](#). The platform is accompanied by a 'proof of concept' virtual reality experience which allows users to visit the site virtually and look at how it is likely to change as the ecosystems are restored.

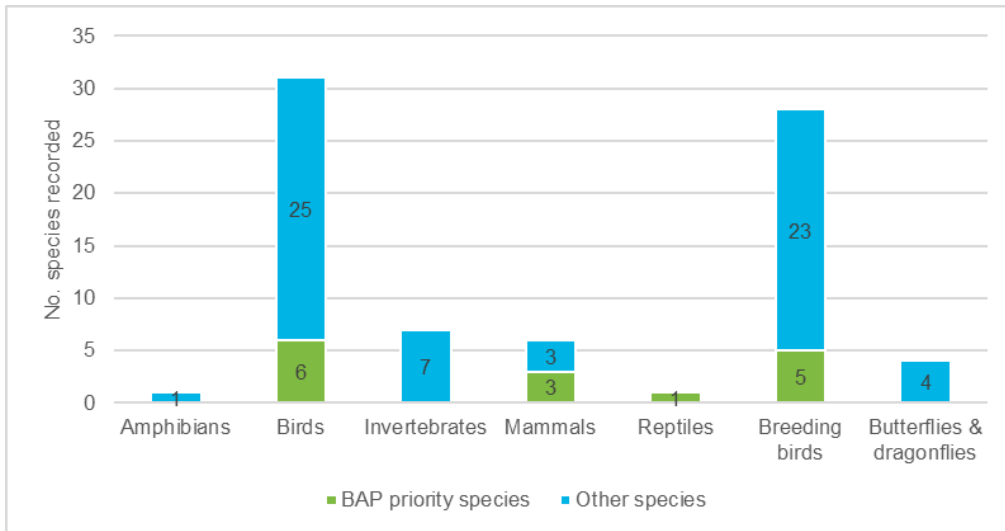
**Figure 1. Extent of ecosystems on site by broad habitat type (left) and breakdown of woodland type (right)**



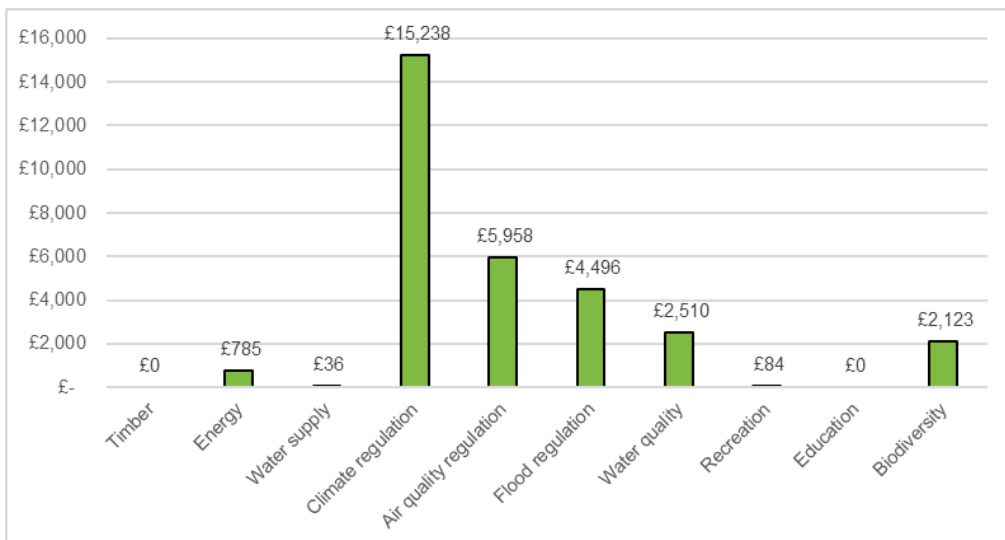
**Figure 2. Condition of ecosystems on site (based on Biodiversity Metric 2.0)**



**Figure 3. Overview of species richness on site**



**Figure 4. Estimate of the annual value of the ecosystem services provided (2018 prices)**





**Table 1. Summary of the natural capital balance sheet**

Balance sheet 2019/20	Discounted Present Value over 25 years		
Assets	Private value	External value	Total value
<b>Natural capital</b>			
Timber	£0	-	<b>£0</b>
Energy (solar and biomass)	£13,000	-	<b>£13,000</b>
Water supply	£1,000	-	<b>£1,000</b>
Global climate regulation	-	£260,000	<b>£260,000</b>
Air quality regulation	-	£102,000	<b>£102,000</b>
Flood regulation	-	£77,000	<b>£77,000</b>
Water quality regulation	-	£43,000	<b>£43,000</b>
Recreation	£1,000	-	<b>£1,000</b>
Education	-	£0	<b>£0</b>
Biodiversity (charismatic species)	-	£36,000	<b>£36,000</b>
<b>Gross natural capital asset value</b>	<b>£15,000</b>	<b>£517,000</b>	<b>£533,000</b>
Liabilities	Private costs	External costs	Total costs
NCL running costs	(£142,000)	-	<b>(£142,000)</b>
Site running costs	(£61,000)	-	<b>(£61,000)</b>
<b>Total liabilities</b>	<b>(£203,000)</b>	-	<b>(£203,000)</b>
Total net value	Private	External	Total
<b>Total net value</b>	<b>(£188,000)</b>	<b>£517,000</b>	<b>£330,000</b>

Some of the key lessons learned from the development of the baseline natural capital account are as follows:

- The site is currently dominated by woodland habitat, much of which is in poor condition. While the site does provide a range of important ecosystem services and supports a number of different species, there is significant potential to improve the condition of the natural capital assets on site and the value of the ecosystem services provided.
- As it stands, the asset account does not provide a complete picture of the extent and condition of all of the natural capital assets on site. While ecosystems and species are well covered, further information needs to be collected on atmospheric conditions, soil, and water quality.
- The current baseline suggests that the site generates a net value of around £0.3 million over a 25 year period. Regulating services, in particular from carbon sequestration, provide a much greater share of the value than either provisioning or cultural services. Further, much of the value is external while all of the costs are private. Looking purely at the private costs and returns, the net value is around -£0.2 million over the same period.
- It is important to note that this estimate of value does not include other capitals at this stage such as social capital (see later sections of this report), or intellectual capital (which is likely to be of significant value although has not been quantified at this stage in the project). Future versions of the account could extend the accounting framework to cover intellectual, human, financial, and manufactured capital.
- The ecosystem service with the highest value on the site was estimated to be global climate regulation. However, the values for estimating carbon sequestration rates for the habitats on site

were relatively high level estimates drawn from studies undertaken elsewhere. Further work could be undertaken to refine and enhance the accuracy of these estimates, given that this is a key ecosystem service provided. This is particularly the case for the peatland ecosystems on site which can have significant variance in terms of their carbon balance depending on the specific conditions of the site.

- Air quality, water quality, and flood regulation are potentially important services provided by the ecosystems on site although the approaches used to quantify these values were very broad approximations taken from studies elsewhere. The literature values may not take into account the rural nature of the site, likely lower levels of background pollution, and the limited number of beneficiaries who are likely to benefit from these services. As such, the values used may overstate the value of the services provided. A more detailed model could be developed for the site to provide a better estimate of the extent and value of these services.
- Estimates of the recreational value were taken from studies elsewhere and are not unique to the site itself. A visitor feedback form could be developed to collect better data on visitor numbers and help to more accurately quantify the value of each visit using a travel cost method.
- The aesthetic value of the site is (anecdotally) reported to be high by visitors and is something that is likely to change significantly over time – particularly as blocks of trees are removed and replanted. A visual aesthetics survey could be undertaken to quantify the change in the flow of this service.
- Biodiversity is an important component of the site but one which is difficult to quantify. A better understanding of the change in species populations over time and the value people place on them through choice modelling surveys would improve this side of the accounts.

## Net gain

The aim of the net gain workstream in Year 1 was to establish the baseline number of biodiversity units on the site and explore ways in which the net gain approach could be integrated into the natural capital accounting framework.

A Phase 1 habitat and National Vegetation Classification Survey was undertaken on the site in May 2019 (see Figure 5 overleaf). The ecologists undertaking the survey recorded the area and condition of each of the habitat types observed on site. The number of biodiversity units was then calculated using the Biodiversity Metric 2.0. The baseline number of units was estimated to be 379. The full results are set out in Appendix B. An orthomosaic aerial map and photogrammetry-derived 3D model of the site was produced using drone footage in order to allow remote monitoring and assessment of the habitats on site (see Figure 6).

The results of the net gain assessment were integrated into the natural capital account in two places:

- As a measure of the extent and condition of the ecosystems within the asset account. Note, these were aggregated into the UK NEA broad habitat types.
- As a measure of the quantity of biodiversity units generated each year through activities on the site in the physical flows account. These units will be used to provide an approximation of the change in biodiversity value of the site each year generated through the rewilding process. The value of this change will be estimated using an average market price per biodiversity unit. For the baseline, the value is not presented in the accounts as there was no change recorded against previous years. The stock value of the existing number of biodiversity units on site is estimated to be around £4 million.

The use of the net gain approach was found to integrate well into the natural capital accounting framework, and to provide a transparent and replicable approach to quantifying change in the biodiversity value of habitats on site. One area of weakness in the approach is that it does not directly quantify change at a species level. As

such, additional sections were included within the account to monitor species richness in the asset account, and populations of certain charismatic species on site (red squirrels) in the physical flows account, with the values being estimated by the public's willingness-to-pay to protect those species.

Figure 5. GIS map of habitat types on site

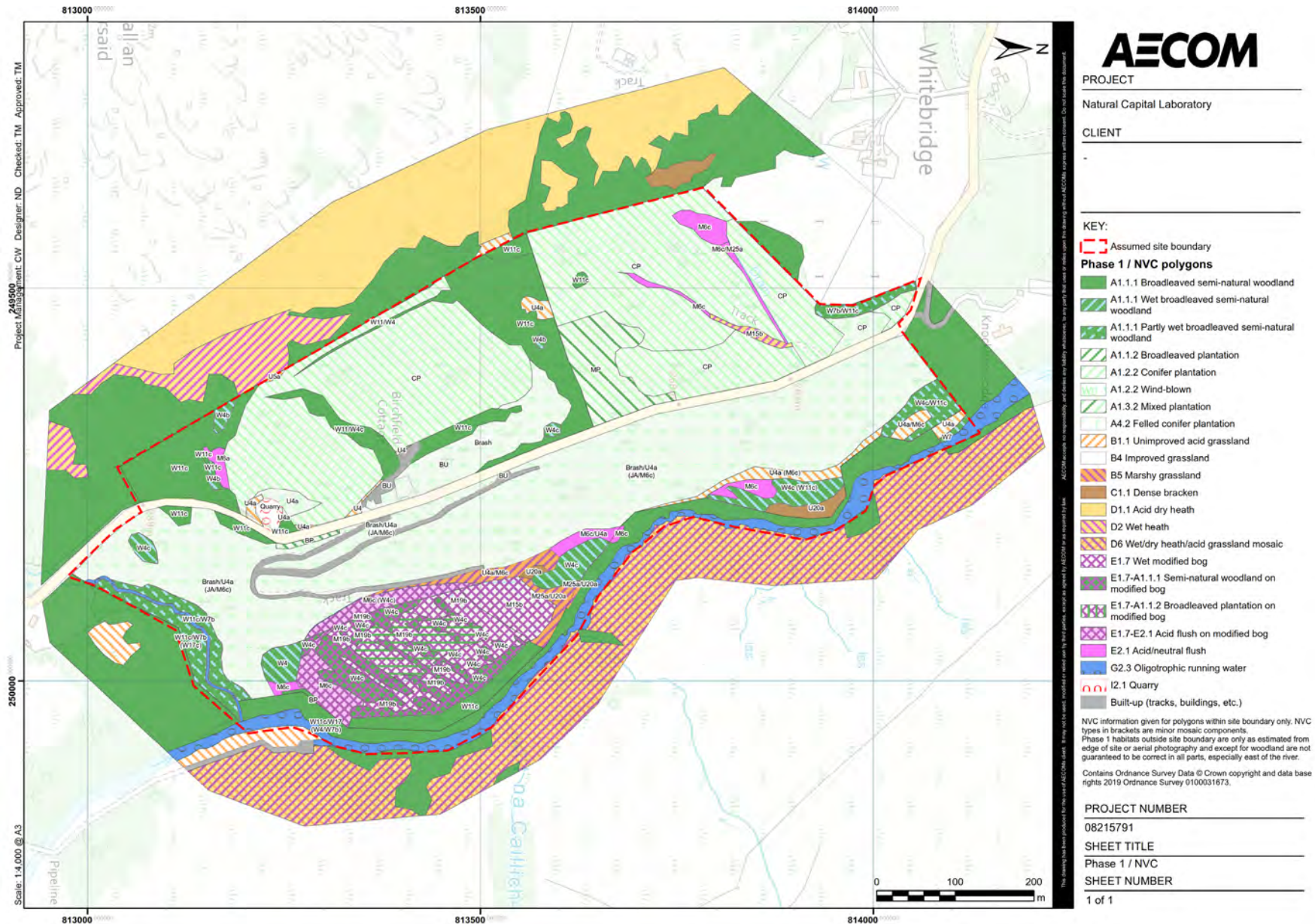


Figure 6. Orthomosaic aerial map and photogrammetry-derived 3D model of the landform



A further piece of research into the use of the net gain approach within natural capital accounting was undertaken as part of a Masters Dissertation project completed on the site.<sup>1</sup> This research looked at whether a blend of classical qualitative ecology with quantitative elements could offer a comprehensive and cost-effective method of quantifying changes in biodiversity instead of, or alongside, the net gain approach.

A metric was developed which incorporates the Ratcliffe criteria; a set of criteria used in the selection of Sites of Special Scientific Interest based on an area's size, diversity, naturalness, rarity, fragility, typicalness, recorded history, position in ecological unit, potential value, and intrinsic appeal.<sup>2</sup> This metric was applied to the NCL site and the results were used to provide an overview of the current biodiversity value of each habitat (see Table 2 for a comparison of scores against the net gain approach). The paper concluded that the approach delivers useful results that could be easily included in or alongside a natural capital account. A copy of the paper is available upon request.

**Table 2. Comparison of scores across Ratcliffe criteria and Biodiversity Metric 2.0 (normalised)**

Habitat type	Score using Ratcliffe criteria	Score using Metric 2.0
Broadleaved semi-natural woodland	1.00	1.00
Oligotrophic running water	0.63	0.20
Mixed plantation	0.46	0.03
Acid grassland	0.45	0.06
Marshy grassland	0.35	0.04
Bog	0.31	0.27
Acid flush	0.28	0.06
Conifer plantation	0.24	0.18
Broadleaved plantation	0.14	0.00
Felled conifer plantation	0.14	0.18
Heath	0.13	0.01
Dense bracken	0.10	0.01
Quarry	0.09	0.00
Built	0.08	0.00

## Remote sensing

The aim of the remote sensing workstream in Year 1 was to test the effectiveness of using satellite imagery as a means to map the existing habitat types that exist on site. The successful implementation of such an approach would allow year-on-year monitoring of the study area with minimal site-based survey requirements. The following section summarises the work that was completed in Year 1 including the limitations that were identified.

Open Source Sentinel-2 multispectral imagery with a resolution of 20 m was used to develop a desktop based habitat classification process. A supervised classification approach was applied which utilised 30 training sites. A training site is the way in which the remote sensing analyst defines a habitat classification through the visual

<sup>1</sup> Stone (2019), 'In what ways can the inclusion of qualitative criteria contribute to a fuller representation of biodiversity value in natural capital assessments?', Dissertation presented as part of, and in accordance with, the requirements for the Final Degree of MSc in Environmental Policy and Management at the University of Bristol, School of Geographical Sciences.

<sup>2</sup> Ratcliffe (1977), 'A Nature Conservation Review', Cambridge University Press.

interpretation of the satellite imagery, for example, an area of broadleaved woodland would be first visually interpreted from the imagery before being digitised by the analyst. The spectral properties of this manually digitised woodland or training site would then be captured and used by the software to identify other areas of woodland across the study area without the analyst having to physically digitise them.

The habitat classification process developed was applied to the Sentinel-2 imagery for May 2019 and June 2018. The resulting habitat classification for 2018 and 2019 was then compared to determine the proportion of change between each habitat type. The results of the Sentinel-2 classification processing and change detection output were reviewed in comparison to a traditional ground-based Phase1 habitat survey. The comparison identified a number of limitations with the Sentinel-2 image processing:

- The delineation of only seven classification types was possible from the Sentinel-2 imagery compared to the 16 types captured during the traditional Phase 1 survey.
- The 20 m spatial resolution of Sentinel-2 was found to be too coarse to correctly classify habitat types and a number of errors were identified when compared to the Phase 1 survey.
- The issue of spatial resolution also impacted on the results of the vegetation indices, with issues such as mixed pixels and fuzzy boundary delineation making it too difficult to determine any real change in vegetation health.

To improve upon the results achieved with the Sentinel-2 imagery, Worldview-2 imagery was purchased for the study area. In comparison to Sentinel-2, Worldview-2 offers a higher spatial resolution of 1.84 m for multispectral imagery. As with Sentinel-2, the Worldview-2 imagery was used to develop a habitat supervised classification process where the Phase 1 survey results were used to produce the necessary training sites.

The resulting Worldview-2 habitat classification was again compared to the Phase 1 survey results (see Figure 7), and the classification was able to delineate all 16 habitat types with a  $\pm 20\%$  variation in actual area. When presented to the ecologist who conducted the Phase 1, it was considered that this level of variation was acceptable and it was possible that in some cases the variance was a result of certain areas having an assumed habitat type due to the inability to access specific locations while onsite.

**Figure 7. Comparison of the Phase 1 habitat survey (left) and Worldview-2 survey results**



The comparison identified a number of limitations with the Worldview-2 image processing:

- The pixel-based classification process occasionally produced a mixed classification or ‘salt and pepper’ effect therefore creating uncertainty on what the actual habitat type was.
- Some of the classes (such as mixed woodlands and marshy grasslands) did not match with the Phase 1 survey, due to image wetness factors and variation in pixels.
- Ultimately the classification was based on a completed Phase 1 survey, rather than being completely desk based or ‘unsupervised’. Ideally the approach would involve the following steps: (1) an initial unsupervised classification to delineate different habitat types; (2) focused site survey to confirm the habitat types identified from the unsupervised classification; and (3) refinement of the classification process.

As a result of the above findings in Year 1 we aim to complete the following tasks that will potentially improve the remote sensing process for Year 2:

- **Further development of habitat classification** – the development of a classification catalogue for all other habitat types allowing us to expand the classification workflow so that it doesn’t just include habitat types exclusive to the NCL study area.
- **Targeted field survey** – to understand whether any changes detected by different years of satellite imagery are correct it is recommended that a focused ground verification survey is completed. This will involve a field ecologist visiting areas of uncertainty and assessing whether the actual habitat matches that of the classification.
- **Development of natural capital accounting rules** – to better inform the natural capital accounting and net gain assessment process, it is recommended that further interpretation is completed to translate the raw habitat types identified into meaningful content such as understanding whether a specific habitat is of a good, moderate, or poor condition.
- **Procure and utilise UAV-based multispectral camera** – although Worldview-2 offers a suitable spatial resolution for conducting habitat classification, with the availability of UAV’s to complete even higher resolution image capture (<10 cm), it is recommended that a flyover is completed on the NCL study area to offer further comparison to the outputs produced to date.

## Social capital

The final workstream in Year 1 of the NCL aimed to develop a quantitative framework to monitor changes in social capital generated by the rewilding process through a social capital account.

In essence, the idea was to develop a social capital account through an extension of the Corporate Natural Capital Accounting (CNCA) framework. The natural capital approach is itself an extension of the economic notion of capital i.e. if you have an asset such as a factory, and you maintain it in good condition, it can produce a flow of goods or services over time that produce value to the organisation and to wider society. In the same way, a natural asset such as a woodland can produce a flow of valuable services over time, such as carbon sequestration and recreation opportunities, if maintained in good condition.

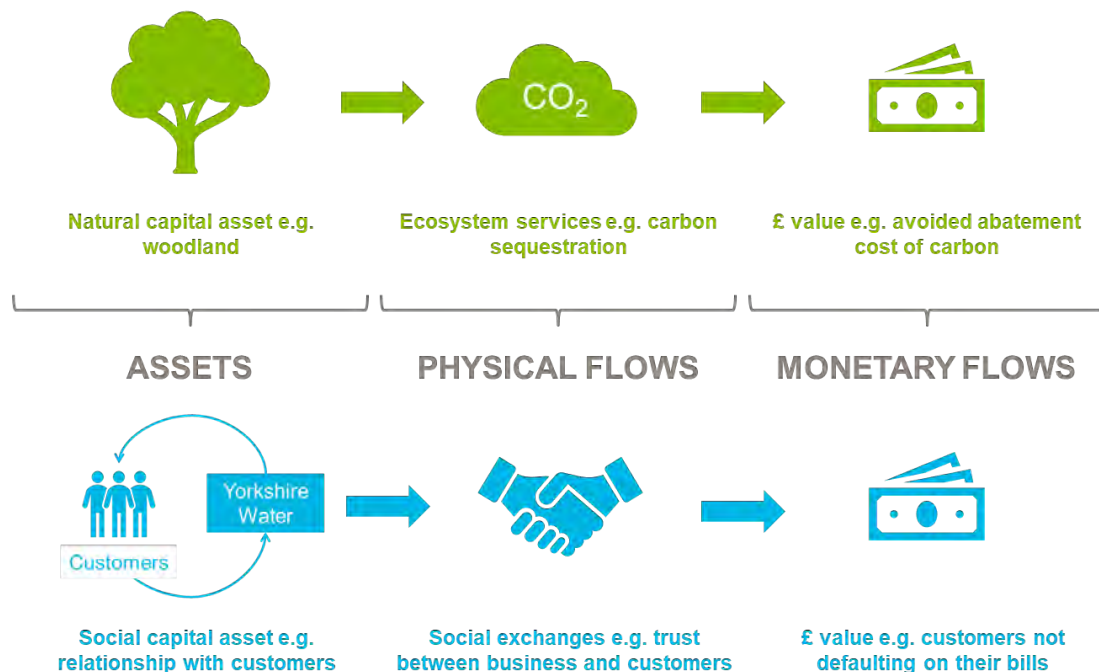
For years, organisations have produced financial balance sheets which record the financial performance of the assets owned or operated. The CNCA approach is an extension of this approach to natural capital assets and provides a structured way of recording: the **extent and condition** of natural capital assets; the **physical flows** of any services provided by those assets; the **monetary value** of those services to the organisation and wider society; and the **costs** of maintaining those assets. The CNCA approach has been widely used by a number of organisations to monitor natural capital and how it changes over time.



As set out in earlier sections, a natural capital account was developed for the NCL site to monitor changes in the natural capital assets as the site is rewilded. A potential limitation of this approach is that it does not capture social issues, which can be critically important in rewilding projects, particularly around issues of trust and community buy-in. To address this issue, a social capital account was also developed for the NCL to sit alongside the natural capital account.

This approach to social capital builds upon the CNCA framework and recognises the concept of social capital assets (in terms of networks and relationships between individuals or organisations), which, depending on their condition, can provide flows of social exchanges (such as trust and wellbeing), that have benefits to individuals, organisations, and to wider society (see Figure 8 below).

**Figure 8. Overview of the logic underpinning the natural and social capital accounting frameworks (drawn from work done by AECOM for Yorkshire Water in developing a social capital account)**



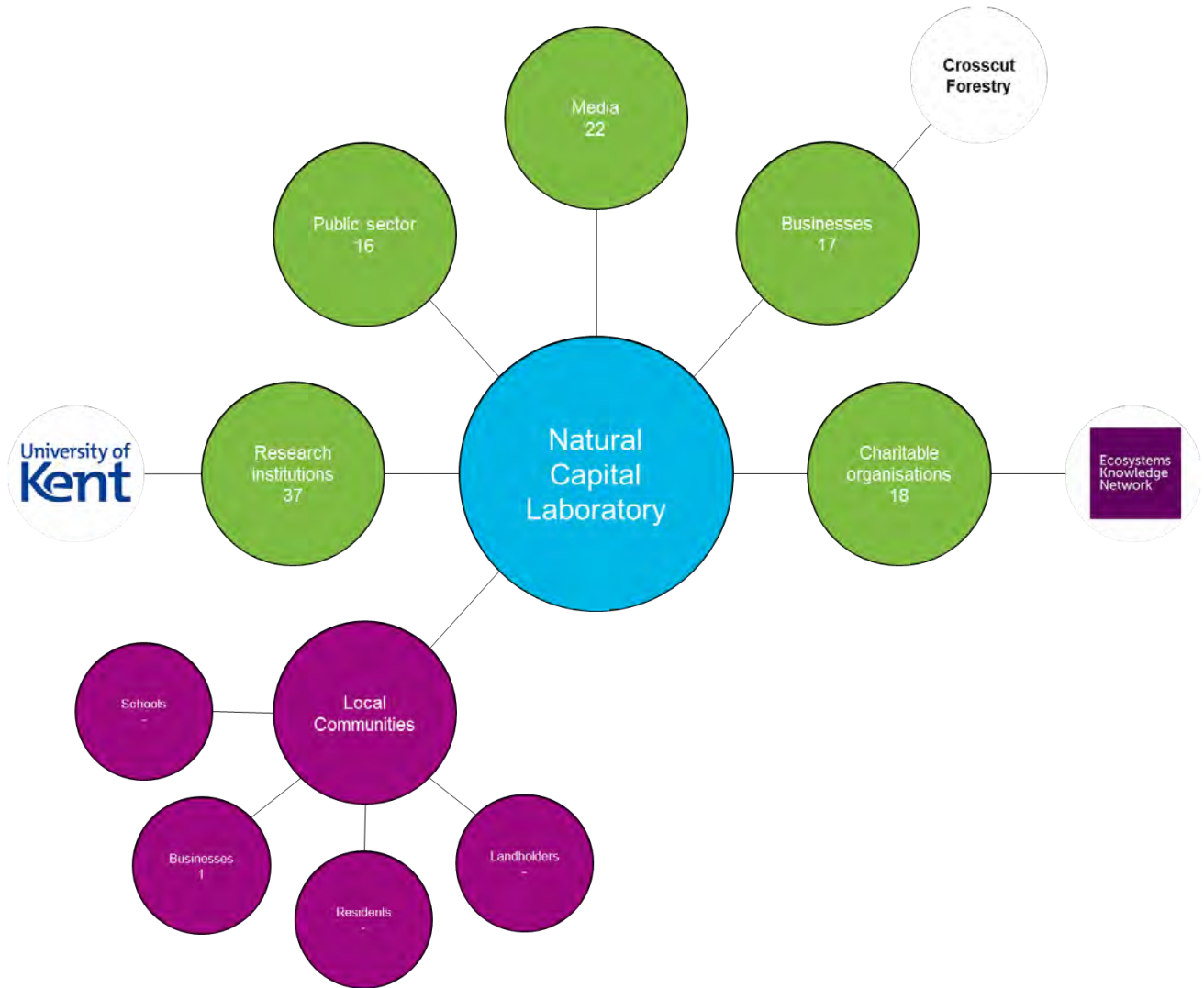
The structure of the social capital account mirrors the natural capital account and covers:

- The **extent of any relationships** built up as part of the project e.g. who are the local communities which may be impacted by decision-making on site, the wider communities which may be interested or inspired by what happens on the site, and the individuals and organisations directly working on the site?
- The **condition of those relationships** and how these change over time e.g. whether attitudes towards the project among local communities are changing over time, and what metrics can be used to monitor changes in those relationships?
- The **social exchanges that flow** from these relationships such as the wellbeing generated, levels of trust built up, opportunities for education, hours of volunteering work provided, changes in environmental or social attitudes, creativity encouraged, engagement with the environment, or potential positive or negative impacts on existing communities, their area, and their way of life.
- The **value of these exchanges** e.g. what is the benefit to the individuals and the NHS from improvements in wellbeing? What is the value of any education or volunteering provided? What is the knock-on effect of this project for individuals not directly involved in the project?
- The **maintenance costs** associated with maintaining these relationships e.g. in terms of the time

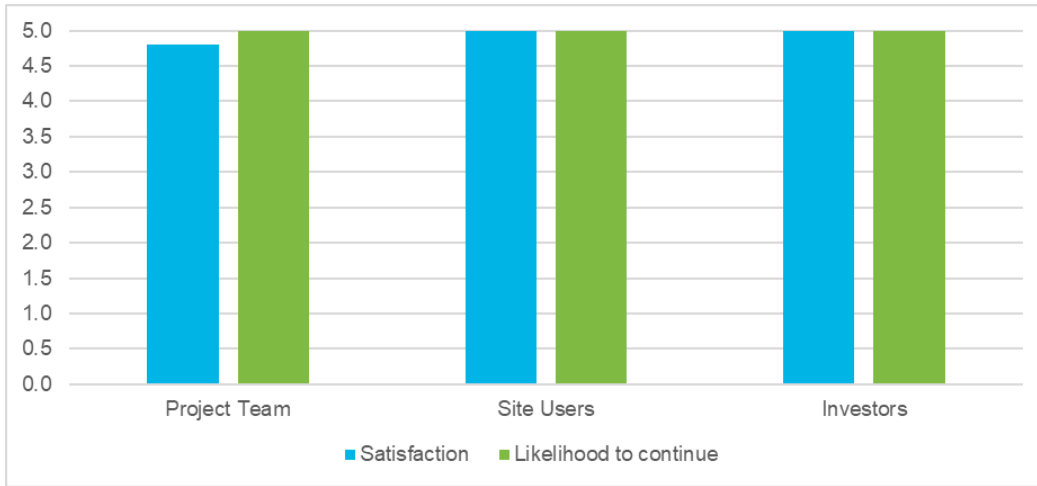
invested in engaging with project staff, stakeholders, and other interested and affected parties.

A summary of the baseline social capital account is set out in the diagrams and tables that follow. Further details are available in Appendix A.

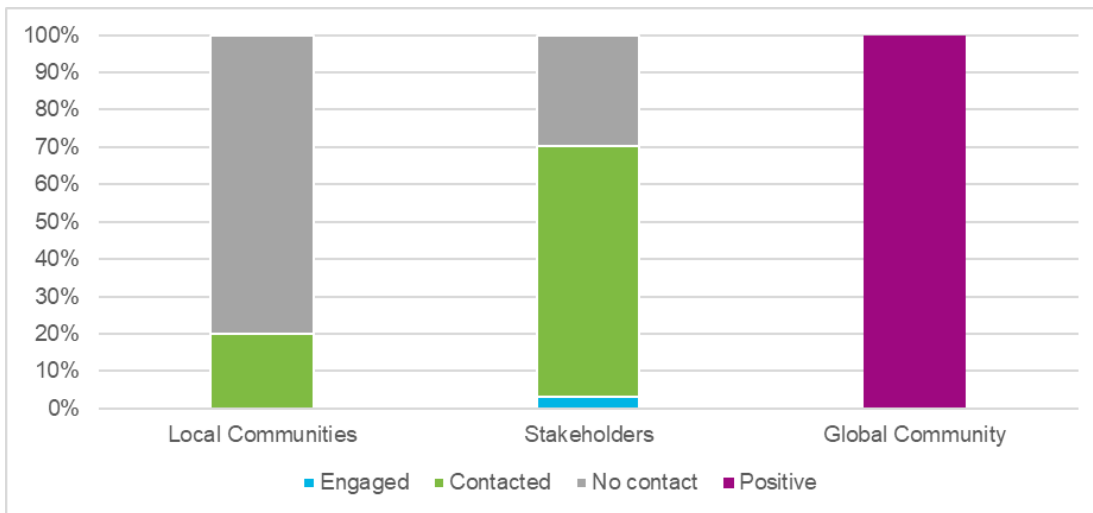
**Figure 9. Number of organisations engaged with the project – with actively engaged organisations highlighted**



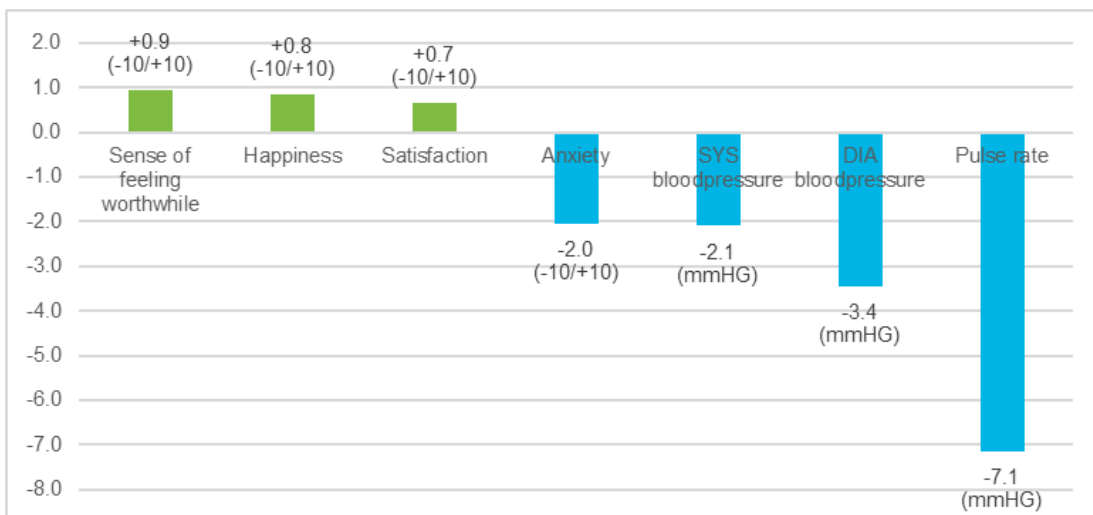
**Figure 10. Level of satisfaction and likelihood to continue engaging with the project for Project Team, Site Users, and Investors (0 = very low / unlikely and 5 = very high / likely)**



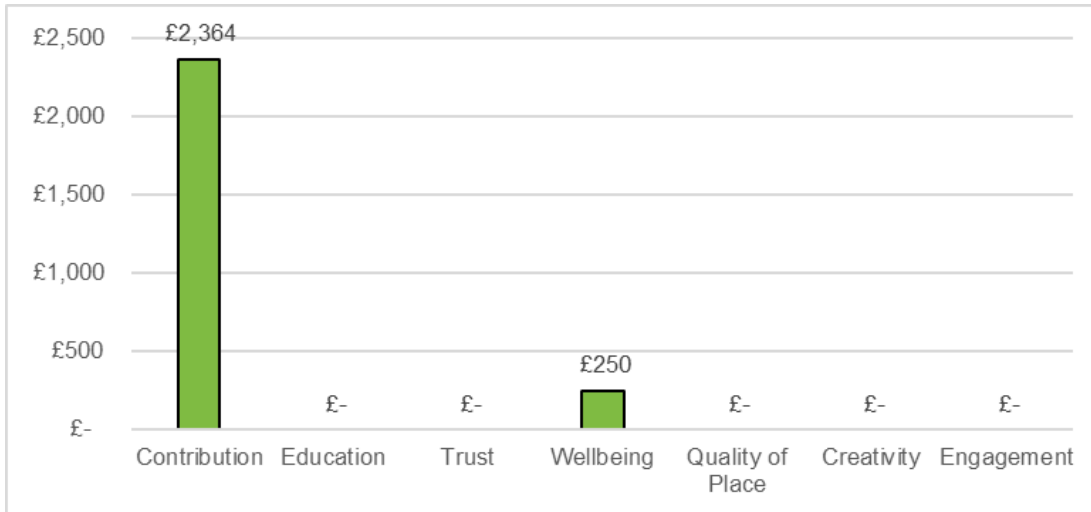
**Figure 11. Level of engagement with Local Communities and Stakeholders (% engaged, % contacted but not engaged, % not contacted) and with Global Community (% positive coverage in media)**



**Figure 12. Change in blood pressure, pulse rate, and wellbeing of visitors to site during their visit relative to before and after the visit**



**Figure 13. Estimate of the annual value of the social exchanges provided (2018 prices)**



**Table 3. Summary of the revised natural and social capital balance sheet**

Balance sheet 2019/20	Discounted Present Value over 25 years		
	Private value	External value	Total value
<b>Assets</b>			
<b>Natural capital</b>			
Timber	£0	-	£0
Energy (solar and biomass)	£13,000	-	£13,000
Water supply	£1,000	-	£1,000
Global climate regulation	-	£260,000	£260,000
Air quality regulation	-	£102,000	£102,000
Flood regulation	-	£77,000	£77,000
Water quality regulation	-	£43,000	£43,000
Recreation	£1,000	-	£1,000
Education	-	£0	£0
Biodiversity (charismatic species)	-	£36,000	£36,000
<b>Gross natural capital asset value</b>	<b>£15,000</b>	<b>£517,000</b>	<b>£533,000</b>
<b>Social capital</b>			
Contribution (volunteer time)	£40,000	-	£40,000
Wellbeing	-	£4,000	£4,000
<b>Gross social capital asset value</b>	<b>£40,000</b>	<b>£4,000</b>	<b>£45,000</b>
<b>Gross asset value</b>	<b>£56,000</b>	<b>£522,000</b>	<b>£577,000</b>
<b>Liabilities</b>	<b>Private costs</b>	<b>External costs</b>	<b>Total costs</b>
NCL running costs	(£142,000)	-	(£142,000)
Site running costs	(£61,000)	-	(£61,000)
<b>Total liabilities</b>	<b>(£203,000)</b>	<b>-</b>	<b>(£203,000)</b>
<b>Total net value</b>	<b>Private net value</b>	<b>External net value</b>	<b>Total net value</b>
<b>Total net value</b>	<b>(£147,000)</b>	<b>£522,000</b>	<b>£374,000</b>

Some of the key lessons learned from the development of the baseline social capital account are as follows:

- Social capital is an important component of rewilding and other environmental projects; focusing solely on environmental impacts is likely to overlook some of the key issues. The social capital accounting framework developed above (and detailed in Appendix A) provides a structured, quantitative framework for quantifying and valuing changes in social capital alongside natural capital.
- Incorporating social capital into the accounts increased the net value from £0.3 million to £0.4 million over a 25 year period – with volunteer time a key part of the value generated. However, many of the social exchanges identified were not quantified or valued and further research is needed in this area to measure flows of social exchanges such as trust, wellbeing, education, quality of place, creativity, and engagement.
- Further work on understanding social attitudes to rewilding is a key area of interest.
- It is interesting to note that surveys of visitors during and after site visits found measurable increases in subjective wellbeing and decreases in anxiety, blood pressure, and pulse rate when on site. Further research could be undertaken to explore this issue in more detail.

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# Next Steps

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## Overview

This section provides an overview of the aims and activities for Year 2 of the NCL.

## Aims

The NCL project is a collaboration between AECOM, the Lifescape Project, and the landowners. Each member of the collaboration has their own set of aims for this project in Year 2 and the coming years:

- AECOM is looking to continue to develop, test, and push forward innovation in environmental and social assessment work in order to develop better ways of collecting data, measuring and valuing environmental change, and communicating the findings in engaging ways to stakeholders.
- The Lifescape Project is looking to use the NCL as a platform to develop innovative ways of demonstrating how rewilding can be undertaken in practice at a site level, to explore how people can be engaged in rewilding, to understand and demonstrate the impact and value of the rewilding work taking place on the site, and to explore how tools and technologies can be used to build the evidence base needed to foster rewilding and conservation projects more generally.
- The landowners are looking to use the NCL project to demonstrate the increase in biodiversity value of the site that may be achieved through restoring the ecosystems and species which used to be there, as well as providing a place for people to re-engage with the environment and cultivate their creativity.

All members of the collaboration have a commitment to sharing the results of this project and engaging with other organisations to help tackle the issues of biodiversity loss and climate change. A key aim of Year 2 of the project will be to expand the number of organisations actively involved and contributing to the project.

## Activities

The workplan for Year 2 of the NCL is as follows:

- **Aquatic ecology** – work with NatureMetrics to undertake a full aquatic ecology baseline of the site, including eDNA analysis, and use this to recommend management measures such as the feasibility of reintroducing salmon and trout.
- **Remote sensing** – expand and develop the approach to remote sensing pioneered in Year 1, including using a multispectral camera to compare drone mapping against remote sensing mapping.
- **Social attitudes** – work with the University of Kent to set up a Masters Dissertation programme to provide ongoing surveys of social attitudes towards rewilding in the area compared against other sites in the UK.
- **Visualisation and auralisation** – develop an immersive, multi-user VR experience with full 3D model of the site which demonstrates the baseline and future scenarios for the site including both visual and auralisation.

- **Missing species** – work with the Universities of Cumbria and Kent to develop an approach for remote monitoring of species populations using camera trapping, engage with a wider range of stakeholders through a citizen science project, and assess the potential for species reintroductions at the site.
- **Tree planting** – work with local forestry manager, Crosscut Forestry, to develop a felling plan, fell and plant trees as set out in the plan, and develop an accessible path for the site, which could include a hide for wildlife watching.
- **Bog restoration** – assess the need for, and feasibility of, bog restoration on the site in order to ensure carbon capture is maximised and previous management measures inhibiting this habitat type's survival and growth are reversed.

Note, the workplan was devised prior to the COVID-19 pandemic. Given the current situation, all activities on site are currently paused and the plan for Year 2 will be revised once the situation becomes clearer.

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# Appendix A. Capitals Accounts

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## Overview

This appendix sets out the details of the Natural and Social Capital Accounts. It is divided into the following sections:

- Natural Capital Account: Scoping
- Natural Capital Account: Asset Register
- Natural Capital Account: Physical Flows Account
- Natural Capital Account: Monetary Flows Account
- Social Capital Account: Scoping
- Social Capital Account: Asset Register
- Social Capital Account: Physical Flows Account
- Social Capital Account: Monetary Flows Account
- Natural and Social Capital Account: Maintenance Cost Account
- Natural and Social Capital Account: Balance Sheet

Further details on the data and calculations, confidence intervals, and sensitivity testing are available upon request.



## Natural Capital Account: Scoping

Natural Capital Assets	Scoped-in	Justification
Ecosystems	✓	Range of different ecosystems on site
Species	✓	Range of species supported on site
Freshwater	✓	Freshwater river forms part of the site
Soil	✓	Soil is an important component of the site
Minerals	✗	Not considered within account as focus is on ecosystems
Atmosphere	✓	Air quality, ambience, and noise are important on site
Oceans	✗	No marine environments present on site

Abiotic Services	Scoped-in	Justification
Fossil fuels	✗	No significant use or supply on site
Mineral extraction	✗	No significant use or supply on site

Ecosystem Services	Scoped-in	Justification
Crops	✗	No significant use or supply on site
Livestock	✗	No significant use or supply on site
Fisheries	✗	No significant use or supply on site
Aquaculture	✗	No significant use or supply on site
Wild foods	✗	May be some supply on site but no significant use
Timber	✓	Commercial forest plantations on site
Energy	✓	Solar power generated and wood fuel harvested on site
Biochemicals & medicines	✗	No significant use or supply on site
Water supply	✓	Water abstracted from a well on site
Fibres & ornamental resources	✗	May be some supply on site but no significant use
Genetic resources	✗	Unlikely to be any resources of significant rarity on site
Local climate regulation	✗	Unlikely the site has a significant impact on the local climate
Global climate regulation	✓	Habitats on site sequester and emit carbon
Air quality regulation	✓	Habitats on site remove pollutants from the air
Flood regulation	✓	Habitats on site regulate the flow of water
Water quality regulation	✓	Habitats on site filter pollutants from the water
Pollination	✗	Unlikely to be significant issue on site
Disease & pest control	✗	Unlikely to be significant issue on site
Noise regulation	✗	Unlikely to be significant issue on site
Soil quality regulation	✗	Unlikely to be significant issue on site
Recreation	✓	Site is used for recreational visits
Education	✓	Site is (or will be) used for educational visits
Heritage	✗	Not possible to quantify at this stage
Aesthetic value	✓	Combination of habitats on site creates aesthetic value
Biodiversity	✓	Important species and habitats present on site
Supporting services	✗	Scoped out to avoid double counting

## Natural Capital Account: Asset Register (2019/20)

Ecosystems	Indicator	Criteria	2019/20	Units	
<b>Extent</b>					
Broad habitat area <sup>1</sup>	Coastal margins		0.00	ha	
	Enclosed farmland		0.00	ha	
	Freshwaters, wetlands, and floodplains		1.53	ha	
	Marine		0.00	ha	
	Mountains, moors, and heaths		5.54	ha	
	Semi-natural grasslands		0.62	ha	
	Urban		0.81	ha	
	Woodland		34.15	ha	
	<b>Total area</b>		<b>42.65</b>	<b>ha</b>	
Woodland area	Broadleaved plantation		0.05	ha	
	Broadleaved semi-natural woodland		8.25	ha	
	Conifer plantation		12.38	ha	
	Mixed plantation		1.02	ha	
	Felled conifer plantation		12.46	ha	
	<b>Total area</b>		<b>34.15</b>	<b>ha</b>	
<b>Condition</b>					
Broad habitat area <sup>1</sup>	Coastal margins	Poor	0.00	%	
		Moderate	0.00	%	
		Good	0.00	%	
	Enclosed farmland	Poor	0.00	%	
		Moderate	0.00	%	
		Good	0.00	%	
	Freshwaters, wetlands, and floodplains	Poor	0.00	%	
		Moderate	0.00	%	
		Good	1.00	%	
	Marine	Poor	0.00	%	
		Moderate	0.00	%	
		Good	0.00	%	
	Mountains, moors, and heaths	Poor	0.38	%	
		Moderate	0.60	%	
		Good	0.02	%	
	Semi-natural grasslands	Poor	0.00	%	
		Moderate	0.74	%	
		Good	0.26	%	
	Urban	Poor	1.00	%	
		Moderate	0.00	%	
		Good	0.00	%	
	Woodland	Poor	0.73	%	
		Moderate	0.07	%	
		Good	0.20	%	
	Woodland area	Broadleaved plantation	Poor	1.00	%
			Moderate	0.00	%
			Good	0.00	%
Broadleaved semi-natural woodland		Poor	0.02	%	
		Moderate	0.16	%	
		Good	0.82	%	
Conifer plantation		Poor	1.00	%	
		Moderate	0.00	%	
		Good	0.00	%	

Ecosystems	Indicator	Criteria	2019/20	Units
	Mixed plantation	Poor	0.00	%
		Moderate	1.00	%
		Good	0.00	%
	Felled conifer plantation	Poor	1.00	%
		Moderate	0.00	%
		Good	0.00	%

Species	Indicator	Criteria	2019/20	Units
<b>Extent</b>				
Species richness (all) <sup>2</sup>	Amphibian	Total	1	no.
	Bird	Total	31	no.
	Invertebrate	Total	7	no.
	Mammal	Total	6	no.
	Reptile	Total	1	no.
	<b>Total species</b>	<b>Total</b>	<b>46</b>	<b>no.</b>
Species surveys (all) <sup>3</sup>	Breeding birds	Total	28	no.
	Butterflies & dragonflies	Total	4	no.
Species richness (BAP) <sup>2</sup>	Amphibian	BAP	0	no.
	Bird	BAP	6	no.
	Invertebrate	BAP	0	no.
	Mammal	BAP	3	no.
	Reptile	BAP	1	no.
	<b>Total species</b>	<b>BAP</b>	<b>10</b>	<b>no.</b>
Species surveys (BAP) <sup>3</sup>	Breeding birds	BAP	5	no.
	Butterflies & dragonflies	BAP	0	no.

Freshwater	Indicator	Criteria	2019/20	Units
<b>Extent<sup>1</sup></b>				
Rivers	Length of rivers		1.1	km
Water inflows	Annual rainfall		645	mm/year
<b>Condition<sup>4</sup></b>				
Rivers	WFD status overall		Good	WFD criteria
	Net gain condition assessment		Good	Poor/Mod/Good
Groundwaters	WFD status overall		Good	WFD criteria
Flooding	Likelihood of flooding		High	High/Med/Low

Atmosphere	Indicator	Criteria	2019/20	Units
<b>Condition</b>				
Noise <sup>5</sup>	LA90 (dB)		40.9	dB
	LA10 (dB)		43.9	dB
	<b>Average</b>		<b>42.4</b>	<b>dB</b>

Footnotes:

<sup>1</sup> Habitat extent and condition based on a Biodiversity Net Gain assessment undertaken by trained ecologists using Biodiversity Metric 2.0

<sup>2</sup> Includes all species recorded during surveys as well as ad-hoc sightings during site visits and downloaded from camera traps

<sup>3</sup> Based on specific surveys undertaken by trained ecologists using standardised techniques

<sup>4</sup> Assessment of condition based on desktop survey except for Net Gain assessment

<sup>5</sup> Average value from recordings made at eight specific locations on site

## Natural Capital Account: Physical Flows Account (2019/20)

Spatial accounting unit	Indicator	Units	2019/20
<b>Timber<sup>1</sup></b>			
Woodland	Total timber harvest	m3/yr	0
<b>Energy</b>			
Urban <sup>2</sup>	Energy produced	kWh/yr	2,165
Woodland <sup>3</sup>	Energy produced	kWh/yr	3,989
<b>Water supply<sup>4</sup></b>			
Site level	Water abstracted for use	m3/yr	15
<b>Global climate regulation<sup>5</sup></b>			
Mountains, moors, and heaths	Carbon sequestered	t/CO2e/yr	8
Semi-natural grasslands	Carbon sequestered	t/CO2e/yr	0.25
Woodland	Carbon sequestered	t/CO2e/yr	216
<b>Air quality regulation<sup>6</sup></b>			
Mountains, moors, and heaths	Pollutants removed	t/yr	0.28
Open water, wetland, and floodplain	Pollutants removed	t/yr	0.06
Semi-natural grassland	Pollutants removed	t/yr	0.03
Woodland	Pollutants removed	t/yr	3.26
<b>Flood regulation<sup>7</sup></b>			
Mountains, moors, and heaths	Water stored	m3/yr	8,645
Woodland	Water stored	m3/yr	13,831
<b>Water quality regulation<sup>8</sup></b>			
Mountains, moors, and heaths	Pollutants removed	kg/N/yr	1,068
Woodland	Pollutants removed	kg/N/yr	1,326
<b>Recreation<sup>9</sup></b>			
Site level	Recreational visits	visits/yr	22
<b>Education<sup>10</sup></b>			
Site level	Educational visits	visits/yr	0
<b>Aesthetic value<sup>11</sup></b>			
Site level	Aesthetic value	-	-
<b>Biodiversity: habitat<sup>12</sup></b>			
Freshwaters, wetlands, and floodplains	Biodiversity units	units/yr	0
Mountains, moors, and heaths	Biodiversity units	units/yr	0
Semi-natural grasslands	Biodiversity units	units/yr	0
Urban	Biodiversity units	units/yr	0
Woodland	Biodiversity units	units/yr	0
<b>Biodiversity: charismatic species<sup>13</sup></b>			
Red squirrel population	Red squirrels	no./yr	7
Pine marten population	Pine martens	-	-

### Footnotes:

<sup>1</sup> No timber harvested during the period

<sup>2</sup> Based on energy produced from solar panels

<sup>3</sup> Based on wood fuel used from site

<sup>4</sup> Based on estimate of water abstracted from well on site

<sup>5</sup> Based on estimates of carbon sequestration set out in: Natural England (2010) 'England's peatlands: carbon storage and greenhouse gases'; and Christie et al. (2010) 'Economic valuation of the benefits of ecosystem services delivered by the UK Biodiversity Action Plan'

<sup>6</sup> Based on pollution removal rates in CEH (2017) 'Developing Estimates for the Valuation of Air Pollution Removal in Ecosystem Accounts'

<sup>7</sup> Based on water storage estimates set out in: Forest Research (2018) 'Valuing flood regulation services of existing forest cover to inform natural capital accounts'; Defra (2020), 'ENCA Services Databook'; and Lane (2010) 'Calculating the ecosystem service of water storage in isolated wetlands using LiDAR in north central Florida, USA (presentation)'

<sup>8</sup> Based on estimates of nitrogen removal set out in: Gumiero (2011) 'Nitrogen removal by an irrigated wooded buffer area'; Meyerhoff (2004) 'The European Water Framework Directive and Economic Valuation of Wetlands'; and Defra (2020), 'ENCA Services Databook'

<sup>9</sup> Based on number of visits recorded to site during the period – excluding visits undertaken for work and/or research

<sup>10</sup> No educational visits recorded during the period

<sup>11</sup> Not included within this version of the account

<sup>12</sup> Based on net change in the number of biodiversity units – as this is the baseline year this value is zero

<sup>13</sup> Based on survey of squirrel population on site using pine cone feeding transects, no data available for pine marten populations

## Natural Capital Account: Monetary Flows Account (2019/20)

Spatial accounting unit	Indicator	Units	2019/20 (2018 prices)	Private / External
<b>Timber<sup>1</sup></b>				
Woodland	Total timber harvest	£/yr	£0	Private
<b>Energy<sup>2</sup></b>				
Site level	Energy produced	£/yr	£785	Private
<b>Water supply<sup>3</sup></b>				
Site level	Water abstracted for use	£/yr	£36	Private
<b>Global climate regulation<sup>4</sup></b>				
Mountains, moors, and heaths	Carbon sequestered	£/yr	£561	External
Semi-natural grasslands	Carbon sequestered	£/yr	£17	External
Woodland	Carbon sequestered	£/yr	£14,660	External
<b>Air quality regulation<sup>5</sup></b>				
Mountains, moors, and heaths	Pollutants removed	£/yr	£276	External
Freshwaters, wetlands, and floodplains	Pollutants removed	£/yr	£63	External
Semi-natural grassland	Pollutants removed	£/yr	£51	External
Woodland	Pollutants removed	£/yr	£15,770	External
<b>Flood regulation<sup>6</sup></b>				
Mountains, moors, and heaths	Water stored	£/yr	£2,574	External
Woodland	Water stored	£/yr	£1,922	External
<b>Water quality regulation<sup>7</sup></b>				
Mountains, moors, and heaths	Pollutants removed	£/yr	£1,119	External
Woodland	Pollutants removed	£/yr	£1,922	External
<b>Recreation<sup>8</sup></b>				
Site level	Recreational visits	£/yr	£84	Private
<b>Education<sup>9</sup></b>				
Site level	Educational visits	£/yr	£0	External
<b>Aesthetic value<sup>10</sup></b>				
Site level	Aesthetic rating	£/yr	-	-
<b>Biodiversity: habitat<sup>11</sup></b>				
Freshwaters, wetlands, and floodplains	Biodiversity units	£/yr	-	-
Mountains, moors, and heaths	Biodiversity units	£/yr	-	-
Semi-natural grasslands	Biodiversity units	£/yr	-	-
Urban	Biodiversity units	£/yr	-	-
Woodland	Biodiversity units	£/yr	-	-
<b>Biodiversity: species<sup>12</sup></b>				
Red squirrel population	Red squirrels	£/yr	£2,123	External
Pine marten population	Pine martens	£/yr	-	-

### Footnotes:

<sup>1</sup> No timber sold during the period

<sup>2</sup> Value estimate based on market value of wood fuel and solar energy produced

<sup>3</sup> Value estimate based on market value of water abstracted on site

<sup>4</sup> Value estimate based on the non-traded carbon price set out in BEIS (2019) 'Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal'

<sup>5</sup> Value estimate based on CEH (2017) 'Developing Estimates for the Valuation of Air Pollution Removal in Ecosystem Accounts'

<sup>6</sup> Value estimate based on a triangulation of studies including: Europe Economics (2015) 'The economic benefits of woodland'; Forest Research (2018) 'Valuing flood regulation services of existing forest cover to inform natural capital accounts'; Ricardo (2016) 'Valuing flood-regulation services for inclusion in the UK ecosystem accounts'; Defra (2020), 'ENCA Services Databook'; and Brander et al. (2011) 'Economic assessment of freshwater, wetland and floodplain'

<sup>7</sup> Value estimate based on Defra (2020), 'ENCA Services Databook';

<sup>8</sup> Value estimate based on Forestry Commission (2017) 'Valuing the social and environmental contribution of woodlands and trees in England, Scotland and Wales'

<sup>9</sup> No educational visits during the period

<sup>10</sup> No valuation approach included within this version of the account

<sup>11</sup> Value estimate based on cost per biodiversity unit although no biodiversity units created or lost during the period

<sup>12</sup> Value estimate based for red squirrels based on White (2001) 'The use of willingness-to-pay approaches in mammal conservation' – no estimates available for pine martens

## Social Capital Account: Scoping

Social Capital Assets	Scoped-in	Justification
Project Team	✓	Employees and volunteers are key to the project
Site Users	✓	Visitors to the site are of key importance
Customers	✗	Not applicable to this project
Local Communities	✓	Community buy-in to rewilding projects is key
Stakeholders	✓	There are a range of stakeholder relationships to be managed
Investors	✓	The project is reliant on investor funding for its continuation
Suppliers	✗	Captured within the Project Team section
Global Community	✓	The project has a media and social media presence

Social Exchanges	Scoped-in	Justification
Contribution	✓	The project involves volunteer time
Education	✓	The project has a strong emphasis on education and research
Trust	✓	Trust is key to rewilding projects
Wellbeing	✓	Understanding and promoting wellbeing is key to the project
Quality of Place	✓	Rewilding can impact upon the quality of a place
Creativity	✓	Understanding and promoting creativity is key to the project
Engagement	✓	Engaging people in the project and rewilding is a key aim

## Social Capital Account: Asset Register (2019/20)

Project Team	Indicator	Criteria	2019/20	Units
<b>Extent</b>				
Employees	No. people working from AECOM		59	no.
	No. people working from Lifescape Project		1	no.
	No. people working from other organisations		3	no.
Volunteers	No. people volunteering from AECOM		3	no.
	No. people volunteering from Lifescape Project		5	no.
	No. people volunteering from other organisations		6	no.
<b>Condition</b>				
Satisfaction <sup>1</sup>	Level of enjoyment of being involved in project		4.8	1-5
	Level of interest of continuing to be involved		5.0	1-5

Site Users	Indicator	Criteria	2019/20	Units
<b>Extent<sup>2</sup></b>				
Visitors	No. site visits for recreation		22	no.
	No. site visits for volunteering		7	no.
	No. site visits for work / research		21	no.
Status	AB		0.50	%
	C1		0.50	%
	C2		0.00	%
	DE		0.00	%
Gender	Male		0.57	%
	Female		0.43	%
Disability status	Disabled		0.00	%
	Not disabled		1.00	%
Ethnicity	White		0.93	%
	Not white		0.07	%
<b>Condition<sup>2</sup></b>				
Satisfaction	Level of enjoyment of visiting the site		5.0	1-5
	Level of interest in visiting again		5.0	1-5

Local Communities <sup>3</sup>	Indicator	Criteria	2019/20	Units
<b>Extent</b>				
Residents	No. people living in the local area identified		-	no.
Landholders	No. landholders in the local area identified		-	no.
Businesses	No. businesses in the local area identified		2	no.
Schools	No. schools in the local area identified		3	no.
<b>Condition</b>				
Engagement	% that have been engaged about the project	Actively engaged	0.00	%
		Contacted	0.20	%
		Not contacted	0.80	%

Stakeholders	Indicator	Criteria	2019/20	Units
<b>Extent</b>				
Businesses	No. stakeholders identified		17	no.
Charities	No. stakeholders identified		18	no.
Media	No. stakeholders identified		22	no.
Public Sector	No. stakeholders identified		16	no.
Research Institutions	No. stakeholders identified		37	no.
<b>Condition</b>				
Engagement	% that have been engaged about the project	Actively engaged	0.03	%
		Contacted	0.68	%
		Not contacted	0.30	%

Investors	Indicator	Criteria	2019/20	Units
<b>Extent</b>				
Investors	No. organisations contributing to project		3	no.
<b>Condition</b>				
Satisfaction <sup>4</sup>	Level of satisfaction with the project		5.0	1-5
	Likelihood of funding in future		5.0	1-5

Global Community	Indicator	Criteria	2019/20	Units
<b>Extent</b>				
Social Media	No. reached on Instagram <sup>5</sup>		89	no.
	No. reached on AECOM Twitter <sup>6</sup>		1,700	no.
	No. reached on AECOM LinkedIn <sup>7</sup>		43,000	no.
	No. reached on other Twitter accounts <sup>8</sup>		27	no.
	No. reached on website <sup>9</sup>		-	no.
Media	No. reached by articles in the media <sup>10</sup>		563,669	no.
	No. reached by internally produced articles <sup>11</sup>		5,600	no.
Events	No. reached by seminars and presentations <sup>12</sup>		725	no.
Other	No. users of virtual reality experience <sup>13</sup>		-	no.
<b>Condition</b>				
Media	% of positive vs. negative press coverage <sup>14</sup>	Positive	1.00	%
		Negative	0.00	%

Footnotes:

- <sup>1</sup> Based on survey of Project Team  
<sup>2</sup> Based on survey of Site Users  
<sup>3</sup> Defined as within a 30 minute drive of the site  
<sup>4</sup> Based on survey of Investors  
<sup>5</sup> Based on followers of @birchfieldshighlands  
<sup>6</sup> Based on views of the NCL video published on AECOM Twitter  
<sup>7</sup> Based on views of the NCL video published on AECOM LinkedIn  
<sup>8</sup> Based on number of external tweets about "Natural Capital Laboratory"  
<sup>9</sup> Digital Natural Capital Accounting Platform not made public by 30 March 2020  
<sup>10</sup> Based on calculations of press impact from standard industry publications  
<sup>11</sup> Based on publication of 7 articles assuming an average of 800 readers per article from:  
<https://academia.stackexchange.com/questions/1206/how-many-people-read-an-individual-journal-article>  
<sup>12</sup> Based on a total of 25 events with an average of 29 attendees per event  
<sup>13</sup> Virtual reality experience not made public by 30 March 2020  
<sup>14</sup> Based on high level content analysis



## Social Capital Account: Physical Flows Account (2019/20)

Social accounting unit	Indicator	Units	2019/20
<b>Contribution</b>			
Project Team <sup>1</sup>	Volunteer hours	hrs/yr	204
<b>Education</b>			
Project Team <sup>2</sup>	Masters Dissertations	no./yr	1
<b>Trust<sup>3</sup></b>			
-	-	-	-
<b>Wellbeing</b>			
Site Users	QALY's generated <sup>4</sup>	no./yr	0.010
	Change in satisfaction <sup>5</sup>	-10 to +10	0.7
	Change in feeling of worth <sup>5</sup>	-10 to +10	0.9
	Change in happiness <sup>5</sup>	-10 to +10	0.8
	Change in anxiety <sup>5</sup>	-10 to +10	-2.0
	Change in SYS bloodpressure <sup>6</sup>	mmHG	-2.1
	Change in DIA bloodpressure <sup>6</sup>	mmHG	-3.4
	Change in pulse rate <sup>6</sup>	PAR	-7.1
<b>Quality of Place<sup>3</sup></b>			
-	-	-	-
<b>Creativity<sup>3</sup></b>			
-	-	-	-
<b>Engagement<sup>3</sup></b>			
-	-	-	-

### Footnotes:

<sup>1</sup> Based on total volunteer time provided to NCL Steering Group and tree planting activities

<sup>2</sup> Based on number of Masters Dissertations completed about the NCL project

<sup>3</sup> Not included in this version of the account

<sup>4</sup> Based on an estimate of the exercise benefits provided by activities undertaken on site using data drawn from White et al. (2016), 'Recreational Physical Activity in Natural Environments and Implications for Health: A Population Based Cross-Sectional Study in England' and Natural England (2017), 'Monitor of Engagement with the Natural Environment'

<sup>5</sup> Based on subjective wellbeing questionnaire of site visitors before and after visit

<sup>6</sup> Based on blood pressure monitoring of site visitors before and after visit

## Social Capital Account: Monetary Flows Account (2019/20)

Social accounting unit	Indicator	Units	2019/20 (2018 prices)	Private / External
<b>Contribution</b>				
Project Team <sup>1</sup>	Volunteer hours	£/yr	£2,364	Private
<b>Education</b>				
Project Team <sup>2</sup>	Master's dissertations	£/yr	-	External
<b>Trust<sup>2</sup></b>				
-	-	-	-	
<b>Wellbeing</b>				
Site Users	QALY's generated <sup>3</sup>	£/yr	£250	External
	Change in satisfaction <sup>2</sup>	£/yr	-	External
	Change in feeling of worth <sup>2</sup>	£/yr	-	External
	Change in happiness <sup>2</sup>	£/yr	-	External
	Change in anxiety <sup>2</sup>	£/yr	-	External
	Change in SYS bloodpressure <sup>2</sup>	£/yr	-	External
	Change in DIA bloodpressure <sup>2</sup>	£/yr	-	External
	Change in pulse rate <sup>2</sup>	£/yr	-	External
<b>Quality of Place<sup>2</sup></b>				
-	-	-	-	
<b>Creativity<sup>2</sup></b>				
-	-	-	-	
<b>Engagement<sup>2</sup></b>				
-	-	-	-	

Footnotes:

<sup>1</sup> Based on average of the minimum and median hourly wage

<sup>2</sup> Not included in this version of the account

<sup>3</sup> Based on QALY estimate of £25,000 taken from average of £20,000 to £30,000 estimated by NICE

## Natural and Social Capital Account: Maintenance Cost Account (2019/20)

Cost items <sup>1</sup>	Units	Annual cost	Private / External
Costs of running the NCL	£/yr	(£30,336)	Private
Costs of managing the site	£/yr	(£3,600)	Private
<b>Total</b>	<b>£/yr</b>	<b>(£33,936)</b>	

Footnotes:

<sup>1</sup> Note, given the potential for overlap the maintenance cost account was prepared for both the natural and social capital as one – all cost estimates taken from the figures for Year 1 of the project

## Natural and Social Capital Account: Balance Sheet (2019/20)

Balance sheet 2019/20 <sup>1</sup>	Discounted Present Value over 25 years <sup>2</sup>		
Assets	Private value	External value	Total value
<b>Natural capital</b>			
Timber	£0	-	£0
Energy	£13,000	-	£13,000
Water supply	£1	-	£1
Global climate regulation	-	£260,000	£260,000
Air quality regulation	-	£102,000	£102,000
Flood regulation	-	£77,000	£77,000
Water quality regulation	-	£43,000	£43,000
Recreation	£1,000	-	£1,000
Education	-	£0	£0
Biodiversity: charismatic species	-	£36,000	£36,000
<b>Gross natural capital asset value</b>	<b>£15,000</b>	<b>£517,000</b>	<b>£533,000</b>
<b>Social capital</b>			
Contribution	£40,000	-	£40,000
Wellbeing	-	£4,000	£4,000
<b>Gross social capital asset value</b>	<b>£40,000</b>	<b>£4,000</b>	<b>£45,000</b>
<b>Gross asset value</b>	<b>£56,000</b>	<b>£522,000</b>	<b>£577,000</b>
<b>Liabilities</b>	<b>Private costs</b>	<b>External costs</b>	<b>Total costs</b>
NCL costs	(£142,000)	-	(£142,000)
Site costs	(£61,000)	-	(£61,000)
<b>Total liabilities</b>	<b>(£203,000)</b>	<b>-</b>	<b>(£203,000)</b>
<b>Total net value</b>	<b>Private</b>	<b>External</b>	<b>Total</b>
<b>Total net value</b>	<b>(£147,000)</b>	<b>£522,000</b>	<b>£374,000</b>

Footnotes:

<sup>1</sup> Note, given the potential for overlap the balance sheet was prepared for both the natural and social capital as one

<sup>2</sup> All figures rounded to nearest thousand

# Appendix B. Net Gain Baseline

## Biodiversity Metric 2.0

This appendix sets out the results of the biodiversity assessment undertaken on the site in May 2019. All biodiversity units were calculated using the Biodiversity Metric 2.0.

Phase 1 code	Phase 1 habitat	Metric 2.0 habitat	Condition	Area (ha)	Units
E2.1	Acid flush	Wetland - Fens (upland & lowland)	Fairly poor	0.02	0.26
E2.1	Acid flush	Wetland - Fens (upland & lowland)	Good	0.12	3.52
E2.1	Acid flush	Wetland - Fens (upland & lowland)	Moderate	0.18	3.42
E2.1	Acid flush	Wetland - Fens (upland & lowland)	Moderate	0.05	0.98
E2.1	Acid flush	Wetland - Fens (upland & lowland)	Moderate	0.12	2.34
E2.1	Acid flush	Wetland - Fens (upland & lowland)	Moderate	0.04	0.85
E2.1	Acid flush	Wetland - Fens (upland & lowland)	Moderate	0.08	1.55
E2.1	Acid flush	Wetland - Fens (upland & lowland)	Moderate	0.07	1.30
A1.1.2	Broadleaved plantation	Woodland & forest - Other woodland; broadleaved	Fairly poor	0.05	0.34
A1.1.2	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous	Fairly poor	0.19	2.07
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.02	0.41
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.05	1.14
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.36	7.84
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	1.56	33.91
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	1.04	22.57
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.24	5.21
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.03	0.63
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.03	0.75
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.07	1.45
A1.1.1W	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	1.76	38.25
A1.1.1W	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.03	0.69
A1.1.1W	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.21	4.60
A1.1.1W	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.07	1.46
A1.1.1W	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.03	0.62
A1.1.1W	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.02	0.47
A1.1.1W	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.03	0.69
A1.1.1W	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.09	1.98
A1.1.1Wp	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.37	8.04
A1.1.1Wp	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.33	7.11
A1.1.1Wp	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Good	0.43	9.26
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Moderate	0.09	1.32
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Moderate	0.11	1.57
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Moderate	0.49	7.12
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Moderate	0.01	0.15
A1.1.1W	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Moderate	0.28	4.10
A1.1.1Wp	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Moderate	0.31	4.52
A1.1.1	Broadleaved semi-natural woodland	Woodland & forest - Lowland mixed deciduous woodland	Poor	0.01	0.09
Built-up	Built-up (buildings, tracks, etc.)	Urban - Developed land; sealed surface	Poor	0.12	0.00
Built-up	Built-up (buildings, tracks, etc.)	Urban - Developed land; sealed surface	Poor	0.57	0.00
Built-up	Built-up (buildings, tracks, etc.)	Urban - Developed land; sealed surface	Poor	0.01	0.00
A1.2.2	Conifer plantation	Woodland & forest - Other coniferous woodland	Poor	3.89	8.56
A1.2.2	Conifer plantation	Woodland & forest - Other coniferous woodland	Poor	1.26	2.76
A1.2.2	Conifer plantation	Woodland & forest - Other coniferous woodland	Poor	0.11	0.25
A1.2.2	Conifer plantation	Woodland & forest - Other coniferous woodland	Poor	0.92	2.03
A1.2.2	Conifer plantation	Woodland & forest - Other coniferous woodland	Poor	5.83	12.82
A1.2.2WB	Conifer plantation	Woodland & forest - Other coniferous woodland	Poor	0.14	0.31
A1.2.2WB	Conifer plantation	Woodland & forest - Other coniferous woodland	Poor	0.22	0.49
C1.1	Dense bracken	Grassland - Bracken	Moderate	0.17	1.47
C1.1	Dense bracken	Grassland - Bracken	Moderate	0.03	0.28
A4.2	Felled conifer plantation	Woodland & forest - Felled	Poor	1.21	5.32
A4.2	Felled conifer plantation	Woodland & forest - Felled	Poor	0.46	2.01
A4.2	Felled conifer plantation	Woodland & forest - Felled	Poor	7.66	33.72
A4.2	Felled conifer plantation	Woodland & forest - Felled	Poor	3.13	13.77
B5	Marshy grassland	Grassland - Other neutral grassland	Moderate	0.25	2.19

Phase 1 code	Phase 1 habitat	Metric 2.0 habitat	Condition	Area (ha)	Units
B5	Marshy grassland	Grassland - Other neutral grassland	Moderate	0.19	1.66
B5	Marshy grassland	Grassland - Other neutral grassland	Moderate	0.01	0.12
A1.3.2	Mixed plantation	Woodland & forest - Other woodland; mixed	Moderate	1.02	8.93
G2.3	Oligotrophic running water	Rivers & Streams (Other)	Good	0.12	1.81
G2.3	Oligotrophic running water	Rivers & Streams (Other)	Good	1.41	20.49
I2.1	Quarry	Urban - Sand pit quarry or open cast mine	Poor	0.11	0.24
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Good	0.03	0.37
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Good	0.01	0.08
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Good	0.06	0.84
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Good	0.05	0.61
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Good	0.01	0.10
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Good	0.01	0.14
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Moderate	0.28	2.42
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Moderate	0.09	0.82
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Moderate	0.08	0.69
B1.1	Unimproved acid grassland	Grassland - Upland acid grassland	Moderate	0.01	0.10
D2	Wet heath	Heathland & shrub - Upland Heathland	Moderate	0.09	1.26
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.46	6.66
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.11	1.64
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.03	0.42
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.52	7.54
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.03	0.41
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.03	0.41
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.04	0.58
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.06	0.88
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.04	0.57
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.01	0.15
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.02	0.24
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.02	0.30
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.00	0.07
E1.7A1.1.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.01	0.13
E1.7E2.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.34	4.94
E1.7E2.1	Wet modified bog	Wetland - Lowland raised bog	Fairly poor	0.36	5.25
E1.7	Wet modified bog	Wetland - Lowland raised bog	Moderate	0.53	10.25
E1.7	Wet modified bog	Wetland - Lowland raised bog	Moderate	0.01	0.27
E1.7	Wet modified bog	Wetland - Lowland raised bog	Moderate	0.03	0.52
E1.7	Wet modified bog	Wetland - Lowland raised bog	Moderate	0.04	0.75
E1.7	Wet modified bog	Wetland - Lowland raised bog	Moderate	0.18	3.46
E1.7	Wet modified bog	Wetland - Lowland raised bog	Moderate	0.04	0.78
E1.7	Wet modified bog	Wetland - Lowland raised bog	Moderate	0.06	1.13
E1.7	Wet modified bog	Wetland - Lowland raised bog	Moderate	0.49	9.52
E1.7A1.1.2	Wet modified bog	Wetland - Lowland raised bog	Moderate	0.67	12.91
<b>Total</b>				<b>42.65</b>	<b>379.01</b>