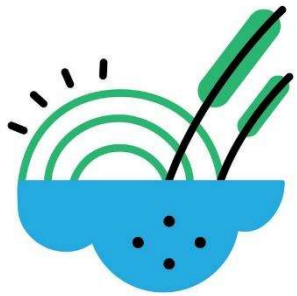

Ponderful

Pond Ecosystems for Resilient Future Landscapes in a Changing Climate

Grant Agreement: 869296

Deliverable 5.7

DATA MANAGEMENT PLAN

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WP Title	Communication, Dissemination and Exploitation	**Document Title**	Data Management Plan
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The main reference documents for partners are:

- PONDERFUL Grant Agreement (v 27/07/2020), containing
- PONDERFUL Description of Work or Annex I (v 27/07/2020)
- Annex II, General Conditions (v 27/07/2020)
- Guide to Financial Issues relating to H2020 Actions (v 27/07/2020)
- PONDERFUL Consortium Agreement (v4, 08/02/2021)

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DATA MANAGEMENT PLAN

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PONDERFUL project overview

Ponds and “pondscapes” (networks of ponds) are crucial for biodiversity conservation and their multiple societally beneficial ecosystem services (ES) provide the means to play a crucial role in mitigating and adapting to climate change. However, ponds are largely neglected in water- and nature-related policies and there is insufficient knowledge on how to manage and restore ponds to maximize their role as nature-based solutions (NBS) to increase resilience of ecosystems and society to climate change (CC). The overarching aim of PONDERFUL is to facilitate improved implementation of pondscapes NBS for CC mitigation and adaptation, biodiversity conservation and delivery of ES through generating and integrating biodiversity, ecosystems, social, economic and policy knowledge and providing evidence-based guidance and tools for pond NBS implementation. To achieve this, PONDERFUL will: 1) evaluate the interactions and feedbacks between biodiversity, ES and climate in pondscapes at multiple spatial scales; 2) together with stakeholders, develop future scenarios for pondscapes in EU and CELAC in the context of CC, land use change, and changed policies; 3) develop and test the implementation of effective multifunctional NBS in close collaboration with the stakeholders using DEMOnstration sites in EU and CELAC countries; 4) develop a sustainable finance and investment guide for NBS, in collaboration with local stakeholders; 5) assess the potential for large-scale implementation of the proposed NBS in relation to existing barriers, enabling factors, financing and as economic viability, as well as social perceptions of benefits from pond NBS. Ultimately, the stakeholder-oriented approach adopted by PONDERFUL will ensure that the scientific knowledge produced on the benefits of using pondscapes as ecosystems delivering multiple ES is explicitly considered in decision making from local management to EU policies.

Executive Summary

This report is the first deliverable of the Task 5.3 “Data Management Plan” and describes the first version of the Data Management Plan (DMP) for the PONDERFUL project, funded by the EU’s Horizon 2020 Programme under Grant Agreement number 869296. The purpose of this document is to provide an overview of all datasets that will be generated during the development of the project (raw, processed and analysed data), as well as to define the PONDERFUL’s data management policy that will be applied to these datasets.

The project’s data strategy counts on the PONDERFUL Information System (IS), which is embedded in the AQUACROSS Information Platform (https://aquacross.eu/), to facilitate an easy electronic access (under copyright and intellectual property constraints), to the wide range of data types generated in PONDERFUL, for a diverse group of data users requiring different levels of interpretation. The AQUACROSS Information Platform is based on Comprehensive Knowledge Archive Network (CKAN) software, an open-source framework for developing open data portals, which provides a reliable entry point for all data and metadata collected, processed or analysed by the project. Actually, CKAN is currently the technical solution implemented by the European Commission to publish pan-European open datasets across the European Union.

The present document follows the structure of the Horizon 2020 DMP template [1]. It describes the data that is being collected, processed and analysed, as well as the methodology and standards that will be followed during the project development regarding data management. In addition, it details when and how this data can be shared and/or made open, and the way it will be organised and preserved.

This initial version of the DMP defines the general policy and the way to broach the matter of data management in PONDERFUL, including the administrative and technical issues regarding data handling. In this sense, it contains information on data and meta-data collection, publication and deposition of open data, on the data repository infrastructure and on the compliance to the Open Access Infrastructure for Research in Europe (OpenAIRE), while the PONDERFUL Information System (IS), embedded in the AQUACROSS Information Platform (http://dataportal.aquacross.eu/), represents the operational software tool for implementing these management practices.

It also describes the expected results of the data collection/production activities in WP1 (Tasks 1.3-1.6), WP2 (Tasks 2.1-2.4), WP3 (Tasks 3.1, 3.2, 3.4, 3.5 and 3.6) and WP4 (Tasks 4.1., 4.3) that are being carried out according to the guidelines on FAIR (Findable, Accessible, Interoperable and Reusable) data management [2].

As the DMP will evolve during the duration of the project, in next versions it will be completed and refined, providing more detail regarding the datasets collected and produced by the PONDERFUL project.

1. Data Summary

PONDERFUL is a transdisciplinary research project with a very broad scientific and geographical scope. To determine how biodiversity, ecosystem function and services interact in ponds and pondscapes, and how climate change may alter these interactions, as well as to forecast how biodiversity, climate change mitigation and adaptation, and other ecosystem services of ponds and pondscapes will respond to near-future climate change, a wide range of data will need to be collected, processed and stored, gathering and integrating socio-economic, policy, biodiversity and ES datasets, both new raw collected data as well as data generated during the project (through processing and analysis). As such, the project is producing a vast array of specialised data, from spatial data to social information. Potential users of the data and information produced by the project cover a wide variety of individuals. Users include high level decision-makers, local managers as well as technical experts. Each of these user groups have very different data and information requirements.

The DMP is an evolving document that will be continually edited and updated throughout the project. As at this stage of the project development the data identification and collection activities are still ongoing, this first version of the DMP can only provide a partial overview of the datasets that will be required in the different demonstration and case study sites and in the PONDERFUL project in general. However, the present data summary provides a good overall picture of the different types of datasets that will be needed as inputs of the different models, tools and other results that will be developed in WP1, 2, 3 and 4.

The objective of this section is to provide an overview of the different datasets that will be managed by the PONDERFUL project. PONDERFUL will gather all types of information generated by the project on ponds, their biodiversity and associated ecosystem services, including: spatial data in raster and vector formats, multimedia files (videos, images, etc.), tables, graphs, web services and any other relevant information sources available in a digital format.

Overall, we can classify data to be used in PONDERFUL according to the following main categories:

- compiled from publicly and private available sources (e.g., inventories from other institutions, reviews)
- data from surveys (e.g., field sampling; interviews)
- simulation (i.e., modelling data)
- derived from PONDERFUL datasets and/or from other available sources (e.g., indicators, downscaling)

A description of the datasets summarised below is available in Annex 1.

1. 1. WP1

Data collection in WP1 "Stakeholder involvement, policy, society, and sustainable financing", will start by stakeholder mapping, i.e., identification of the relevant stakeholders to reach the various targets of PONDERFUL and the development of a consolidated glossary for PONDERFUL framing project research in the context of ES and NCPs. Once the stakeholders are identified, the collection of data for the analysis of social aspects, ecosystem services and perception of cultural values of ponds, as well as for the socio-economic analysis, can be conducted through the development and distribution of a survey among stakeholders as well as to the general public in the different DEMO sites. The survey will consist mainly of closed questions. Additional data will be collected through structured discussions at stakeholders' workshops to establish a typology of society's perceptions of pondscapes. Using this typology, the variability of benefits provided by pondscapes and ecosystem service priorities will be identified and based on that guidelines on how to adapt NBS and pondscape management to the local social context will be developed, contributing information to tools developed in WP4 (see below).

Apart from this, a policy inventory will be conducted to explore the policy context both at EU level and in all DEMO site regions. Specifically, EU policy processes and instruments relevant for pondscape implementation will be identified and reviewed, including existing indicators and data to support pond NBS development and management. The aim of this inventory is to understand how local, regional, national, and EU level policies can support or hinder the implementation of multi-functional ponds NBS, analysing biodiversity, ecosystem services and climate change policies simultaneously.

Similarly, a live inventory of sustainable financing options will be developed based on international best practice financing examples, drawing on both pond and other NBS, deriving from literature review including reports from related European projects, such as H2020 Naturvation, H2020 NAIAD, H2020 SINCERE, FP7 EPI-WATER, UN and EC's Sustainable Finance typologies, and non-European examples from the academic and grey literature. This will be supported by inputs from an expert workshop, where 10-15 experts will identify best practice examples, common challenges, practical solutions, and open questions.

Furthermore, social and economic benefits of pond NBS will be quantified using the economic evaluation methodology of the multi-criteria analysis (i.e., a nonparametric mathematical programming method) and information from public surveys (i.e., society's perception) and focus groups on stakeholder workshop (i.e., expert judgement) in all the DEMO sites. The analysis will be based on social indicators, economic indicators and conservation gains of the implementation.

Finally, the assessment of best practice in the implementation of pondscapes NBS in the socio-economic context will be conducted by ranking the different NBS strategies based on socioeconomic indicators collected in stakeholder workshops.

Within this WP, interviews and their transcripts will be recorded, as well as group discussions on workshops. This data will not be openly shared, due to confidentiality and ethical issues, and they will be treated according to the guidelines described in sections 2.2.4, 2.4.1 and 5. below. Data gathered by

the social survey will be anonymised and they will be stored as a database (e.g., excel files). Other files generated during WP1 development are policy documents and results of their analysis (in the form of narrative and texts), as well as weighting of socio-economic indicators. At this stage of development, the size of the files to be managed in this WP is still unknown since it will depend on the amount of recordings although they are not expected to be large files. Data generated will be mainly used by other researchers in the project, although results of analysis and synthesis could potentially be used by external users.

1. 2. WP2

In WP2, we will determine how biodiversity, ecosystem state, and ecosystem services co-vary and interact in ponds and pondscapes across a broad climatic gradient, and investigate how climate change may alter the interrelations between biodiversity, ecosystem functions and services. This will be achieved by complementing existing data from a large number of ponds in Europe with newly collected data obtained by a standardized stratified survey and targeted case studies.

A pan-European spatially-explicit database on pond biodiversity, local environmental conditions, and land use will be created by combining a large number of published and unpublished datasets that have been collected by different research teams over the past decades. In addition, a stratified survey for biodiversity, ecosystem functions and ecosystem services will be conducted in eight countries following a highly standardized methodology. We will measure a wide array of local environmental pond conditions and determine community characteristics of multiple aquatic organism groups. The stratified survey will also quantify ecosystem functions and services in each pond (carbon sequestration, pond metabolism, greenhouse gas emissions). Existing data and newly collected data will be complemented with information on land use intensity as derived from satellite products (Sentinel 1 and 2 from Copernicus and Landsat TM data). The pan-European dataset will cover a broader climatic and geographic gradient than the data from the stratified survey, but information per pond is less comprehensive and standardized. These two datasets are therefore highly complementary and will be combined for several analyses. The targeted case-studies focus on temporal dynamics and resampling to address stability and resilience of pond biodiversity and ecosystem functions and services to climate change.

The compiled databases will be provided as tables in excel format and they will contain information on more than 2,500 ponds at pan-European level, 240 ponds from the stratified survey and about 90 ponds from the different case studies. The obtained data will be highly valuable for the scientific community as a whole, but are also relevant for local, regional and national authorities committed to environmental management and biodiversity monitoring. Several local stakeholders might also be interested.

1. 3. WP3

All the tasks included in WP3 “Scenarios and modelling” involve (spatial) data analysis, and largely build on knowledge acquired in other WPs, specifically WP1 (stakeholder needs, co-developed scenarios, narrative elaboration), WP2 (empirical observations and statistical relationships on biodiversity, ecosystem functions and services, and climate and land use), WP4 (NBS designs to inform scenarios). The research activities included here will result in spatial datasets, unique added insights, support for the development of the decision-making tool (WP4) and scientific publications for decision-making tools (managers’ guidance in WP4) and scientific publications.

In WP3, the geo-referenced data on ponds in Europe (collected under WP2, see above), existing spatial datasets on small water bodies in Europe, and newly available remote sensing products (Sentinel 1 and 2 from Copernicus and Landsat TM data) will be combined to map the spatial distribution of pondscapes, assessing the density and distribution of ponds in different regions across Europe (Task 3.1). This will result in raster datasets of pondscapes.

To develop spatially-explicit projections of the main drivers of biodiversity and ecosystem services change (Task 3.2), land use maps and socio-economic statistics (some obtained in WP2) will be used to characterise historical, current and projected downscaled climate (obtained from the CMIP6 repository and covering a wide range of possible future climates, i.e., RCP2.6, RCP4.5 and RCP8.5) and land use trends (‘baseline scenarios’ and ‘stakeholder scenarios’). For quantifying land use trends in different modelling scenarios (‘baseline scenarios’ and ‘stakeholder-based scenarios’), data from the European Commission Land use (LUISA), and Land Use Harmonization project will be downscaled. For finer spatially-explicit models to project land use change, historical land use dynamics locally observed around the ponds and its association with the local socio-economic dynamics (e.g., population dynamics, infrastructure development, GDP, accessibility) will be applied. The local projections will then be refined taking into account the stakeholders’ feedback (‘stakeholder scenarios’). The outcome will be a series of GIS land use rasters for the pondscapes and their surroundings.

Hydrology and hydroperiod are key to pond number, biodiversity and ES. For a selection of ponds (chosen to reflect differences in depths and surface-volume ratio) in each of the DEMO sites and stratified sampling regions, changes in water level and area-volume ratios will be monitored and combined with existing data on water level fluctuations collected through other initiatives (e.g. Spanish national projects, “Mediterranean temporary ponds: biodiversity refuges to preserve” and COMEDI) and water level data from all ponds in the stratified sampling taken during the visits to obtain carbon sequestration and GHG emission data (see WP2 above). Using the different scenarios, the water balance dynamics can be simulated to predict changes in water level and surface area fluctuations resulting from projected climate change and land use changes, particularly qualitative changes (Task 3.2) – the outcome will likely be a series of time series ascii (text) files with data on water level and surface area of the selected ponds for the different scenarios.

Complementary to the empirical relationships developed in WP2, we will build lottery models (Task 3.4). For each region and organism group (differing in dispersal capacity), a metacommunity network

lottery model will be constructed to provide insights into the association between biodiversity and pondscape connectivity. The network simulations will be used to model scenarios in which ponds are lost or created (e.g., NBS using ponds and pondscapes) and predict how biodiversity (and associated carbon storage and other ES) will change under these scenarios. The outcome will be mainly ascii based data, and graphical visualizations of the simulated network structures.

Spatial data will be integrated with the hydrological model outputs obtained in WP3 and lottery model outputs together with pressure-state and mitigation-state relationships found in WP2 and WP4, into a predictive modelling framework that enables scenario projections of biodiversity, carbon storage, GHG emissions and other ES (e.g., pollination) under different management, land use, connectivity and climate change scenarios (Task 3.5). The outcome when running the modelling framework will mainly be GIS maps and ascii data (supported by graphical visualizations) that illustrate the outcome of the different scenario projections. The production of these maps is done in Task 3.6.

The modelling framework mainly targets technical users and scientists in PONDERFUL, but the resulting maps will also be instrumental to the Decision Support Tool developed for project stakeholders in WP4, where maps from WP3 will be an integrated part.

In general, the data produced in WP3 will expectedly range from a few MB (e.g., ascii files) to likely a few hundred MB (that latter may be the case for some GIS maps).

1. 4. WP4

WP4 “Nature-based solutions and management to mitigate and adapt to climate change” links the existing knowledge from a review of Nature Based Solutions (NBS) focused on ponds and pondscapes in Europe to the new data obtained in WP1, WP2 and WP3 (see above) to guide efficient and cost-effective application of NBS to manage pondscapes for enhanced resilience to climate change.

Within this WP, two data bases will be generated:

Databases 1. “NBS databases”, produced in the framework of Task 4.1.

A database of NBS implemented in European pondscapes will be built gathering general information in terms of existing knowledge, ecosystem services, biodiversity, economic benefits, and potential for mitigation of climate change. The information will be collected from the stakeholders.

Databases 2. “DEMO site assessments”, produced in the framework of Task 4.3.

A total of 15 pondscapes will be characterized by the measurement of a set of indicators. The data will be obtained from different approaches: (i) undertaking surveys to general public on the perception of cultural values of ponds collected under the guidance of WP1 (Task 1.3), (ii) using the methods to assess ES described in WP2, (iii) using results from the models produced by WP3, and (iv) using existing data

from ES characterisations already undertaken by local SMEs and/or NGOs. In addition, from the different workshops organised by WP4, with WP1 support, policy and practice priorities and needs will be identified providing data and insights on policy, social and economic context (WP1), and lead to co-development of scenarios (WP3).

Data will be recorded as numerical, text and alpha-numerical variables that will be stored as excel/access databases. The expected sizes of each data bases will be < 50'000 Ko. Databases 1 will be made available on a public platform. It will be used mainly by stakeholders. Databases 2 will be used within PONDERFUL Task 4.3 (assessment of the 15 pondscapes), and made available to the stakeholders involved in each PONDSCAPE. The data will be presented during workshop 3, and on leaflets describing each pondscape. The best-practices leaflets will be largely disseminated, especially through WP5 activities, and made available to the public.

2. Data management policy

The data management policy in PONDERFUL (please see next sections below) fulfils the Horizon 2020 FAIR principles [2], open data requirements [3] and implementation guidelines [4]. This policy concerns new datasets and information that are being produced in PONDERFUL and which will be made available as open source, open science and open data.

PONDERFUL data will be available online through both the IS CKAN data catalogue (all PONDERFUL data, including research, non-research, public and non-public data; in the latter case, only metadata will be open access, see section 2.1.4 below) as well as via open access data repositories, in the particular case of the PONDERFUL open research data and publications.

The PONDERFUL consortium has decided to use Zenodo (http://www.zenodo.org) as a common default Open Access repository of PONDERFUL publications and research data underlying those. Zenodo is an EC-co-funded, multidisciplinary repository, for publications and data which allows to archive any research outputs in any size, any format and from any discipline. Specifically, data is stored in the CERN cloud infrastructure. Zenodo is compliant with the open data requirements of Horizon 2020, the EU Research and Innovation funding programme and OpenAIRE. OpenAIRE2020 assists in monitoring H2020 research outputs and is a key infrastructure for reporting H2020's scientific publications, as it is loosely coupled to the EC's IT backend systems. PONDERFUL research data and publications will be available through OpenAIRE since it is connected to Zenodo so all the data and information uploaded to Zenodo is shown in OpenAIRE.

2. 1. Making data findable, including provisions for metadata

2.1.1. Persistent identifiers

Persistent identifiers are used when citing and managing data and information to provide a permanent link to them. A persistent Uniform Resource Locator (URI) will be provided to all the data stored in the PONDERFUL IS (e.g., http://dataportal.aquacross.eu/dataset/group-intercontinentalbiosphere-ecosystemservices), thus they are properly identifiable and locatable.

Zenodo allows researchers to deposit both publications and research data, while providing means to link them. In this sense, the PONDERFUL publications and data, including associated metadata (see section 2.1.3.) needed to validate the results presented in scientific publications (hereafter "research results") will be deposited in the open access repository Zenodo where they will be automatically assigned a Digital Objective Identifiers (DOIs) automatically, benefitting from Zenodo's DOI versioning support (see section 2.1.2.). DOI is assigned to all Zenodo files, which can be uploaded in any file format.

In addition, a DOI will also be assigned for PONDERFUL research results that are deposited in institutional repositories, repositories of scientific publishers or other data and research repositories, if the institution has an agreement with a DOI registration agency and it is therefore a DOI registrant. Apart from DOI, other unique identifiers could be assigned to the PONDERFUL scientific publications depending on the scientific Publisher and on the open access strategy (green or gold) chosen by the editors, such as Publisher Item Identifier (PII), International Standard Serial Number (ISSN), etc.

2.1.2. Naming conventions and keywords

In the framework of PONDERFUL, a meaningful but brief system with unique names is defined. In this sense, the general naming convention for uploading data and documents to the IS and or to Zenodo will be the following: make a reference to the DEMO site/WP and the date of the data version uploaded: DemositeX_Partner_Date or WPX_Partner_Date (e.g., Demosite2_UVic_2022_11_30 or WP4_KUL_2021_11_30). In case data is generated by more than one partner, the reference would be as follows: DemositeX_PONDERFUL_Date or WPX_PONDERFUL_Date.

In addition, when the PONDERFUL data and research results are deposited in the IS and in the default repository Zenodo, they will be provided with proper search keywords together with other required metadata (see section 2.1.4).

Regarding version control, Zenodo has a feature that enables users to update the record's files after they have been made public. Similarly, it allows researchers to easily cite either specific versions of a record or to cite, via a top-level DOI, all the versions of a record (https://help.zenodo.org/#versioning). Moreover, DOI versioning allows for updating a dataset after it has been published and to cite either a specific version of a data set or all versions of a data set (see https://blogs.OpenAIRE.eu/?p=2010). All PONDERFUL research results deposited in the Zenodo repository will use this DOI versioning.

2.1.3. Metadata standards

Metadata (i.e., "data about data") contains information that documents the basic characteristics of a specific dataset allowing users to find the data that they need and, thereafter, evaluate whether this resource satisfies the user's requirements. Metadata is also key to organising all the digital information generated (through data processing and analysis of pre-existing data or data collected in the framework of the project), allowing archiving and preservation of the information resources. A proper metadata schema allows for an accurate and consistent identification of the PONDERFUL data and research results both for citation and retrieval purposes.

In this sense, the data generated during the project will be appropriately documented following relevant metadata standards and will be INSPIRE/OGC compliant. The standards used to fulfil metadata will be based on the ISO 19139 which provides the XML implementation scheme for ISO 19115 specifying the metadata record format. These standards will be used to describe, validate, and exchange geospatial and non-spatial metadata prepared in XML. In addition to this, other relevant standards such as the Catalogue Service for the Web (CSW) from the OGC will be implemented in order to facilitate metadata information exchange with third party platforms.

The metadata files will be generated using a graphical user interface as part of the IS in which authorised users will be able to enter and edit the metadata. The metadata files will be stored in a relational database following INSPIRE metadata standards for spatial datasets and Dublin Core for non-spatial datasets. The final catalogue will be open to all the PONDERFUL project partners and the general public.

Following the AQUACROSS Information Platform, a catalogue metadata schema is established in the project (see below) for those datasets that are published in the IS. This schema is compatible with the Zenodo deposition metadata domain model (http://developers.Zenodo.org/#representation), which is based on DataCite's metadata schema (https://schema.datacite.org/), and provides minimum and recommended terms.

2.1.4. Default Catalogue Metadata schema for data generated by the project

For PONDERFUL, the following deposition metadata fields are mandatory:

- Title (name of the dataset)
- Date of uploading (i.e., date of publication)
- Contributor (i.e., creators, authors)
- Language
- Description (abstract or description)
- Resource type (type of resource from a controlled vocabulary, see section 2.3.1)
- License (access right, see section 2.4.1)

- Subject (from a controlled vocabulary, see section 2.3.1)
- Keywords
- Lineage (Description of the approach followed to create the data)
- Responsible party (organisation, contact person-contact details and role-)
- Geolocation (projection, spatial extent)

This minimal metadata schema can be extended by arbitrary subjects from a taxonomy or controlled vocabulary as described in the Zenodo API documentation if necessary, according to data-type specific schemas or specific data repositories. Therefore, extensions to the default metadata schema described above, for example in relation to spatial or linked data, will be described in next versions of the data management plan, if necessary.

In this sense, in the particular case of publications deposited in Zenodo, the bibliographic metadata will be in a standard format, including:

- the terms “European Union (EU)” and “Horizon 2020”;
- the name of the action, acronym and grant number (“PONDERFUL has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869296”);
- the publication date, and length of embargo period if applicable (see section 2.2), and
- a persistent identifier.

Apart from license, legal/ethical statements can also be included in the metadata record (data protection, ethical approval, commercial constraints, sensitive information).

2.2. Making data openly accessible

2.2.1. Openly available data and data shared under restrictions

PONDERFUL partners have full intellectual ownership of the data generated by the project thus the default rule is that data produced in the project shall be available without restrictions on access and re-use if no particular reasons for non-disclosure of data (e.g., ethical issues, social/policy data) is specified [2]. Currently, no beneficiary has the intention to opt-out from the open data rule for new data generated within PONDERFUL. If the situation changes, the consortium agreement will be changed and the DMP updated accordingly.

When PONDERFUL partners are full owners of the intellectual property rights of the data, but reasons for non-disclosure of data have been specified (e.g., privacy and/or integrity of individuals, commercial interests of a natural or legal person, including intellectual property, court proceedings and legal advice,

the purpose of inspections, investigations and audits), the reasons specified will be reviewed by the Data Management Team. All ethical standards and guidelines of Horizon2020 will be rigorously applied, regardless of the country, and as described in section 5 below.

Therefore, overall all the information produced within the PONDERFUL project will be released under an Open Data License (Creative Commons CC Zero License or Creative Common Attribution License-CC-BY v4.0) unless there are restrictions imposed by third parties (see section 2.4 below).

2.2.2. Data accessibility

PONDERFUL research data will be made accessible according to the Rules on Open Access to Scientific Publications and Open Access to Research Data in Horizon 2020 [3]. All project foreground information including newly collected and processed data, results of analysis, tools and products developed by the project will be accessible through the PONDERFUL IS. This platform will offer the possibility of creating several views using the same dataset allowing users to explore and analyse the data on the fly making the data easier to understand without having to install any specific software or download the data for analysis.

Additionally, research results produced in PONDERFUL will be also deposited in the corresponding open data repositories (see section 2) as soon as possible. Specifically, research data needed to validate the results in the scientific publications will be deposited in the data repository at the same time as a publication. Regarding peer-reviewed scientific publications derived from the project, open access will be ensured either by publishing in green or gold open access journals with or without author processing fees. However, green open access journals or gold open access journals without author processing fees will be preferred for disseminating PONDERFUL scientific publications.

Furthermore, any scientific publications from PONDERFUL and the related bibliographic metadata will be made available as open access and announced at the project website (http://www.ponderful.eu/) as well as in the OpenAIRE portal (https://www.OpenAIRE.eu/) and in the EC Research Participant Portal (https://www.openaire.eu/reporting-to-the-ec). To automate the process of reporting scientific publications and related research data in OpenAIRE, the publication will be deposited in Zenodo, either by the authors of the publication (green open access) or by a scientific publisher (gold open access).

2.2.3. Software tools

Apart from the data that will be used to validate the research results, which will be open accessed through Zenodo, all other datasets of the PONDERFUL IS CKAN data catalogue will be available online, so the users can access the data without having to install any specific software or plug-in, in their favourite internet browsers. In this sense, there is a user manual for the Information Platform providing instructions on how to use the PONDERFUL IS.

On the other hand, open-source software developed by PONDERFUL will be accessed from the PONDERFUL website and it will be made available together with the respective open data in the Zenodo repository.

2.2.4. Restrictions on use and access providing

In the case of public data not directly accessible through PONDERFUL IS, the sources of the data and respective contact points will be provided, along with the metadata uploaded to the IS. This is often the case for many of the national and regional datasets to which access is only granted upon direct request to the institutional data owners.

Where a restriction on open access to research data is necessary, attempts will be made to make data available under controlled conditions. In the case of PONDERFUL project partner/data holder who do not have full intellectual ownership of the data, they will be requested to verify who can access the data and which restrictions apply, following the recommendations of the Guidelines to the Rules on Open Access to Scientific Publications and Open Access to Research Data in Horizon 2020 [3]. Specifically, if the data produced involves third party data or the PONDERFUL project partner/data holder does not hold full ownership of the data, they will be requested to verify the use conditions (licensing, see section 2.4) of the data. If the third-party data has been previously published under a specific license, the data holders should verify the license used (section 2.4). If the third-party data has not yet been published, the PONDERFUL partner/data holder will be requested to obtain permissions from the third party to make the data available. The information regarding the dataset contributors will be recorded in the metadata file (see section 2.1.4). In case there could be access restrictions on data needed to validate the results presented in scientific publications, access to individuals with legitimate interest will be granted on request.

In case there could be access restrictions on data needed to validate the results presented in scientific publications (due to confidentiality, security, personal data protection obligations or IPR issues related to specific research data), non-public research results will be archived at the Zenodo repository using a restricted access option (see section 2.2.4 above).

On the other hand, in the case where restricted or embargoed data is stored in the Zenodo repository, information about the restricted data will be published in the repository, and details of when the data will become available will be included in the metadata. Metadata for both open, closed, embargoed and restricted records will be always publicly available in Zenodo. Data files and data sets for restricted access records are only visible to their owners and to those the owner grants access. Restricted access allows a researcher to upload a dataset and provide the conditions under which he/she grants access to the data. Researchers wishing to request access must provide a justification for how they fulfil these conditions. The owner of the dataset gets notified for each new request and can decide to either accept or reject the request. If the request is accepted, the requester receives a secret link which usually expires within 1-12 months.

In case there are any issues regarding the restricted access to research results, PONDERFUL's Data Management Expert Group can seek clarification.

2.3. Making data interoperable

2.3.1. Exchange and re-use of the data

The PONDERFUL IS will take advantage of the latest developments and interoperability standards for harvesting and collecting relevant data and metadata files from other European reference data portals. The aim of this functionality will be to create an access point to the different existing data portals without replicating the information by developing a decentralised information system.

After registration, project partners of the PONDERFUL consortium will be able to upload and publish the metadata and data in the IS. The default rule is that data produced in PONDERFUL shall be available without restrictions on access and re-use. This means that the data shall be made available in accordance with the standard European Commission (EC) Reuse and Copyright notice (https://data.jrc.ec.europa.eu/licence/com_reuse). The end-user community will be able to query and interrogate the data and metadata of all public datasets. Datasets will be published following all the relevant standards for publishing information on the web and ensuring maximum interoperability with other existing environmental information platforms such as FIP, WISE and BISE. The information will be available using open data file formats and machine-readable formats such as Comma Separated Values (CSV), JSON, TIFF, Shapefiles and XML. Moreover, the CKAN API (Application Programming Interface) will be used to expose the data and functionalities developed as part of the IS, allowing end-users to connect and interact with the PONDERFUL datasets.

PONDERFUL IS is based on CKAN software, is open-source and maintained in GitHub. It is freely available to the public for use and modification in other projects, enhancing the visibility and interoperability with other information platforms.

Information on metadata standards to promote interoperability is described in the section 2.1.4 above. Future versions of the DMP will include a general glossary to share information about the vocabulary and general methodologies employed for the generation of the datasets.

2.4. Increase data re-use (through clarifying licences)

2.4.1. Data licenses

As we mentioned above, in the case that PONDERFUL partners have full intellectual ownership of the data and no restrictions imposed by third parties or no other reasons for non-disclosure of data have been specified, the data will be released under an Open Data License (Creative Commons CC Zero License or Creative Common Attribution License-CC-BY v4.0).

If anybody can access the data obtained from the third party, the following open licenses are recommended:

- CC0 1.0 Universal (Creative Commons Public Domain Dedication License; https://creativecommons.org/publicdomain/zero/1.0/)

- CC-BY v4.0 (Creative Common Attribution License; https://creativecommons.org/licenses/by/4.0/)

If permission from the third party has only been granted under specific conditions and data use is permitted for authorised users only, PONDERFUL partners should use one of the non-open licenses for data not fully owned by the PONDERFUL project (see Table 1).

The Project Data Manager (see section 3 below) will supervise that each responsible partner uploading data to the IS and to the open access data repositories apply the proper licenses for the data and, where possible, will seek to ensure free, open access for this data.

Following the license scheme described above, PONDERFUL partners will be able to decide whether the access will be widely open (this should be the case of all foreground project outputs), available after user registration, or restricted to specific groups:

- Free access to the IS: any user without registration can download and view the datasets;
- Authenticated users: only users who have previously registered to the IS can have access to the datasets; authenticated users subscribed to a specific group, will have access to certain datasets, such as, for instance, unpublished datasets of the project case studies.

Table 1: Types of non-open licenses for data not fully owned by PONDERFUL

License Name	You are free to	Under the following terms	Additional restrictions
CC-BY-SA v4.0 (Creative Common Attribution Share-Alike Licence)[1]	Share copy and redistribute the material in any medium or format Adapt remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms.	Attribution You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. Share Alike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.	No additional restrictions You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.
CC-BY-NC v4.0 (Creative Common Attribution Non-Commercial Licence)[2]	Share copy and redistribute the material in any medium or format Adapt remix, transform, and build upon the material The licensor cannot revoke these freedoms as long as you follow the license terms.	Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. Non-commercial — You may not use the material for commercial purposes.	No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.
CC-BY-NC-SA v4.0 (Creative Common Attribution Non-Commercial Share-Alike Licence)[3]	Share — copy and redistribute the material in any medium or format Adapt — remix, transform, and build upon the material The licensor cannot revoke these freedoms as long as you follow the license terms.	Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. Non-commercial — You may not use the material for commercial purposes. Share Alike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.	No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.

[1] http://creativecommons.org/licenses/by-sa/4.0/

[2] https://creativecommons.org/licenses/by-nc/3.0/

[3] https://creativecommons.org/licenses/by-nc-sa/2.5/

The users count on a protocol, which is described in Figure 1 below, that must be followed to specify the recommended data license before publishing data or metadata into the IP.

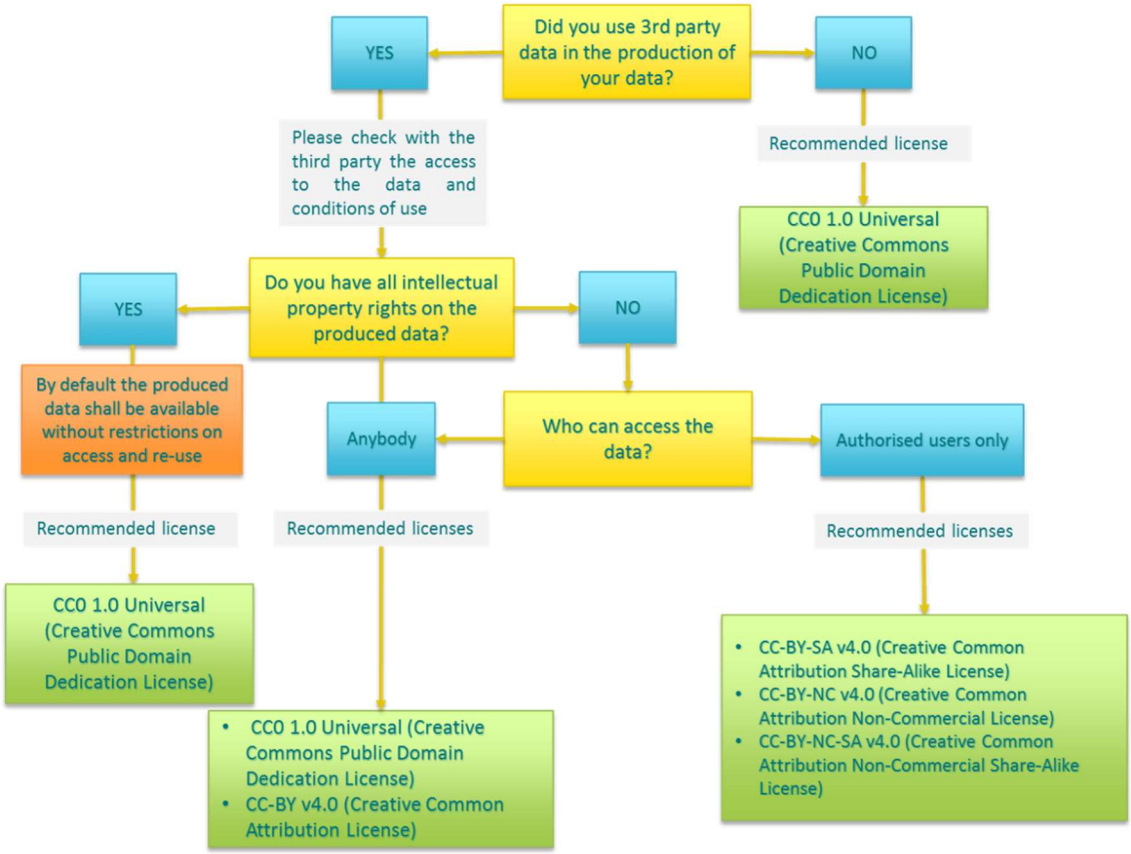

Figure 1: Data origin and respective licensing scheme

2.4.2. Embargo periods

"Embargo" periods are imposed by PhD thesis and by the publication policy of some journals. In case of green open access, the scientific publisher's modalities for open access (e.g. embargo periods) must allow the researcher to fulfil the EC's open access obligations. Furthermore, the repository used by the scientific publisher should be OpenAIRE-compliant and issue a DOI (see section 2.1.1) if the researcher is not allowed to deposit a copy of the publication in a repository of his/her choice. For finding suitable open access publishers, PONDERFUL researchers will be encouraged to consult the Directory of Open Access Journals (https://doaj.org/), a service that indexes high quality, peer-reviewed open access academic journals that use an appropriate quality control system.

2.4.3. PONDERFUL long-term data storage

The long-term archiving and preservation of PONDERFUL data will be based on the best research data management practices coming from the OpenAIRE (https://www.openaire.eu) and Zenodo. In this sense, the research results from PONDERFUL, which will be deposited in Zenodo repository will be available by third parties after the end of the project, since the preservation of the datasets is guaranteed by the Zenodo archive server. In this sense, the open results that are deposited in the

Zenodo repository, according to Zenodo's general policies (http://about.zenodo.org/policies/), will be retained for the lifetime of the repository. This is currently the lifetime of the host laboratory CERN, which currently has an experimental programme defined for the next 20 years at least.

2.4.4. Quality assurance

Quality assurance concerning accuracy and completeness of metadata will be performed by the data managers mentioned in 2.6 according to the quality control procedures described in the Grant Agreement.

3. Allocation of resources

3.1. Costs for making PONDERFUL data FAIR

There are no immediate costs anticipated to make FAIR the research results generated in PONDERFUL as there are no costs for storing open results in the project's default repository (Zenodo, see section 2). Similarly, no immediate costs are anticipated for open data that is stored for long-term preservation in the Zenodo repository. Costs related to open access to research data in Horizon 2020 are eligible for reimbursement during the duration of the project under the conditions defined in the Grant Agreement.

Regarding the PONDERFUL IS, the costs for development and maintenance will be covered as part of WP5. Additional details will be reported, as needed, in next versions of the DMP.

3.2. Roles for data management in PONDERFUL

Data management activities concern the whole project and need to be coordinated and monitored both at project and work package level. Data management is also linked to publication of project results and thus dissemination activities. According to the previous points, the following roles and responsibilities can be identified:

1. **Project Data Manager (i.e., leader of the Data Management)** is responsible for:

    - developing the data management plan and policy in cooperation with the project manager and the technical partners
    - coordinating the technical realization of PONDERFUL's DMP
    - providing support to WP data managers
    - coordinating the writing of the DMP deliverable documents
    - ensuring that the open access policy of the journal complies with the H2020 open data requirements before the researcher submits a manuscript

- monitoring that open results (data, software and metadata) are deposited in the PONDERFUL IS and sending reminders to partners
- supervise that each responsible partner uploading data to the IS and to Zenodo apply the proper licenses for the data

2. Work package Data Managers

- the implementation of the data management policy in their respective WPs
- monitoring data management activities and deadlines and sending reminders to partners
- asking partners for missing information or clarifications
- providing input to the DMP deliverable documents by analysing and summarizing the WP-specific datasets
- contacting the Data Management Expert Group in case of questions and ethical and privacy issues that may forbid a publication of the data
- ensuring that the metadata of data used and produced at WP-level is made available according to the PONDERFUL data management policy and guidelines in a timely manner

3. Dissemination Manager

- offering assistance in choosing the right publication path (green or gold open access) and guidance for publishing scientific publications
- monitoring that publications are deposited in Zenodo and sending reminders to partners
- monitoring that research data related to a publication is made available in Zenodo and linked to respective publication
- monitoring that green access (self-archiving) publications are deposited in repositories and sending reminders to partners
- monitoring that metadata about publications is made available in the EC Research Participant Portal (preferably automatically through OpenAIRE) and on the PONDERFUL website
- monitoring possible embargo periods and sending reminders to partners
- monitoring that open results available in OpenAIRE (through Zenodo) are properly linked with the PONDERFUL IS

4. Quality Assurance and Ethics Manager

- performing a quality assurance and ethics assessment of open data before their publication
- keeping contact with data managers and decide together with the Data Management Expert Group on critical issues

5. **Data Provider / Scientist**

- informing the data and dissemination managers when new open data / publications ready for publishing are available
- describing the data (by means of appropriate metadata) or scientific publication in accordance to the PONDERFUL data management policy and with help of the tools (i.e., PONDERFUL IS) provided by the project
- depositing (i.e., publishing) into Zenodo the research data and scientific publications in accordance to the PONDERFUL data management policy

4. Data security

4.1. Data recovery and secure storage and transfer of sensitive data

Backups of data stored in the PONDERFUL IS will be performed weekly or daily depending on the amount of data transferred and the use level of the IP. All backups will be stored on a dedicated server and, if possible, also on a local machine.

In addition, all the publications and research data uploaded to Zenodo, both data files and metadata, will be kept in multiple online replicas and will be backed up to tape every night. Moreover, since all uploads will be registered with DOIs (see section 2.1.1), all citations and links to Zenodo resources of PONDERFUL data would not be affected by the closure of the repository (but see section 2.4.3 on long-term preservation).

With respect to data collected and generated within the PONDERFUL project that does not fall under personal data and is planned to be used within the IS (see Section 2.1), this data will generally use already publicly available information and, as such, will not have any significant security implications that need to be addressed. However, in order to protect privacy, security, confidentiality and intellectual property rights, the data providers (see section 3.2) are allowed to specify the recommended data license before publishing data or metadata into the IS (see section 2.4.1, Figure 1). On the other hand, research results deposited in the Zenodo repository are stored in CERN's EOS service (http://eos.web.cern.ch/content/about-eos), which is managed according to the CERN Security Baseline for Servers (see section 2). Furthermore, research results deposited in the Zenodo repository are safely stored for long time preservation (see section 2.4.3).

Regarding the management of personal data, at every stage of the project, data will be held in accordance with the data protection legislation currently in force in the countries of PONDERFUL participants. As such, personal data will only be collected for the organisation of meetings and events and will not be uploaded to the repositories. Any personal data gathered in the course of PONDERFUL project will be duly secured and handled in accordance with the principles of good practice according to EU Directive 95/46/EC such that data must be: fairly and lawfully processed; processed for limited purposes; adequate, relevant and not excessive; accurate; not kept longer than necessary; processed

in accordance with the data subject's rights; secure; not transferred to countries without adequate protection.

References

[1] C. Ramjoue and O. Marganne, “TEMPLATE HORIZON 2020 DATA MANAGEMENT PLAN (DMP),” 13 October 2016. [Online]. Available: https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-data-management/data-management_en.htm [Accessed 3 February 2021].

[2] Directorate-General for Research & Innovation, “Guidelines on FAIR Data Management in Horizon 2020, Version 3.0,” EUROPEAN COMMISSION, 26 July 2016. [Online]. Available: http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf. [Accessed 10 May 2021].

[3] Directorate-General for Research & Innovation, “Guidelines to the Rules on Open Access to Scientific Publications and Open Access to Research Data in Horizon 2020, Version 3.2,” European Comission, 2017 March 21. [Online]. Available: https://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf. [Accessed 10 March 2021].

[4] European Research Council, “Guidelines on the Implementation of Open Access to Scientific Publications and Research Data in projects supported by the European Research Council under Horizon 2020, Version 1.1,” 21 April 2017. [Online]. Available: https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/oa-pilot/h2020-hi-erc-oa-guide_en.pdf. [Accessed 11 May 2021].

Annex I – Brief description of the PONDERFUL datasets

Name	Responsible party	WPs involved	Data provenance	Intended use	Data type	File format	Temporal coverage	Spatial coverage	Temporal/Spatial resolution	Descriptive text	Open access	Owner
stratified survey	KU Leuven	WP2		address the objectives of WP2	excel	xlsx	2021-2022	Europe+Uruguay			yes	WP2 contributors
pan-European database	KU Leuven	WP2		address the objectives of WP2	excel	xlsx	2000-2023	Europe			partly	contributors
targeted case studies	KU Leuven	WP2		address the objectives of WP2	excel	xlsx	2007-2023	BE, FR,UK,S,CH			partly	contributors
mesocosm experiment	UA	WP2		address the objectives of WP2	excel	xlsx					restricted access	UA
land use scenarios	BU	WP3	LUISA	Used for downscaling land use scenarios at pondscapes	Grid data	Raster	varied	europe	10 m to 60 m		yes	LUISA
satellite derived pondscapes	METU	WP3	Copernicus	Used for identifying ponds and their hydroperiods	Grid data	Raster	days to weeks	World (but focus on Europe in PONDERFUL)			yes	Copernicus
land use scenarios	BU	WP3	LUH2	Used for land use projections	Grid data	Netcdf	850-2100	global	years at 0.25 degrees	https://luh.umd.edu/	yes	University of Maryland
land cover high resolution layers	BU	WP3	Copernicus	Used for land use models	Grid data	Raster	2012, 2015, 2018	Europe	every 3 years	https://land.copernicus.eu/pan-european/high-resolution-layers	yes	Copernicus
climate projections	BU	WP3	CHELSA	used for cc scenarios	Grid data	Raster	varied	Global	varies	https://chelsa-climate.org/	yes	Swiss Federal Institute for Forest, Snow and Landscape Research WSL
pondscape morphometric information	all DEMO-site leaders	WP4	task 4.3	In DEMO-sites: Pondscape presentation	numerical values	excel/access	2010-2023	in each pondscape (15 pondscapes)	various	These data are collected for the description of the 15 pondscapes. They will be	yes	PONDERFUL

Name	Responsible party	WPs involved	Data provenance	Intended use	Data type	File format	Temporal coverage	Spatial coverage	Temporal/Spatial resolution	Descriptive text	Open access	Owner
(surface area , shape, land use)				(leaflet) and pondscape assessment						partially presenmted in a leaflet, available to stakeholder (or other interested parties)		
Physico-chemistry of water of several ponds in a pondscape	all DEMO-site leaders	WP4	task 4.3	In DEMO-sites: Pondscape presentation (leaflet) and pondscape assessment	numerical values	excel/access	2010-2023	in each pondscape (15 pondscapes)	various	These data are collected for the description of the 15 pondscapes. They will be partially presenmted in a leaflet, available to stakeholder (or other interested parties)	yes	various (stakeholder / PONDERFUL)
Ecosystem function indicators (Carbon sequestration, pond metobolism, GHG production, decomposition)	all DEMO-site leaders	WP4	task 4.3	In DEMO-sites: Pondscape presentation (leaflet) and pondscape assessment	numerical values	excel/access	2010-2023	in each pondscape (15 pondscapes)	various	These data are collected for the description of the 15 pondscapes. They will be partially presenmted in a leaflet, available to stakeholder (or other interested parties)	yes	various (stakeholder / PONDERFUL)
Indicators measured in a set of NCPs (from a list of 11 NCPs)	all DEMO-site leaders	WP4	task 4.3	In DEMO-sites: Pondscape presentation (leaflet) and pondscape assessment	numerical values	excel/access	2010-2023	in each pondscape (15 pondscapes)	various	These data are collected for the description of the 15 pondscapes. They will be partially presenmted in a leaflet, available to stakeholder (or other interested parties)	yes	various (stakeholder / PONDERFUL)
Biodiversity indicators (taxa lists and various metrics)	all DEMO-site leaders	WP4	task 4.3	In DEMO-sites: Pondscape presentation (leaflet) and pondscape assessment	numerical values	excel/access	2010-2023	in each pondscape (15 pondscapes)	various	These data are collected for the description of the 15 pondscapes. They will be partially presenmted in a leaflet, available to stakeholder (or other interested parties)	no (as data sources are various)	various (stakeholder / PONDERFUL)
Cost-benefits indicators	all DEMO-site leaders	WP4	task 4.3	In DEMO-sites: Pondscape presentation (leaflet) and pondscape assessment	numerical values	excel/access	2010-2023	in each pondscape (15 pondscapes)	various	These data are collected for the description of the 15 pondscapes. They will be partially presenmted in a leaflet, available to stakeholder (or other interested parties)	yes	various (stakeholder / PONDERFUL)

Name	Responsible party	WPs involved	Data provenance	Intended use	Data type	File format	Temporal coverage	Spatial coverage	Temporal/Spatial resolution	Descriptive text	Open access	Owner
NBS	UVic	WP4	task 4.1	Internal use and external public platform	text/alpha-numerical	excel/access	various	Europe	various	These descriptions of NBS are collected all over Europe, and a large selection will be made publiquely available on EU platforms (like OPPLA)	yes	PONDERFUL