



User Guide to Field Survey Data

Version Number: 1.2

Document Description

This document is a user guide to the field (or sub-catchment) surveys collected on the North Wyke Farm Platform (NWFP). Most surveys are site-wide across all the NWFP fields, while some are specific to a given triplet or small group of NWFP catchments.
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Associated Documents	Description
FP_UG.Doc.004_FieldEvents&LivestockData	User Guide to field events and livestock data
Technical Case Study No. 1	Determination of areas using GPS and GIS
Technical Case Study No. 2	Field spreading area calculations

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1.1	08 May 2017	Figure 2 added as omitted in version 1.0. Full list of vertebrate data available in Data Portal added to Table 1. Release date added for extra invertebrate data. Insect survey references added.
1.2	28 Nov 2018	Table 2 edited to include 2016 soil survey data. Section 6 & Table 3 added with further information about the 2016 soil survey. Section 10 added with information about 2016 botanic survey.

Preface

The North Wyke Farm Platform (NWFP) represents a large investment by BBSRC in the future, to not only study but also improve grassland livestock systems in a national and global research asset linked to real-world farming. It is a world-class facility and a key member of the Global Farm Platform network <http://www.globalfarmplatform.org/> which attracts researchers from different communities and disciplines seeking to develop sustainable ruminant production systems. It provides access to a range of in situ state-of-the-art instrumentation in hydrologically isolated (sub-) catchments to better address key issues in sustainable agriculture related to:

- Replacement of N fertiliser with N-fixation by legumes - achieving a reduction in energy and greenhouse gas emissions for both environmental and economic reasons.
- Using plants to manage soils and hydrology in green-engineering solutions to flooding.
- Efficient phosphorus cycling in grassland systems.
- Resilience of soil biota and their functions in land-use change.
- Impact of grassland management on carbon cycling and storage.
- Water resource use efficiency.
- Systems modelling to design optimal grassland production systems.

The NWFP provides three farming systems in farmlets, each consisting of five component catchments comprising approx. 21 ha in total per farmlet. Each farmlet is managed using alternative approaches to livestock production from grassland. Measurements on water, air and soil are also recorded. Much of this data has a fine-scale (15 minute) temporal resolution, such as water flow and water chemistry data measured at a flume for each of the 15 catchments, which can comprise either single or multiple fields. As a National Capability, the data collected are made publicly available.

The main farming systems or 'treatments' on the platform are:

- 1) Permanent pasture: improvement through use of inorganic fertilisers (Green farmlet).
- 2) Increased use of legumes: replacing nitrogen fertilisers with biological fixation using sown legume and grass mixtures (Blue farmlet).
- 3) Planned reseeding: regular renewal, providing opportunities for introducing innovative varieties with desirable traits. Currently, high sugar and deep rooting grasses are studied (Red farmlet).

See more at: <http://www.rothamsted.ac.uk/farmplatform>



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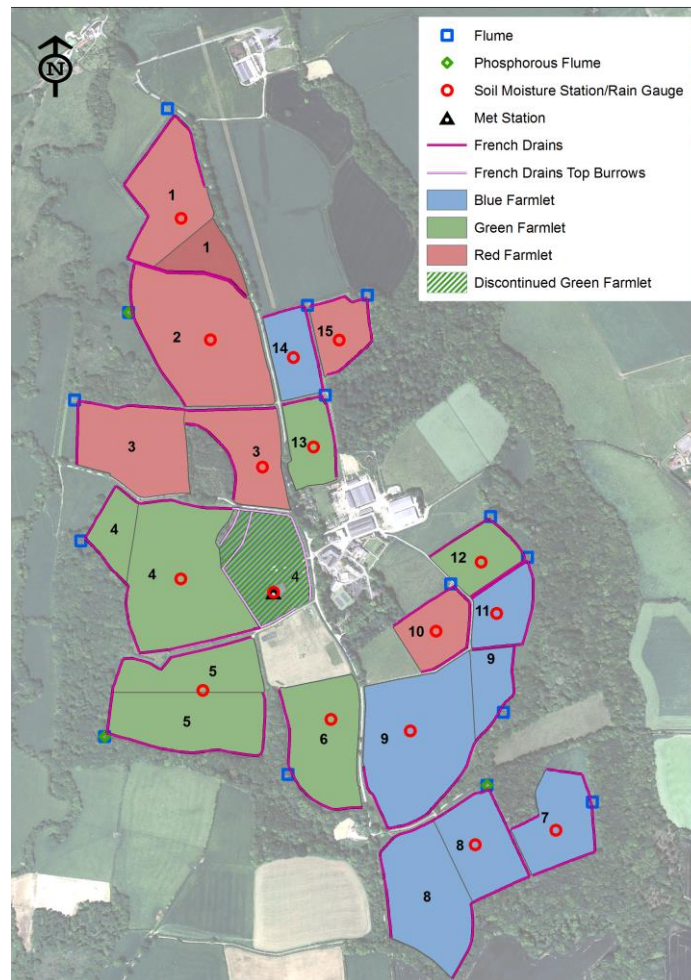
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1 Introduction

The NWFP is located on a ridge at 120 – 180 m above sea level, where the land slopes down on the west to the River Taw and on the east to one of its tributaries, the Cocktree stream. Over a 30-year period from 1982, the mean annual precipitation at the North Wyke site was 1044 mm; with the first, second and third quartiles of this annual distribution given at 924 mm, 1031 mm and 1158 mm, respectively. A significant feature of the site is the presence of clay-rich subsoils beneath the sub-surface horizons. Below the topsoil layer, the subsoil is highly impermeable to water and is seasonally waterlogged with most excess water leaving by surface and sub-surface lateral flow across the clay layer. This pattern in the movement of water allows for interception by a bounded drainage system and was a key factor in making this farm-scale experiment viable.

Figure 1. Map of NWFP showing farmlets (as of 2015)



The NWFP consists of three individual ‘farmlets’ each of which is approximately 21 ha and has been designed to test the productivity and environmental sustainability of contrasting temperate grassland beef and sheep systems at appropriate farm and land management scales ([Figure 1](#)). The main farming systems or treatments on the platform are:

1. Permanent pasture: improvement through use of inorganic fertilisers (Green farmlet).
2. Increased use of legumes: replacing nitrogen fertilisers with biological fixation using sown legume and grass mixtures (Blue farmlet).
3. Planned reseeded: regular renewal, providing opportunities for introducing innovative varieties with desirable traits. Currently, high sugar and deep rooting grasses are studied (Red Farmlet).

Each of the three farmlets contains five catchments (15 in total), with each catchment hydrologically isolated through a combination of topography and a network of 9.2 km of drains constructed around the perimeters of each catchment. The drainage network is made up of 800 mm deep trenches containing perforated drainage pipe and backfilled to the surface with 20-50 mm clean, carbonate-free granite chips. This type of construction is commonly referred to as a French drain [[French, 1859](#)]. Each of the catchments was allocated to one of the three farmlets according to some or all of the following conditions: (i) expert knowledge of the physical properties of the North Wyke site; (ii) the need for a degree of spatial connectivity between the five catchments of each farmlet; (iii) historical farm practice; and (iv) farm/research operational requirements.

2 LiDAR, soil classes and other contextual spatial data sets

For the NWFP site, LiDAR data [[Ferraccioli et al., 2014](#)] provides both a digital surface model (DSM) and a digital terrain model (DTM) of the NWFP (see representations given in [Figure 2](#)). The soil is predominantly of two similar series, Hallsworth and Halstow, that comprise of a slightly stony clay loam topsoil (approximately 36% clay) overlying a mottled stony clay (approximately 60% clay), derived from carboniferous culm measures [[Harrod T.R and Hogan D.V, 2008](#)]. The subsoils data are depicted in [Figure 3](#), together with the 15 NWFP catchments and 21 field boundaries. All such contextual spatial data sets are available to registered Data Portal users via an HTTPS download. This includes the shapefiles necessary to produce the NWFP map in [Figure 1](#).



Figure 2. Elevation for NWFP site

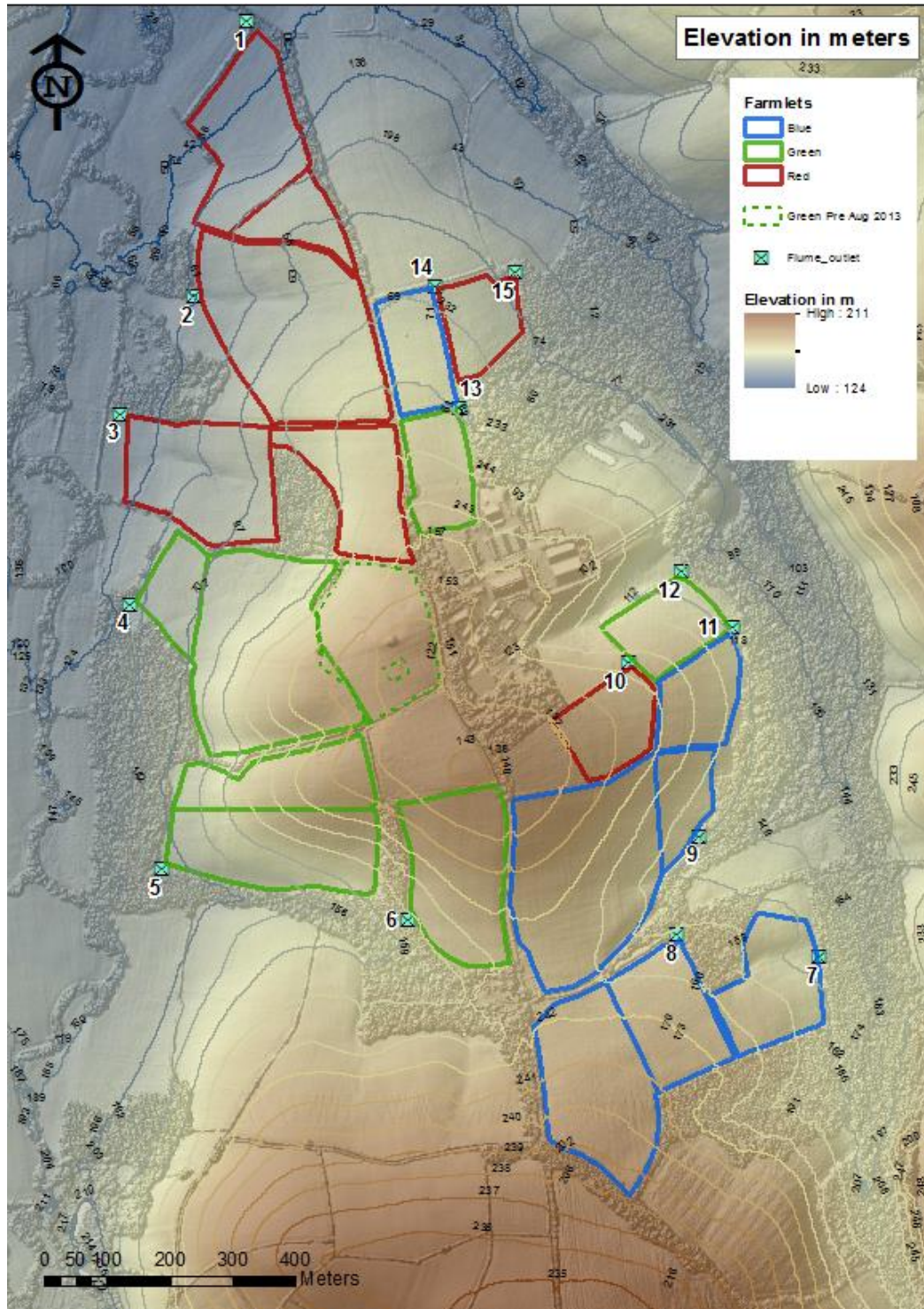
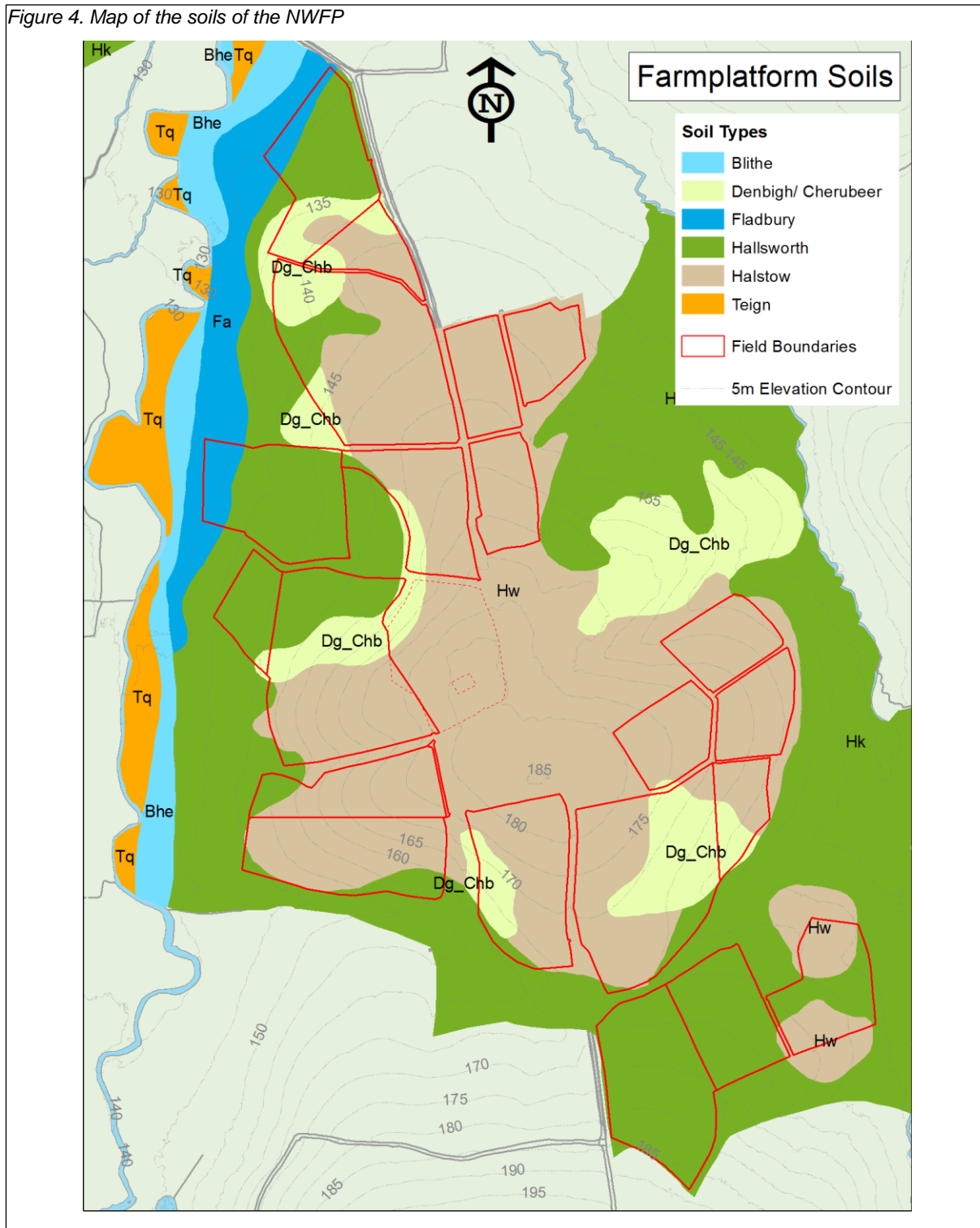




Figure 4. Map of the soils of the NWFP





3 Survey Sample Locations

A number of field surveys have taken place since 2011 on the NWFP, ranging from soil nutrients to soil fauna to botanics. The surveys have been predominantly carried out on pre-established grid locations, or occasionally on 'off-grid' sampling locations (especially when a good assessment of small-scale spatial variation is required). In both cases, RTK GPS equipment was used to locate and record the sampling locations. For the grid, a 25 m resolution is used that covers the entire NWFP site. This enables sampling surveys to be performed consistently on any 25, 50, 75 or 100 m interval (Figure 5)¹. All sampling points and their coordinates are stored in the NWFP database, together with the survey measurements.

Figure 5. The 25m sampling grid of the NWFP



¹ Note that the 50 m grid is not fully-regular in that it is shifted by 25 m along a vertical line between catchments 6 and 9 (see Figure 1). This affects several surveys.

4 Survey Data Releases

Registered users can download the survey data in the form of a csv file, which will contain the survey results for each sampling point, the OSGB36 grid-coordinates² for that point and a sampling ID (but only if the sampling point coincides with an existing 25 m grid-location). The data contain the Experiment ID, which can be used to identify a specific survey (e.g. the Experiment ID of the 2012 Soil nutrients survey is FP003). The data download file will contain the whole dataset of the selected surveys during the selected time-interval, including data that fall outside that time-interval. Note that even if one sample point falls within the time-interval selected for the data-download, the WHOLE dataset will be returned. Also provided in the data download is the UTC-timestamp, as the time and date of sampling are essential. For example, a field could have been treated with fertilizer a few days before the samples were taken. As the fertilizer application would affect the results of the soil sample, it is vital to record the sample date. Livestock movement is also an important consideration in this respect too (see, [FP_UG.Doc.004_FieldEvents&LivestockData](#)); as are times when fields or catchments were ploughed and reseeded – moving from baseline to post-baseline status. Further documents of note are how the field polygons are created and the field spreading area calculations (see [Technical case studies 1 and 2](#), respectively). Additionally, each listed survey parameter will have a traffic light flagging system for quality control (QC), together with the date of this QC. Currently the traffic light quality flag assignment consists of the following 6 levels: Not Set; Good; Acceptable; Suspicious; Highly Suspicious; and Reject.

For field survey data **released on the 29/02/2016 & 17/07/2018**, and soils invertebrate survey data **released on the 30/09/2016**, the baseline surveys are summarised in [Table 1](#). All survey parameters have been flagged as “Acceptable”.

² Details on the coordinate systems that are used are available on request. It is also useful to link to <https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/navigation-technology/os-net/surveying.html>



Table 1. Field survey data released 29/02/2016 & 17/07/2018

Survey	Year(s)	Experiment ID	Parameters measured†
Site-wide (most catchments)			
Soil nutrients	2012	FP003	Bulk Density, pH, SOM, Total N, Total C, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$
	2016	FP059	Bulk density, pH, SOM, Total N, Total C ^{13}C , ^{15}N , AL, As, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Se, Ti, Zn (mg/kg DM soil), Olsen extractable P (mg/kg DM soil), water extractable PO_4 (molybdate-reactive PO_4 by discrete photometric analysis; mg/kg DM soil) & water extractable total phosphorus (by discrete photometric analysis; mg/kg DM soil)
Soil invertebrates (soil fauna)	2012; 2013	FP002	Anthomyiidae, Bibionidae, Cantharidae, Carabidae (adult & larvae), Chironomidae, Chrysomelidae, Dolichopodidae (A&B), Elateridae, Muscidae, Noctuidae, Psychodidae, Scatopsidae, Sciaridae, Stratiomyidae, Tipulidae, Unknown Coleoptera
Herbage (plant nutrients)	2013	FP010	Total N, Total C, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, Average Sward Height
Botanics (floristics)	2013	FP013	Cover of plant species
Limited (few catchments)			
Silage cuts	2011	NW558	Silage Dry Matter Yield
	2012	NW569	
	2013	NW583	
Soil nutrients	2013	FP008	pH, SOM, Total N, Total C
Soil pH	2013	FP012	pH

†See Table 2 or Table 3 for acronyms used



5 2012 Soils Nutrients: Site-wide Survey

The first soil nutrients survey was carried out during the summer of 2012 on the 50 m sampling grid (e.g. Noacco 2012; Harris et al. 2014). This is viewed as the main baseline survey for soil nutrients and sampled for the parameters listed in Table 2. This data's sampling period ran from 01st June 2012 to 31st July 2012. All 15 catchments were sampled. Figure 6 displays an example map of these data.

Table 2. 2012 Soil Nutrient Parameters

Parameter	Units
Bulk Density	g dry soil/cm ³
pH	-
Soil Organic Matter (SOM)	% of Dry Matter
Total Carbon (Total C)	% of Dry Matter
Total Nitrogen (Total N)	% of Dry Matter
$\delta^{13}\text{C}$ (isotope of C)	delta vs air
$\delta^{15}\text{N}$ (isotope of N)	delta vs PDB [†]

[†]Pee Dee Belemnite

6 2016 Soils Nutrients: Site-wide Survey

A secondary soil nutrients survey was carried out between 01st July to 21st July 2016. All the NWFP fields were surveyed (21 fields in total). Most were sampled on the 50 m sampling grid but some were sampled on the 25 m grid (Longlands North, Longlands South, Longlands East, Dairy North, Dairy South, Dairy East and Lower Wheaty). The samples were analysed for the parameters listed in Table 3.

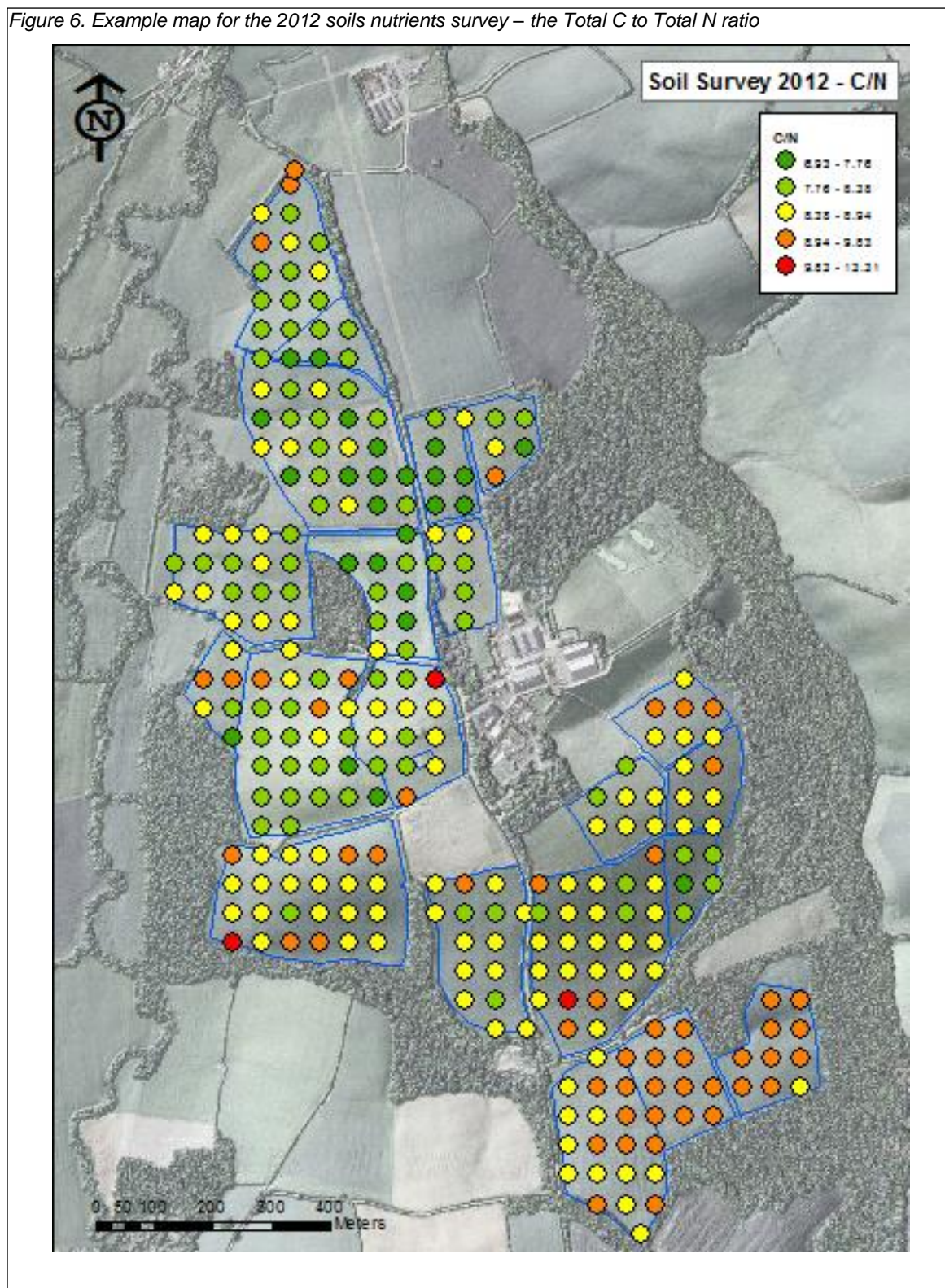
Table 3. 2016 Soil Nutrient Parameters

Parameter	Units
Bulk Density	g dry soil/cm ³
pH	-
Soil Organic Matter (SOM)	% of Dry Matter
Total Carbon (Total C)	% of Dry Matter
Total Nitrogen (Total N)	% of Dry Matter
Olsen P, Total P & PO ₄	mg / kg Dry Matter
$\delta^{13}\text{C}$ (isotope of C)	delta vs air
$\delta^{15}\text{N}$ (isotope of N)	delta vs PDB [†]
Major & Trace Elements	mg / kg Dry Matter

[†]Pee Dee Belemnite



Figure 6. Example map for the 2012 soils nutrients survey – the Total C to Total N ratio

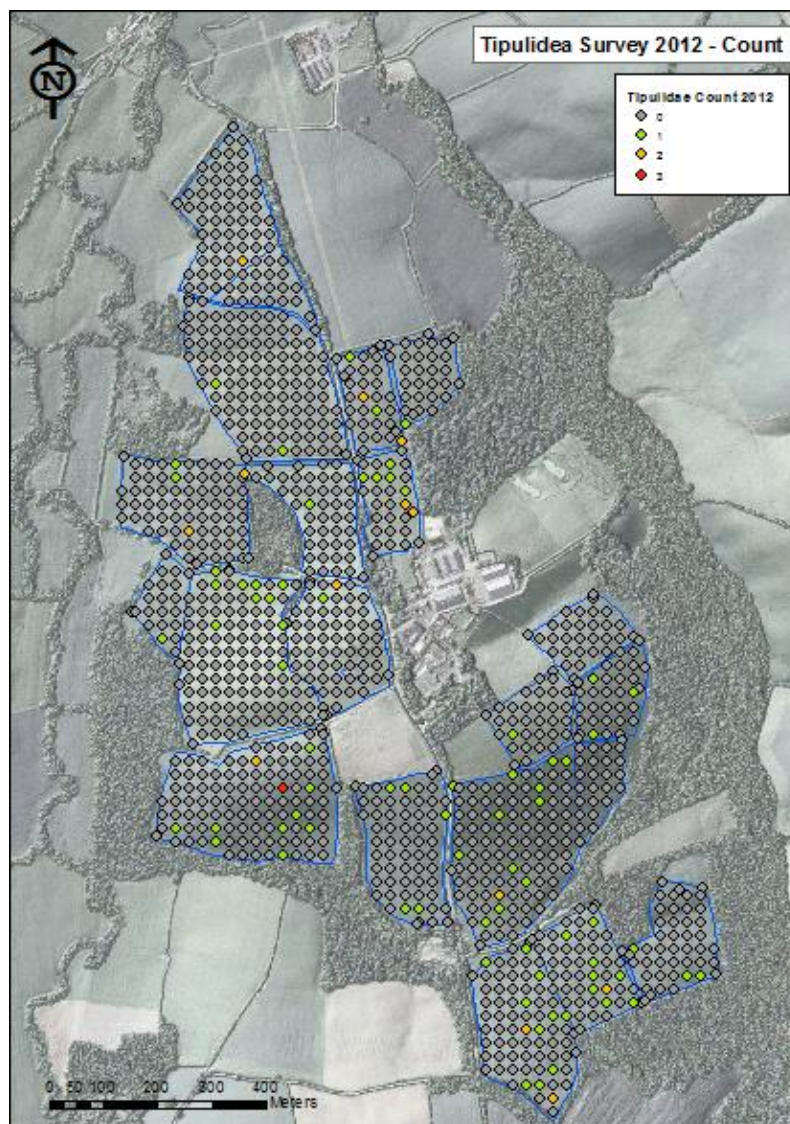




7 2012-3 Soils Invertebrates: Site-wide Surveys

Soil fauna (insect taxa) surveys were conducted over a three-year period starting 15/11/2011 and ending on 08/04/2013 (see [Table 1](#)). This resulted in two site-wide surveys covering all 15 catchments on the 25 m grid. One survey was aligned to 2012, the other 2013. Both surveys can be viewed as baseline. Details of this fuller sampling campaign can be found in [Ahmed \(2013\)](#), [Benefer et. al. \(2016\)](#) and [Wei et. al. \(2016\)](#). [Figure 7](#) displays an example map of this data for 2012.

Figure 7. Example map for the 2012 soils invertebrates survey





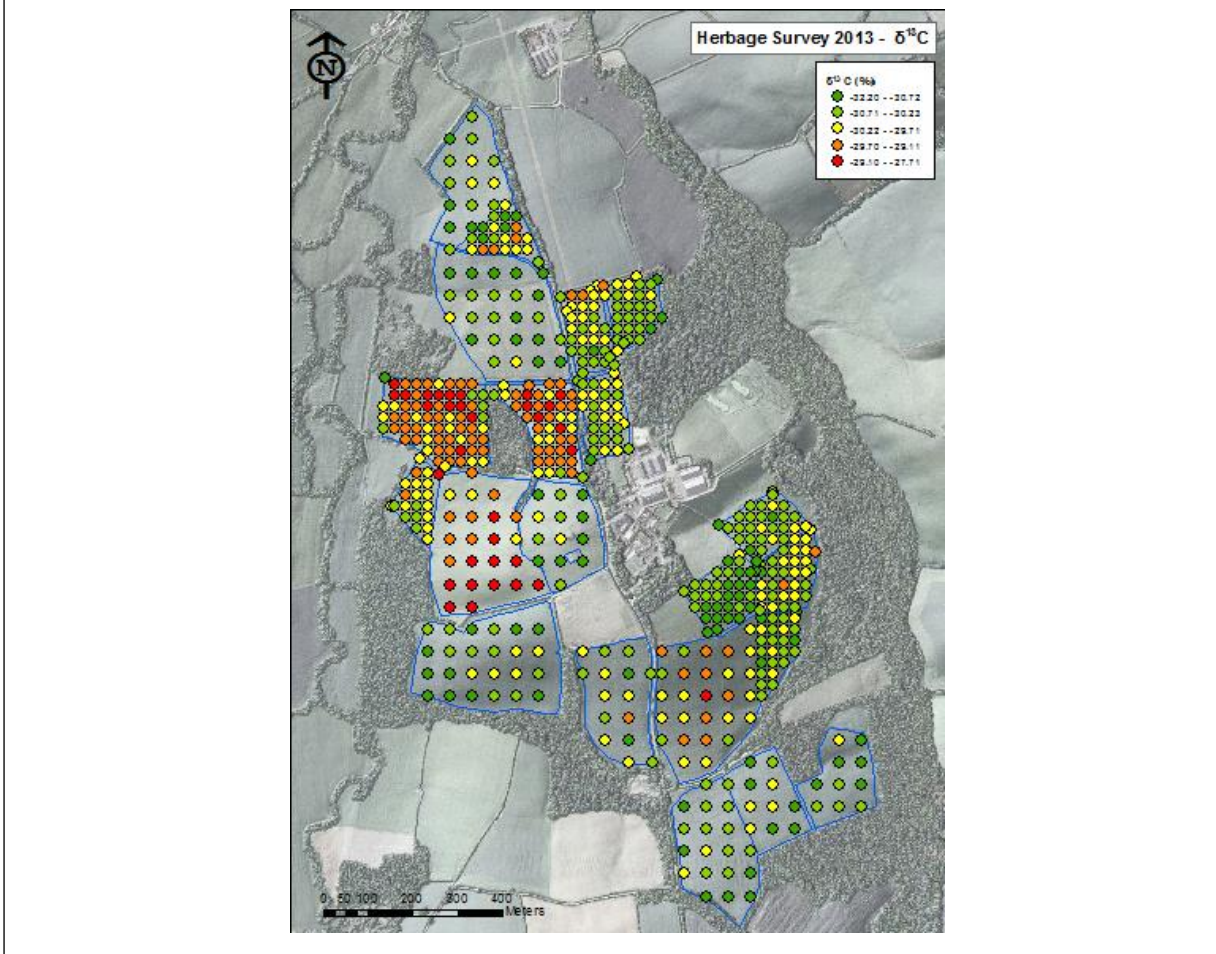
8 2013 Herbage: Site-wide Survey

A plant nutrients (herbage) survey was carried out during the summer of 2013 on a mixture of the 25 and 50 m sampling grids (e.g. Kear 2013). Sampled parameters are listed in Table 4. This data's sampling period ran from 12/06/2013 to 2/07/2013. All 15 catchments were sampled. Figure 8 displays an example map of this data.

Table 4. 2013 Plant Nutrients Parameters

Parameter	Units
Total Carbon (Total C)	% of Dry Matter
Total Nitrogen (Total N)	% of Dry Matter
$\delta^{13}\text{C}$ (isotope of C)	-
$\delta^{15}\text{N}$ (isotope of N)	-
Average Sward Surface Height	cm

Figure 8. Example map for the 2013 plant nutrients survey - $\delta^{13}\text{C}$



9 2013 Botanic - Site-wide Survey

Botanical assessments of the NWFP fields were undertaken during the summer of 2013 on a mixture of the 25 and 50 m sampling grids (Tozer 2013). A quadrat consisting of a 50x50 cm metal frame was used to assess the botanical composition. The frame was placed on the ground with the SW corner directly on the sampling point; using a compass to align the edge in a Northerly direction. The botanical composition was assessed in these 0.25 m² quadrats at each of 293 sampling locations and species were scored according to the Domin Scale. The National Vegetation Classification: Users' Handbook (Rodwell 2006) describes the Domin Scale in the following manner: "For every species recorded in the sample, an estimate should be made of its quantitative contribution to the vegetation. Cover is a measure of the vertical projection on to the ground of the extent of the living parts of a species." Cover is defined according to the following categories given in Table 5. Domin scale data can be converted to a linear scale using a suitable conversion (see Tozer 2013).

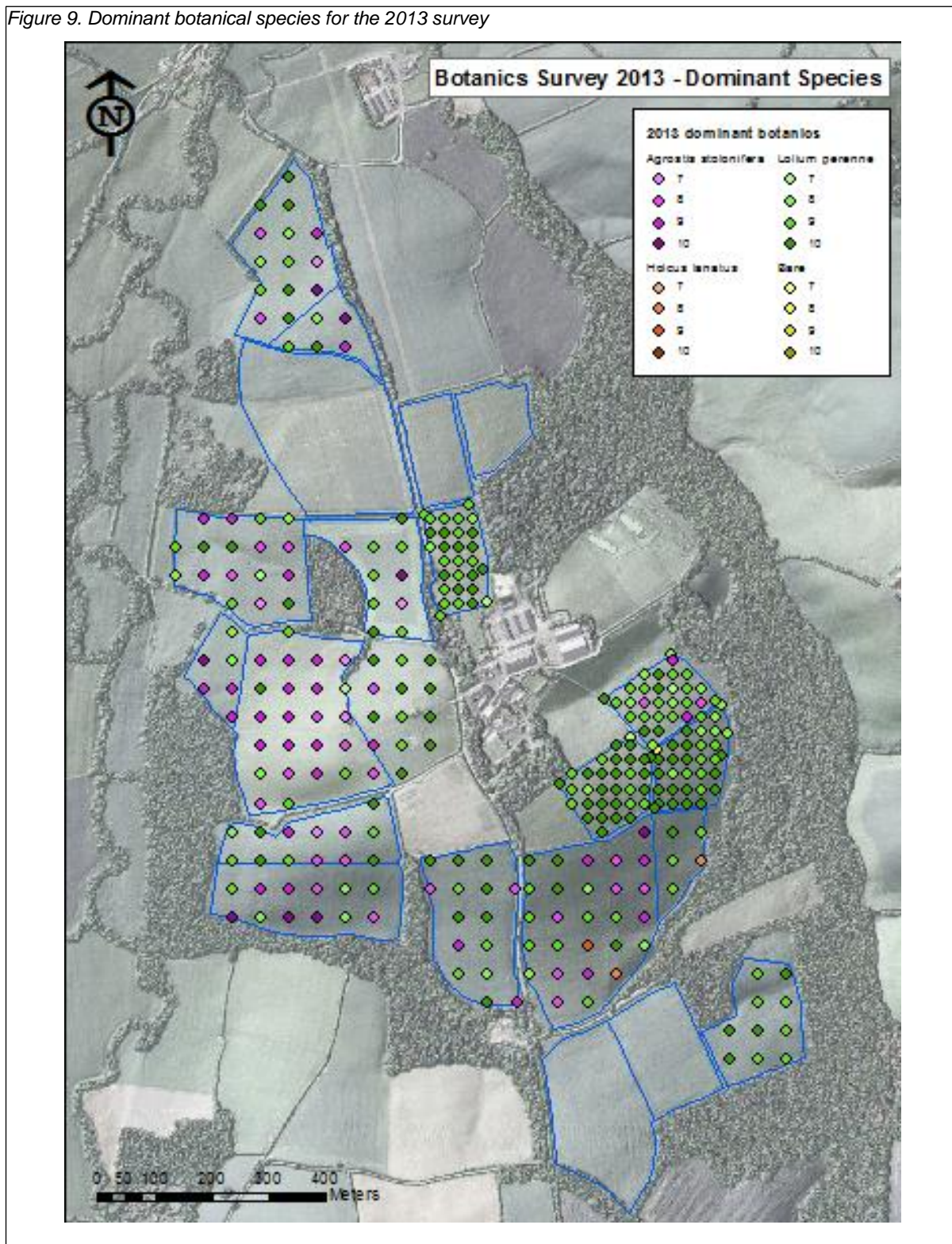
Table 5. Domin Scale used to classify grassland vegetation.

Cover	Domin Score
91–100%	10
76–90%	9
51–75%	8
34–50%	7
26–33%	6
11–25%	5
4–10%	4
<4% (many individuals)	3
<4% (several individuals)	2
<4% (few individuals)	1

Rodwell's handbook explains that "Even when vegetation does not appear to be considerably layered, the sum of all the Domin values for a species can be greater than 100% cover because of structural overlap of the plants." The species observed were: *Agrostis stolonifera*, *Alopecurus geniculatus*, *Dactylis glomerata*, *Holcus lanatus*, *Lolium perenne*, *Phleum pratense*, *Poa annua*, *Poa trivialis*, *Cardamine pratensis*, *Cerastium fontanum*, *Cirsium arvense*, *Juncus effuses*, *Ranunculus repens*, *Rumex crispus*, *Rumex obtusifolius*, *Veronica serpyllifolia*, *Taraxacum officinale*, *Trifolium repens*, and also 'Bare' and 'Dung'. This data's sampling period ran from 22/07/2013 to 07/08/2013. The study is considered site-wide, but only 11 of 15 catchments were sampled due to re-seeding in some catchments. Figure 9 displays an example map of this data.



Figure 9. Dominant botanical species for the 2013 survey





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10 2016 Botanic - Site-wide Survey

This was carried out using the same methodology as that for the 2013 survey except that the SW corner of the quadrat frame was placed exactly 1 m due north of the sampling grid points to avoid freshly trampled areas resulting from a different type of field survey that had used the same grid points.



11 2011-2013 Silage Cuts - Limited Surveys

On the NWFP, grass for silage is cut approximately twice a year when not needed for grazing. To determine the dry matter yield, cuts of 1.5 m wide and approximately 10 m in length (measured accurately), with a sample point (or predefined GPS location) at its centre are made. Fresh samples are dried and the dry matter yield is calculated and expressed in kg per hectare. **Figure 10** maps the field locations of the cuts for 2011, 2012 and 2013. **Figure 10** provides an example output of this data.

Figure 10. Location of silage fields for 2011, 2012 and 2013

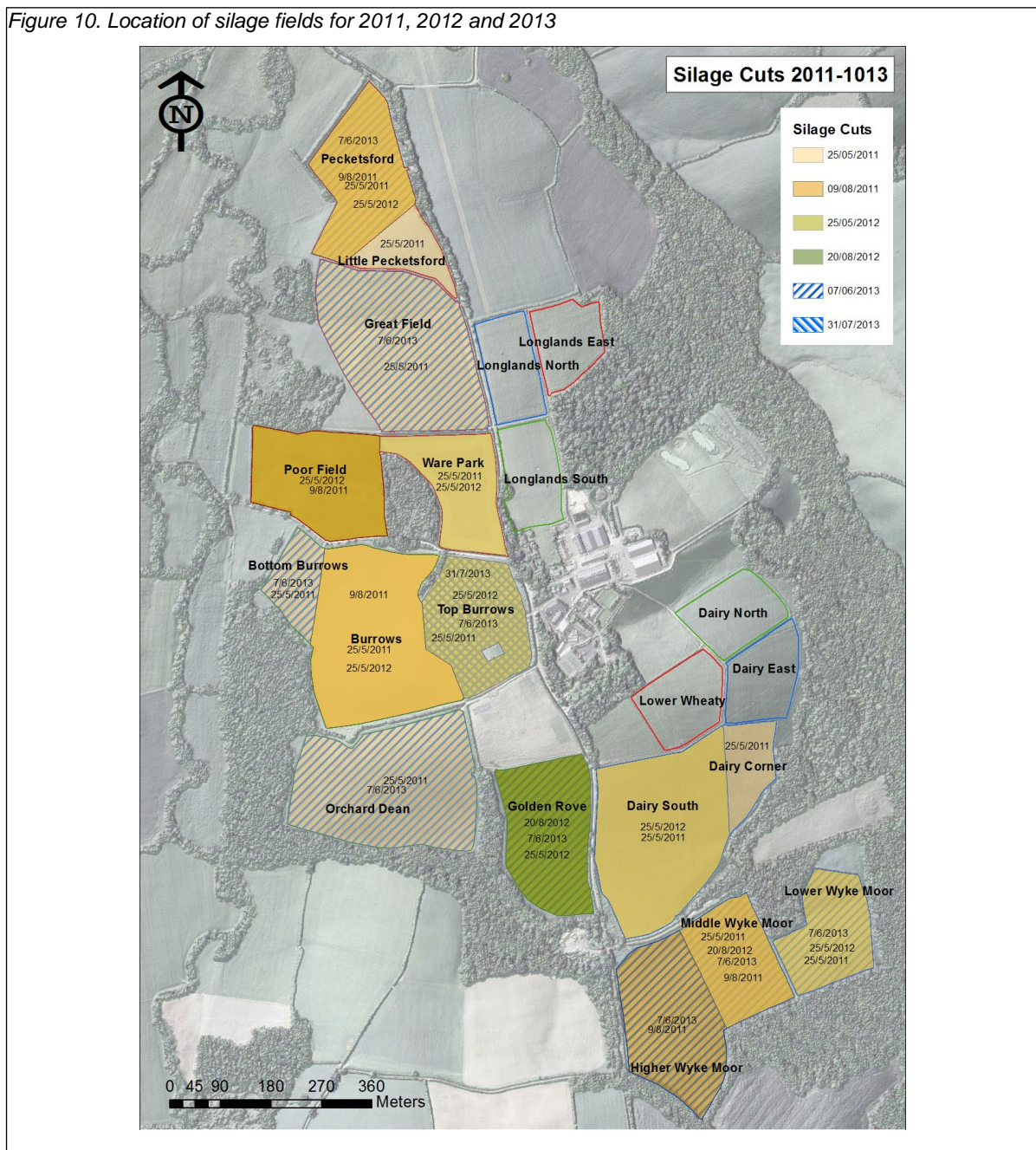




Figure 11. Example output from data portal for silage cuts

Experiment_Id	SP_ID	sample_distance (m)	Field	Flume	Sample_date	Sample_time	comments	Start_Sample_Date	GPS_Sample_Nr	Easting	Northing	Silage Dry Matter Yield (kg/ha)	Silage Dry Matter Yield Quality	Silage Dry Matter Yield Quality Last Modified
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	1	265701.23	99027.88	6220.02	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	2	265621.36	99162.64	8335.66	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	3	265637.33	99038.39	7116.73	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	4	265595.77	99118.06	7003.35	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	5	265615.02	99241.73	8485.22	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	6	265637.09	98733.25	6037.3	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	7	265721.10	98793.43	7351.36	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	8	265672.90	98935.10	7192.93	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	9	265596.13	98952.16	7291.08	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	10	265616.02	98873.17	6595.04	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	11	265651.76	98817.32	6441.03	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	12	265776.81	98702.39	8375.28	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	13	265791.05	98485.19	6513.4	Not set	09/04/2015
NW558_SC1	NA	NA	NA	NA	25/05/2011	12:00:00		NA	14	265799.51	98624.97	7425.67	Not set	09/04/2015

2013 Soils Nutrients - Limited Survey

A limited soils nutrients survey was carried out during the summer of 2013 on the 25 m sampling grid (Baldet 2013). The soils nutrients parameters that were sampled are listed in Table 6. This data was sampled in one day on 01/06/2013. Only 3 catchments were sampled (Longlands East, South and North) provided 89 sampling locations in total.

Table 6. 2013 Soils Nutrients Parameters

Parameter	Units
pH	-
Soil organic matter (SOM)	% of Dry Matter
Total Carbon (Total C)	% of Dry Matter
Total Nitrogen (Total N)	% of Dry Matter

12 2013 Soils pH – Limited Temporal Surveys

A temporal pH survey was carried out during the summer of 2013 on the 25 and 50 m sampling grids in order to inform a precision application of prilled lime. The pH data was collected at sites in Longlands East, Longlands South, Longlands North and Higher Wyke Moor (one field of catchment 8). Ten different sampling times were used, thus providing a spatio-temporal data set for pH. First days sampling was conducted on the 08/08/2013 and the last on the 14/10/2013.



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