Ricardo
Energy & Environment

Llyn Bran Environmental and Ecology Baseline Report

Report for Dŵr Cymru Welsh Water

ED 12621100 | Issue Number 1 | Date 14/02/2020

FINAL REPORT

Customer:

Dŵr Cymru Welsh Water

Customer reference:

ED12621100

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14 February 2020

Ricardo Energy & Environment reference:

Ref: ED12621100- Issue Number 1

Executive summary

Llyn Bran is situated in the County of Denbighshire about 12km southwest of Denbigh at National Grid Reference (NGR) SH 962 593. The reservoir is formed from a natural lake in a late-glacial depression, with higher ground to the north and east. The natural lake was raised by a small impounding gravity dam, built in 1899 at the southern end of the reservoir, raising the lake level by 2.4m. The dam incorporates the overflow weir, from which water passes down the original watercourse downstream, flowing into Llyn Brenig ~2km to the south.

Llyn Bran has been identified, through consultation with Natural Resources Wales (NRW), as a suitable compensatory habitat site for impacts arising from the Llyn Anafon Special Area of Conservation (SAC) discontinuance (in the interest of public safety).

Several compensation measures have been agreed in consultation with NRW, including:

- The discontinuance of the existing Llyn Bran reservoir and the complete removal of the dam structure to restore connectivity with downstream waterbodies and restore natural lake hydrology;
- The translocation of hybrid *Potamogeton* species to identified lakes and off-site locations;
- Restoration of the inflow to Llyn Bran and the reinstatement of the original outflow once final water levels are reached;
- Restoration of the terrestrial habitats surrounding Llyn Bran reservoir, some of which could potentially be considered Annex 1 habitats; and
- Removal of the disused buildings and structures at Llyn Bran.

In order to implement the compensation measures it was identified that water quality monitoring, lake sediment sampling, peat, NVC, and protected species surveys would be required to inform the methodology required and assess the feasibility of the proposals. These surveys were undertaken at Llyn Bran between May and October 2019. The results of these surveys have been used to identify the potential impacts and required mitigation to inform the Llyn Anafon Compensation Plan.

During 2019, Llyn Bran has met the CSMG targets for dissolved oxygen, pH, nitrogen, and total phosphorus. However, previous monitoring in 2018 showed the lake was failing due to elevated phosphorus concentrations. The proposed restoration of the inflow and outflow of Llyn Bran, creation of a buffer area between the lake and farm land to the north, reduction in forestry activity, discontinuance of the reservoir, and the restoration of terrestrial habitats, have potential to improve water quality within the reservoir to meet the required CSMG standard for oligotrophic lakes and provide suitable compensation habitat for Llyn Anafon.

Lake sediment surveys showed that marginal sites are characterised by coarse pebbles, while those sites further away from the margins are characterised by sand and silt. Two marginal sites are characterised predominantly by silt. This data shows that the hard bed in the southern portion of the reservoir is composed predominantly of peat, while the north is predominantly of clay or silt. This suggests that under the proposal drawdown scenario, much of the hard bed which will be exposed is likely to be composed of peat. Although there will be areas along the existing north and east lake margins composed of exposed coarse pebbles following drawdown of the reservoir.

The results of the peat survey show that there are deposits of peat found on both the south-east and south-west margins of the reservoir. Of these, the south-west margin is the most extensive, with depths of peat up to 2.8m, although depths were mostly around 1.5m-2.3m. A break of slope appears to define the western limit of the peat. The south-east margin contains relatively shallow deposits of peat, around 0.11-0.65m in thickness, although close in to the reservoir peat depth increased to 1.65m. The reduction in lake level is likely to change the saturation of the deeper peat in the flat areas which are influenced by the high ground water level due to the lake in the south-east and south-west of the reservoir. This may result in changes to peat formation and condition with an increase in humification in these areas. However, as the peat formation occurred in this location prior to installation of the dam it is unlikely to significantly affect the structure and function of the peat in these areas.

The habitats within the site include unimproved acid grassland, marshy grassland, blanket mire, dwarf shrub heath, swamp and tall herb fen, and coniferous plantation woodland. The Site predominantly comprises a mosaic of mire, wet, and dry shrub heath. The communities include wet mires which are likely to be influenced by the current lake level and rain-fed soligenous mires and wetter community mosaics higher up the hill from the lake. Natural regeneration of exposed shore habitats and restored watercourse should be monitored through walkover botanical surveys following the reduction in lake levels. The results of the walkover surveys will be used to identify additional interventions required to ensure habitat restoration. Mitigation measures will also be required for the restoration of habitats and soils for construction of a temporary access track to enable dam removal.

The fish eDNA survey identified that Llyn Bran supports two species of fish: European perch and northern pike. The reduction in water levels is unlikely to result in fish stranding or mass mortality as the level will be reduced over 2-3 years. The discontinuance of the reservoir would re-establish connectivity with the downstream surface waterbodies and will enable the movement of priority fish species, such as European eels (*Anguilla anguilla*), into Llyn Bran.

Great crested newts are highly unlikely to be present within the Site or the adjacent terrestrial habitats due to the absence of suitable breeding habitat within 250m of the Site. No further survey work or mitigation is required for great crested newts as part of this scheme.

The reptile surveys undertaken in 2019 identified that the habitats surrounding Llyn Bran support common lizards. Although the surveys undertaken were for presence/likely absence and not population estimate surveys the peak count of common lizards recorded was four which indicates that the Site supports a low population.

No setts or signs of badgers were identified within the Site or 30m of the site boundary, the proposed scheme has negligible potential to affect any badger setts.

No evidence of roosting bats was identified by the dusk emergence and dawn re-entry surveys at the Utility Building or Boat House. No activity surveys were undertaken at the Site as part of the ecological monitoring in 2019. However, activity levels and species diversity recorded during the emergence/re-entry surveys indicates that over all activity is low at the site. The high elevation, exposed open habitats, and surrounding coniferous woodland reduce the suitability of the Site for foraging bats. Therefore, it is considered unlikely that the lake and adjacent habitats are of high significance for large number of bats.

Otters were confirmed to be present at Llyn Bran as otter spraints were identified on the reservoir margins and dam wall in August and September 2019. No evidence of otter holts, couches, or lay ups were identified during the surveys.

Water vole activity including latrines, feeding remains and burrows was recorded during both surveys at Llyn Bran in 2019. The field signs indicate that water vole activity was highest on the west and north banks of the reservoir with activity also recorded along the reservoir outflow The proposed works and reduction in lake level will result in a reduction in habitat availability for water voles. There is also a risk of disturbance and/or destruction of burrows and direct mortality from ground works, track creation, and plant movements during dam removal and associated decommissioning works.
The reduction in lake levels will cause a long term reduction in habitat quality as the water recedes leaving bare ground between the habitats that contain the burrows and provide cover and feeding opportunities. Although the existing terrestrial habitats will remain, the increased distance to water will make the water voles present in these areas more susceptible to predation. A conservation licence will be required to undertake the proposed works at Llyn Bran.

Mitigation is required to reduce the potential impacts as result of the proposed works on water quality, terrestrial vegetation, breeding birds, reptiles, bats, otters, and water voles.

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1 Introduction

1.1 Background

Llyn Bran is situated in the County of Denbighshire about 12km southwest of Denbigh at National Grid Reference (NGR) SH 962 593. The reservoir is formed from a natural lake in a late-glacial depression, with higher ground to the north and east. The natural lake was raised by a small impounding gravity dam, built in 1899 at the southern end of the reservoir, raising the lake level by 2.4m. The dam incorporates the overflow weir, from which water passes down the original watercourse downstream, flowing into Llyn Brenig ~2km to the south.

Llyn Bran has been identified, through consultation with Natural Resources Wales (NRW), as a suitable compensatory habitat site for impacts arising from the Llyn Anafon Special Area of Conservation (SAC) discontinuance (in the interest of public safety). Stage 1 Habitat Regulations Assessment (HRA) screening was completed in December 2017 in consultation with NRW. Following Stage 2 HRA (Appropriate Assessment), it was not possible to mitigate for the loss of 2.05ha of the SAC qualifying feature: 'oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea'*. As such, undermining of the conservation objectives for this qualifying feature is anticipated and therefore adverse effects on the integrity of the SAC are likely. Competent authorities (in this case Dŵr Cymru Welsh Water) cannot consent to or proceed with plans, projects or operations if the Appropriate Assessment concludes that the plan, project or operations may have an adverse effect on the integrity of a European site such as an SAC.

Several alternative options have been considered as Stage 3 of the HRA (assessment of alternative solutions). It was concluded that the alternative solutions fail to meet the objective of the project.

Article 6(4) of the Habitats Directive provides a derogation provision whereby if the relevant competent authority is satisfied that, there being no alternative solutions, a plan or project must be carried out for 'imperative reasons of overriding public interest' ("IROPI"), it may agree to the plan or project notwithstanding a negative assessment of the implications for a European site (HRA Stage 4). In such circumstances, the Habitats Regulations require compensatory measures be secured to ensure the overall ecological coherence of the Natura 2000 network is maintained.

Several compensation measures have been agreed in consultation with NRW, including:

- The discontinuance of the existing Llyn Bran reservoir and the complete removal of the dam structure to restore connectivity with downstream waterbodies and restore natural lake hydrology;
- The translocation of hybrid *Potamogeton* species to identified lakes and off-site locations;
- Restoration of the inflow to Llyn Bran and the reinstatement of the original outflow once final water levels are reached;
- Restoration of the terrestrial habitats surrounding Llyn Bran reservoir, some of which could potentially be considered Annex 1 habitats; and
- Removal of the disused buildings and structures at Llyn Bran.

In order to implement the compensation measures it was identified that water quality monitoring, lake sediment surveys, and a peat survey would be required to inform the methodology required and assess the feasibility of the proposals. The results of these surveys are presented in this report.

Ricardo Energy & Environment was commissioned in October 2018 by Dŵr Cymru Welsh Water to undertake an extended Phase 1 habitat survey as part of a Preliminary Ecological Appraisal (PEA) to identify potential ecological constraints to the proposed decommissioning and restoration work at Llyn Bran. The results were presented in Ricardo (2018) Llyn Bran Decommissioning and Restoration: Preliminary Ecological Appraisal Report. This report provided general advice on ecological constraints associated with this project and included recommendations for further surveys based on the evidence of protected species and the presence of habitats suitable to support protected species. The PEA report identified the requirement for a National Vegetation Classification (NVC) survey of the habitats surrounding Llyn Bran and further surveys for the following protected species:

- Bats
- Breeding birds
- Badger (*Meles meles*)
- Reptiles
- Great crested newt (*Triturus cristatus*)
- Water vole (*Arvicola amphibius*)
- Otter (*Lutra lutra*)

1.2 Study area and location

The Llyn Bran Reservoir is located in Denbighshire, North Wales at an elevation of 460m and comprises approximately 13ha of standing open water. The study area comprised the land immediately surrounding the reservoir. The reservoir is located to the south of the A543, which runs adjacent to the reservoir at its northern edge. To the south and east lies a large extent of conifer plantation woodland, areas of which have been subject to recent felling works. The reservoir outflow runs due south and feeds the Llyn Brenig Reservoir located approximately 2km to the south.

The wider landscape encompasses areas of sheep-grazed upland grassland and heath, coniferous forestry plantations, and several other upland reservoirs.

The study area broadly comprised the following Phase 1 Habitat Survey classification habitats[1]:

- Wet dwarf shrub heath
- Standing open water
- Flowing waterbodies
- Plantation woodland (coniferous)
- Felled plantation (coniferous)
- Re-planted plantation (coniferous)
- Marshy grassland
- Scattered scrub
- Buildings and structures.

1.3 Project appreciation and report structure

Under HRA Stage 4, the compensatory measures must be secured before consent is given for a proposal with adverse effects on an SAC. In other words, the component authority should be satisfied that all the necessary legal, technical, financial and monitoring arrangements are in place to ensure compensatory measures proceed as agreed and remain in place over the full timescale needed.

As such, DCWW required development of a management plan suitable for the Llyn Anafon IROPI case submission to Welsh Government. To develop the management plan for securing the compensation measures the following was required:

1. Surveys and assessment to inform the restoration of terrestrial habitats associated with the discontinuance of Llyn Bran.

2. Surveys and assessment to inform the restoration of reservoir inflow and outflow after reservoir discontinuance (**not provided** within this report).

[1] Ricardo Energy and Environment (2018) Llyn Bran Decommissioning and Restoration Preliminary Ecological Appraisal Report

3. Water quality monitoring to provide sufficient baseline data to inform mitigation requirements

4. Baseline ecological surveys to further develop the monitoring and mitigation requirements at Llyn Bran (**Section 4** of this summary report)

5. Development of a management plan for the translocation of hybrid *Potamogeton* species from Llyn Anafon to Llyn Bran, including biosecurity considerations and the identification of possible offsite facilities (**not provided** within this report).

The project ensured the continuity of works that have been completed/achieved to date in relation to the proposed compensatory measures for the discontinuance of Llyn Anafon reservoir. Necessary references have been made to the following reports (2019), produced by Ricardo on behalf of DCWW:

- Stage 1, 2, 3 and 4 HRA reports for the proposed discontinuance of Llyn Anafon reservoir; and
- a report on compensation measures at Llyn Bran.

2 Methodology

2.1 Water quality surveys

A six-month baseline monitoring programme for water quality was undertaken by Ricardo between June 2018 and October 2018 to inform the suitability of Llyn Bran as a compensation site for decommissioning Llyn Bran. The initial monitoring programme highlighted that the lake is currently sub-optimal when compared to Common Standards Monitoring Guidelines (CSMG) water quality targets for oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*. CSMG targets for Total Phosphorus concentrations are 10 – 15 µg/l for deep lakes such as Llyn Bran. Total Phosphorus concentrations during previous sampling at Llyn Bran ranged from 22 µg/l to 35 µg/l[2]. In comparison, Total Phosphorus concentrations at Llyn Anafon are <10 µg/l. Following consultation after the previous water quality surveys, Natural Resources Wales (NRW) indicated that a more suitable analysis methodology should be used to inform Total Phosphorus concentrations as phosphorus measurements at very low concentrations have proven to be unreliable. The analysis method used for analysis of previous samples is known to show significant variability at very low (<20 ug/L) concentrations when measuring total phosphorus and orthophosphate. Consequently, the samples collected in 2019 were analysed by National Laboratory Service (NLS) with an analysis suite that included a method specific for low-level Total Phosphorous concentrations (>0.001µg/l).

Surface water quality samples and *in-situ* field readings were collected at three locations during each field survey. These locations included a sample site near the existing Boat House (Site 1 - NGR SH 96047 59435), near the centre of the lake (Site 2 - NGR SH SH 96372 59211) and near the outflow (dam wall, NGR SH 96203 58909). The locations of the water quality sampling points are shown in Appendix B.

Water samples were collected in clean polyethylene containers and sent to NLS where they were analysed for: alkalinity, total phosphorus as P, soluble reactive phosphorus (SRP), ammoniacal nitrogen as N, nitrate as N, nitrite as N, turbidity, chlorophyll a and colour (in Hazen Units). At each of the sample locations, in-situ water quality readings were taken using a YSI Multiparameter Sonde to measure temperature and dissolved oxygen.

Water quality samples and *in-situ* water quality readings were collected at each site on four occasions: 30 May 2019, 19 June 2019, 11 July 2019, and 07 August 2019. A further seven surveys have been scheduled and will be completed by March 2020, totalling 11 surveys.

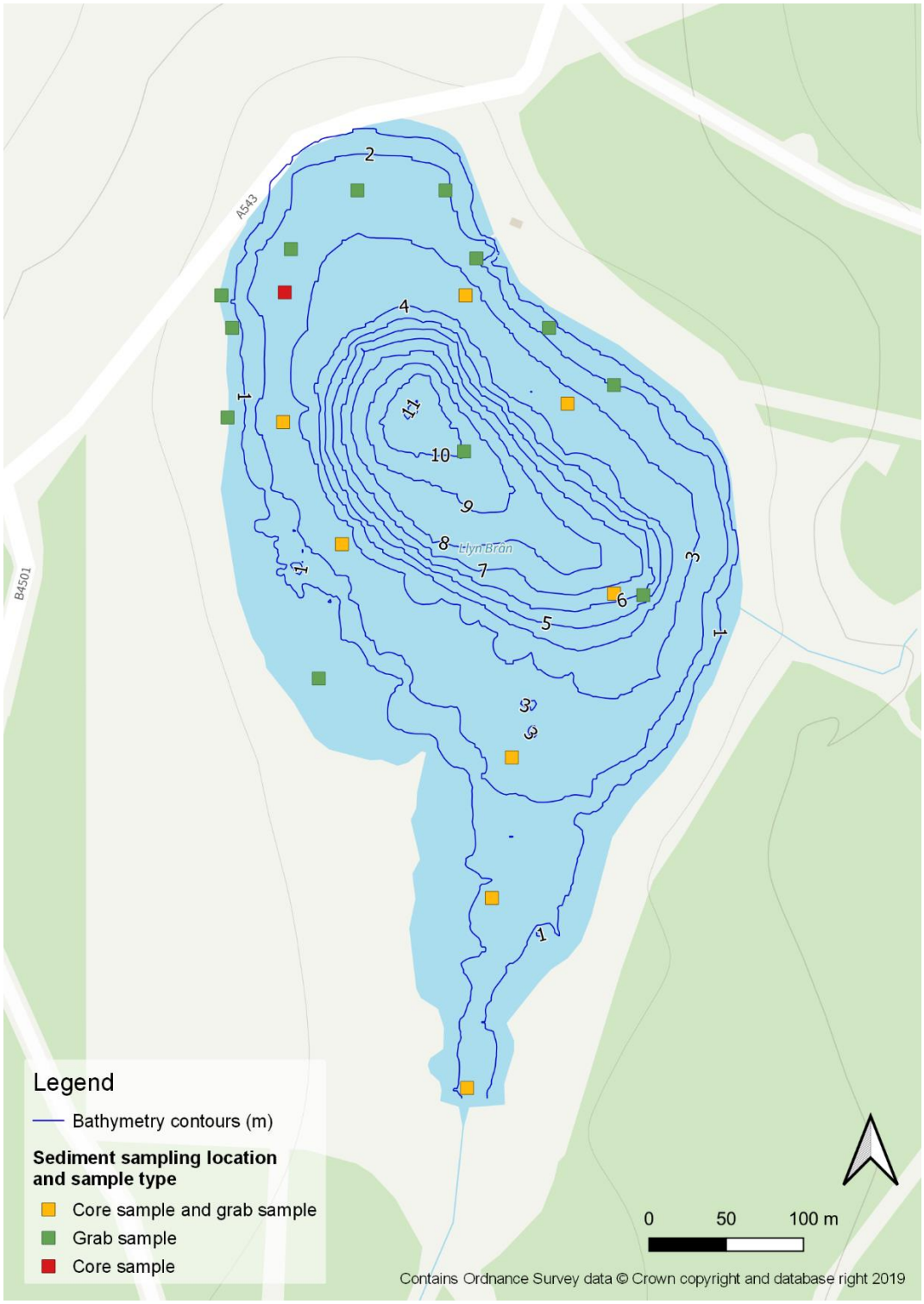
2.2 Lake sediment survey

Understanding the sediment composition and quality is of great importance in order to correctly design the restoration. For example, an understanding of the particle size distribution and sediment quality informs the correct restoration habitat types and helps ascertain if the quality of the sediment could impact on the future evolution of the restored habitat. Grab sampling and core sampling were used to sample bed sediments around the reservoir margin in water 2m deep or shallower. A total of 21 sample sites were used. These sites were selected to provide good coverage of the marginal area of the reservoir but were also selected based on the proximity to key features that could have influenced particle size distribution, sediment quality and sediment thickness, such as the inflowing stream to the east of the lake, the road to the north of the reservoir and close to the impounding structure at the south.

All sediment sampling was undertaken from a Zodiac boat. Each site was identified on the lake using the Global Positioning System (GPS) with a series of pre-defined coordinates. At each site, a drag anchor was used to maintain station while samples were collected. Collected samples were processed on the boat prior to visiting the next site. Sampling locations are shown in **Figure 2.1**.

[2] Ricardo (2019) Llyn Anafon Decommissioning Compensation Plan. Report for Dŵr Cymru Welsh Water

Figure 2.1: Sediment sampling locations.



Grab sampling was undertaken using a Van Veen grab sampler at a total of 20 sites (**Figure 2.1**). At each sampling site, the grab was lowered onto the bed and a surface sample retrieved. Appropriate sample notes were made, and the sample was securely stored in the correct container, as issued by the analysing laboratory, and clearly marked with a unique identifying code.

Core sampling was undertaken at nine sites (**Figure 2.1**) using a Beeker Sampler. This allowed an undisturbed core of 1m in length to be extracted from bed sediments submerged under several metres of water. Each core retrieved was photographed and a log of the core was drawn up to scale including

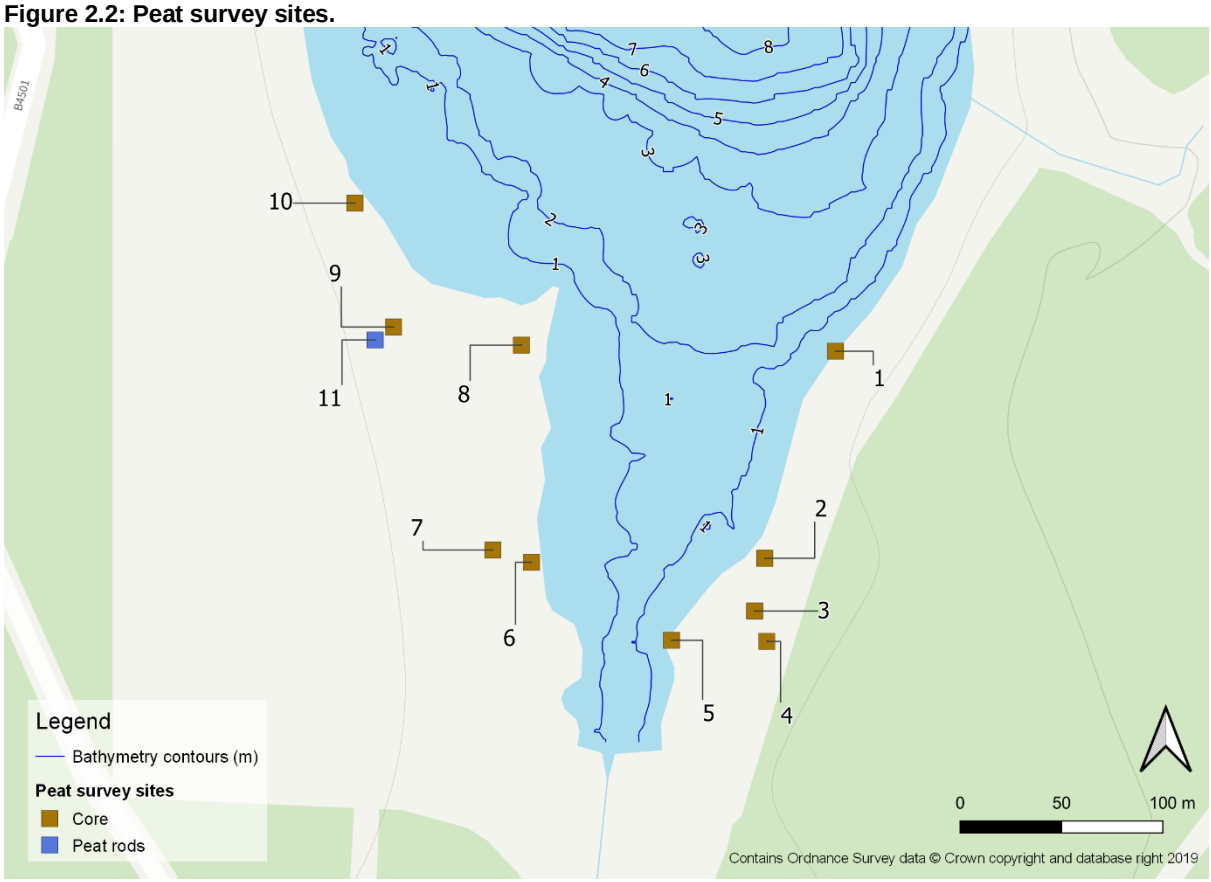
estimations of particle size, changes in sediment colour and properties and any other notable features. After the core log was completed, a composite sample of the basal 0.7-1.0m of the core was extracted for particle size and quality analysis. These samples were securely stored within a container, as issued by the analysing laboratory, and clearly marked with a unique identifying code.

The sampled sediment extracted from the lake was sent to National Laboratory Services (NLS) for analysis of particle size distribution and a suite of sediment quality determinands, including physico-chemical properties, sanitary and nutrients and heavy metals. A discussion of the findings of the analysis is provided in Section 3.2. The full results of the Sediment analysis are shown in **Appendix C:**.

2.3 Peat survey

An indication of the potential presence of peat around the south-east and south-west margins of the reservoir had been gained from the lake sediment surveys, ecological surveys and anecdotal evidence. In order to confirm or refute the presence of peat, 11 peat surveys (ten peat cores and one peat depth test) were undertaken around the reservoir. The survey sites were chosen mostly at random within the pre-established south-east and south-west survey areas, although locations were guided by topographic features (e.g. confining coring to flatter areas) and also guided by the results of prior peat surveys (i.e. peat depth and peat quality). **Figure 2.2** shows the location of these sites with respect to the southern margins of the reservoir.

Figure 2.2: Peat survey sites.



At sites 1 to 10 (Figure 2.2), cores were taken of the substrate using a gouge corer. Coring was accomplished using a 1m long gouge corer with extension rods which can reach to depths of around 5.5m. Upon reaching a selected coring site, the location of the core was determined using GPS and recorded on a coring log record sheet. The gouge corer was assembled and pushed into the peat until the top of the gouge section was level with the bog surface. The corer was then extracted and placed on a mat while the core hole was marked using the T-handle from the peat depth rods. The top surface of the peat core was cleaned with a knife. A tape measure was presented alongside the core to act as a scale and the core was detailed on a set of bespoke core log sheets. Notable changes in peat layers and their depth within the core were identified and logged onto the core log sheet. In order to understand

the humification of the peat extracted from each of the ten cores, individual peat samples representing various depths in the peat profile were taken from the core sample. These samples were then analysed using the Von Post Humification Scale[3] field test to classify their degree of humification (Table 2.1). For each sample tested, the H number of the peat was written down at the depth of the sample within the retrieved core on the core log sheet. Upon completion of logging the gouge corer was cleaned of peat, another 1m extension rod was added to the corer, the corer was repositioned in the marked core hole (after removal of the T-handle) and was then pushed a further metre into the peat to extract the next section of the bog. Coring and logging of the recovered core continued in this fashion at metre depth intervals until the base of the peat bog was reached.

Table 2.1: Von Post Classification Scale summary table

Code	Water	Finger squeeze test	Amorphous material	Plant remains
H1	Almost clear.		None	Easily identifiable.
H2	Almost clear to yellowish.		None	Easily identifiable.
H3	Muddy brown water.	No peat between fingers.	None	Still identifiable.
H4	Very muddy brown water.	No peat between fingers.	Very small amount	Loss of some features, slightly pasty.
H5	Very muddy brown water.	Some peat.	Small amount	Quite indistinct, very pasty residue.
H6	Very dark brown.	~1/3 peat escapes through fingers.	Much material	Very indistinct (more distinct after squeezing than before).
H7	Very dark brown and almost pasty (if any released).	~1/2 peat escapes between fingers.	Much material	Faintly recognisable.
H8	Small volume of pasty water may be released.	~2/3 peat escapes between fingers.	Much material	Very indistinct. Remaining material is roots and fibres.
H9	No water.	Nearly all peat squeezed out as fairly uniform paste.		Hardly recognisable.
H10	No water.	All wet peat escapes between fingers.		No discernible structure.

N.B. This was the table developed for use in the field. It allows rapid determination of the degree of humification (other scales being very verbose) and represents a distillation (but importantly an unabridged version) of the key points of the scale shown in much greater detail at the FAO website[4]. It also takes elements from the Von Post Scales showing on http://www.epa.ie/licences/lic_eDMS/090151b28008827d.pdf and https://www.blacklandcentre.org/the-science/von-post-humification-scale/.

At site 11, a single peat depth measurement was taken to understand the depth of the peat close to a topographic break in slope (contour adjacent to sites 10 and 11 on Figure 2.2). This depth was taken using peat rods; these are an extendible fibreglass peat rod system which is formed of six individual rods which were sequentially screwed into each other via brass coupling bushes as the peat depth rods are inserted further into the bog (up to a maximum depth of 5m). A T-handle was used to push and pull the rods into the substrate. The site location was recorded using a GPS. The peat depth was measured by inserting the peat depth rod into the peat until increased resistance could be felt and the rods could be inserted into the peat no further. This was taken as the base of the peat bog and the depth was recorded as metres below ground level.

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A brief overview of the results of the peat surveys is presented in Section 3.3.

[3] Food and Agriculture Organisation (FAO) of the United Nations, (1988). FAO soils bulletin 59: Nature and Management of Tropical Peat Soils. Chapter 5: Classification. Table 16: The Von Post Scale of Humification. *http://www.fao.org/docrep/x5872e/x5872e07.htm*

[4] Food and Agriculture Organisation (FAO) of the United Nations, (1988). FAO soils bulletin 59: Nature and Management of Tropical Peat Soils. Chapter 5: Classification. Table 16: The Von Post Scale of Humification. *http://www.fao.org/docrep/x5872e/x5872e07.htm*

2.4 Ecology surveys

2.4.1 Botanical Survey

A botanical survey was undertaken of representative examples of the surrounding natural heathland and woodland habitats to determine the target communities and species for planting schemes. The survey was undertaken on 19th and 20th June 2019 by Lisa Peirce an experienced ecologist.

The methodology followed the National Vegetation Classification (NVC), which is standard classification used for describing vegetation in Britain (Rodwell, Volumes 1-4)[5]. All higher plants were listed, and their percentage cover estimated according to the DOMIN scale to describe their relative abundance (refer to Table 2.2) within sample patches (quadrats) (typically 4m^2 but depends on habitat type).

Table 2.2: Domin Scale

Percentage cover (%)	Domin Number
91-100%	10
76-90%	9
51-75%	8
34-50%	7
26-33%	6
11-25%	5
4-10%	4
<4% - many	3
<4% - several	2
<4% - few	1

The species composition and relative abundance were used to identify the NVC communities using Tablefit software[6] and reviewed against the community types defined by Rodwell to identify the vegetation communities. A total of 34 quadrats were surveyed within five habitats types; the locations of the quadrats are shown in **Figure 1** in **Appendix D:**.

The typical species of these communities were then used to inform planting plans and an assessment of the likely success of natural regeneration of the target community. In addition, the survey also included the recording of any vegetation that has come up within the clear-felled woodland within sample patches (4m^2) to represent the variation present.

These data will form the baseline and the method for future monitoring. It will inform of the likely natural regeneration communities and inform planting plans and management of undesirable species.

2.4.2 Ecological Desk study

Biological records were requested from North Wales Environmental Information service (Cofnod) as part of a Preliminary Ecological Appraisal (PEA) of the site undertaken by Ricardo Energy and Environment in October 2018[7]. The records were analysed to determine their relevance to the Site and the proposed works, taking into consideration the dates and locations of each record.

[5] Rodwell, J.S. (ed.) 1991. British Plant Communities. Volume 1. Woodlands and scrub. Cambridge University Press.
Rodwell, J.S. (ed.) 1991. British Plant Communities. Volume 2. Mires and heath. Cambridge University Press.
Rodwell, J. S. (ed.) 1992. British Plant Communities. Volume 3. Grassland and montane communities. Cambridge University Press.
Rodwell, J.S. (ed.) 1995. British Plant Communities. Volume 4. Aquatic communities, swamps and tall-herb fens. Cambridge University Press
[6] Marrs, RH (2019) TABLEFIT v. 3.0 & v.4, programs for the identification of vegetation types according to the British National Vegetation Classification Includes software. Centre for Ecology & Hydrology, Wallingford.
[7] Ricardo Energy and Environment (2018) Llyn Bran Decommissioning and Restoration Preliminary Ecological Appraisal Report

Aerial photography and Ordnance Survey maps were reviewed to help identify all ponds and ditches within 250m of Site.

2.4.3 Fish environmental DNA survey

Environmental DNA (eDNA) sampling was undertaken as it is a rapid process to identify the fish species present and structure of the fish community. eDNA kits provided by Nature Metrics were used to collect eDNA samples which were analysed by Nature Metrics Laboratories. Taxa were identified by comparing unique sequences against a curated reference database for European fish species. The methodology used for eDNA sample analysis is presented the Nature Metrics report in **Appendix E:**. Prior to undertaking the eDNA sampling, sampling locations were distributed around the lake to ensure all habitats were sampled.

2.4.4 Breeding bird surveys

Two breeding bird surveys were undertaken at the Llyn Bran site on the 21st May 2019 and 25th June 2019. The surveys were based on the standardised BTO/JNCC/RSPB Breeding Bird Survey (BBS)[8] survey technique where two survey visits are undertaken during the main bird breeding season.

The breeding bird survey methodology requires three visits with the initial visit to assess the habitats present at the Site to identify suitable transect routes. As a Phase 1 habitat survey was undertaken as part of a PEA[9] of the Site in October 2018, the first survey visit was unnecessary as surveyors had prior knowledge of the Site and the habitats present.

Surveys were undertaken in accordance with standard guidance[10], during calm and dry weather conditions. There was good visibility during the survey in May 2019, but there was heavy fog during the first 30 minutes of the survey on 25th June 2019, this is discussed further in the Limitations Section 2.5. The metadata for the breeding bird surveys undertaken at Llyn Bran in 2019 are presented in Table 2.3 below.

The surveys commenced after the period of peak bird activity at dawn, as the abundance of information at dawn can be difficult to record. Surveys were undertaken by two surveyors to ensure the health and safety of the surveyors due to the remote location.

Table 2.3 Bird survey timings, weather and order of transects

Date	Start	End	Weather	Transect Order
21st May 2019	08:21	11:16	Dry, light winds and good visibility, 10% cloud cover and a temperature of 10°C	1, 2, 3, 4
25th June 2019	07:41	10:56	Dry, light winds, poor visibility for first 30 mins of survey due to thick fog, increased visibility over time, with intermittent overcast and clear periods, 16°C.	2, 1, 4, 3

Surveyors recorded bird activity by following 1 km transects spaced to cover the dominant habitats, as identified during the Phase 1 habitat survey, throughout the Site including the margins of Llyn Bran, wet dwarf shrub heath, and plantation woodland. All birds were identified by direct observation, using 10x magnification binoculars, and/or by their vocalisations. Due to the size of the Site, four transects are considered to achieve full coverage of the site. The order in which the transects were undertaken in alternate directions minimised any temporal bias in the survey results. The locations of the singing birds were marked on site maps to indicate possible territory locations.

[8] BTO/JNCC/RSPB (2015) Breeding Bird Survey Instructions. Available at: https://www.bto.org/sites/default/files/u16/downloads/forms_instructions/BBS-Instructions-2015-online.pdf .pdf .
[9] Ricardo (2018) Llyn Bran Decommissioning and Restoration: Preliminary Ecological Appraisal Report
[10] BTO/JNCC/RSPB (2015) Breeding Bird Survey Instructions. Available at: https://www.bto.org/sites/default/files/u16/downloads/forms_instructions/BBS-Instructions-2015-online.pdf_.pdf

The location of the breeding bird transects are shown on **Figure 3.6** and **Figure 3.7** in Section 3.7.2.

2.4.5 Great crested newt surveys

Waterbody scoping survey

A scoping survey was undertaken to verify the presence of the water bodies identified within 250m of the proposed works by the desk study and PEA in 2018. The scoping survey was undertaken on the 20th May 2019 and information gathered during this survey was used to determine which waterbodies would require a Habitat Suitability Index (HSI) assessment. The water body scoping survey and HSI assessment were undertaken by Ricardo ecologists and led by a surveyor registered to use a Natural Resources Wales great crested newt survey licence.

The water bodies identified during the PEA included sections of a drainage ditch adjacent to a fire road to the south-west of the Site which held water during the PEA survey in October 2018.

Habitat Suitability Index assessment

The water bodies identified during the scoping survey were subjected to a Habitat Suitability Index (HSI) Assessment[11], where applicable, on 20th May 2019. The HSI assessment provides an index between 0 and 1: 0 indicates unsuitable habitats and 1 optimal habitat. Ten indices are used to calculate this overall index score, each of which represent a factor considered to affect the suitability of potential breeding ponds for great crested newts. These factors include: geographical location; pond area; frequency of pond drying; water quality; shading; waterfowl presence; fish presence; pond density in the vicinity; terrestrial habitat in vicinity; and macrophyte cover.

The HSI was developed with respect to ponds, and as such where this method is used to assess still-water ditches, these have been treated as narrow linear ponds. The factors used to calculate the HSI are measured as an average across the length of the ditch.

The resulting overall HSI is categorised in terms of pond suitability for GCN as an overall score:

- <0.5 = poor
- 0.5 – 0.59 = below average
- 0.6 – 0.69 = average
- 0.7 – 0.79 = good
- >0.8 = excellent

The water body scoping survey results were used to determine which water bodies were best suited to GCN occupancy and breeding, and to provide a shortlist (where applicable) of water bodies requiring further, more detailed survey and indicate appropriate survey methods. There is a strong positive correlation between higher HSI scores and the percentage of ponds that are used by GCN. The system is, however, not sufficiently precise to conclude that any pond with a high score will support GCN, or that a pond with a low score will not support them.

2.4.6 Reptile presence/absence surveys

Reptile surveys were undertaken to determine the presence or likely absence of reptiles at the Site. The reptile survey involved the installation of 95 artificial refuges (0.5m by 0.5m tiles of roofing felt), in habitats suitable to support reptiles surrounding Llyn Bran including marshy grassland, dwarf shrub heath, and woodland edges. The artificial refuges were installed on the 14th May 2019 and left to "bed-in" for two weeks prior to commencing the reptile surveys.

As reptiles are cold blooded, they need to bask in the sun in order to raise their internal body temperature. The artificial refuges made of black roofing felt provide a clear area to bask and the dark colour increases the temperature relative to surrounding vegetation making them attractive locations for reptiles to bask and provide a dry warm area to shelter below the felt.

[11] Oldham, R.S., Keeble, J., Swan, M.J.S, and Jeffcote, M. (2000) Evaluation the suitability of habitat for the Great Crested Newt (*Triturus cristatus*)

The artificial refuges and any existing refuges (debris) within the Site were checked on six occasions in favourable conditions (between 10˚C and 20˚C, with little or no wind, and no rain), across May and June 2019. In addition, one survey visit was undertaken in September 2019. Whilst checking the artificial refuges a 'slow-walk' technique was implemented between refuges with attention paid to areas of potential for reptiles such as tall grass/ scrub mosaics where lizards and snakes might be observed openly basking.

A map showing the approximate location of reptile refuges is shown in **Appendix D:.**

2.4.7 Bat emergence/re-entry surveys

An external inspection of the Boat House and Utility Building was undertaken to determine the suitability to support roosting bats during a PEA of the Site in October 2018[12]. The Utility Building was assessed as having high suitability and the Boat House as having low suitability. Therefore, in line with the current survey guidelines[13] the Utility Building and Boat House were subject to three dusk emergence/dawn re-entry surveys and one dusk emergence survey, respectively, these surveys are summarised in **Table 2.4** below.

Table 2.4: Bat survey summary

Building Name	Bat roost suitability	**Survey Date**
Boat House	Low	13th June 2019 (Dusk emergence)
Utility Building	High	13th June 2019 (Dusk emergence) 11th July 2019 (Dawn re-entry) 19th August 2019 (Dusk emergence)

All bat surveys were undertaken in accordance (where possible) with current best practice guidance for bat surveys[14]. Any survey limitations are described below.

The surveys were led by Ricardo ecologists registered to use the Natural England level 1 bat survey class licence assisted by suitably experienced Ricardo ecologists. The surveyors were positioned around each of the identified buildings so that all aspects and potential roost features were covered.

The dusk emergence surveys commenced 15 minutes prior to sunset and continued for a minimum of 1.5 hours after sunset. Dawn re-entry surveys commenced at least 1.5hours prior to sunrise and continued for 15 minutes after or until bat activity had ceased. During the surveys, the time, location, number of bats, species (where possible), activity type and direction of flight were recorded for each bat pass (either echolocation heard, or activity seen) encountered during each survey visit. Notes were made on weather conditions prior to and during the surveys and are summarised in Section 3.1 below.

Echo Meter Touch Pro (using iPad Air 125GB) and a Heterodyne (Bat Box duet III) bat detectors were used to detect and record any ultrasonic bat calls during the surveys. The calls were recorded in .WAV format using the Echo Meter Touch mobile application and analysed using Analook W.

2.4.8 Badger survey

The badger (*Meles meles*) survey was undertaken on 14th June 2019 by suitably qualified Ricardo ecologists. Badger surveys can be performed at any time of year, but the optimal time is in early spring or late autumn when levels of territoriality are higher and vegetation cover is reduced.

For this study, a sett was considered to be any underground or covered structure or place which shows signs indicating it's being used by a badger for shelter and rest. This means that the tunnels, chambers and entrances all form constituent parts of a sett.

Signs surveyed for include:

[12] Ricardo Energy and Environment (2018) Llyn Bran Decommissioning and Restoration Preliminary Ecological Appraisal Report
[13] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.
[14] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

- sett entrances, e.g. entrance tunnels that are normally 25 to 35cm in diameter and shaped like a 'D' lying on its straight side;
- large spoil heaps outside sett entrances;
- bedding outside sett entrances;
- badger footprints;
- badger paths;
- dung pits and latrines;
- badger hairs on fences or bushes;
- scratching posts; and
- foraging signs such as snuffle/foraging holes and prey remains attributable to badgers.

These signs could remain for several weeks or months after the last occupation by a badger. Potential development impacts to consider include:

- damage to setts;
- loss of setts;
- loss of foraging areas;
- severance of regular commuting routes; and
- disturbing badgers while they're occupying setts with noise, lights, vibration, fires or chemicals.

Where access permits, each sett entrance would be examined to check whether the tunnel narrows or turns into a blind-ending tunnel, suggesting it was created by rabbits (*Oryctolagus cuniculus*) instead and can therefore be discounted from further assessment.

Any holes discovered were categorised into sett types using the following criteria, based on Natural England guidance[15][16]:

- **Main sett** – Usually appearing well-used, well established and having a large number of entrance holes with big spoil heaps, often with piles of old bedding outside. Main setts tend to have well-worn paths between the sett and foraging areas, and between sett holes. They are generally considered to be breeding setts (i.e. where cubs are most likely to be born) and are typically in use all year round. A social group of badgers will only have one main sett within their territory.
- **Annexe sett** – Annexe setts are always close to a main sett and are usually connected by one or more obvious well-worn paths. They consist of several holes but are not necessarily in use the whole time, even if the main sett is very active. Should a second litter of cubs be born within the social group, they are likely to be raised within an annexe sett.
- **Subsidiary setts** – Often these have multiple but fewer entrance holes, are usually more than 50m from a main sett and do not have an obvious path connecting them with the main sett. Subsidiary setts are not continuously active.
- **Outlying setts** – Usually comprising one or two holes with very little spoil outside (thus indicating that the tunnel system underground is not extensive), outlying setts have no obvious path connecting them with another sett and are used only sporadically.

2.4.9 Water vole survey

The desk study undertaken as part of the 2018 PEA report[17] identified historic records of otter and water vole within the Llyn Bran reservoir and the downstream watercourse that feeds the Llyn Brenig reservoir. The surveys for riparian mammals included the banks of the reservoir and a 200m stretch of the downstream and upstream watercourses.

[15] Natural England (2007) Badgers and Development A Guide to Best Practice and Licensing (interim guidance document)
[16] Andrews, R. (2013) The Classification of Badger *Meles meles* Setts in the UK: A Review and Guidance for Surveyors. Inpractice: Bulletin of the Chartered Institute of Ecology and Environmental Management. Issue 82. December 2013
[17] Ricardo Energy and Environment (2018) Llyn Bran Decommissioning and Restoration Preliminary Ecological Appraisal Report.

The methodology for surveying for water voles in relation to developments follows the guidance set out in the Water Vole Mitigation Handbook (2016) [18] and includes an assessment of the (relative) suitability of the habitat for water voles and a search for field signs indicating the presence, or possible presence, of water voles.

Habitat assessment

An assessment of the habitat provided by the waterbody was undertaken during the initial survey visit in June 2019 and updated to identify any significant change during the second survey visit in August 2019. This assessment was based on the consideration of numerous factors, such as the presence of dry areas above water level for nesting, burrow entrances, bank profile, bank substrate, hydrology, herbaceous vegetation to provide food, cover, and escape routes from predators.

Searching for field signs

Searches were undertaken for field signs as described in the Water Vole Conservation Handbook (2011)[19] and Water Vole Mitigation Handbook (2016). The presence of water vole may be indicated by the following signs:

- Burrows
- Faeces and/or latrines
- Feeding stations/remains
- Other feeding signs (e.g. grazed 'lawns' outside burrow entrance)
- Above-ground nests
- Paths or runways
- Footprints (although rarely distinguishable from rat)
- Direct observation of water voles

Searches for water vole field signs comprised the marginal vegetation along the bank of the water body and extending 200m of the impounding wall. The survey was undertaken from within the water body aboard a small inflatable boat; where suitable habitat was identified, further investigations were undertaken from the bank.

The presence of any field signs that indicate the presence of key predators, such as American mink (*Mustella vison*) or otter, were also searched for. Evidence of other potential predators, such as cats and foxes was also noted, where identified.

The optimum period for determining the presence of water vole is during the breeding season, during which latrines are regularly visited and marked. As per the guidance in the Water Vole Mitigation Handbook (2016), two survey visits were undertaken. The water vole survey season usually starts in April and extends to September however, this is generally considered to be shorter in upland areas of North Wales, where Llyn Bran is situated. Therefore, the riparian mammal surveys were conducted in mid-June, with the second survey then undertaken in mid-August.

Outflow walkover

A walkover of the reservoir outflow stream was undertaken on 28th November 2019 to identify the suitability of the watercourse for water voles to identify potential receptor areas for water voles if water voles are removed from Llyn Bran under a Conservation Licence whilst the proposed works are undertaken.

The walkover did not constitute an exhaustive survey for water vole field signs and is not possible to determine the presence or absence of water voles on the water course outside of the sections subject to a full survey as outlined in Section 2.4.9 above and in the figure in **Appendix H:**.

[18] Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016) The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series) Eds Fiona Mathews and Paul Chanin. The Mammal Society, London.
[19] Strachan R and Moorhouse T (2011) Water Vole Conservation Handbook 3rd Edition. Wildlife Conservation Research Unit, Oxford.

2.4.10 Otter

The methodology for surveying otters broadly follows the guidance set out in English Nature's Document by Chanin, P. (2003)[20] and includes an assessment of the (relative) suitability of the habitat for otters and a search for field signs indicating the presence, or possible presence.

Habitat suitability
An assessment of the suitability of the habitats provided by the waterbody was undertaken during the initial survey in June 2019. The assessment was based upon the supply of food, water quality and the likelihood of anthropogenic mortality (mainly road casualties).

Field signs
Searches were undertaken for field signs as described by Chanin, P. (2003)[20]. Surveys were carried out during periods of low rainfall. The presence of Otter may be indicated by the following signs:

- Holts
- Spraints (droppings)
- Footprints
- Evidence of feeding (fish carcasses)

Searches for signs indicating the presence of otter were undertaken alongside water vole surveys with an optimum period for surveys occurring over the same period (May-September). The initial survey was completed in late June 2019 and a subsequent survey completed in September 2019.

2.5 Limitations

The absence of desk study records cannot be relied upon to infer absence of a species/habitat. Often, the absence of records is a result of under-recording within the given search area.

The survey area includes extensive areas of heather and sphagnum making ground visibility difficult in some areas and therefore difficult to locate potential badger field signs. Although the badger survey was undertaken in June outside of the optimal period (Early spring or autumn). The vegetation types present (heath, coniferous woodland etc.) do not experience much seasonal variation in ground cover. This, in addition to the site's elevation and habitats being sub-optimal for badgers, mean that these are not likely to significantly affect the conclusions drawn within this report.

There was light rain for six minutes from 21:44 to 21:50 during the dusk bat emergence survey undertaken at the Utility Building on 19th August 2019. No bats were recorded by the surveyor south of the building during this period to protect the equipment from damage from the rain. The surveyors continued to watch the building for bat emergence or entry during this period. Bats were recorded foraging close to the building before, during, and after the rain shower. Due to the short duration of the rain shower and its occurrence one hour and ten minutes after sunset, which is after bat species typically emerge from roosts, this is not considered to be a constraint to the findings of the survey.

The temperature during the dusk bat emergence survey of the Utility Building and the Boat House was 10°C at the start of the survey and 8°C the end of the survey. The current best practice guidelines[21] identify 10°C at sunset as the lower limit for undertaking bat survey. The survey was undertaken following a period of wet weather so represented a good foraging opportunity for bats despite the relatively low temperature. The buildings are located at an elevation of approximately 440m above sea level so low night time temperatures are representative of the conditions found at this site. Therefore, although there were relatively cold temperatures during the survey, this is not considered to be a constraint to the findings of this report.

The tall, dense vegetation means that it is likely that some signs of water vole activity and burrows may have been missed during the surveys in June and August 2019. However, this is not considered to be a constraint to the findings of the report as the searches of the banks of the reservoir recorded signs of

[20] Chanin P. (2003) *Monitoring the Otter, Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series 10.
[21] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London

activity and burrows during both surveys which combined with the habitat assessment results followed a precautionary approach to determine the presence/likely absence of water voles.

During the walkover of the reservoir outflow in November 2019, the vegetation adjacent to the watercourse showed evidence of recent high flows, so any field signs are likely to have been washed away prior to the walkover. This is not considered to be a constraint to the findings, as the survey was used to assess habitat suitability and not the presence/ likely absence of water voles. The walkover was undertaken outside of the optimal period for water vole surveys, so the absence of field signs has not been used to infer the absence of water voles.

This report deals with matters of legal significance but does not constitute professional legal advice. The Client may wish to seek professional legal interpretation of the relevant wildlife legislation cited in this document, which is summarised in **Appendix 1.**

3 Survey Results

3.1 Water Quality

To date, a total of four surveys has been carried out, once per month from May 2019 through to August 2019. A further seven surveys have been scheduled and will be completed by March 2020, totalling 11 surveys.

As seen from **Table 3.1**, the water quality data gathered during this time has been summarised in order to ascertain whether the lake's water quality is representative of an Oligotrophic to Mesotrophic type lake.

Table 3.1: Water quality summary for Llyn Bran

Variable	Unit	Average (May 2019 – August 2019)
Total Phosphorus	µg/l	10
Nitrate as N	mg/l	<0.2
Nitrite as N	mg/l	<0.004
SRP Ortho Phosphate as P	mg/l	0.001
Ammoniacal Nitrogen as N	mg/l	<0.03
Total Alkalinity as CaCO3	mg/l	14.8
Dissolved Organic Carbon	mg/l	4.0
Electrical Conductivity @25 °C	uS/cm	106.9
pH	pH units	7.3
Turbidity	NTU	2.2
Chlorophyll	ug/l	3.6

Based on the available water quality data for Llyn Bran, the average measurements for dissolved oxygen, pH, nitrogen, and total phosphorus concentrations are within the target ranges as identified by Common Standards Monitoring Guidance (CSMG) for oligotrophic lakes. The CSMG targets for oligotrophic lakes are shown in **Table 3.2**.

Table 3.2: CSMG water quality standards for oligotrophic lakes

Water Quality Parameter	CSMG Targets
pH (units)	5.5 - 9
Dissolved Oxygen (mg/l)	7 - 9
Total Phosphorus (µg/l)	10 - 15
Nitrogen (mg/l)	<1.5

3.2 Lake sediment sampling

The results of the sediment sampling are provided in **Figure 3.1** (particle size distributions around the reservoir), **Figure 3.2** (cumulative particle size distribution curves) and **Figure 3.3** (distribution of soft and hard bed sediments). The findings of the analyses are discussed briefly below.

Figure 3.1: Particle size distribution at sample locations around Llyn Bran

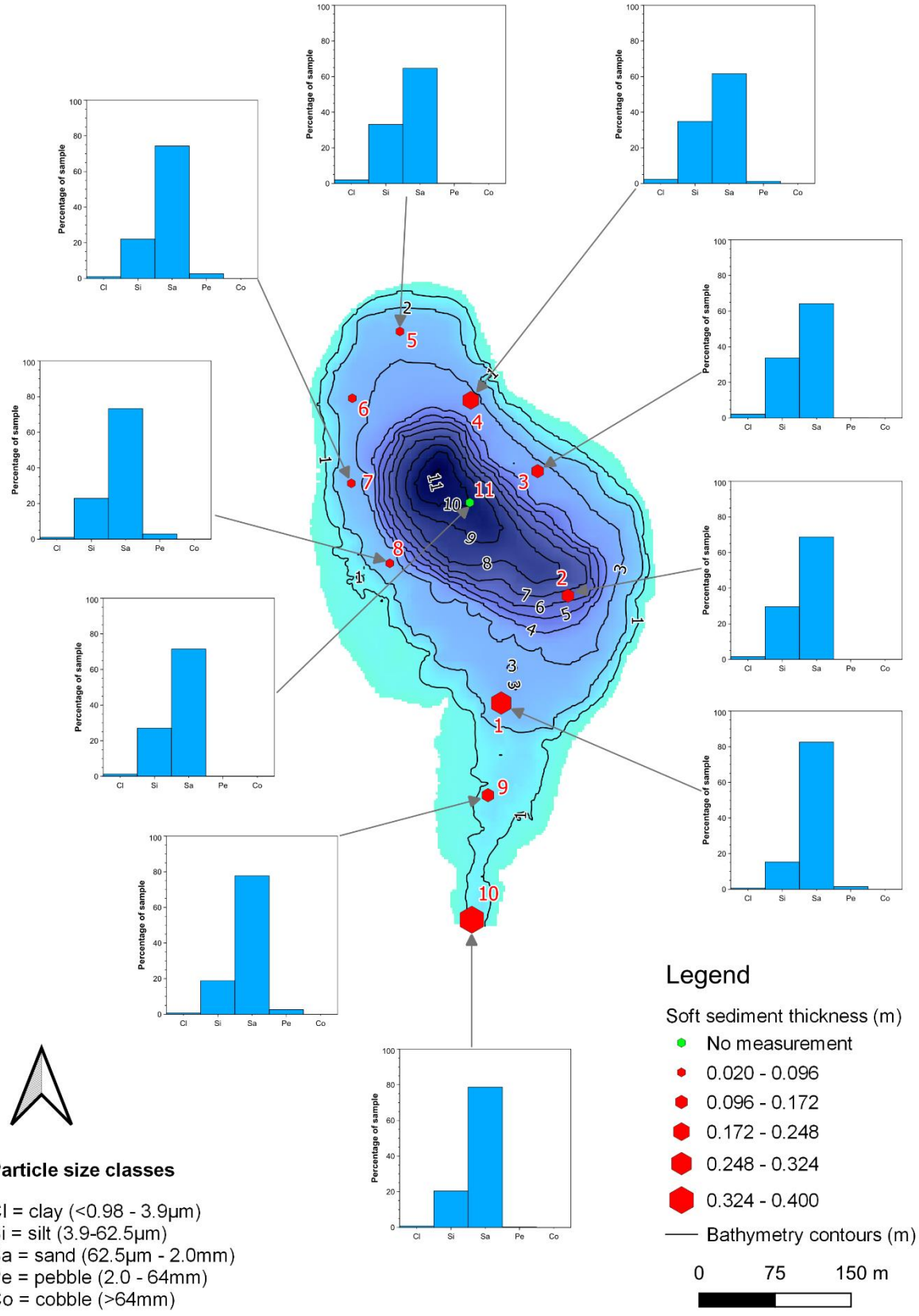


Figure 3.2: Particle size distribution plot for several sediment sample sites in the lake

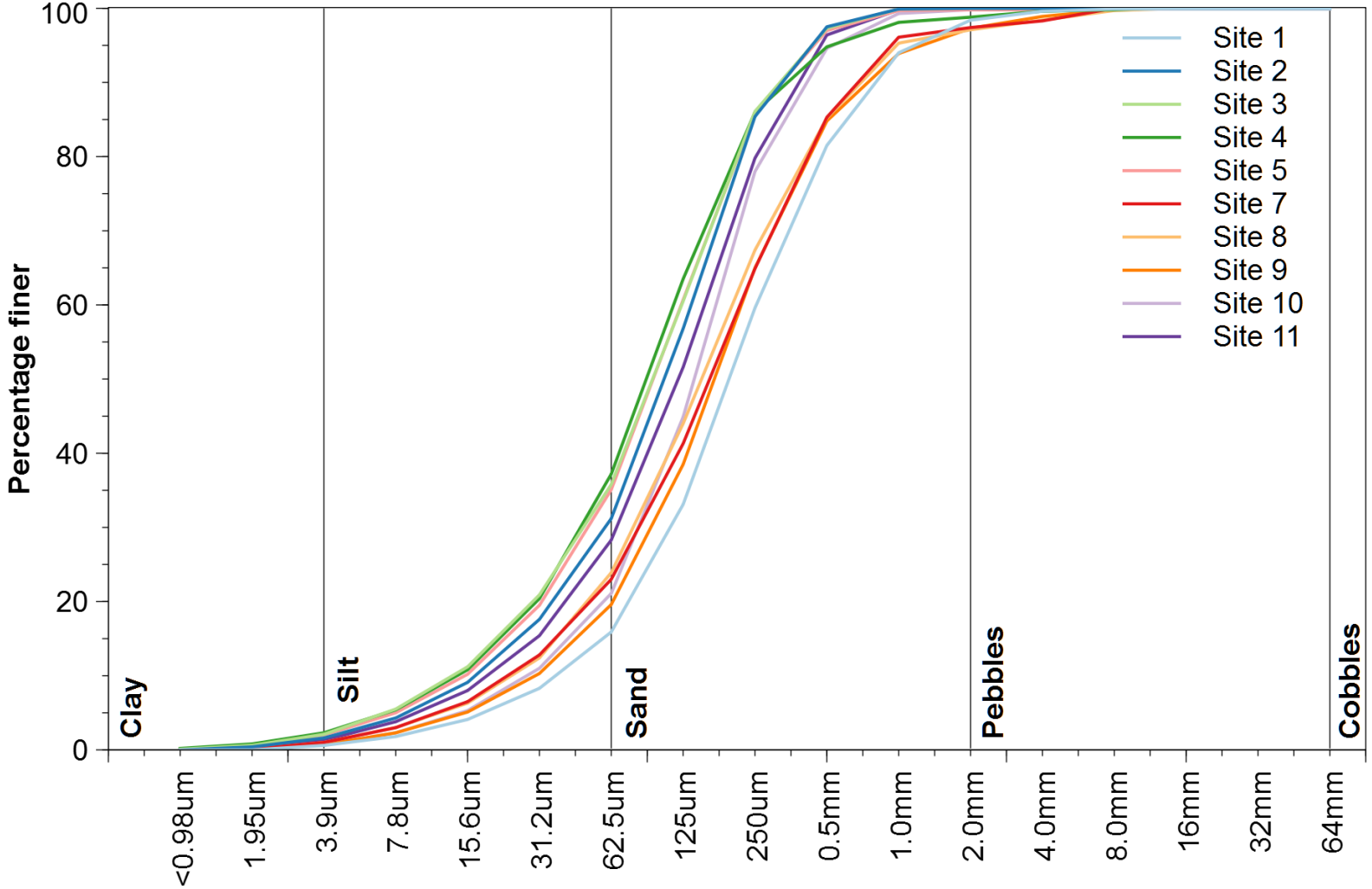


Figure 3.3: Distribution of soft bed surface and hard bed sediment around the lake.

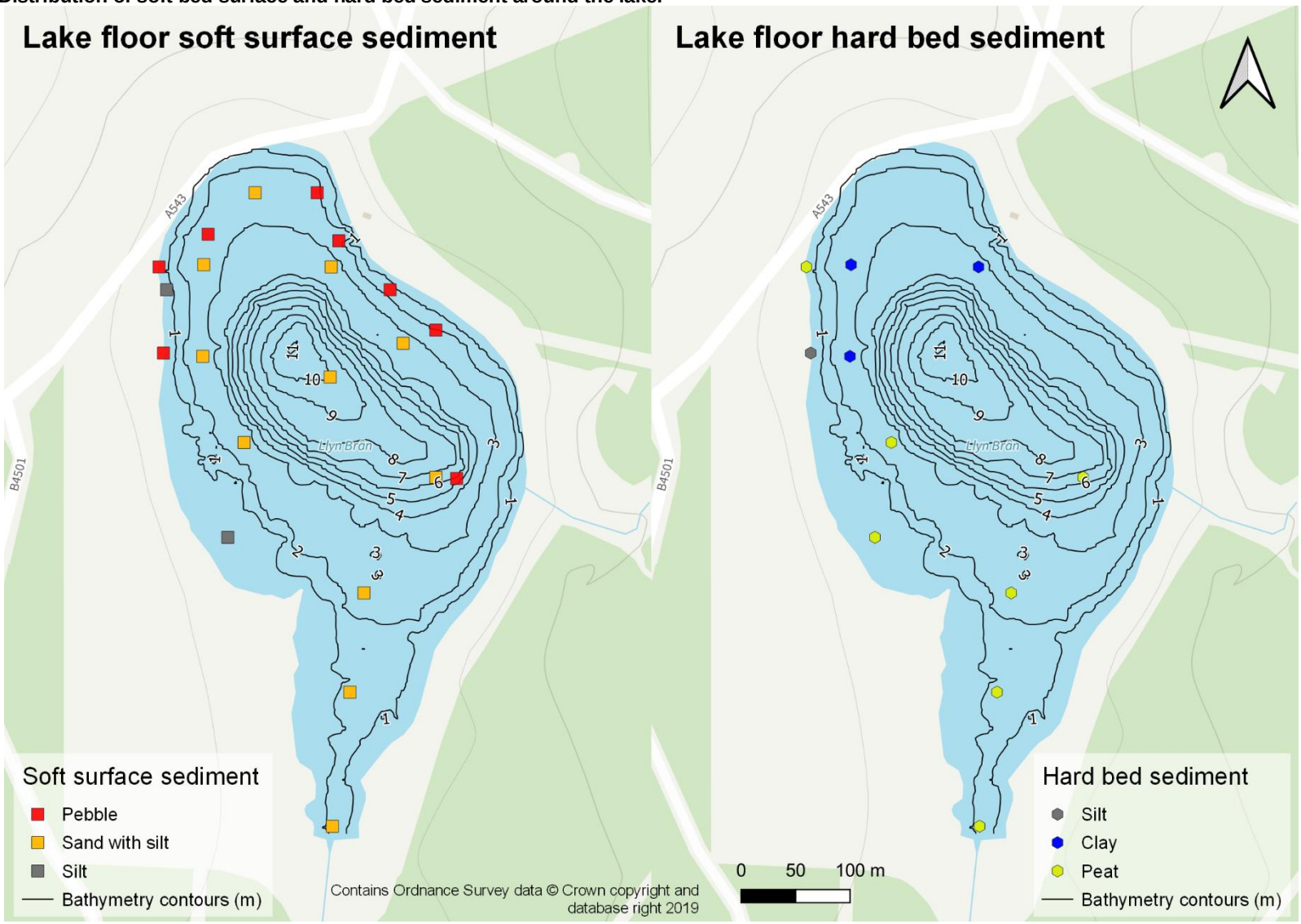


Figure 3.2 shows that particle size distributions of the soft (unconsolidated) bed sediment (that covering the harder, consolidated bed of the reservoir) measured at 11 sites around the reservoir margins are overwhelmingly dominated by sand and silt sized sediment (0.0039 – 2.0mm). Occasionally there are finer and coarser fractions, but these comprise less than a few percent of the total particle size distribution. This layer of soft sediment is thickest towards the dam and to the north-east margin near the jetty, ranging between 0.2-0.4m thick. For the other sites where soft sediment thickness was measured, this ranges between 0.02-0.15m thick, indicating only a thin layer of soft sediment covering much of the reservoir bed. The lack of variation in particle size at the 11 sample sites and the dominance of the sand fraction is clearly shown in the quite uniform cumulative particle size distribution (**Figure 3.2**).

A comparison of the average particle size for the soft bed sediments measured at all sediment sample sites in the reservoir is presented in **Figure 3.3**. This shows that the most marginal sites are characterised by coarse pebbles, while those sites further away from the margins are characterised by sand and silt. Two marginal sites are characterised predominantly by silt. The hard bed composition at several sites is displayed in **Figure 3.3**. This data shows that the hard bed in the southern portion of the reservoir is composed predominantly of peat, while the north is predominantly of clay or silt. This suggests that under the proposed drawdown scenario, much of the hard bed which will be exposed is likely to be composed of peat.

3.3 Peat survey

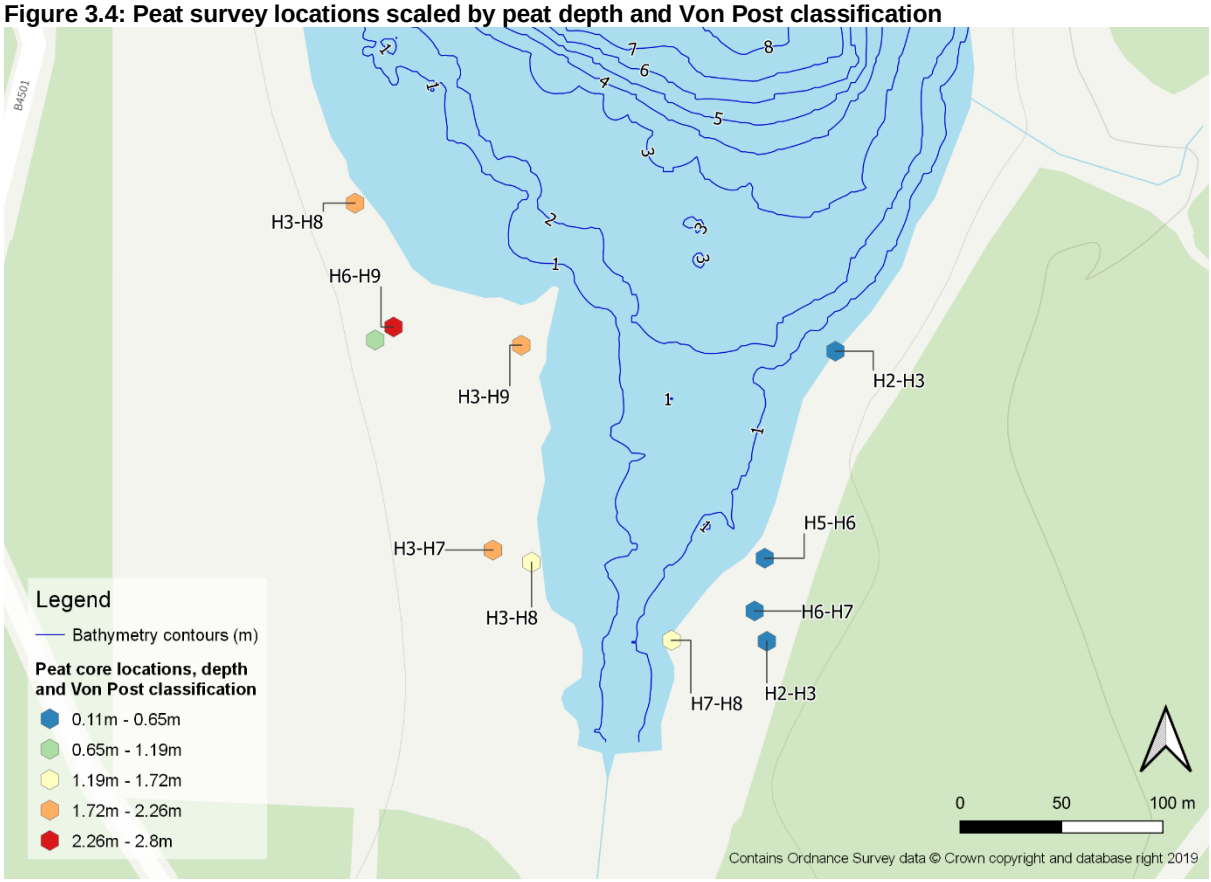
The results of the peat survey show that there are deposits of peat found on both the south-east and south-west margins of the reservoir. Of these, the south-west margin is the most extensive, with depths of peat up to 2.8m, although depths were mostly around 1.5-2.3m. A break of slope (indicated on **Figure 3.4** as the north-south trending grey contour line) appears to define the western limit of the peat, and this is likely supported by the depth measurement taken at site 11 that shows peat depth rapidly shallowing to 0.68m. The south-east margin contains relatively shallow deposits of peat, around 0.11-0.65m in thickness, although close in to the reservoir peat depth increased to 1.65m.

Peat humification varied across both sites; however, the south-western peat deposits exhibit higher maximum levels of humification (generally H7-H9) than those of the south-eastern deposits (generally H3-H7).

No peat cores were taken south of the dam due to time constraints, however observations of cut soil in the outflow stream from the reservoir due to river bank management suggested that there are likely to be deposits of peat in this area also. It is possible that the peat deposits identified along the south-east and south-west flanks may extend to this area.

Figure 3.4 displays the key findings of the peat survey.

Figure 3.4: Peat survey locations scaled by peat depth and Von Post classification



In addition to a peat depth and humification survey, a survey of the vegetation and habitat at each of the peat coring sites (excluding site 11 which was only a depth assessment site) was undertaken. The results of this survey are recorded in **Table 3.3**Error! Reference source not found..

Table 3.3: Peat coring survey site vegetation communities.

Peat coring site reference	Habitat notes	Species recorded
Site 1	H12 *Calluna vulgaris-Vaccinium myrtillus* heath	Heather (*Calluna vulgaris*), crowberry (*Empetrum nigrum*), bilberry (*Vaccinium myrtillus*), haircap moss (*Polytrichum commune*), red-stemmed feather-moss (*Pleurozium schreberi*), and little shaggy-moss (*Rhytidiadelphus loreus*).
Site 2	M19 / M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire or H12 Calluna vulgaris-Vaccinium myrtillus heath	Bilberry, heather, haircap moss (*Polytrichum* sp.), Hare's tail cotton grass (*Eriophorum vaginatum*), common cotton grass (*Eriophorum angustifolium*), wavy hair grass (*Deschampsia flexuosa*), crowberry, soft rush (*Juncus effusus*), bog moss (*Sphagnum* sp.), red-stemmed feather-moss, and haircap moss
Site 3	M19 / M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire or	Bilberry, crowberry, heather, hare's tail cotton grass, Sphagnum sp., and cross leaved heath (*Erica tetralix*).
Site 4	H12 Calluna vulgaris-Vaccinium myrtillus heath	Heather, bilberry, wavy hair grass, haircap moss, red-stemmed feather-moss, and *Sphagnum* sp.
Site 5	The habitat for this sample is not a god fit for the NVC communities and appears to be a transitional area from M19	Common cotton grass, hair cap moss, *Sphagnum* sp., crowberry, bilberry, Yorkshire fog (*Holcus lanatus*), marsh penny wort (*Hydrocotyle vulgaris*), and heather.

	/ M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire to marshy grassland (M23) close to the lake margin	
Site 6	M19 / M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire	Heather, cross-leaved heath, bilberry, crowberry, haircap moss, *Sphagnum* sp, and hare's tail cotton grass.
Site 7	M19 / M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire	Crowberry, hare's tail cotton grass, heather, red-stemmed feather-moss, wavy hair grass, hair cap moss.
Site 8	M19 / M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire	Heather, hare's tail cotton grass, wavy hair crowberry, cross-leaved heath, red-stemmed feather-moss, *Sphagnum* sp.
Site 9	M19 / M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire	Heather, crowberry, bilberry, hare's tail cotton grass, wavy hair grass, red-stemmed feather-moss, purple moor grass (*Molinea caerulea*), and heath plait-moss (*Hypnum jutlandicum*).
Site 10	M19 / M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire	Heather, bilberry, crowberry, hare's tail cotton grass, purple moor grass, haircap moss, *Sphagnum* sp., wavy hair grass.

Bog asphodel (*Narthecium ossifragum*) and bog cranberry (*Vaccinum oxycoccos*) were observed on the western margins within 5m of the bank of the reservoir during the peat surveys but were not recorded at the sampling sites or during the NVC survey. These species are specialised bog plants that are associated with wet peaty soils which are low in nitrogen and have a high water table.

3.4 Botanical survey

3.4.1 Site Description

The Site lies within a shallow upland moorland valley. The survey area around the lake supports a mosaic of wet and dry dwarf shrub heath and mire communities. Occasional patches of acid grassland with elements of neutral grassland lie along the northern shore, by the road. Swamp communities lie within the flush in the east of the Site and marshy grassland forms a mosaic with mire/flush communities along flushes in the north-west, bank margins in the west, and south of the Site by the stream. Two buildings are located on the lake bank in the north-east of the site.

To the west of the lake the heathland is fairly uniform, but patches of hair's-tail cotton grass and a predominance of sphagnum mosses indicates a perched water table and possibly deeper peat along breaks in the slope and flatter areas adjacent to the lake. The heath supports a dominance of ericoids, mostly ling (*Calluna vulgaris*) and bilberry (*Vaccinium myrtillus*) and sphagnum and non-sphagnum mosses and a few native saplings have seeded on the high ground. Fringing the lake is a strip of marshy grassland/mire, dominated by rushes and mosses behind a fringe of rushes, and a small flush enters the lake from the north-west corner supporting orchids. Overall, the habitat appears to be subject to very light grazing and is relatively undisturbed, evident from the height and density of the heath and low abundance of grassland species within the sward.

The eastern side of the lake supports wet dwarf shrub heath, with more frequent presence of bell heather (*Erica cinerea*), beyond which lies an area of recent clear-fell conifer in the south-east, which has partially been re-planted with native, broadleaved trees and shrubs, and conifer plantation in the north-east.

At the southern end of the lake is a concrete weir structure, beyond which is a small stream that flows through marshy grassland/mire communities and then conifer plantation. The northern side of the lake lies a road and pasture grassland beyond.

Small stands of sedges and rushes fringe the lake along more sheltered margins of the west and southern shores, but more generally the bank is steep and undercut (c.30cm high) with overhanging, vegetated peat. The eastern and northern shores are subject to wave wash, evident by the steep and

undercut, bare, earth banks (30cm-2m high) with overhanging mats of vegetated peat. The water level at the time of survey was below the bottom of the bank in places, exposing a gravel toe. Bank protection measures, slate bank re-enforcement, has been installed along the northern shore and is mostly intact, but towards the east and south-east the bank has eroded behind this and washed out the bank re-enforcement. The lake narrows towards the southern end, to the outfall over a weir and to a narrow stream that flows through marshy grassland and conifer plantation.

The lake supports macrophytes within central, western and southern parts of the lake where there is peat and an accumulation of silt and the shores are less impacted by wave wash. The lake bed of the western and northern shores is comprised of consolidated and unconsolidated gravel, where the peat layer has eroded, and is devoid of macrophytes. The macrophyte communities are further described in the Llyn Anafon Compensation Plan (Section 4.3.3 of that plan).

The following sections describe the flora, structure and habitats of these NVC communities and any associated observed sub-communities, as found within this study area.

3.4.2 NVC Community Descriptions

Acid grassland: unimproved (elements of neutral grassland)

Communities and sub-communities recorded:

- U4b / U4d - *Festuca ovina – Agrostis capillaris – Galium saxatile* grassland
- MG1e - *Arrhenatherum elatius* grassland
- MG8b – *Cynosurus cristatus - Carex panicea - Caltha palustris* grassland
- MG9 - *Holcus lanatus - Deschampsia cespitosa* damp pasture

(Quadrats 1-5, Figure in **Appendix D**:)

Quadrats 1-5 lie within grassland on a stony bank along the northern lake margin. Patches are likely to be recently established since the underlying rock revetment was installed. Its composition is a mixture of acid and mesotrophic grassland types, perhaps reflective of the influence of road / pasture run-off and disturbance (trampling). The fitness of the community to NVC is very poor; however, it is more likely to comprise U4. U4 is an upland acid grassland community, typical of heavily grazed grassland, characterised by sweet vernal grass (*Anthoxanthum odoratum*), common bent (*Agrostis capilaris*), tormentil (*Potentilla erecta*) and heath bedstraw (*Galium saxatile*) with a mat of mosses, which in this case are feather moss (*Rhytidiadelphus loreus*) and red-stemmed feather moss (*Pleurozium schreberi*). Other typical constituents include sweet vernal grass (*Anthoxanthum odoratum)*, common wood-rush (*Luzula multiflora*) and heath bedstraw (*Galium saxatile*), tormentil (*Potentilla erecta*). U4b *Holcus lanatus-Trifolium repens* sub-community is the more mesotrophic sub-type and tends to occur where there has been some nutrient enrichment and is less mossy and has more species indicative of improvement such as Yorkshire-fog (*Holcus lanatus*) and yarrow (*Achillea millefolium*). U4d *Luzula multiflora-Rhytidiadelphus loreus* sub-community, which was found further from the road on a less disturbed bank, tends to be very mossy in appearance, with velvet bent (*Agrostis canina*), occasional clumps of tufted hair-grass (*Deschampsia cespitosa*). The presence of cock's-foot (*Dactylis glomerata*), common nettle (*Urtica dioica*) and creeping thistle (*Cirsium arvense*) reflects the community MG1, more typical of hedgerow and road margins. The elements of MG8 and MG9 are likely reflective of nutrient input from run off and impeded drainage and are characterised by the presence of Yorkshire-fog and tufted hair-grass.

If these habitats are drained and grazed, they are likely to convert to MG6 and species-poor U4 grassland.

Marshy grassland, Mire and Flush Communities

Communities and sub-communities recorded:

- M6 / M6c *Carex echinata - Sphagnum fallax/denticulatum* mire, *Juncus effusus* sub-community

(Quadrats 18, 21, 22 and 25 on Figure in **Appendix D**:)

M6 communities are soligenous mires typically supporting a species-poor sward of sedges or rushes over a dense layer of the mosses and were associated with flushes found along the stream to the south of the lake and in depressions/flushes on the south-west and south-east shores. The sphagnum mosses and common haircap moss were abundant and also occasional stands of purple moor-grass (*Molinia*

caerulea), tormentil and heath bedstraw, which are typical of this community; however, the sward was a mosaic and also shared elements of M23 and M19, which may account for the poor NVC fit. The M6c Juncus effusus sub-community reflects the dominance of soft-rush. Star sedge (*Carex enchinata*) was recorded within this habitat but did not fall within the quadrats.

- M19 / M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire, *Vaccinium vitis-idaea-Hylocomium splendens* sub-community

(Quadrats 11, 14, 15, 16, 19, 20, 24, and 26 on Figure in **Appendix D**:

M19 are blanket mires, and this community was typified by a dense, tussocky sward of ling and hair's-tail cotton grass (*Eriophorum vaginatum*), bilberry and low clumps of crowberry (*Empetrum nigrum* ssp. *nigrum*). The ground had a cover of red bog moss (*Sphagnum capillifolium*) and large mosses such as splendid feather moss (*Hylocomium splendens*) and red-stemmed feather moss, which typify this community. This habitat is typical of gentle slopes where deep peat has accumulated and is one of the drier mire communities closely resembling wet dwarf shrub heath. Patches were also noted along breaks of slope on the west valley side and on low ground towards the outfall.

- M23 - *Juncus effusus/acutiflorus-Galium palustre* rush-pasture

(Quadrats 6, 8, 9 on Figure in **Appendix D**:)

M23 is a marsh grassland community and lies along the western shore associated with a flush and comprised a tall sward of soft-rush, sharp flowered rush and jointed rush, with grasses, such as Yorkshire-fog and sweet vernal grass and a few mesotrophic herbs, such as marshy pennywort and lady's smock and water horsetail; however, this community also included elements of blanket mire (M6), with distinct mossy components, such as common haircap moss and red bog moss (*Sphagnum capillifolius*) and wet heath species, such as (M19) bilberry and ling and the mosaic of these communities may account for the poor NVC fit.

These communities typically lie along wet margins of dwarf shrub heath and acid grassland communities and indicate deep peat with acid to neutral soils and the dominance of common haircap moss indicates low to moderate levels of nutrient for mires. They are rain fed and kept wet throughout the year by flushing and seepage. If left to succeed to climax vegetation, M23 may initially support carr woodland with grey willow (*Salix cinerea*) and birch (*Betula* sp.), which is present as the occasional shrub around the lake margins, or *Alnus-Fraxinus-Lysimachia* woodland W7. Drainage of these communities with grazing is likely to lose sphagnum mosses and increase common haircap moss and convert to acid grassland, such as U4, with grazing.

Dwarf shrub heath

Communities and sub-communities recorded:

- H12 *Calluna vulgaris-Vaccinium myrtillus* heath

(Quadrats 12, 23, 27-29 on Figure in **Appendix D**:)

This community was recorded covering large areas of higher ground within a mosaic with mire communities M19 and H18. This community typically consists of a rather uniform heather-dominated sward which is interlaced with bilberry and crowberry over an underlay of large pleurocarpous mosses, such as splendid feather moss, lanky moss and red-stemmed feather moss. Wavy hair-grass (*Deschampsia flexuosa*), which is usually more constant in this community, was present but uncommon, possibly due to a lack of grazing, favouring ericoid shrubs.

Calluna-Vaccinium heath occurs over a wide variety of siliceous rocks, including sandstone, gritstone, meta-sediments and granite, or on drift and gravel derived from acid rock. H12 can transition to H10 *Calluna vulgaris-Erica cinereal* dry heath. Succession is usually to birch woodland. More mature woodland would develop to sessile oak (*Quercus petraea*) and windblown moss (*Dicranum* sp.).

- H18 / H18a / H18c *Vaccinium myrtillus-Deschampsia flexuosa* heath

(Quadrats 7, 10 and 17 on Figure in **Appendix D**:)

This community formed a mosaic with mire and marshy grassland on the lower slopes. This very mossy heath is characterized by bilberry, wavy hair-grass and heath bedstraw with a deep carpet of pleurocarpus mosses, although wavy hair-grass was uncommon. This sward was dominated by bilberry

and wetter areas also supported soft-rush and heath rush (*Juncus squarrosus*). The H18a *Hylocomium splendens-Rhytidiadelphus loreus* sub-community is the typical and most common form of the community and supported a dominance of these moss species. The H18c *Racomitrium lanuginosum-Cladonia* sub-community is typically species-poor and supported a great proportion of crowberry.

This community is typical of moist but free-draining soils over steeper slopes and can form the climax vegetation in mountain areas but can succeed to sessile oak woodland on at lower altitudes.

Swamp and tall herb fen

Communities and sub-communities recorded:

- S10 *Equisetum fluviatile* swamp / S11c *Carex vesicaria* swamp, *Carex-Equisetum* sub-community / M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture

(Quadrat 30 and 34 on Figure in **Appendix D**:)

These swamp communities were recorded within the lower part of a flush and stream in the east of the site. S10 occurs in shallow to moderately deep, eutrophic to oligotrophic, standing waters in both lowland and upland lakes and pools and, like S11c, is a transitional habitat to open water. In these communities, water horsetail (*Equisetum fluviatile*) is the most abundant species and sedge is uncommon, which is typical for these communities. Elements of M23 and possibly S27 *Carex rostrata – Potentilla palustris, Equisetum fluviatile* subcommunity were present but dominated by soft-rush and water horsetail. S10 is characteristic of the drawdown zone of reservoirs and inundation margins of high order streams. The NVC fit was very poor, likely reflecting the diversity of species present and the mosaic of swamp and marshy grassland communities within this habitat. Other species included marsh thistle (*Cirsium palustre*), star sedge and water forget-me-not (*Myosotis scorpioides*).

The head of the stream flowed through an area of clear-fell plantation and some logs had been placed within the channel and feeder stream to the south-west. Therefore, the surrounding land had up to 50% bare ground and erosion of the stream was evident.

Coniferous plantation woodland / clear-fell (CP)

(Quadrats 31, 32, 33 and 34 Figure in **Appendix D**:)

Plantation woodland is present to the south and east of the Site and predominantly comprised Sitka spruce (*Picea sitchensis*). The woodland to the south of the reservoir comprised mature conifer stands to the east and transitioned to a younger compartment to the west. The area of woodland immediately to the south-east of the reservoir had recently been felled and had a high density of stumps. The majority of the ground was covered with brash and a few logs were also present, notably by a stream in the west of the site, the headwaters of which came from the felled woodland area. Part of this area had been re-planted with alder (*Alnus glutinosa*) and birch at low density.

The ground was predominantly bare and the felled woodland ground flora sparse and comprised occasional bramble (*Rubus fructicosus* agg.), holly (*Ilex aquifolium*), red bog moss, and tormentil. More frequently occurring species included red-stemmed feather moss, bilberry, common bent, common haircarp moss, with occasional creeping buttercup (*Ranunculus repens*) and creeping soft-grass (*Holus mollis*). The NVC community most resembled H12.

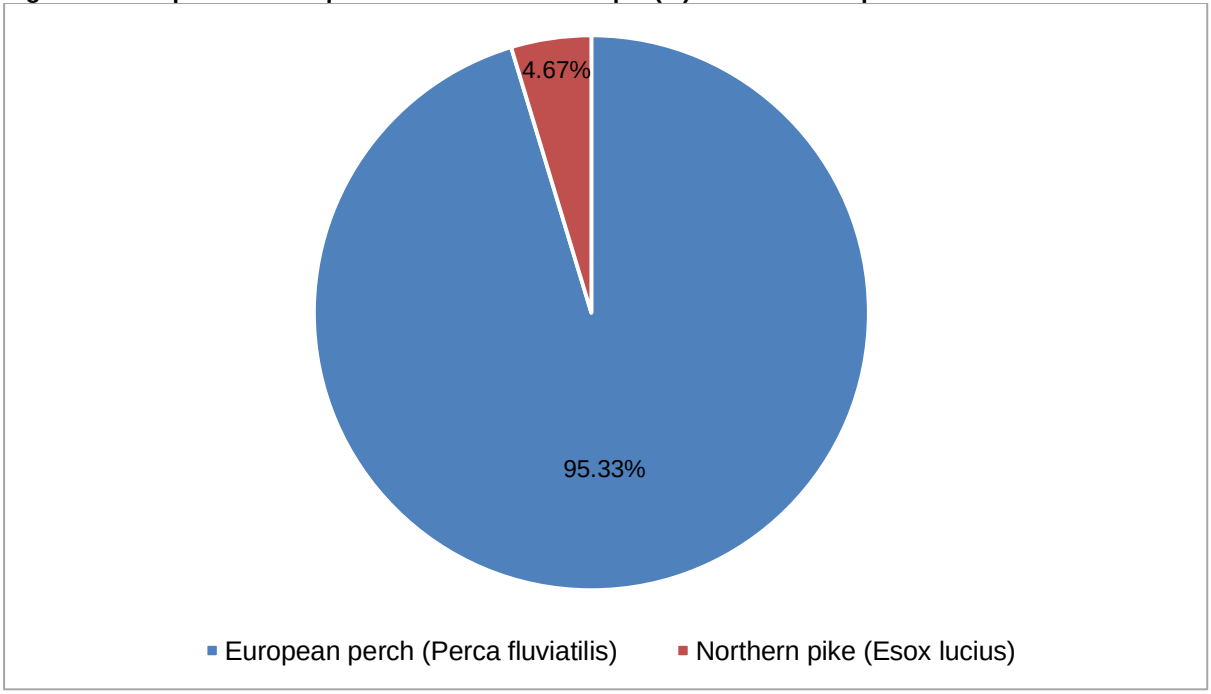
Patches of rosebay willowherb were present within the clear-felled area and along the entrance track from the road to the north. Occasional bracken and a patch of montbretia (*Crocosmia x crocosmiiflora*) were present, these are undesirable species, which could spread through the site.

The clear-felled area shows signs of natural regeneration with typical species of the surrounding communities. The hardy and more drought tolerant species of moss are likely to colonise first, and grasses may come to dominate depending on levels of grazing. The quantity of brash may reduce light and re-colonisation rates; however, it does provide some deterrent from grazing. In the long-term, it is likely to revert to perhaps an H12 or H10 Calluna vulgaris-Erica cinereal dry heath community. The recently planted broadleaved trees/shrubs are typical of the native woodland climax community.

3.5 Fish eDNA survey

Two fish species were detected in Llyn Bran by eDNA sampling: perch (*Perca fluviatilis*) and pike (*Esox lucius*). Perch made up 95.33% of the DNA sequence output and pike made up the remaining 4.67%. The relative proportion of the sequences found in each of the samples is shown in Figure 3.15. The relative proportions of DNA in the sample gives an indication of the relative populations in the waterbody but not population size.

Figure 3.5: Proportion of sequences in the eDNA sample (%) for each fish species identified



3.6 Great crested newts

3.6.1 Desk study

No records of great crested newts were received from COFNOD for within 2km of the proposed works. Examination of maps, aerial imagery, and the PEA report in 2018 identified the presence of three waterbodies within 250m of the Site: Llyn Bran, a drainage ditch on the north-east side of a forestry track, and a parallel ditch on the south-west side of the track.

3.6.2 Waterbody scoping survey

The waterbody scoping survey identified two drainage ditches to the south-west of Llyn Bran within either side of a forestry track, these ditches held water during the PEA survey in October 2018 but were dry at the time of the waterbody scoping survey. No other waterbodies were identified within 250m of the Site.

The location of the waterbodies and distance from the Site are shown in **Table 3.1**.

Table 3.4: Waterbody Locations

Waterbody	NGR	Distance from Site (m)
Llyn Bran	SH 9619759236	0m
Drainage Ditch - north-east of track	SH 95913 58960	225m
Drainage Ditch - south west of track	SH 95908 58959	230m

3.6.3 Habitat Suitability Index (HSI) results

The results of the HSI assessments are shown in **Table 3.5** below.

Both Llyn Bran and the two drainage ditches identified during scoping survey scored similarly for HSI (**Table 3.4)**. Both waterbodies scored the same for location, pond count, shade and terrestrial habitat, but scored differently in factors such as permanence, presence of fish, water quality, pressure from waterfowl and macrophytes. The permanence of the drainage ditches scored low, having been observed to dry out at least once between the initial PEA survey and waterbody scoping survey we can assume that the ditches dry out at least annually. The drainage ditches also scored low in water quality due to the seasonality of water and lack of macrophytes within the ditches being able to only support low invertebrate diversity. In contrast, Llyn Bran scored higher in factors such as permanence, water quality and macrophytes but scored lower for the presence of waterfowl and fish as multiple species of waterfowl have been observed at the Site as well predatory fish.

Llyn Bran and both forestry drainage ditches scored 'Below Average' indicating that they are sub-optimal for great crested newts.

In addition, Llyn Bran is considered unsuitable for great crested newts due to the large size of the waterbody and known populations of predatory fish including northern pike and European perch[22] as described in Section 3.5; pike were observed in Llyn Bran during water quality surveys in July 2019.

The drainage ditches adjacent to the forestry track are of too steep a gradient to hold water for most of their length typically only holding water behind temporary debris dams, as observed across the PEA and scoping surveys. Therefore, due to the ditches only temporarily holding water during wet periods and the absence of suitable still water habitats for breeding, they are considered to be unsuitable for great crested newts.

Table 3.5: HSI assessment results

Parameters	HSI Assessment		
Waterbody	**Llyn Bran**	**Drainage Ditch north-east of track**	**Drainage Ditch south west of track**
Grid Reference	SH 96197 59236	SH 95913 58960	SH 95908 58959
Geo Location	1	1	1
Area	*	0.5	0.5
Permanence	0.9	0.1	0.1
Water Quality	0.67	0.33	0.33
Shade	1	1	1
Waterfowl	0.67	1.0	1.0
Fish	0.01	1.0	1.0
Pond Count	0.83	0.83	0.83
Terrestrial Habitat	1	1	1
Macrophytes	0.4	0.3	0.3
HSI Score	**0.52**	**0.58**	**0.58**
HSI Category	**Below average**	**Below average**	**Below average**

***This parameter was not included within the HSI calculation as Llyn Bran has a surface area of 126150m^2 but the index does not allow for areas over 2000m^2.**

3.7 Breeding Birds

3.7.1 Desk study

Records of birds from COFNOD for within 2km of the Site included records of 50 bird species; the full list of species identified is shown in **Table 3.6.** The records included four species listed under Schedule 1 part 1 of the Wildlife and Countryside Act 1981 (as amended): common crossbill (*Loxia curvirostra*),

[22] Vale of Clwyd Angling Club website: http://valeofclwydanglingclub.org/our-waters/#1444215787909-1d04d543-fcc5 accessed 31 July 2019

fieldfare (*Turdus pilaris*), hen harrier (*Circus cyaneus*), and merlin (*Falco columbarius*). One species recorded, greylag goose (*Anser anser*), is listed under Schedule 1.2 of the Wildlife and Countryside Act 1981 (as amended). 11 species recorded are listed under Section 7 of the Environment (Welsh) Act 2016, with 8 listed as a Welsh priority species. The species identified also included 15 species on the Birds of Conservation Concern (BoCC) red list and 13 BoCC amber list species.

Six of the records received were from within the Site and included three species: tufted duck (*Aythya fuligula*), siskin (*Spinus spinus*), and great crested grebe (*Podiceps cristatus*).

Table 3.6: Species listed in records received from COFNOD for within 2km of the Site

Common Name	Scientific name	BoCC	WCA	E(W)A	BAP
Barn owl	*Tyto alba*	-	-	-	-
Black grouse	*Tetrao tetrix*	Red	-	Sect 7	Wales
Black-headed gull	*Chroicocephalus ridibundus*	Amber	-	Sect 7	-
Blue tit	*Cyanistes caeruleus*	-	-	-	-
Buzzard	*Buteo buteo*	-	-	-	-
Chiffchaff	*Phylloscopus collybita*	-	-	-	-
Coal tit	*Periparus ater*	-	-	-	-
Common crossbill	*Loxia curvirostra*	-	Sch 1	-	-
Common sandpiper	*Actitis hypoleucos*	Amber	-	-	-
Cormorant	*Phalacrocorax carbo*	-	-	-	-
Cuckoo	*Cuculus canorus*	Red	-	Sect 7	Wales
Curlew	*Numenius arquata*	Red	-	-	-
Dunnock	*Prunella modularis*	Amber	-	-	-
Fieldfare	*Turdus pilaris*	Red	Sch 1	-	-
Goldcrest	*Regulus regulus*	-	-	-	-
Goldeneye	*Bucephala clangula*	Amber	-	-	-
Goldfinch	*Carduelis carduelis*	-	-	-	-
Goosander	*Mergus merganser*	-	-	-	-
Grasshopper warbler	*Locustella naevia*	Red	-	-	Wales
Great crested grebe	*Podiceps cristatus*	-	-	-	-
Great spotted woodpecker	*Dendrocopos major*	-	-	-	-
Greylag goose	*Anser anser*	Amber	Sch 1.2	-	-
Hen harrier	*Circus cyaneus*	Red	Sch 1	Sect 7	-
Herring gull	*Larus argentatus*	Red	-	Sect 7	Wales
Kestrel	*Falco tinnunculus*	Amber	-	Sect 7	-
Lesser black-backed gull	*Larus fuscus*	Amber	-	-	-
Lesser redpoll	*Acanthis cabaret*	Red	-	Sect 7	Wales
Linnet	*Linaria cannabina*	Red	-	Sect 7	Wales
Mallard	*Anas platyrhynchos*	Amber	-	-	-
Meadow pipit	*Anthus pratensis*	-	-	-	-
Merlin	*Falco columbarius*	Red	Sch 1	-	-
Mistle thrush	*Turdus viscivorus*	Red	-	-	-
Oystercatcher	*Haematopus ostralegus*	Amber	-	-	-
Raven	*Corvus corax*	-	-	-	-
Red grouse	*Lagopus lagopus*	Amber	-	Sect 7	Wales
Red kite	*Milvus milvus*	-	-	-	-

Common Name	Scientific name	BoCC	WCA	E(W)A	BAP
Reed bunting	*Emberiza choeniclus*	Amber	-	-	-
Sand martin	*Riparia riparia*	-	-	-	-
Siskin	*Spinus spinus*	-	-	-	-
Skylark	*Alauda arvensis*	Red	-	Sect 7	-
Snipe	*Gallinago gallinago*	Amber	-	-	-
Sparrowhawk	*Accipiter nisus*	-	-	-	-
Stonechat	*Saxicola rubicola*	-	-	-	-
Swallow	*Hirundo rustica*	-	-	-	-
Tree pipit	*Anthus trivialis*	Red	-	Sect 7	Wales
Tufted duck	*Aythya fuligula*	-	-	-	-
Wheatear	*Oenanthe oenanthe*	-	-	-	-
Whinchat	*Saxicola rubetra*	Red	-	-	-
Willow warbler	*Phylloscopus trochilus*	Amber	-	-	-
Woodcock	*Scolopax rusticola*	Red	-	-	-

The Site comprises a range of habitats[23] including wet dwarf shrub heath, standing open water, flowing water, coniferous plantation woodland, felled plantation, wet flushes, marshy grassland, scattered scrub, and two small unoccupied buildings. These habitats are suitable to provide foraging and nesting opportunities for a wide variety of bird species.

The two buildings present within the Site, a single storey brick Utility Building located at NGR: SH 96234 59468, and a small Boat House are located at the edge of the reservoir NGR: SH 96237 59448. The wooden roof trusses (Boat House) and external crevices (Utility Building) could provide suitable areas for shelter as well as nesting opportunities for the bird species present.

3.7.2 Survey results

In total, 142 individuals comprising 36 species were recorded during the May survey (**Figure 3.6**). This included five red-list and eight amber-listed species, of which four are listed in the Welsh Biodiversity Action Plan. One species included under Schedule 1.2 of the Wildlife and Countryside Act 1981 as amended, greylag goose (*Anser anser*) was identified during the survey.

During the June survey (**Figure 3.7**) 134 individuals comprising 32 species were recorded. This included 7 red-list and 5 amber-listed species, of which 4 are listed in the Welsh Biodiversity Action Plan. No Schedule 1 species were recorded during the June survey. Birds identified during the June survey, but which were not recorded in May include cuckoo (*Cuculus canorus*), dunnock (*Prunella modularis*), grey wagtail (*Motacilla cinerea*), and tufted duck (*Aythya fuligula*). There was higher species diversity and total abundance in May compared to June.

Mallards (*Anas platyrhyncos*), black-headed gulls (*Chroicocephalus ridibundus*), Canada geese (*Branta canadensis*), sand martins (*Riparia riparia*) (May only) and tufted ducks (June only) were recorded within or flying over Llyn Bran in groups. A pair of great black-backed gulls (*Larus marinus*) were recorded nesting on the small island close to the western bank of the reservoir during the June survey. Chaffinches (*Fringilla coelebs)*, robins (*Erithacus rubecula)* and siskins (*Carduelis spinus)* were more abundant in the areas of wet dwarf shrub heath surrounding the reservoir in May than in June. These three species were abundant within the small strip of woodland alongside the western boundary of the Site. Conversely, the plantation woodland to the east contained significantly fewer willow warblers (*Phylloscopus trochilus*), chaffinch, and wrens (*Troglodytes troglodytes***)** in May relative to June.

The coniferous plantations to the south-east/east of the Site contained high species diversity, particularly in June, with mistle thrush (*Turdus viscivorus*), robin, wren and chaffinch all frequently

[23] [23] Ricardo (2018) Llyn Bran Decommissioning and Restoration: Preliminary Ecological Appraisal Report

recorded during the surveys. Several species were identified using their songs or call, meaning that the numbers presented provide a representative sample of the species within the area and are not true values.

Table 3.7: Species and abundances during breeding bird surveys in May and June 2019

Common Name	Scientific Name	BTO code	May Abundance	June Abundance
Blackbird	*Turdus merula*	B.	1	-
Blackcap	*Sylvia atricapilla*	BC	1	1
Black-headed Gull	*Chroicocephalus ridibundus*	BH	5	-
Bullfinch	*Pyrrhula pyrrhula*	BF	1	-
Buzzard	*Buteo buteo*	BZ	2	2
Canada goose	*Branta canadensis*	CG	1	4
Carrion crow	*Corvus corone*	C.	3	-
Chaffinch	*Fringilla coelebs*	CH	14	22
Chiffchaff	*Phylloscopus collybita*	CC	1	8
Coal tit	*Periparus ater*	CT	1	1
Cuckoo	*Cuculus canorus*	CK	-	1
Dunnock	*Prunella modularis*	D.	-	1
Goldcrest	*Regulus regulus*	GC	4	3
Goosander	*Mergus merganser*	GD	1	-
Great black-backed gull	*Larus marinus*	GB	2	2
Great crested grebe	*Podiceps cristatus*	GG	1	-
Great spotted woodpecker	*Dendrocopos major*	GS	1	1
Great tit	*Parus major*	GT	1	-
Grey heron	*Ardea cinerea*	H.	-	1
Grey wagtail	*Motacilla cinerea*	GL	-	5
Greylag goose	*Anser anser*	GJ	3	-
Herring gull	*Larus argentatus*	HG	1	3
Lesser black-backed gull	*Larus fuscus*	LB	-	2
Linnet	*Linaria cannabina*	LI	1	-
Mallard	*Anas platyrhynchos*	MA	5	4
Meadow pipit	*Anthus pratensis*	MP	18	25
Mistle thrush	*Turdus viscivorus*	M.	-	5
Pied wagtail	*Motacilla alba*	PW	1	3
Raven	*Corvus corax*	RN	5	4
Robin	*Erithacus rubecula*	R.	5	8
Sand martin	*Riparia riparia*	SM	4	-
Sanderling	*Calidris alba*	SS	1	-
Siskin	*Spinus spinus*	SK	5	3
Skylark	*Alauda arvensis*	S.	1	1
Song thrush	*Turdus philomelos*	ST	6	1
Stonechat	*Saxicola rubicola*	SC	4	3
Swallow	*Hirundo rustica*	SL	4	9
Tree pipit	*Anthus trivialis*	TP	-	2
Tufted duck	*Aythya fuligula*	TU	-	9
Woodpigeon	*Columba palumbus*	WP	11	-

Common Name	Scientific Name	BTO code	May Abundance	June Abundance
Wren	*Troglodytes troglodytes*	WR	14	-
Willow tit	*Poecile montana*	WT	1	-
Willow warbler	*Phylloscopus trochilus*	WW	13	-
	Total abundance, all species		**142**	**134**
	Total number of species recorded		**36**	**28**

Figure 3.6: Breeding Bird Survey Results: 21st May 2019

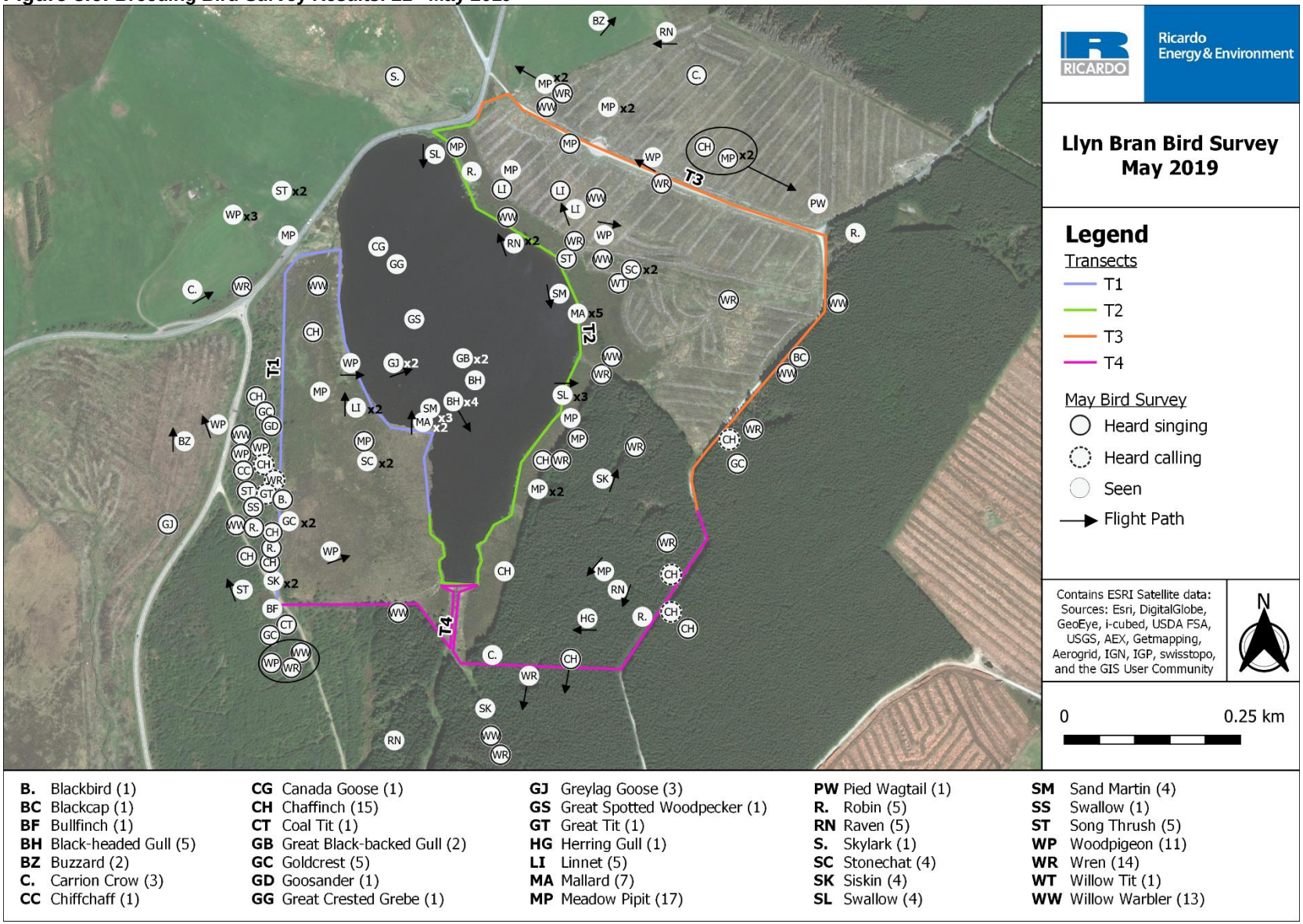
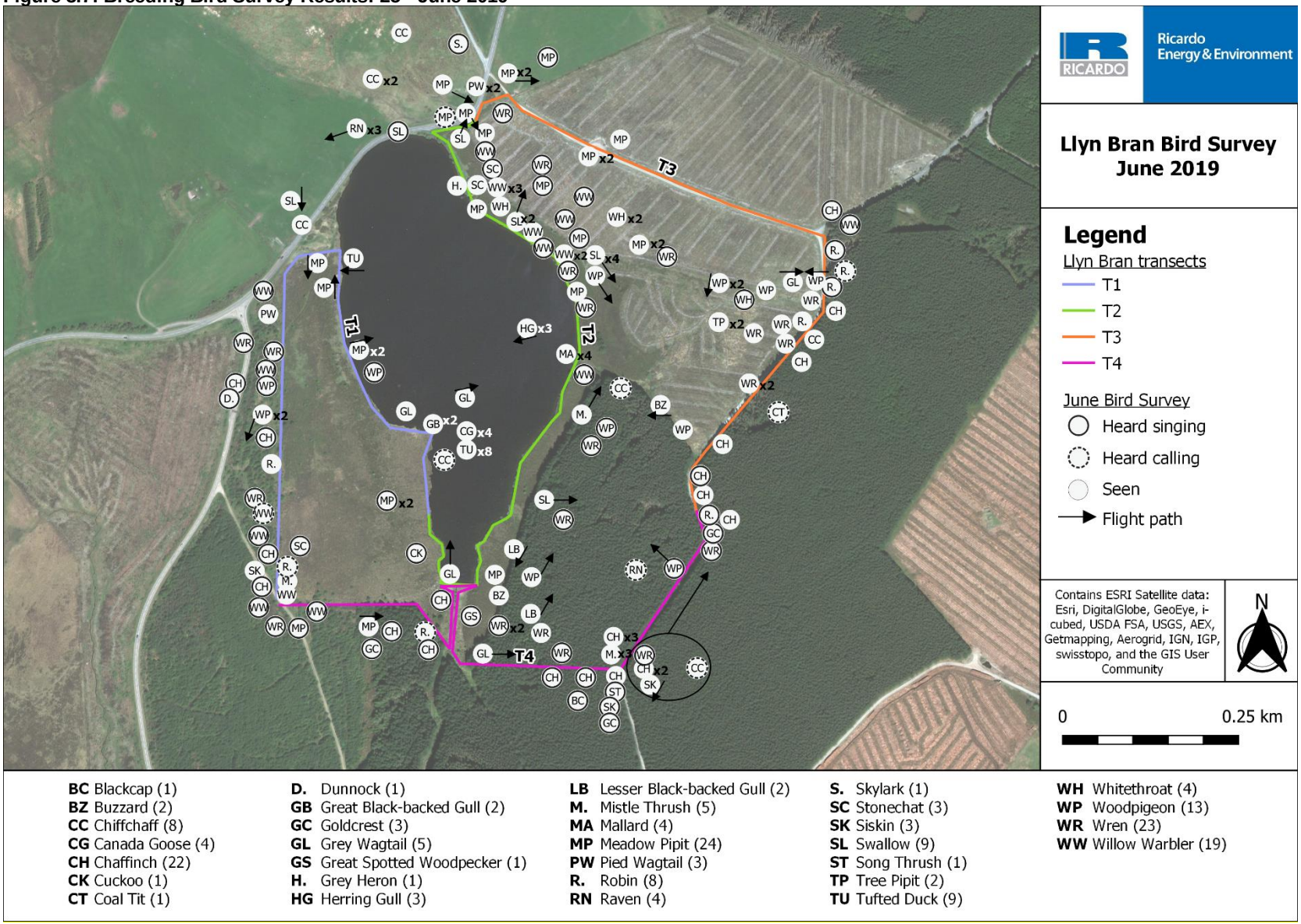


Figure 3.7: Breeding Bird Survey Results: 25th June 2019



3.8 Reptiles

3.8.1 Desk study

Data returned from COFNOD included 230 records of adder (*Vipera berus*) and 81 records of common lizard (*Zootoca vivipara*) within 2km of the Site. There were no records of reptiles from within the Site, the records were predominantly located between 1.4 km and 2 km south-east of Llyn Bran along the B4501 and around Llyn Brenig.

3.8.2 Survey results

Common lizard was the only species of reptile recorded during the surveys at Llyn Bran in May, June, and September 2019. The common lizards were recorded at low abundances during the surveys with a maximum of four lizards recorded on 21 June 2019 across the 95 artificial refuges.

The majority of the common lizards recorded were in areas of wet dwarf shrub heath and marshy grassland to the north-west of Llyn Bran. One adult common lizard was recorded at refuge 25 located south of the Llyn Bran dam.

Table 3.8: Reptile survey results

Date	Time start-end	Weather conditions	Common lizard abundance	Refuge number
30 May 2019	11:00-13:00	16°C, dry, calm, overcast	0	N/A
14 June 2019	09:22-11:40	11°C, dry, light breeze, overcast	1 adult female	89
			1 juvenile	90
19 June 2019	08:50-09:50	16°C, dry, calm, partial cloud	1 adult	81
21 June 2019	09:10-10:30	16°C, dry, light breeze, sunny with partial cloud	1 adult	25
			1 adult	81
			1 adult	89
			1 adult	94
26 June 2019	18:00-19:30	16°C, sunny, partial cloud, dry	1 Juvenile	94
27 June 2019	08:00-10:00	16°C, sunny, clear sky, dry, light breeze	0	N/A
23 September 2019	10:30-12:00	12°C, overcast with sunny spells, dry, light breeze	1 adult male	90

3.9 Badger

3.9.1 Desk study

There were no COFNOD records of badger within 2km of the Site.

3.9.2 Survey results

No evidence of badger setts or badger activity was identified during the survey in May 2019. The habitats surrounding Llyn Bran are dominated by dwarf shrub heath which is considered suboptimal foraging habitat for badgers and is likely to be unsuitable for badger setts due to the high water table and waterlogged soils. Suitable foraging habitat for badger is present within the coniferous plantation woodland to the south and south-east of Llyn Bran; however, no evidence of badger setts or activity was identified in this area.

3.10 Bats

3.10.1 Dusk emergence and dawn re-entry surveys

The results of the dusk emergence and dawn re-entry surveys undertaken in 2019 are shown summarised below, and the full survey results are presented in **Appendix G:**.

Utility Building

No bats were observed emerging from the Utility building during the dusk emergence survey undertaken on the 13th June 2019. Two bat species were recorded during the survey, common pipistrelle (*Pipistrellus pipistrellus*) and soprano pipistrelle (*Pipistrellus pygmaeus*). Bat activity levels surrounding the building were low, all bats recorded during the survey were heard but not seen. The first bat recorded during the survey was a common pipistrelle recorded at 22:34; one hour and nine minutes after sunset.

Table 3.9: Dusk Emergence Survey 13th June 2019 Meta Data

Survey Start	Survey End	Sunset	Temp Start	Temp End	Precipitation	Wind speed (Beaufort)
21:15	23:15	21:25	10°C	8°C	None	2

No bats were observed entering the Utility building during the dawn re-entry survey undertaken on the 11th July 2019. Three bat species were recorded during the survey: soprano pipistrelle, common pipistrelle, and noctule (*Nyctalus noctula*). Bat activity surrounding the building comprised low numbers of soprano pipistrelle bats foraging over the margins of Llyn Bran reservoir and noctule bats foraging over heathland to the east of the Utility Building. The last bat recorded was a noctule recorded at 04:22, 40 minutes before sunrise.

Table 3.10: Dawn Re-Entry Survey 11th July 2019 Meta Data

Survey Start	Survey End	Sunset	Temp Start	Temp End	Precipitation	Wind speed (Beaufort)
03:30	05:17	05:02	15°C	14°C	None	2

No bats were observed emerging from the Utility building during the dusk emergence survey undertaken on the 19th August 2019. Four bat species were recorded during the survey: soprano pipistrelle, common pipistrelle, unidentified pipistrelle sp., noctule, and an unidentified *Myotis* sp. which is likely to have been a Daubenton's bat. The fist bat recorded was a noctule foraging above the Utility Building and surrounding habitats at 21:14, 41 minutes after sunset. The bat activity recorded predominantly comprised common and soprano pipistrelles foraging between the Utility building and Llyn Bran, with occasional noctule bats foraging over the reservoir and adjacent habitats, in addition to a single pass from a *Myotis* species.

Table 3.11: Dusk Emergence Survey 19th August 2019 Meta Data

Survey Start	Survey End	Sunset	Temp Start	Temp End	Precipitation	Wind speed (Beaufort)
20:16	20:33	22:03	12°C	11°C	Light rain between 21:44 and 21:50	2

3.10.2 Boat house

No bats were observed emerging from the Boat house during the dusk emergence survey undertaken on the 13th June 2019. Two bat species were recorded during the survey including common pipistrelle, soprano pipistrelle, and an unidentified pipistrelle species[24]. Bat activity levels surrounding the building were low with activity predominantly from soprano pipistrelle, all bats recorded during the survey were

[24]Common and soprano pipistrelles have an overlapping range for peak frequency of the calls so pipistrelle calls with a peak frequency of between 49KHz and 51KHz can't be identified to species. Therefore, pipistrelle calls within this range have been recorded as unidentified pipistrelle species.

heard but not seen. The first bat recorded was a soprano pipistrelle at 22:35, one hour and ten minutes after sunset.

Table 3.12: Dusk Emergence Survey Meta Data

Survey Start	Survey End	Sunset	Temp Start	Temp End	Precipitation	Wind speed (Beaufort)
21:15	23:15	21:25	10°C	8°C	None	2

3.11 Otter

3.11.1 Desk study

The data request from COFNOD identified the presence of 10 records of otters from within 2km of the Site.

Previous surveys undertaken by Cartmel Ecology[25] in 2014 identified the presence of otter in both the reservoir and outflow stream through the identification of otter spraint. A record of an artificial holt at Pont-y-Brenig (approximate NGR SH 96203 57273) was also reported by Cartmel Ecology in 2014. This is located approximately 1.5km from the Site adjacent to the stream from the Llyn Bran reservoir upstream of Llyn Brenig.

3.11.2 Survey results

No definitive evidence of otter activity or holts was identified during the surveys in June 2019.

An otter spraint was identified on the bank of Llyn Bran at NGR SH 96177 58960 on the south-west side of the reservoir during the survey in August 2019; No evidence of otter holts was identified during the survey.

Three otter spraints were identified on the eastern end of the Llyn Bran dam wall at NGR SH 96227 58897 during the final reptile survey undertaken on 23 September 2019.

Llyn Bran provides suitable foraging habitat for foraging otters. The high elevation, lack of connectivity and oligotrophic status of the lake mean that it is a relatively unproductive lake for fish and is unlikely to be the main source of food for foraging otters. The lake has low levels of anthropogenic disturbance, the A453 is located to the north of the lake but is unlikely to result in otter casualties due to it being at the top of the catchment with no watercourses suitable for otters to the north. The reservoir outflow provides a suitable commuting corridor to Llyn Bran, the stream passes through a pipe culvert under the B4501 this culvert is passable by otters. The overhanging vegetation and eroded banks on the east of the reservoir are the most suitable holt locations but the substrate is boulder clay making excavation of holts unlikely. Due to the remote location of Llyn Bran and distance to other suitable foraging areas it is unlikely that otter holts are present at the lake. The downstream plantation woodland and areas around Llyn Brenig provides more suitable locations for holts and couches.

3.12 Water vole

3.12.1 Desk study

Data returned from COFNOD included five records of water vole within 2km of the Site. Although no records were provided within the Site, records were provided in a downstream watercourse with connectivity to the Site.

Previous surveys undertaken by Cartmel Ecology[26] in 2014 identified the presence of water vole in both the reservoir and outflow stream through the identification of latrines.

3.12.2 Survey results

Water vole activity including latrines, feeding remains and burrows was recorded during both surveys at Llyn Bran in 2019. The field signs indicate that water vole activity was highest on the west and north banks of the reservoir with activity also recorded along the reservoir outflow. No evidence of water vole

[26] Pant y Maen Wind Farm Environmental Statement, Appendix 9 – Ecology, Part 2. Otter and Water Vole survey. Cartmel Ecology Ltd 2014.

activity was recorded along the eastern side of the reservoir, this is likely to be due to the lack of suitable habitat due to the high eroding banks and shallow margins. The detailed results of the water vole surveys undertaken at Llyn Bran in June and August 2019 are presented in Table 3.13.

The surveys identified that the margins of Llyn Bran comprised 698m of suitable water vole habitat, 440m of sub-optimal water vole habitat, and 485m of habitat that is unsuitable for water voles. The surveyed reach of the reservoir outflow comprised 187m of suitable water vole habitat. The outflow at the dam was unsuitable due to the concrete apron below the dam and recent widening downstream which had removed vegetation, exposing bare ground on the western bank and in patches on the eastern bank.

Table 3.13: Results of water vole and otter surveys undertaken in June and August 2019

Survey reach reference	Reach length	Brief description of reach features	Water vole habitat suitability	Change in habitat suitability at the second visit	Visit 1 Field signs 25-26 June 2019	Visit 2 Field signs 20 August 2019
N1	116m	Bank running parallel to road wall, approximately 1 m wide consisting of coarse slate. Little to no organic sediment or vegetation. Shallow margins (>15cm) with no emergent vegetation.	Habitat is generally not suitable for water vole, few areas of substrate suitable for burrowing and lacking food sources compared to adjacent reach W1. Relatively exposed with little to no refuge from predators.	No change from previous survey.	**Water vole:** No definitive signs of water vole identified. **Otter:** No definitive signs of otter identified.	**Water vole:** Possible water vole burrow in bank below road. **Otter:** No definitive signs of otter identified.
N2	130m	Slate reinforcement continuing from the road creating exposed slate banking intermixed with concrete ramp and jetty. Some overhanging trees/bushes with sections of the grassy bank.	Poor habitat lacks adequate substrate for burrowing, relatively exposed with some shading provided by trees. Low food density,	No change from previous survey.	**Water vole:** No definitive signs of water vole identified. **Otter:** No definitive signs of otter identified. **Other Species:** field vole burrows and latrines.	**Water vole:** No definitive signs of water vole identified. **Otter:** No definitive signs of otter identified. **Other Species:** field vole burrows, feeding remains, and latrines.
E1	355m	Typically, 1-1.5m of vertical clay bank with 0.5m of peat overhanging. Vegetated with heath (Bilberry, Crowberry, drier moss species) which protrudes for ~0.5m. Shallow Margins (<10cm) with a bed of gravel and slate.	Unsuitable for water vole due to the vertical nature of heavily eroded bank combined with dense clay/gravel matrix. Lack of suitable food plants and refuge from predation.	No change from previous survey.	**Water vole:** No definitive signs of water vole identified. **Otter:** No definitive signs of otter identified. **Other Species:** Possible bank vole burrow and two latrines.	**Water vole:** No definitive signs of water vole identified. **Otter:** No definitive signs of otter identified. **Other Species:** field vole burrows, feeding remains, and latrines.

E2	324m	The bank supports a mosaic of sedge and marshy grassland, heath, and wet woodland. Typically, banks are no higher than 30cm above water level, banks consist of a clay gravel matrix with overhanging mats of peat. Bankside vegetation overhangs the bank. Shallow margins (>30cm) deep with emergent reeds/rushes and abundant submerged macrophyte.	Sporadic food availability with sections of rush and sedge. Refuge from predation in the form of very dense vegetation and overhanging banks.	No change from previous survey.	**Water vole:** No definitive signs of water vole identified. **Otter:** No definitive signs of otter identified. **Other Species:** Numerous field vole latrines, feeding piles and runs.	**Water vole:** No definitive signs of water vole identified. **Otter:** No definitive signs of otter identified. **Other Species:** field vole burrows, feeding remains, and latrines.
W4	363m	Marshy grassland mixed with heath and dense moss. Banks consist of peat with overhanging vegetation. Marginal depth between 15-60cm with sporadic emergent rushes and abundant submerged macrophyte.	Good water vole habitat with abundant food and refuge from predation provided by overhanging vegetation and emergent rushes. Dense moss and soft organic substrate providing a good opportunity for burrowing.	No change from previous survey.	**Water vole:** High activity, with latrines, runs and feeding piles found every 5m in areas of marshy grassland. Dead water vole found in the northern extent of this reach. **Otter:** No definitive signs of otter identified. **Other Species:** Numerous field vole latrines, feeding piles and runs found in areas with overhanging heath/moss.	**Water vole:** Moderate activity with runs found regularly in this section. Latrines and feeding remains more abundant at the northern end of the section. **Otter:** Old otter spraint in vegetation in southern end of section approximately 60m north of dam. **Other Species:** Regular field vole latrines, feeding piles and runs found throughout vegetation in this section.
W3	192m	Heath and dense moss. Banks consist of peat with overhanging	Good water vole habitat with abundant food and refuge from predation	No change from previous survey.	**Water vole:** 2 possible water vole burrows. **Otter:**	**Water vole:** 4 possible water vole burrows feeding remains

		vegetation. Marginal depth between 15-60cm with sporadic emergent rushes and abundant submerged macrophyte.	provided by overhanging vegetation and emergent rushes. Dense moss and soft organic substrate provide a good opportunity for burrowing.		No definitive signs of otter identified. **Other Species:** Numerous field vole latrines, feeding piles and runs.	and a latrine also found in north of section. **Otter:** No definitive signs of otter identified. **Other Species:** Numerous field vole latrines, feeding piles and runs.
W2	91m	Marshy grassland. Banks consist of clay topped with peat with overhanging vegetation, typically no higher than 25cm from water's surface. Marginal depth ~30cm with abundant emergent rushes and submerged macrophyte.	Good water vole habitat with abundant food and refuge from predation provided by overhanging vegetation and emergent rushes. Dense moss and soft organic substrate provide good opportunity for burrowing.	No change from previous survey.	**Water vole:** High activity, 4 latrines, multiple runs, 2 feeding piles and 1 burrow. **Otter:** No definitive signs of otter identified. **Other Species:** Numerous field vole latrines, feeding piles and runs.	**Water vole:** Highest activity in August 2019, 3 large well-used latrines, multiple runs, feeding piles and 1 burrow. **Otter:** No definitive signs of otter identified. **Other Species:** Numerous field vole latrines, feeding piles and runs.
W1	52m	Heath, banks consist of peat with overhanging vegetation. The marginal depth around 20cm with sporadic emergent rushes and abundant submerged macrophyte.	Good water vole habitat with abundant food and refuge from predation provided by overhanging vegetation and emergent rushes. The soft organic substrate provides a good opportunity for burrowing.	No change from previous survey.	**Water vole:** Network of burrows of both water and field vole size. **Otter:** No definitive signs of otter identified. **Other Species:** network of burrows of both water and bank vole size.	**Water vole:** Two water vole burrows and large well-used latrines. **Otter:** No definitive signs of otter identified. **Other Species:** field vole burrows and feeding remains.
S1	29m	Concrete apron at the front of the impounding wall to approximately 3m downstream. Widening downstream of	Remaining undisturbed habitat provides abundant food and refuge with steep banks of the soft substrate	No change from previous survey.	**Water vole:** One burrow in widened section of the stream. **Otter:**	**Water vole:** One burrow in widened section of the stream. **Otter:**

		impounding wall in this section has removed vegetation exposing bare ground on the western bank and in patches on the eastern bank; disturbance extends to approximately 20m downstream. The stream is approximately 90cm wide at the concrete apron narrowing to 60cm at the downstream edge of the reach. Remaining vegetation on the western bank consists of marshy grassland.	with overhanging vegetation.		No definitive signs of otter identified.	No definitive signs of otter identified.
S2	70m	The stream flows through a 20m wide flood plain of marshy grassland and enters plantation pine forest at the end of the reach at approximately 90m downstream of impounding wall. Banks comprised of earth over a peat layer with some sections of bank sloping to the water edge and some sections undercut with overlying vegetation.	Good water vole habitat with abundant food source and refuge from predation.	No change from previous survey.	**Water vole:** 1 water vole burrow. **Otter:** No definitive signs of otter identified. **Other Species:** 1x field vole burrow with feeding signs.	**Water vole:** Three water vole burrows, no feeding remains, or latrines identified. **Otter:** No definitive signs of otter identified. **Other Species:** field vole feeding remains.
S3	117m	Reach extends 110m into the plantation pine forest; the stream is bordered within a 15m floodplain consisting of uncut	The groundwater level in this reach is very high with most of the ground being waterlogged, making burrowing and	No change from previous survey.	**Water vole:** 2x possible water vole burrows. **Otter:**	**Water vole:** No definitive signs of water voles identified **Otter:**

		marshy grassland in a ride through the plantation. The banks consist of peat topped by soil. Erosion has formed steep banks, and in some areas, erosion has formed small tunnels.	nest building difficult. Food is abundant, and the nature of the banks would provide adequate shading and refuge from predation.		No definitive signs of otter identified. **Other Species:** 2x possible field vole burrow.	No definitive signs of otter identified. **Other Species:** field vole feeding remains

3.12.3 Outflow walkover

Water vole burrows were identified on reach S3 (as identified in **Table 3.13**). No evidence of water voles was observed on the rest of the watercourse during the walkover in November 2019. The vegetation adjacent to the watercourse showed evidence of recent high flows so any field signs (droppings, feeding remains etc.) are likely to have been washed away prior to the walkover.

The results of the walkover are presented in **Table 3.14** below.

Table 3.14: Reservoir outflow walkover survey 28th November 2019

Distance from dam[27]	Suitable for water voles?	Description
1-90m	Yes (confirmed presence)	The stream flows through a 20m wide flood plain of marshy grassland and enters plantation pine forest at the end of the reach at approximately 90m downstream of impounding wall. Banks comprised of earth over a peat layer with some sections of bank sloping to the water edge and some sections undercut with overlying vegetation. Two water vole burrows observed during walkover, the burrows were previously identified during the surveys in June and August 2019. Water voles were confirmed to be present during surveys in 2019.
91-250m	Sub-optimal	Water vole survey reach S3 extends 110m into the coniferous plantation (see Table 3.13) and covers the majority of this reach. The watercourse is in a narrow channel approximately 40- 60cm deep with a water depth ranging from 15-40cm. The banks consist of peat topped by soil, erosion has formed steep and undercut banks, and in some areas, erosion has formed small tunnels. Further from the reservoir the channel had barely any bank above the water level, bank height approximately 5-10cm above the water. The bankside vegetation had a sward height of approximately (10cm) and was relatively sparse compared to the upstream reach. The vegetation comprised marshy grassland with occasional sedges in drier areas. The ground adjacent to the watercourse where the banks are low had waterlogged ground with vegetation dominated by bryophytes including bog moss (*Sphagnum* sp.). The upper parts of the reach are suitable for water voles and evidence of water vole activity was recorded during the survey in June 2019. Overall, this section of the watercourse is considered to be sub-optimal due to the paucity of potential burrowing locations due to low banks and flat waterlogged ground adjacent to the stream. No evidence of water voles observed during walkover.
250-330m	Yes	This reach has higher banks (approximately 20-30cm above water) than upstream reach. The marshy grassland adjacent to the watercourse provides more food resource and better cover than the upstream reach due to the taller and denser sward with grass tussocks and soft rush. There was occasional heather (*Calluna vulgaris*) close to plantation edges. The ride between the coniferous plantation opens out to approximately 15m providing more light for bankside vegetation. No evidence of water voles observed during walkover.

[27] Distances were measured remotely using Q GIS software, the measurements were based on aerial imagery but as the stream is small and meandering the exact rout is not clear for the full length therefore the measurements used are likely to be an underestimate.

330-345m	No	Pipe culvert under forestry track. Entrance to culvert was submerged during walkover survey. Water voles are unlikely to be able to pass through the culvert even at low flows. The track is raised on an embankment approximately 3-4m above the watercourse. Due to the lack of vegetation the track may provide a barrier to movement.
346-650m	Yes	This reach is situated between the forestry track culvert and the B4501. The watercourse channel is approximately 50cm-70cm wide with a variable water depth of between 15cm and 40cm. The water course meanders, creating variations in bank height and water depth. The banks consist of peaty soil suitable for burrowing. The adjacent habitats are comparable to the habitats surrounding Llyn Bran. The stream is bordered by marshy grassland with soft rush. Further from the watercourse there is an increase in the proportion of ericoid shrubs and bryophytes such a Sphagnum. Mature coniferous plantation was present an 10m – 15m east of the stream up a steep bank. The habitats to the west comprised heath with immature spruce trees. The encroaching immature spruce trees to the west of the stream in some parts of this reach will reduce habitat suitability in the long term. There is a steeper gradient downstream of the forestry track with an associated increase in flow velocity. This reach was not subject to a water vole survey as it will not be impacted by the proposed decommissioning works.

3.13 Invertebrates

3.13.1 Desk study

The data received from Cofnod contained records of seven invertebrate species that are of Principle Importance listed under section 7 of Environment (Wales) Act 2016. These priority species identified were butterflies and moths that are associated with open woodland or heathland. One notable aquatic species was identified a nationally scarce stone fly (*Amphinemura standfussi*) this is a widespread species associated with flowing streams in the sub-arctic region.

Table 3.15: Species listed in records received from COFNOD for within 2km of the Site

Scientific name	Common name	Designation
Acronicta rumicis	Knot Grass moth	Environment (Wales) Act Section 7
Boloria selene	Small Pearl-bordered Fritillary	Environment (Wales) Act Section 7
Brachylomia viminalis	Minor Shoulder-knot	Environment (Wales) Act Section 7
Ceramica pisi	Broom Moth	Environment (Wales) Act Section 7
Coenonympha pamphilus	Small Heath	Environment (Wales) Act Section 7
Entephria caesiata	Grey Mountain Carpet	Environment (Wales) Act Section 7
Spilosoma lubricipeda	White Ermine	Environment (Wales) Act Section 7
Agonum (Agonum) ericeti	A ground beetle	Nationally scarce[28]
Amphinemura standfussi	A stone fly	Nationally scarce
Calliphora loewi	Long-horned Bluebottle	Notable[29]
Deleaster dichrous	A rove beetle	Notable B[30]

[28] 'Nationally Rare - Occurring in 15 or fewer hectads in Great Britain. Includes rare species qualifying under the main IUCN criteria.
[29] 'Species which are estimated to occur within the range of 16 to 100 10km squares. (subdivision into Notable A and Notable B is not always possible because there may be insufficient information available). Superseded by Nationally Scarce, and therefore no longer in use.
[30] 'Taxa which do not fall within Red data book categories, but which are none-the-less uncommon in Great Britain and thought to occur in between 31 and 100 10km squares of the National Grid or, for less-well recorded groups between eight and twenty vice-counties. Superseded by Nationally Scarce, and therefore no longer in use.

Exechia pectinivalva	A fungus gnat	Nationally Scarce-excludes[31]
Macrocera estonica	A fly	Nationally Scarce-excludes
Molophilus propinquus	A crane fly	No designations
Acleris caledoniana	Caledonian Button	No designations
Bombus monticola	Bilberry (Blaeberry) Bumblebee	No designations
Catoptria margaritella	Silver-stripe Grass-veneer	No designations
Elachista kilmunella	Moorland Dwarf	No designations
Parasemia plantaginis	Wood Tiger	No designations
Scopula ternata	Smoky Wave	No designations
Xylena vetusta	Red Sword-grass	No designations

[31] 'Nationally Scarce - Occurring in 16-100 hectads in Great Britain. Excludes rare species qualifying under the main IUCN criteria

4 Discussion and Recommendations

4.1 Water Quality

Llyn Bran meets CSMG targets for dissolved oxygen, pH, and nitrogen. The total phosphorus concentrations during sampling in 2018 were indicative of eutrophication, exceeding the CSMG target of 10 -15 µg/L which applies to Oligotrophic to Mesotrophic deep (>3 m) lakes. The higher phosphorus concentrations recorded during 2018 were indicative of the impacts of tree felling in the wider catchment[32]. However, during the sampling between May and October 2019 average total phosphorus was at the lower end of the CSMG target range.

The restoration of the inflow and outflow of Llyn Bran, creation of a buffer area between the lake and farm land to the north, reduction in forestry activity, the discontinuance of the reservoir, and the restoration of terrestrial habitats, have potential to improve water quality within the reservoir.

4.2 Lake sediments

Particle size distributions of the soft (unconsolidated) bed sediment (covering the harder, consolidated bed of the reservoir), measured at 11 sites around the reservoir margins, are overwhelmingly dominated by sand and silt sized sediment. Occasionally there are finer and coarser fractions, but these comprise a low proportion of the total particle size distribution.

The layer of soft sediment is thickest towards the dam and to the north-east margin near the jetty, ranging between 0.2-0.4m thick. For the other sites where soft sediment thickness was measured, this ranges between 0.02-0.15m thick, indicating only a thin layer of soft sediment covering much of the reservoir bed. The lack of variation in particle size at the 11 sample sites and the dominance of the sand fraction is clearly shown in the quite uniform cumulative particle size distribution.

This shows that the most marginal sites are characterised by coarse pebbles, while those sites further away from the margins are characterised by sand and silt. Two marginal sites are characterised predominantly by silt. This data shows that the hard bed in the southern portion of the reservoir is composed predominantly of peat, while the north is predominantly of clay or silt. This suggests that under the proposal drawdown scenario, much of the hard bed which will be exposed is likely to be composed of peat. Although there will be areas along the existing north and east lake margins composed of exposed coarse pebbles following drawdown of the reservoir.

To minimise downstream siltation and suspended solids in the reservoir, several measures should be put in place. Drawdown will be in stages to minimise silt remobilization. The initial pumping of water is unlikely to cause a sediment risk, due to low quantity of sediment within the lake. The fine sediment deposits will then be physically removed from the old channel, behind the dam to suitable location on site to reduce wash out of these deposits. Prior to drawdown, a sediment trap would be created downstream of the weir and managed until the dam removal work and bank reinstatement is complete. Silt will be exposed on the lake bottom and there is potential for an initial flush of silt downstream following exposure, which is likely to deposit downstream of the weir. This brings benefits in terms of natural habitat regeneration within the exposed lake bed and any silts will be caught by the sediment trap.

4.3 Peat coring

The results of the peat survey show that there are deposits of peat found on both the south-east and south-west margins of the reservoir. Of these, the south-west margin is the most extensive, with depths of peat up to 2.8m, although depths were mostly around 1.5m-2.3m. A break of slope appears to define the western limit of the peat; this is supported by the depth measurement taken at site 11 which shows peat depth rapidly shallowing closer to the slope. The south-east margin contains relatively shallow deposits of peat, around 0.11-0.65m in thickness, although close in to the reservoir peat depth

[32] Ricardo (2019) Llyn Anafon Decommissioning– SAC Compensation Plan

increased to 1.65m. This is reflected by the vegetation communities observed at the sampling sites with the shallower peat (<0.65m) associated with drier dwarf shrub heath communities (H12 *Calluna vulgaris-Vaccinium myrtillus* heath) and the deeper peat (1.19m to 2.8m) supporting bog/mire communities such as M19 - *Calluna vulgaris-Eriophorum vaginatum* blanket mire.

Peat humification varied across both sites. However, the south-western peat deposits exhibit higher maximum levels of humification than those of the south-eastern deposits indicating historically drier conditions.

No peat cores were taken south of the dam wall. However, visual observations of the outflow stream from the reservoir of cut soil due to river bank management suggested that there are deposits of peat in this area. It is possible that the peat deposits identified along the south-east and south-west banks, and within the reservoir, may extend to this area.

The reduction in lake level is likely to change the saturation of the deeper peat in the flat areas in the south-east (Site 5) and south-west (Sites 6-10) of the reservoir. This may result in changes to peat formation and condition with an increase in humification in these areas. However, as the peat formation occurred in this location prior to installation of the dam it is unlikely to significantly affect the structure and function of the peat in these areas. The exposure of the lake margin following draw-down will result in a step (approximately 50cm high) with exposed peat; this may result in localised drying of peat close to the existing lake margin. The exposed peat step will be susceptible to wind and rain erosion in the short term before vegetation establishes. The implications for the potential changes to the habitats associated with the peat deposits are addressed in Section 4.4. The peat present on the slopes above the lake level that supports dwarf shrub heath habitats is likely to be dependent on surface water and not the current lake level for maintaining the existing peat.

4.4 Botanical Survey

Acid grassland: unimproved (elements of neutral grassland)

Communities and sub-communities recorded:

- U4b / U4d - *Festuca ovina – Agrostis capillaris – Galium saxatile* grassland
- MG1e - *Arrhenatherum elatius* grassland
- MG8b – *Cynosurus cristatus - Carex panicea - Caltha palustris* grassland
- MG9 - *Holcus lanatus - Deschampsia cespitosa* damp pasture

Quadrats 1-5 lie within grassland on a stony bank along the northern lake margin. Patches of acid grassland are likely to be recently established since the underlying rock revetment was installed. Its composition is a mixture of acid and mesotrophic grassland types, perhaps reflective of the influence of road / pasture run-off and disturbance (trampling). If these habitats are drained and grazed, they are likely to convert to MG6 and species-poor U4 grassland.

Marshy grassland, Mire and Flush

Communities sub-communities recorded:

- M6 / M6c *Carex echinata - Sphagnum fallax/denticulatum mire, Juncus effusus* sub-community
- M19 / M19c - *Calluna vulgaris-Eriophorum vaginatum* blanket mire, *Vaccinium vitis-idaea-Hylocomium splendens* sub-community
- M23 - *Juncus effusus/acutiflorus-Galium palustre* rush-pasture

These communities typically lie along wet margins of dwarf shrub heath and acid grassland communities and indicate deep peat with acid to neutral soils and the dominance of common haircap moss indicates low to moderate levels of nutrient for mires. They are rain fed and kept wet throughout the year by flushing and seepage. If left to succeed to climax vegetation, M23 may initially support carr woodland with grey willow (*Salix cinerea*) and birch (*Betula* sp.), which is present as the occasional shrub around the lake margins, or *Alnus-Fraxinus-Lysimachia* woodland W7. Drainage of these communities is likely to lose sphagnum mosses and increase common haircap moss and grazing is likely to convert to acid grassland, such as U4.

Dwarf shrub heath

Communities and sub-communities recorded:

- H12 *Calluna vulgaris-Vaccinium myrtillus* heath
- H18 / H18a / H18c *Vaccinium myrtillus-Deschampsia flexuosa* heath

This community is typical of moist but free-draining soils over steeper slopes and can form the climax vegetation in mountain areas but can succeed to sessile oak woodland at lower altitudes.

Swamp and tall herb fen

Communities and sub-communities recorded:

- S10 *Equisetum fluviatile* swamp / S11c *Carex vesicaria* swamp, Carex-Equisetum sub-community / M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture

The head of the inflow stream flowed through an area of clear-fell plantation and some logs had been placed within the channel and feeder stream to the south-west. Therefore, the surrounding land had up to 50% bare ground and erosion of the stream was evident.

Coniferous plantation woodland / clear-fell

The clear-felled area shows signs of natural regeneration with typical species of the surrounding communities. The hardy and more drought tolerant species of moss are likely to colonise first, and grasses may come to dominate depending on levels of grazing. The quantity of brash may reduce light and re-colonisation rates; however, it does provide some deterrent from grazing. In the long-term, it is likely to revert to perhaps an H12 or H10 *Calluna vulgaris-Erica cinerea* dry heath community. The recently planted broadleaved trees/shrubs are typical of the native woodland climax community.

4.4.1 Recommendations

The drawdown has potential to impact on the peat habitats around the lake margins. The exposed west bank will sit 30-50cm above the exposed bed level and the edge habitat may dry out to some extent. This could alter the mire/wet dwarf shrub heath communities, as the peat dries out to favour drier heath communities. However, the Site is comprised of a mosaic of mire/wet and dry shrub heath; therefore, it is unlikely to substantially change the species composition. Furthermore, the communities include rain-fed soligenous mires and wetter community mosaics higher up the hill from the lake, therefore ground water level is not the main influence on habitat composition. The east bank is already exposed, as bank erosion from wave wash has left some sections of the bank c.2m above the summer lake levels. Despite this, the top of the bank still supports wet dwarf shrub heath communities, which further supports the likelihood of wet heath continuing along the west bank following drawdown. The possibility of some edge drying and loss of area of the wetter marshy communities along this edge cannot be ruled out entirely, and edge peat may break up and drop in level as it dries. However, the exposed lake bed will recolonise which will compensate for this loss in the long-term. Initially, the bed may colonise with a rush and grass dominated sward and within two years it is likely to be mostly vegetated. The lake sediment analysis indicates that the substrate that will be exposed in the southern and western parts of the reservoir are a thin layer of silt and sand over peat. This habitat is likely to succeed to mire and heath communities over time and seeding/planting is not proposed in order for the natural, local seed bank to take hold. Monitoring will determine the need for any management intervention, such as planting, seeding or turf relocation.

Commercial forestry will not replant the land to the south and east with conifers, which will have beneficial effects on the peat communities by reducing upstream water uptake. Grazing control measures will be assessed and informed through monitoring. Fencing should be installed if additional measures are required, if for example, this is favouring a grass dominated sward and hindering heathland regeneration. The NVC survey identified the signs of successful natural regeneration within an area of clear-fell plantation to the south-east of the lake, with species indicative of dry dwarf shrub heath communities (H12 *Calluna vulgaris-Vaccinium myrtillus* heath) and the pH and lake nutrient levels indicate the underlying peat will be suitable for regeneration to heath. Monitoring should be undertaken during the initial two years for any undesirable species and willow saplings should be removed to favour regeneration of heath.

The NVC surveys also identified the presence of self-sown spruce (*Picea* sp.) saplings with the heath and mire habitats. The saplings are from encroachment of the forestry plantations to the south and east

of the lake. The trees are non-native species and will negatively affect the heath and mire vegetation communities through shading and increased water use if left unmanaged. The self-sown trees will be removed as part of the terrestrial habitat management to stop succession into coniferous woodland.
The peat soils of the east shoreline have been eroded by wave wash and the unconsolidated gravel and shale in the current lake margins are unlikely to allow natural regeneration in the short and medium term. The sediment analysis shows that the substrate on the east of the lake close to the predicted lake margin following drawdown comprises soft fine sediment (silt and sand) over clay. However, the extents of the finer sediments in the area along the new shoreline are not clear. Occasional grey willow (*Salix cinerea*) lines the shore and provides some bank protection. It is possible that willow may colonise the exposed shore naturally; however, ground investigations should be undertaken following the trial drawdown to assess the potential for tree planting.

Natural regeneration of exposed shore habitats should be monitored through walkover botanical surveys three times a year in the first year, twice in the second year, and full NVC surveys annually in years 3 and 5. The botanical walkover will note the plant species and percentage cover (% bare ground), indicator species of typical NVC communities and any undesirable species e.g. willow, ruderals. Monitoring will inform the need for remedial measures, such as removal of undesirable species or the need for planting/seeding intervention if there are no signs of recolonisation or if the rate of colonisation is linked to water quality issues.

Creation of a temporary access track during the dam removal will be undertaken in an environmentally sensitive way. Existing peat or soils will be retained if possible or removed and stored to allow reinstatement of habitats following completion of the works. The Peat survey indicates that there are peat deposits west and south of the dam which may extend to the potential track route. The vegetation present along the access track route and the slope of the ground indicates that any peat present along the route is likely to be relatively thin (<1m, this has not been confirmed). Where possible the access track should be 'floated' on the peat to minimise excavation and disturbance to the soil structure and hydrological regime. However, it is recognised that excavation is likely to be required in some areas. The peat survey identified that the peat deposits on the west of Llyn Bran showed a relatively high degree of humification. High humification is associated with lower shear strength and reduces the feasibility of floating access tracks on peat. Habitat restoration of disturbed areas following removal of the access track will focus on natural regeneration to replicate the existing heath and mire communities. Regeneration will, as far as practicable, use stripped and stored soil and vegetation to restore the habitats. To enable this, the following mitigation will be required:

- Surface vegetation would be turf-cut and stored. The topsoil or peat which contains the seedbank will be stripped and stored in clearly defined stockpiles for the duration of the works. Due to the upland location and high rainfall at the site the stored material is unlikely to dry during autumn or winter if the access track is required for long periods over summer it is unlikely to be feasible to keep the vegetation sufficiently wet to ensure survival and additional restoration may be required.
- Soil horizons will be excavated where required and stored separately.
- Stockpiles will be located away from water courses to avoid sediment contamination.
- Any imported ballast material should be pH neutral; alkali material such as limestone or other stone which could affect the soil pH should not be used.
- Vegetation establishing on stockpiles should be monitored and controlled mechanically where required with no use of herbicides.
- Backfill following removal of the track will ensure soil and peat horizons are maintained through use of the separate stockpiles. Backfilled material will be appropriately profiled without excess compaction.
- All reinstated areas would subsequently be monitored for germination /regeneration over at least two full growing seasons as part of the CSMG surveys outlined for the exposed lake sediments.
- The proposed monitoring will be used to identify the requirement for additional intervention for vegetation restoration such as seeding or soil stabilisation techniques such as use of heather brash, geotextiles etc.
- Vegetation clearance should follow the mitigation outlined for breeding birds, reptiles, and water voles below.

4.5 Fish

The fish eDNA survey identified that Llyn Bran supports two species of fish: European perch and northern pike. European eel and salmonid fish were not detected by eDNA sampling so are presumed to be absent from the reservoir. There was no evidence that the reservoir had been stocked by non-native fish for angling that could have a negative impact on downstream fish communities.

The removal of the dam and reduction in lake level will result in a decrease in available marginal habitat; the reduction of shallow marginal habitats and reduction in area of aquatic macrophytes will result in a reduction in available spawning habitat for perch and pike. There is potential to affect fish communities present through pollution events or sediment run-off during the proposed decommissioning works which should be mitigated by undertaking the proposed works under a construction environmental management plan.

The reduction in water levels is unlikely to result in fish stranding or mass mortality as the level will be reduced over 2-3 years. The discontinuance of the reservoir would re-establish connectivity with the downstream surface waterbodies and will enable the movement of priority fish species, such as European eels (*Anguilla anguilla*), into Llyn Bran.

As the fish community within Llyn Bran contains no protected or notable species, mitigation requirements for the fish community are limited to standard pollution and sediment control measures during dam removal and river restoration works to the outflow.

4.6 Great crested newts

Great crested newts are highly unlikely to be present within Llyn Bran or the adjacent terrestrial habitats due to the absence of suitable breeding habitat within 250m of the Site.

No records of great crested newts were received from COFNOD for within 2km of the Site.
The three waterbodies identified within 250m of the Site, Llyn Bran and two drainage ditches, are unsuitable to support breeding great crested newts. Llyn Bran is considered unsuitable for breeding great crested newts due to the large size and population of predatory fish which mean that great crested newts are highly unlikely to be present.

The two drainage ditches were dry during the scoping survey. Due to the gradient of the ditches they only occasionally hold pools of water behind debris dams during wetter periods. Therefore, they are unsuitable for breeding great crested newts due to the isolation ephemeral nature of the waterbodies.

No further survey work or mitigation is required for great crested newts as part of this scheme.

4.7 Breeding birds

Data collected via the ornithological desk study identified 50 species within the wider environment, including species listed under Schedule 1 of the Wildlife and Countryside Act, Welsh priority species, red and amber listed species. The Site supports a high diversity of bird species with 38 recorded during the surveys in May and June 2019.

The desk study identified four species, common crossbill, fieldfare, hen harrier, and merlin, which are listed under Schedule 1 of the Wildlife and Countryside Act 1981 which makes it an offence to intentionally or recklessly disturb at, on or near an ‘active’ nest. These species were not recorded during the breeding bird surveys in 2019 but the Site contains suitable nesting habitat for crossbill, hen harrier and merlin. Fieldfare are typically winter migrants to the UK so are highly unlikely to be breeding at the Site. Hen harrier and merlin are known to nest on the ground in areas of heather moorland and heathland.

The most suitable habitats on Site for supporting breeding birds include the areas of mire and dwarf shrub heath, particularly to the north-east of the reservoir, the woodland strip to the west, and the conifer

plantations to the south-east or the reservoir. During the breeding bird surveys, these habitats showed the highest species diversity and levels of breeding behaviour such as singing or sightings of pairs of birds. Bird abundance and species diversity was lowest in the areas of clear-felled planation south-east of the reservoir.

The species identified as being present within the Site contain a number of ground nesting birds that utilise dwarf shrub heath or grassland for nesting including black-headed gull, lesser black-backed gull, meadow pipit, skylark, and wren. Other ground nesting species identified by the desk study and possibly present within the Site include hen harrier, merlin, curlew, and black grouse.

Four migratory species which may be breeding at the Site were identified during the surveys including: swallow (*Hirundo rustica*), common whitethroat (*Sylvia communis*), willow warbler (all arriving from southern Africa) and cuckoos (*Cuculus canorus*) (arriving from sub-Saharan Africa). These species typically arrive in the UK between April-May and typically leave between August-October. It has been discovered that nearly half of summer migrant species show long-term population declines within the UK[33] and therefore areas utilised by these species should be considered for enhancement or retention.

Swallows were observed nesting in both the Utility Building and Boat House during the bat emergence/re-entry surveys undertaken on the buildings.

It should be noted that, due to the location of the site, disturbance events found elsewhere such as dog walkers, pedestrians, cyclists, and noise from traffic are limited here, and therefore the birds present on Site are likely to be highly sensitive to noise and visual disturbance. The proposed works may result in increased level of disturbance compared to current baseline conditions to which birds are habituated. If this is the case, based on the above information, it is considered highly likely that disturbance and displacement of breeding species will occur as a result of construction works within the proposed works area if undertaken during the breeding season.

Outline mitigation measures to reduce the risk of adverse effects on breeding birds within the Site include:

- Vegetation clearance contractors to be given an ecology toolbox talk prior to site clearance work.
- Demolition of the Utility Building should only be undertaken between October-February to avoid the bird nesting season.
- Use of visual and acoustic barriers to minimise noise transmission and disturbance of surrounding habitats during dam removal.
- Vegetation clearance or tracking over with vehicles required for the access track creation and building demolition should ideally be undertaken outside of the bird breeding season (March to August) – the ideal time for such work is late September to February inclusive. Alternatively, if this is not possible, a thorough check for any nesting birds should be undertaken by a suitably qualified ecologist within 48 hours prior to works. If any active bird nests are found, then works with the potential to impact on the nest must cease and an appropriate buffer zone (minimum 5m radius) should be established until the young have fledged and the nest is no longer in use. Should any Schedule 1 species be identified nesting within or adjacent to the works areas, the mitigation will need to be reassessed with the buffer required dependant on the species present.

Wintering bird surveys have not been undertaken at Llyn Bran as part of the is study. The desk study identified the presence of migratory species that over winter in the UK (e.g. goldeneye and field fare) and resident species (e.g. black grouse, raven) which could use the site year round. None of the designated species identified by the desk study would be likely to be dependent on the lake habitat during winter. The reduction in lake size has potential to adversely affect wintering waterfowl at Llyn Bran. The upland location of the lake, relatively small size, and absence of adjacent grassland or

[33] RSPB (2014) The State of the UK's Birds

wetlands (marsh or flood plain grazing) mean that Llyn bran is unlikely to support significant populations of over wintering waterfowl. Wintering bird surveys are not considered necessary for the proposed scheme due the absence of special protected areas within 10km, limited value of the habitats for aggregations of wintering birds, proposed mitigation relating to disturbance, and terrestrial habitat restoration which will provide additional habitat for heathland species. There is no way to mitigate for the reduction in available open water habitat following lake drawdown and dam removal. However, there will not be a complete loss of open water habitat so the lake will still provide habitat for over wintering water birds following drawdown. The presence of large populations of wildfowl on the lake would be detrimental to the water quality objectives and macrophyte communities which are the driver behind the proposed re-naturalisation works to Llyn Bran.

4.8 Reptiles

The reptile surveys undertaken in 2019 identified that the habitats surrounding Llyn Bran support common lizards. Although the surveys undertaken were for presence/likely absence and not population estimate surveys the peak count of common lizards recorded was four which indicates that the Site supports a low population. No other reptile species were identified during the surveys; however, adders were identified as being present in the wider environment. Common lizards were predominantly recorded in the habitats to the west of the reservoir although one common lizard was recorded east of the reservoir. Therefore, common lizards are assumed to be present in all areas surrounding Llyn Bran but at low population densities.

Common lizard and adder are partially protected under the Wildlife and Countryside Act 1981 (as amended). Under this legislation it is an offence to intentionally kill, injure or take any reptile. Consequently, mitigation will be required during implementation of the proposed decommissioning works.

The proposed works, including building demolition, dam removal, access track creation, and plant movement, have the potential to kill and injure common lizard which have been confirmed within the site.

Due to the likely low population density present and the small area that will be directly affected during dam removal, trapping and removal of common lizards is not considered necessary.

Instead, it is considered that phased vegetation clearance (sometimes referred to as habitat manipulation) would be the most pragmatic and proportional approach to avoid impacts to the species:

- Clearance of vegetation (where required) should be undertaken during the active season for reptiles, between late April and September during suitably warm and dry conditions, to make the habitat unsuitable for reptiles. This should be overseen by an ecologist.
- Potential hibernacula (piles of stones, logs, etc.) should not be disturbed between November and March to avoid unnecessary disturbance during hibernation. The route of the proposed access track should be cleared of potential hibernacula under supervision of ECoW prior to phased clearance.
- The vegetation should first be cut to 15cm in height (being careful to avoid any ground impact), followed by a second cut to ground level after a period of 48 hours, with arisings removed from the works area to retained habitat and piled up in sunny locations near cover within DCWW's land ownership boundary to provide potential refuges.
- The vegetation should be cut working in the direction of the retained habitat. This will persuade any reptiles present to move of their own accord to adjacent habitat.
- Any animals found during clearance should be relocated to the adjacent retained habitat by the ecologist.
- Where plant movements and groundworks will occur, vegetation should then be kept short throughout the implementation period to keep the Site unsuitable for protected species. This would not require ecological supervision.
- Arisings from tree removal should be stacked in a safe area, outside of the construction zone, but within the ownership boundary, to create refuges for reptiles, amphibians, small mammals, and invertebrates.

Although the decommissioning works will cause short-term disturbance and temporary small-scale habitat loss, the reduction in lake level and revegetation of the newly exposed lake margins will result in an overall increase in available habitat for reptiles.

4.9 Badgers

The proposed scheme has negligible potential to affect any badger setts.

No setts or signs of badgers were identified within the Site or 30m of the site boundary. The majority of habitat surrounding the reservoir was wet dwarf shrub heath, dominated by heather and sphagnum. This provides minimal foraging opportunities for badger due to the dense wet vegetation and would provide difficult conditions for sett building. Due to the surrounding woodland outside of the Site providing more suitable habitat for badgers, it is unlikely badgers would utilise the site.

Due to the transitory nature of badgers, a pre-commencement walkover should be undertaken by a suitable qualified ecologist before any works start on site to confirm continued absence of badger setts.

4.10 Bats

No evidence of roosting bats was identified by the dusk emergence and dawn re-entry surveys at the Utility Building or Boat House. A total of four bat species were recorded foraging in the habitats surrounding the buildings: common pipistrelle, soprano pipistrelle, noctule, and an unidentified *Myotis* species likely to be Daubenton's bat based on the calls recorded and habitat. During the dusk emergence surveys at both buildings, bats were typically first recorded 40 minutes to one hour ten minutes after sunset. During the dawn re-entry survey at the Utility Building the last bat was recorded 40 minutes before sunrise. This indicates that the bats recorded foraging during the surveys do not roost close to the buildings as pipistrelle bats and noctules are early emerging species[34].

Should the proposed demolition works be deferred for a period in excess of 12 months from the date of this report, then it is recommended that the emergence and re-entry surveys be repeated on the Utility Building and Boat House.

As no bat roosts have been recorded, the scope of the mitigation requirements is limited to breeding birds. During the dusk emergence and dawn re-entry surveys, barn swallows (*Hirundo rustica*) were observed nesting in the Utility Building and Boat House. Consequently, demolition of the buildings should be undertaken outside of the nesting bird season (March-August inclusive). If the proposed works are undertaken within the breeding bird season, they must be checked for nesting birds by an ecologist within 24 hours prior to starting the works. If any bird nests are identified, then the work must be suspended until the young have fledged and left the nest.

If the Boat House building is retained, it could be improved to increase the suitability for roosting bats or nesting birds through installation of nest boxes. The nest boxes should be suitable for swallows as they currently use both buildings for nesting.

No activity surveys were undertaken at the Site as part of the ecological monitoring in 2019. However, activity levels and species diversity recorded during the emergence/re-entry surveys indicates that overall activity is low at the site. The high elevation, exposed open habitats, and surrounding coniferous woodland reduce the suitability of the Site for foraging bats. Therefore, it is considered unlikely that the lake and adjacent habitats are of high significance for large number of bats.

Noctule bats forage high over open habitats and whilst they will forage over rivers and lakes, they are not reliant on aquatic habitats. Common and soprano pipistrelle bats are associated with edge habitats such as woodland edges, rivers, and hedgerows. Soprano pipistrelles are more commonly recorded close to watercourses. Daubenton's bats are strongly associated with rivers and lakes where they forage by skimming insects off the surface.

[34] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

The proposed work is unlikely to significantly alter the suitability of the Site for foraging bats in the long-term as the lake will be retained (albeit smaller surface area), there will be an increase in water course length of reservoir outflow, and there will be a restoration of exposed terrestrial habitats following draw down. There is potential to disturb foraging bats during removal of the dam and buildings due noise and light from the proposed works if undertaken at night. Night working should be avoided where possible. If lighting is required at the site, it should be positioned to avoid illuminating sensitive habitats such as waterbodies or surrounding woodland edge.

4.11 Otter

Otters were confirmed to be present at Llyn Bran as otter spraints were identified on the reservoir margins and dam wall in August and September 2019. No evidence of otter holts, couches, or lay ups were identified during the surveys. As otter have a large home range, they are assumed to only occasionally utilise Llyn Bran for foraging and are likely to be more dependent on the larger downstream Llyn Brenig reservoir. This is also evidenced by the absence of field signs of otters during the initial survey in June 2019. The reservoir provides suitable foraging and feeding habitat whereas the outflow channel is likely to be used as commuting corridor for otter rather than a foraging resource.

As no otter holts or layups were identified during surveys is it predicted that impacts are likely to be limited to disturbance during the proposed works and loss of habitats.

Disturbance (both direct via noise and indirect from barriers in the channel) is the most significant consideration for this Proposed Scheme. In order to minimise this to an acceptable level, the following mitigation measures will be implemented.

A pre-construction check of habitats within 50m of the works should be undertaken to ensure the continued absence of any otter holts or couches that might be disturbed. If any such features are recorded during this check, construction work in the vicinity may require application for a mitigation licence from NRW and additional mitigation prior to and during dam decommissioning works; this could include, but not be limited to, amendments to construction methodology, timing and exact position of the works.

As otters are typically more active at night, there is to be no night working adjacent to the reservoir, dam, or reservoir outflow. There should be no generators used at night within 20m of the waterbodies, to minimise noise disturbance. Where fencing is required to protect members of the public, this should be designed to limit obstruction to otters commuting up the outflow to Llyn Bran.

It will not be possible to mitigate for the loss in foraging habitat due to the reduction in lake level and area. However, as the reservoir is isolated at the top of the catchment and connected to Llyn Brenig which contains a large suitable foraging area it is unlikely that otters present would be significantly adversely affected by the reduction in foraging habitat and food resource.

4.12 Water vole

Water vole activity including latrines, feeding remains and burrows was recorded during both surveys at Llyn Bran in 2019. The field signs indicate that water vole activity was highest on the west and north banks of the reservoir with activity also recorded along the reservoir outflow. No evidence of water vole activity was recorded along the eastern side of the reservoir, this is likely to be due to the lack of suitable habitat due to the high eroding banks and shallow margins. The habitats along most of the eastern bank are unsuitable for water voles due to the vertical nature of heavily eroded bank combined with dense clay/gravel matrix, lack of suitable food plants within 2m of banks, and shallow (<15cm) margins which don't provide adequate refuge from predation. A summary of the length of suitable water vole habitats around Llyn Bran and the reservoir outflow is shown in **Table 4.1**.

Table 4.1: Water voles habitat length summary

Existing habitat	Pre-works Length	Water vole present during surveys

Llyn Bran perimeter	1665m	-
Llyn Bran suitable water vole habitat	698m	Yes
Llyn Bran sub-optimal water vole habitat	440m	No
Llyn Bran unsuitable water vole habitat	527m	No
Outflow (surveyed reach) suitable habitat	187m	Yes
Outflow unsuitable habitat	29m	Yes
Inflow	N/A	No

The proposed works and reduction in lake level will result in a reduction in habitat availability for water voles. There is also a risk of disturbance and/or destruction of burrows and direct mortality from ground works, track creation, and plant movements during dam removal and associated decommissioning works.

The demolition of the Utility building is unlikely to adversely affect water voles due to the distance of the bank (>5m) and the lack of suitable habitat along the north-eastern reservoir banks adjacent to the building.

The reduction in lake levels will cause a long term reduction in habitat quality as the water recedes leaving bare ground between the habitats that contain the burrows and provide cover and feeding opportunities. Although the existing terrestrial habitats will remain, the increased distance to water will make the water voles present in these areas more susceptible to predation[35]. It is unlikely that terrestrial vegetation will establish on the exposed sediments at fast enough rate as the water recedes to ensure marginal habitats are still suitable to support water voles. The predicted lake margin following a reduction in level of 2.9m will be up to 70m from the existing water vole burrows identified on the west banks of the reservoir.

The reduction in lake level by 2.9m will result in the loss of 698m of suitable water vole habitat, 440m of sub-optimal water vole habitat, and 485m of habitat that is unsuitable for water voles. In addition, the river restoration works on the reservoir outflow have potential to result in temporary impacts to 187m of suitable water vole habitat. The existing and predicted length of suitable water vole habitat are shown in **Table 4.2** below.

Table 4.2: Water vole habitat loss/gain during lake draw-down

Habitat	Pre-works Length	Water vole present	Length following 2.9m reduction in water level[36]	Predicted length of suitable habitat (42% of perimeter of lake)	Change in habitat length	Change in suitable habitat
Llyn Bran perimeter	1665m	Yes (approx. 698m)	1013m – 1262m	424m-529m	403m – 652m reduction	169m-274m reduction
Outflow (surveyed reach)	216m	Yes (approx. 187m)	446m (including surveyed reach)	446m	230m increase	230m increase

[35] Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). The Water Vole Mitigation Handbook (*The Mammal Society Mitigation Guidance Series*). Eds Fiona Mathews and Paul Chanin. The Mammal Society, London.

[36] Range in lake perimeter length following a 2.9m reduction is due to the uncertainty as to what the perimeter shape for the remaining lake will be. The upper range is the perimeter based on a 1m grid resolution from the bathymetry data. The lower value was calculated using the simplify geometry function in Quantum GIS to reduce the complexity of the perimeter of the bathymetry data. The actual length is likely to be within this range but closer to the lower value.

Inflow (not surveyed)	N/A	No	30m	30m	30m increase	No net change
Net change in habitat					143m - 392m reduction	Between 44m decrease and 61m increase

There will be a net reduction in potential water vole habitat (lake perimeter and outflow length) of between 143m and 392m due to the predicted 2.9m reduction in water level following removal of the dam. However, this includes the loss of 527m of bank that is currently unsuitable for water voles and 440m of sub-optimal water vole habitat which contained no evidence of water vole activity during surveys in 2019.

If the proposed compensation activities to establish vegetation on the newly exposed substrate surrounding the remaining lake can provide suitable water vole habitat around the full lake perimeter there is potential to have a net increase of 575m of available water vole habitat following completion of the works. Water vole activity was identified on 42% of the existing lake perimeter with an additional 26% considered sub-optimal but with no confirmed presence. Therefore, taking a precautionary approach and assuming a similar proportion of the remaining lake can be restored to be suitable for water voles gives 424m-529m of suitable habitat and 267m-333m of sub-optimal habitat following a reduction in lake level of 2.9m. There is predicted to be an overall reduction in available habitat of between 143m - 392m. The net change in habitat suitable to support water voles is predicted to be between a 44m decrease and 61m increase (for both lake perimeter and restored outflow)[37].

The proposed habitat restoration works to restore terrestrial habitats on newly exposed lake substrates will not be completed or sufficiently established on the margins until after the lake drawdown is completed which is predicted to take 2-3 years. Therefore, there will be medium-term impacts (2-3 years) to water voles during drawdown that will require mitigation despite a potential for overall net gain in available habitat for water voles.

Water voles will need to be trapped and removed from Llyn Bran under a conservation licence prior to commencing the proposed decommissioning works and the proposed trial draw down. The trapped water voles could be translocated to a suitable receptor site and prevented from re-entering the Llyn Bran. The receptor site should ideally be located with the same catchment to maintain to local population. Water voles are territorial, so the receptor site needs to not have an existing water vole population, or it should have spare carrying capacity to support the additional water voles removed from Llyn Bran.

The walkover of the reservoir outflow identified that it contained 380m suitable habitat, excluding the reach immediately downstream of the outfall confirmed as supporting water voles during the surveys in June and August 2019. Most of the suitable habitat is situated between the forestry track and the B4501. The stream in this area is typical of water vole habitat in upland areas with narrow moorland streams bordered by grasses and soft rush. The long-term suitability of the habitat could be improved by removing the immature coniferous trees to the west of the stream that are encroaching on the corridor of open habitat. This land is owned by Natural Resources Wales and permission would be needed to use this area as a receptor site. Prior to translocating to this area, a survey would need to be undertaken to assess the current status of water voles. The use of the downstream water course as a receptor site would allow eventual natural re-colonisation of the lake by water voles following completion of the habitat restoration works.

The proposed restoration of the reservoir in-flow stream will create additional suitable habitat for water voles. Debris dams will raise the water level and decrease the water velocity in the deep section of the channel and will increase the availability of suitable food plants. Translocation of suitable marginal plants to support water voles will be undertaken if not establishing as informed by the vegetation monitoring schedule.

If a suitable receptor site cannot be found, water voles could be trapped (under licence from NRW) and kept in captivity until the vegetation restoration on the outflow and lake perimeter has established sufficiently to allow re-introduction. This would require specialist care and breeding of the water vole population for approximately 3-4 years. Water vole life spans are typically 2-3 years in captivity so a breeding programme would be required to ensure there no reduction in the population to be re-introduced to the site following completion of the works.

Due to the presence of water vole burrows in the outflow below the dam and the predicted impacts to the water vole population during drawdown of Llyn Bran, a conservation licence from Natural Resources Wales will be required to undertake the proposed decommissioning works. The following mitigation is proposed to minimise the potential impacts to water voles:

- A Conservation Licence will be required from Natural Resources Wales to undertake the proposed decommissioning works. This should cover translocation of water voles to a receptor site or removal and a captive breeding programme to allow later reintroduction. NRW should be consulted to confirm their preferred approach. Permission would be required from NRW to use the downstream outfall as a receptor site as it is on NRW-owned forestry land.
- Water voles should be displaced from the outflow channel prior to installation of the sediment trap and dam removal to avoid damage to active burrows or killing/injuring water voles. Displacement should be done under licence using phased strimming of vegetation to temporarily reduce the suitability of the habitat in line with the methodology outlined in the Water Vole Mitigation Handbook[38]. This methodology can only be used on a 50m section of watercourse.
- Works required to create the access track and remove the dam wall which require works within 15m of the reservoir outflow channel should be completed under a working method statement to ensure compliance with conditions of the Conservation Licence (to be agreed with NRW).

As water voles will need to be taken into captivity and released at an offsite receptor site or re-introduced following establishment of vegetation. Post completion monitoring will be required as part of the conservation licence in order to confirm successful establishment of released population. The success of the habitat creation/restoration will be undertaken as identified in Section 4.4.

In line with the current best practice guidelines the post-release monitoring should comprise of annual field sign surveys and habitat assessment (at the release site either Llyn Bran or reservoir outfall) for four years (during the breeding season with each survey at a consistent time of year). Post-release trapping should also be undertaken after release to assess the survival, breeding condition and juvenile presence in late September in the year of release.

4.13 Invertebrates

The records of protected and notable species received from Cofnod identified seven priority species listed under section 7 of the Environment (Wales) Act 2016. In addition to two Nationally Scarce species including on aquatic species. The notable or designated invertebrate species identified are considered to be unlikely to be significantly affected by the proposed works. The seven species of moth and butterfly that are of Principle Importance are dependent on terrestrial habitats and will be adversely affected by the reduction in lake size following drawdown. Several of notable species are dependent on heathland plants or habitats. As these habitats will increase in area following drawdown and implementation of the identified mitigation here will be an over net gain in available habitat for these species. The short term habitat loss/disturbance during the proposed works is not considered significant enough to require specific mitigation beyond that recommended for other protected species. The notable aquatic species (*Amphinemura standfussi*) is potentially susceptible to increased sedimentation if present in the reservoir outflow stream. However, the general sediment and pollution control measures identified above will provide adequate mitigation to prevent adverse impacts to this species. The re-connectivity of Llyn Bran with the outflow stream and more natural flow regime will benefit aquatic invertebrates downstream of the reservoir. Although there will be a reduction in the available habitat for the aquatic invertebrate communities present within Llyn Bran there will be an increase in habitat quality due to

[38] Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016) The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series) Eds Fiona Mathews and Paul Chanin. The Mammal Society, London.

increased water quality from increased flushing rates following dam removal and as a result of the above water quality mitigation measures.

Although the desk study identified the presence of designated and notable invertebrate species within the wider environment No dedicated monitoring for terrestrial or aquatic invertebrates are recommended due to the lack of adverse impacts predicted as a result of the proposed works.

4.14 Summary

Table 4.3: Environmental survey summary

Receptor	Legislation	Summary
Water quality	Water Framework Directive 2000/60/EC	During 2019, Llyn Bran has met the CSMG targets for dissolved oxygen, pH, nitrogen, and total phosphorus. However, previous monitoring in 2018 showed the lake was failing due to elevated phosphorus concentrations.
Lake sediments	Water Framework Directive 2000/60/EC	Particle size distributions of the soft (unconsolidated) bed sediment are dominated by sand and silt. The hard bed in the southern portion of the reservoir is composed predominantly of peat, while the north is predominantly of clay or silt. The marginal sites are predominantly characterised by coarse pebbles, while sites further from the margins are have a substrate of sand and silt.
Peat coring	Environment (Wales) Act 2016	Peat deposits are present in the south-east and south-west margins of the reservoir. The peat is deepest south-west of the reservoir with depths up to 2.8m. The deep areas of peat were on flat areas and close to the lake level and were associated with blanket bog/mire vegetation. The shallow peat is present on sloping areas and is associated with dwarf shrub heath communities.

Table 4.4: Ecology survey results summary

Receptor	Relevant Legislation	Status on site
Habitats	Environment (Wales) Act 2016	The habitats within the site include unimproved acid grassland, marshy grassland, blanket mire, dwarf shrub heath, swamp and tall herb fen, and coniferous plantation woodland. The Site predominantly comprises a mosaic of mire, wet, and dry shrub heath. The communities include wet mires which are likely to be influenced by the current lake level and rain-fed soligenous mires and wetter community mosaics higher up the hill from the lake.
Fish	Water Framework Directive 2000/60/EC	Llyn Bran support a community comprising European perch and northern pike. No protected or notable species were identified in the reservoir.
Great crested newts	Conservation of Habitats and Species Regulations 2019, Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	Likely absent from the site due to absence of suitable breeding habitat within 250m.
Breeding birds	Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	The Site supports bird communities typically associated with moorland/heath, plantation coniferous woodland, and open water. The species recorded at the Site include five red-list and eight

Receptor	Relevant Legislation	Status on site
		amber-listed species, and four species listed under the Environment Wales Act. Four Schedule 1 species were identified in the desk study from within 2km of the Site: hen harrier, merlin, common crossbill, and fieldfare.
Reptiles	Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	The dwarf shrub heath and grassland habitats surrounding Llyn Bran supports a low population of common lizard (*Zootoca vivipara*). Adder (*Vipera berus*) were not identified during surveys but are assumed to be present in low numbers due to suitable habitat and presence in wider environment.
Badgers	Wildlife and Countryside Act 1981, Protection of Badgers Act 1992	Likely absent from the site, no evidence of badger activity during survey in 2019.
Bat roosts	Conservation of Habitats and Species Regulations 2019, Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	No bat roosts were identified in the Utility Building or Boat House during surveys in 2019. Low levels of activity were recorded during emergence/re-entry surveys comprising low numbers of commoner species. Dedicated activity surveys are not considered necessary to inform the required mitigation for this scheme.
Otter	Conservation of Habitats and Species Regulations 2019, Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	Otter activity was confirmed at Llyn Bran during surveys in 2019. No evidence of otter holts, couches, or lay ups was identified.
Water voles	Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	Water voles were identified as being present at Llyn Bran. Water vole activity was concentrated on the west and north-western banks of the reservoir and the reservoir outflow.
Invertebrates	Environment (Wales) Act 2016	The records of protected and notable species received from Cofnod identified seven priority species listed under Section 7 of the Environment (Wales) Act 2016 with 2km of the Site. Two nationally scarce species were also identified.

Table 4.5: Mitigation summary

Receptor	Mitigation required	Timing
Water quality and lake sediments	Sediment management through: creation of a sediment trap in the reservoir outflow, phased drawdown and dam removal, CEMP, movement of deep sediments behind dam (if required). Restoration of reservoir inflow channel. Creation of a buffer to reduce run off rates from livestock pasture north of the reservoir. Ongoing water quality monitoring to confirm baseline WFD status prior to works.	Pre commencement monitoring and creation of a sediment trap and buffer. Sediment management and monitoring during works. Post works monitoring.

Receptor	Mitigation required	Timing
Habitats and peat	Natural regeneration of exposed shore habitats and restored watercourse should be monitored through walkover botanical surveys three times a year in the first year, twice in the second year, and full NVC surveys annually in years 3 and 5. Restoration of habitats and soils along access track route. Management of self-sown coniferous trees from heath and mire habitats	During construction of the access track and post works monitoring.
Fish	Pollution and sediment control measures.	During dam decommissioning works
Great crested newts	No mitigation required not present within the Site.	N/A
Breeding birds	• Avoid removal of vegetation or building demolition during breeding bird season (March to August inclusive). • Where this is not possible, check for breeding birds a maximum of 48 hours before starting clearance/disturbance. • Visual barrier between works and adjacent habitats (where possible) to limit disturbance to breeding birds. • Restoration of terrestrial habitats following removal of temporary haul road.	Pre-commencement survey 48 hours prior to each section of decommissioning works affecting vegetation or structures.
Reptiles	• Displacement of reptiles from access tracks and works areas prior to commencing. • Removal of potential hibernacula (where required) outside of the hibernation period. • ECoW during vegetation removal and tool box talk. • Restoration of terrestrial habitats following removal of temporary haul road.	Prior to starting track creation or tracking vehicles.
Badgers	No mitigation required - not present within the Site.	N/A
Bats	Building demolition undertaken during winter November-February inclusive to avoid potential risk to roosting bats and nesting birds. Avoid night time working where possible. If required avoid light spill onto sensitive areas such as waterbodies and woodland.	During building demolition and dam removal works.
Otter	Avoid night-time working to limit disturbance. Maintain habitat connectivity during dam removal and river restoration.	During dam decommissioning works.
Water voles	• Avoid night-time working. • Pre-works checks for water vole burrows. • Displacement of water voles from outflow channel within 15m of works area prior to commencing works. • Application of conservation licence to trap and remove water voles from lake.	Pre-commencement (licence application) and during decommissioning works, post completion monitoring following re-introduction.

Receptor	Mitigation required	Timing
	• Identification and restoration (if required) of a receptor site. • Restoration of outflow channel following drawdown. • Restoration of inflow channel. • Re-establish vegetation on exposed sediments following drawdown. • Monitoring following re-introduction/ removal of fencing.	
Invertebrates	• Water quality and sedimentation mitigation as identified as above. • Restoration of terrestrial habitats following completion of the works as identified above.	No specific mitigation covered by habitat and water quality mitigation.

Appendix A: Relevant legislation and policy

The Wildlife & Countryside Act 1981 (as amended)

Provides for **designation** and protection of Sites of Special Scientific Interest (SSSI), which are areas that represent the most valuable habitats in the UK for nature conservation.

The Act creates the following **offences:**

- To intentionally kill, injure, or take any wild bird or their eggs or nests (with exception to species listed in Schedule 2). Special penalties are available for offences related to birds listed on Schedule 1, for which there are additional offences of disturbing these birds at their nests, or their dependent young.
- To intentionally or recklessly kill, injure, or take, possess, or trade in any wild animal listed in Schedule 5, and intentionally or recklessly interfere with places used for shelter or protection, or disturb animals occupying such places.
- Certain methods of killing, injuring, or taking wild animals listed in Schedule 6.
- To pick, uproot, trade in, or possess (for the purposes of trade) any wild plant listed in Schedule 8, and prohibits the unauthorised intentional uprooting of such plants.
- The release of certain non-native animals and planting of plants listed in Schedule 9.

It also provides a mechanism making any of the above offences legal through the granting of licences by the appropriate authorities.

The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019

The principal means by which the European Habitats Directive is transposed in England and Wales.

Provide for the **designation** and protection of a network of 'European Sites' (also termed Natura 2000), including Special Areas of Conservation (SAC) and Special Protection Areas (SPA).

Regulation 43 creates the following offences relating to European Protected Species (EPS):

- deliberately capture, injure or kill any wild animal of a European Protected Species;
- deliberately disturb animals of any such species in such a way as to be likely to:
    - impair their ability to survive, breed, rear or nurture their young, hibernate or migrate, or
    - significantly affect the local distribution or abundance of the species to which they belong;
- deliberately take or destroy the eggs of such an animal; or
- damage or destroy a breeding site or resting place of such an animal.

The Regulations also make it an offence (subject to exceptions) to deliberately pick, collect, cut, uproot, destroy, or trade in the plants listed in Schedule 5.

However, the actions listed above can be made lawful through the granting of licences (European Protected Species Licence) by the appropriate authorities (Natural England in England). Licences may be granted for a number of purposes, but only after the appropriate authority has determined that the following regulations are satisfied:

- the works under the licence are being carried out for the purposes of ‘preserving public health and public safety, or for other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment’.
- there is ‘no satisfactory alternative’
- the action 'will not be detrimental to the maintenance of the population of the species concerned at favourable conservation status in their natural range'.

To apply for a licence, the following information is required:

- The species concerned.
- The relative size of the population at the site (note this may require a survey to be carried out at a particular time of the year).

- The impact(s) (if any) that the development is likely to have upon the populations.
- What measures will be conducted to mitigate for the impact(s).

Environment (Wales) Act 2016

Interim list adopted from and replacing previous list under Section 42 of the Natural Environment & Rural Communities (NERC) Act 2006.

Section 7 requires the Welsh Ministers to prepare and publish a list of the living organisms and types of habitat which in their opinion are of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales.

The Act requires all public authorities, when carrying out their functions in Wales, to seek to "maintain and enhance biodiversity" where it is within the proper exercise of their functions. In doing so, public authorities must also seek to "promote the resilience of ecosystems". This duty applies to public authorities such as the Welsh Ministers, local authorities, public bodies and statutory undertakers.

The Protection of Badgers Act 1992

This makes it an offence to wilfully kill, injure, take, possess or cruelly ill-treat a badger, or to attempt to do so and to intentionally or recklessly interfere with a sett. Sett interference includes disturbing badgers whilst they are occupying a sett, as well as damaging or destroying a sett or obstructing access to it.

Under Section 10 (1)(d) of the Protection of Badgers Act 1992, a licence may be granted by Natural England to interfere with a badger sett for the purpose of development, as defined by Section 55(1) of the Town & Country Planning Act 1990.

The Wild Mammals (Protection) Act 1996

The Wild Mammals (Protection) Act 1996 makes it an offence for any person to mutilate, kick, beat, nail or otherwise impale, stab, burn, stone, crush, drown, drag or asphyxiate any wild mammal with intent to inflict unnecessary suffering.

National Planning Policy Framework

The NPPF was published in March 2012 and was revised and updated in July 2018, relevant sections are identified below (although full details should be considered):

Section 15 of the NPPF relates specifically to "Conserving and Enhancing the Natural Environment". Paragraph 170 states that "Planning policies and decisions should contribute to and enhance the natural and local environment by:

A) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);
B) recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland;
C) maintaining the character of the undeveloped coast, while improving public access to it where appropriate;
D) minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;
E) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;
F) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate."

Paragraph 171 states that Plans should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework; take a strategic approach to maintaining and enhancing networks

of habitats and green infrastructure; and plan for the enhancement of natural capital at a catchment or landscape scale across local authority boundaries

Paragraph 174 states that: To protect and enhance biodiversity and geodiversity, plans should:

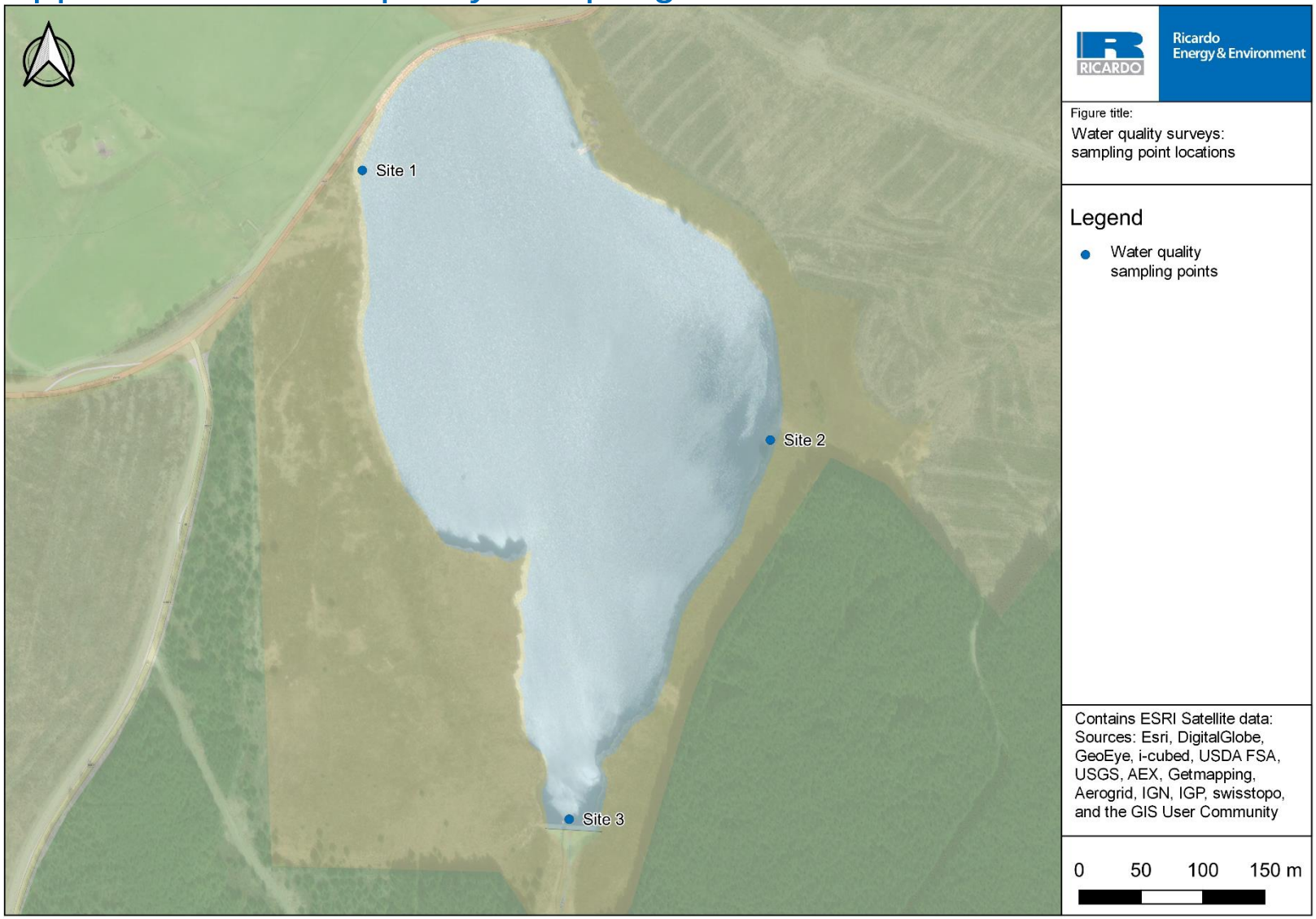
A) Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation; and
B) promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity.
C) Paragraph 175 states: When determining planning applications, local planning authorities should apply the following principles:
D) if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;
E))development on land within or outside a Site of Special Scientific Interest, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. The only exception is where the benefits of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of Sites of Special Scientific Interest;
F) development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) should be refused, unless there are wholly exceptional reasons and a suitable compensation strategy exists; and
G) development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to incorporate biodiversity improvements in and around developments should be encouraged, especially where this can secure measurable net gains for biodiversity.

Paragraph 176 states: The following should be given the same protection as habitats sites:
potential Special Protection Areas and possible Special Areas of Conservation;

A) listed or proposed Ramsar sites; and

B) sites identified, or required, as compensatory measures for adverse effects on habitats sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites.

Appendix B:Water quality sampling locations



Appendix C: Sediment sampling results

Table Appendix C: Llyn Bran sediment sampling results received from National Laboratory services: Sites 1 - 5

Analyte	*Units*	Site 1 19-JUN-19 09:05	Site 2 19-JUN-19 09:45	Site 3 19-JUN-19 11:21	Site 4 19-JUN-19 12:04	Site 5 19-JUN-19 12:30
Nitrite: Dry Wt as N	mg/kg	<0.9	<0.5	<0.5	<0.3	<0.3
Nitrogen: Total Oxidised: Dry Wt as N	mg/kg	37	<20	<20	<8	<8
Orthophosphate: Dry Wt as P	mg/kg	57	33	27	8.1	8.7
pH: Solid sample	pH Units	7.4	7	6.8	6.7	6.7
Nitrate: Dry Wt as N	mg/kg	<37	<20	<20	<8.0	<8.0
Sorting Coefficient	Unitless	1.68	1.62	1.72	1.76	1.68
Particle Diameter: Median	mm	0.195	0.106	0.0958	0.0896	0.0958
Grain Size Inclusive Mean	mm	0.19	0.0893	0.08	0.0791	0.0823
Particle Diameter: Mean	mm	0.35	0.144	0.136	0.201	0.143
Kurtosis	Unitless	1.17	1.14	1.08	1.19	1.12
Grain Size Inclusive Kurtosis	mm	0.443	0.455	0.471	0.438	0.461
Inclusive Graphic Skewness:- {SKI}	Unitless	-0.0893	-0.274	-0.257	-0.171	-0.231
Grain Size Fraction: < 0.98 microns: {>10 phi}	%	0	0.04	0.12	0.207	0.14
Grain Size Fraction: 0.98 to 1.38 microns: {10 to 9.5 phi}	%	0	0.12	0.22	0.266	0.22
Grain Size Fraction: 1.38 to 1.95 microns: {9.5 to 9 phi}	%	0.00966	0.23	0.3	0.334	0.279
Grain Size Fraction: 1.95 to 2.76 microns: {9 to 8.5 phi}	%	0.174	0.43	0.53	0.551	0.489
Grain Size Fraction: 2.76 to 3.91 microns: {8.5 to 8 phi}	%	0.386	0.8	0.979	0.964	0.878
Grain Size Fraction: 3.91 to 5.52 microns: {8 to 7.5 phi}	%	0.541	1.14	1.4	1.32	1.24
Grain Size Fraction: 5.52 to 7.81 microns: {7.5 to 7 phi}	%	0.734	1.58	1.93	1.79	1.71
Grain Size Fraction: 7.81 to 11.1 microns: {7 to 6.5 phi}	%	0.966	2.09	2.54	2.34	2.28
Grain Size Fraction: 11.1 to 15.6 microns: {6.5 to 6 phi}	%	1.26	2.71	3.21	3	2.93
Grain Size Fraction: 15.6 to 22.1 microns: {6 to 5.5 phi}	%	1.8	3.72	4.29	4.13	4.05
Grain Size Fraction: 22.1 to 31.3 microns: {5.5 to 5 phi}	%	2.4	4.76	5.4	5.49	5.31
Grain Size Fraction: 31.3 to 44.2 microns: {5 to 4.5 phi}	%	3.14	5.84	6.55	7.2	6.77
Grain Size Fraction: 44.2 to 62.5 microns: {4.5 to 4 phi}	%	4.47	7.74	8.34	9.57	8.84
Grain Size Fraction: 62.5 to 88.4 microns: {4 to 3.5 phi}	%	6.94	11	11	12.3	11.6

Analyte	*Units*	Site 1 19-JUN-19 09:05	Site 2 19-JUN-19 09:45	Site 3 19-JUN-19 11:21	Site 4 19-JUN-19 12:04	Site 5 19-JUN-19 12:30
Grain Size Fraction: 88.4 to 125 microns: {3.5 to 3 phi}	%	10.3	14.6	13.7	14	14
Grain Size Fraction: 125 to 177 microns: {3 to 2.5 phi}	%	13.1	15.8	14.2	13.1	14.1
Grain Size Fraction: 177 to 250 microns: {2.5 to 2 phi}	%	13.4	12.8	11.4	9.44	11.1
Grain Size Fraction: 250 to 354 microns: {2 to 1.5 phi}	%	12.1	8.09	7.31	5.63	7.17
Grain Size Fraction: 354 to 500 microns: {1.5 to 1 phi}	%	9.74	3.99	3.92	3.18	3.85
Grain Size Fraction: 500 to 707 microns: {1 to 0.5 phi}	%	7.53	1.81	1.99	2.16	1.99
Grain Size Fraction: 707 to 1000 microns: {0.5 to 0 phi}	%	4.96	0.61	0.6	1.17	0.709
Grain Size Fraction: >1000 microns: {<0 phi}	%	6	0.0984	0.0711	1.92	0.243
Grain Size Fraction: <1000 microns: {>0 phi}	%	94	99.9	99.9	98.1	99.8
Grain Size Fraction: 1000 to 1400 mic: {0 to -0.5phi}	%	2.84	0.0246	0.0237	0.29	0.0629
Grain Size Fraction: 1400 to 2000 mic: {-0.5 to -1.0phi}	%	1.65	0.0369	0.0237	0.346	0.0449
Grain Size Fraction: 2000 to 2800 mic: {-1.0 to -1.5phi}	%	0.783	0.0123	0.0119	0.498	0.027
Grain Size Fraction: 2800 to 4000 mic: {-1.5 to -2.0phi}	%	0.35	0.0123	0.0119	0.359	0.0449
Grain Size Fraction: 4000 to 5600 mic: {-2.0 to -2.5phi}	%	0.33	0.0123	0	0.0063	0.00899
Grain Size Fraction: 5600 to 8000 mic: {-2.5 to -3.0phi}	%	0	0	0	0.113	0.0539
Grain Size Fraction: 8000 to 11200 mic: {-3.0 to -3.5phi}	%	0	0	0	0.271	0
Grain Size Fraction: 11200 to 16000 mic: {-3.5 to -4.0phi}	%	0.0412	0	0	0.0378	0
Grain Size Fraction: 16000 to 22400 mic: {-4.0 to -4.5phi}	%	0	0	0	0	0
Grain Size Fraction: 22400 to 31500 mic: {-4.5 to -5.0phi}	%	0	0	0	0	0
Grain Size Fraction: 31500 to 45000 mic: {-5.0 to -5.5phi}	%	0	0	0	0	0
Grain Size Fraction: 45000 to 63000 mic: {-5.5 to -6.0phi}	%	0	0	0	0	0
Grain Size Fraction: > 63000 microns: {< -6.0 phi}	%	0	0	0	0	0
Particle Size Report	Text	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.

Analyte	*Units*	Site 1 19-JUN-19 09:05	Site 2 19-JUN-19 09:45	Site 3 19-JUN-19 11:21	Site 4 19-JUN-19 12:04	Site 5 19-JUN-19 12:30
Dry Solids @ 30°C	%	12.7	20.8	19	37.4	25.2
Accreditation Assessment	No.	2	2	2	2	2
Additional Material Present	Text	Plant material	Plant material	Plant material	Plant material	Plant material
Drying Method	Text	Air dried at 30°C	Air dried at 30°C	Air dried at 30°C	Air dried at 30°C	Air dried at 30°C
Rejected Matter Description	Text	No material removed	No material removed	No material removed	No material removed	No material removed
Sample Colour	Text	Black	Black	Black	Brown	Brown
Sample Matrix	Text	Clay Sediment	Clay Sediment	Clay Sediment	Clay Sediment	Clay Sediment
Sample Preparation	Text	Homogenised & Left as received	Homogenised & Left as received	Homogenised & Left as received	Homogenised & Left as received	Homogenised & Left as received

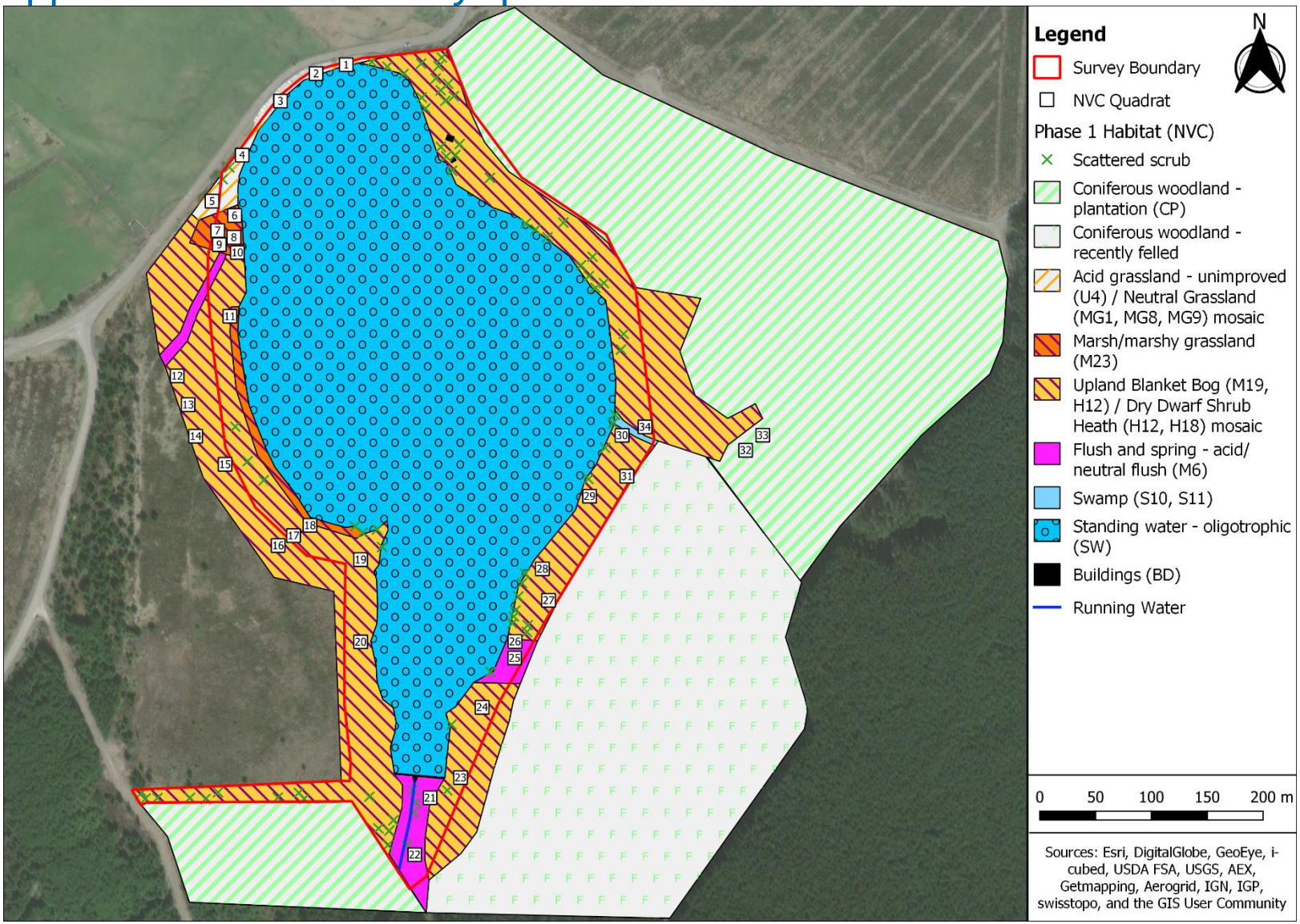
Table Appendix C: Llyn Bran sediment sampling results received from National Laboratory services: Sites 7 -11

Analyte	*Units*	Site 7 19-JUN-19 13:01	Site 8 19-JUN-19 13:29	Site 9 19-JUN-19 14:22	Site 10 19-JUN-19 15:07	Site 11 19-JUN-19 15:27
Nitrite: Dry Wt as N	mg/kg	<0.7	<1	<0.8	<0.9	<0.6
Nitrogen: Total Oxidised: Dry Wt as N	mg/kg	<20	<30	<20	<30	<20
Orthophosphate: Dry Wt as P	mg/kg	12	23	18	39	68
pH: Solid sample	pH Units	6.3	6.3	6.2	6.5	6.4
Nitrate: Dry Wt as N	mg/kg	<20	<30	<20	<30	<20
Sorting Coefficient	Unitless	1.84	1.84	1.77	1.46	1.62
Particle Diameter: Median	mm	0.162	0.149	0.169	0.139	0.12
Grain Size Inclusive Mean	mm	0.146	0.142	0.159	0.125	0.104
Particle Diameter: Mean	mm	0.37	0.376	0.365	0.193	0.163
Kurtosis	Unitless	1.09	1.11	1.23	1.24	1.11
Grain Size Inclusive Kurtosis	mm	0.469	0.463	0.428	0.423	0.462
Inclusive Graphic Skewness:- {SKI}	Unitless	-0.164	-0.0968	-0.0874	-0.208	-0.249
Grain Size Fraction: < 0.98 microns: {>10 phi}	%	0	0	0	0	0
Grain Size Fraction: 0.98 to 1.38 microns: {10 to 9.5 phi}	%	0	0	0	0	0
Grain Size Fraction: 1.38 to 1.95 microns: {9.5 to 9 phi}	%	0.0872	0.0967	0.0189	0.02	0.17
Grain Size Fraction: 1.95 to 2.76 microns: {9 to 8.5 phi}	%	0.3	0.31	0.246	0.24	0.39
Grain Size Fraction: 2.76 to 3.91 microns: {8.5 to 8 phi}	%	0.581	0.59	0.473	0.46	0.729
Grain Size Fraction: 3.91 to 5.52 microns: {8 to 7.5 phi}	%	0.843	0.832	0.672	0.66	1.04
Grain Size Fraction: 5.52 to 7.81 microns: {7.5 to 7 phi}	%	1.16	1.13	0.917	0.93	1.43
Grain Size Fraction: 7.81 to 11.1 microns: {7 to 6.5 phi}	%	1.55	1.48	1.2	1.25	1.87
Grain Size Fraction: 11.1 to 15.6 microns: {6.5 to 6 phi}	%	2.01	1.87	1.56	1.69	2.37
Grain Size Fraction: 15.6 to 22.1 microns: {6 to 5.5 phi}	%	2.75	2.56	2.21	2.45	3.21
Grain Size Fraction: 22.1 to 31.3 microns: {5.5 to 5 phi}	%	3.54	3.49	2.98	3.26	4.2
Grain Size Fraction: 31.3 to 44.2 microns: {5 to 4.5 phi}	%	4.41	4.81	3.91	4.17	5.48
Grain Size Fraction: 44.2 to 62.5 microns: {4.5 to 4 phi}	%	5.8	6.7	5.41	5.95	7.45
Grain Size Fraction: 62.5 to 88.4 microns: {4 to 3.5 phi}	%	7.94	9.02	7.9	9.48	10.2
Grain Size Fraction: 88.4 to 125 microns: {3.5 to 3 phi}	%	10.3	11.1	11	14.3	13.1
Grain Size Fraction: 125 to 177 microns: {3 to 2.5 phi}	%	11.8	12.1	13.3	17.4	14.7

Analyte	Units	Site 7 19-JUN-19 13:01	Site 8 19-JUN-19 13:29	Site 9 19-JUN-19 14:22	Site 10 19-JUN-19 15:07	Site 11 19-JUN-19 15:27
Grain Size Fraction: 177 to 250 microns: {2.5 to 2 phi}	%	11.8	11.3	13.2	15.7	13.5
Grain Size Fraction: 250 to 354 microns: {2 to 1.5 phi}	%	11	9.8	11.3	10.8	10.4
Grain Size Fraction: 354 to 500 microns: {1.5 to 1 phi}	%	9.44	7.98	8.53	5.8	6.16
Grain Size Fraction: 500 to 707 microns: {1 to 0.5 phi}	%	7.02	6.22	6.01	3.13	2.74
Grain Size Fraction: 707 to 1000 microns: {0.5 to 0 phi}	%	3.73	3.87	3.11	1.64	0.639
Grain Size Fraction: >1000 microns: {<0 phi}	%	3.99	4.75	6.04	0.676	0.1
Grain Size Fraction: <1000 microns: {>0 phi}	%	96	95.2	94	99.3	99.9
Grain Size Fraction: 1000 to 1400 mic: {0 to -0.5phi}	%	0.643	0.883	1.96	0.248	0.0431
Grain Size Fraction: 1400 to 2000 mic: {-0.5 to -1.0phi}	%	0.685	0.988	1.44	0.203	0.0287
Grain Size Fraction: 2000 to 2800 mic: {-1.0 to -1.5phi}	%	0.415	0.694	0.832	0.135	0.0144
Grain Size Fraction: 2800 to 4000 mic: {-1.5 to -2.0phi}	%	0.498	0.589	0.684	0.0676	0.0144
Grain Size Fraction: 4000 to 5600 mic: {-2.0 to -2.5phi}	%	0.498	0.526	0.721	0	0
Grain Size Fraction: 5600 to 8000 mic: {-2.5 to -3.0phi}	%	1.22	0.736	0.185	0.0225	0
Grain Size Fraction: 8000 to 11200 mic: {-3.0 to -3.5phi}	%	0.0208	0.294	0.222	0	0
Grain Size Fraction: 11200 to 16000 mic: {-3.5 to -4.0phi}	%	0	0.0421	0	0	0
Grain Size Fraction: 16000 to 22400 mic: {-4.0 to -4.5phi}	%	0	0	0	0	0
Grain Size Fraction: 22400 to 31500 mic: {-4.5 to -5.0phi}	%	0	0	0	0	0
Grain Size Fraction: 31500 to 45000 mic: {-5.0 to -5.5phi}	%	0	0	0	0	0
Grain Size Fraction: 45000 to 63000 mic: {-5.5 to -6.0phi}	%	0	0	0	0	0
Grain Size Fraction: > 63000 microns: {< -6.0 phi}	%	0	0	0	0	0
Particle Size Report	Text	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.	The sample received was a Slightly Gravelly Muddy Sand in a 500G pot. The entire sample was analysed.
Dry Solids @ 30°C	%	14	10.4	12.4	10.7	16.5
Accreditation Assessment	No.	2	2	2	2	2
Additional Material Present	Text	Plant material	Plant material	Plant material	Plant material	Plant material
Drying Method	Text	Air dried at 30°C	Air dried at 30°C	Air dried at 30°C	Air dried at 30°C	Air dried at 30°C
Rejected Matter Description	Text	No material removed	No material removed	No material removed	No material removed	No material removed

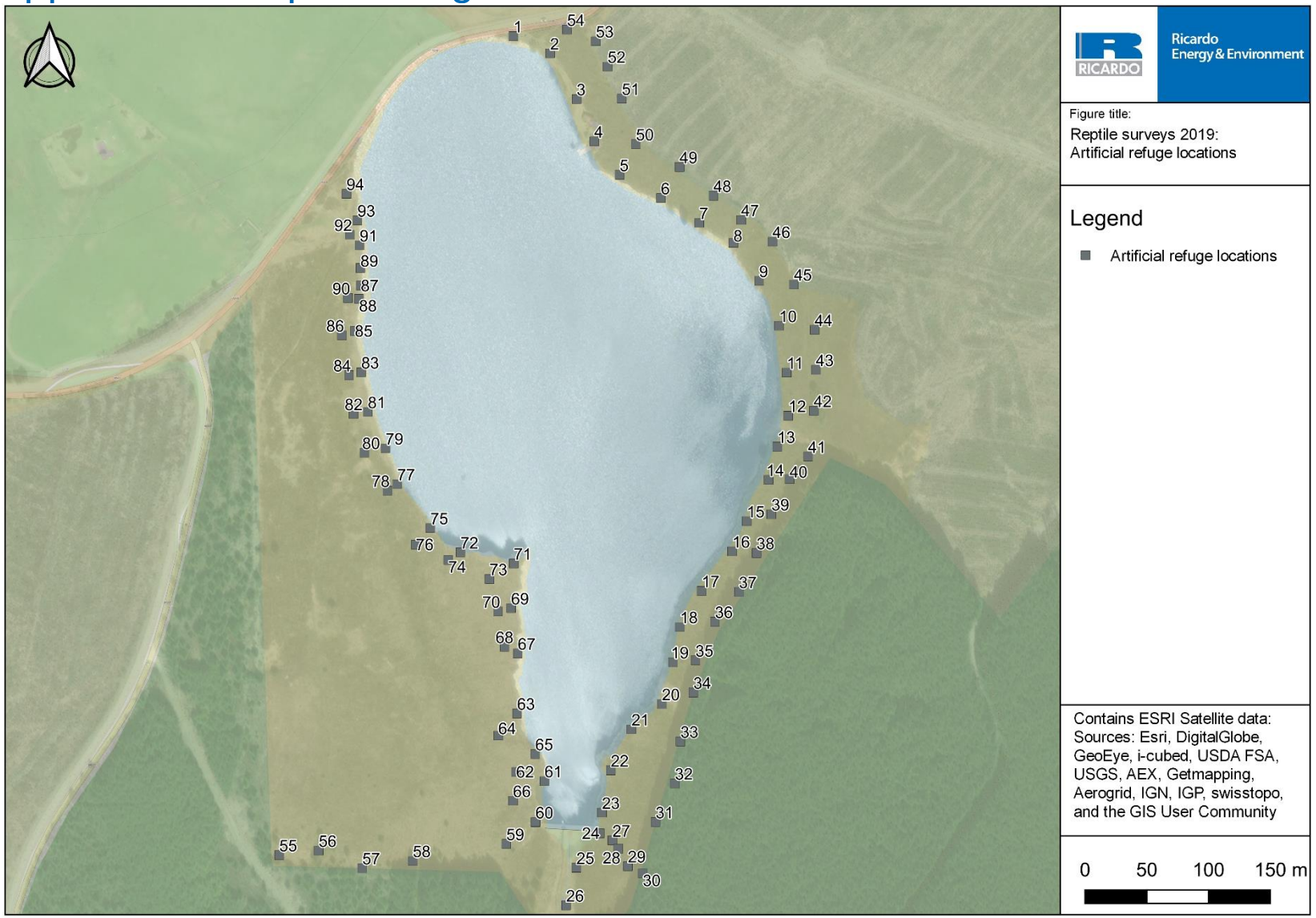
Analyte	*Units*	Site 7 19-JUN-19 13:01	Site 8 19-JUN-19 13:29	Site 9 19-JUN-19 14:22	Site 10 19-JUN-19 15:07	Site 11 19-JUN-19 15:27
Sample Colour	Text	Brown	Brown	Brown	Brown	Brown
Sample Matrix	Text	Clay Sediment	Clay Sediment	Clay Sediment	Clay Sediment	Clay Sediment
Sample Preparation	Text	Homogenised & Left as received	Homogenised & Left as received	Homogenised & Left as received	Homogenised & Left as received	Homogenised & Left as received

Appendix D: NVC survey quadrat locations



Appendix E: Fish eDNA laboratory results

Appendix F: Reptile refuge locations



Appendix G:Bat survey forms and photographs

Bat preliminary roost assessment photographs

Above (clockwise from top left): 1 – External veiw from north of Utility Building. 2 – Veiw of roof. 3 – Access oportunities via ventiliation holes. 4 – Internal view of eastern section of building.

Above (clockwise from top left): 1 – External view from west of Boat House. 2 – Internal view of Boat House. 3 – Swallow nest. 4 – Rotten beam and loose roofing sheet.

Table E.1: Boat house - Bat emergence survey results 13 June 2019

Job name:	Llyn Bran Decommissioning	**Temperature:**	10°C	8°C
Site:	Llyn Bran	**Wind:**	2 (light breeze)	2 (light breeze)
Date:	13 June 2019	**Cloud cover:**	100%	100%
Surveyor(s):	JW	**Precipitation:**	None	None

Start time:	21:15
Sunset/sunrise time:	21:25
End time:	11:15

Building name:	Boat House

Emtouch Serial No.:	EMT2	**Ipad:**	Manchester Ipad 1
Equipment issues:	None		

Comments about any mistakes / mishaps / constraints:	None

Time	Map ref	Species	Comments (*emergence/ ref no. on plan/ flight direction/ foraging/ commuting/ HNS*)
22:53	N/A	Common pipistrelle	Heard not seen
22:58	N/A	Common pipistrelle	Heard not seen
22:35	N/A	Soprano pipistrelle	Heard not seen
22:41	N/A	Soprano pipistrelle	Heard not seen
22:43	N/A	Soprano pipistrelle	Heard not seen
22:47	N/A	Soprano pipistrelle	Heard not seen
22:50	N/A	Soprano pipistrelle	Heard not seen
22:51	N/A	Soprano pipistrelle	Heard not seen
22:55	N/A	Soprano pipistrelle	Heard not seen

Table E.2: Utility building - Bat emergence survey results 13 June 2019

Job name:	Llyn Bran Decommissioning	**Temperature:**	10°C	8°C
Site:	Llyn Bran	**Wind:**	2 (light breeze)	2 (light breeze)
Date:	13 June 2019	**Cloud cover:**	100%	100%
Surveyor(s):	LD	**Precipitation:**	None	None

Start time:	21:15
Sunset/sunrise time:	21:25
End time:	11:15

Building name:	Utility building – East

Bat detector:	Batbox Duet	**Recorder**	Anabat
Equipment issues:	None		

Comments about any mistakes / mishaps / constraints:	Really rainy in week prior to survey. Temperature not great during survey but not raining so good opportunity to catch bats feeding.

Time	Map ref	Species	Comments (*emergence/ ref no. on plan/ flight direction/ foraging/ commuting/ HNS*)
22:41	N/A	Soprano pipistrelle	Heard not seen
22:42	N/A	Soprano pipistrelle	Heard not seen - close
22:46	N/A	Common pipistrelle	Heard not seen
22:56	N/A	Common pipistrelle	Heard not seen

Table E.3: Utility Building - Bat emergence survey results 13 June 2019

Job name:	Llyn Bran Decommissioning	**Temperature:**	10°C	8°C
Site:	Llyn Bran	**Wind:**	2 (light breeze)	2 (light breeze)
Date:	13 June 2019	**Cloud cover:**	100%	100%
Surveyor(s):	RF	**Precipitation:**	None	None

Start time:	21:15
Sunset/sunrise time:	21:25
End time:	11:15

Building name:	Utility building – north-west

Bat detector:	EMT 1	**Recorder**	Manchester Ipad 2
Equipment issues:	None		

Comments about any mistakes / mishaps / constraints:	None

Time	Map ref	Species	Comments (*emergence/ ref no. on plan/ flight direction/ foraging/ commuting/ HNS*)
22:34	N/A	Common pipistrelle	Heard not seen
22:37	N/A	Common pipistrelle	Heard not seen
22:39	N/A	Common pipistrelle	Heard not seen – two bats
22:42	N/A	Common pipistrelle	Heard not seen – two bats
22:43	N/A	Soprano pipistrelle	Heard not seen
22:54	N/A	Soprano pipistrelle	Heard not seen
22:56	N/A	Common pipistrelle	Heard not seen

Table E.4: Utility Building - Bat emergence survey results 11 July 2019

Job name:	Llyn Bran Decommissioning	**Temperature:**	15°C	14°C
Site:	Llyn Bran	**Wind:**	2 (light breeze)	2 (light breeze)
Date:	11 July 2019	**Cloud cover:**	100%	100%
Surveyor(s):	RF	**Precipitation:**	None	None

Start time:	03:31
Sunset/sunrise time:	05:02
End time:	05:17

Building name:	Utility building – South

Bat detector:	EMT E2A00828	**Recorder**	Bristol Ipad
Equipment issues:	None		

Comments about any mistakes / mishaps / constraints:	None

Time	Map ref	Species	Comments (*emergence/ ref no. on plan/ flight direction/ foraging/ commuting/ HNS*)
03:34	1	Common pipistrelle	Heard not seen
03:59		Soprano pipistrelle	Foraging south of building
03:59		Soprano pipistrelle	Heard not seen
04:00		Soprano pipistrelle	Heard not seen
04:02		Soprano pipistrelle	Heard not seen
04:02		Noctule	Heard not seen
04:04		Noctule and Common pipistrelle	Two noctules and a common pipistrelle foraging
04:06	2	Soprano pipistrelle	Foraging south of Utility Building, flew west
04:10	3	Noctule	Foraging north-east of Utility Building
04:12		Noctule	Heard not seen
04:13		Noctule	Heard not seen
04:14		Noctule	Heard not seen
04:17	4	Noctule	Two noctule foraging above and south-west of Utility Building
04:22		Noctule	Heard not seen
04:26			

Table E.5: Utility Building - Bat emergence survey results 11 July 2019

Job name:	Llyn Bran Decommissioning	**Temperature:**	15°C	14°C
Site:	Llyn Bran	**Wind:**	2 (light breeze)	2 (light breeze)
Date:	11 July 2019	**Cloud cover:**	100%	100%
Surveyor(s):	TP	**Precipitation:**	None - mist	None - mist

Start time:	03:31
Sunset/sunrise time:	05:02
End time:	05:17

Building name:	Utility building – North-west

Bat detector:	EMT 2	**Recorder**	TP Iphone
Equipment issues:	None		

Comments about any mistakes / mishaps / constraints:	None

Time	Map ref	Species	Comments (*emergence/ ref no. on plan/ flight direction/ foraging/ commuting/ HNS*)
03:38		Common pipistrelle	Brief pass – heard not seen
03:43		Common pipistrelle	Brief pass – heard not seen
03:59	A	Soprano pipistrelle	Commuting north along edge of reservoir
04:02		Soprano pipistrelle	Foraging – head not seen
04:07		Soprano pipistrelle	Foraging – head not seen – brief pass
04:07		Soprano pipistrelle	Heard not seen – social call
04:10		Soprano pipistrelle	Foraging – heard not seen
04:12	B	Noctule	Foraging over area east of Utility Building
04:18	C	Noctule	Foraging then flew south
04:22		Noctule	Foraging - heard not seen

Table E.6: Utility Building - Bat emergence survey results 9 August 2019

Job name:	Llyn Bran Decommissioning	**Temperature:**	12°C	11°C
Site:	Llyn Bran	**Wind:**	2 (light breeze)	1
Date:	9 August 2019	**Cloud cover:**	70%	90%
Surveyor(s):	TP	**Precipitation:**	None	light rain 21:44-51

Start time:	20:16
Sunset/sunrise time:	20:35
End time:	22:03

Building name:	Utility building – North-west

Bat detector:	EMT E2A00828	**Recorder**	Ipad – GCGVH9XQHLF9
Equipment issues:	None		

Comments about any mistakes / mishaps / constraints:	Light rain from 21:44-21:50 – bats foraging throughout this period not considered to be a constraint

Time	Map ref	Species	Comments (*emergence/ ref no. on plan/ flight direction/ foraging/ commuting/ HNS*)
21:14-18		Noctule	Foraging and feeding HNS
21:14		Pipistrelle species	Foraging heard not seen
21:17		Pipistrelle species	Heard not seen – brief pass
21:18-32	A	Soprano pipistrelle	Foraging along edge of reservoir and social calling
21:21		Pipistrelle species	Social calling
21:29		Common pipistrelle	Foraging heard not seen
21:34	A	Common pipistrelle	Foraging
21:35-40	A	Soprano pipistrelle	Foraging and social calling
21:39	B	Common pipistrelle	Foraging between Utility Building and reservoir
21:40		Noctule	Foraging heard not seen
21:40-44	B+A	Soprano pipistrelle	Foraging and social calling
21:45		Pipistrelle species	Foraging heard not seen
21:46-49	A	Soprano pipistrelle	Foraging heard not seen
21:49		Daubenton's bat	Single pass heard not seen
21:52		Common pipistrelle	Foraging heard not seen
21:52		Soprano pipistrelle	Foraging heard not seen
21:54	B	Soprano pipistrelle	Foraging heard not seen
21:58		Soprano pipistrelle	Foraging heard not seen
21:59		Soprano pipistrelle	Foraging heard not seen

Table E.7: Utility Building - Bat emergence survey results 9 August July 2019

Job name:	Llyn Bran Decommissioning	**Temperature:**	12°C	11°C
Site:	Llyn Bran	**Wind:**	2 (light breeze)	1
Date:	9 August 2019	**Cloud cover:**	70%	90%
Surveyor(s):	KM	**Precipitation:**	None	light rain 21:44-51

Start time:	20:16
Sunset/sunrise time:	20:35
End time:	22:03

Building name:	Utility building – south

Bat detector:	EMT2	**Recorder**	Ipad – GCTW4383HLF9
Equipment issues:	None		

Comments about any mistakes /constraints:	Light rain from 21:44-21:50 – detector covered to protect from rain no recording during this period.

Time	Map ref	Species	Comments (*emergence/ ref no. on plan/ flight direction/ foraging/ commuting/ HNS*)
21:14	A	Noctule	Foraging above building
21:16	B	Noctule	Foraging over reservoir
21:18		Soprano pipistrelle	Heard not seen
21:18		Noctule	Heard not seen
21:19	C	Common pipistrelle	Foraging south of building flew towards reservoir
21:19		Soprano pipistrelle	Foraging south of building flew towards reservoir
21:20	D	Common pipistrelle	Heard not seen
21:21	B	Soprano pipistrelle	Foraging south of building flew towards reservoir
21:21	E	Common pipistrelle	Foraging over reservoir
21:22	B	Soprano pipistrelle	
21:23		Common pipistrelle	Foraging over reservoir
21:24	F	Soprano pipistrelle	
21:25	G	Soprano pipistrelle	Foraging south of building flew towards reservoir
21:26	D	Common pipistrelle	
21:27	G	Soprano pipistrelle	
21:28	F	Soprano pipistrelle	
21:29	H	Common pipistrelle	Foraging - flew towards reservoir
21:31		Soprano pipistrelle	Foraging over building and reservoir
21:34	D	Common pipistrelle	Heard not seen
21:36	H	Soprano pipistrelle	
21:37		Soprano pipistrelle	Foraging west of building
21:39		Common pipistrelle	Heard not seen
21:39	I	Soprano pipistrelle	Heard not seen
21:40		Noctule	Flying east away from reservoir
21:41		Soprano pipistrelle	Heard not seen
21:45		Common pipistrelle	Heard not seen
21:44-21:50			Raining activity not recorded
21:51		Soprano pipistrelle	Heard not seen
21:53		Soprano pipistrelle	circling over reservoir margins
21:58		Soprano pipistrelle	Heard not seen

Appendix H: Water vole survey results

Figure H.1: Llyn Bran water vole field signs identified during the survey on 25-26 June 2019.

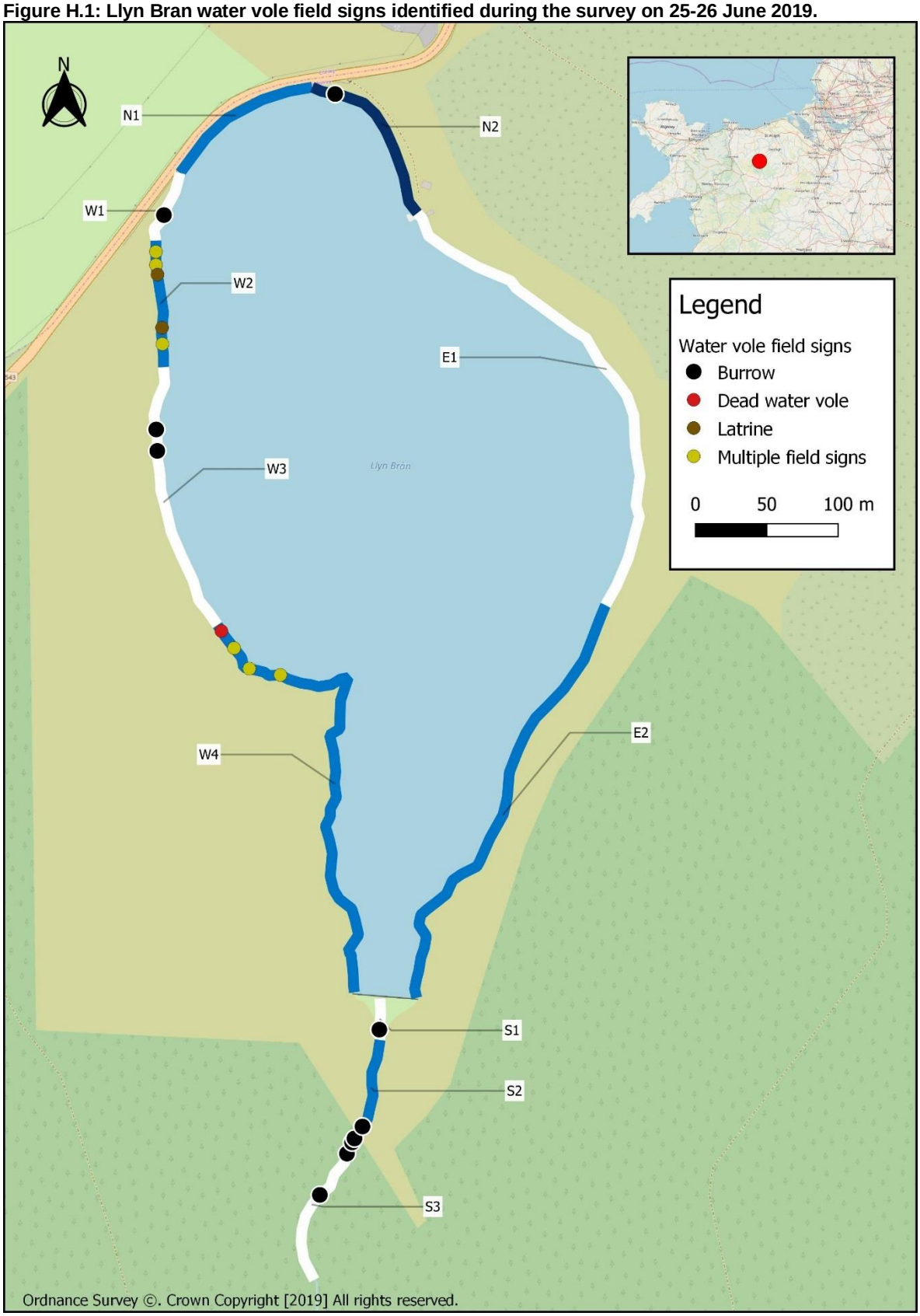


Figure 2: Llyn Bran water vole field signs identified during the survey on 20 August 2019.

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