Identification of Functionally Linked Land supporting SPA waterbirds in the North West of England – Phase 2

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Citation

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Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Executive summary

‘Functionally linked land’ (FLL) is a term often used to describe areas of land or sea occurring outside a designated site which is considered to be critical to, or necessary for, the ecological or behavioural functions in a relevant season of a qualifying feature for which a Special Area of Conservation (SAC) / Special Protection Area (SPA)/ Ramsar site has been designated. These habitats are frequently used by SPA species and supports the functionality and integrity of the designated sites for these features.

There is a requirement for competent authorities to consider the importance of functionally linked habitats in Habitats Regulation Assessments (HRAs) when assessing new plans or projects to ensure the Conservation Objectives for the site can still be delivered. The impact of the loss of functionally linked land on European sites can be difficult to determine as there is often limited information available.

This report has been commissioned to extend a previous project by Natural England: ‘NECR361 Edition 1 Identification of Functionally Linked Land supporting SPAs waterbirds in the North West of England’ which was published by Natural England in 2021. It is intended that this report be read in conjunction with the original project.

This report aims to address some of the recommendations suggested within the initial project. This includes collating evidence from existing bird records to create maps showing important supporting habitats around the Dee Estuary and improve understanding of which bird species are using these sites. This report also includes the results from bird surveys carried out by Bowland Ecology in 2022. This project will help to ensure the current geographical spread of supporting habitats across the North West are maintained and enhanced to ensure the integrity of the SPA sites are protected in the long term.

Bowland Ecology has undertaken this project in partnership with Natural England.

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1. Introduction

Functionally linked land (FLL) is supporting habitat beyond the boundary of a focal area, such as a designated site, that is connected to the life and reproduction of a population for which a site has been designated or classified. This land will be important to the continuing survival, reproduction and viability of the species population associated with a designated site.

This updated study aims to support existing mapping of potentially important FLL at a regional scale connected to six SPAs in the North West, using targeted field surveys to improve Natural England's understanding of where FLL is located and which species are using these areas.

The following Special Protection Areas (SPA) are included within this study:

- Dee Estuary SPA;
- Mersey Narrows & North Wirral Foreshore SPA;
- Mersey Estuary SPA;
- Liverpool Bay SPA;
- Ribble & Alt Estuaries SPA; and
- Morecambe Bay & Duddon Estuary SPA.

This study also aims to refine existing FLL mapping with a focus on the Dee Estuary SPA, using existing bird data collated from CAWOS and the BTO WeBS data.

2. Methodology

2. 1 Definitions

For the purpose of this study, FLL is defined as: areas of land occurring within 20 km of an SPA, that are regularly used by significant numbers of qualifying bird species.

This definition has been developed and agreed with Natural England. A buffer of 20 km has been used based on the distance Pink-footed Geese tend to travel from their roost sites within an SPA site.

For the purpose of this study:

A significant number of birds has been defined as 0.5% of the GB population or 1000 individuals.

The first of four Stage 1 criteria for designating SPAs states an area must support 1% of the GB population of a qualifying species. In collaboration with Calum Booth (RSPB) and Natural England it was decided that, for the purposes of this project an area should support at least 0.5% of the GB population of a qualifying species, or 1000 birds, to be considered FLL. This provides a good threshold for data inclusion when applied to the suite of data used in this project.

A threshold of 0.5% of the whole GB population has been used, rather than 1% of the qualifying population for each separate SPA. Because the SPA population of individual species varies across the North West, using a separate threshold for each SPA would require associating each area of land in the North West with a specific SPA based on distance and would therefore not take account of birds moving between SPA's. For example, Pink-footed Geese can travel up to 20 km in a day and it would be reasonable to suggest that these birds can cross over boundaries of different SPA associated FLL. While this study is limited by not considering the varying SPA populations, using a single threshold simplifies the approach, making the analysis much less time-consuming and resulting in a single set of outputs.

Regular usage is defined as being used by significant numbers of birds for 7 or more years since 2010.

Defining regular usage means counting the number of times a significance threshold is surpassed. Stroud *et al.* (2001) defined 'regular' as when a threshold is met in two thirds of the season for which adequate data are available. This project includes data from 2010, so 7 or more years has been used as a regularity threshold as this covers roughly two thirds of the seasons for which data is available, in accordance with

Stroud *et al.* (2001). However, this proved to be a high threshold for this study as most of the data available had not been collected in a regular way. Therefore, areas have been mapped as moderate or low FLL even if the threshold for regularity was not met.

The definition of qualifying bird species includes both non-breeding qualifying species and assemblage qualifying species, as mentioned in the citations of the SPAs included in this study (Appendix 2). The species list has been decided on with help from Paul Ellis (Fylde Bird Club).

2.2 Methodology

The steps taken to carry out this project are as follows:

1. Field surveys were carried out for 61 sites across the North West, including WeBS sectors with 'No Data', and areas near the Dee Estuary with recommendations for more data collection (as identified in the 'NECR361 FLL Project 2021'). Surveys were undertaken between 7th January to 17th February 2022 by experienced ornithological surveyors. The bird survey method followed Gilbert *et al.* (1998):
    - A single survey visit was undertaken to each site, within 2 hours of high tide.
    - The survey comprised either a transect of the site, where access was available, or a vantage point survey. All qualifying bird species that were observed using the habitat for feeding and roosting were recorded using a specific survey form (Appendix 3).
    - Counts were made from the public footpaths. Survey duration varied depending on the size of the site. Weather conditions for the surveys are shown in Appendix 4.
2. A specific survey form has been developed and is included in Appendix 3. The form is designed to record the presence of qualifying bird species in a consistent manner. Additional information recorded includes 8-figure grid references, bird activity, habitat type, land use and disturbance. It is intended that the form is adopted by bird recorders to ensure that further refinement of FLL areas is based upon up to date and consistent evidence.

3. Data holders were contacted, including BTO and CAWOS, and existing available data was collated (please see Appendix 1 for copyright and licencing information). The datasets and sources used in this study are as follows:
    - BTO WeBS Core Counts;
    - CAWOS Bird Club Data;
    - Survey results from Bowland Ecology;

- ‘Appendix 11’ of the ‘Third SPA Network Review’ (Stroud *et al* 2016, JNCC); and
- Habitat data from the Crop Map of England (CROME) published by the Rural Payments Agency.

4. This data was analysed to extract any usable records and converted into formats for use in GIS systems.

The data handling process for each dataset is discussed in more detail below.

2.3 Data handling

This study into FLL reviewed several different data sources as evidence for FLL. There are a number of caveats associated with each data source, these are outlined in the ‘Results and Discussion’ section of the report.

a) BTO WeBS core count data

WeBS core count data for 2020 and 2021 was provided by the BTO and has been verified according to the definition of FLL described in the methodology. This data is considered to be of a high quality, as it is generally collected in a systematic way, meaning any WeBS sectors found to have significant and recurring counts were considered to have high confidence as FLL.

1. The WeBS monthly core count data for 2020 and 2021 associated with sectors within the Dee Estuary area was downloaded from the BTO WeBS database. The core counts were chosen to reflect the non-breeding counts relevant for this study.
2. The data was then verified according to the thresholds of significance described above. Then, for each WeBS sector, the number of significant counts for each species and for each year was tallied for each WeBS sector using pivot tables in excel.
3. The total number of years where significant numbers of any species occurred was also counted, to identify those sectors that have not been visited regularly by a single species, but rather an assemblage of birds.
4. This data was then uploaded into QGIS to see if any of the WeBS sectors could be upgraded to a higher level of significance.

b) CAWOS bird data

CAWOS provided their bird data for the species included in this study for the last 10 years, and this has been used to create maps showing significant bird counts. Since 2020 CAWOS have been inputting their data into BTO BirdTrack, and as a result, the bird records have low spatial accuracy so could only be displayed at tetrad level. CAWOS used their existing records of their regular survey areas to input grid

references back into the database for 2020 and 2021, allowing these records to be used in the study.

The excel spreadsheets containing the point data were first filtered to include only SPA qualifying species since 2010, with the significance thresholds applied. Next, the spatial information associated with each significant record was interrogated to identify the spatial resolution.

Point data records with 6 figure grid references accurate to 100m were extracted from the CAWOS dataset and uploaded into the GIS program Quantum GIS (QGIS) (26,695 points in total). These were used to draw polygons around any fields containing significant counts. All the fields that overlapped the 100 m square containing the point (the area covered by the grid square reference provided) were included in the polygon, as it can be assumed that that point could be located anywhere within that area. If polygons overlapped or were touching, they were combined to create a larger polygon. A series of rules were used to determine the 'functionality' level of each polygon:

1) Regularity – whether a polygon contains counts covering more than two thirds of the seasons of this study – minimum 7 years (Stroud *et al*, 2001)
2) Location accuracy – whether there is confidence that the significant count occurred within that polygon; and
3) Multiple counts – whether a point contains more than one significant count (see explanation below).

If a polygon meets the criteria of a rule, using the CAWOS point data as evidence, '1' is inputted into the adjacent column, and 1 point would be given to the final 'Functionality Score'. If the point does not meet the criteria, then '0' is inputted and 0 points are given. This method results in an overall functionality score between 1 and 3 (any polygons with a score of 0 were not included in the final maps). Any polygons with a functionality score of 3 are considered to offer high potential FLL. Scores of 1 or 2 are lacking some of the data needed to confirm high potential FLL. As such, a score of 2 offers moderate potential FLL and a score of 1 offers low potential FLL.

Multiple counts – this column differentiates between polygons containing 1 significant count, and polygons containing multiple significant counts. This has been included to lower the functionality score of areas only visited once, as this is most often a single Great White Egret count, which is an assemblage species.

More information about each polygon of FLL can be found in the attribute table when viewed in a GIS system. This includes a list of species that regularly visit that FLL polygon, a list of occasional visitors to that polygon, the total number of significant counts and the number of years in the past ten that the polygon has been visited. A

‘Justification/comments’ column has also been included, which explains when decisions have been made to map polygons in that way, and a ‘Further Recommendations’ column, which offers advice on how to improve the maps in the future.

A distinction has been made between areas of FLL visited in significant numbers for 7 or more years by a single species, and areas of FLL visited in significant numbers for 7 or more times in total, but by an ‘assemblage’ of species. The former means that the area of FLL is important for the life cycle of one or more specific species, whereas the latter means that the area of FLL is important as it regularly supports a variety of different birds in significant numbers, yet no single species meets the regularity threshold on its own. This difference is shown in the ‘Regular Species’ column of the attribute table, with the label ‘Regularly visited by an assemblage of birds’.

c) Bowland Ecology Survey Results

The data collected by Bowland Ecology during the surveys was imported onto QGIS. BTO species codes for each species recorded for each site during the survey are displayed on the maps. The sites were colour coded based on the primary habitat present. The sites were also colour coordinated based on the category of FLL given by the surveyor, either ‘high’ for definite FLL, ‘moderate-low’ for possible FLL and ‘negligible’ for no FLL. The results from the surveys were also inputted into a summary table in Excel (Appendix 4).

d) ‘Appendix 11’ of the ‘Third SPA Network Review’

Findings from ‘Appendix 11’ of the ‘Third SPA Network Review’ were used to narrow the likely areas of use by different species. Appendix 11 includes a table (Table 1 in the JNCC report) detailing the cropped habitat requirements of birds in the SPA network. Only a small number of qualifying species from the SPA’s of interest are present in the table however information on the non-breeding habits of Whooper swan, Pintail, Pink-footed goose, Curlew and Wigeon were collected. These were then used to create buffers of likely maximum distances of these species from the SPA’s. For example, Wigeon are considered to only travel approximately 2km from their roost site, therefore a 2km buffer has been created around each SPA to show the likely areas that Wigeon will use. It was considered that further narrowing the mapping of use down to specific field types was not possible given the broad habitat use types given in Appendix 11, for example curlew are said to use ‘Improved and rough grasslands, arable fields’. In addition, the location of specific field types are likely to change year to year due to rotation of crops.

e) CROME habitat data

Data from the Crop Map of England (CROME) published by the Rural Payments Agency was acquired and analysed. CROME data is available for the years 2018-2020 for the areas of study, in this case the most recent year's data, 2020 has been used. The data was downloaded from the GOV.UK website and opened in QGIS. The data consists of 0.4 hectare (ha) hexagons identified as being individual crop types for example 'beans', 'potatoes', 'spring wheat' etc. Crop types considered unsuitable for qualifying species were removed from the data set, these were 'non-vegetated land', 'heathland and bracken' 'trees and scrub, short woody plants, hedgerows', and 'heather'. The remaining polygons were combined for ease of viewing giving a layer which indicates a higher probability for use by qualifying species and potential qualification as FLL.

3. Results and discussion

The outputs of this study are updated FLL maps showing the CAWOS data mapped alongside the existing polygons from the 'NECR361 FLL Project 2021', with FLL labelled as high, moderate and low potential areas. The CROME habitat data is also included in these maps. The species buffer maps and Bowland Ecology survey result maps are also outputs. An example of each map is shown in this report and is further explained below (the full maps can be found in Appendix 5-7).

3.1. Drawing title: WeBS sector FLL (Figure 1)

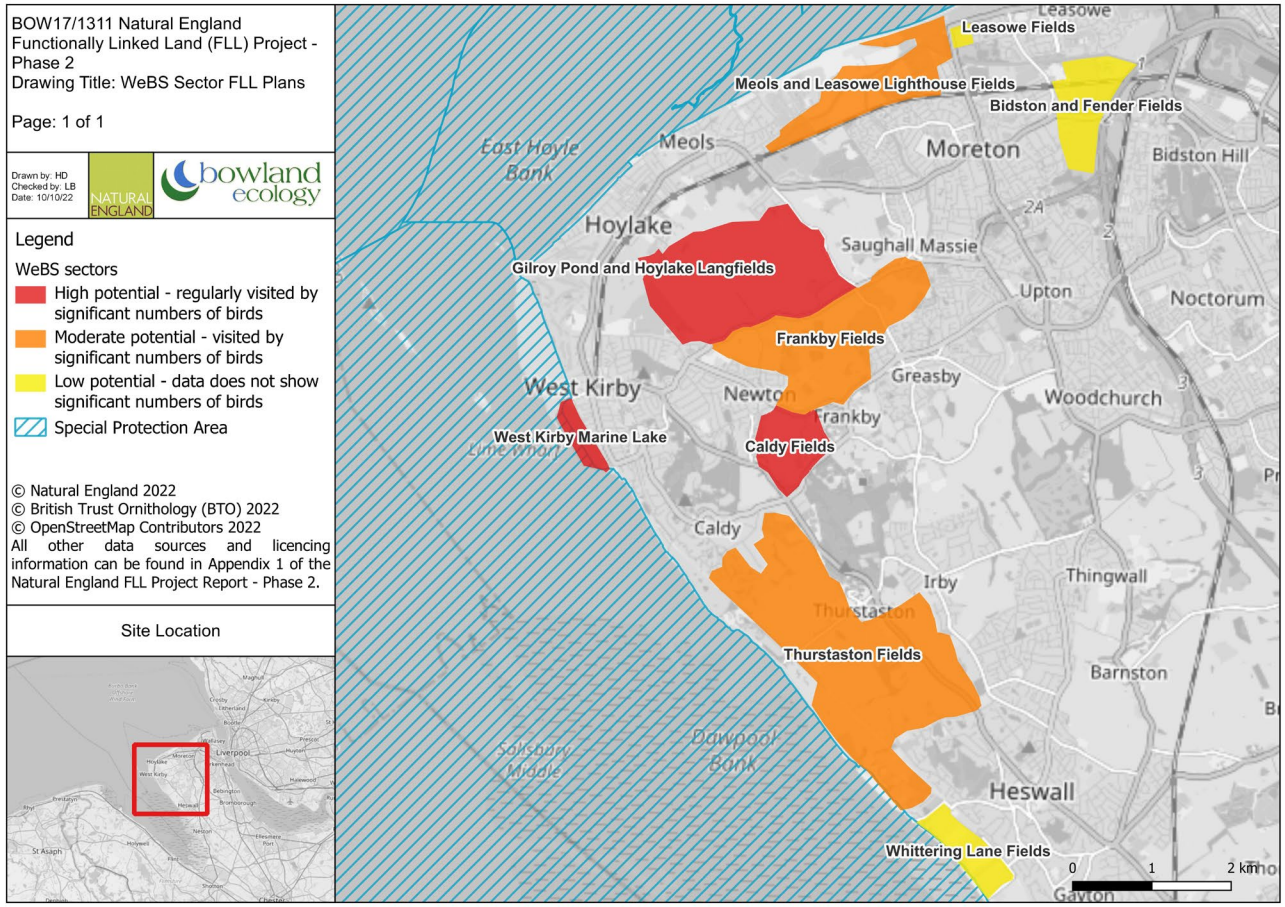

Figure 1. Wetland Bird Survey (WeBS) sector data for the Dee Estuary identifying potential FLL © British Trust for Ornithology 2022.

a) Overview

These maps show the WeBS sectors for the Dee Estuary, categorised as high (red), moderate (orange) and low (yellow) potential FLL, that have been updated with WeBS counts from 2020 and 2021. Three sectors that were missing from the previous report, Leasowe Fields, Bidston and Fender Fields, and Whittering Lane Fields, have also been included. The data for these maps comes from the BTO WeBS monthly core counts since 2010.

a) More information

The WeBS sector monthly core count data was filtered to show only SPA qualifying species. The number of times each sector showed a count that met the 0.5% GB threshold was then calculated.

- The red sectors show areas that are regularly visited by significant numbers of species and have therefore been given a label of high FLL potential. This means that these sectors have been visited by SPA qualifying waterbirds in numbers of at least 0.5% of the GB population, in 7 or more years since 2010.
- Orange sectors have significant counts associated with them, however the data suggests they haven't been visited as regularly as the high potential areas. This means that these sectors have been visited by at least 0.5% of the GB population of SPA qualifying species, but have been visited in less than 7 years since 2010.
- The yellow sectors show low potential for FLL, this means the data suggests there are no significant counts meeting the 0.5% GB threshold since 2010.

The 2020 and 2021 counts have increased West Kirby Marine Lake from low potential to high potential, as this sector has been visited by significant numbers of qualifying species for 8 years since 2010. Similarly, Caldy Fields has been increased from moderate to high potential due to being regularly visited in 8 years since 2010. The boundary of Leasowe fields has been updated to exclude residential areas and scrub. No other WeBS sectors have changed since the previous report.

3.2. Drawing title: CAWOS FLL Maps (Figure 2)

a) Overview

These maps show 124 coloured polygons representing different levels of potential FLL at individual field level:

- Red showing high potential;
- Orange showing medium potential; and
- Yellow showing low potential.

The polygons are either block colour, representing polygons created from the CAWOS data, or dashed outlines, representing polygons taken from the NECR361 FLL Project 2021.

The mapped areas are classified as high, moderate and low potential FLL defined by a functionality score' of 1-3. The map location is shown in the bottom left corner of each map. The associated data can be viewed in GIS systems.

b) More information

High potential areas, with a score of 3 and shown as red polygons, are areas where significant numbers of SPA qualifying species are regularly visiting, and there is high confidence the accuracy of the location of the polygon.

Moderate potential areas with a score of 2 and displayed as orange polygons show where significant numbers of water birds are visiting, but where a piece of information is missing that would otherwise yield a high degree of confidence. This could be that there is not enough data to suggest that the site is being visited regularly, or confidence is low in the exact location of this polygon.

Low potential areas with a score of 1, mapped as yellow polygons, show where some aspect of the evidence base suggests that there is a potential for FLL, as there are one or more significant counts recorded in the area. However, some information relating either to regularity of use or location accuracy is missing, and there may be only one significant record located in the polygon.

Some of the CAWOS FLL polygons are located within the polygons from the NECR361 FLL Project 2021. This provides an understanding of where FLL may be located at a finer scale than the previous maps.

The CROME habitat layer shows cropped habitats suitable for qualifying bird species. This layer can be used to infer functional linkage by users of these maps, for example if a cluster of fields containing significant counts occur within a larger area of the same habitat, the user might infer that those species could also be using the surrounding fields.

This map is most useful when used within a GIS system. Clicking on a polygon brings up the attribute table showing how the functionality score of that polygon has been decided, the species visiting, further recommendations on how to improve confidence in this data, and other pieces of information.

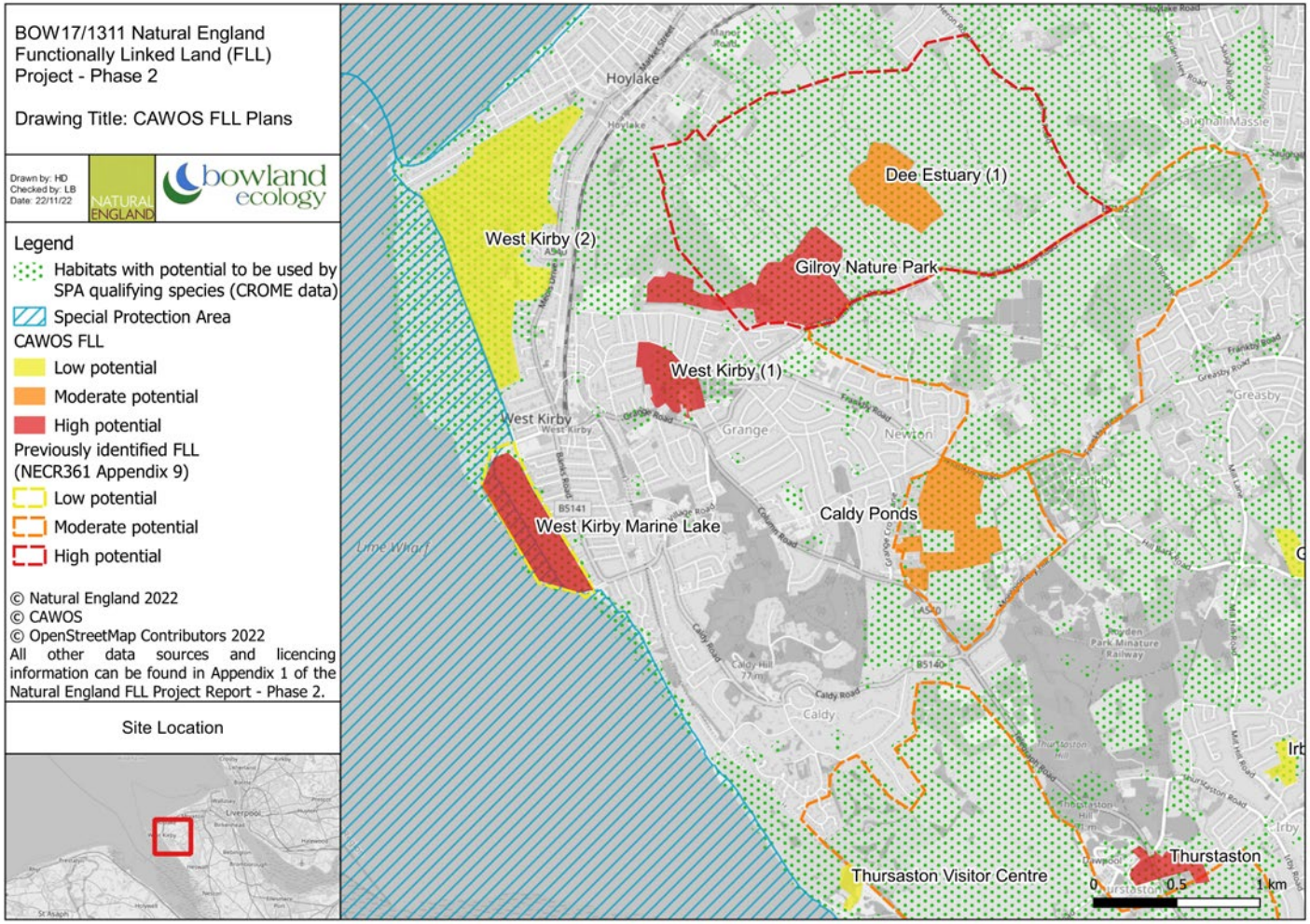

Figure 2. Cheshire and Wirral Ornithological Society (CAWOS) FLL plans © CAWOS, © Natural England 2022, © OpenStreetMap Contributors 2022 – see Appendix 5 for the full maps

3.3. Drawing title: Bowland Ecology Survey Results (Figure 3)

a) Overview

These maps show some of the results from the surveys in 2022, undertaken by Bowland Ecology to investigate certain areas in the North West that were found to have 'no data' in the NECR361 FLL Project 2021. The areas visited by Bowland Ecology are mapped as polygons, and symbolised according to the FLL classification, main habitat type and disturbance. The outline of the polygon denotes the level of FLL designated by the surveyor:

- Red – high potential;
- Orange – low/moderate potential; and
- Black – no potential;

The colour of the hashed lines within the sectors shows the main habitat type for each sector:

- Blue – waterbodies (pond, lake, reservoir, river or canal);
- Green – farmland;
- Purple – coastal (estuarine);
- Pink – human (parks); and
- Brown – heathland and bogs.

A red star within the polygon shows when a sector was subject to an activity that was considered as a source of potential disturbance to birds. The type of disturbance has been recorded in the summary spreadsheet in column J in Appendix 4. Finally, the polygons have been labelled with the bird species recorded during the survey, along with the type of activity. The BTO bird codes have been used in the maps, rather than the species common name.

b) More information

Polygons with a red outline have 'high' potential, where the surveyor is confident that the sector should be considered FLL, and as such should be subject to regular surveys. The sectors outlined in orange have 'low-moderate' likelihood of being FLL, meaning the surveyor couldn't confirm whether these sectors should be classified as FLL, and so should be subject to further surveys to determine the functional linkage of the site. The polygons outlined in black offer 'no potential', meaning the surveyor found that either the habitats, land use, disturbances or other factors meant that these sectors should not be considered to be FLL.

The polygons have been classified as FLL based on a single survey visit, therefore the species recorded may not accurately represent all the species that use these sites throughout the year.

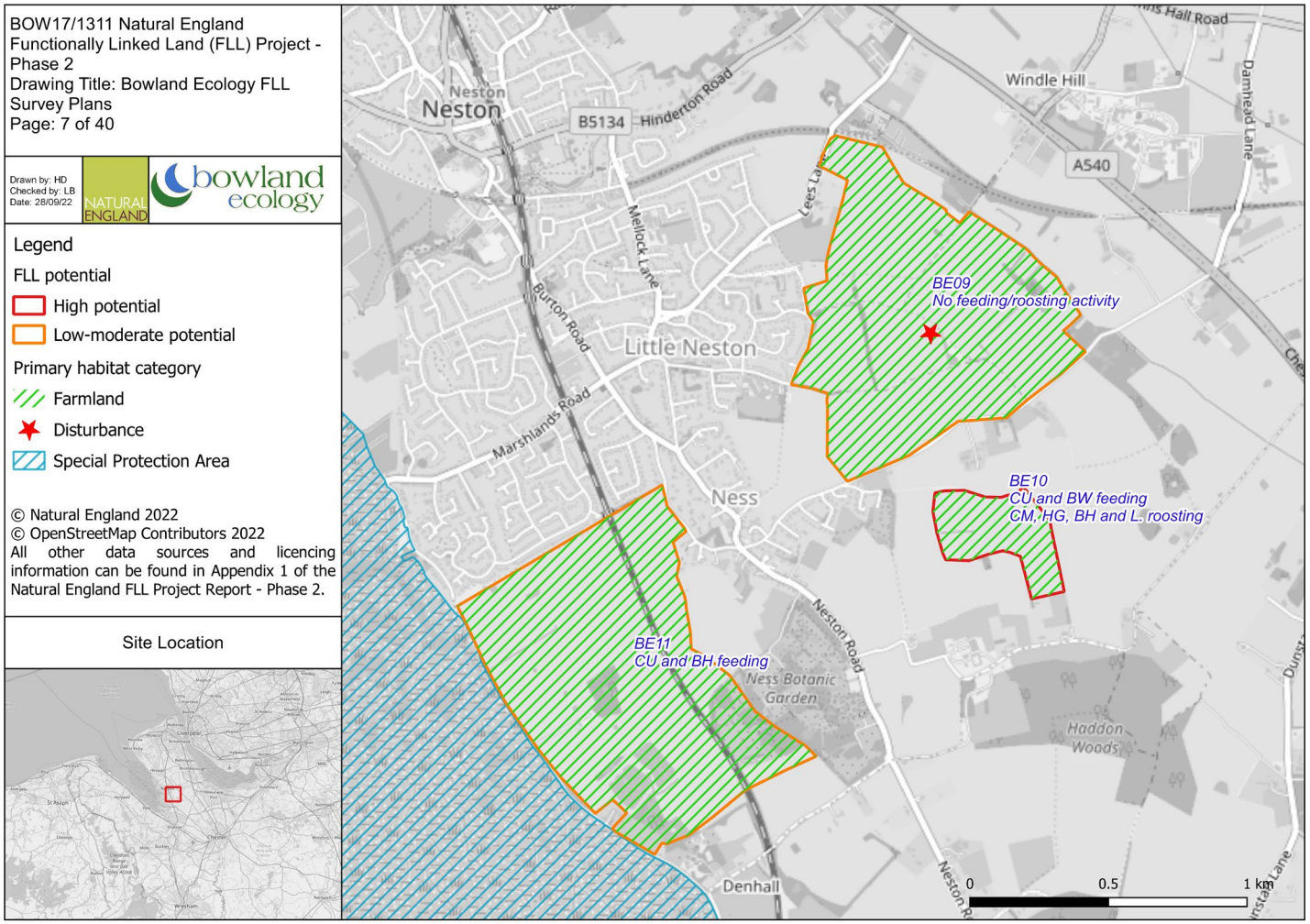

Figure 3 – Bowland Ecology FLL Survey Plans © Natural England 2022, © OpenStreetMap Contributors 2022 – see Appendix 6 for the full maps

3.4. Drawing title: Qualifying Species Buffer Plans (Figure 4)

a) Overview

These maps show the different distances that certain qualifying species could travel from the six SPA's in the study. The SPA's are shown as light blue hashed polygons. The different coloured lines represent the different buffers for each species. The maps also show the CROME habitat data as a base layer, displayed as pink polygons. The data for the maps comes from 'Appendix 11' of the 'Third SPA Network Review', and the following species are included in the maps:

- Wigeon – 2km buffer, red hashed line;
- Curlew – 15km buffer, solid purple line;
- Pintail – 2km buffer, solid pink line; and
- Whooper Swan – 5km buffer, solid blue line.

b) More information

It can be assumed that any areas with suitable habitat and located inside the buffer line, could be potentially FLL for the species shown in the maps. The maps can be used to infer likely areas of FLL based on habitat and distances travelled, but do not show definitive FLL.

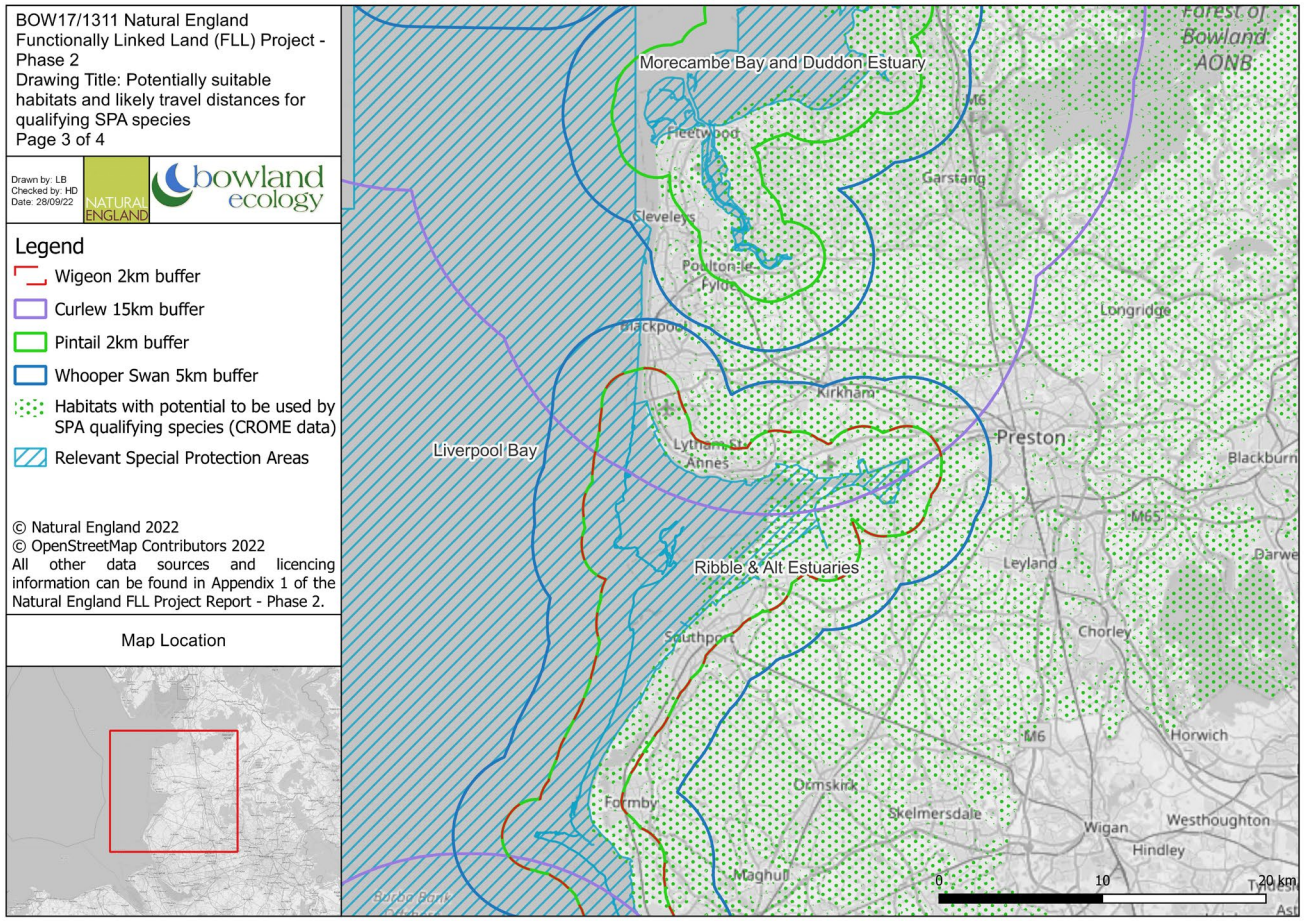

Figure 4 – Qualifying Species Buffer Maps © Natural England 2022, © OpenStreetMap contributors 2022 – see Appendix 7 for the full maps

4. Conclusions

The maps produced by this study can be used to help improve Natural England's understanding of the spatial distribution of qualifying SPA bird populations utilising FLL and as part of the evidence base used when advising on casework applications. This information will help Natural England to provide advice to local planning authorities and developers on the potential impacts of development and recreational disturbance on FLL. It will also inform strategic mitigation/compensation areas, provide evidence for the emerging Local Nature Recovery Strategies (LNRS) by identifying potential habitat creation and enhancement opportunities and targeting of biodiversity net gain.

The information does not negate the requirement to undertake a Habitat Regulation Assessment in compliance with the Conservation of Habitats and Species (Amendment) Regulations 2019. In addition to the information included in this report, local authorities and developers will still be required to provide evidence to demonstrate a development proposal would not result in an adverse effect on the SPA site whether it be inside or outside FLL areas, for example, undertake a desk-based study and/or conduct bespoke bird surveys. The limitations set out below need to be considered when using the maps.

5. Limitations

5.1 Definition of FLL

The definition of FLL used in this study was designed to take account of the project aims, distribution of sites and birds, availability of data, and time constraints. Other ways of defining FLL may be more appropriate if circumstances differ.

5.2 Species list

This study was based on the qualifying species listed for six SPAs in the North West. This would likely differ if a different suite of SPAs was being considered. To ensure the correct species are included, it is important that SPA citations are carefully consulted. Consideration should be given to the inclusion of additional species/populations that have been recommended through the SPA Review process (Special Protection Areas (SPAs) (JNCC, 2020).

Areas of FLL mapped in the study vary in terms of how many and which species they are likely to be important for. Some areas are based on records of multiple species and multiple counts, whereas some are based only on a single species count, which in some cases is for a species that forms part of the qualifying assemblage rather than an individually listed qualifying species. Further, some species included in this study are only featured in one of the six SPA citations, so may not be appropriate when mapped in regions other than that particular SPA. Users can interrogate the GIS maps to determine which species underpin each area of FLL.

5.3 Regularity

Regularity of use is strongly influenced by the size of sites that have been recorded. Large WeBS sectors are more likely to have records of birds visiting for more than 7 years, compared to individual fields, as they provide a larger area of suitable habitat. Combining smaller adjacent polygons helps address this, however where there are gaps between polygons it is uncertain how best to map the larger area without making assumptions.

Further, the definition of regularity is one of two definitions proposed by Stroud and others (2001), so in the future it is recommended that both definitions are used together to provide a more comprehensive understanding of regularity.

The surveys conducted by Bowland Ecology only included a single visit to each site, and therefore could not confirm whether the sites were being regularly visited by

qualifying species. Regular surveys would be required in order to determine regular usage.

5.4 Limitations of data

The maps of FLL produced in the study are dependent on the availability and completeness of the underpinning bird records. It is known that recording has not been systematic and survey effort has varied significantly from area to area, with many areas under-recorded. It is important that the maps produced should be seen as indicative rather than comprehensive; there are undoubtedly others important areas of FLL for birds that are not shown. It is important to emphasise that gaps in the maps do not mean a lack of birds, but rather, a lack of data, and gaps should be viewed as areas where survey effort should be focussed. Further, some of the bird counts used in the reports may be overflying records, and while an effort has been made to remove these during data analysis, in some cases they are not identified as overflying and therefore may still be included in the data. Finally, many of the grid references within the CAWOS dataset were identical, and as such 21,987 points resulted in 124 polygons. It is likely that in some cases surveyors gave a general grid reference for the entire area surveyed, rather than the specific location within that site where the birds were actually located. This means that some areas may have been mapped as only a few small fields, when really the counts should cover a wider site.

Land use change means that FLL is constantly changing as well. Different crops are planted each year, dog walking, recreation or other activities may disturb birds, and habitats may have changed since the 2021 CROME data used in this study. Displaying FLL as a static habitat could therefore be misleading. The maps can be updated when new data becomes available, supplemented by knowledge provided by local bird experts.

5.5 Surveys

The surveys carried out only involved a single visit to each site, rather than a systematic survey of these areas. Therefore, it is likely that the species lists collected for these areas will not accurately represent the full assemblage of birds using these sites over the last 10 years. As such, the species lists included on the maps should only be used as an indication for the species that may be using these site.

6. Recommendations for future study

While lots of water bird data exists, many records only identify the tetrad they were counted in, and in order to map FLL at field level, at least a 6-figure grid reference is required. It is recommended that bird clubs, WeBS counts and BirdTrack place an emphasis on recording accurate grid references with bird count data in the future, by using the data collection form in Appendix 3. Recording bird disturbances, land use and habitat types in a systematic and uniform way will also help improve Natural England's understanding of how best to support water birds in the North West.

The initial aim of the study was to recreate the maps created by the Lancaster and District Birdwatching Society from the NECR361 FLL Project 2021, but for the Dee Estuary. However, it became apparent that as bird clubs are usually run by volunteers, most will not have time to hand draw all of their survey areas in a similar way to LDBWS. Therefore, in the future, Natural England should aim to provide funding and assistance to collaborate with bird clubs to map the areas of FLL within their districts.

The buffer maps produced in this study could be greatly improved by increasing the number of bird tagging projects in the SPA's. In discussion with Kane Brides (WWT), the importance of bird tagging was emphasised as the best way to understand bird behaviour and patterns. Tagging different species and seeing how they use different habitats inland would aid understanding of functional linkage. It would also provide an insight into the distances usually travelled by qualifying species from the SPA's, which could eventually allow potential areas of FLL to be predicted with greater accuracy, based on behavioural patterns.

Feedback from local bird clubs has been highlighted that the Bidston and Fender fields WeBS sector is little used by wetland birds now. Further, the Moreton Brick Pit WeBS sector is no longer suitable for wetland birds as it is now a fishery and is heavily disturbed. Future projects should consider removing these sectors from the maps. Recent evidence suggests the Meols and Leasowe Lighthouse fields WeBS sectors have high potential for wetland birds, and so should be subject to further annual surveys in order to establish regularity. Finally, although CAWOS bird data supports high and moderate FLL in Meols and West Kirby (2), these areas have been identified as being heavily disturbed, with the former being a mown greenspace popular with dogwalkers, and the latter a golf course. As such, the potential of these areas has been lowered to moderate and low, but future works should look to remove these areas from the maps if they are confirmed to be unsuitable for wetland birds due to disturbance.

Further survey visits to more ‘no data’ areas would be valuable to expand the FLL maps, and assess habitat use and disturbance in relation to FLL. Areas identified as low-moderate FLL could also be surveyed to produce more extensive maps showing disturbances to FLL across the North West. Visits to high potential FLL areas could help develop an understanding of the types of habitats preferred by different species, and thus inform habitat creation and enhancement project.

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