DWC – Data Management Plan

(M18 update)

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License	 This work is licensed under a Creative Commons Attribution 4.0 International License
Abstract	The Data Management Plan (DMP) is a guidance document, which introduces a series of clear rules and procedures to improve data management during the project and foster the reuse of publications and data in open access.

Dissemination level of the document

X	PU	Public
	PP	Restricted to other programme participants
	RE	Restricted to a group specified by the consortium
	CO	Confidential, only for members of the consortium

Versioning and contribution history

Version*	Date	Modified by	Modification reasons
D1	2020-11-23	M. Rustler (KWB)	Updated data table and added licence (CC-BY-4.0), based on Rustler and Caradot (2019)
S	2020-11-28	N. Caradot (KWB)	Final version for submission

* The version convention of the deliverables is described in the Project Management Handbook (D7.1). *D* for draft, *R* for draft following internal review, *S* for submitted to the EC and *V* for approved by the EC.

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List of Abbreviations

CC: Creative Commons

DOI: Digital Object Identifier

DMP: Data Management Plan

EC: European Commission

EU: European Union

FAIR: Findable, Accessible, Interoperable and Reusable

FOSS: Free and Open Source Software

OA: Open Access

ORDP: Open Research Data Pilot

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Executive summary

The Data Management Plan (DMP) is a guidance document, which introduces a series of clear rules and procedures to improve data management during the project and foster the reuse of publications and data in open access.

This document is a first update of the initial data management plan (Rustler and Caradot, 2019), which is delivered in M18 and indicates the level of confidentiality of the data collected and generated during the project.

Further updates of the DMP are planned in M30 and M42.

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1. Introduction

DWC's main goal is to boost the integrated management of water systems in five major European cities – Berlin, Milan, Copenhagen, Paris and Sofia – by leveraging the potential of data and smart digital technologies. 24 partners from 10 European countries will develop and demonstrate the benefits of a panel of innovative digital solutions to address major water-related challenges. These include the protection of human health, the performance and return on investment of water infrastructures and the public involvement in urban water management. DWC integrates the development of digital solutions in a dedicated guiding protocol to cover the existing gaps regarding governance, interoperability and cybersecurity.

The **Data Management Plan** (DMP) describes the "data management life cycle for the data to be collected, processed and/or generated by the project" (H2020 online manual). In particular, it includes information on

- the handling of research data during and after the end of the project
- what data will be collected, processed and generated
- which methodology and standards will be applied
- whether data will be shared and made open access and
- how data will be curated and preserved, including after the end of the project

The DMP introduces a series of clear rules and procedures to improve data management during the project and foster the reuse of publications and data in open access.

Following the rules of H2020, DWC must ensure open access to all peer-reviewed **scientific publications** relating to its results.

As a project participating in the Open Research Data Pilot (ORDP) in Horizon 2020, DWC will make its research data findable, accessible, interoperable and reusable (FAIR). It means that the **research data** needed to validate the results must be made publicly available (open access) together with the publications. Nevertheless, data sharing in the open domain can be restricted, taking in account "the need to balance openness and protection of scientific information, commercialization and Intellectual Property Rights (IPR), privacy concerns, security as well as data management and preservation questions" (EC, 2017a).

This version is the first update of the initial DMP (Rustler and Caradot, 2019) of the project. As data management will evolve during the lifetime of the project, updates of the DMP are planned in project-months 30 and 42, and whenever significant changes arise (e.g. new data, consortium policies/composition).

Chapter 2 introduces briefly the DWC approach for ensuring open access to publication and data. Chapter 3 presents the list of data generated during the project. Chapter 4 describes the rules and procedures adopted for the FAIR principles whereas the final chapters give insights on resources (Chapter 5), data security (Chapter 6) and ethical aspects (Chapter 7).

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2. Workflow FAIR

Figure 1 shows the DWC approach for the application of the FAIR principles as a function of the dissemination level (public or confidential).

For **confidential deliverables**, the draft versions are uploaded to Nextcloud, used for short-term file sharing within the project consortium. The final version is uploaded to the online repository Zenodo for long-term archiving, but with restricted access to externals (only metadata are visible to the public). Deliverables with business-critical data might not be uploaded on the repository.

For **public deliverables and journal publications**, the **research data** (see Appendix 1) required to validate the results are first uploaded with open access on Zenodo before the publication so that the data can be properly cited. In case this is not possible (e.g. double-blind review), data should be made available after acceptance.

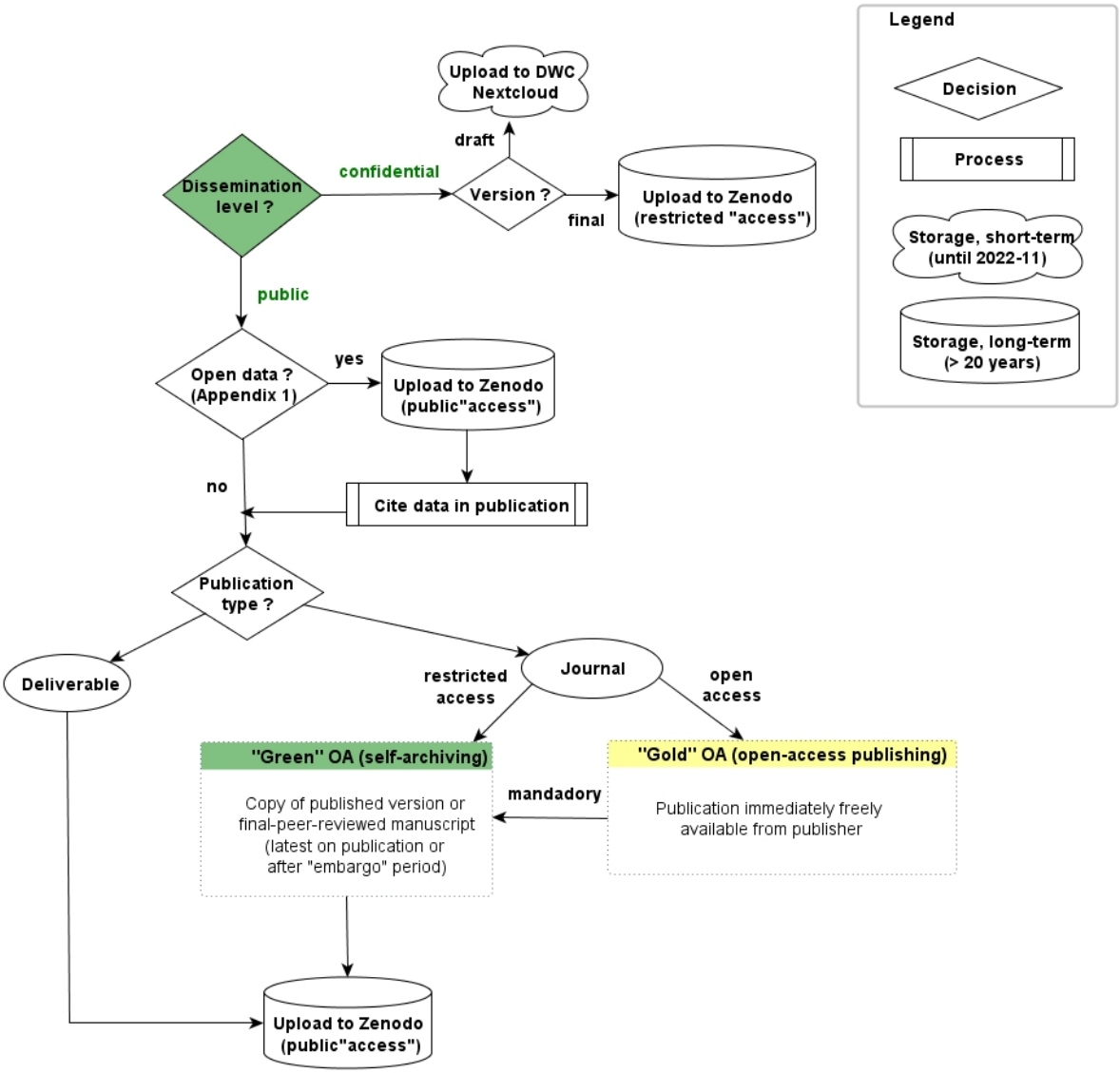

Figure 1 DWC`s workflow for providing FAIR data

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Then, the workflow differs depending on the type of publication:

Public deliverables are stored with open access on Zenodo after their validation by the European Commission.

Scientific publications are published either on green or gold access:

- ***Gold open access*:** the article is publicly available via the publisher website. Gold access typically requires the authors` to pay an article processing fee. Even in this case, self-archiving in an online repository is mandatory by the European Commission for guaranteeing long-term availability (EC, 2017a).
- ***Green open access:*** by publishing in a restricted access journal (paid subscription needed), a copy of the published version or final-peer-reviewed manuscript is stored on Zenodo. This must be done at the date of publishing or at latest after an embargo period of at maximum six months (EC, 2017a).

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3. Data Summary

A table in Appendix 1 presents a first overview of all data collected and generated during the project, including:

- General description of the data
- Name of the beneficiary responsible
- Work package (WP) involved
- Type, format and expected size of data
- Production and origin (how has the data been produced?)
- Purpose (what is the utility of the data in DWC?)
- Potential for reuse (what would be utility of the data for other users?)

It also specifies if each data will be publicly available in open access or if access needs to be restricted (open access: yes / no) in case of range of sensitive data such as information on critical infrastructures, personal data affected by GDPR or raising any ethical concerns (see Chapter 7).

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4. FAIR data

4.1. F(indable)

4.1.1. Naming and versioning

Consistent and descriptive file naming conventions have been defined to facilitate the findings of the files during and after the project and to understand quickly their content.

For deliverables, the naming convention (e.g. controlled vocabulary for drafts, submitted and approved versions) is defined in the DWC Project Management Handbook (Deliverable 7.1).

For data, it is recommended to use the best-practices on file and folder naming (Rustler et *al.*, 2019) developed within the research data management project FAKIN at KWB. It consists in using only a series of allowed characters:

- upper case letters (A-Z),
- lower case letters (a-z),
- numbers (0-9),
- underscore (_),
- hyphen (-) and
- dot (.)

Instead of spaces the characters underscore (_) or hyphen (-) should be used. Underscore (_) should be used to separate words that contain different types of information (e.g. **results_today** instead of **results-today**). Hyphen (-) should be used instead of underscore (_) to visually separate the parts of compound words or names:

- **site-1** instead of **site_1**,
- **dissolved-oxygen** instead of **dissolved_oxygen**,
- **clean-data** instead of **clean_data**

DWC data should be encoded in UTF-8 and follow the naming convention below:

"dwc_{data-name}_{version-number}.{file-type}"

with:

dwc: identifier of DWC project (all lower-case)

data-name: short but informative data description, e.g. ` site_dissolved-oxygen ` or `fluidion_site-paris_e-coli'. The hyphen (-) is used to visually separate the parts of compound words while the underscore (_) separates words that contain different types of information and

version-number: semantic versioning (i.e. v0.1.0, v0.2.0, v1.0.0) in combination with a metadata file (e.g. VERSIONS.txt) briefly describing the major changes in the data should be used. In case of programming code the use of version control software (e.g. Git, Subversion) is recommended.

file-format: data should be saved in long-term preservation friendly file formats (Table 1)

Example of a file name: dwc_fluidion_site-paris_e-coli_v1.0.0.csv

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4.1.2. Metadata

In addition, a metadata file (e.g. a plain text file “README.txt”), which describes the data in more detail should be added along the data (stored in same folder). This file should contain the descriptions and definitions for the following type of content (DataOne, 2019):

- Parameter names and units
- Formats for dates, time, geographic coordinates and other parameters
- Coded values (e.g. error numbers)
- Quality flags (e. g. 0 = raw-data, -1 = potential problems, 1 = "good data")
- Missing values (e.g. NA = not available)

For example in case of publishing time-series from data-loggers, the content of all columns need to be described in a separate metadata file (e.g. attribute name and physical unit) – ideally using a controlled vocabulary like ODM-2 (http://vocabulary.odm2.org/) in order to increase reusability and interoperability. This file needs to be prepared by the data owner before uploading the data for long-term archiving, which is described in the following sub-chapter.

4.1.3. Long-term archiving

The publications and data generated within DWC will be **stored in Zenodo**, a general-purpose repository for long-term archiving the whole research life cycle (e.g. raw data, processed data, program code or deliverables). Zenodo is operated by CERN and funded by the EU, and is FAIR compliant (https://about.zenodo.org/principles/#fair-principles).

Data stored in the repository Zenodo are described with **metadata** following a JSON schema defined by Zenodo, which can be exported in several standard formats such as MARCXML, Dublin Core, and DataCite Metadata Schema (according to the OpenAIRE Guidelines). As additional metadata, search keyword categories will be assigned to the data (to be defined within the course of the DWC project).

Zenodo automatically assigns a DOI (**Digital Object Identifier**) to every submitted record and each of its versions, for research data as well as for publications. Research data may be linked to the corresponding publications and vice versa via their DOIs. According to the principle of "Good Scientific Practice" the data files cannot be changed after they have been published in Zenodo. Therefore, one of the core functions of Zenodo is versioning, which allows new versions of published records while previous versions are kept available (e.g. in order to guarantee correct citation). To every new version, a new persistent identifier (DOI) is assigned. Previous and new versions are linked to each other automatically.

To enable search engines and service providers to index content which is stored in Zenodo, it is offering an OAI-PMH interface. Zenodo is registered in OpenDOAR and publishes its records in OpenAIRE. Zenodo is included in common search engines, e.g. Google Scholar, BASE – Bielefeld Academic Search Engine and others. Furthermore, the DOI registration agency DataCite itself acts as a data provider: while registering a DOI, all important metadata are sent to DataCite.

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4.2. A(ccessible)

As a general policy, data generated within DWC will be shared and made available on open access (see table in Appendix 1).

Publication and open data will be stored on the DWC community folder within the online repository Zenodo (https://zenodo.org/communities/dwc/) (Figure 2). Data should be released before publishing the associated deliverable or journal paper, so it can be cited. In case this is not possible (e.g. double-blind review), data should be made available after acceptance.

Partners may deposit **restricted files** (e.g. confidential deliverables) with the ability to share access with others if certain requirements are met. These files will not be made publicly available and sharing will be made possible only by the approval of the depositor of the original file.

Partners can also assign an **embargo** to the files. The embargo blocks the publication of the files until a certain date or allow a restricted access (e.g. to project partners only).

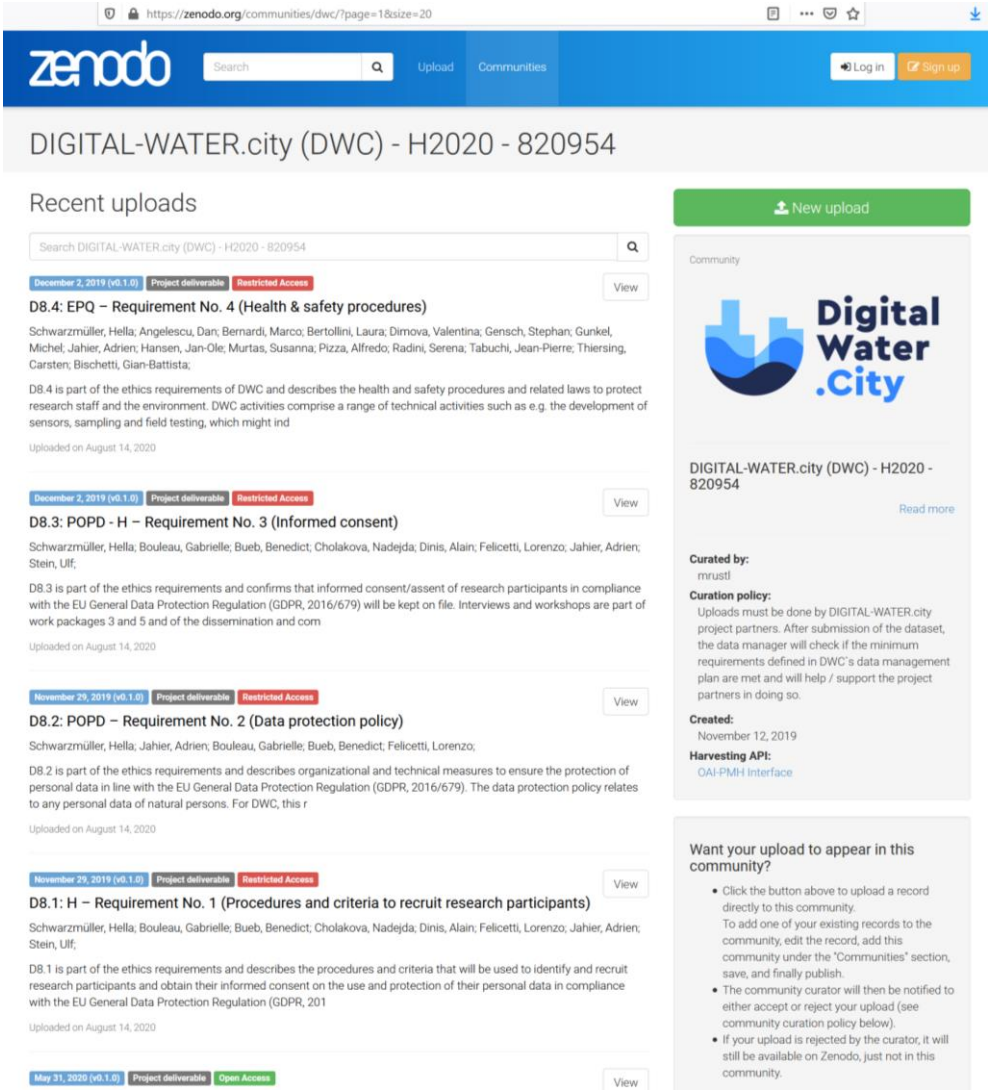

Figure 2. DWC community in online repository Zenodo

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By default, all **metadata** in Zenodo are publicly available as soon as the file is published, even if accessibility is limited due to an embargo. In this way and even in case of access restrictions, any scientist interested by an uploaded file can contact the author to ask for individual access agreements.

A **license** is assigned to each file released on Zenodo (based on Open Definition), which specifies the permission rights (see Chapter 4.4 for recommended licenses of DWC outputs).

Accessing Zenodo's repository system does not require any specific software and provides open access according to national and EU regulation. However, only DWC project partners will have permissions to upload files to the community. For uploading a new file, the following workflow applies:

- Go to: https://zenodo.org/deposit/new?c=dwc,
- Upload your file (< 50GB),
- Add additional metadata required for Zenodo (i.e. access right, license, grant id, keywords) and finally
- Click on save and publish.

Subsequently the file will be in draft status, which still requires approval. DWC`s data manager will check if the provided file complies with DWC`s FAIR principles and if so approve it for open access publication.

4.3. I(interoperable)

Open data should be provided in long-term preservation friendly (> 10 years) file formats (Table 1). For data, (e.g. raw or processed data), the non-proprietary, human readable file format CSV is recommended, as it can be opened with every text editor (e.g. open source Notepad++), thus minimizing the need of proprietary software (e.g. MS Office).

Table 1 Suitability of file formats for long-term preservation (Kaden and Kleineberg, 2018)

	More than ten years	Up to ten years	Not suitable
Text	PDF/A, TXT, ASC, XML	PDF, RTF, HTML, DOCX, PPTX, ODT, LATEX	DOC, PPT
Data	CSV	XLSX, ODS	XLS
Pictures	TIFF, PNG, JPG 2000, SVG	GIF, BMP, JPEG	INDD, EPS
Audio	WAV	MP3, MP4	
Video	Motion JPG 2000, MOV	MP4	WMV

It is one of the principles of Zenodo to use standard interfaces (e.g. OAI-PMH for data-exchange), protocols and metadata. Using standard metadata schemes in Zenodo, metadata can easily be converted into other metadata schemas. For example, research data deposited at Zenodo will get additional metadata, which are based on controlled vocabularies for licenses (Open Definition), funders (FundRef) and grants (OpenAIRE).

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4.4. R(eusable)

As seen in the previous sections, the long-term (re)usability of DWC`s open data by third parties is ensured by the use of appropriate file formats and of the repository Zenodo, which guarantees data storage and open access for at least the next 20 years (see also Chapter 6).

The release of files in Zenodo required the selection of an **appropriate license**. The following licenses (Creative Commons, MIT) will be used to increase the reusability of DWC`s research outcomes:

- Data and publications: CC licenses
- Software/Source code: free and open source software (FOSS) compliant permissive license (e.g. MIT License)

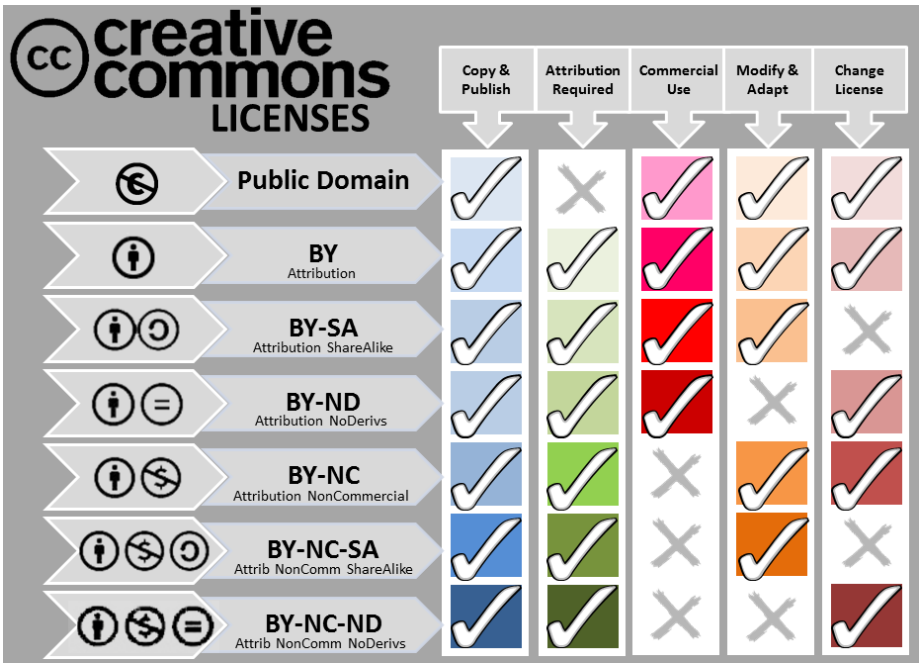

Figure 3. Comparison of Creative Commons licences (source: Northeastern University, ITS)

Creative Commons (CC) is a non-profit organisation dedicated to increasing the number of cultural works in the public domain (Creative Commons, 2019). It does so by providing a number of different licenses that content creators can use to indicate the terms under which content is made available. Figure 3 summarises the main differences of the seven different Creative Commons licenses. The licenses range from complete public domain (CC Public Domain), which allow anyone to use the content for anything, to licenses that only allow non-commercial use (CC-BY-NC), to licenses that allow use with attribution to the original source.

For open data and publication, the most permissive license with attribution (CC-BY 4.0 International) is recommended as default. However, each researcher is free to choose a more restrictive license if needed for his/her work. In this case CC`s step-by-step guide for choosing a license is recommended.

MIT is a short and simple permissive license for licensing software (software), only requiring preservation of copyright and license notices, i.e. licensed works, modifications and larger

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works may be distributed under different terms and without source code (Open Source Initiative, 2019). It is used by Kompetenzzentrum Wasser Berlin gGmbH for all of its public source code and recommended as default for DWC`s public software products. However, if this license does not fit a researcher`s need, the website https://choosealicense.com/ (choosealicense, 2019) can help to find a better fit.

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5. Allocation of resources

5.1. Open access costs

As introduced in Chapter 2, two main routes to open access are considered for the dissemination of peer-reviewed scientific publications.

Self-archiving / 'green' open access – the author archives the published article or the final peer-reviewed manuscript in the online repository Zenodo at latest upon publication or after a given embargo period requested by the publishers. To provide support concerning compliance with Horizon 2020 embargo periods (< 6 months) the European Commission offers a model amendment to publishing agreement (EC, 2017b), which is often signed between authors and publishers. Within the DWC project this model should be used by authors for negotiations with the publisher in case 'gold' open access was not planned. The version deposited should be identical to the published version (in layout, pagination, etc.). In case the publisher rejected the model amendment, at least the deposition of a preprint should be possible for almost all journals and publishers (Wikipedia, 2019).

Open access publishing / 'gold' open access - the article is immediately published in open access mode via the publisher website. In this model, the payment of publication costs is shifted away from subscribing readers. Researchers can publish in open access journals, or in hybrid journals that both sell subscriptions and offer the option of making individual articles openly accessible. The costs, often referred to as Article Processing Charges (APCs) are charged to the author. Note that there are also some 'gold' open access journals that do not require payment of APCs (e.g. https://www.sciencedirect.com/journal/applied-computing-and-informatics. Two 'gold' open-access publications are planned in DWC for a total cost of 6000 €. The EC requires also in case of open-access publishing ('gold' open access) to self-archive ('green' open-access) in a repository, to ensure that the article is preserved in the long term (see above).

5.2. Data management costs

During the project, the open source file sharing platform Nextcloud is used to facilitate efficient internal communication and collaborative work (https://nextcloud.org). Nextcloud is hosted on a managed server (including backups up to six months) for 50 €/month.

The long-term storage of data and publications is ensured by the repository Zenodo which is free of charge (limit: 50 GB per file). However, uploading files and adding relevant metadata (e.g. keywords, project grant and license) requires human resources, which will vary depending on the complexity of the file.

5.3. Data management responsibilities

The DMP applies to all project partners and subcontractors. Each beneficiary will be responsible to manage its data adequately. If a beneficiary intends to publish with external co-authors, he will make them aware of the DWC DMP requirements and make sure that primary research data are stored to the same standard as required for H2020 projects.

Within the DWC project the following data management responsibilities are defined:

The **data providers** are responsible for the metadata management as well as for the quality check of the data. From a large amount of collected data during the project, they select the relevant data that shall be preserved. In the submission process to Zenodo, they describe

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and upload the data. Data providers are also responsible to create new versions of published submissions, if necessary. The submission process of a new data version is the same as the primary process.

The **data manager** (Michael Rustler, KWB) is responsible for the quality check of the metadata and the formal check of the submitted files. The uploaded files are not published immediately but stored in an intermediate store. The data manager verifies if the submitted file follows the rules proposed in the DMP (e.g. name conventions, metadata descriptions, file formats, etc.), if necessary contacts the data provider in case of an issue, and finally proceeds to the official publication on Zenodo.

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6. Data security

Data security is the responsibility of each partner. However, some general recommendations are given below:

- Back up your files/data regularly and use different media for it (e.g. external hard drives, computer hard drives, departmental server)
- Enable computer firewalls and keep antimalware software up-to-date and operational.
- Users must have access to the computers and/or servers via individual user accounts, not via shared accounts.
- Collaborative networks/platforms/intranets: permission-controlled files so that users, depending on their status, have only “read only” or also “write” access to files.
- Computers connected to networks should not store sensitive data, unless data is encrypted, so as to minimize network vulnerabilities.
- Cloud-based storage (Nextcloud, Zenodo) is useful as a secondary or tertiary storage location for your files.

Nextcloud

The security of the open-source software Nextcloud (https://nextcloud.org) was evaluated by DWC's data security officers in August 2019, who provided a series of recommendation, such as to back up the cloud-storage for at least one year. Nextcloud service provider “dogado GmbH” stores backups for the last six months (1 week: daily, 1 month: weekly, 6 months: monthly) and daily backups are saved on the internal server of KWB. “dogado GmbH” is also in charge to perform regular Nextcloud security updates to minimise the risk of cyberattacks. The latest security check performed on 2019-11-12 using the tool https://scan.nextcloud.com indicates that “this server is up to date, well configured and has industry leading hardening features applied, making it harder for an attacker to exploit unknown vulnerabilities to break in” (see: https://scan.nextcloud.com/results/da5a977b-eef8-4a21-8f23-e3084c3d67cf).

Zenodo

The research data repository Zenodo applies a large range of measures for data security (https://about.zenodo.org/infrastructure/#security) and guarantees that “data and metadata will be retained for the lifetime of the repository”, which is currently “for the next 20 years at least”. (https://about.zenodo.org/principles/). However, Zenodo`s ‘closed-access’ is not suitable for business-critical confidential data, as these files are “stored unencrypted and may be viewed by Zenodo operational staff under specific conditions” (https://about.zenodo.org/infrastructure/#security)."

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7. Ethical aspects

The following DWC deliverables deal with ethical and legal aspects:

- D 8.1: Procedures and criteria to recruit research participants
- D 8.2: Data protection policy
- D 8.3: Informed consent
- D 8.4: Health and safety procedures

All content stored in Zenodo will be anonymised according to the DWC`s ethical rules, i.e.:

- **Anonymization of personal data:** when submitting a data file in Zenodo the submitter confirms that the submitted data do not contain any personal data. If personal data are contained they are anonymized completely according to canonical standards and the human subjects have consented to the data collection as well as to the publication of the (anonymized) data.
- **Personal rights:** when submitting a data file in Zenodo the submitter also confirms that by submitting personal metadata (name and surname of the participating scientists) he/she acts in consent with all persons whose data he/she enters. He/she also confirms that he/she doesn't violate any personal rights by omitting the name of any participating scientist.

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Appendix 1

ID	Water cycle	Description 1	Description 2	Cities involved	General information	Related digital solution	Responsible	Involved partners	WP	Type	Format	Production / Origin	Expected size	Purpose Use in DWC	Potential for reuse Use for others outside DWC	Open data? Y/N	If confidential: justification	Comments
1	River	Measurement	E-coli, enterococci	Berlin	Measurement of bacterial concentration with FLUIDION ALERT System	1	KWB	FLUIDION	1	Time series	csv, txt	ALERT System	Mb	Analysis of bathing water quality and calibration of forecasting tools	New development of simulation tools of river water quality	N	Critical infrastructure	
2	River	Measurement	E-coli, enterococci	Paris	Measurement of bacterial concentration with FLUIDION ALERT System	1	SIAAP	FLUIDION	1	Time series	csv, txt	ALERT System	Mb	Analysis of bathing water quality and calibration of forecasting tools	New development of simulation tools of river water quality	Y		
3	River	Measurement	E-coli, enterococci	Milan	Measurement of bacterial concentration with FLUIDION ALERT System	1	CAP	FLUIDION	1	Time series	csv, txt	ALERT System	Mb	Analysis of bathing water quality and calibration of forecasting tools	New development of simulation tools of river water quality	Y		Processed/elaborated data will be open. Raw data will be confidential
4	River	Measurement	Water quality	Paris	Measurement of water quality in the river	2	SIAAP	/	1	Time series	csv, txt	Multi-parameter sensors, turbidi-meter	Mb	Analysis of correlation between sewer discharges and river impacts + calibration of forecasting tool	New development of simulation tools of river water quality	N	Private data	
5	Sewer	Measurement	Flow	Paris	Measurement of flow in major CSO discharges	2	SIAAP	/	1	Time series	csv, txt	Ultrasonic monitoring device	Mb	Analysis of correlation between sewer discharges and river impacts + calibration of forecasting tool	New development of simulation tools of river water quality	N	Private data	
6	Sewer	Measurement	Water quality	Paris	Measurement of water quality in sewer discharges	2	SIAAP	/	1	Time series	csv, txt	Multi-parameter sensors, turbidi-meter	Mb	Analysis of correlation between sewer discharges and river impacts + calibration of forecasting tool	New development of simulation tools of river water quality	N	Private data	
7	River	Simulation	E-coli, enterococci	Paris	Simulation of E-coli concentration in Paris	2	KWB	/	1	Time series	csv, txt	Simulation tool, R code	Mb	Prediction of water quality for model validation	Verify the accuracy of the EWS developed in DWC	Y		
8	River	User data	/	Paris	Information about user interaction with the app for bathing water quality	2	SIAAP	IRSTEA	3	Data-base	to be defined	Bathing water quality web app	Mb	Assess the relevance and define the user requirement of the app	/	N	Privacy issue	

ID	Water cycle	Description 1	Description 2	Cities involved	General information	Related digital solution	Responsible	Involved partners	WP	Type	Format	Production / Origin	Expected size	Purpose Use in DWC	Potential for reuse Use for others outside DWC	Open data? Y/N	If confidential: justification	Comments
9	Sewer	Measurement	Temperature	Berlin	Measurement of temperature in the sewer network	14	BWB	ICRA, IOTSENS	2	Time series	csv, txt	Temperature sensors, offline export or online via cloud	Mb	Identification of beginning and duration of CSOs	Understanding of system behaviour; Calibration of sewer models	N	Critical infrastructure	
10	Sewer	Measurement	Temperature	Sofia	Measurement of temperature in the sewer network	14	SV	ICRA, IOTSENS	2	Time series	csv, txt	Temperature sensors, offline export or online via cloud	Mb	Identification of beginning and duration of CSOs	Understanding of system behaviour; Calibration of sewer models	N	Critical infrastructure	
11	Sewer	Video	Cleaning operation	Sofia	Inspection of sewer pipes during cleaning	15	SV	IPEK	2	Videos	mp4.	Xpection software	Gb	Assess the efficiency of Xpection VS traditional cleaning method	/	N	Critical infrastructure (sewer condition)	
12	WWTP	Measurement	Flow and quality	Milan	Measurement of several quality/flow parameters at WWTP	3	CAP	UNIVPM, ISS	1	Time series	csv, txt	Sensors	Mb	Control treatment processes and risk assessment	Development of soft sensors and WWTP models	Y		Processed/elaborated data will be open. Raw data will be confidential
13	Agri-culture	Measurement	Flow and quality	Milan	Measurement of several quality/flow parameters at crop field	5.2	CAP	UNIMI	2	Time series	csv, txt	Sensors	Mb	Assess water stress and irrigation needs	Verify the precision of the drone developed in DWC	Y		
14	Agri-culture	Measurement	Imagery	Milan	UAV with thermal and hyper spectral imagery	5.1	CAP	UNIMI	2	Time series	csv, txt	Sensors embedded in drone	Gb	Assess water stress and irrigation needs	Verify the precision of the drone developed in DWC	Y		
15	/	Simulation	Serious game	Milan	Artificial or simulated data for serious game on water reuse – carbon – energy – food – climatic nexus	6	UNIVPM	CAP, UNIMI	3	Data-base	to be defined	water quality, energy and GHG emissions meters. Parametric tools developed by UNIVPM	Mb	Constitution of the scenarios of a serious game on the nexus	Deployment of the game in other cities/contexts	Y		Processed/elaborated data will be open. Raw data will be confidential
16	/	User data	Serious game	Milan	Users data for the serious game	6	UNIVPM	CAP, UNIMI	3	Data-base	to be defined	Serious game	Mb	Outcomes and game related data from the users	Analyse the behaviour of the users	N	Privacy issues	
17	/	?	?	Milan	Webgis	4	CAP	/	1	?	?	?	?	?	?	?		Still to be define, development did not started yet
18	Ground-water	Information	Maintenance	Berlin	Description of well condition and operation	7	BWB	VRAGMENTS	2	Data-base	to be defined	App for data collection	Mb	Simplify the workflow and develop predictive maintenance procedures	/	N	Critical infrastructure	

ID	Water cycle	Description 1	Description 2	Cities involved	General information	Related digital solution	Responsible	Involved partners	WP	Type	Format	Production / Origin	Expected size	Purpose Use in DWC	Potential for reuse Use for others outside DWC	Open data? Y/N	If confidential: justification	Comments
19	Sewer	Measurement	Temperature	Berlin	Temperature measurement along fibre optic cable in the sewer network	8	BWB	P4UW	2	Time series	csv, txt	DTS technology	Gb	Assess the performance of DTS to track illicit connections	Verify the performance obtained by the digital solution	N	Critical infrastructure	Need to provide anonymous data (no geographical link)
20	Sewer	Simulation	Flow and quality	Berlin	Simulation of flow and quality for model calibration and scenario analysis	14	BWB	KWB	2	Time series	txt, csv	Infoworks	Gb	Simulate planning scenario for the future evolution of the sewer network	/	N	Critical infrastructure	Internal results for BWB planning strategy
21	Sewer	Measurement	Flow and quality	Berlin	Measurement of several quality/flow parameters in the sewer network	9	BWB	KANDO	2	Time series	csv, txt	Multi-parameter sensors, turbidimeter	Mb	Develop a new method to identify illicit connections	Verify the performance obtained by the digital solution	N	Critical infrastructure	Need to provide anonymous data (no geographical link)
22	Sewer	Measurement	Electrical conductivity	Berlin	Measurement of EC in the sewer network to detect illicit connections	9	BWB	/	2	Time series	txt, csv	EC sensor	Mb / Gb	Develop a new method to identify illicit connections	Verify the performance obtained by the digital solution	N	Critical infrastructure	
23	Ground-water	Simulation	Flow and quality	Berlin	Simulation of groundwater level and quality	10	KWB	/	3	Data-base	to be defined	Simulation model, which?	Mb	Reproduce in 3D the groundwater behavior for AR visualization	Development of new AR applications	N	Critical infrastructure	
24	Sewer	Measurement	Flow and quality	Copen-hagen	Measurement of flow and quality in the sewer network	12	BIOFOS	DHI	2	Time series	txt, csv	Flow and multi-parameter sensors	Mb	Development of sewer inflow forecast	Verify the performance obtained by the digital solution	N	Critical infrastructure	
25	Sewer	Simulation	Flow	Copen-hagen	Simulation of sewer inflow to the WWTP	11	BIOFOS	DHI	2	Time series	txt, csv	Machine Learning and hydrodynamic model	Mb	Validate the new inflow forecast; compare accuracy with hydrodynamic model; assess uncertainties	Verify the performance obtained by the digital solution	N	Critical infrastructure	
26	/	Interview report	/	All	Material from targeted interview for the development of the guiding protocol for ICT uptake	/	ECOLOGIC	/	3	Docu-ment	docx, xlsx	Interview	Mb	Development of a guiding protocol to identify the non-technical barrier for the uptake of digital solutions	Validate the protocol	Y		

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