MoorLIFE 2020:

D5 Update Report 2016:

A guide to the project carbon audit processes and protocols, including a presentation of Year 1 project audit figures

August 2016

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Contents

List of Tables

1. Project timescales and reporting

The MoorLIFE 2020 project (ML2020) started on 1st October 2015. To align the carbon audit with financial year reporting, Year 1 of the audit runs from the project start date until the end of the financial year: 31st March 2016, totalling six months' duration. Year 2 of the carbon audit follows the next complete financial year, April 1st 2016 to March 31st 2017. Years 3, 4, and 5 audit the financial years 2017-18, 2018-19 and 2019-20 respectively. Finally, Year 6 of the audit will run from 1st April 2020 until the project end date in the financial year 2020-21 (est. January 2021).

2. Scope and boundaries of the MoorLIFE 2020 project carbon audit

The scope of the ML2020 carbon audit is defined as those activities carried out for, and invoiced to, the full suite of ML2020 project actions.

In addition, where possible, supply chain emissions will be considered for reporting in the audit.

MFFP follow guidelines issued by the Department of Environment and Rural Affairs (Defra) for UK organisations and businesses complying with GHG reporting regulations. MFFP follow the Defra Guidelines (2013) where possible in order to produce a first order estimate of GHG emissions to a recognised national standard (Maskill *et al.* 2015).

The Defra guidelines state the importance of identifying the activities in an organisation (or in this case, the project) that are responsible for GHG emissions, and from which areas of an organisation (or project) information needs to be gathered.

There are three recognised groups of emissions-releasing activities which are stated as follows:

"Scope 1 – Direct emissions: Activities owned or controlled by your organisation that release emissions straight into the atmosphere. They are direct emissions."

"Scope 2 – Energy indirect: Emissions being released into the atmosphere associated with consumption of purchased electricity, heat, steam and cooling. These are consequences of an organisation's activities, but occur at sources not owned or controlled by the organisation."

"Scope 3 – Other indirect: Emissions that are a consequence of your actions, which occur at sources which are not owned or controlled, and which are not classed as scope 2 emissions."

Scope 1 and scope 2 emissions are the recommended emissions types to audit, and scope 3 are discretionary. Scope 3 emissions can be especially important because there is a risk, should the organisation or business responsible for those emissions undertake a carbon audit, of double counting. However, it is acknowledged that it can be difficult to identify whether emissions fall into scope 1 or scope 3.

The ML2020 project will contract out most of the concrete conservation (C) actions hence the following activities often fall within scope 3: delivery by road, flying, contractor travel, material production (e.g. brash cutting).

The previous EU-LIFE project MoorLIFE (MLFE) was the first Moors for the Future Partnership (MFFP) project to have undergone a carbon audit. The focus of the audit was restricted to the conservation works (c) actions that were controlled and supervised by MFFP.

In the previous MLFE carbon audit, helicopter travel to and from works site from helicopter company base was not reported on. We aim to include these scope 3 emissions data in our new project audit in recognition of helicopter "commute" distances. Staff commute to the office (petrol/diesel) will also be reported on in this new project audit, which was previously omitted from the scope of the MLFE audit. Office energy use is another new addition to the scope of the audit since the original MLFE project audit (scope 2 emissions). Note that Scope 2 emissions for staff

working from home will be difficult to incorporate into the audit and a decision has been made to exclude this reporting from the scope of the ML2020 carbon audit.

Greenhouse gas (GHG) emissions relating to Preparatory (A), Monitoring (D), Communications (E) and Project Management (F) actions were not reported on in the MLFE carbon audit. It is anticipated that the bulk of emissions resulting from the activities that are delivered by ML2020 under those four actions will result from travel (staff and volunteers) to monitoring sites and events.

The systems we have in place for recording travel under ML2020 clearly documents recharges to individual ML2020 action codes. We are therefore able to report more easily on emissions by action code (A, B, C, D, E, F), as well as by activity (for a full list of activities see table 1), since improvements have been made to data recording systems in preparation for the ML2020 project delivery at MFFP.

3. Data owners

Data spreadsheets and protocols were developed in-house for the MLFE project carbon audit. Data recording processes were reviewed and improved on as the project progressed. We are now able to build further on the MLFE project carbon audit processes, by adapting existing spreadsheet templates for data recording for ML2020 auditing. A number of recommendations for future MFFP carbon audits were given in Maskill *et al.* (2015).

Through this learning, we recognise the importance for data 'owners' to be identified early on in the project, i.e. the staff member responsible for collating certain data and ensuring its accuracy, integrity and timeliness. Early identification of data owners aims to prevent a backlog of data. It is also important in recognition of the assumption that conservation works are likely to go ahead without data recording systems in place and that it will not always be possible to record emissions data retrospectively.

Data owners were identified in preparation for the ML2020 carbon audit and these are listed against the full suite of activities which were audited as part of the MLFE carbon audit (as detailed in Appendix 1 of Maskill *et al.*, 2015) in table 1 of this report, as well as against any known additions to the audit, such as office energy use data. It is likely that the list of activities will grow as the project progresses through its development stages this year as new techniques are developed for ground works.

Any changes in staffing that arise in the lifetime of the project can be identified from the table and a new data owner will be appointed from the same organisation, likely someone with the same job title or with a similar role as the original data owner.

Carbon audit requirement		Data owner		
Activity & Scope	**Data source**	**Organisation**	**Job title / Staff member**	**Notes**
Delivery by road **(Scope 3)**	Material delivered – invoice Tonnes delivered – invoice Type of vehicle – interview Number of journeys – delivery notes Payload – estimated / interview Km travelled under full load – Google maps Km travelled empty – Google maps Litres of fuel used (if known) – estimated / interview Site associated with delivery – interview / project records	MFFP	Senior Conservation Works Officer, K Thorpe	Project conservation works data records are input by CALM team staff at the time of the works, into a **Google Docs file share.** This method of recording is currently up for review. Revisions will be made by the MFFP Conservation Contracts Manager and Senior Conservation Works Officer as the works schedule is identified and rolls out towards the end of this preparatory project year. The timeliness and accuracy of the information recorded by the team is checked by the data owner. Relevant data is extracted for carbon audit recording into the D5 spreadsheets on a weekly basis, during the works period (15th July to 15th April). "Interview" typically involves a phone call to check contractor records, rather than face-to-face time.
Flying **(Scope 3)**	Area treated – GIS Material applied / delivered – invoice / project records Helicopter model - invoice Fuel type – interview (always aviation turbine fuel) Application rate – works plan Number of flights – based on tonnes applied and hopper capacity Distance between lift site and centre of works area - GIS Total km flown – calculated / GIS Helicopter fuel consumption – interview Litres of fuel used – flight log / calculations / interview (including helicopter "commute" to works site	MFFP	Senior Conservation Works Officer, K Thorpe	As above for Delivery by road
Contractor travel **(Scope 3)**	Site, parking and access – interview/ project records Treatment area – works plan / GIS Contractor base (office / local accommodation) – invoices / interview Vehicle type used to transport contractor staff – interview Number of days worked on a task – interview / project records Distance between base and site – Google maps Total km driven per vehicle – calculated	MFFP	Senior Conservation Works Officer, K Thorpe	As above for Delivery by road
MFFP staff travel **(Pool vehicles: Scope 1; Employee-owned vehicles: Scope 3; Public transport:**	Miles travelled - Programme Office travel spreadsheets (pool car records and staff mileage claims) Vehicle type - Programme Office travel spreadsheets ML2020 action code - Programme Office travel spreadsheets	MFFP	Research & Monitoring Officer, J Benson	

Scope 3)	Staff commute details			
Beneficiary organisation staff travel **(Pool vehicles: Scope 1; Employee-owned vehicles: Scope 3; Public transport: Scope 3)**	Miles travelled – template spreadsheets are provided to beneficiaries by MFFP for data input	MFFP	Research & Monitoring Officer, J Benson	
	Vehicle type - template spreadsheets provided by MFFP			
	ML2020 action code - travel template spreadsheets provided by MFFP			
Material production (e.g. brash cutting) **(Scope 3)**	Source site - contract	MFFP	Senior Conservation Works Officer, K Thorpe	As above for Delivery by road
	Number of bags cut - invoice			
	Number of days spent cutting – interview			
	Vehicle used – interview			
	Fuel type – interview / Defra guide			
	Km travelled whilst cutting – interview			
	Litres of fuel used - interview			
Office energy use (Scope 2)	Water usage – water bills for Moorland Centre (Property Service records)	MFFP	Research & Monitoring Officer, J Benson	
	Electricity usage – electricity bills for Moorland Centre (Property Service records)			

Table 1. Data owners identified for the ML2020 carbon audit

4. UK GHG conversion factors

GHG emissions figures are extracted annually from the Defra conversion factors spreadsheets, which are available to download online from www.ukconversionfactorscarbonsmart.co.uk

As new releases become available, the new conversion factor figures are extracted for use in the carbon audit reporting spreadsheets for later project audit years.

The UK GHG conversion factors will continue to be updated annually in May, by Dept. for Business, Energy & Industrial Strategy (BEIS), previously updated by Dept. of Energy & Climate Change (DECC).

Example: Year 2 auditing

The 2016 conversion factors are valid from their release in May 2016 until the expiry date of 31st July 2017. The 2016 conversion factors will be extracted and used for the most part of the Year 2 (2016-17) audit update. The 2015 figures will be used for the remaining dates between 1st April 2016 and the release date of the 2016 spreadsheet in May 2016.

5. Delivery by road

GHG emissions associated with the delivery by road of materials are audited for the full range of conservation works treatments, including:

- brash
- geotextile
- gully blocking
- lime, seed and fertiliser application
- plug planting
- *Sphagnum*

Identifying the type of vehicle involved in delivery of road by materials is key in assessing GHG emissions from this scope 3 activity. The different vehicle types use different conversion factors. For example, previously in the MLFE carbon audit the range of heavy goods vehicle (HGV) and van types included:

- 28t Articulated <33t (0%, 100%, 44%, 50%)
- Articulated <33t (0%, 0% laden, 5%, 50% laden)
- Articulated >33t (0%, 0.32%)
- Rigid <17t (0%, 5%)
- Rigid >17t (0%, 2%, 5%, 50%, 100%)
- Van Diesel Class 3

Fuel type is also important in assessing GHG emissions associated with road delivery. For example an assumed fuel consumption of gas oil of 0.24 litres per km was used for GHG emissions calculations of tractor and tractor pulling trailer in the previous MLFE project audit when only distance data was available for the audit (Maskill *et al.* 2015).

Freighting goods conversion factors can be used specifically for the shipment of goods over land, by sea or by air through a third party company. Factors are available for a whole vehicles' worth of goods or per tonne of good shipped via a specific transport mode (Defra, 2015). The previous MLFE carbon audit used 2009 Defra conversion factors to calculate GHG emissions from delivery of materials by heavy goods vehicles HGVs and vans, found under 'Annex 7: Freight transport' (HGVs). For the year 1 ML2020 project audit, 2015 Defra conversion factors can be extracted to use in their place. Conversion factors relating to HGVs are found under the 'Freighting goods' tab. The 2015 'Well to tank (WTT) conversion factors for delivery vehicles & freighting goods' can be used to report the upstream scope 3 emissions associated with extraction, refining and transportation of the raw fuels before they are used to power the transport mode (Defra, 2015).

For each delivery job charged to ML2020, either total km travelled (use 'Freighting goods' conversion factors) or total units of fuel used (use 'Fuel' conversion factors) is multiplied by the conversion factor specific to the vehicle or fuel type (kg CO_2e per vehicle/fuel unit), for each GHG in turn: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and Total Indirect GHG (upstream WTT emissions). The sum of these figures gives total kg carbon dioxide equivalents (CO_2e) for the delivery job.

Delivery by road data is recorded in the relevant conservation works treatment spreadsheet on the 'Delivery' tab e.g. 'Dams – delivery'.

The Year 1 treatment carbon audit spreadsheets include: 'Year 1 Gully Blocking Work carbon audit.xls'; 'Year 1 Plug Planting and Sphagnum carbon audit.xls'; 'Year 1 Brash Work carbon audit.xls' and 'Year 1 LSF carbon audit.xls':

The list of files will increase as new conservation works treatments are developed under the project; a new file is required for recording the GHG emissions associated with each treatment.

Once finalised, the delivery data will be copied over to the relevant column headers in the master spreadsheet **'ML2020 D5 Carbon Audit Data v1.xls:**

5.1. Year 1 update: delivery by road carbon audit

No deliveries were made by road for conservation works (C) project actions in Year 1 of the project audit.

6. Flying

GHG emissions associated with flying are audited for the full range of project conservation works treatments, listed under section 5: Delivery by road.

Different treatment stages of the conservation works involving flying, a scope 3 activity, include:

- Application of material
- Delivery of material
- Stockpiling
- Distributing stockpile
- Removing empties

The previous MLFE carbon audit used 2009 Defra conversion factors to calculate GHG emissions from flying, found under 'Annex 1: Fuel' (always aviation turbine fuel). 2015 Defra conversion factors are extracted to use in their place for the Year 1 audit: found under the 'Fuels' tab. 'WTT fuels' conversion factors are used to account for the upstream scope 3 emissions associated with extraction, refining and transportation of the raw fuel sources to site, prior to combustion (Defra, 2015).

Different helicopter models assume different fuel consumption (litres per km); therefore identifying helicopter model is key in assessing GHG emissions associated with flying. Table 1 in "MoorLIFE: A carbon audit of the project: final report" by Maskill *et al.* 2015, listed the assumed fuel consumption for the different helicopter models flown in the previous MLFE project. These figures are also presented in table 2 of this report for quick reference, alongside the latest assumptions that can be used in the ML2020 project audit.

Helicopter model	Assumed fuel consumption (litres per km)	
	MoorLIFE (2011 – Sept 2015)	**MoorLIFE 2020 (Oct 2015 - Jan 2021)**
Bell 205	4.80	5.00
Single Squirrel	3.15	3.30
Bell 206	1.50	1.60
Long Ranger	1.25	1.50
Hughes 500	0.80	1.58

Table 2. The assumed fuel consumption of helicopters used in GHG emissions calculations when only distance data was available for the MLFE project audit alongside new assumed fuel consumption figures for use in the ML2020 audit.

Fuel consumptions for the MLFE project audit were obtained through interviews with the helicopter companies and were derived from records of a specific job, rather than presenting an average consumption figure. The latest updates from the helicopter companies were provided to the data owner in August 2016. These new figures represent average fuel consumption whilst lifting a load at capacity for a typical Peak District job of a 3 km carry.

It is assumed that on average the helicopters fly approximately 60 km per hour when load lifting and this is generally how the helicopter companies estimate jobs for MFFP. Several helicopter flight logs were used to calculate this average speed for the previous MLFE project audit. This assumption is also valid for the ML2020 project audit, since helicopter models are not foreseen to change.

For each activity involving flying charged to the project, fuel consumption of the helicopter model (table 2) was multiplied by km flown to give total litres of fuel used for the job. Total litres of fuel used is then multiplied by the aviation turbine fuel conversion factor (kg CO_2e per vehicle unit), for each GHG in turn: CO_2, CH_4, N_2O and Total Indirect GHG (upstream WTT emissions). The sum of these figures gives total kg CO_2e for the flight activity.

In preparation for ML2020 carbon audit data acquisition, a clause has been incorporated into tenders with the expectation that contractors will be able to provide the number of litres of fuel used per job. Therefore we only need to use the assumptions in table 2 in cases where this information is not able to be provided by the company.

Flight data is recorded in the relevant conservation works treatment spreadsheet on the 'Flying' tab e.g. 'Dams – flying'. A full list of Year 1 treatment carbon audit spreadsheets are listed under Section 5 of this report.

Once finalised, the flight data will be copied over to the relevant column headers in the master spreadsheet.

6.1. Year 1 update: flying carbon audit

No flights were undertaken for conservation works (C) project actions in Year 1 of the project audit.

7. Travel

GHG emissions associated with travel by project staff and contractors, by road and public transport, are audited for the full range of project actions.

7.1. Contractor travel

Records of information about contractor travel to works sites are used to audit GHG emissions arising from this scope 3 activity (table 1).

Travel by contractor staff from base (or otherwise from a home address or local accommodation) to site occurs typically at the manual application stage of the conservation works treatments: geotextile (fixing), gully blocking, plug planting and *Sphagnum* works. Contractor travel for brash works is necessary at both the production and manual application (spreading) stages of treatment.

Identifying the type of vehicle used to transport contractor staff is key in assessing GHG emissions associated with contractor travel. For the previous MLFE project audit, type of vehicle was identified on the 2009 Defra conversion factors spreadsheet, on the 'Annex 6: Passenger transport' tab. For example a Dual Purpose 4x4 diesel vehicle was used to transport contractor staff to site for brash works in year 3 of the project. Since a series of updates were made to the Defra conversion spreadsheets, the equivalent factors can now be found under the 'Passenger vehicles' tab, for use in future project years.

We can also report on the upstream scope 3 emissions associated with extraction, refining and transportation of the raw fuels before they are used to power the transport mode. These indirect emissions factors can be found on the '*WTT conversion factors for passenger vehicles and business travel on land*' tab (Defra, 2015).

Contractor travel data is recorded in the relevant conservation works treatment spreadsheet on the 'Staff' tab e.g. 'Dams – staff'. A full list of Year 1 treatment carbon audit spreadsheets are listed under Section 5 of this report.

Once finalised, the travel data will be copied over to the relevant column headers in the master spreadsheet.

7.2. Staff travel

7.2.1 MFFP: pool vehicles

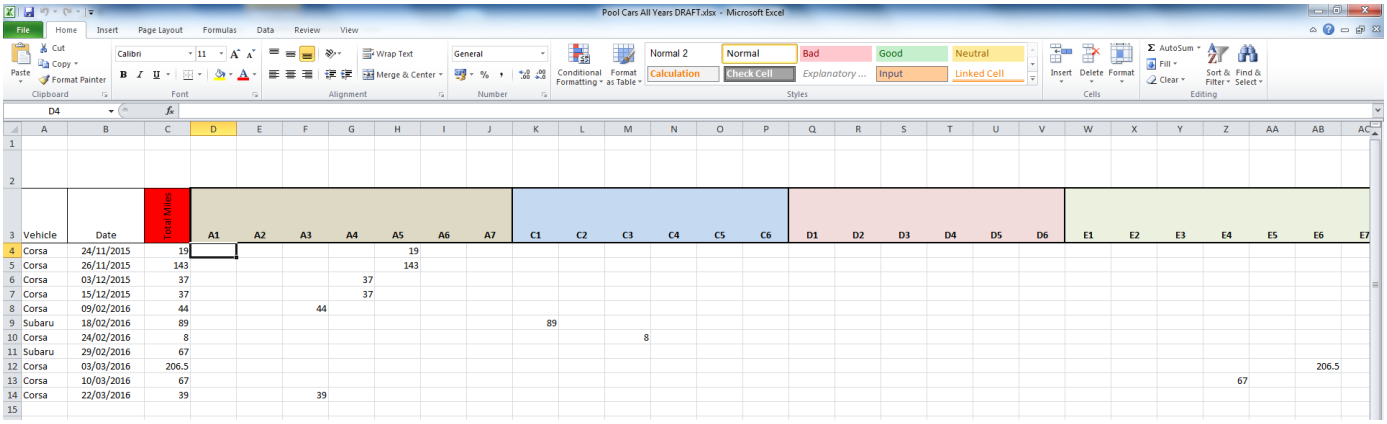
Pool car mileage is recorded and updated monthly by Programme Office by date, project code and action code.

Mileage spreadsheets specific to ML2020 usage have been created by Programme Office for financial reporting purposes in preparation for the purchase of a fleet of new pool vehicles.

Annually after financial year end, the mileage figures under the column 'WMB MoorLIFE 2020' with the action code column figures are extracted and copied onto a new tab in the 'Pool Cars All Years' spreadsheet so that they are ready to work with in the carbon audit. It is important to note that we cannot edit the original Programme Office spreadsheets, so a copy of the data is required before we can re-work it in any way (e.g. sorting/filtering columns).

Once the data is saved in "Pool Cars All Years", it is checked to see if there are any circumstances where an action code has not been assigned to the mileage. These recharges can be queried using Programme Office's VM3 budget spreadsheet.

The data owner enters/copies all of the pool car mileage entries over into the relevant Year tab in "Pool Cars All Years" spreadsheet, where a new row is required for each new date.



	Vehicle	Date	Total Miles	A1	A2	A3	A4	A5	A6	A7	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	E1	E2	E3	E4	E5	E6	E7
4	Corsa	24/11/2015	19					19																					
5	Corsa	26/11/2015	143					143																					
6	Corsa	03/12/2015	37				37																						
7	Corsa	15/12/2015	37				37																						
8	Corsa	09/02/2016	44			44																							
9	Subaru	18/02/2016	89								89																		
10	Corsa	24/02/2016	8										8																
11	Subaru	29/02/2016	67																										
12	Corsa	03/03/2016	206.5																									206.5	
13	Corsa	10/03/2016	67																							67			
14	Corsa	22/03/2016	39			39																							

After the data has been entered under the correct action code, the remaining columns are filled in over to the right hand side, including: vehicle (e.g. Corsa = Small Diesel up to 1.7), and km (total miles are converted to km by multiplying by 1.609344).

The 2015 *'passenger vehicles'* conversion factors (scope 1) were used to report on pool vehicles for the Year 1: 2015-16 audit update (1st October 2015 (project start date) – 31st March 2016 (end of financial year)), as these figures were valid from their release until expiry date quoted on the Introduction tab: 31st May 2016.

The 2015 '*WTT conversion factors for passenger vehicles and business travel on land*' were used to report the upstream scope 3 emissions associated with extraction, refining and transportation of the raw fuels before they are used to power the transport mode (Defra, 2015).

Once finalised, the data will be copied over to the relevant column headers in the master spreadsheet.

7.2.2. Beneficiary organisations: pool vehicles

Template spreadsheets are sent out to National Trust and RSPB for data input relating to staff travel accountable to the ML2020 project. Note that Pennine Prospects staff do not have a pool vehicle available for use and therefore rely on employee-owned vehicles for business mileage.

The timeliness of these records is checked by the MFFP data owner. It's recommended that the checks form a routine part of project update meetings as the project gains momentum in Year 2. Since GHG emissions arising through travel by pool vehicles are incurred by staff working on the ML2020 project in vehicles owned by MFFP, this is classed as a scope 1 activity and the *'passenger vehicles'* conversion factors and '*WTT conversion factors for passenger vehicles and business travel on land*' are used to report on pool vehicles in the same way as for the MFFP pool vehicles (section 7.2.1).

Once finalised, the data will be copied over to the relevant column headers in the master spreadsheet.

7.2.3. MFFP: employee-owned vehicles

Mileage for business purposes in cars owned by employees is recorded by Programme Office in both the 'ML2020 Project Staff Travel' spreadsheet' and the 'ML2020 Casuals Travel' spreadsheet.

Annually after financial year end, the mileage figures, which are split by action code, are copied into the carbon audit "Project Staff Travel All Years" and "Casual Staff Travel All Years" spreadsheets, respectively, so that they are ready to work with.

The 2015 '*business travel- land*' conversion factors were used to report on vehicles that are used by MFFP but aren't owned by the organisation, in scope 3 instead of scope 1. This includes mileage for business purposes in cars owned by employees, public transport and hire cars (Defra, 2015).

Information about employee-owned vehicles is stated on staff mileage claims. Information is collated in the "Employee Vehicle Information" spreadsheet, under the column headings: vehicle make, CC of vehicle, fuel type and vehicle type, for easy reference:

7.2.4. Beneficiary organisations: employee-owned vehicles

Template spreadsheets were created for National Trust and RSPB for data input relating to staff travel accountable to the ML2020 project incurred in employee-owned vehicles and by public transport: road and rail. The timeliness of these records is checked by the MFFP data owner. It's recommended that the checks form a routine part of project update meetings as the project gains momentum in Year 2. GHG emissions are reported as scope 3 passenger vehicle emissions, since these vehicles aren't owned by the organisation: in the same way as detailed under section 7.2.3: MFFP employee-owned vehicles. Data is collated by the MFFP data owner.

7.2.5. Project staff travel by public transport: road and rail

GHG emissions arising from travel by rail or bus by volunteers are reported by "passenger.km", rather than km.

7.2.6. Project staff commute

To capture staff commute information, a spreadsheet was set up for ML2020 project staff to update themselves annually: "Employee Commute All Years MFFP.xls". The spreadsheet has a new tab for each project audit year:

The data owner is responsible for reminding all project staff to update their information upon completion of the financial year in time for the project audit year update reporting. Copies of the spreadsheet are also sent to ML2020 project staff at National Trust and RSPB to capture this information. The spreadsheet was not sent to Pennine Prospects staff during the Year 1 audit because the current Project Officer for Pennine Prospects either cycles or walks to the office base.

Detailed instructions were emailed to project staff for their attention with the spreadsheet link, to ensure data consistency and quality. The wording is saved in the "Please read – Year 1" tab at the beginning of the spreadsheet. These instructions can be adapted to for use in future project years.

To ensure that the raw data is kept 'clean' and tidy for future reference, analysis of the staff commute data is worked on separately in a second spreadsheet: 'Employee Commute All Years - analysis.xls':

GHG emissions are reported as scope 3 passenger vehicle emissions, since these vehicles aren't owned by the organisation: in the same way as detailed under section 7.2.3: MFFP employee-owned vehicles.

Once finalised, the data will be copied over to sit under the relevant column headers in the master spreadsheet.

7.3. Volunteer travel

Records of MFFP volunteer travel claims that have been recharged to ML2020 project actions can be found on the Programme Office's VM3 budget spreadsheet.

It's important to note that travel claims for volunteer journeys are capped at a maximum of £15 per day, so actual mileage cannot be inferred from this budget spreadsheet. Instead, the budget spreadsheet is used as a reference tool to signpost to the original volunteer travel claim forms where it is possible to look up the actual mileage travelled for a particular journey. The ML2020 Project Administrator keeps a ring binder of paper copies of volunteer travel claims and scanned copies are saved onto the network here, filed by financial year:

Mileage figures are entered into the "Volunteer Travel All Years.xls" spreadsheet:

GHG emissions arising from travel by road by volunteers are reported as scope 3 passenger vehicle emissions, in the same way as detailed under section 7.2.3: MFFP employee-owned vehicles.

As we don't ask for the full suite of vehicle details on the volunteer expenses claim forms (vehicle type, make/model, CC, fuel type), vehicle details are looked up using the car registration number given on the claim form using the website: https://www.mycarcheck.com/

Template spreadsheets were created for National Trust and RSPB for data input relating to volunteer travel accountable to the ML2020 project incurred in volunteer-owned vehicles and by public transport. The timeliness of these records is checked by the MFFP data owner. It's recommended that the checks form a routine part of project update meetings as the project gains momentum in Year 2.

GHG emissions arising from travel by rail by volunteers are reported by "passenger.km", rather than km.

Once finalised, the data will be copied over to sit under the relevant column headers in the master spreadsheet.

7.4. Year 1 update: Travel carbon audit

No journeys were made by contractor staff in Year 1 of the project audit, nor were there any volunteer journeys made by road or public transport.

Travel by project staff accounted for **3992 kg CO_2e** total GHG emissions during Year 1:

- Travel in MFFP pool vehicles accounted for **222 kg CO_2e**,
- Travel in MFFP employee-owned vehicles and by public transport accounted for **491 kg CO_2e**,
- MFFP employee commute by road and rail accounted for **3279 kg CO_2e**.

Travel by ML2020 project staff employed by beneficiary organisations is not reported in the Year 1 audit update as we have incomplete returns from the data requests sent out to project staff. These GHG emissions figures will be presented instead in the Year 2 carbon audit report update (August 2017).

8. Material production

GHG emissions associated with material production were audited for brash cutting in the previous MLFE project. The system for assessing emissions data associated with brash cutting is used in the ML2020 project audit. Other materials that are used in conservation works treatments will be reported on in a similar way, once these are identified as new conservation treatment techniques are developed on the ground for the ML2020 project. We will adapt the carbon audit data recording systems for brash cutting to incorporate these new materials into the audit.

Identifying the type and number of units of fuel used in brash cutting is key to assessing GHG emissions from this scope 3 activity. Three tractors are often used for cutting and the tractor fuel is gas oil. An assumed fuel consumption of gas oil of **0.24 litres per km** was used for GHG emissions calculations to audit emissions associated with tractors in the previous MLFE audit.

Previously, Maskill *et al.* (2015) assumed that two tractors together travel 0.0125 km per bag, whilst one tractor (lone working) travels 0.05 km per bag during brash cutting works. The total distance travelled by tractor whilst cutting (km) was calculated using the formula:

= 2 * [(# bags * 0.0125) + (# no. bags * 0.05)]

This distance is then multiplied by 0.24 to calculate the total number of litres of gas oil used for the job.

For each brash cutting job charged to ML2020, total litres of gas oil is multiplied by the conversion factor specific to gas oil (kg CO_2e per vehicle unit), for each GHG in turn: CO_2, CH_4, N_2O and Total Indirect GHG (upstream WTT emissions). The sum of these figures gives total kg CO_2e for the brash cutting job.

Data is recorded in the Year 1 treatment spreadsheet: 'Year 1 Brash Work carbon audit.xls', on the 'Brash cutting' tab. Once finalised, the brash cutting data will be copied over to sit under the relevant column headers in the master spreadsheet.

8.1. Year 1 audit: material production carbon audit

No brash cutting was undertaken for conservation works (C) project actions in Year 1 of the project audit.

9. Purchased materials

As part of the previous MLIFE project audit, total spend on purchased materials over the lifetime of the project was identified, excluding VAT, under the following three product categories:

i) Stone, sand and clay, other materials*
ii) Fertilisers
iii) Cement, lime and plaster

*Note that the category 'stone, sand, clay and other materials' was used purely for the stone used for gully blocking in the previous MLFE audit.

For the ML2020 project audit, we aim to include a fourth category: plastic, coir and timber material production costs in our assessment. An appropriate Defra conversion factor(s) needs to be identified, in order to be able include the new product category in the audit.

The spend figures over the lifetime of MLFE were converted to total emissions in kilograms of carbon dioxide equivalent (total kg CO_2) by multiplying by the Defra's 2009 conversion factor (Annex 13 'Indirect emissions from the supply chain'), where 'SIC code' is the standard industrial classification of economic activities:

	A	B	C	D	E	F	G	H	I	J	K
1	SIC code (SIC 2003)	Product category	Carbon dioxide	Methane	Nitrous oxide	HFCs	PFCs	SF6	Total spent in MoorLIFE	Total kg CO2e per £	Total kg CO2e
2	14	Stone, sand and clay, other materials	1.55	0.28	0.04	0.01	0.00	0.00	11500.00	1.89	21,735
3	24.15	Fertilisers	2.89	0.23	2.98	0.04	0.01	0.01	186414.00	6.15	1,146,446
4	26.5	Cement, lime and plaster	12.09	0.32	0.08	0.02	0.00	0.00	227671.00	12.51	2,848,164
5											

For the ML2020 project audit, we will report total kg CO_2e from purchased materials annually, as well as presenting a grand total for the lifetime of the project. A record of spend on purchased materials is kept in the Programme Office "VM3 budget spreadsheet":

The VM3 spreadsheet shows all actual spend on purchasing as well as committed expenditure. Most of the materials will fall under the 'Consumables' category ('WMF').

We need to be certain before extracting the data that the figures in the budget spreadsheet are final and are not subject to change. The advice from ML2020 Programme Administrator is that when an entry is recorded as a commitment it means that an order has been placed with a supplier. Once invoiced and all is okay then Programme Office process the invoices and pass to Finance to pay. Only when the payment appears on the NPA's Finance system ('FRED') are we sure that it's final – the column with a 'tick' indicates this. There may be an issue however at the end of one financial year and the start of the next where we might have some outstanding orders carried forward, but not actually have received the goods. It's recommended the MFFP data owner looks into those cases together with the ML2020 Programme Administrator at the time.

Data are extracted over into the "Purchased Materials All Years" spreadsheet,

We will cross check the financial reporting figures against actual numbers that are reported by Conservation Works Officers (CWOs) to the Senior CWO. For example, in the previous MLFE project audit where records of the number bags of brash spread differed to the invoiced amount, the lower figure (usually from invoice) was used for the carbon audit. For the ML2020 audit we aim to cross check more quickly with the CWO records to make a better informed decision.

9.1. Year 1 update: Purchased materials carbon audit

No materials were purchased under the categories i, ii, iii or iv in Year 1 of the project audit.

10. Office energy use

GHG emissions associated with water and electricity consumption are reported on for the primary MFFP staff base: Moorland Centre, Edale. Whilst the facility is shared by four services: MFFP, PDNPA Visitor Centre, PDNPA Ranger Service and Fieldhead campsite, the campsite tenant bills the PDNPA for our contribution to the water supply (MFFP/Visitor Centre/Rangers). The campsite is therefore not accounted for in the PDNPA's Moorland Centre usage figures (see 10.1 Moorland Centre electricity usage). However, this still leaves a situation where three services are sharing one facility/utility bill. We therefore need to estimate the split across the three services to be able to estimate the contribution by MFFP. Further still, an estimate needs to be made to isolate the contribution of the ML2020 project out of the full programme of MFFP projects (See 10.5 Calculating staff working hours for ML2020).

Similarly, the utility bill figures for electricity consumption are for the Moorland Centre as a collective: MFFP/Visitor Centre/Rangers, and do not include the campsite's contribution, so the same splits can be used to estimate the contribution that the ML2020 project makes to electricity consumption.

The amount of time which each accountable service uses the building each year was also considered (see 10.4 Days per year that MFFP are operational vs the other PDNPA accountable services below for more details).

When calculating the energy used in heating, the amount of floor space used by each accountable service was taken into account along with how this changes over the lifetime of the project, (See 10.2 Moorland Centre heating usage and 10.3 Expansion of the office space for the Moorland Centre below for more details).

To simplify the process for future years, a template was created to guide the user through the process.

10.1 Moorland Centre electricity usage

Prior to February 2017, the electricity supply to the Moorland Centre and Fieldhead Campsites was supplied by two separate systems; meaning that the Fieldhead Campsite electricity usage was already excluded from the total energy usage figures. From February 2017, the Fieldhead Campsites electricity usage **was** included within the Moorland Centres usage figures, due to a combined system being installed; this means that for future years the electricity used on the campsite will need to be subtracted from the total energy figures. As both accountable services use electricity meters, it is simple a case of subtracting the campsites usage figure from total electricity usage to calculate electricity used solely by the Moorland Centre. The data can be provided by Matt Freestone in Property Services, and is provided per quarter for operations during the day and night. For the purposes of the carbon audit the nightly figures were excluded from the calculations as the Moorland Centre is not used at night.

With the Moorland Centre electricity usage separated from total electricity usage, the MFFP split can be calculated using the inventory of energy using appliances spreadsheet. This spreadsheet identifies the wattage of each appliance and which appliance each accountable service uses at the Moorland Centre. This data is kept by PDNPA Property Services. The total wattage of each of these appliances was totalled up for each accountable service and a percentage split calculated see

Table 3.

Service	Percentage of total wattage (Year 1)	Percentage of total wattage (Year 2)
MFFP	35 %	37%
Visitor Centre	31 %	29%
Ranger Service	33 %	34%

Table 3- Estimations for the percentage split of energy using appliances at the Moorland Centre by the three accountable services sharing the facility in year 1 and 2 of ML2020

10.2 Moorland Centre heating usage

Heating at the Moorland Centre is controlled by 2 separate heat pumps which utilises electricity to generate heat. The amount of heating used by each accountable service is dictated by the floor space used by each accountable service.

A record of the floor space associated with each room in the Moorland Centre was provided by PDNPA property services, and includes those rooms previously used by the campsite. Columns were added to this spreadsheet to identify which areas were used by MFFP (see

Table 4 below).

Area	Floor Space (M^2) Year 1	Floor Space (M^2) Year 2
Offices ground floor (including toilets and lobby)	41.8	41.8
Offices first floor	87.4	87.4
Lab and office above (was ranger briefing centre, workshop and stairwell)		
Stores including plant room	38.3	38.3
Campsite facilities		
Visitor centre		
Sedum room and meeting room		95.06
Total office space (M^2)	**167.5**	**262.56**
Percentage floor space used by MFFP	**30%**	**47%**

Table 4 Estimations of floor space used by MFFP at the Moorland Centre to estimate heating usage for year 1 and 2 of ML2020

Calculating the GHG emissions used to heat the Moorland Centre involved subtracting the electricity used by both heat pumps from total electricity used by the Moorland Centre to obtain a total heating figure. The percentage floor space used by MFFP was calculated and then applied to the total heating figure, giving the total heat used by MFFP to heat the Moorland Centre. The electricity used by both heat pumps can be provided by Matt Freestone of PDNPA property services.

10.3 Expansion of the office space for the Moorland Centre

To successfully deliver the ML2020 project the MFFP team expanded rapidly at the start of the project, and to accommodate this rise in staff numbers MFFP spread into additional areas of the Moorland Centre. This meant that both electrical appliances used by MFFP and floor space increased, explaining why MFFP percentage split increase between years 1 and 2 of the project.
Table 5 below identifies when each new room was first used by MFFP.

Area	Date first used
Sedum office and meeting room	July 2016
Middle Office	April 2017
Lichen	February 2017
Sphagnum	April 2016

Table 5- Date each area of the building was first used by MFFP

10.4 Days per year that MFFP are operational vs the other PDNPA accountable services

Whilst the different accountable services that utilise the Moorland Centre work different hours (e.g. the MFFP team occupying the building all year round, the PDNPA visitor centre shuts in winter). This split is not taken account of within the carbon audit calculations, as the heating is not controlled on a room by room basis, and as MFFP occupy the majority of the building changing any of the heating settings would impact on a room used by MFFP.
Splitting electrical use by the hours each accountable service is operational would not be applicable either, as any electricity used to operate appliances (e.g. computers) will be taken account of by the electricity meters and the office energy use spreadsheet.

10.5 Calculating staff working hours for ML2020

Multiple projects are delivered by MFFP staff members, meaning that not all energy used at the Moorland Centre can be attributed to ML2020. To take account of this the percentage each staff member spends on ML2020 is calculated per annum from their timesheets and an average staff time figure calculated. This percentage was then applied to the overall energy usage.

Any data **MUST BE copied from the staff time recharges spreadsheet** into the Project Staff ML2020 avg hours per week spreadsheet, as the staff time recharges spreadsheet is used to track MFFP spending by project and **cannot be altered**. Staff time spent on the ML2020 project was calculated annually for the first 2 years of the project as additional staffing resource was added thus increasing total staff hours on ML2020 each year.

10.6 Calculating water usage for the Moorland Centre

The Moorland Centre and the Fieldhead Campsite are supplied by the same water pipe, with a sub-meter for the water used by the Fieldhead Campsite. In order to calculate the water usage by the Moorland Centre the campsite metered figure was subtracted from the total water metered figure. It is however impossible to identify which water was used by which PDNPA accountable service. Therefore a total water usage figure for the whole building was used. Total water usage figures and sub metered water figures are supplied quarterly, and can be obtained from the PDNPA finance department.

10.7 Year 1 update: Office energy use carbon audit

Whilst energy use figures were obtained for year 1 from PDNPA Property Services, these have not yet been worked on to estimate the contribution that the ML2020 project makes to water supply and treatment and electricity consumption. These year 1 figures will therefore be presented in the year 2 update report alongside the year 2 figures (August 2017).

11. Assessing the carbon benefits of the MoorLIFE 2020 project

Whilst the GHG emissions resulting from conservation works activities can be regarded as a one-off event, when treatments cease, the benefit of peat stabilisation will continue to accrue over the coming years (Maskill *et al.* 2015).

Currently, the best available data on the carbon benefit of moorland restoration is provided by Worrall *et al.* (2011), which was also the case during the lifetime of the previous MLFE project audit (pers. comms., Professor Fred Worrall, University of Durham). The carbon benefits of the MLFE project were calculated with respect to the carbon budget figures presented for the stabilisation of Bleaklow plateau in Worrel *et al.* (2011). Details can be found in "MoorLIFE: A carbon audit of the project: final report" by Maskill *et al.* 2015.

Using this same methodology, we aim to estimate the magnitude of the avoided loss of carbon from areas of bare peat resulting from the delivery of ML2020 at the end of the ML2020 project conservation works delivery phase. To calculate this estimate, the areas of active blanket bog that are protected by stabilising bare peat through the delivery of ML2020 will be identified.

The ML2020 project monitoring action D1: 'Monitoring of concrete conservation actions using Earth Observation' aims to yield a dataset of 86 km2 of Earth Observation (EO) data captured from a UAV, including RBG, VNIR and thermal imagery, covering the project area. Land cover maps of this area before and after restoration treatment will be produced alongside the derived land cover change maps using eCognition for action A7: 'Produce 2015 land cover map of the SPM SAC using Earth Observation'. A report for the entire project area will be produced for action D1, presenting an analysis of the impact of the project on land cover change and the protection of active blanket bog. The bare peat stabilisation area information required the assessment of the carbon benefits of the ML2020 project will most likely be best sourced through the delivery of the D1 monitoring action report, to avoid duplication of effort.

11.1 Forecasted carbon benefit of bare peat stabilisation works

The ML2020 project bid documents (2015) forecast that 2040 hectares of damaged ground will be stabilised and diversified through the delivery of ML2020 conservation works actions within a mosaic of 10,453 ha of active blanket bog. 43 of those hectares were identified at the time as bare and eroding peat.

Work is now underway with project preparatory actions to develop project plans for conservation works. The target restoration works areas are able to be refined utilising the land cover map, supported by ground trothing works. An estimate is that 48 ha of bare and eroding peat will be identified to stabilise through the delivery of ML2020, which is 5 ha in excess of the project KPI (43 ha). The bare peat stabilisation works are scheduled to be delivered in Years 2 and 3 of the project, with completion date 31st March 2018.

We can estimate the avoided loss of carbon from areas of bare peat one year following revegetation using the carbon budget figures presented for the stabilisation of the Bleaklow plateau (Worrall *et al.*, 2011). The authors reported that the carbon sequestration benefit of peatland restoration would range between 122 and 833 tonnes C/km2/yr (the former for a 1-year post revegetation site with flat topography and the latter a 4-year post revegetation site with erosion gullies) (Maskill *et al.* 2015). With some adjustments of units of area and by converting tonnes of carbon to tonnes of CO_2e using a conversion factor of 3.67 (IPCC, 2000), this is equal to a minimum carbon benefit **4.48 tonnes CO_2e/ha/yr** (Maskill *et al.* 2015).

We can forecast that the minimum carbon benefit of the project one year following revegetation will be **193 tonnes CO_2e/year,** achieved through the stabilisation of areas of bare and eroding peat through the delivery of ML2020, if the KPI (43 ha) is successfully met by March 2018.

11.2 The carbon benefits of protecting active blanket peat

Worrall *et al.* (2011) also calculated carbon budgets for intact common cottongrass (*Eriophorum angustifolium*) dominated blanket bog on Bleaklow. These sites had carbon budgets of -75 and -103 C/km2/yr, i.e. they were sinks of carbon (Maskill *et al.* 2015).

During the later project works delivery years we will have a greater knowledge about the restoration techniques that are being utilised in the project to protect areas of active blanket peat. The carbon auditing processes for capturing data will continue to be developed alongside these developments on the ground. We aim to investigate further the benefit of protecting active blanket peat, for example by estimating the carbon benefit of *Sphagnum* reintroduction in addition to benefits achieved through the stabilisation of areas of bare and eroding peat.

12. References

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