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Co-UDlabs

COLLABORATIVE URBAN DRAINAGE RESEARCH LABS COMMUNITIES

Grant Agreement No. 101008626

Co-UDlabs

Building Collaborative Urban Drainage research labs communities

D10.1 Periodic Technical Report

Part B

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List of acronyms

CA	Consortium Agreement
DMP	Data Management Plan
EU	European Union
GA	Grant Agreement / General Assembly
IAHR	International Association of Hydro-environmental Research
IWA	International Water Association
JRA	Joint Research Activity
KoM	Kick off meeting
PEDR	Plan for Exploitation and Dissemination of the Project Results
RI	Research Infrastructure
SC	Steering Committee
TA	Transnational Access
UD	Urban Drainage
UDS	Urban Drainage Systems
UFA	User Facility Agreement
UPP	User Project Plan
UWWTD	Urban Wastewater Treatment Directive

List of project partners acronyms

UDC	UNIVERSIDADE DA CORUÑA
USFD	UNIVERSITY OF SHEFFIELD
DEL	STICHTING DELTARES
EAWAG	EIDGENOESSISCHE CH ANSTALT FUER WASSERVERSORGUNG ABWASSERREINIGUNG UND GEWAESSERSCHUTZ
IKT	IKT - INSTITUT FUR UNTERIRDISCHE INFRASTRUKTUR GGMBH
INSA	INSTITUT NATIONAL DES SCIENCES APPLIQUEES DE LYON
AaU	AALBORG UNIVERSITET
GRAIE	GROUPE DE RECHERCHE ANIMATION TECHNIQUE ET INFORMATION SUR L'EAU
EURO	Euronovia

1 Explanation of the work carried out by the beneficiaries and overview of the progress

Co-UDlabs is a four-year project which aims to integrate research and innovation activities at a European level in the field of Urban Drainage Systems (UDS) to address pressing public health, flood risks and environmental challenges. In the project 17 key large scale research facilities of seven Research Infrastructures (RI) have been integrated on an European scale into an ambitious project aiming at offering the international urban drainage R&D community, water infrastructure operators and their supply chain high quality laboratory and field facilities, human resources and improved data sharing platforms in order to meet critical UDS related societal, environmental, and economic sustainability challenges of the 21st Century. Co-UDlabs has been designed to offer a range of complementary research infrastructures to cover the entire range of UDS processes. The project will close a current innovation gap by providing access to full-scale field and large-scale laboratories to investigate different catchment surface and sewer network processes, CSO management approaches and SuDS techniques in a programme of at least 29 Transnational Access projects.

During the first 18 months of the project, Co-UDlabs has worked extensively on the consolidation of its unique RI ecosystem, in line with the requirements of Annex 1 of its Grant Agreement (GA). Under the coordination of the University of A Coruña (UDC) and the concerted effort of the leaders of the project's ten Work Packages, all partners were put in the best position to pursue the goals and commitments of their workplans and tasks. At the end of Reporting Period 1 (RP1), all expected Deliverables had been correctly submitted to the European Commission, and all Milestones but one had been achieved according to plan. Co-UDlabs successfully opened its first global call for Transnational Access (TA) proposals, with 13 selected proposals, user-groups led by institutions from 11 different countries, users from 18 countries, over 60 different institutions participating in the call, and almost 100 first-time users obtaining access to the Co-UDlabs' Research Infrastructure. One fourth of all users are female, and almost half of all users are from outside Academia. Eight PhD students are involved in the proposals, thus promoting early-stage research work at the Co-UDlabs facilities, and additional positions have been opened from several of the applying institutions. Four Co-UDlabs partners were able to begin selected Transnational Access (TA) projects at their facilities by the end of RP1.

The Consortium was convened for its first General Assembly in June 2022, and the Steering Committee of the project met regularly to provide guidance to WP leaders in the development of their workplans and ensure institutional representation when meeting with the project's International Advisory Board and convening the External Evaluation Panel that led the selection of awarded TA proposals.

In RP1, moreover, the consortium ensured the publication of an updated Data Management Plan and the establishment of its first open-access databases, hosting various data and information developed through the Joint Research Activities (JRAs) and Networking Activities (NAs) planned in Co-UDlabs' Grant Agreement. As far as dissemination is concerned, Co-UDlabs has also consolidated its web presence and activity. Co-UDlabs' website has been visited on average by 80 unique visitors per month, and nearly 40 news and event reports have published online since the establishment of the website. Social media presence has also been supportive of Co-UDlabs' activities. Visibility was high especially as key milestones such as the first global call for TA proposals or the project's first General

Assembly were advertised. The project's Twitter account alone has recorded over 64,000 impressions and nearly 18,000 profile visits since the beginning of Co-UDlabs. Co-UDlabs was also able to set up workshops and open events at two major international conferences such as IWA's World Water Congress & Exhibition (September 2022) and the 10th International Conference on Sewer Processes and Networks (SPN10, August 2022).

Besides these positive outcomes, a few conditions have impacted on the effectiveness of the project's workplan implementation. As a starting community, Co-UDlabs met more difficulties than expected in establishing a consistent research community around its JRAs, NAs, and TA activities. While the response to the TA programme was outstandingly supportive, the coordination of 13 selected proposals across ten of the available facilities has been a demanding process: accordingly, only a few TA projects could be physically initiated before the Reporting Period's deadline. This has also translated into an implementation rate that — both in terms of allocated budget and personnel dedication — has been lower than originally expected. These figures will inevitably benefit from the actual realisation of planned TA projects in the following reporting periods. Some of the expected delays or bottlenecks in the implementation of project tasks inevitably depended, moreover, on travel and activity restrictions following the Covid-19 pandemic. This unpredictable event has seriously disrupted the *modus operandi* that was foreseen in the project's Grant Agreement. Faced with the impossibility to travel and meet as it was common in pre-Covid arrangements, Co-UDlabs had to find alternative ways to act and produce. These methods — remote meetings, virtual counselling to applicants, etc. — were extremely effective and managed not to alter the project's productivity. They have, however, affected figures in budget and personnel sheets. These were minor deviations that are addressed in detail in the report and that, luckily enough, also came with a much lower carbon footprint for the project's activities.

Finally, this section presents a short summary of the main achievements of the project per each Work Package. This overview provides a comprehensive idea of the current progress in the process of implementation of Co-UDlabs.

WP1: Sectorial Integration and Sustainability Strategy. WP1 is developing the knowledge and working methods to promote the long-term sustainability and impact of the Co-UDlabs Integrated Action on the EU's UDS community. During RP1 the main task performed were:

- Development of an inventory of existing users of the Co-UDlabs RIs and related stakeholders and a mapping of potential future users of the RIs (which will also serve for dissemination in WP4) and other new stakeholders from the community. We have created a database with 155 stakeholders and potential RI users which is continuously growing.
- Existing roadmaps that have been produced by several stakeholders in the EU water sector at different levels (regional level, national level, and EU level) have been reviewed by different partners. Co-UDlabs partners participated in the open consultation of the new EU Urban Wastewater Treatment Directive. The revision of the roadmaps, and interviews with potential RI users (Deliverable 1.1), provided the evidence base for the analysis that forms the basis of a multi-author journal paper which will be submitted before the end of 2022.
- Creation of an Early Adopters Users Group, closely related with the activities of Task 6.2 of WP6. Two open workshops were organised with this aim at the SPN10 congress (within the framework of WP6) and at IWA's WWC&E congress.

WP2. Harmonisation and capacity building. WP2 is developing a framework for the organisation and consolidation of the harmonisation of methodologies, procedures, and data from the different facilities of the consortium, and the integration of Co-UDlabs data platform in the European Open Science Cloud. Exchange of best practices and know-how among the researchers working in Co-UDlabs will boost the adoption of common standards, protocols and enable data interoperability and will allow members of the project team to deliver the best support to researchers who access the facilities. WP2 has taken action to promote a culture of evidence-based decision making in the field of UDS by starting to map existing "bottlenecks" in the compliance assessment of interment discharges from urban drainage systems and to investigate the impact of promoting public access to monitoring data. During the first reporting period (RP1) the main tasks performed were:

- WP2 has built a core group in Co-UDlabs which is concerned with data harmonisation, mobility of staff and internal knowledge exchange, as well as supporting smart management of UDS through policy analysis around using monitoring data for compliance assessment. Existing sensors and data management structures of the different RI have started to be analysed in detail, mainly to provide a good description of the RI for the first TA call (see WP5 report), but further work will be performed after RP1.
- Mobility of personnel has so far been underdeveloped due to start-up problems of some JRA and lack of definition of joint objectives. One week-visit was performed by an UDC researcher to Aalborg University. Furthermore, shorts visits of one Sheffield researcher to IKT and INSA, and one EAWAG researcher visited INSA were also performed.
- The survey of available performance data and mapping of best practices is in progress and will be completed before M24 as stated in the GA. A workshop in the IWA World Water Congress about the value of data in UDS was performed to complement the work to be developed within WP1 and WP2 tasks.

Due to unforeseen difficulties and challenges, the work in WP2 has been lagging in RP1. This is explained in detail in sections 1.2.2. 1.2.12 and 5.1.

WP3. Training activities. WP3 improved collaboration between the different Co-UDlabs beneficiaries and the transfer of knowledge to the urban drainage sector. Free open training activities for Junior and Early-Stage Researchers from the Co-UDlabs consortium and the broader Urban Drainage community (Task 3.1); training activities oriented to industry and practitioners (Task 3.2); and public webinars (Task 3.3) have all been delivered in RP1. The key results of training activities are reported in Deliverable 3.1 (M17) and in the WP3 report below. These include:

- 1 in-person open workshop for early-stage researchers, in-person (20 attendees).
- 1 internal Co-UDlabs early-stage researcher seminar, hybrid (34 attendees).
- 1 Workshop on Urban Drainage Practice and Research Needs, online (59 attendees).
- 1 open webinar of FTIR chemical mapping, online (18 attendees).
- the official launch of Co-UDlabs YouTube channel.

WP4. Communication, dissemination, and exploitation of results. WP4 dealt with the coordination of the communication, dissemination and exploitation activities and effective interfacing with industrial and academic stakeholders as well as the urban drainage community at large. A set of clustering activities involving water utilities, practitioners, and end-users is being promoted at the

national level with specific project information packages in different languages to increase the impact of dissemination activities. During RP1, the main tasks performed were:

- Preparation of the first version of the Plan for Exploitation and Dissemination of the project Results (Deliverable 4.2), including the provision of dissemination events and exploitation strategy.
- Preparation of several dissemination actions such as the stakeholders' database (jointly with WP1), 9 scientific events related with the TA (WP5), outreach and training activities (WP3), participation in 7 scientific conferences, 7 national events and 1 exhibition trade event.
- Several communication activities including the project visual identity, project executive summary, website, social media and media coverage.
- Preparation, validation, and submission (in the form of Deliverable 4.1) of the project's Data Management Plan.

All the project deliverables, data-sets and scientific contributions are available through the project website and our Zenodo community (https://zenodo.org/communities/coudlabs/).

WP5. Management of Transnational Access (TA). The work developed during RP1 in WP5 has allowed the organisation, outreach and evaluation of the first call for Co-UDlabs Transnational Access. The objective evaluation of the proposals received and the awarding of the first projects that are taking place or will take place in the coming months in the facilities offered has been completed. During the first reporting period (RP1) the main tasks performed were:

- Preparation of documentation for the TA before the opening of the first call of proposals.
- Launch of the first TA call.
- Development of specific TA outreach and engagement activities, such as an introductory webinar, the 1st Co-UDlabs Hackathon and the project's Ideas Marketplace. These activities were an addition to what the Grant Agreement originally foresaw but were effective tools for external engagement.
- Receipt and organisation for evaluation of 15 access proposals.
- Evaluation of the first TA call proposals, by the External Expert Evaluation Panel.
- Organisation of the TA access period for the 13 granted proposals.

WP6. JRA 1 – Smart sensing and monitoring in urban drainage. WP6 fosters a paradigm shift in UDS management: transitioning from current inefficient approaches towards a digitised, informed, shared, evidence-based decision process based on truly smart monitoring. During the first reporting period (RP1) the main tasks performed were:

- Selection and testing of a set of sensors, technologies and communication technology for UDS environments,
- The Urban Drainage Metrology Toolbox (UDMT) has been developed to guarantee the robustness and feasibility of the monitored data, generic methods and tools for online data validation and data fusion have been adapted to urban drainage sensors. After the initial testing phase, data protocols and procedures will also be implemented after RP1 in the Co-UDlabs data harmonisation procedures developed in WP2 and will be made publicly available.

To date, these methods are being tested internally and by an "Early Adopters Users Groups" established at SPN10 conference (Graz, Austria), in which a workshop of the UDMT was held.

- Space distributed monitoring and data interpretation has been carried out using the open national data set of CSO locations and spill events available in the UK.

WP7. JRA 2 – Evaluation of assets deterioration in urban drainage systems (UDS). WP7 aims to improve our understanding of frequent UDS failures such as pipe collapse or blockages and find a consensus for the quality and quantity of urban drainage and sewer asset defects and condition data. This data is necessary to ensure the quantification of the deterioration of UDS, so that network renewal, renovation and repair options can be intelligently selected to ensure sustainable and high-level performance -to guarantee sanitation and flood safety. The tasks performed during RP1 were the following:

- Review of current and emerging in-pipe inspection techniques, which examines historical and recent methods to characterise in-pipe defects reported in Deliverable 7.1.
- Preparation of an open database of CCTV image defects and development of a Deep Learning (DL) toolbox to automate image inspection tasks for sewer operators.
- Review of different pipe mapping condition defect schemes to propose a more unified framework.
- Preparations for laboratory tests to establish the best way to create common in-pipe laboratory defects.
- Examination of the feasibility of using ML analysis to link failures and defects over a network, early preparation for Task 7.3.

Due to unforeseen challenges such as the reluctance of sewer operators to share openly their CCTV images and delays in the recruitment of personnel with image analysis expertise. Some parts of Task 7.1 have been over schedule. This delay and current plans will be explained in detail in the WP7 report and section 5.1.

WP8. JRA 3 - Improving resilience and sustainability in urban drainage solutions. WP8 has focused on understanding the hydraulic and pollutant retention performance of emerging types of urban drainage infrastructure. The main tasks performed during RP1 were the following:

- Regarding the development of scalable hydrodynamic performance protocols (Task 8.1), we elaborated an analysis and assessment of new techniques to build-up the topography/geometry of Urban Drainage infrastructure with high resolution. A paper on "Optical imaging for process monitoring in urban drainage" has been carried out and will be submitted during RP2.
- For the development of scalable measurement protocols to assess the pollutant retention and release potentials of Urban Drainage Structures (Task 8.1), some experiments have been performed to measure the transport of pollution from sewers to surface, the interception of microplastics by stilling stormwater basins, the determination of sediment deposits in urban drainage infrastructure from high-resolution temperature signals and the definition of standard methods to assess permeable pavement performance and increase understanding of clogging process

- The tasks comprising the analysis of hydrodynamic design for stormwater detention ponds, optimised for cost-efficient maintenance, and the analysis of different infiltration models for soil designers have been started as expected in the DoA.

Due to unforeseen challenges such delays in the recruitment of personnel or the availability of research installations, some activities of Task 8.1 have been over schedule. This delay and current plans will be explained in detail in the WP8 report and section 5.1.

WP9. Transnational Access provision. WP9 deals with the access to 17 facilities of the 7 RI offered in the project. In the RP1, the partners have worked in the preparation of access and provision of the first unit of access for the selected User Projects of the 1st Call as summarised in Table 1. TA was awarded by May 2022. The access periods have already started in 6 projects. Many access periods are planned to take place during 2023, so just initial planning meetings and some access provisions have been completed in RP1. A total of 13 projects over the 29 expected in Co-UDlabs have been accepted for the 1st TA call.

*Table 1. Summary of the work performed in the different facilities of Co-UDlabs in the 1st Call during RP1 (indicative dates at the end or RP1 marked with *) .*

Host Institution	Facility	Awarded Proposal – Acronym	Project start date	Project end date	Granted access days in RP1	Granted access days in 1st call
DC	BENS	Evaluation of new flow and quality monitoring devices for sewers - UDC-01-BENS-Peña	April 2023*	June 2023*	0	60
UDC	BLOCK	Methodology to determine the potential resuspension load of heavy metals from road sediments associated with surface runoff - UDC-02-BLOCK-Zafra	19/01/2023	22/04/2023	0	60
UDC	STREET	Urban Flooding: Houses as reservoir (UF-HOUR) - UDC-03-STREET-Bellos	17/10/2022	14/12/2022	11	40
USFD	A/B	Pollutant Transport in Urban Floodwaters - USFD-01-ABFLUME-Mignot	30/10/2022	31/12/2022	1	60
USFD	ANNULAR	Temperature time series analysis for predicting sedimentation in sewer systems - USFD-02-ANNULAR-Regueiro	May 2023*	July 2023*	0	60
USFD	ANNULAR	Annular Flume studies to test the effect on Antibiotic Resistant Genes and Use of CRISPR- Cas in E. coli from sediments affected by sewage pollution - USFD-03-ANNULAR-Morato	01/03/2023	31/05/2023	0	60
USFD	BURIED	Hydraulic Analyses of the Toronto Exfiltration System (TES) - USFD-04-BURIED-Li	March 2023*	July 2023*	0	60
EAWAG	HALL	Non-contact assessment of TSS and COD concentrations in wastewater with hyperspectral imaging - EAWAG-01-HALL-Bares	15/05/2022	15/04/2023	18	40
EAWAG	HALL	Characterisation of thermal properties of sediment samples in urban drainage systems with temperature probes - EAWAG-02-HALL-Langeveld	01/06/2022	31/03/2022	28	40
EAWAG	UWO	A Probabilistic Machine Learning-based Framework to Improve Urban Drainage Modeling Reliability - EAWAG-03-UWO-Dittmer	15/01/2023	31/07/2023	1	20
IKT	IKT-LTF	Assessment of Inspection tools for Rising Mains (AIR) - IKT-01-LTF-Verhulst	01/02/2023	April 2023*	0	40
IKT	IKT-LTF	Investigation of the rehabilitated wastewater pressure pipes in response to pressure surges in operation - IKT-02-LTF-Beenen	01/02/2023	31/03/2023	0	40
INSA Lyon	OTHU-SUDS	In-situ SUDS modelling - INSA-01-OTHU-Fuchs	29/08/2022	April 2023	3	10

WP10. Project Management. WP10 encompassed all management and coordination tasks relevant to the implementation of the project. During this period, several structures were set, as follows:

- The General Assembly (GA, all partners) acts as the ultimate decision-making body of the consortium and comprises one representative of each of the partner organisations. This met twice during RP1: during the initial Kick-Off Meeting (KOM) in May 2021, and at the project's first official General Assembly in June 2022.
- The Management Support Team (MST) was appointed by the Project Coordinator. The MST facilitated the work of the Steering Committee and the Coordinator to execute the decisions of the General Assembly as well as the day-to-day management of the project, including communication with the Project Officer.
- Steering Committee (SC): is the supervisory body for the execution of the Project and was accountable to the Coordinator and General Assembly. This comprised all Work Package Leaders (WPL) and representatives of AaU and IKT partners, as they are not in charge of any WP.
- International Advisory Board (IAB): This comprised mainly industrial and relevant experts in the field to provide advice on strategic direction, quality improvement, and assess the project effectiveness. IAB meetings (online) were held during the KOM and in M16 of the project. As stated in the WP description, the next IAB meeting will be held during the next Co-UDlabs GA.

Besides this decision-making, operational, implementation and advisory bodies, defined in the Grant Agreement, Co-UDlabs has also set up an External Evaluation Panel to evaluate TA proposals as explained in WP5 and Section 1.4.1 reports.

There were no significant deviations from the expected work plan of WP10. All Deliverables were submitted when due, and the WP has so far achieved all the planned Milestones but one (MS16): this deviation is explained in detail in the WP7 report. Specific items in the implementation of the work plan had to be adjusted or rescheduled but did not require significant changes in the operations of the WP or any of the beneficiaries. Regarding the financial payment, UDC received the advance payment from the EC and distributed it to all participants once the CA was signed. Some measures to improve project implementation after the end of RP1 will be explained in Section 5.

1.1 Objectives

The main objective of Co-UDlabs is to provide a transnational multidisciplinary collaborative research infrastructure to bring European stakeholders, academic researchers, and innovators in the urban drainage and water management sector together. The Co-UDlabs framework allows them to share ideas, co-produce project concepts, and benefit from access to top-class research infrastructures, with the goal of developing, improving, and testing innovative methods and technology and building a collaborative European Urban Drainage innovation community. The project will deliver a range of other activities that will engage with the multi-disciplinary urban drainage research community; water utilities and their supply chains, local authorities and regulators so that other institutions and organisations across the EU can play a role in the development of an efficient research and innovation environment based around the research infrastructure within Co-UDlabs.

In relation with the main objective, Co-UDlabs addresses the following specific objectives:

O1: To foster a culture of co-operation between RIs and the urban drainage community through a set of coordinated Networking Activities - NA (WP1 to WP5), which help to develop a more inclusive, open and efficient research and innovation environment. A program of collaborative activities will engage the EU urban drainage sector to exchange knowledge, collaboratively generate and encourage innovation and enable multiple avenues of research, development of technology and innovation, thereby contributing to the delivery of a long-term, sustainable Research Infrastructure in the European water sector.

The main contributions of the different WPs towards this specific objective can be summed up as follows:

- In WP1, the definition of UDS research needs serves as a blueprint to define the Research Infrastructure's contribution to Europe's overall research and innovation capacity. This information is key to help the industry transition to more sustainable and smart UD systems. The work developed in RP1 took the first step for which areas the different stakeholders define a need to be fulfilled that enables this transition.
- WP2 is contributing to the standardisation of data collection and data management. Data curation will be performed by each TA facility provider and open data will be available through project Zenodo community. New metadata standards and procedures are expected to be defined for RP2 once the first round of TA ends and more data are gathered within JRA. The networking performed with TA users and sharing of best practices in internal capacity building activities will boost harmonisation procedures.
- Work performed within WP1 (Task 1.2), WP2 (Task 2.3) and WP6 (Task 6.3) will also contribute to reducing the "bottlenecks" to implement data supported assessment of the regulatory compliance of urban drainage systems.
- Training activities developed in WP3 will contribute to (i) enhance transfer of knowledge and develop new skills inside and outside Co-UDlabs platform, by raising the awareness about the CoUDlabs project in academia, industrial and practitioners' communities; (ii) foster the use of Co-UDlabs RI via tailored training actions; and, (iii) create a pool of high qualified professionals, with a special attention to industry and early-stage researchers. European Junior Scientist workshop and Early-Stage researchers seminars helped to engage junior researchers and identify potential collaborations world-wide. Co-UDlabs open webinars aimed to raise the interest of the UDS community about emerging techniques and the development of new contacts that might bring Transnational access opportunities.
- Lastly, as collected in project continuous report, Co-UDlabs outcomes are being disseminated in a structured way within the framework of WP4 to a wide range of relevant stakeholders and to society through a series of dissemination activities designed to engage the urban drainage community and the public. The visibility of the project is also ensured through dedicated communication activities.

O2: To facilitate free of charge Transnational Access – TA (WP5, 9) to 17 leading European facilities by two open calls. The calls and the project both focus on support to scientific communities and water utility and supply chain innovators in their access to highly relevant research facilities. Co-UDlabs will provide research infrastructure (physical and knowledge-based) to undertake breakthrough engineering and scientific research and innovation using multi-institutional and multi-sectorial teams to develop solutions that have the potential to transform the European urban drainage sector and provide credible evidence that these solutions work.

The main objective of WP5 and WP9 has been accomplished for the first call for proposals of Co-UDlabs TA programme, including organisation and management of the-TA of external user groups in a single-entry point, development of the call with preparation of all the documentation, engagement activities to create multi-sectorial facility user groups, the support to the users, the evaluation and selection of access projects, and the development of the users stay rules. The procedure will be optimised for future according to the feedback obtained from user groups after the TA period. The work performed within WP5 and WP9 will also contribute to the fulfilment of the previous specific objective.

O3: To enlarge and strengthen the quality and quantity of the services offered at European level by Co-UDlabs through a combination of interconnected Joint Research Activities - JRA (WP6, WP7, WP8). These activities will improve our understanding of asset deterioration and secure the long-term resilience and sustainability of urban drainage systems with the help of more robust, autonomous and interconnected smart monitoring techniques, and digital water data analysis tools.

The main contribution of the different WP towards this specific objective are:

- In WP6 the testing of novel sensors will contribute to secure the resilience and sustainability of UDS and to spread new smart monitoring techniques with different TRLs within the UDS community. For instance, novel techniques to monitor *E.Coli* open new doors for evidence-based decision making: This could be bathing water sites, which are now being closed for long durations after emissions from combined sewer overflows (CSOs) could with this technology be monitored and managed more effectively based on real-time transmitted data from digitised sensor platforms.
- The Urban Drainage Metrology Toolbox provides an easy-to-use and free access toolbox assisting both researchers and practitioners to deliver smart and better-quality data in urban drainage, by facilitating the application of metrology best practices (systematic sensor calibration, data correction, uncertainty assessment and data validation). Higher quality data will therefore lead to more evidence-based urban drainage approach and management.
- Lastly, methodological analysis - performed on urban drainage spatial data on CSO emissions directly supports evidence-based decisions, e.g.,e.g., compliance assessment of the (new) UWWTD. New methods and tools to analyse space-distributed CSO spill frequencies event durations, which are a cornerstone of the revision of the UWWTD and will be more widely available to member states in the future.

- The work developed in WP7 within RP1 allowed the evaluation of several in-pipe condition protocols. The review of current and emerging in-pipe inspection technologies has highlighted the current dominance of image-based systems. This review has also highlighted several alternative technologies that could improve the accuracy of defect characterisation or the efficiency of inspection. Research has been carried out using Deep Learning based approaches to automatically identify in-pipe defects from CCTV images.
- Work has also been carried out to build and validate ML based models that use existing data on asset condition and system performance. This has shown that it is possible to quantify linkages between asset condition (e.g.,e.g., blockage) and system performance (e.g., local flooding). These results have confirmed that there is significant potential in using data-driven modelling approaches to link asset condition data and system performance. However, it has also shown the need for better, more spatially dense asset data.
- Lastly, in WP8 the activities performed in RP1 showed that the application of imaging techniques creates better digital model elevations of urban topography, allowing for more reliable urban flooding and pollution transport modelling approaches. Ongoing work for RP2 will include a review paper of "Optical imaging for process monitoring in urban drainage" as well as tailored experiments developed in the research infrastructures will help to develop consensus on methodologies needed to provide high resolution data to assess the performance of urban drainage technologies.
- More activities have been carried out to contribute to our understanding on how pollution moves from sewers to the surface under flood conditions, how microplastics are intercepted by stormwater basins and how solids are retained by permeable pavements during storm events. Lastly, the last set of activities which are being developed within this WP are aimed at examining the hydrodynamic and sediment processes and how to manage these to optimise long-term maintenance of sustainable solutions such as SuDS stormwater detention ponds after RP2.

1.2 Explanation of the work carried per WP

1.2.1 Work Package 1 - Sectorial Integration and Sustainability Strategy

WP1 has promoted consensus on how to use common research infrastructure and develop practices to enhance the implementation of relevant EU environmental, economic and societal policies. The objectives of WP1 are to: (i) develop a roadmap for policy makers, water utilities and their associations to indicate the RI structures needed for a more rapid transition to smart and sustainable urban drainage system management; (ii) develop recommendations as to how scientists and innovators can integrate their activities at a European level in order to help practitioners and regulators better meet the future needs of the EU's UDS; and (iii) identify the future RI and innovation capacity needed to assure the long-term sustainability of the Co-UDlabs. WP1 is led by GRAIE and all project partners, except Euronovia are involved.

Task 1.1. Mapping of RI users and community needs to transition to more sustainable and smart urban drainage systems (Lead GRAIE)

The aim of this task was to collect and identify needs and visions from different stakeholders involved in the transitioning of Urban Drainage Systems within the EU and associated countries towards sustainable and smart infrastructure. Three different sources were considered: (i) policy documents existing in the countries represented in the project; (ii) input from the academic researchers and scientists involved in the Co-UDlabs project; and (iii) feedback from early adopters and (potential) users of the Research Infrastructure made accessible within the project.

Within this task GRAIE coordinated the design of the inventory of existing users of Co-UDlabs RIs and related stakeholders to map potential future users of the RIs and to disseminate project activities in the framework WP4. A database of individuals and institutions interested in receiving information on the project has been created. The registration form is available on the project's website (https://co-udlabs.eu/contact/) in three languages: English, Spanish and French (Figure 1).

Figure 1. Co-UDlabs contact form to map potencial RI users available at project website (https://co-udlabs.eu/contact/).

Co-UDlabs organised two open workshops to promote the formation of an Early Adopters Groups to stimulate the participation of end-users in the training and transnational access activities of the project. As will be described in the WP6 report, a pre-conference workshop has been held at SPN10 in Gratz (Austria) in August 2022. In addition, a workshop that was not initially planned in the GA was planned and developed at the WWC&E congress in Copenhagen (Denmark) in September 2022 (see details in Task 1.2).

Task 1.1 has been completed in full and has been reported in Deliverable 1.1 "Identification of RI users and UDS community needs". In addition, an article with all the co-authors will be submitted to the journal Urban Water in December 2022, summarising the methodology and lessons learned from this work.

Task 1.2. Development of a roadmap to identify the role of RI to transition to more sustainable and smart urban drainage systems (Lead GRAIE)

The aim of this task is ultimately to produce a roadmap identifying the position of RI in the landscape of the UDS community to foster the transition to more sustainable and smart urban drainage systems. One of the main bottlenecks identified through the revision performed in Task 1.1 and the ongoing activities on WP2 (Task 2.3 – Smart governance and public access to data) is related with data quality and assurance. To engage UDS community within this key issue, Co-UDlabs hosted a successful workshop on 'Tapping the value of urban drainage systems (UDS) data' at IWA World Water Congress and Exhibition (https://co-udlabs.eu/2022/09/19/co-udlabs_iwa_wwc_2022/).

The event, which welcomed nearly 40 attendees, favoured active participation from researchers and practitioners in the audience, marked a very valuable opportunity to present the latest advances of the Co-UDlabs project on collection, management, and analysis of urban drainage data. Small groups worked together to discuss many open questions and relevant issues. The limitations of very nation-based data; the huge amounts of data that are not adequately exploited; the difficulties to access open, free or inexpensive, interoperable data; or the lack of standardised methods and platforms to collect massive amounts of information are just some of the issues that the audience raised when debating with the Co-UDlabs' researchers. Audience contributions is being analysed and interpreted by Co-UDlabs staff by jointly writing a white paper which will serve as starting point for ongoing activities within this WP.

Furthermore, GRAIE with Co-UDlabs facility providers will promote a meeting with RI users in a dedicated workshop on July 3, 2023. It will be a unique opportunity to exchange feedback from the 1st TA call users on their experience and imagine the future of shared urban drainage RIs. This workshop is organised to fit right before the 11th Novatech conference about stormwater management in Lyon, France. In view of the Novatech workshop, an invitation was sent in November 2022 - save the date to current RI users (up to 70 recipients). The workshop outcomes, which will be analysed for the next RP, will help evolving future strategies for such a shared approach of research infrastructures in Europe, and will include the analysis of the following topics:

- How did the transnational access to existing Co-UDlabs research infrastructures (RIs) allow you to advance in your research?
- How did you experience your visit at the RI you have chosen?
- Were the offered Co-UDlabs RIs able to fulfil your research needs?
- What could be improved in such a transnational access programme?
- Are there different or additional RIs necessary that would be desirable in the field of urban drainage? If yes, which ones? How would you imagine a possible network of shared RIs?

Task 1.3. Co-UDlabs Strategy for RI Sustainability and Community (Lead UDC)

The work of this task is planned to finish in M48. Some preliminary advances have been achieved during the RP1 by starting with the contacts with other RI and EU level projects as defined in the WP4 report. Besides these initial contacts, a preliminary literature review and web searching of possible RI to complement Co-UDlabs facilities has been initiated. AQUAFIN company expressed their interest to share some real scale sewer facilities for the eventual continuation of Co-UDlabs. After the RP1 period there will be more concise planning to develop to fulfil GA requirements.

Summary of Deliverables

Deliverables completed:	**D1.1 - Identification of RI users and UDS community needs. (M15 -> M17)**
Deliverables passed due date:	Deliverable D1.1 was initially planned for M15 but we agreed with the Project Advisor to postpone it due the above mentioned difficulties to submit in M17.

Summary of Milestones

Milestones completed:	**MS01 - Seminar/Special Session on SPN 2022 to boost the early adoption of good practices in UDS (M16).** The Seminar of SPN is link with the work performed in T6.2. As explained in the text, a complementary workshop not included in the GA was held in IWA WWC&E in M17.
Milestones passed due date:	None

1.2.2 Work Package 2 – Harmonization and Capacity Building

The goal of this WP is to harmonise data formats and collection procedures for Urban Drainage Systems, including capacity building among the partners, exchange of experimental protocols and organising and promoting public access to monitoring data to support evidence-based management of UDS. The main objectives of WP2 are to: (i) standardise experimentation and operation of Co-UDlabs RI and ensure consistent high-quality data collection via the use of agreed validation protocols; (ii) organise an effective data management system for the data collected during the project; (iii) exchange best practices and know-how among the project staff and the participants working in the RI; and (iv) eliminate bottlenecks by data supported assessment and provide capacity building to improve the data-literacy of the next-generation urban drainage workforce.

WP2 is led by EAWAG but all partners are involved in this WP dedicating time for this activity along the whole lifetime of the project. Main achievements include a thorough review of data sharing platforms, and a conference publication at the SPN22 to build the early adopters. Difficulties arose from personnel changes at the EAWAG partner, which caused some delay in the data harmonization activities and selection of a common data sharing solution. However, this is not critical for the project, because EAWAG was able to mitigate it by attracting additional funding.

Task 2.1. Ensuring interoperability by definition of common standards, protocols and methods (Lead EAWAG)

Although common standards are required to effectively re-use monitoring data these standards are currently lacking in the UDS community. In addition, metadata standards are not only lacking to exchange hydraulic and water quality monitoring data, but also there are weaknesses in the standards used to assess the structural and service condition of assets (cf. WP 7, evaluation of asset defects and condition). As this prevents the effective use of monitoring and inspection data in compliance assessment and knowledge sharing on management strategies of UDS, efficient harmonization data and EU-wide reporting is a cornerstone of the new proposal for the Urban Wastewater Treatment Directive.

To provide an efficient harmonization and data management in Co-UDLabs, WP2 first preliminary assessed existing best practices for data collection and sharing in the Research Infrastructures (RI). The information gathered related with the different project facilities was included in the description of the facilities available for the TA user groups within WP5 outcomes. This task is still in progress.

Although it is always best to deposit research data with a subject specific repository that is recognised in the specific field, there is no such repository for UDS data. Consequently, standards to create added value in terms of providing quality control or additional context to support future reuse are lacking. We formed a core group for WP2, which involves all partners, but is mainly driven by the partners who are actively collecting monitoring data in their facilities, e.g., EAWAG, INSA, UDC and UFSD. We held 4 meetings online and provided an overview over in-house platforms, such as the OTHU metadata-database, the UWO datapool and other data sharing platforms. In addition, we exchanged information with the IWA MetaCO task group on WWTP metadata collection and organization. The taskforce is in the process of compiling a guidance document for monitoring data from wastewater treatment plants (https://iwa-network.org/groups/meta-data-collection-and-organization-metaco/). In addition, we exchanged information with the OGC-WMO on technical standards and information models they use to represent hydrological time series data, i.e., WaterML. We have not contacted yet other INFRAIA projects which share similar data, e.g., HYDRALABS community.

Second, we performed an in-depth analysis of 4 platforms for data sharing in the Co-UDlabs project: I) DRYAD, ii) EOSC, iii) ERIC/open, iv) Zenodo. While DRYAD is a high-quality, curated service, its Data Publishing Charges of $120 USD are prohibitive for our Co-UDlabs starting communty. In the last year we experienced EOSC as not suited for our needs, but recently, it has developed into a very promising environment (see below). Therefore, we compared the capabilities of ERIC/open and Zenodo for data sharing:

- ERIC/open is the “Eawag Research Data Institutional Repository”. It is the place where EAWAG scientists publish their research data. Research data is organised in Packages which contain one or more Resources and can be explored with queries and visualisations directly on ERIC (Figure 1), if they are in recognised formats, e.g., CSV. ERIC/open is a FAIR Open Research Data repository and has an API to batch-access data for further processing.
- Zenodo is a free open-access repository managed by CERN for researchers to publish and archive data, software and reports (https://zenodo.org). Submissions receive a DOI, can be updated with new versions and metadata with external vocabularies are supported. Zenodo also has an API to remotely interact with the data. The biggest advantage of Zenodo is its reliability and ensured longevity.

We prepared an example dataset from WP8 (JRA3) for publication and sharing. The data is a collection of sediment temperature relations from laboratory experiments. They consist of time series of sediment temperatures, as well as secondary information on the experimental setup in the laboratory, etc. (Figure 2).

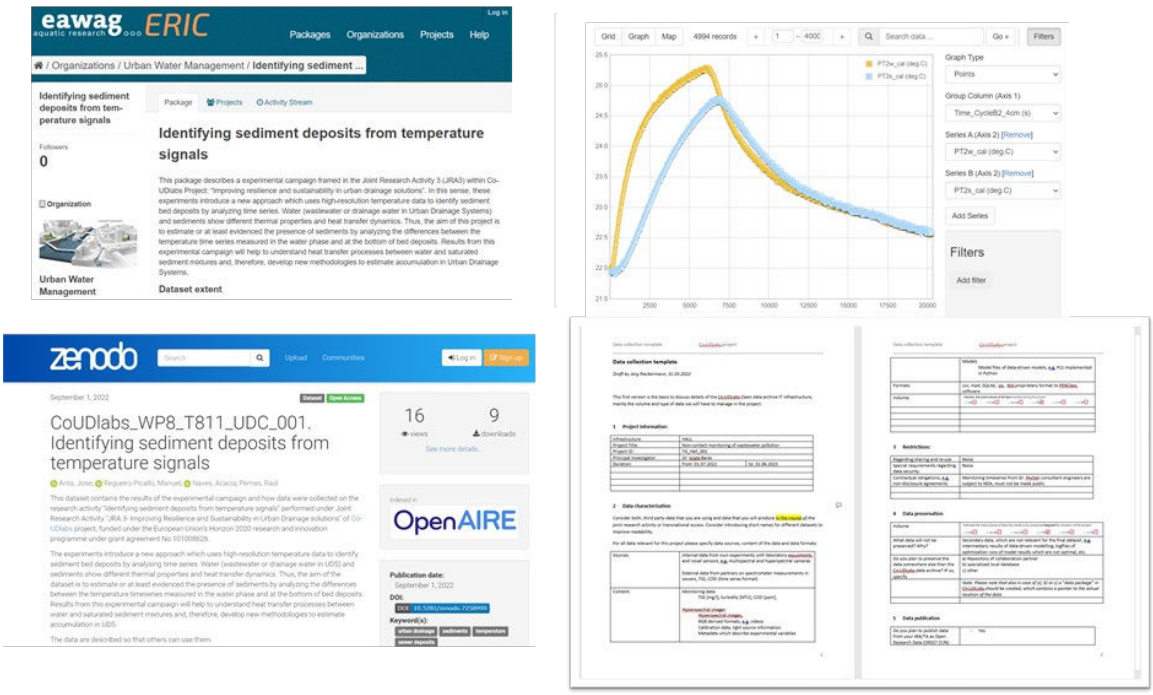


Figure 2. Top row: Example dataset from WP8 demonstrates superior metadata and explorative capabilities of ERIC. Bottom, left: The same dataset was uploaded to Zenodo. The functionality is very basic, but satisfies the major needs of Co-UDlabs. The dataset has already achieved 9 downloads. Major bottleneck to re-usability is a common metadata structure. Bottom, right: Data collection template developed by EAWAG.

For publication and sharing, we chose the platforms ERIC and ZENODO, which ranked first in our analysis. We found that the conceptual benefits of ERIC/open do not outweigh the practical downsides and therefore we chose ZENODO as our platform of choice, even if it has no capabilities to explore the datasets before downloading. Depending on the size of the data, this can be a limiting factor which will be explored in the future.

To harmonise data collection, we have developed a data collection template (Figure 2, bottom right), which is based on the proven data management protocols by EAWAG. On the one hand, it reflects practical aspects to characterise the data, such as the source, content, formats, data volume, etc. On the other hand, it also requires information on the future re-use and sharing of the data sets. In particular, this concerns restrictions regarding sharing and re-use, special requirements regarding data security, contractual obligations, such as non-disclosure agreements with utilities and commercial TA users, etc. Also, it concerns data preservation issues ("What data will not be preserved?"; "Why?"; "Do you plan to preserve the data somewhere else than the Co-UDlabs data archive?"). Also, foreseen data publications are an issue. While this template has been developed early in 2022, it has not been distributed to all the partners due to unforeseen personnel changes (see below). Also, we have developed a draft of "Publishing and archiving guide" to harmonise data sharing.

Scientifically, a conference paper on the potential of Open Research Data in UDS data was presented at the SPN10 conference. We were able to show that re-using spectrophotometric water quality data with an improved data analysis provided better concentration measurements. Furthermore, we had intensive discussions with the UDS community on Open Data and metadata

standards in the UDS community. Finally, a complementary proposal on Open Research Data in UDS proposal has been granted by the ETHdomain (see below).

Task 2.2. Development and mobility of personnel staff (Lead Euronovia)

The objective of Task 2.2 is to organise mobility for project partners (as TA providers) in order to facilitate the exchange of best practices and know-how among the project staff and the participants working in Research Infrastructures. This activity is meant to support the networking and trust between all partners, stimulate exchange, development and inspire new ideas for improved quality and services.

In regard to mobility sessions organised by TA providers, some work has been developed so far. A one-week visit of the UDC staff to the stormwater pond placed at Aalborg (AaU) in the context of the WP Joint Research Activity T8.3, a visit by UFSD staff to IKT in context of JRA2 WP7, a visit by UFSD staff to INSA in context of JRA3 WP8 and a visit by EAWAG staff to INSA in the context of JRA1 WP6 can be mentioned.

Task 2.3. Smart governance and public access to data (Lead EAWAG)

The goal of Task 2.3 is to support evidence-based management of UDS by eliminating bottlenecks in the data-based compliance assessment and organise and promote the public access to compliance data. To eliminate "bottlenecks" in the compliance assessment of urban drainage systems, we have been discussing the elements of a survey to understand what UDS performance data are available at utilities, for which purpose they are being used and whether institutional or individual factors hinder their use in compliance assessment. This survey is based on a recent survey performed in Switzerland (Manny *et al*., 2018. Policy Analysis for Better Protection of Receiving Waters during Wet Weather). The results suggest that monitoring data, e.g., days with combined sewer overflows, are often available at the utility (Figure 3, middle), but that it is not analyzed or reported to the regulatory authorities.

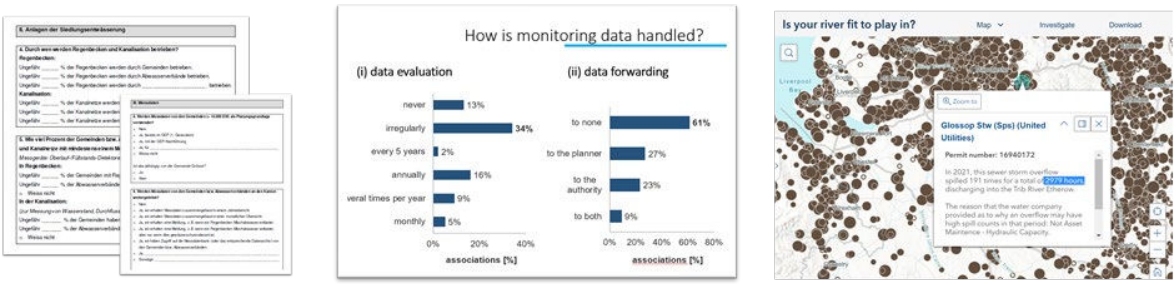


Figure 3. Draft survey to elicit the current availability of Monitoring data in the UDS (left), results for Switzerland (2018) demonstrate that Monitoring data are being collected for operational purposes, but rarely used by authorities in compliance assessment (middle) and compliance data of CSO spills in the UK, made public through the river trust NGO revealed substantial deficits in CSO operation and led to more stringent environmental legislation (right).

In earlier work USFD has been collaborating with the EU's JRC, which performed modelling to support the development of the new UWWTD. This collaboration concluded that reducing pollution from UDS is "best made in the context of an integrated urban water management plan taking into account factors such as other ongoing initiatives in urban greening" (Quarantana et al, 2022, https://doi.org/10.1016/j.jenvman.2022.115629). In addition, USFD has started to analyse the now

public spatial CSO EDM database (Figure 3, right). The results have been fed back to the UK's Environment Agency via Dr P Hulme, Senior Policy Advisor. In addition, USFD is part of a technical sub-group advising UK policy makers on secondary regulations for water quality CSO monitoring which will be implemented in the UK from 2025 onwards.

Summary of Deliverables

Deliverables completed:	Deliverable 2.1 and 2.3 will be submitted on M24. A deadline extension is proposed on section 5 to M30 for Deliverable 2.1
Deliverables passed due date:	None

Summary of Milestones

Milestones completed:	The first MS of this WP will be achieved on once Deliverable
Milestones passed due date:	None

1.2.3 Work package 3 – Training Activities

WP3 involves the organisation and execution of training activities through the project duration. These training activities are strategically based in three main focal points: (i) Junior and early-stage researchers networking activities and training events (Task 3.1); (ii) Training activities oriented to industry professionals and practitioners (Task 3.2); (iii) Public webinars to disseminate emerging monitoring techniques in urban drainage (Task 3.3).

These three tasks are distributed through the project planning attending to timing (respecting domain-wise scientific congresses and industrial fairs etc.), availability of training personnel and identified field specific needs. Additionally, to allow for auto-referencing we will use an action naming convention as depicted in Table 2.

Table 2. Completed action list in WP3 until the mid-term reporting date

Action Code	Name	Completed (date)
WP3.A.1	Workshop on Urban Drainage Practice and Research Needs (IKT)	November 3-4, 2021
WP3.A.2	European Junior Scientists Workshop on "Monitoring Urban Drainage Systems and Rivers" EJSW25	May 15-21, 2022
WP3.A.3	Co-UDlabs early-stage researcher seminar (UdC)	June 27-28, 2022
WP3.A.4	Webinar 1: Fourier transform infrared spectroscopy (FTIR) chemical mapping	September 21, 2022

WP3 is led by Deltares but all partners are involved in this WP dedicating time for this activity along the whole lifetime of the project.

Task 3.1. UD early-stage researcher activities and training events (Lead INSA)

Two types of activities were planned within this pillar:

1. Two **internal Co-UDlabs early-stage researcher seminars** targeting PhDs and early-stage researchers from partner institutions of Co-UDlabs, aiming to enhance interaction between academics, sharing ideas and promote common experimental protocols. These seminars have a duration of 2 days and are targeting 20 participants.
2. One **open workshop and one PhD course** targeting the UD European junior research community.

In the first reporting period, we have organised the following training events for UD junior and early-stage researchers:

- **One open workshop**: The **25th EJSW – European Junior Scientists Workshop on "Monitoring Urban Drainage Systems and Rivers" (WP3.A.2)** was held on 15-21 May 2022, in St-Maurice-en-Valgaudemar, France. This workshop was jointly organised by the Sewer Systems and Processes Working Group of the IWA/IAHR Joint Committee on Urban Drainage and the Co-UDlabs project. It gathered 20 junior-scientist participants from institutions based in 11 countries and even more diverse nationalities. The 25th EJSW included:
    - 20 oral presentations by the junior scientists (20 min presentation + 10 min for Q&A).
    - 5 short courses (45 min) by senior organisers on i) low-cost monitoring, ii) uncertainty assessment, iii) data validation, iv) application of cameras in discharge monitoring, and v) 3D-printing applied to urban drainage and river monitoring.
    - 1 workshop (1.5 h) on ethics in science and research.
    - 4 afternoon hands-on sessions (for each junior participant), to be chosen among the following 8 sessions that took place.

  The EJSW was a great opportunity for sharing knowledge, networking and creating links between participants. The evaluation provided by all participants is truly outstanding (anonymised feedback and more information is available here https://co-udlabs.eu/2022/05/26/25th-ejsw-2022/). This gives confidence that this activity is a very valuable tool for the UD scientific community that allows transfer of hard (i.e., technical competences) and soft skills (e.g., dealing with ethical issues in science or learning to collaborate in an international academic setting) from senior to early-stage researchers in the field.
- An **internal Co-UDlabs early-stage researcher seminar (WP3.A.3)** took place on June 27, 2022 at the UDC's School of Civil Engineering in A Coruña (Spain). The seminar (organised by UDC) aimed to enhance interactions between PhD students and junior researchers of the project, sharing ideas while identifying and promoting common experimental protocols and approaches. The event included 9 presentations and discussions about sediment accumulation, wastewater turbidity monitoring, infrastructural planning for heavy-rain laboratories, as well as innovative approaches to flooding induced health risks, performance assessment in UDS, LIDAR and SfM-based techniques for surveying and experimental planning. 34 attendees were involved in the seminar (8 junior researchers), both in person and remotely. More information is available on the project website (https://co-udlabs.eu/2022/07/04/co-udlabs-celebrated-its-first-general-assembly-and-early-stage-researchers-seminar/).

Task 3.2. UD Industry professionals and practitioners training activities (Lead DEL)

This task concerns the organisation of free training activities aimed specifically at urban drainage industry stakeholders, regulators, professionals, and other practitioners. During the reporting period there has been one activity carried out:

- The first of these events was organised by IKT on November 3-4, 2021. The free online **Workshop on Urban Drainage Practice and Research Needs (WP3.A.1)** aimed to identify valuable good practices and research for the optimisation of UD assets' performance and improve their resilience to climate change and sustainability. More specifically, the workshop was also designed to introduce Co-UDlabs' three Joint Research Activities and to illustrate their themes to network owners and researchers and to present 1st TA call, as a complementary activity to TA outreach. The workshop was attended by 59 participants (51 joined both days). All presentations are available for download on the project website (https://co-udlabs.eu/2021/11/09/ikt-workshop/). Due to pandemic situation in Europe this workshop was held online instead of having a physical event as defined in the DoA.

Furthermore, during the reporting period started with the organisation of the Industrial workshop on flow rate determination of pressurised hydraulic pipelines and pumping stations. The course was held online on 17th November 2022 (RP2). Web registration: https://softwaredays.deltares.nl/-/co-udlabs-course-2022. The course will take place within the Deltares Software Days platform as an online course. This represents a minor deviation from the original plan, which specified a physical course. However, the online version was preferred due to several reasons: i) The course would be recorded such that it could be shared through the Co-UDlabs website and YouTube channels, ii) due to the length of the event (1 day), an online version will be more convenient to attract EU participants.

Task 3.3. UD Industry professionals and practitioners training activities (Lead IKT)

Task 3.3 involves the organisation of public webinars on specific and emerging monitoring techniques. This focuses on the organisation of free of access, online webinars oriented to highlight different aspects of an emerging technology in urban drainage metrology. These are oriented to researchers and practitioners mainly and can be co-organised by members of Co-UDlabs with the participation of relevant persons of interest from other academic, public or private institutions involved in the field of urban drainage. Table 3contains the up-to date list of webinars that can be accessed through project website (https://co-udlabs.eu/networking/training/).

Table 3. List of Co-UDlabs webinars

Webinar title	Date planned	Partner in charge [+ co-organisers]
1 - FTIR Chemical mapping	**(Completed) September 21, 2022**	**AaU**
2 - Acoustic turbidity measurements	End of January 2023	EAWAG, UDC
3 - Optical and computer vision techniques for flow and processes	February-March 2023	DEL, UDC [USFD, INSA]
5 - Routine uncertainty assessment (UA) in urban drainage data	March-May 2023	INSA, GRAIE
4 - Underground infrastructure monitoring techniques	[Late] 2023	IKT, USFD, DEL
6 - Routine data validation (DV) in urban drainage	May 2024	INSA, GRAIE

The first Co-UDlabs webinar was carried out on September 21 (2022). This was organised by the University of Aalborg (AaU). After introducing basic concepts about Infrared Spectroscopy and how an FTIR spectrometer works, infrared microscopy was briefly explained, including different modes of collecting spectra at the microscopic scale. Finally, µFTIR-chemical mapping technology was introduced, focusing on theoretical and practical details related to this technique. To conclude, the webinar provided a short overview of the main applications of µFTIR-chemical mapping ranging from biomedical science to material science and microplastic analysis on environmental samples, focusing on urban water microplastic monitoring. This public webinar was attended by 18 participants. The webinar was recorded in video and was made available through the YouTube channel (https://www.youtube.com/watch?v=WL-ZprjvmUg).

Within WP3, we envisioned the creation of a YouTube channel curated by Co-UDlabs. A project branding effort was done to create a homogeneous audio-visual identity which is inherited in all materials released by Co-UDlabs in the channel. The channel was created in the Month 12 following MS7 (Release of Co-UDlabs YouTube channel, https://co-udlabs.eu/2022/04/22/co-udlabs-is-now-on-youtube/), this can be accessed here: www.shorturl.at/emp23. As more industrial courses and webinar actions take place (only 2 so far), more material will be added to the channel.

The contents of the Webinar series were agreed with all Co-UDlabs partners. Exact dates for the webinar series are to be set, yet we expect to deliver 4 more webinar series through 2023 and a last webinar in 2024, all materials will be recorded and made available through the YouTube repository.

Summary of Deliverables

Deliverables completed:	**D3.1 - 1st Report on training and educational activities (M17)** An updated version of this document will be submitted at M34 and M44
Deliverables passed due date:	There were no delays in the submission of deliverables in this reporting period

Summary of Milestones

Milestones completed:	**MS6. Release of webinar programme (M6)** **MS7. Release of Co-UDlabs YouTube channel (M12)**
Milestones passed due date:	None

1.2.4 Work Package 4 - Communication, dissemination and exploitation of results

WP4 deals with the coordination of the communication, dissemination and exploitation activities and effective interfacing with the stakeholders and urban drainage community. The objectives of this WP are to: i) create a European wide network for urban drainage practice and research; ii) identify the potential different routes for innovation and exploitation of the project results in order to maximise the project impact on a wide range of stakeholders; iii) disseminate the information about the project to stakeholders, scientific community and the non-academic actors in order to engage the community behind the project, and to transfer knowledge and results; iv) ensure maximum visibility of the project through tailored communication activities in order to raise awareness about the potential of Co-UDlabs and reach out to society and show the impact and benefits.; v) ensure that all data used within the project are available in accordance with H2020 Open Access Data Policy in order to boost the exploitation of the results through direct access to project data; vi) implement actions to boost

coordination and synergies with relevant EU projects in order to widen exponentially the dissemination of the project results.

WP4 is led by Euronovia but all partners are involved in this WP dedicating time for this activity along the whole lifetime of the project.

Task 4.1. Plan for exploitation and dissemination of the project results - PEDR (Lead Euro)

Within this task the deliverable D4.2 was prepared and submitted as planned at M6 (October 2021). The document is composed of 2 main parts:

1. *Communication and dissemination strategy* including a description of the target audiences, messages, rules, communication tools and dissemination actions planned during the project lifetime. It also includes a section on impact assessment and KPIs.
2. *Exploitation strategy* including an overview of the preliminary list of exploitable results, the actions planned to achieve the exploitation of the project results and increase the impact of the project, as well as a section on open access and intellectual property.

The deliverable has been updated at the end of the first reporting period (M20 – December 2022). The updates include the communication and dissemination actions performed during RP1, a report on KPIs and updates on the exploitation plan. Annex 1 include the summary table with project KPIs.

Task 4.2. Dissemination actions to engage the community behind the project (Lead Euro)

During this first reporting period the Co-UDlabs consortium performed several dissemination actions:

1. As a starting point, during the first 6 months of the project, the consortium identified a **list of stakeholders** to be targeted for the dissemination of project results. Different categories of target groups have been identified including: academics and researchers; industrials, water utilities and practitioners; governmental bodies; EU/national/international technology networks; related EU-funded research projects; and the general public. The latest version of this list, which is not exhaustive since it is constantly updated, has been included in the PEDR (D4.2). A contact form has also been developed on LimeSurvey by GRAIE (in the framework of WP1) in collaboration with UDC and Euronovia in order to invite additional interested stakeholders to join the community (feeding therefore the **project database**). At the end of RP1 (M18), 155 stakeholders have filled out GRAIE's contact form to join the project community and 140 people have subscribed to the Newsletter mailing list.

   In addition, within WP1, project partners worked to make an inventory of existing and potential future users of the Co-UDlabs RIs (see D1.1).
2. The consortium **organised several events** with different formats:

- Co-UDlabs Introductory Webinar on Transnational Access, organised by UDC on October 13, 2021 (online)
- Co-UDlabs Hackathon on Transnational Access to RIs, organised by Deltares on November 23 and 25, 2021 (online)
- Co-UDlabs live workshop on "Strengthening the links between scientists and practitioners to accelerate the transition towards smart and sustainable urban stormwater management – the

Co-UDlabs project" organised by GRAIE at the CGLE Carrefour des gestions locales de l'eau on June 29-30, 2022, Rennes (France)

- Co-UDlabs Workshop on "Urban Drainage Metrology Toolbox", organised as a side-event to the International Conference on Sewer Processes and Networks (SPN) by INSA on August 23, 2022 in Graz (Austria)
- Co-UDlabs session on "Tapping the value of urban drainage systems (UDS) Data" organised as part of the IWA World Water Congress by UDC on September 13, 2022 in Copenhagen (Denmark)

Furthermore, and as stated in WP3 report, the following training events were organised:

- Co-UDlabs Online Workshop on UD Practice and Research Needs, organised by IKT on November 3-4, 2021 (online)
- Co-UDlabs 25th EJSW - European Junior Scientists Workshop on "Monitoring urban drainage systems and rivers", organised by INSA and DELTARES on May 15-21, 2022 in St-Maurice-en-Valgaudemar (France)
- Co-UDlabs 1st Early-Stage Researchers Seminar, organised by UDC on 1 June 27-July 1, 2022 in A Coruña (Spain)
- Co-UDlabs Webinar on "Fourier transform infrared spectroscopy (FTIR) chemical mapping", organised by AAU on September 21, 2022 (online)

3. The consortium participated in several **external events for scientific dissemination** where partners presented the work done within the project with an oral or poster presentation:

7 scientific conferences

- Poster presentation by EAWAG at Aqua Urbanica 2021 "Schwammstadt" - German speaking Urban Drainage community on 13-15 September 2021, Innsbruck (Austria)
- Oral presentation by UDC at the GW4 WSA Seminar Series of the GW4 Water Security Alliance on May 26, 2022 (online)
- Oral presentation by UDC during the IAHR Institute Meetings (part of the 39th World Congress of IAHR) on June 19-25, 2022 in Granada (Spain), and two oral presentations by UDC and UDC-EAWAG.
- Oral presentation by UDC at the Water Innovation Europe 2022 (NBS working group event) - 23 June 2022
- Oral presentations by USFD and EAWAG at the 10th International Conference on Sewer Processes and Networks on August 23-25 in Graz (Austria).
- Oral presentation by UFSD, UDC and IKT and discussion on future research directions at the Symposium on Urban Flooding Experiments on September 1-2, 2022 in Lyon (France)
- Oral presentation by IKT at the POLLUTEC conference on October 2021, Lyon (France)

7 national technical events

- Oral presentation by UDC at the Galicia Innovation Days – Towards Horizon Europe on October 25-29, 2021 (online)

- Oral presentation by IKT at the StarkRegen Congress 2021 (Heavy Rain Congress) on December 2-3, 2021 in Gelsenkirchen (Germany)
- Oral presentation by IKT at the Göttinger Abwassertage (Goettinger Wastewater Days) on February 15-16, 2022 (online)
- Oral presentation by UDC at the 14th Annual Seminar of the Spanish Network of Hydraulics Laboratories on March 29, 2022 in Barcelona (Spain).
- Poster presentation by UDC at the Jornadas de la AEAS on September 28-30, 2022 in Córdoba (Spain)
- Oral presentation by INSA and GRAIE at the Journée d'échanges Autosurveillance des systèmes d'assainissement on October 13, 2022 in Lyon (France)
- Poster presentation by GRAIE at the Webinar France-Québec "Ville Perméable" - 17 March 2022

1 exhibition trade

- Online booth organised at the ICRI 2022 conference – 19-21 October 2022, Brno (Czech Republic) – hybrid event

1 Other event

- Oral presentation by UDC at the LIFE DRAINRAIN project final event on October 20, 2022 in Ferrol (Spain)

4. **Partners have published 8 conference papers**:

- "Co-Udlabs: Una red europea de infraestructuras de investigación en saneamiento y drenaje urbano", *Jose Anta, Jerónimo Puertas, Luis Cea, Joaquín Suárez, Juan Naves, Manuel Regueiro, Andrea Ciambra, XIV Seminario de la Red de Laboratorios de Hidráulica de España, RLHE*
- "Permeable Pavement Clogging Laboratory Experiments Using Rainfall Simulators", *Jose Anta, Joaquín Suárez, Proceedings of the 39th IAHR World Congress*
- "Monitoring Sewer Sediment Deposits with Passive Temperature Sensors", *Jose Anta, Jörg Rieckermann, Proceedings of the 39th IAHR World Congress*
- "Improving sediment monitoring strategies based on analysing heat transfer processes in sewer pipes", *Jörg Rieckermann, Proceedings of the 10th International Conference on Sewer Processes and Networks*
- "How reusable are your data? - Towards truly FAIR open data for urban drainage", *J. Rieckermann, P. Lechevallier, J. Agustsson, L. Rossi, S. Tait, Proceedings of the 10th International Conference on Sewer Processes and Networks*
- "Machine learning to improve understanding of sewer pipe failures", *Ehsan Kazemi, Will Shepherd, Simon Tait, Proceedings of the 10th International Conference on Sewer Processes and Networks*
- "Towards non-contact pollution monitoring in sewers with hyperspectral imaging", *P. Lechevallier, C. Felsheim, J. Rieckermann, Proceedings of the 10th International Conference on Sewer Processes and Networks*

- "Co-Udlabs: Construyendo una red europea de grandes instalaciones de investigación en saneamiento y drenaje urbano", *Jose Anta, Jerónimo Puertas, Luis Cea, Joaquín Suárez, Juan Naves, Manuel Regueiro, Andrea Ciambra, XXXVI CONGRESO. Asociación Española de Abastecimientos de Agua y Saneamiento*

All open access **deliverables** submitted during this first reporting period are available for download in the dedicated page of the website (https://co-udlabs.eu/dissemination/deliverables/) and on the project community on Zenodo (https://zenodo.org/communities/coudlabs/).

The Co-ordinator received the permission from IAHR to publish the "Monitoring Sewer Sediment Deposits with Passive Temperature Sensors" and "Permeable pavement clogging laboratory experiments using rainfall simulators" papers on the open-access Zenodo repository, under the Co-UDlabs community, during the embargo period. The Permission letter from IAHR can be forwarded on request.

The full list of KPIs reports on communication and dissemination activities for PR1 are provided in the Annex I and summarized in Section 3. Impacts

Task 4.3. Exploitation plan of the project results (Lead Euronovia)

The exploitation strategy outlined in the Grant Agreement has been further developed and outlined in the PEDR submitted at M6 and updated at M20. Intellectual Property Rules and conflict resolution procedures for IPR have been detailed in the Consortium Agreement (CA) signed by all partners prior to the start of the project. These aspects are very important for a proper exploitation of the project results.

This task involves the International Advisory Board (IAB), constituted by industrial and relevant experts in the UD field to provide strategic direction, quality improvement, and assess the project effectiveness in order to foster exchanges with external industrial players regarding the exploitation potential and options. The real work on exploitation will start in 2023 (around mid-term), when the list of potential exploitable results of the project presented in the GA will be updated by the consortium under the lead of EURONOVIA. The results having the best potential for exploitation (Key Exploitable Results - KERs) will be identified and analyzed during an Exploitation Seminar. This will be done with the help of the IAB and the Horizon Results Booster (Module C) service.

Task 4.4. Communication activities (Lead Euronovia)

Several communication materials and tools have been created during this first reporting period:

- The project **logo**, **visual identity,** and **templates** (deliverable, poster, meeting/event agenda and minutes) were created at the start of the project and made available to project partners to help them to communicate about the project in a uniform, consistent, and professional manner.
- At the start of the project, a **project executive summary** was prepared to summarise the most important information related to the project (scope, objectives, activities planned) to help the consortium to communicate the right information about the project. This was also included in the IAHR/IWA Joint Committee on URBAN DRAINAGE Newsletter of May 2021: http://www.jcud.org/downloads_file/2021_JCUD_Newsletter_final.pdf.

- A project **flyer and roll-up banner** were prepared in October 2021 with the aim of being printed by partners on the occasion of external events. These were also translated in French and Spanish for better communication with national UD communities targeted by national events organised in France and Spain. This material is available at https://co-udlabs.eu/dissemination/communication-material/.
- The first 2 issues of the newsletter were created in November 2021 and May 2022 and - sent out to the project mailing list and disseminated through social media and the project partners network to maximise its dissemination. These are available for download at https://co-udlabs.eu/dissemination/newsletter/.
- The Co-UDlabs **project website** (https://co-udlabs.eu/) was launched and published online in October 2021 and is being constantly updated with news, events announcements and new documents. During RP1, 37 news have been published and 80 users visited the website on average each month. More information on the content and structure of the website can be found in deliverable D4.2.
- A **LinkedIn page** (https://www.linkedin.com/company/co-udlabs-project/), **Research Gate** (https://www.researchgate.net/project/Co-UDlabs-Building-Collaborative-Urban-Drainage-research-labs-communities) and a **Twitter account** (https://twitter.com/CoUDlabs) have been created in the first months of the project to develop a community of people interested in the project, to raise awareness on the project launch and objectives and to allow for more interaction with similar projects and initiatives. At the end of RP1, the project LinkedIn group hit 228 subscribers and 37 news items have been posted. The project Twitter account has 164 followers, and 142 tweets were published. In addition, several partners used their institutional LinkedIn and Twitter accounts to communicate about the project, some of them being very active on social media and with an important number of followers.
- A **YouTube** channel has been created at M12: www.shorturl.at/emp23. At the end of RP1, this YouTube channel contains **3 videos** (recordings of the project webinars).
- A **press release** including the most important information related to the project (scope, objectives, messages) was drafted in July 2021 to officially communicate the launch of the project. It is available in English and French at https://co-udlabs.eu/dissemination/communication-material/. This press release was published by project partners on their institutional websites and disseminated through their contact networks. In addition, **several news articles were** published by the project partners on their institutional websites to give updates on the different activities taking place within the project (events, transnational access calls, etc.).
- During the first reporting period, the Co-UDlabs project benefited from a large **media coverage:**
    - **Several articles** have been published by the project coordinator (UDC) in the Spanish national press to inform and update the Spanish UD community on the project. Other partners (IKT, INSA) contributed to raise awareness of the project at national level (in French and German national websites/journals).

- The project coordinator presented Co-UDlabs during a radio interview on a Spanish regional radio in April 2021: https://www.crtvg.es/rg/destacados/a-tarde-a-tarde-do-dia-29-04-2021-5012510
- Elodie Brelot from GRAIE presented the CO-UDlabs project during a filmed interview by Actu Environment in June 29, 2022: https://youtu.be/vjD8WLFPzL4

- With relation to **synergies with other projects**, the consortium has identified a list of EU projects working on a similar domain with which a collaboration can be envisaged to create synergies and maximise mutual impact. This list is available in the PEDR. Some of the Co-UDlabs partners are also partners or are in close contact with some of these project consortia (NICE NBS, MultiSource, LabPlas, Ponderful, Urban GreenUp, Smart Cities EU) and are keen to help in developing synergies during the next reporting period. First contacts have been established with the VITALISE project coordinator (to work together on RIs best practices in the following months) and GEOlab RI project, as well as with the LIFE DrainRain project for cross dissemination.
- The project coordinator participated in 1 **open-science event** for communication purposes:
  - The project was presented by UDC with a poster at the Galician Night of Researchers taking place at A Coruña (Spain) on September 24, 2021.

The KPIs report on communication and dissemination activities for PR1 is provided in Annex 1.

Task 4.5. Data management plan (Lead: Euronovia)

A first version of the Co-UDlabs **Data Management Plan** was prepared and submitted as a deliverable (D4.1) at M6. The aim of the DMP is to outline how partners will collect data, will catalogue it and, when appropriate, how they will make it available on an open access basis during and after the project. The plan also describes the mechanisms the consortium will use to ensure that as much of the data collected during the project is made available as soon as is practicable. During the General Assembly organised in La Coruña in June 2022, the data management strategy was discussed and revised: Partners agreed on the necessity to provide a specific DMP for each JRA and TA, and to use the **DMPonline tool** to draft and maintain each DMPs.

At M17, UDC developed a "**Guide on how to upload JRA and TA datasets on Zenodo**", together with a "**Data storage report template"** to be filled in and attached to the repository alongside the datasets by each JRA and TA team. The DMP will be updated at M20 (December 2022) with the latest project datasets and with the revised strategy. Further updates are planned for the end of the 2nd reporting period (M36) and for the end of the project (M48).

The **open-access datasets** related to this first reporting period have been uploaded on **Zenodo**, under the Co-UDlabs community created in October 2021: https://zenodo.org/communities/coudlabs/.

Summary of Deliverables

Deliverables completed:	**D4.1 – Data Management Plan (M6)** **D4.2 – Plan for exploitation and dissemination of the project results (M6)** Updated versions of these documents were submitted soon after the end of the RP1 (M20).

Deliverables passed due date:	There were no delays in the submission of deliverables in this reporting period

Summary of Milestones

Milestones completed:	**MS8 - Communication package ready (M6)**
Milestones passed due date:	None

1.2.5 Work Package 5 - Management of the TA

The main objective of this WP is the organisation and management of the trans-national access for external user groups. It includes the development of two calls to the 17 large research facilities offered in Co-UDlabs proposal transnational access, engagement activities to encourage multi-sectorial users groups, the evaluation and selection of access projects, and the development of the users access rules.

Task 5.1. Launch of the access call and outreach to users (Lead UDC)

This task consisted of the preparation of documentation for the Transnational Access before the open of the first call of proposals (M1-M6), launch of the first call (M6) and the preparation of the outreach activities for the call.

Preparation of the call. UDC as coordinator and all the partners involved in the TA revised and agreed on common procedure, rules, and conditions for the first call of the Co-UDlabs TA programme. The documentation required included:

- The final TA call, including the summary of all the aspects related to the Co-UDlabs first call for proposals to be disseminated through the UD community: general description, eligible costs, support offered by facility providers, conditions for access, key dates and deadlines, application, evaluation and selection rules and a short technical description of the facilities available.
- A detailed description of the 17 infrastructures offered within the Co-UDlabs TA programme, uploaded to the Co-UDlabs website and compiled also for the purposes of WP2.
- Rules and conditions of TA participation, including rules of procedure as well as the responsibilities and duties of awarded groups and facility providers during the access.
- A description of the evaluation and selection process for user groups to be aware of the requirements and evaluation criteria during the preparation of the proposals (consistent with the project's MS10 'Definition of Users Selection Procedure for TA access').
- All templates required and the proposal form hosted on the website, where user-groups could upload all needed documentation.

All this information has been compiled and explained in detail in a TA manual as a practical guide for potential user groups for the preparation and submission of project proposals. This document has been made available to users via the web on the following link https://co-udlabs.eu/access/ta-call/ along with the rest of documents mentioned above.

Launch of the first TA call. The first Co-UDlabs call for TA proposal was officially opened on 31st October 2021. From that moment, all the documentation related with the TA proposal and the

proposal submission system were available for potential User Groups on Co-UDlabs website. Efforts were made to ensure that the call for proposals had the widest possible reach through social media, different mailing lists and professional contacts to which the project partners have access, conferences, and events held by Co-UDlabs such as the introductory webinar, the Online Workshop on UD Practice and Research Needs (3-4 November 2021) and the Co-UDlabs Hackathon. A 'Facility contact form' was also made available on the website to facilitate - communication between users preparing their proposals and facility providers. Everyone contemplating submitting a proposal to this call was advised to submit a draft proposal to the corresponding facility provider at least 4 weeks before the deadline. In this way, providers were able to advise on issues related to technical constraints, feasibility or eligibility conditions and/or - provide additional information to improve the final proposals. This approach - worked - well and - led to - relatively high-quality proposals. The call was closed on January 31, 2022.

Some specific outreach activities within the framework of WP5 were arranged to promote the call (further details on complementary actions are provided in Section 1.4).

- Co-UDlabs introductory webinar. On 13 October 2021, a 2-hour webinar to introduce the 1st Transnational Access call was organised by Deltares and UDC, giving key information on how to benefit from Co-UDlabs Transnational Access programme. The Webinar featured an introductory keynote by Co-UDlabs Project Coordinator followed by a Q&A session. The second part of the Webinar was focused on the introduction of the Co-UDlabs Transnational Access programme and the 17 infrastructures offered by the partners of Co-UDlabs, as well as the possibilities of each facility to host research facing problems affecting UDS. The event had more than 150 registered participants with a peak of just over 100 participants in attendance at the Webinar, with representation from 36 countries and different agents of the water sector with 20 registrations from SMEs. The webinar was recorded and was uploaded to Co-UDlabs YouTube channel and website for dissemination.
- 1st Co-UDlabs Hackathon. Co-UDlabs organised a Hackathon online event on November 23 and 25, 2021, with the aim to make more accessible Co-UDlabs research infrastructures and engage the multi-disciplinary urban water scientific community. Deltares supported the Co-UDlabs partners (with RI) in the online organisation of the event. The Hackathon sought to identify and share valuable ideas facing challenging problems within urban drainage systems and was an opportunity to build synergies, teams, and improve project ideas and designs. The Hackathon included first a project introduction and description of the facilities and an open brainstorming session to foster the connection between different participants. 12 participants contributed with 14 project idea presentations and were warmly invited to build on their ideas and transform them into full-fledged proposals for Co-UDlabs' Transnational Access call, leading to some projects that have finally been granted in this first call. The results of the Hackathon were used to create a Co-UDlabs Ideas Marketplace in which the people of our community can exchange propositions, ideas, contacts, and methods that may lead to Transnational Access project proposals.

  The winner of the Hackathon was awarded with a field visit to the facility of their choice in order to gain more insights to prepare their call proposal.

Task 5.2. Review of access proposals (Lead UDC)

In Task 5.2 the proposals from the 1st call were evaluated by the External Evaluation Panel of the project. The Co-UDlabs TA first call was closed on 31st January 2022 with a total of 15 project proposals received. The user groups were led by institutions in 11 countries and included members and researchers from a total of 19 different countries. 100 users from 60 different institutions were part of the teams that submitted their proposals.

The call was successful in mobilising interest and participation outside of university: 45% of staff involved in the proposals came from non-academic institutions and partners. 25% of all users are female, a low figure which will have to be the focus of more innovative and inclusive recruiting in the future. Junior researchers were also involved in the project proposals with at least 8 PhD students already included in the user groups and several open positions were planned in user-group institutions because of their participation in the TA.

An External Evaluation Panel of international experts evaluate the proposals, based on the common user selection and evaluation procedure agreed by Co-UDlabs partners. Each eligible and feasible proposal, checked by Co-UDlabs management team and facility providers respectively, was evaluated in-depth by two members of the EEP. The EEP discussed these reports in a joint meeting and finally decided to select 13 project proposals to be granted with TA access to Co-UDlabs facilities and to be developed until July 2023 (see Table 4). The list of awarded projects was published on the website and social media on 28th April 2022 and facility providers officially communicated to corresponding user groups the acceptance by mail. Detailed results of the evaluation procedure of the first call have been reported on D5.2 Report on evaluation procedure 1st call. In M30, the first report on TA provision is planned.

Table 4. Selected proposal by the External Evaluation Panel to be awarded with Transnational Access.

Acronym	Awarded Proposal	Group leader institution
UDC-01-BENS-Peña	Evaluation of new flow and quality monitoring devices for sewers	Photrack
UDC-02-BLOCK-Zafra	Methodology to determine the potential resuspension load of heavy metals from road sediments associated with surface runoff	Francisco José de Caldas University
UDC-03-STREET-Bellos	Urban Flooding: Houses as reservoir (UF-HOUR)	Democritus University of Thrace
USFD-01-ABFLUME-Mignot	Pollutant Transport in Urban Floodwaters	Fluid Mechanics and Acoustics Laboratory
USFD-02-ANNULAR-Regueiro	Temperature time series analysis for predicting sedimentation in sewer systems	Universidade da Coruña
USFD-03-ANNULAR-Morato	Annular Flume studies to test the effect on Antibiotic Resistant Genes and Use of CRISPR- Cas in E. coli from sediments affected by sewage pollution	Universitat Politècnica de Catalunya
USFD-04-BURIED-Li	Hydraulic Analyses of the Toronto Exfiltration System (TES)	Ryerson University
EAWAG-01-HALL-Bares	Non-contact assessment of TSS and COD concentrations in wastewater with hyperspectral imaging	Czech Technical University in Prague
EAWAG-02-HALL-Langeveld	Characterisation of thermal properties thermal properties of sediment samples in urban drainage systems with temperature probes	Delft University of Technology
EAWAG-03-UWO-Dittmer	A Probabilistic Machine Learning-based Framework to Improve Urban Drainage Modeling Reliability	Technical University of Kaiserslautern
IKT-01-LTF-Verhulst	Assessment of Inspection tools for Rising Mains (AIR)	Stichting RIONED
IKT-02-LTF-Beenen	Investigation of the rehabilitated wastewater pressure pipes in response to pressure surges in operation	VLARIO
INSA-01-OTHU-Fuchs	In-situ SUDS modelling	Institut für technisch-wissenschaftliche Hydrologie

Task 5.3. Organisation of the TA access period (Lead UDC)

Once a user-group's project is accepted, the management of the TA to the Co-UDlabs facilities was transferred from UDC to the corresponding facility provider (UDC, USFD, DEL, EAWAG, IKT, INSA or AaU) to subscribe to the specific User Facility Agreement (UFA) between users and provider and develop the project. The UFA includes dates for the TA, responsibilities and duties of the user group and the Facility Provider, expenses covered and applicable law. All UFAs must annex a User Project Plan (UPP) in which the experimental setup, the experimental procedure, the programme of tests and the access plan with visitors and dates have to be described in detail to be agreed by both the user group and the facility provider before - the TA starts. The main objective of this agreement is to ensure the coordination between user groups and facility providers before the Access starts. An UFA example was developed by UDC to be adapted for the rest of the members. UDC has also drafted a User Project Plan template, revised and agreed by the partners involved in TA, to facilitate consistency in the implementation of the -TA.

The facility providers have been asked to arrange a starting meeting with the user group representatives to start drafting the UFA and the User Project Plan, schedule access dates, and commit to prepare an initial Data Management Plan of the project to be developed prior the TA starts. The meeting is also useful to arrange facility's Health and Safety Requirements and Training Activities needed before the TA. Facility providers regularly informed UDC, as task leader, of the progress of each TA.

UDC, as the coordinator of Co-UDlabs project, has made available private SharePoints in the Teams environment for the coordination and communication between user groups and facility providers and for the secure storage of the data generated within the TA. All the information related to the implementation of the different TA in RP1 is described within WP9 report and section 1.4.

Summary of Deliverables

Deliverables completed:	**D5.1 - Manual with the TA call rules and procedures and the description of the facilities (M6)** **D5.2 – Report on evaluation procedure 1st call (M18)**
Deliverables passed due date:	There were no delays in the submission of deliverables in this reporting period

Summary of Milestones

Milestones completed:	**MS10: Definition of Users Selection Procedure (M6)** **MS11: 1st call proposals launched and evaluated (M12)** News on Co-UDlabs website and D5.1 support the completion of the MS.
Milestones passed due date:	None

1.2.6 Work Package 6 - JRA 1. Smart sensing and monitoring in urban drainage

The Joint Research Activity "Smart sensing and monitoring in urban drainage" is developed in the framework of WP6. The objectives of this WP are to: i) foster a paradigm shift in UDS management,

transitioning from current inefficient approaches towards a digitised, informed, shared, evidence-based decision process based on truly smart monitoring; ii) identify and evaluate new sensors and technologies for hydrological and hydraulic variables, pollutant load monitoring and UD underground asset inspection; iii) define and evaluate new methods and tools to improve evidence base for reliable and validated urban drainage monitoring data; and iv) define and evaluate new methods to analyze and interpret urban drainage space and distributed data. WP 6 is led by INSA and most of the TA facility providers are involved in their development (UDC, USFD, DEL, EAWAG).

Task 6.1. Evaluation of sensor and new data sources for hydraulics, pollutant load monitoring and asset inspection (Lead EAWAG)

The goal of Task 6.1. was to review innovative sensors technology for UDS (Sub-Task 6.1.1.) and select promising sensors for in-depth testing (Sub-Task 6.1.2.).

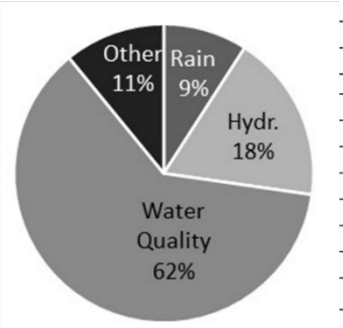
In SubTask 6.1.1., we first formed a core-group (Deltares, EAWAG, INSA, UDC, USFD) and applied a three-phased approach. First, we brainstormed a comprehensive list of 55 sensors and digital monitoring technologies. The list had a strong focus on online water quality monitoring, which is currently perceived to be most lacking in UDS, but also included promising recent developments in data transmission and energy harvesting technologies. The latter are especially vital for UDS, because they are environments which require autonomous sensors with wireless data transmission, because they are difficult to access.

In a second step, the Co-UDlabs partners selected 8 out of the 55 sensors which measure, i) coliforms continuously with in-situ fluorescence, ii) electrical conductivity with low-power, iii) water velocities with cameras, iv) NH4 and other pollutants with a submersible spectrophotometer, v) multiple pollutants with hyperspectral imaging, vi) polycyclic aromatic hydrocarbons PAHs with in-situ fluorescence, vii) pipe condition, and viii) 3D sediment beds with LiDAR. Of those 8 instruments, 4 have a low technology readiness level (TRL) and have been selected for their potential to advance urban drainage research. In contrast, 3 other sensors have a TRL of 8 or higher, which means that, if tests are successful, they could readily be integrated into new monitoring services.

Figure 4 shows the distribution of suggested sensors and the intermediate and final list selected for the development of the task. Details on this process are documented in Deliverable 6.1.

In SubTask 6.1.2. the selected sensors are currently undergoing in-depth field testing by the individual groups. The core group discussed common standards for sampling and data collections as well as desired outcomes and joint actions during a meeting on 25 May 2022. Testing of the individual sensors has been progressing according to plan, with progress in the individual groups. For example, online e-coli sensor (USFD) and non-contact water quality sensor (EAWAG) have both collected water quality samples together with reference data and are preparing peer-reviewed scientific publications, as part of PhD studies.

As additional achievements, the Co-UDlabs activities on the non-contact monitoring have sparked R&D projects with SUEZ France and Photrack AG (aiming at augmenting their cameras with water quality monitoring capabilities together with CSEM in Switzerland). Photrack AG sensors will be tested by UDC.



ID	Parameter	Sensor title	Type	Brand	Model	Proposer	TRL_est*
6*	Coliforms (faecal, E. coli, total)	Proteus	Meas.	Proteus	Mult. Par. Water Quality Sensor	UoS	8
7*	Conductivity	LoRaWan Conductivity	Meas.	in-house development	inductive EC probe	EAWAG	4
9	CSO event	LoRaWan CSO detector	Meas.	in-house development	capacitative sensor	EAWAG	4
12*	Discharge	Camera Flow Meter	Meas.	Photrack	Discharge Keeper	EAWAG	5
13	Discharge	Coriolis flowmeter	Meas.	Serv instrumentation		INSA	4
14	Discharge	laser based discharge Meas.	Meas.	Ijinus	ISCO laser	INSA	9
24*	Multi	Submersible spectrometer	Meas.	Go-Sys	ISA	INSA	9
26	Multi	SQUID	Meas.	in-house development	SQUID	EAWAG	4
27*	Multi	Non-contact quality sensor	Meas.	Headwall photonics	Hyperspec MV.X	EAWAG	0
31*	PAH	PAH probe	Meas.	Aquams	TriOS	INSA	9
33*	Pipe mapping	FSB	Meas.	Deltares	FSB	EAWAG	5
38	Rain	Raingauge with Corriolis flowmeter	Meas.	in-house development	NA	INSA	0
43*	Sediment	3d LiDAR sediment mapping	Meas.	Intel RealSense	LiDAR Camera L515	UDC	2
44	Sediment	3d mapping of sediment with SfM	Meas.	in-house development	Photo camera	UDC	4
55	Water quality	Microsensors	Meas.	Unisense	various	UoS	9-1

Figure 4. The suggested sensors mostly concerned water quality, but also other variables (left), the intermediate list of pre-selected sensors obtained from step two (right). The final selection is labelled with a star. The full list of sensors and further information is given in D6.1.

In WP6, Task 6.1 the sensor testing activities in T6.1.2. were slowed down initially because Dr. Frank Blumensaat left EAWAG. Internally, Dr. Mathieu Lepot (INSA took over the initial coordination to compile the comprehensive list of sensors). This was achieved with internal efforts, without re-distributing resources within Co-UDlabs.

Task 6.2. Smart methods and tools to improve the evidence base for reliable and validated monitoring data (Lead INSA)

Sub-Task 6.2.1 "Defining standard methods and protocols for metrology, and the associated open-source codes" is finished. A first list of methods and protocols to be included in T6.2 was established and discussed by Co-UDlabs in Autumn 2021. After the priorities were defined and validated by the WP6 partners, a final list based on the following 5 groups of urban drainage metrological tools was created:

1. Sensor calibration / correlation
2. Calibration / correlation correction
3. Uncertainty assessment
4. Data validation
5. Tracing experiments.

Groups 1 to 4 include various methods and protocols.

Initially, Task 6.2 objective was to propose a list of codes to apply the selected methods and protocols. During the course of Sub-Task 6.2.1, it has been decided by the WP partners that, aiming to facilitate the use of the selected methods by the highest number of users, a free online webapp with an easy-to-use interface would be better than a collection of open-source codes, as it requires less skills for users, in particular practitioners. It has thus been decided to develop a web application, based on Matlab codes, to avoid local installation of codes by each user, and to facilitate the use and the maintenance of the software, etc. At the end of the project, final versions of all Matlab codes developed for the webapp will be made publicly available in the Co-UDlabs Zenodo repository.

Sub-Task 6.2.2 "Internal application and testing of methods and protocols" is in progress according to plan. The webapp, named UDMT (Urban Drainage Metrology Toolbox), has been developed and is now fully functional with all 5 groups of tools implemented (Figure 5). The Matlab codes of all individual metrological tools and of the webapp interface itself have been written by INSA. The implementation of the Matlab codes on a remote virtual server and its functional deployment on internet are provided by an IT subcontractor (Alison company) according to GA. The first official release UDMT 2022a has been published in October 2022 (M18). It can be accessed to by any user, for free and without any registration or sign-in requirement, at http://vps-7bc5cf87.vps.ovh.net:9988/webapps/home/session.html?app=coudlabs.

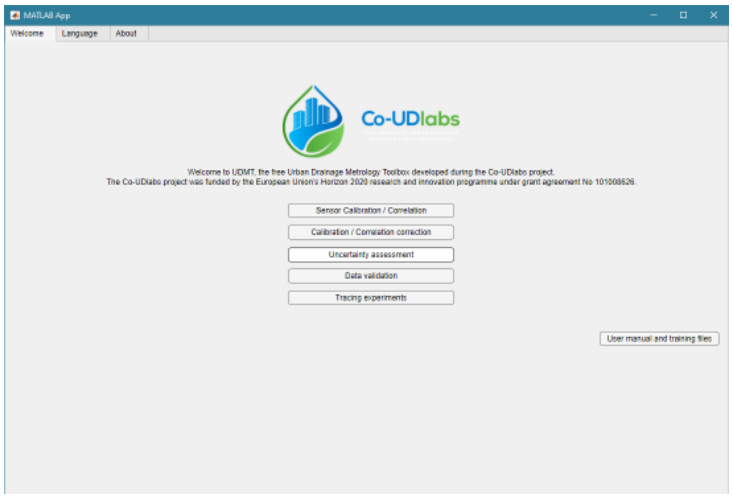


Figure 5. Main user interface of the webapp UDMT (version 2022a), with 5 main central buttons providing access to the 5 groups of methods and protocols, and a right-side button giving access to the user manual and data files for replicating all examples.

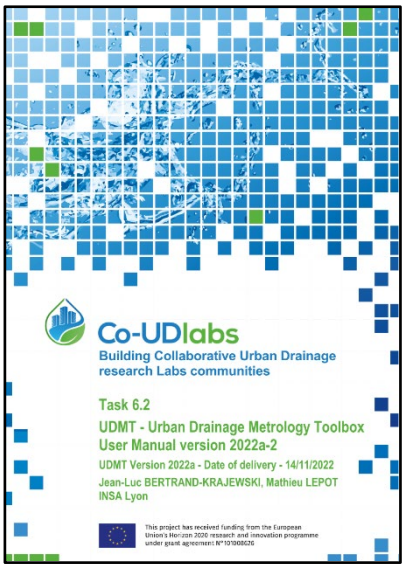


Figure 6. Front page of the 70-page UDMT user manual (version 2022a-2).

A complete user manual has been written, with detailed examples of application of all methods (Figure 6). The user manual pdf file, all csv data files of the examples given in the user manual, additional documents (scientific papers, book) are available in a Cloud directory accessible from the webapp (right-side button in Figure 5).

A first international workshop for the presentation and demo of the UDMT prototype has been held as a pre-conference workshop at the 10th SPN – Sewer Processes and Networks international conference in Graz, Austria, on 23 Aug. 2022. The participants gave comments and feedback which have been accounted for to develop the first official release UDMT 2022a in October 2022. They are invited to use and test the webapp until end of Nov. 2022. After a quick presentation of the UDMT in a French national conference in Lyon, France on 13 Oct., a one-day training course for urban drainage French practitioners is in preparation for March-April 2023 (exact dates to be defined).

In Task 6.2, the development of the UDMT webapp required more PMs than expected for two main reasons: (i) developing a unified webapp required more time than providing a collection of individual source codes; and (ii) developing a webapp required to develop internally (INSA) new skills about webapps in general, adaptations of codes for use on remote servers and closer links with the IT sub-contractor. On the other hand, it will save PM in the next phase as there will be no need for distribution and local installation of codes which always require a lot of time for user assistance.

Task 6.3. Space distributed monitoring and data interpretation (Lead USFD)

Two meetings have taken place between UOS and the Environment Agency of England and Wales, regarding explanations about the open-access Combined Sewer Overflow (CSO) database, explanation of some of the meta-data, and discussions regarding the ongoing development of new CSO regulations in the UK. A postdoc has been appointed (part-time) to Task 6.3, to work on analysis of the spatial CSO data, work to start in 2023. This work will be carried out in collaboration with Task 2.3 and other Co-UDlabs partners will be urged to contribute their local knowledge of CSO data and use of this data for compliance in their countries. USFD has supervised two Masters projects in the 2021-2022 academic year, looking at initial analysis of the spatial distribution of CSO occurrences and durations in relation to population density, and existing more sporadic 'grab' water quality samples. One of these students has subsequently been offered a PhD position at the University of Sheffield, working on the topic of 'A data-driven model to improve the design of combined sewer overflow spill mitigation in UK catchments', this will not be funded by CO-UDlabs, the student is expecting Saudi government funding. The work of the PhD will be aligned with Task 6.3

Summary of Deliverables

Deliverables completed:	**D6.1 – Report on review and selection of 6 new/ emerging monitoring technologies to be tested in T6.1.2. (M12)** An updated version of this document has been uploaded to Zenodo community (https://zenodo.org/record/7261621#.Y4Cs-y8rz0o)
Deliverables passed due date:	There were no delays in the submission of deliverables in this reporting period

Summary of Milestones

Milestones completed:	**MS13 - Identification and selection of 6 new/ emerging technologies of Task 6.1 (M12)** Fulfilled through D6.1 **MS14 - Definition of methods and tools of Task 6.2 (M12)** A progress report is available upon request.
Milestones passed due date:	None

1.2.7 Work Package 7 - JRA 2. Evaluation of asset deterioration in urban drainage systems

The Joint Research Activity "Evaluation of asset deterioration in urban drainage systems" is developed in WP7 and runs from M1 to M44 of the project. The aim of this WP is firstly to review and evaluate current pipe inspection practices and defect identification protocols and then to understand how individual pipe defects can impact on system performance. A secondary aim is to start to understand how pipe defects develop and gain a physical understanding as to how buried drainage pipes deteriorate to be able to make more informed decisions on renewal, rehabilitation and repair.

WP 7 is led by UFSD, and IKT, DEL, INSA and UDC are involved in their development. Activities have started in Task 7.1 and Task 7.2 in RP1 and the main activities associated with Task 7.3 have still to begin, although some preliminary studies have started.

Task 7.1. Inspection data to system knowledge (Lead USFD)

This first task is to examine whether current in-pipe inspection methods can be improved so that better and more consistent data on defects can be obtained, and it has three subtasks.

In **SubTask 7.1.1**, a review on current and emerging in-pipe inspection methods was carried out by UFSD, with support from IKT and DEL. The review on in-pipe inspection methods was written up as Deliverable 7.1 and was submitted in M18 as expected. This review examined historical and more recent developments in the technologies used to locate, identify and characterise in-pipe defects. This review has shown that CCTV inspection currently still dominates sewer inspection, despite the recognition that there is significant uncertainty and cost associated with human based analysis of CCTV images. Different sensing approaches, e.g., electrical and acoustic based have been developed and deployed to identify defects that are difficult to identify using visual means and also allow for larger proportions of sewer networks to be inspected. The review has also shown the benefits of multi-sensor approaches when identifying and characterising sewer pipe defects. Emerging inspection technologies can be organised into 3 groups: new sensing technologies, multi-sensor inspection platforms and adaptation of existing Artificial Intelligence (AI) based approaches to better identify and characterise in-pipe defects from CCTV images.

Newer sensing technologies based on laser scanning, acoustic and electric conductivity-based methods are starting to be used and these new inspection techniques are collecting more physically relevant inspection data. However, their deployment is limited. Even with this advantage CCTV based inspection still dominates in-pipe inspection in urban drainage systems and will continue to do so until the newer technologies move from TRL 5/6 to 8/9 and this may take several years.

Several 1000s CCTV images have been obtained from a small number of utilities. One issue we have encountered is the reluctance of utilities to make these images fully open access at the end of our work. With this data set we have started to examine the uncertainty associated with various automated image-based approaches. Existing methods used to deliver automated defect detection from images normally consist of two stages – i) object detection using classical computer vision methods such as colour thresholding and feature extraction, and ii) Machine Learning (ML) algorithms for classification of objects/defects. Recently, in other engineering areas more advanced computer vision models have been developed using Deep Learning (DL) to identify physical artefacts without the

need for a separate phase of feature extraction since DL approaches can automatically learn an object's inherent features through analyzing images at a pixel level.

In this task, a DL-based framework is being developed to automatically predict defects in sewer pipes. This work has involved the development of DL based codes to identify typical defects. The DL model was trained using CCTV images with pre-labelled joints and obstacles, and then employed for prediction of location of joints and obstacles in unseen CCTV videos of different sewer pipes (Figure 7). The models, although trained with a limited amount of data, can detect joints and certain types of obstacles with a good accuracy and a 'confidence' above 95%. Indicating a performance that is better than the earlier feature extraction and ML based approach.

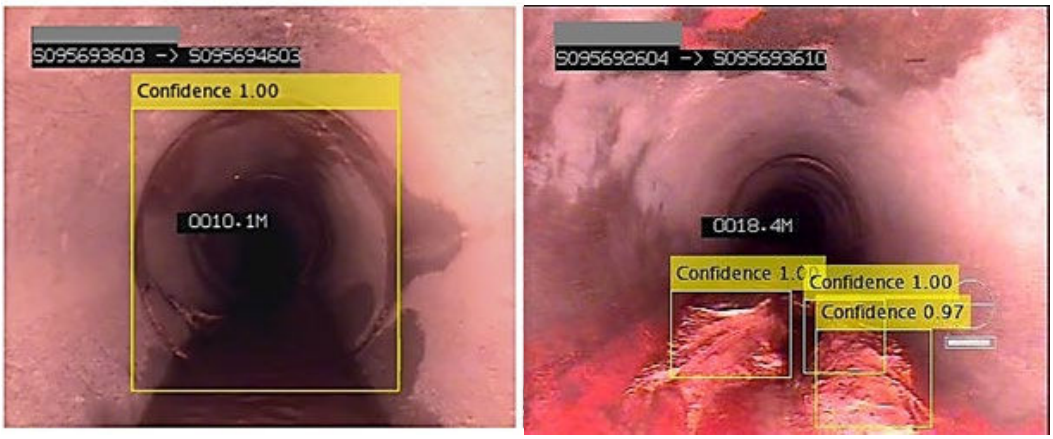


Figure 7. Example of joint and blockage identified by trained DL algorithm.

This image analysis work is continuing in two ways; the DL modelling is being extended to look at other common in-pipe defects and secondly work is looking at ways to gain physically relevant data from the identified defects. Labelled training data sets are being expanded, and new DL based algorithms obtained for these other defect types and then validated.

The current DL framework is written in MATLAB and is based on the YOLO v4 DL code, YOLO v7 is now available and faster and is expected to have greater accuracy than its previous versions, (i.e., YOLO v5 and YOLO v4) but its implementation is not yet available in MATLAB, but is already present in Python libraries. Therefore, the MATLAB software is being transferred into python to be able to use YOLO v7 for faster and more accurate predictions. python is an open-source software so the cost (and expertise) barrier to use the developed DL codes will be significantly reduced. The researcher involved in the work has also received training from professional software engineers to ensure that the final DL code will be formatted and supported by documentation that will allow the code to be used independently by end users. It is our intention to make all the analysis code open access, with support documentation to allow existing sewer engineers and inspection companies to test and use it.

To deal with the issue as regards the provision of CCTV images to allow end users to train and use DL based analysis software data UFSD and IKT are working together. IKT are a partner in a research project on the development of the condition of sewers (acronym: ZEMuS) started in May 2022, which is funded by the Ministry of the Environment of North Rhine-Westphalia. Inspection data from sewer network operators from regular CCTV inspections over a period of more than 20 years is being evaluated in this project. The aim is to use CCTV from the sewer network operators involved in the

ZEMuS project (including municipalities like Cologne, Duisburg, Leverkusen, Hagen, Essen, Neuss...) to analyse possible changes in condition over time. At present, the project is requesting and combining the data from the network operators and developing an evaluation routine. UFSD are examining the potential to use DL approaches to automate, or partially automate the analysis in the ZEMuS project. If the DL based analysis shows promise it would be the intention to introduce such techniques to the ZEMuS project partners for use in their own working environment, so that DL based image analysis could be introduced without specialist support.

Moving forward, typical examples of damage patterns identified in the ZEMuS project will be made available to Co-UDlabs for further analysis, provided there is approval from the Municipalities – which is currently being sought. The new python-based software from USFD may be used in the identification of damage patterns and further analysis. The observations and initial work results on the actual condition development of existing damage patterns and failure mechanisms of ZEMuS (in coordination with the funding body) could be used within the framework of Co-UDlabs.

In **SubTask 7.1.2**, a second review has been carried out into the different defect classification schemes used in different European countries. This review identified the historical commonalities in the classification schemes used in different countries. In 2003, a new 'Euro Code'-EN13508: Part 2 was produced, strongly based on the knowledge gained from earlier experience within the U.K. Other European countries created their own sewer inspection standards (e.g.,e.g., AFNOR, 2011, NEN 2011) based on the structure of the earlier UK standard and was compliant with the 2003 Euro code. All the newer national defect classification schemes did not take the opportunity to rationalise defect codes. Considering the various standards across Europe the number of defect codes are now greater than 300. In Japan, a defect classification system was developed by the Japan Sewage Works Association, independently of the UK influenced standards found in the US and Europe. The Japanese standard has just 10 defect types, with each defect type assigned one of three severity scores. This classification system is considerably simpler to apply than the other defect coding systems currently used in Europe and the US. There is growing evidence that coding systems with a larger number of defect codes leads to a reduction in the accuracy of defect identification and characterisation. Thus, it is likely that using different defect coding systems as well as different inspection technologies will impact on the quality of the knowledge gained from the inspection of sewers. This information is now being synthesised by UFSD in order to produce a revised condition assessment scheme proposal.

Lastly, in **SubTask 7.1.3** laboratory work is planned to establish the best way to create common in-pipe defects that can be used to create common EU in-pipe defect scenarios to aid technology development that can be benchmarked. IKT have a long track record in assessing the quality of rehabilitation methods using large scale tests.

They have shared information on the use of full-scale pipe defects in the laboratory as a result of visits (Naismith to UFSD and Tait to IKT). IKT have developed a systematic way to simulate defects that have the confidence of their end user community. UFSD will take advantage of this knowledge exchange. Preparations have been made to prepare a full-scale buried pipe section at UFSD by developing laboratory measurement methods for water tightness in preparation for a full-scale loading test in M21-22, Q1/2 2023 – see Figure 8 a) and b). Gaining experience in testing such sub-systems will allow for a more systematic series of tests to be conducted on a more complex large-scale laboratory model planned in M30-31, Q3/4 2023. In addition, it is also planned to use some of the sample damage patterns developed in the German research project "Comparative Investigations of

Rehabilitation techniques for Rising mains" for laboratory tests by IKT, which were coordinated in cross-border partnership partner projects with UK water companies and a Dutch Municipality. Close links will also be maintained with the Transnational Access project (AIR, acronym: IKT-02-LTF-Beenen) at IKT that is considering sensing defects in pressurised sewers. This work provides preparatory knowledge for Task 7.2.1 that started in M18.

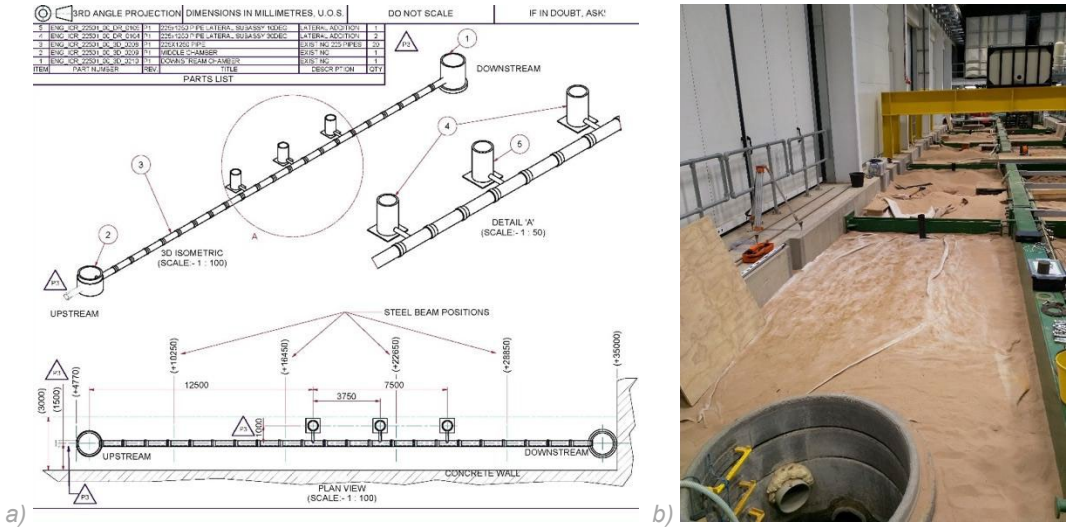


Figure 8. a) Buried Pipe to be tested, manhole 1 shown in photograph to right, b) Photo of test rig – yellow loading frames will use 25kN actuator to load soil surface and apply repeated forces to buried pipe.

Task 7.2. Developing failure scenarios for defects (Lead IKT)

In this task, a small number of laboratory sub systems at USFD and IKT will be subject to external loading and the mechanisms that promote pipe failure will be observed and reported. See above in terms of the collection of knowledge for the preparatory works for sub task 7.2.1.

Task 7.3. Application of proposed defect deterioration models to real systems (Lead USFD)

Although this task is not due to start until M25, we took advantage of availability of defect data and failure data for a UK sewer network and started to develop data–driven ML approaches to link defects and system failures. The early results were reported in a paper to SPN10 in Graz and were also part of a joint IKT/UFSD presentation at the Co-UDLabs workshop at the World Water Congress in Copenhagen in September 2022. These presentations showed the potential for data-driven approaches to estimate the local failure (e.g.,e.g., blockage/flooding) risk in sewer/drainage systems and so allow the development of risk based intervention strategies. Figure 9 shows that a trained ML model is able to predict relative probabilities of system failure (blockage formation) to individual pipe level offering the potential for directed risk-based maintenance. As further data becomes available this work will develop before the time anticipated in the original plan.

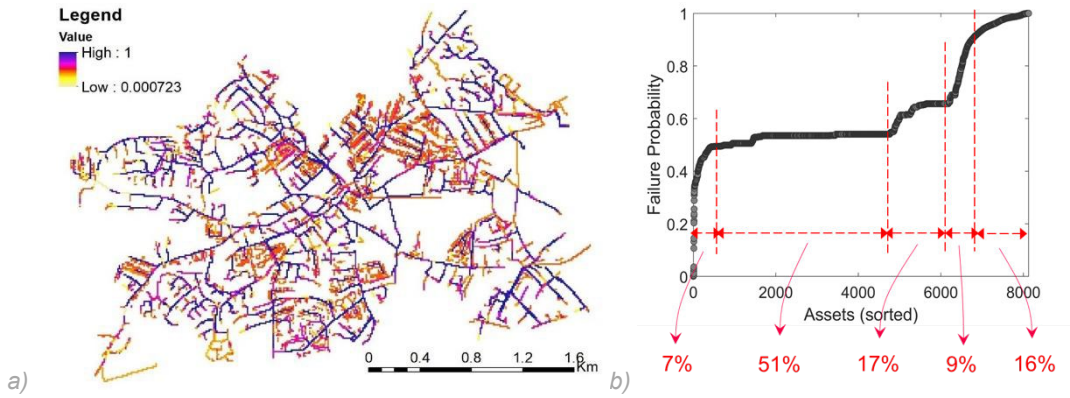


Figure 9. a) Relative probability of blockage formation, b) Cumulative likelihood of blockage formation (failure) over defined period.

Summary of Deliverables

Deliverables completed:	**D7.1 - Report on testing methodology identify in-pipe defects (M18)**
Deliverables passed due date:	None

Summary of Milestones

Milestones completed:	None
Milestones passed due date:	**MS16 - Transnational Database of In-Pipe Defect Images (M18)** On-going discussions with ZeMUS project partners and other water utilities are aimed at obtaining additional CCTV images, software has been developed and will be used to label images. The transnational database will contain labelled images and DL based code to identify defects. Software development is on-going, experienced researcher. An interim progress report is available. Expected delivery of milestone M26

1.2.8 Work Package 8 - JRA 3. Improving resilience and sustainability in urban drainage solutions

The Joint Research Activity "Improving resilience and sustainability in urban drainage solutions" is developed in the framework of WP8. The objectives of this WP are to: i) develop consensus on methodologies needed to provide high resolution data to assess the performance of urban drainage technologies; ii) demonstrate how the urban flood resilience and pollution transport/retention properties of urban drainage technologies can be evaluated; and iii) demonstrate and propose a methodology for the evaluation of the sustainability of new and emerging urban drainage technologies.

WP 8 is led by UDC and USFD, DEL, EAWAG, IKT, INSA, and AaU.

Task 8.1. Development of Consensus on Measurement of Hydraulic and Water Quality Performance of Urban Drainage technologies (Lead UDC)

The goal of Task 8.1. was the development of scalable hydrodynamic performance protocols (Sub-Task 8.1.1.) and development of scalable measurement protocols to assess the pollutant retention and release potentials of Urban Drainage Structures (Sub-Task 8.1.2), both during M1-M24 of the project. Three main activities were carried out within **SubTask 8.1.1**, summed up as follows.

1. Analysis and assessment of new techniques to build-up the topography/geometry of Urban Drainage infrastructure with high resolution. In the first activity we analysed the suitability and benefits of using LIDAR (Light Detection and Ranging) and SfM (Structure from Motion) for the reconstruction of the geometry of urban drainage infrastructure with a very high spatial resolution. These visualisation techniques were used to obtain the roof and pavement elevations of an urban drainage experimental platform at UDC. The digital reconstructions obtained were both satisfactory, in terms of the detail of the elements, and similar between each other, with a mean vertical error for both surfaces less than 2 mm. To obtain the elevations with the SfM technique, the surfaces were first photographed with a conventional digital camera and VisualSfM software was used for the digital reconstruction of the model and MeshLab software was used for point cloud processing and mesh generation. An Intel RealSense LiDAR Camera L515 together with the commercial software RecFusion have been used to directly obtain the digital reconstruction of the installation using the LiDAR technique.

The final products consist of two Digital Elevation Models (DEM) with a 5 mm spatial resolution (Figure 10). Differences between Digital Elevation Models (DEM) obtained with each technique were quantified using the Root Mean Square Error (RMSE) using the LiDAR topography as reference. The mean vertical error obtained for roof and paved surface topographies was less than 2 mm.

The comparison of the elevations in the facility shows that the result is similar regardless of the technique used. Nevertheless, as main differences, it should be noted that the SfM technique allows to obtain a greater detail of the surface macro-roughness, such as roof tile channels, mainly due to the higher density of points. On the other hand, the LiDAR technique shows greater advantages when processing point clouds since the mesh can be obtained directly by using the sensor-software combination, and within a known coordinate system and scale.

The reconstruction obtained was implemented in a dual urban drainage numerical model of the facility in order to assess the potential benefits of using high-resolution DEMs. This numerical analysis is being undertaken currently and it is expected to be published in a research journal. Furthermore, a dataset with the topographic survey will be also released in Zenodo community in RP2.

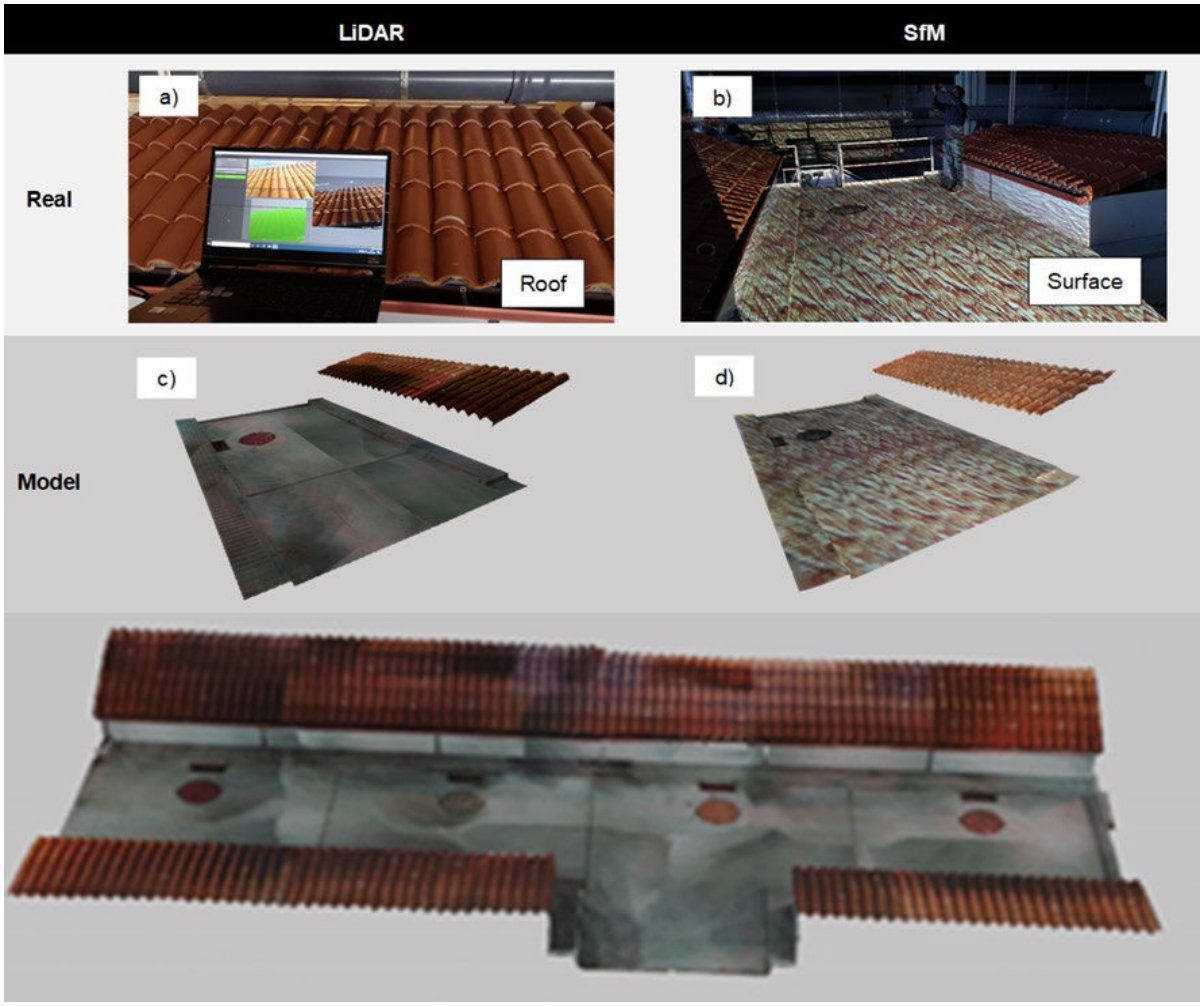


Figure 10. 3D reconstruction of the BLOCK facility at the Hydraulics Laboratory of UDC, using LiDAR and SfM techniques.

2. Review paper on "Optical imaging for process monitoring in urban drainage". During RP1 we have started to prepare a review paper on "Optical imaging for process monitoring in urban drainage", that will include, among other image-based techniques, the assessment of imaging velocimetry techniques for urban drainage laboratory and field applications. The paper is led by Deltares, but almost all project partners will contribute since most of them have expertise in the application and development of imaging techniques. Paper will be submitted during RP2.

3. Assessment and application of imaging velocimetry techniques for Urban Drainage applications. During RP1 we have performed several experimental tests in the BLOCK facility, at the Hydraulics Laboratory of UDC, in which we have measured the surface runoff velocity under rainfall conditions using Large Scale PIV (LSPIV). For this purpose, eight low-cost cameras based on Raspberry Pi were installed and the surface runoff velocities were measured in 9 tests with different rain patterns (Figure 11). The results from these tests will be used to calibrate and validate a 2D shallow water model during RP2.

Figure 11. Experimental test in the BLOCK facility at the Hydraulics Laboratory of UDC, for measuring the surface runoff velocity under rainfall conditions using LSPIV. Cameras are highlighted with A,B,C in the left picture. In the right picture camera calibration pattern is shown.

At the end of RP1, the main activities carried out in **SubTask 8.1.2** were:

1. Measuring the transport of pollution from sewers to surface. The Above Below flume facility at USFD has been used to consider the movement of pollution from sewer networks to surface flows during urban flood tests during the TA project 'Pollutant Transport in Urban Floodwaters'. Initial tests focused on the evaluation of measurement techniques to quantify the mass transport and mixing of soluble material in shallow surface flows. Three methods are being tested: 1) use of a saline tracer and point measurements at discrete locations in the surface flow to evaluate the change in concentration with position; 2) use of a hot water tracer and evaluation of spatial distribution of tracer with a thermal camera (Figure 12) and; 3) use of dye as a tracer and evaluation of spatial distribution of tracer with optical techniques.

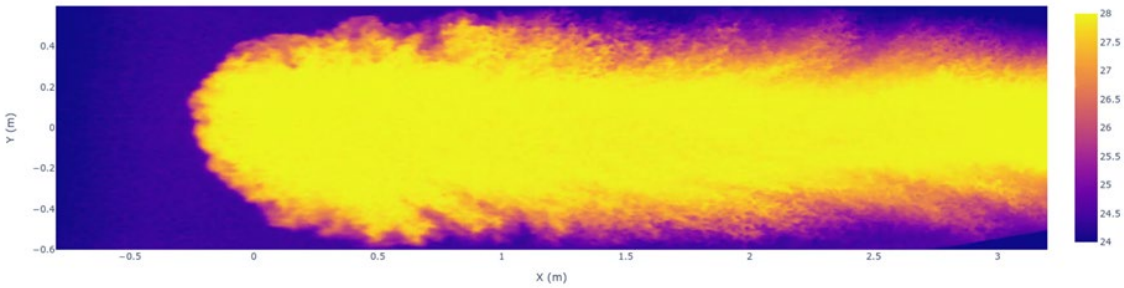


Figure 12. Picture from a heat camera installed on A/B flume at USFD, with hot water being ejected from a manhole located at (0,0) into shallow (about 10mm) surface flow.

Work will be extended to cover the movement of fine sediments under urban flood conditions. This testing, which will be contribute to Task 8.1.2 but also to Task 8.2, has not yet commenced due to delays in recruiting a suitable researcher (PhD student) to undertake testing. The researcher (PhD student) has now been recruited and will commence work on developing understanding of the release of sediment from manholes in 2023.

2. Measuring the interception of microplastics by stilling stormwater basins. In RP1 the small-scale physical model of a stilling basin mimicking OTHU-DRB infrastructure was used to evaluate its capability to intercept microplastic particles (MPs) conveyed in combined sewer overflows. Flow patterns and turbulence quantities were measured by means of the ADV technique. Furthermore, interception and entrainment of MPs were investigated by means of experimental particle transport

tests. In addition, a correlation between the deposition areas and the low near-base TKE (turbulent kinetic energy) values will be addressed. First results on MPs interception will be available in January 2023. It is planned to submit a paper with the results of these experiments to a leading journal (e.g.,e.g., Journal of Hydrology) in RP2.

3. Measuring sediment deposits in urban drainage infrastructure from high-resolution temperature signals. Sediment accumulation in urban drainage systems (UDS), as gully pots or sewer pipes, is a problem that requires costly maintenance and cleaning strategies. Attempts so far to monitor these processes have been based on techniques that require exhaustive work in their installation or in taking punctual field measurements. The underlying idea in this activity is based on recent work in measuring bedload in rivers by analysing the difference on temperature time series (amplitude and phase) at different locations to estimate the deposition and erosion.

A set of experiments was performed at UDC in order to develop a new approach that uses high-resolution temperature data to identify sediment bed deposits by analysing temperature time series (Figure 13). A MsC student and the postdoctoral researcher Manuel Regueiro (granted with a Regional postdoct research contract) from UDC were involved in the development of this tests.

A dataset with the experiments developed at UDC is available at Zenodo Community (https://zenodo.org/record/7258999#.Y4C0ry8rz0o). Water and sediments show different thermal properties and heat transfer dynamics. Thus, the aim of the dataset is to estimate or at least evidenced the presence of sediments by analysing the differences between the temperature time series measured in the water phase and at the bottom of bed deposits.

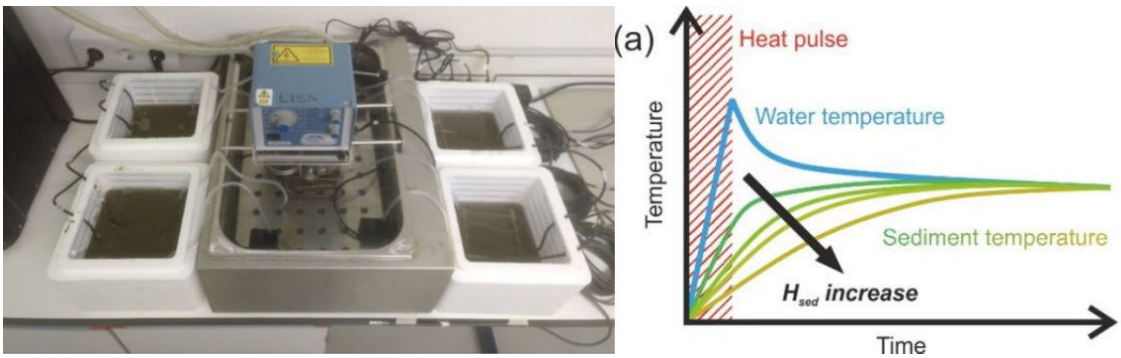


Figure 13 . Experimental tests to measure sediment deposits in UDS from high-resolution temperature signals.

Results from this experimental campaign will help to understand heat transfer processes between water and saturated sediment mixtures and, therefore, develop new methodologies to estimate accumulation in UDS. Two congress papers have been prepared on the basis of the above-mentioned dataset at SPN10 congress and IAHR congress during RP1. Furthermore, at the end of RP1 new tests on sediment accumulation in gully pots using high-resolution temperature measurements began to be carried out at Deltares with the help of Manuel Regueiro and Deltares and UDC support.

4. Definition of standard methods to assess permeable pavement performance. The UDC has carried out an experimental campaign on the long-term performance of permeable pavements analysing the clogging process of a porous asphalt for sediments with different granulometries. The experiments, developed within the scope of the national project POREDRAIN and Co-UDlabs project, were carried out with asphalt test slabs in a rainfall simulator of 1 m^2 and then at 1:1 scale on the STREET facility at the Hydraulics Laboratory of the UDC. During the experiments, the performance of the pavement in

terms of clogging was characterised, improving the understanding of the process, and generating interesting datasets for model development and validation. The study seeks to develop new experimental methods and improve protocols to assess permeable pavements against road sediments towards a consensus. After RP1 further joint tests on permeable pavement clogging between UDC and IKT will be performed to assess the effect sediment of particle size distribution using German protocols.

The data obtained is being interpreted and prepared for dissemination. First results analysed showed the high influence of sediment granulometry in the clogging process, being key to the use of continuous grain size distributions to reach reliable results (Figure 14). First results were presented at IAHR congress by UDC.

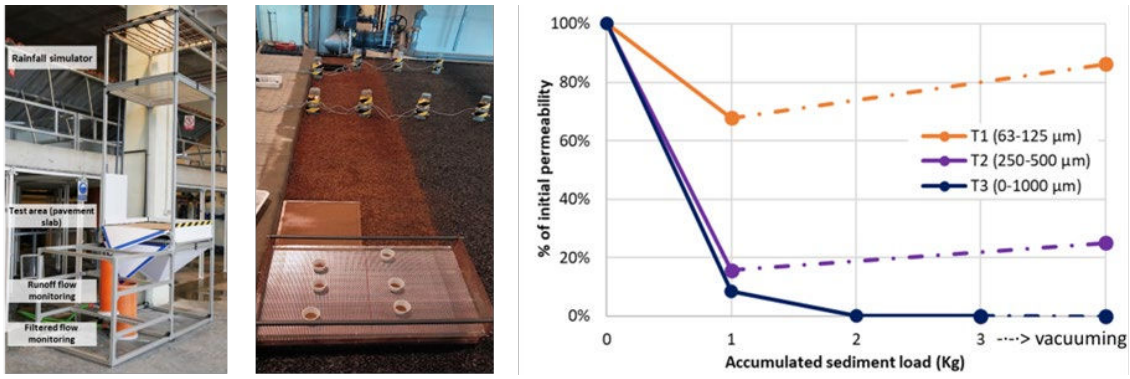


Figure 14. Experimental tests to assess the clogging of permeable pavements with sediments, performed in the STREET facility and a 1 m² rainfall simulator at the Hydraulics Laboratory of UDC.

Task 8.2. Quantifying the resilience of urban drainage infrastructure (Lead USFD)

Task 8.2 will begin on M24 of the project.

Task 8.3. Improving the sustainability of urban drainage infrastructure (Lead INSA)

The goal of Task 8.3. was to demonstrate and propose a methodology for the evaluation of the sustainability of new and emerging urban drainage technologies. In Sub-Task 8.3.1 the hydrodynamic design for stormwater detention ponds will be analysed to optimise cost-efficient maintenance and in Sub-Task 8.3.2 designer soils for Sustainable Urban Drainage Systems will be proposed. As of the end of RP1, the main activities carried out in **SubTask 8.3.1** are as follows.

1. Installation of LSPIV on AaU detention pond. The installation of LSPIV equipment in the AaU experimental SUDS basin was MS20 planned for M18 that was correctly accomplished. This activity was carried out during the visit of Juan Naves (UDC) to AaU in the framework of capacity building activities (Task 2.2). During the visit, the design and fabrication of pieces for weather-protective hermetic boxes were made and a total of three cameras with online access were installed at the facility (Figure 15). The purpose of the installation is to test the application of LSPIV measurements in stormwater detention basins as proof of concept.

Figure 15. LSPIV installation and tests at AaU experimental SUDS facility.

2. Improve the management of detention ponds. This task is ongoing and expected to be completed by M30, as initially planned. The developments and experimental work are performed using the AaU experimental SuDS basin. The experimental SuDS basin receives separated stormwater from a nearby urban catchment of about 5 ha. The facility consists of three main structures: the inlet structure, the main basin and the outlet pumps. The inlet structure is used to control the filling of the main basin. Here the inflow of stormwater from the urban catchment can be fully or partly bypassed, conditional to the desired experimental scenario. Similarly, the outlet pumps are used to control the emptying of the basin. The main basin is constructed in concrete with hard-surface walls and bottom.

The fundamental concept is to separate the two basic properties of a traditional stormwater detention pond: the stormwater detention and the sedimentation of particulates. The idea is simply to have two separate volumes one optimised for sedimentation and one designed for detention. Separating the two properties facilitates a more controlled and elaborate treatment of everyday rainfall events. By controlling the in- and outflow to the treatment unit, the residence time can vary during the rainfall event, ensuring that for example, the first part of the event has a longer residence time than the last part of the event, facilitating more efficient sedimentation of particulate matter from the stormwater. Between events, the sediment can be drained dry. Draining the sediment also reduces the maintenance cost of removing the sediment.

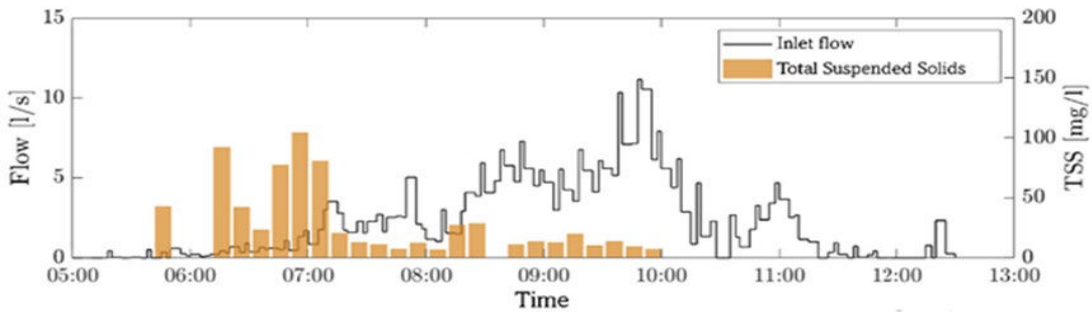


Figure 16. TSS concentration measurements (catchment sediment load).

To evaluate whether there exists a potential for improving the treatment of the stormwater by increasing the residence time of the first part of rainfall events the catchment sediment load has been measured with a high temporal resolution for two rainfall events. Water samples were taken every ten minutes using an autosampler and the TSS concentration was analysed in the laboratory. The result for one event is illustrated in Figure 16, where TSS concentration measurements clearly illustrate that far most of the sediment load is transported with the first part of the catchment runoff. This demonstrated that there exists a potential for improving the treatment of the stormwater runoff by controlling the residence during the rainfall event.

The main basin is equipped with two radar water level sensors: one at each end of the basin. The flow of the outlet pumps is monitored by flow gauges and the operation frequency and power consumption are monitored. Furthermore, the water level of the pump sump is measured by a radar water level sensor. All the sensors' readings are collected and stored locally at the facility; therefore, a significant task has been to make these data online available for the project. This has been achieved by developing a webpage, form where the current situation is visualised and can be downloaded (Figure 17).

Figure 17. Webpage for data visualisation and data access

The inlet flow creates a jet into the main basin that, if not damped, has the potential to generate rather violent flow conditions in large fractions of the basin. In order to avoid this and to ensure more calm flow conditions favourable for the sedimentation of particulate matter, a porous 'wall' barrier is installed in the first part of the main basin in front of the inlet. The Hydrodynamic properties of the porous wall have been tested and quantified in the laboratory flume at AsU in order to parametrise the energy loss for CFD modelling.

As regards **SubTask 8.3.2** INSA has already started working, although it was scheduled to begin on M24. Three physically-based infiltration models were developed to simulate the water budget and to evaluate SuDS techniques performance. The three models rely on a Green-Ampt (GA) approach with the description of the water flux as the product of the equivalent hydraulic gradient and the equivalent hydraulic conductivity. These models were firstly subjected to preliminary mathematical and analytical analysis. Subsequently, they were used to model water infiltration into dry, intermediately wet, and wet soils, and were compared to numerical resolution based on Richards' equation, using the Hydrus software. The differences between the proposed models and the numerically generated reference data were then discussed to assess the capability of the developed models to comply with the key principles of the physics of water infiltration into soils. Finally, we evaluated the reformulated models using data derived from six experimental infiltration campaigns to assess their capability to fit real data and predict accurate values of hydrodynamic parameters, in particular the saturated hydraulic conductivity. The results show that one the new models seemed more appropriate to comply with the principles of the physics of water infiltration and should be preferred in this context. These findings will provide the basis for further developments in the hydrological modelling of SuDS and their hydraulic performance. INSA will coordinate future tests and applications of developed models in line with AaU and UDC.

Summary of Deliverables

Deliverables completed:	Deliverables 8.1 and 8.2 will be submitted on M24. A deadline extension is proposed on section 5 to M30.
Deliverables passed due date:	NA

Summary of Milestones

Milestones completed:	**MS20 - Installation of LSPIV on AaU retention pond (M18)** A progress report is available upon request. The installation visit will be reported within Task 2.2.
Milestones passed due date:	None

1.2.9 Work Package 9 – TA provision

The main objective of this WP is to provide coordinated transnational access to researchers or research teams from academy, industry and other urban drainage stakeholders to the advanced Urban Drainage facilitates presented in Figure 18.

Figure 18. RI and facilities offered in Co-UDlabs (https://co-udlabs.eu/access/research-facilities/)

An important feature of the TA offer is that it is free at the point of access, which removes a traditional barrier for many groups to access the unique urban drainage facilities of Co-UDlabs. The unified access entry point is provided by using an internal intranet based on Microsoft Sharepoint – Teams environment hosted at UDC.

A total number of 13 projects were awarded in the 1st Co-UDlabs call. In RP1, 6 TA projects were initiated at Co-UDlabs facilities at UDC, USFD, EAWAG and INSA. For 5 more proposals, Co-UDlabs partners have begun coordination to grant access and preparatory work to guarantee facility updates and adaptations for visiting user-groups (further details are provided in Section 1.4). For the 2

remaining projects, teams have arranged preliminary dates for the beginning of their stays and project tasks. All the projects of the 1st call will be finished by end of July 2023.

Due to limited available resources to provide access and the scheduling of other experiments in several Co-UDlabs facilities, most partners agreed to have different access visits at their Research Infrastructures consecutively, thus avoiding overlapping schedules or resource-intensive accumulation of work at the facilities. Section 1.4 provides a full description of selected proposals, users-groups, and resources allocated to TAs.

The main deviation that has occurred in this task is the distribution in terms of facilities of the transnational access granted in this first access call. While some of the facilities have covered all the expected projects for the full duration of the Co-UDlabs project, others have not received proposals and have remained deserted. In any case, almost half of the expected projects for the two planned calls have been covered (Table 1), which is seen very positive, especially considering that Co-UDlabs is a starting community.

1.2.10 Work Package 10 – Management and Co-ordination

WP10 is dedicated to the overall project coordination and the monitoring of the fulfilment of the project plan and objectives, within time and budget constraints. The main objectives of this WP are to: (i) coordinate the actions of participants and progress monitoring for implementation of the work plan; (ii) provide financial and administrative management of the consortium as a whole; (iii) ensure an effective collaboration and information exchange between the partners, (iv) become a single contact point with the European Commission; (v) ensure the high quality of the project outcomes, (vi) consider relevant gender issues; and (vii) identify and mitigate the project risks by performing an effective risk management. WP 8 is led by UDC and all partners are involved in their development.

Task 10.1. Technical and administrative coordination (Lead UDC)

UDC has been in charge of the day-to-day management of Co-UDlabs since the inception of the project in May 2021. As part of UDC's role as project coordinator, UDC established a Management and Support Team (MST) to be tasked with the daily operations of coordination of project activities and communication. Andrea Ciambra was hired since the beginning of the project as Project Manager. UDC team coordinator, Jose Anta, and UDC researcher, Juan Naves, are also part of the MST and have actively supported the managing activities of UDC on scientific, administrative, and financial matters (also with the help of UDC EU office). The MST was immediately in charge of the organisation of the project's Kick-Off Meeting (KOM), the consortium's first opportunity to meet and discuss each Work Package's work plan. The MST ensured that the Consortium Agreement was correctly signed by all beneficiaries and provided for the process of pre-payment submission to all partners.

WP10 was also in charge of the Project Management Handbook (Deliverable D10.4), which is designed to be the consortium-wide resource containing all rules of procedure for the management and implementation of Co-UDlabs. The Handbook, most relevantly, includes an overview of all rules concerning the convening and working of the project's main consultation and decision-making bodies (see also T10.2). The Handbook also singles out all requirements, duties, and rights of beneficiaries, as well as the rules to interact with the European Commission and its representatives. The Handbook has been made available to all beneficiaries for reference, since its submission, on the project's internal SharePoint platform.

Since the inception of the project, the MST at UDC has also been in charge of both supervising the quality of the workflow, especially across different WPs, and adequate communication among partners. WP10 was tasked with the establishment and management of the SharePoint platform that Co-UDlabs is currently using as the main repository of information, files, research and working materials, and as the environment of choice for intra-consortium communication and exchange. Next section below explains in detail the mechanism of Co-UDlabs' Regular Meetings, set up to guarantee that the whole consortium is periodically engaged with project-related matters and schedules. The MST has also worked as an information hub for the whole consortium, both by curating e-mail communication among partners and by keeping the documentation and materials available on the common SharePoint updated and effective.

As part of quality assurance in project implementation, the MST has also provided support on specific project tasks in various WPs. It has also provided guidance in the development of several Deliverables and the achievement of several Milestones throughout the first reporting period. In general, the MST was consulted before submission of every Deliverable (12 submitted during this reporting period) and the fulfilment of Milestones (10 achieved) for quality check in terms of consistency across documents, style, readability, and fulfilment of requirements.

The MST has also been in charge of identifying potential deviations from the expected workflow and establishing an adequate communication system for all involved partners to provide a solution. This was ultimately required in rare occasions, including an expected delay in the recollection of data and information for Deliverable D1.1. Whenever necessary, the MST has also taken care of direct communication with the European Commission and Co-UDlabs' Project Advisor (PA) more specifically — acting as intermediary on behalf of the whole consortium. Communication with the PA has been extremely open and comfortable since the beginning of the project and the office has provided valuable feedback on matters concerning all stages of project implementation — from the organisation of the first Co-UDlabs General Assembly to the re-scheduling of Deliverables or specific inquiries on the reporting process.

Finally, the MST has been significantly involved in the establishment of the Co-UDlabs Transnational Access programme. UDC was involved not only as project coordinator, but also as one of the partners providing access to their research infrastructure. The WP10 work of the MST for the arrangement of the TA framework overlaps with specific tasks of WP5. The MST was actively engaged in the coordination and preparation of the first global call for TA proposals (opened in October 2021 until January 2022). It provided supported to TA-providing partners for the setting up and preparation of their research installations. It assisted on communication and dissemination procedures and strategies. It also provided a common platform for the evaluation of TA proposals, the convening of the External Evaluation Panel meetings, and more generally provided quality assurance for the correct and timely deployment of the TA framework.

Task 10.2. Organisation of consortium meetings (Lead UDC)

UDC as coordinator is in charge of ensuring consortium-wide communication and the organisation of periodic meetings of the project's main institutions, as agreed in both the Grant Agreement and the Consortium agreement. The MST was tasked with coordinating and setting up the following type of events:

- The Co-UDlabs General Assembly and Kick Off Meeting

- Co-UDlabs' Steering Committee meetings
- Co-UDlabs' International Advisory Board meetings
- Co-UDlabs' internal Regular Meetings

The overall structure of Co-UDlabs' governance is regulated by Section 6 (Governance Structure) of the project's Consortium Agreement and is described in detail in Part B of the Grant Agreement (Section 3.2, Management structure, milestones and procedures).

Members of the General Assembly of Co-UDlabs were convened at the very beginning of the project in its initial Kick-Off Meeting (KOM), held remotely under the coordination of UDC on May 25 and 28, 2021. Co-UDlabs' KOM was a key institutional venue for all partners to meet for the first time following the acceptance of the project proposal, and an essential meeting for the consortium to discuss a set of initial decisions and strategic steps before beginning the implementation of its Description of Action. The KOM was also an opportunity for all partners and Work Package leaders to present their detailed workplan for the first months of Co-UDlabs. Public presentations and sessions gathered up to 34 participants.

The first General Assembly of Co-UDlabs as a stand-alone event was then convened on June 27-30, 2022, and hosted by UDC as project coordinator. WP10 contributed extensively to the organisation of the event, including tasks to:

- schedule the Assembly according to the availability of all partners;
- coordinate the travel and accommodation agendas of all participating project members;
- define the event agenda and provide required presentation materials (e.g., templates, consortium-wide data)
- define and set up collateral social activities for networking and informal consortium work on shared activities and tasks;
- consolidate the logistics of the event (including the possibility to hold the event in a hybrid form, granting remote access to participants who could not attend in person) and integrate the General Assembly with the Early-Stage Research Seminar (foreseen in Task 3.1 of WP3), whose first iteration was organised back-to-back with the General Assembly to incentivise partners' participation.

The Assembly was a crucial opportunity for all partners to present their updated work plans and a consortium-wide venue to check on progress in project implementation and the attainment of Co-UDlabs objectives and results in its first year of work. Pairing the event with the 1st Early-Stage Researchers Seminar was also a valuable opportunity to engage younger members of partners' teams and locate their current research agendas into the bigger picture of Co-UDlabs' goals and priorities. At the General Assembly, INSA offered its availability to host the 2nd General Assembly in Lyon, in July 2023. The University of Sheffield also agreed to host the 2nd Early-Stage Researchers Seminar in Q2/Q3 of 2024. News on the General Assembly proceedings and outcomes was published on Co-UDlabs' website (**link**). The official minutes are stored for safe-keeping by UDC and can be provided upon request.

The Steering Committee (SC) is expected to meet at least quarterly (CA Article 6.2.2.1). During Reporting Period 1 the Co-UDlabs Steering Committee met five times:

- May 25, 2021. The SC was first convened during the project's Kick-Off Meeting in a joint meeting with the project's International Advisory Board.
- September 9, 2021. Another SC meeting was scheduled on M5 for an initial overview of the project's work plan implementation and results following the submission of the first set of Deliverables in M4.
- January 18, 2022. The 3rd SC meeting was convened immediately before the closing of Co-UDlabs' first global Transnational Access call for proposals for a preliminary assessment of the selection procedure.
- March 24, 2022. The SC met again in a joint session with the TA External Evaluation Panel, the board tasked with evaluating and selecting the competing proposals for the TA programme.
- September 19, 2022. The fifth SC meeting was held in a joint session with Co-UDlabs' International Advisory Board, which was informed on the outcomes of the 1st TA call and the current developments of the selected TA projects.

For all Steering Committees, WP10 has been in charge of circulating save-the-dates, preliminary agendas, and presentation templates. WP10 has managed the Teams platform required for the organisation of the SC meetings. WP10 was in charge of note-taking during the meetings and the elaboration of the official minutes. These are stored for safe-keeping by UDC and are available upon request. The next Steering Committee is scheduled for December 15, 2022, and will discuss progress in the periodic report as well as consolidate the schedule of Co-UDlabs' Project Review Meeting.

WP10 has also provided logistical support for the participation of Co-UDlabs' International Advisory Board (IAB) in the dedicated meetings and activities. Even though it was expected (Section 3.2.1.e of the Grant Agreement) for the IAB to meet at the same location of the General Assembly, this was not possible due to the exceptional circumstances of the COVID-19 pandemic. This decision is detailed below in Section 3 on deviations from expected action.

WP10 also oversaw a system of biweekly Regular Meetings (usually on Thursdays), in which partners have been meeting to provide constant updates on the implementation of their work plans. Regular Meetings have been useful to keep track of progress and identify potential deviations or regressions and address them timely. Any partners could ask the Coordinator to devote any Regular Meeting to a specific topic or task. These 'specialised' Regular Meeting were extremely helpful ahead of relevant Milestones or Deliverables — e.g., the organisation of the first TA call, the 2021 Hackathon event, the evaluation of TA proposals, and this very reporting process. Because of the Regular Meeting's intensive schedule, however, the partners have been discussing re-thinking the Meeting's structure, with a less frequent calendar and more responsibilities handed to WP leaders. This item will be part of the next Steering Committee's agenda.

Finally, WP10 was intensively involved in the establishment of the TA framework. The MST oversaw the establishment of the application platform, provided support in the organisation of the Hackathon prior to the closing of the 1st TA call, and managed logistics and communication with the External Evaluation Panel.

Task 10.3. Reporting (Lead UDC)

WP10 oversees project-wide informal and formal internal reporting, as well as the activities for official reporting to external stakeholders and, in particular, the European Commission. WP10 assisted

on informal internal reporting by managing the information that was provided by Co-UDlabs partners during Regular Meetings and other opportunities to meet. The MST was also responsible for ensuring communication between partners on specific topics or providing support to WP leaders for internal task implementation. The MST made sure that effective and clear minutes of the Regular Meetings were circulated at the earliest opportunity, minimising the possibility for loss of information, and simplifying access to SharePoint and other shared resources.

WP10 performed formal internal reporting by guaranteeing the communication flow and reviewing process for the submission of project Deliverables and the attainment of Milestones. Procedures for formal internal reporting were outlined since the inception of the project in the Project Management Handbook (Section 6.2.1). The MST verified that early Deliverable drafts were made available to relevant partners and the project coordinator in time for final revisions before the official submission to the EC portal.

WP10 is also coordinating the process of official external reporting to the European Commission. The MST has been in charge of all submissions and input to the EC portal for the Co-UDlabs' Continuous Reporting, overseeing timely submission of Deliverable and uploading all required information and data (e.g., all submitted reports, data on dissemination and communication, key performance indicators, etc.). The MST has also been the main interlocutor with the Project Advisor with regard to all requirements of continuous reporting. Following the end of M18 (October 31, 2022), WP10 has overseen the project's Periodic Report on the first reporting period. It has provided templates to all partners and all WP leaders for each workgroup to provide required information and data about project implementation. It has provided guidance to all partners for the completion of their reporting tasks (a Reporting Guide was made available on the SharePoint) and devoted two Regular Meetings to reporting-related issues and outstanding problems. WP10 will oversee, on behalf of UDC as project coordinator, the successful and timely update of all required information for the Periodic Report, including:

- Uploading all requested data for the Continuous Report;
- Cross Checking information on each partner's financial statements before approving submitted CFS drafts on the portal;
- Putting together the Part B of the Technical Report thanks to the WP reports submitted by WP leaders.

WP10 has also taken part in the conversation with the office of the Project Advisor to define date, time, and a preliminary agenda of Co-UDlabs' Project Review Meeting, to be held in early 2023.

Task 10.4. Financial administration (Lead UDC)

UDC as project coordination has managed under WP10 the transfer of funds from the European Commission and then to the individual partners of the consortium. While all beneficiaries remain responsible for the financial fitness of their actions in the framework of Co-UDlabs, WP10 has also provided guidance for financial administrators and is working as a helpdesk to address outstanding financial issues related to Co-UDlabs funding under the rules agreed in the Grant Agreement.

As project coordinators and under WP10, UDC will also aid in the drafting of the Financial Statements that have to be submitted by all eligible beneficiaries. This has also implied constant communication with partners about sound distribution of workforce and time dedication, calculations

of personnel and other direct costs, and the consolidation of certified roles for individuals authorised to upload information on the project's portal page.

Summary of Deliverables

Deliverables completed:	**D10.1 - 1st periodic report (M18)** Submitted in M20 **D10.4 - Project Management Handbook (M3)**
Deliverables passed due date:	None

Summary of Milestones

Milestones completed:	**MS23 - Kick-off meeting – (M1)** Kick-off meeting minutes are available under request **MS24 - First Intermediate GA – (M24)** The first Co-UDlabs General Assembly was held in A Coruña in M13. The next Co-UDlabs General Assembly will be held in Lyon in M26.
Milestones passed due date:	None

1.2.11 Work Package 11 - Ethics Requirements

The objective of WP11 was to ensure compliance with the 'ethics requirements' set out in the GA. At M4 the requested deliverables about Protection of Personal Data (POPD) and EPQ requirement were submitted to the portal:

- Deliverable 11.1 aims to provide all information required as regards the methods, procedures, and policies for the collection, management, treatment, and storage of personal data throughout the implementation of the project and its activities.
- Deliverable 11.2 aims to ensure that appropriate health and safety procedures conforming to relevant local/national guidelines/legislation are followed for staff involved in Co-UDlabs project.

Summary of Deliverables

Deliverables completed:	**D11.1: POPD - Requirement No. 1 – (M4)** **D11.2: EPQ - Requirement No. 2 – (M4)**
Deliverables passed due date:	None

Summary of Milestones

Milestones completed:	None
Milestones passed due date:	None

1.2.12 Short description of the next steps to be achieved after the first periodic reporting period in the different WPs

In this section the next steps of the implementation of Co-UDlabs for the coming months are presented in brief. The main tasks to the develop within Co-UDlabs Networking Activities are:

- In WP1 we will work on the preparation of a white paper with the results of the IWA WWC&E congress, we will continue with networking with other projects and we will resume more intensive work from the Novatech July 2023 workshop. This meeting will allow us to refine first recommendations for RI to be useful and efficient to transition to more sustainable UDS.
- In WP2 Task 2.1 was delayed because the senior researcher Frank Blumensaat left EAWAG Also, our data manager, Christian Förster, who is a key knowledge holder for the interoperability standards has left the department. As a solution, additional funding was acquired during 2021 through a Swiss Open Research Data funding initiative. EAWAG will hire a Post Doc with external funding, an expert on interoperable information systems, for 18 months. The PostDoc will be versed in technical standards and information models used to represent hydrological time series structures, i.e.,i.e., WaterML, to developing a suitable data model for time series data from UDS (WaterML-UDS). This data model will then be the basis for an interoperable data standard proposed in Co-UDlabs. A deadline extension for Deliverable 2.1 to M30 is proposed by WP leader.

  In Task 2.2, after RP1, an agenda of the staff mobility weeks will be agreed on with partners involved (UDC, UoS, DELTARES, EAWAG, IKT, INSA and AaU). Each hosting organisation will share in advance a mobility programme, including the purpose and duration of the mission and a presentation of the activities. In April 2023, an Intermediate report on Staff development (D2.3) will provide detailed information on the mobility sessions which would have been organised up to M24 based on the reports shared by the assigned staff after completion of the planned missions.
- In WP3, an Industrial workshop was organised in November 2022. In 2023 we will organise 3 open webinars, the 2nd Internal Early-Stage Researchers Seminar and a PhD course on Sewer process. Initial tentative dates for the events are available at Co-UDlabs website, but exact dates will only be fixed between 2-3 months before the event to be able to accommodate possible changes in availability of personnel and plan around industry-field specific events and national holidays, such that the impacts of the activities are maximised.
- In WP4, the next communication and dissemination activities will be carried out in line with the Grant Agreement and the Plan for the Exploitation and Dissemination of project Results (D4.2). The motion design video to present Co-UDlabs was released in M20 (December 2022). The next issue of the Newsletter will be released at M21. During RP2, at least 2 articles will be published in specialised magazines. Now that some results are available, the consortium will focus efforts on disseminating project results through scientific publications and technical articles. A specific brochure will be designed to present and describe the 17 infrastructures and to inform about the 2nd TA call to open in October 2023 (M30). A promotional webinar will be organised as well to launch the access campaign and present the project. A Media press kit will be developed to inform a wider audience about the project results.

The YouTube channel will be fed with the videos of partners' interviews and the recordings of the training materials. The Co-UDlabs team will also make sure to attend open-science events to meet the KPI's objectives. Deliverable D4.3 to be published at M24 will report on all dissemination and communication activities carried on since the beginning of the project. Regarding exploitation, the list of potential exploitable results of the project presented in the GA will be updated by the consortium under the lead of EURONOVIA. Then with the help of the IAB, the results having the best potential for exploitation (Key Exploitable Results - KERs) will be identified and analyzed during an Exploitation Seminar. We will also apply for the Horizon Results Booster (Module C) to receive expert guidance and training to improve the project strategy towards effective exploitation of these KERs.

- As regards Transnational Access, the work developed in WP5 and WP9 was advanced as planned enabling the award on time of 13 grants for transnational access in 10 of the offered Co-UDlabs facilities. The results achieved in this first call of proposals showed that dissemination of the call, application of proposal process, and evaluation procedure were effective, and the participation is seen to be very positive, especially considering that Co-UDlabs is a starting community. Co-UDlabs will try to continue working on this line and reinforce the procedure for the second call for TA proposals initially scheduled for October 2023.

  Efforts will continue to be made in the promotion and improvement of the next call initially planned for October 2023 to try to increase the number of proposals received, increase the diversity of proposal and team compositions, and also to complete the facilities that have not had yet access in this first call. In Q1 of 2023 Co-UDlabs Steering Committee will analyse the feasibility of preparing an intermediate call (e.g., before the summer) to allow more time for the development of users' projects before the end of Co-UDlabs and also to reduce the risk that some of the facilities remain without proposals.

  In the second and subsequent calls, if any and as long as the budget permits, those facilities would continue to be offered in which the expected number of projects has already been reached and which have been shown to be of interest to external users. Furthermore, the possibility is foreseen to redistribute the budget first among facilities of the same partner or even as a last option among partners if necessary to continue hosting projects in those facilities that arouse more interest.

Lastly, regarding the Joint Research Activities we can summarise the following tasks:

- The three tasks of WP6 are on the way. The next steps include the establishment of systematised meetings in order to exchange information of the tests performed in Task 6.1. In Task 6.2 wider dissemination of Urban Drainage Metrology webapp in an internal workshop and external workshop at the 2023 Novatech congress and with industry practitioners, continue with the toolbox update and preparation of a journal paper. In Task 6.3 we will continue with the work on CSO data and we will initiate the work on integration of decentralised SuDS monitoring signals at catchment scale.
- In WP7 the release of the CCTV open database, including ML based defect identification tools (MS16) is expected for M26. Within Task 7.1, a workshop related with revised asset condition assessment concepts will be held before M24. Regarding Task 7.2, a full-scale loading test will

be carried out in Q1/2 2023. Work associated with Task 7.3 on data analysis of asset and service failures will continue and will examine the use of transnational data.

- In WP 8, the following months most of the work will be dedicated to finish all the activities of Task 8.1. Some of them have already been accomplished, but there are others that are a little behind schedule because of problems in the recruitment of personnel (UDC, USFD). The main tasks to be performed are (i) review paper on "Optical methods in UDS"; (ii) numerical analysis of LiDAR and SfM data tests (UDC); (iii) the development of transport of solids from sewers to surfaces under flood conditions tests at USFD; (iv) analysis of Microplastic interception by stilling stormwater basins (INSA); (v) development of new tests for permeable pavement assessment (IKT, UDC).

  In Task 8.3, the activities will be focused on measuring with the recently installed LSPIV at the Aalborg Pond. Furthermore, AaU will test different soil designs (Techno soils). INSA will continue to work in collaboration with AaU and will perform additional infiltration measurements in order to better characterise and improve the infiltration efficiency of SuDS. A journal paper including the results obtained in the infiltration tests is expected.

  Due to the amount of work to be performed, partners will ask for an extension of the planned Deliverables of Task 8.1 to M30.

1.3 Impact

The main impact of the Co-UDlabs Starting Community is to establish and make sustainable a European level and user-based network for Urban Drainage facing current and future challenges and research questions. The development of a set of coordinated NA fed by JRA actions, focused in the standardisation of the large data-sets gained in the operation of real field sites and the large-scale facilities offered as TA, will allow European stakeholders, researchers and innovators in the urban drainage sector to raise and accelerate the efficiency of research by avoiding duplication of work, building common interests, sharing knowledge and fostering international innovation in a collaborative way. This approach will have a strong and positive impact on UDS users, such as water utilities, operators, administrations and policy-makers, and the European society.

Although the project has just passed the first 18 months or their lifetime, all the actions performed have managed to create and start to consolidate Co-UDlabs network within Urban Drainage Community. Joint events and booths have been organised with related EU-funded research projects in order to optimise dissemination impact. We started to engaging other INFRAIA projects such as Vitalise project, which leads an informal network of RI projects presented at ICRI conference in Brno (October, 2022) and by the presentation of Co-UDlabs in a virtual booth. We have also contacted other RI projects related with critical infrastructures such us GEOlab project and had the opportunity to present CO-UDlabs at the LIFE DRAIN RAIN project closing event organised in October 2022. During RP2, the consortium will maintain collaboration with the following research projects working on the same topic in order to share initial work, knowledge and observations: the Transnational Access project AIRE; the German research project "Comparative Investigations of Rehabilitation techniques for Rising mains" and the ZEMuS project; Nice NBS project or Multisource project.

In the following, we present the proposed impact of the project (from Section 2.1 of the DoA) and a brief explanation of the main actions taken and to be performed to ensure the expected impact by the end of Co-UDlabs.

1.3.1 Expected impacts included in the H2020-INFRAIA-02-2020 call

Table 5 presents a summary of the main contributions and indicators of the project as stated in the DoA. Although the project reached the 37% of their lifetime, **TA provision activities began in May 2022 (M13) and most of the projects are planned to be developed during the first half of 2023**. This is what is stated in the DoA. For this reason, the **TA-related indicators will improve for RP2 when the projects of the first call are completed and those of the second call are advanced**. The number of TA projects is roughly half of the proposed projects, which is a good level considering we are a Starting community. **Indicators related to the work carried out by the JRAs will also improve at RP2** as just some initial deliverables were released. As indicated previously in section 1.2, there have been some delays in the development of some tasks related with JRA, so that journal articles have not yet been published in the project.

Table 5. Co-UDlabs contributions and indicators to measure the success of the impacts mentioned in the INFRAIA 02-2020 call

Expected Impact	Co-UDlabs contributions from the DoA Contributions – Indicators in RP1 (Target at the end of Co-UDlabs)
Wider, simplified, and more efficient access to RI.	- Co-UDlabs catalogue of RI and facilities covers the full Urban Drainage System spectrum - Two online events will stimulate the creation of multi-sectorial TA groups. - Two open calls will be launched - An external independent evaluation panel will select access proposals **Contributions and Indicators in RP1** - A comprehensive guide to apply to call is available in the project website, including a description of the facilities - Co-UDlabs 1st hackathon and Market place allows to different actors join together to the call and prepare joint projects (e.g., industry+academia, experimentalists+modelers). 11 proposals were presented in the Market-Place and 4 then applied to 1st Call. **1 online event** (Target: 2) - First call launched and evaluated. **15 user projects received, 14 user projects evaluated and 13 accepted** (Target: 29) - **Involvement of 14 invited researchers in RP1** (Target: 140) - Not papers nor datasets published from TA yet
New or more advanced RI services are made available to a wider community	- Co-UDlabs will expand the capabilities European RIs ecosystem by providing a set of leading-edge complementary infrastructures for UDS research community and EU water sector. - JRA actions (WP6,7,8) will provide new services to RI users, the UD research community and EU water sector. Contributions and Indicators in RP1 - The first Industrial Workshop allowed industry and operators to share research problems and how they could benefit from Co-UDlabs TA and JRA activities. - An initial dissemination of the Urban Drainage Metrology Toolbox was performed. More dissemination activities are planned for RP2. The Open database of CCTV inspections was not released in RP1 and we expect to do that in M26. The remaining outcomes of JRA were planned after the RP1. - **New monitoring technologies, improved methods for underground assets and standardised methodologies planned within the different JRA are being developed at this stage of the project and are not openly accessible yet**. (Target: 400 downloads per JRA)

Expected Impact	Co-UDlabs contributions from the DoA Contributions – Indicators in RP1 (Target at the end of Co-UDlabs)
TA providers develop synergies to improve their common services. Less duplication of efforts and improved used of efforts is achieved.	- The implementation of NA seeks to develop the complementary capacities of the RIs participating in the project, to lift multiple synergies and to strengthen the European research community - In addition, the coordination of the JRAs will fine-tune the synergies and highlight the complementarities of the involved RIs. *Contributions and Indicators in RP1* - Outcomes from the expected harmonisation procedure will help to share data much easier. Some results are expected for RP2 - Mobility and training actions for Co-UDlabs staff: **1 Early-Stage Researcher course celebrated in A Coruña** (Target: 2) **and 4 capacity building mobility actions** (Target: 25) - **Joint open data-sets related with JRA and harmonisation: 1** (Target: 8) - **Number joint reports with JRA actions and data harmonisation procedures: 2** - Deliverable 6.1 and Deliverable 7.1 (Target: 8) - **Number joint publication related to the improvements of services provided by the JRA: 0** (Target 4).
Innovation is fostered through a reinforced partnership of research infrastructures with industry.	- International Advisory Board will give advice to reinforce partnerships in Co-UDlabs - Co-UDlabs hackathon will promote the participation of industry and SME - Co-UDlabs will also disseminate the project in trade fairs and national level non-academic congresses. *Contributions and Indicators in RP1* - **Is too early to have relevant impact of the project activities in RP1.** - The IAB was established from the beginning of the project. Two meetings were held during RP1. - **Attendees to Workshop on Urban Drainage Practice and Research Needs: 59 attendees** (target 40) - **Number of Access days from user groups leading by non-academia: 150 days / 590 days – 25% in the first TA Call** (Target 30%) - **Number of industrial organisations and SMEs attending to webinars promoting RI call: 20 in the presentation of the project, 28 in the Urban Drainage Practice and Research Needs and 5 in the hackathon. Total: 53** (Target: 60) - **Number of dissemination events in trade fairs and other technical events: 3** (Target: 3) - **Creation of Co-UDlabs market place (not foreseen in the DoA).** 11 proposals were presented in the Market-Place and 4 then applied to 1st Call.
A new generation of researchers is trained and educated.	- Researchers supporting Co-UDlabs are PhD students and early-stage researchers - Creation of open tools and training programme within WP3 and JRA framework *Contributions and Indicators in RP1* - Most of the webinar activities are planned to run between 2023-2024, we expect that by engaging directly with the community via the online participation (and by making available the materials in the youtube channel and the project webpage) we will increase the exposure of emerging technologies to the community. - **Number of PhD students and early-stage researcher who attended to Co-UDlabs internal events: 8 early-stage participants in the 1st internal seminar organised on June 29, 2022** (target 40) - **Number of PhD students and early-stage researcher who attended to Co-UDlabs external events: 22 participants in the 25th EJSW on Monitoring Urban Drainage Systems and Rivers** (Target 40) - Number of downloads of tutorials, visits to webinar sessions and YouTube channel: 18 participants in the Webinar on Fourier transform infrared spectroscopy (FTIR) chemical mapping organised on September 21, 2022 plus 13 views on YouTube (Target 2000)

Expected Impact	Co-UDlabs contributions from the DoA Contributions – Indicators in RP1 (Target at the end of Co-UDlabs)
Closer interactions between researchers around Co-UDlabs RIs facilitate cross-disciplinary and a wider sharing of information, knowledge and technologies, between academia and non-academic UD actors.	- Close interaction between a large number of researchers from academia and industry. - This number will be increased by the participation of researchers in training, harmonisation, JRA and TA activities. *Contributions and Indicators in RP1* - **Is too early to have relevant impact of the project activities in RP1.** - Number of joint scientific and technical publications: 0 scientific publication and 0 technical article (Target: 18) - **Percentage of multi-sectorial User groups in the first call: 45%** (35% target)
The integration of Co-UDlabs RI instruments leads to better management of the data-sets collected in the facilities	- The major RI in UDS has never developed a common data sharing framework in Europe. The results of the TA and JRA carried out in these will be available at Zenodo. - The harmonisation and data management actions will allow to define a common framework to implement FAIR principles to increase data availability for the UD community. *Contributions and Indicators in RP1* - **Is too early to have relevant impact of the project activities in RP1** - **Number of visits / downloads of data-set to Co-UDlabs Zenodo data-sets:** 24 views and 17 downloads for the first Dataset "Identifying sediment deposits from temperature signals" (3000 target) - **Number of unique downloads of tutorials, webinars views and open-data sets and project reports related with JRA and data harmonisation:** 42 unique downloads for the Dataset "Identifying sediment deposits from temperature signals", D6.1 and D7.1 (target 500)
Integrated and harmonised access to Co-UDlabs contributes to evidence-based policy making.	- TA providers research groups already work together with the policy-makers in their respective countries and as international consultants. - Currently, UDS challenges include the analysis of runoff water pollution, intermittent spills from CSOs, and how new emerging strategies such SuDS can improve system performance. This is being included in the regulations, but there is a lack of technical knowledge about the real performance of these new techniques and some of the process. *Contributions and Indicators in RP1* - A seminar will be launched at Novatech (M26) on planning and technologies for sustainable stormwater management to engage different Urban Drainage community users - **Water utilities and network operators participate and/or benefit from the development of "early adopters group" launched at SPN 10 congress (2) and IWA WWC&E congress (8)** (Target 10) - Survey to understand performance of UDS data and their purpose (RP2) - **Participation in national level events for non-scientific UD actors: 1** (Target: 10)

1.3.2 Other relevant impacts

In the DoA, a number of relevant impacts not specified in the INFRAIA call were included. We can highlight that due to the creation of various groups multi-sectorial teams (including researchers from academia and industry, and end-users) in the 1st call for TA access, innovate products and solutions are being tested at the full-scale Co-UDlabs installations. This socio-economic impact of Co-UDlabs was boosted with the creation of Co-UDlabs marketplace and 1st Co-UDlabs hackathon which allows to different actors come together for the preparation of TA proposals.

At the end of RP1 it is too early to be able to quantify these socio-economics impacts, as well as other socio-environmental impacts or governance impacts expected through Joint Research Activities outcomes and harmonization activities.

1.4 Access provisions to Research Infrastructures

1.4.1 Trans-national Access Activities (TA)

In the following section we specifically pinpoint the requests from H2020 Periodic report template for Co-UDlabs TA activities developed under the WP5 – TA management and WP9 – TA provision.

Description of the publicity concerning the new opportunities for access

All the information and documentation related to the call was published online on Co-UDlabs website (co-udlabs.eu). The call was announced on Co-UDlabs social media, on the first issue of the Co-UDlabs newsletter, which was released on November 2nd, 2021, on the JCUD newsletter and on IAHR newsflash, among others. Co-UDlabs partners also used their professional networks and contacts for more direct and personal contact with potentially interested users and stakeholders.

Several events have been organised and detailed documentation has been produced to inform the urban drainage community about the call, to highlight the possibilities of the unique facilities offered and to explain the application procedure, the rules of the call and the evaluation criteria established:

- On October 13th, 2021, Co-UDlabs held an Introductory Webinar in which the scope, goals, and research infrastructure of the project were presented with a particular focus on the details of the Co-UDlabs Transnational Access programme and the description of the 17 facilities offered.
- A complete TA Call Reference Manual (Deliverable 5.1) was published and made openly available on Co-UDlabs website (https://co-udlabs.eu/access/ta-call/) with detailed information for potential users of the Co-UDlabs TA programme, including the call selection and application procedures with a description of the facilities and access provided.
- On November 3 and 4, 2021, Co-UDlabs held an Online Workshop on Urban Drainage Practice and Research Needs. The Workshop was a great venue to introduce Co-UDlabs open Transnational Access (TA) call to a predominantly non-academic audience.
- On November 23 and 25, 2021, Co-UDlabs organised a global 'Hackathon' event to meet with researchers and practitioners from a number of scientific and technology fields. The results of the Hackathon were used to create a Co-UDlabs Ideas Marketplace in which the people of our community can exchange propositions, ideas, contacts and methods that may lead to Transnational Access project proposals.

Additionally, as well as events organised by the project, Co-UDlabs partners are spreading the word of the benefits of the Co-UDlabs TA programme through conferences, seminars, meetings, and workshops in which they are participating. Some of these events with Co-UDlabs participation are 7 scientific conferences: Aqua Urbanica 2021 (Innsbruck, Austria), GW4 WSA Seminar Series 2022 (online), IAHR Institute Meetings as part of the 39th World Congress of IAHR 2022 (Granada, Spain), 10th Sewer Networks and Process (Graz, Austria), Symposium on Urban Flooding Experiments (Lyon, France), Water Innovation Europe 2022 by NBS working group event (Lyon, France) and POLLUTEC

Conference 2021 (Lyon, France); 7 national technical conference: Galicia Innovation Days 2021 – Towards Horizon Europe (online), StarkRegen Congress 2021 (Gelsenkirchen,Germany), Göttinger Abwassertage (online), Annual Seminar of the Spanish Network of Hydraulics Laboratories 2022 (Barcelona, Spain) Jornadas AEAS 2022 (Córdoba, Spain), Journée d'échanges Autosurveillance des systèmes d'assainissement 2022 (Lyon, France) and Webinar France-Québec "Ville Perméable" 2022 (online); 2 workshops organized at 10th Sewer Networks and Process (Graz, Austria) and IWA World Water & Exhibition Congress (Copehnagen, Denmark); 1 exhibition trade at the ICRI 2022 conference (Brno, Czech Republic) and an oral presentation at the LIFE DRAINRAIN project final event on 2022 in Ferrol (Spain).

Description of the selection procedure

The facility providers participating in Co-UDlabs have agreed a single common User Selection Procedure that was made available during the first call. In summary, this common User Selection procedure includes the following (see also Deliverable 5.1):

Before proposals are ranked, they must meet two essential selection criteria, which are judged by facility providers: the user group must be eligible according to EU rules and the project must be practically feasible within the access period timescale. The eligibility of the proposals received were checked first by Co-UDlabs management team. The eligibility conditions were included in the User Selection Procedure document available on TA call website and the TA call Reference Manual (Deliverable 5.1). Then, the provider of the facility requested in each proposal assessed its feasibility considering the logistics of the facility, the access period timescale and the resources and budget available. If one of these conditions was not met, the proposal was not ranked and is directly rejected. Feasibility reports were made by facility provider and shared a posteriori with granted and non-granted user groups in order to serve as feedback and refine project proposals for the TA Access, or for the second TA call in case of rejection. To ensure eligible and feasible proposals, the applying user groups were given the possibility to submit a preliminary proposal 4 weeks before the deadline, which then can be modified and improved based on the remarks of the facility manager.

A fully independent panel of experts was assigned to evaluate all eligible and feasible proposals using pre-described and agreed selection and ranking criteria. The External Evaluation Panel (EEP) consisted of 12 members of academia and no academia members and with diversity in nationalities, institutions and field of expertise. It is being ensured that no conflict of interest existed between EEP members and the proposals to be reviewed or Co-UDlabs facility providers. Table 6includes the composition of Co-UDlabs EEP.

Each proposal was evaluated in-depth by two members of the EEP. This evaluation consisted in comments and numeric scores regarding the excellence of the proposal, the impact of expected results and the potential for academic or industrial innovation. These in-depth evaluations were sent to all EEP members before the EEP session to ensure their knowledge about each proposal reviewed. This EEP-Co-UDlabs meeting for the final assessment and ranking of the proposals submitted to the first TA call was held online on March 24,2022.

Table 6. Composition of Co-UDlabs External Evaluation Panel, included affiliation and corresponding country.

Name	Affiliation	Country
Arthur Scott	Heriot Watt University (Edinburgh)	UK
Ángel Villanueva	Agbar Group (Veolia) / AEAS	Spain
Antonio Lastra	Canal Isabel II	Spain
Caroline Wadsworth	Isle Utilities Ltd.	UK
Emmanuel Berthier	CEREMA	France
Frank Blumensaat	Landesdirektion Sachsen	Germany
Franz Tscheikner-Gratl	NTNU	Norway
Johan Van Assel	Aquafin	Belgium
Maria Viklander	Luleå Tekiska Universitet	Sweden
Marie-Christine Gromaire	Ecole des Ponts ParisTech / Leesu	France
Philipp Staufer	Canton Solothurn, Environment Office	Switzerland
Sophie Duchesne	INRS	Canada

A total of 15 proposals were received in the 1st call for access. During the meeting, 14 eligible and feasible proposals were evaluated to access 11 of the facilities offered by Co-UDlabs. The meeting was attended by 5 EEP members in charge of rank and select the granted proposals and the facility providers whose role was only to provide additional information of the corresponding facility to the panel where necessary. The decisions agreed upon during the EEP-Co-UDlabs meeting were:

- All proposals above the cut-off threshold of 13 points, as stated by the TA regulations in Co-UDlabs' Grant Agreement with the European Commission, and that applied for a facility that only received one proposal was granted access to the facility.
- When two eligible proposals with a score higher than 13 are applying for the same facility, both were accepted as long as the budget and timescale are appropriate to facility providers
- The three feasible proposals that did not meet the scoring requirement at the first attempt were recommended to revise, improve and re-submit their proposals according to the evaluators and facility providers comments for a new evaluation. The EEP agreed to grant these proposals in case they were over the cut-off threshold of 13 points after the evaluation of the revised proposal by the EEP members.

In summary, we received 15 proposals, 14 proposals were eligible and feasible and the the EEP finally proposed 13 user groups from leading institutions from 10 countries to be granted with Transnational Access to 10 of the facilities offered by Co-UDlabs in this first call, which are provided by 5 different partners. All user groups were informed from Co-UDlabs team about the result of their proposals. In case of non-acceptance, the applicant was informed by email with a summary of the comments made by the EEP and their rank and scores. Where appropriate, the report also include recommendations and suggestions for improvement and resubmission of a new proposal for the second call for projects scheduled for 2023. Resubmission for the second call will however not give any preference or priority in the user selection procedure.

In complement to the awarded proposals shown in Table 4, the following proposals were not selected for access:

- USFD-05-BURIED-Abba. A novel manhole design for separate sewer systems. This proposal was not eligible as the group leader was from the facility country (Liverpool John Moores University, UK)
- IKT-03-TEST-Ayesa. Efficiency on Microplastics and sediments removal on Stormwater by Hydrodynamic Separators. This proposal was not granted as it was scored below the cut-off threshold

Lastly, in the RP1 two projects have started with preparatory works but no access days were granted yet which have a majority of users non-working in an EU or associated country:

- SFD-04-BURIED-Li. Hydraulic Analysis of the Toronto Exfiltration System (TES). Ryerson University (Canada). This proposal has devoted 60 days of access
- UDC-02-BLOCK-Zafra. Methodology to determine the potential resuspension load of heavy metals from road sediments associated with surface runoff. Fo J. De Caldas University (Colombia). This proposal has devoted 60 days of access

Thus, the total number of units of access provided for projects with a majority of users non-working in an EU or associated country is 120 days, representing the 20.33% of access days (590 days) which will be provided in the 1st Co-UDlabs call.

Description of the Trans-national Access activity

During the RP1 a total number of 11 projects has been initiated, although the physical access provision was granted to 6 projects as stated in Table 7. A total number of 14 researchers visited physically the facilities during the access days periods (see Section 12 of Part A of the Periodic report). A full list of users and summary statistics will be provided in Deliverable 9.1 in M30 and RP2.

Table 7. Status of projects awarded in the 1st call at the end of RP1 (indicative dates marked with *).

Host Institution	Project Acronym	Status	Project Start date
UDC	UDC-01-BENS-Peña	Preliminary coordination	April 2023
UDC	UDC-02-BLOCK-Zafra	Preparatory works	19/01/2023
UDC	UDC-03-STREET-Bellos	Project launched	17/10/2022
USFD	USFD-01-ABFLUME-Mignot	Project launched	30/10/2022
USFD	USFD-02-ANNULAR-Regueiro	Preliminary coordination	May 2023*
USFD	USFD-03-ANNULAR-Morato	Preparatory works	01/03/2023
USFD	USFD-04-BURIED-Li	Preparatory works	March 2023*
EAWAG	EAWAG-01-HALL-Bares	Project launched	15/05/2022
EAWAG	EAWAG-02-HALL-Langeveld	Project launched	15/06/2022
EAWAG	EAWAG-03-UWO-Dittmer	Preparatory works	15/01/2023
IKT	IKT-01-LTF-Verhulst	Preparatory works	01/02/2023
IKT	IKT-02-LTF-Beenen	Preparatory works	01/02/2023
INSA Lyon	INSA-01-OTHU-Fuchs	Project launched	31/08/2022

According to the template of H2020 periodic reporting, Table 8 includes the list of user-projects with the project acronym, their main objectives and the amount of access days granted in RP1.

Table 8. Full list of projects in which costs have been incurred in RP1, including project objectives and the amount of access days provided.

Host Institution	Project Acronym	Objectives	Units of access provided in RP1	Total number of unit of access
UDC	UDC-01-BENS-Peña	To adapt and validate new monitoring flow and quality technologies for sewers	0	60
UDC	UDC-02-BLOCK-Zafra	To investigate the mobilisation of heavy metals (HM) associated with urban diffuse pollution that is generated and accumulated in the streets and roads	0	60
UDC	UDC-03-STREET-Bellos	To investigate the impact of the potential storage of flooded houses acting like reservoirs in a pluvial flood hitting an idealised city	11	40
USFD	USFD-01-ABFLUME-Mignot	To conduct a series of experiments to compare different measurement techniques to characterise transport of soluble pollutants and conduct a series of benchmarks tests under different geometrical and flow conditions	1	60
USFD	USFD-02-ANNULAR-Regueiro	To test innovative thermal probes to measure to monitor sediment bed thickness, under temperature-controlled conditions at the annular flume.	0	60
USFD	USFD-03-ANNULAR-Morato	To evaluate the role of riverine biofilms, affected by wastewater discharges, in the spread of antibiotic resistance in the environment and to evaluate the use of CRISPRCas9 as a mitigation technique	0	60
USFD	USFD-04-BURIED-Li	To investigate a novel stormwater sewer infiltration system at full-scale	0	60
EAWAG	EAWAG-01-HALL-Bares	To assess the feasibility of non-contact water quality monitoring methods with hyperspectral imaging	18	40
EAWAG	EAWAG-02-HALL-Langeveld	To stablish the optimal configuration of thermal sensors distribution to determine sewer sediment thermal properties and thickness.	28	40
EAWAG	EAWAG-03-UWO-Dittmer	Improve the reliability of Urban Drainage Modelling with probabilistic Machine Learning-methods	1	20
IKT	IKT-01-LTF-Verhulst	To test sewer rehabilitation relining solutions for sewage pressure pipes	0	40
IKT	IKT-02-LTF-Beenen	To test innovative inspection techniques that provide meaningful results on the condition of the sewage pressure pipes	0	40
INSA Lyon	INSA-01-OTHU-Fuchs	To measure the spatial distribution of soil moisture in a swale under artificial heavy rains	3	10

In the following lines a short description of each project and the work carried out in the reporting period will be shown.

- **UDC-01-Bens-Peña. Project: Evaluation of new flow and quality monitoring devices for sewers**

Two SMEs (Photrack and Ubertono) and two universities (Polytechnic University of Cartagena and Trinity College Dublin) joined and proposed this awarded TA project. The objective is to adapt and validate new monitoring flow and quality technologies for sewers. Ubertone will test and compare a new profiler in terms of capability, quality and limits, with other conventional methods available in the flume facility. Photrack will explore the applicability in sewers of a non-contact image-based systems for flow monitoring developed, already tested and successfully implemented in river monitoring.

- **UDC-02-BLOCK-Zafra. Methodology to determine the potential heavy metal loads washed-off by stormwater runoff from road-deposited sediments**

The study focuses on the analysis of the mobilisation of heavy metals (HM) associated with urban diffuse pollution that is generated and accumulated in the streets and roads of an urban area, and which is subsequently washed by stormwater and discharged into natural water bodies. The project consists of three phases: (i) Characterisation of the RDS load, (ii) assessment of HM wash-off in the physical model, and (iii) application of the wash-off equation model (iii). All the phases will be carried out at the University of A Coruña (Spain) facilities.

- **UDC-03-STREET-Bellos. Project: Urban Flooding: Houses as reservoir (UF-HOUR)**

A laboratory experiment is proposed to investigate the impact of the potential storage of flooded houses acting like reservoirs in a pluvial flood hitting an idealised city. This storing flood volume, the so-called storage effect, has not been approached, either numerically or experimentally. Different scenarios for several city configurations will be implemented as the distorted physical model will allow various rainfall-runoff intensities and adjustment of the flood volume stored in buildings. Flood characteristics such as water depths, velocities and hydrographs will be obtained from measurements.

In RP1 the User Facility Agreement (UFA) and User Project Plan (UPP) have been completed and signed. The facility was modified to allow testing the city-scale physical model proposed by the user-group. The model set-up and the installation of the sensors was performed, and tests are currently ongoing (Figure 19). All health and safety requirements have been fulfilled by the users in advance of the visits.

Figure 19. Preparatory works and model set-up of street facility for UDC-03-STREET-Bellos project.

- **USFD-01-ABFLUME-Mignot. Project: Pollutant Transport in Urban Floodwater.**

The aim of the project is to conduct a series of experiments to a) compare different measurement techniques for the characterisation of transport and mixing of soluble pollution is shallow urban flood flows and b) conduct a series of benchmarks tests under different geometrical and flow conditions for the purpose of numerical model development texting and validation.

In RP1 the User Facility Agreement (UFA) and User Project Plan (UPP) have been completed and signed. The facility was modified for testing and all health and safety requirements have been fulfilled by the users in advance of the visits. During RP1 three researchers visited the facility on 30th October to start the testing (Figure 20).

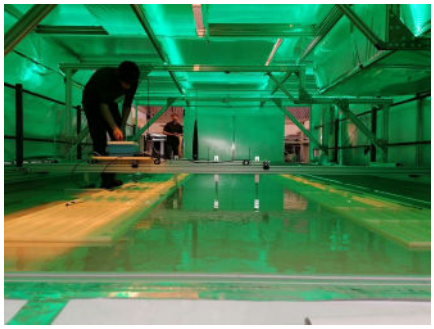


Figure 20. Initial experiments undertaken for USFD-01-ABFLUME-Mignot project.

- **USFD-02-ANNULAR-Regueiro. Temperature time series analysis for predicting sedimentation in sewer systems**

Sediment accumulation in sewer systems causes major problems such as loss of hydraulic capacity, increasing risk of blockages and generation of hazardous gases. However, there is a lack of methodology to continuously monitor the sedimentation process. This TNA activity will focus on testing the innovative use of thermal probes to measure temperature oscillations in the liquid phase and the sediment bed, to monitor sediment bed thickness, under temperature-controlled conditions at the annular flume. There is currently a lack of knowledge on thermal properties and heat exchange processes in urban drainage systems, and a scarcity of temperature data from sewer systems.

- **USFD-03-ANNULAR-Morato. Annular flume studies to test the effect on antibiotic resistant genes and use of CRISPR-Cas in E. Coli from sediments affected by sewage pollution**

The aim of this study is to evaluate the role of biofilms attached to sediments in rivers affected by wastewater discharges in the spread of antibiotic resistance in the environment. The study will evaluate the exchange of antibiotic resistance between biofilms and river water using the annular flume facility at the University of Sheffield (UFSD). The experiments will allow for the study of the dissipation of antibiotic-resistant genes (ARG) and the use of the genome editing CRISPR-Cas9 technology as a mitigation technique of ARG in *E. coli.*

A researcher from UPC will visit the UFSD for 60 working days to develop the project. Two other project members from the UPC, will visit Sheffield during the project to discuss progress, develop research ideas and participate in knowledge exchange activities between both Universities.

- **USFD-04-BURIED-Li. Hydraulic Analyses of the Toronto Exfiltration System (TES)**

The project is to be based in the buried test facility at the UFSD and involves the construction, at pilot scale, of a novel stormwater sewer infiltration system. The system includes a conventional stormwater sewer attached to two parallel slotted pipes in which excess stormwater can be allow to safely infiltrate into the surrounding soil. The system will be built using full-scale components and the test cell will be spilt into two so that two soil test cases can be examined, one with limited infiltration potential and one with high permeability soil. The test rigs will be heavily instrumented so that the hydraulic behaviour in different elements of the system can be measured simultaneously. The output of the project will be a comprehensive and high-quality data set that reliable models can then be developed and used to simulate such hybrid stormwater systems (pipe/infiltration) and then provide the evidence/assurance for end users to adopt such a new approach to piped drainage for stormwater. The research team includes both experimentalists and numerical modelers.

The design work for the layout has been completed, and the installation work and pipe procurement has been described and listed and been sent out to suppliers and a quotation for the installation and pipework received. As the work involves the excavation, removal and placement of 500 m^3 of material – local storage for soil and pipes has to be arranged through the University's Estates Department and this is still being organised. Given the large volume of material an external groundworks contractor is being used. This will mean that some staff costs will be transferred to other costs, but the overall budget will be maintained. Once this task has been completed, a final installation date and starting date for the experiments can be confirmed.

- **EAWAG-01-HALL-Bares. Non-contact assessment of TSS and COD concentrations in wastewater with hyperspectral imaging**

In this proposal, a user group with 5 partners from academia and industry suggest the very first experimental investigations to assess the feasibility of non-contact water quality monitoring methods with hyperspectral imaging. To fully benefit from the HALL infrastructure, they propose dedicated laboratory trials with synthetic and real wastewater, followed by experiments with real moving wastewater in the unique flume at the HALL to assess the performance regarding turbidity and COD monitoring. The results of these investigations should provide new insights into wastewater pollution monitoring.

The Access has been started on 15th of May 2022 (Figure 21). The user group decided to follow the experimental trials remotely and hold a user group meeting, when an intermediate set of results with sufficient quality had been achieved by the host. This was possible, because Pierre Lechevallier is investigating the topic in the scope of his PhD and the EAWAG team had frequent exchange with one of the partners Photrack AG. Due to administrative difficulties the UFA has not yet been fully completed. So far, the first series of targeted experiments in laboratories with 144 samples obtained from real sewer wastewater and mixtures with synthetic wastewater have been performed. After a period of in-depth data analysis, the results have been discussed at the first user group meeting on 16th November 2022, which was held as a video conference during the visit of one person from TU Graz at the facility. In total 18 days of access have been provided. Tests are proceeding according to plan and will be extended to the flume to be performed with live flowing wastewater in January of 2023. As the results are coming in, regular follow-up meetings are expected during and after the first quarter of 2023.

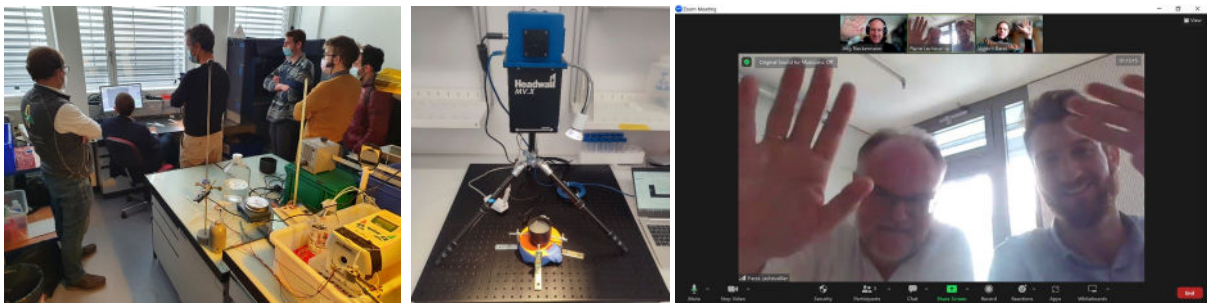


Figure 21. Christian Felsheim from Headwall is demonstrating the capabilities of the MV.X camera to the partners from Geoconcept and Photrack AG at the EAWAG HALL (left), the experimental setup for the first set of hyperspectral imaging experiments with wastewater for the EAWAG-01-HALL-Bares project (middle) and screenshot from the first user group online meeting on 16/11/2022 (right).

- **EAWAG-02-HALL-Langeveld. Characterisation of thermal properties in drainage systems with temperature probes**

Physicochemical transformations of sediments deposited in sewers influence significantly in erosion and transport processes. This TA suggests the development a system that combines active heaters and temperature sensors to monitor thermal properties of sediments, as an indicator of the transformations in physicochemical properties. For this purpose, a user group of 5 researchers has been planning a series of laboratory experiments in the HALL facility at EAWAG, developing and deploying active-heat temperature sensors with the help of the EAWAG Sensorlab and using it to characterize different sediment mixtures from combined sewers, combined sewer overflow tanks and gully pots (Figure 22).

In RP1 the User Facility Agreement (UFA) has been drafted, but not yet been completed. As outlined in the proposal, a sediment thermostat (plastic cylinder with a diameter of 20 cm and a height of 60 cm) has been constructed which has an insulating cover to ensure stable temperature conditions. The sensoring of the thermal properties consists of 5 temperature sensors and 1 heat pulse system at the bottom of the thermostat. The experimental system has been tested and validated and a series of thermal characterization tests have been performed with sediments collected from 2 gullypots, a sewer and a CSO (Figure 22). All tests have been performed by the UDC partner, who was a visiting PostDoc at EAWAG, so that no physical user group meeting was necessary at the facility. In total 28 days accessing the HALL facility were provided. The first user group meeting was held at the SPN10 conference in Graz, where several partners were present to discuss initial results. Currently, the experimental system is optimized for outdoor operation in real gully pots in terms of battery life and IoT data transmission. A final user group meeting is planned in Q1 2023. The TA will finish on March 1st 2023.

Figure 22. The experimental sediment thermostat prototype, including sensoring (left), sediment sampling campaign with the Zurich wastewater utility (middle), and thermal characterization of the different collected sediments for the EAWAG-02-HALL-Langeveld project (right).

- **EAWAG-03-UWO-Dittmer. A probabilistic machine learning-based framework to improve urban drainage modelling reliability**

The aim of this TA is to evaluate the role of advanced machine learning methods, generative adversarial networks (GANs) to improve the quality of monitoring data as well as capabilities for data-driven modelling of urban drainage systems. Specifically, the user group will use the datasets of water quantity (and quality) collected in the UWO field lab to compare the performance of autoencoder and GAN-based methods. Besides, different statistical data analysis methods will be also used in this step for certain tasks like outlier detection. The numerical experiments will allow for the study of data-driven modelling as a mitigation technique for process-based models and bad data quality.

A series of email has been followed by an initial meeting with the group from TU Kaiserslautern on 20/09/2022 to explain the current state and limitations of the UWO dataset. As the collection and cleaning of datasets and, most importantly, the associated metadata has been seriously delayed, the TA has not started yet. In 2023 the group plans two visits to the EAWAG.

- **IKT-01-LTF-Verhulst. Investigation of the rehabilitated wastewater pressure pipes in response to pressure surges in operation**

IKT will provide access to two projects in the 1st call. Both of these are for use of the IKT Large Test Facility and are being run concurrently as there is capacity in the facility for both projects and they are using similar equipment.

The project is addressing an important question that the owners of pressure sewers have concerning how the pronounced pressure surges that can occur because of the operation of the pumps may affect the performance of pipe lining technology installed to extend the life of pressure pipes. For such relining solutions the fundamental question is how the host pipe-liner combination behaves under pressure surge loadings and to what extent it can withstand this. There are currently no reliable statements on this because common calculation approaches and currently available publications on scientific investigations are aimed at the host pipe and the situation of an undamaged sewage pressure pipe, but not at a rehabilitated pipe.

The current calculation methods for undamaged pipe are to be examined, and, if necessary, adapted accordingly. Firstly, the extent to which these existing calculation approaches and load patterns can be transferred to the host pipe-liner combination will be examined, to what extent new calculation approaches need to be developed, that address the interaction of host pipe- and liner. Based on this, a calculation model will be developed (approximation formula) and tested with the help of laboratory tests based on operational load scenarios. For this purpose, a test setup will be used in the laboratory consisting of a pressure pipeline into which a close-fit type liner will be installed. It will then be subjected to the determined pressure surge loads. The pressure surges and fluctuations will be simulated using a pressure pump and a dynamic valve arrangement.

- **IKT-02-LTF-Beenen. Assessment of Inspection tools for Rising mains (AIR)**

Sewage pressure pipes, or 'rising mains' are particularly critical structures in the sewerage system. In the event of their failure, exfiltration of sewage, flooding and the associated risks for people and the environment are to be expected. In order to minimise the risk of damage or operational failure of these pipes, regular condition assessments are required. However, the inspection of wastewater pressure pipes poses a problem for many operators. A conventional CCTV condition assessment or leak test as with gravity pipelines is usually not possible due to certain boundary conditions (e.g., lack of access openings, bends, full or partial filling of the pipelines as well as gradient and incline sections). New, innovative inspection techniques are required that provide meaningful results on the condition of the sewage pressure pipe. In recent years, some promising inspection techniques have been (further) developed.

Within the framework of this TA project, selected innovative inspection techniques are now to be examined in a test set-up for their performance and application limits. The project will use an existing test setup in the large-scale test facility of the IKT, consisting of a system of wastewater pump and pressure pipe, with typical damage patterns to be detected by the inspection techniques. Different

pipe materials will be installed in two sections of the test setup in order to be able to take into account the influence of the material structure on the different inspection techniques.

- **INSA-01-OTHU-Fuchs**

The aim of the project is to test and to improve existing models with respect to the use of data collected on an equipped SUDS (Sustainable Urban Drainage System) operating under extreme precipitations events. SUDS benefit from various types of GI (green infrastructure) and NBS (nature-based solutions) in order to increase evapotranspiration in contrast to runoff and to minimise the inflow of pollutant loads into urban drainage systems. For the implementation of the project, OTHU-SuDS infrastructure was used. Additional soil moisture sensors and a system for artificial precipitation (self-built prototype) were installed at INSA Lyon (Figure 23).

Figure 23. View of the saturated swale and the sprinkler system.

By using the soil moisture sensors, the water distribution in the subsurface (horizontal and vertical) becomes clear and it is possible to draw conclusions about the effectiveness of SUDS. New findings such as possible parameter simplifications for SUDS can be implemented as features in numerical models to enable more effective planning of SUDS and to improve their design. A Master student is currently analysing all collected data to get the map of soil moisture.

Scientific output of the users at the facilities

As none of the projects has finished in the RP1 no scientific outputs have been derived yet from the TA project activities. Nevertheless, and according to the different Users Facility Agreements (UFA) and User Project Plans (UPP) already signed, a several congress papers, journal papers and open datasets are expected. A number of potential publications have been identified and it is in the intention that all the data will be collated, organised and uploaded to Co-UDlabs Zenodo community to be available to a wider modelling community. Furthermore, most of the project results will be used for numerical model development and calibration. Most of the user-projects are interdisciplinary and accounts with both modellers and experimentalist profiles.

Besides purely scientific outputs, and due to the large number of industry users involved in the call, the results of the more oriented industry research projects will be disseminated through national and international technical events, sewer operators and manufacturers. Eventual IPR resulting from the TA projects will be analysed and reported in project PEDR, Deliverable 9.1 and subsequent periodic reports.

User meetings

In the following a comprehensive description of the support provided to TA teams through meetings is reported per each TA project. Table 9 summarised the users meetings held during the 1st reporting period.

Table 9. Summary of the users' meetings with TA users during RP1

Project Acronym	Date	Venue	Approx. number of attendees	Description
UDC-01-BENS-Peña	28/07/2022	Online	3	Preliminary coordination
UDC-02-BLOCK-Zafra	23/06/2022	Online	4	Preliminary coordination
	14/07/2022	Online	4	Definition of tests and requirements for the access.
	20/09/2022	Online	4	
UDC-03-STREET-Bellos	14/06/2022	Online	4	Coordination, definition of tests and requirements for the access.
	26/07/2022	Online	4	
	16/09/2022	Online	5	Discussion on experimental setup
	29/09/2022	Online	5	Hosting and per diem information
	17/10/2022	UDC	7	Experimental procedure and test plan.
	19/10/2022	UDC	7	Experimental procedure discussion
	21/10/2022	UDC	8	Experimental procedure discussion
USFD-01-ABFLUME-Mignot	13/1/22	Online	9	Preliminary Discussion
	28/1/22	Online	11	Preliminary Discussion
	25/5/22	Online	16	Preliminary Coordination
	9/6/22	Online	16	Coordination and Experimental Design
	6/10/22	In person visit	1	Discussion of Setup and Instrumentation
USFD-02-ANNULAR-Regueiro	June 2022	Online	2	Preliminary coordination. Definition of requirements for the access.
	August 2022	SPN10 congress	3	
USFD-03-ANNULAR-Morato	19/07/2022	Online	4	Preliminary coordination.
	03/08/2022	Online	5	Definition of requirements for the access.
	03/11/2022	Online	4	
	05/11/2022	Online	4	
USFD-04-BURIED-Li	17/06/2022	Online	5	Preparatory works.
	18/07/2022	Online	5	Definition of tests and requirements for the access.
	03/08/2022	USFD	4	
	18/08/2022	Online	5	
	30/08/2022	Online	4	
	09/09/2022	Online	4	
	14/10/2022	Online	4	
EAWAG-01-HALL-Bares	16/11/2022	EAWAG	4	Discussion of progress, preliminary results, publications
EAWAG-02-HALL-Langeveld	25/08/2022	SPN10 congress	3	Discussion of progress, preliminary results, publications
EAWAG-03-UWO-Dittmer	20/09/2022	FC-EAWAG	4	Discussion of UWO data format, "Data slice", limitations and access to the data
IKT-01-LTF-Verhulst	10/06/2022	Online	5	Presentation of the project.
	24/06/2022	Online	4	Discussion of experimental plan.
	07/07/2022	Online	4	Discussion about rehab. Projects.
	12/08/2022	Online	3	Designing of the project setup.
	26/08/2022	IKT	4	Physical visit to installations.
	20/09/2022	Online	4	Discussion of innovative techniques
	28/09/2022	Online	4	Discussion about air pockets
	07/09/2022	Online	4	Definition of materials for the test.
IKT-02-LTF-Beenen	14/06/2022	Online	5	Presentation of the project.
	14/07/2022	Online	5	Discussion of experimental plan.
	11/08/2022	Online	5	Discussion about materials and setup needed. Discussion of techniques.
	25/08/2022	Online	5	
	12/10/2022	Online	5	Discussion of communication plan for stakeholders.

Project Acronym	Date	Venue	Approx. number of attendees	Description
INSA-01-OTHU-Fuchs	29/08/2022	INSA	3	Installing the sensors, testing the set-up, and check data
			3	Optimising the set-up and perform the experiments with artificial rainfall events
			3	Check data availability and discussion on further steps

- **UDC-01-Bens-Peña. Project: Evaluation of new flow and quality monitoring devices for sewers**

A meeting between User Group Leader and UDC has been held on 28th July, agreeing that the Transnational Access will be tentatively carried out from April to July 2023 and the User Facility Agreement will be signed at the beginning of 2023 with the support of UDC in its preparation during January 2023, having enough time to setting up the facility and other requirements before the Access start.

- **UDC-02-BLOCK-Zafra. Methodology to determine the potential heavy metal loads washed-off by stormwater runoff from road-deposited sediments**

After holding several meetings with the Colombian researchers, from the Universidad Distrital Francisco José de Caldas, progress has been made in consolidating the initial proposal and a detailed experimental procedure has been developed, in which the experience of both research teams has been integrated and many of the experimentation opportunities offered by the CITEEC team are being exploited. User Project Plan and User Facility Agreement will be signed by the end of 2022.

- **UDC-03-STREET-Bellos. Project: Urban Flooding: Houses as reservoir (UF-HOUR)**

The Access has been started on 17th October 2022 and the experiment will be carried out until 14th December 2022. Previously, the User Facility Agreement has been signed and all the Training and Health and Safety requirements have been completed. An important modification of the facility was necessary to carry out the experiments with the construction of an elevated concrete platform that includes scaled square buildings. The Access started with the visit of four User Group member during a week (from 17 to 21 October 2022), staying one of the researchers for the complete Transnational Access. More short visits are planned for two additional User Group members during November 2022 (from 21 and 23 to 25) to collaborate in the development of the experiments. Tests are proceeding according to plan and follow-up meeting are expected during and after the Access with User Group members.

- **USFD-01-ABFLUME-Mignot. Project: Pollutant Transport in Urban Floodwater.**

Four online meetings were held between January and June 2022 to discuss the project idea, refine the experimental plan and coordinate the testing. These have been coordinated by Emmanuel Mignot and James Shucksmith. This was followed by a short visit to USFD by a team member from Lyon (Louis Gostiauix) in October 2022 to view the facility and discuss instrumentation. The user agreement and project plan has been completed and signed. The facility has been modified to allow testing of different measurement techniques (specifically, a hot water tank has been fitted to allow thermal imaging tests). All health and safety requirements have been fulfilled by the users in advance of the visits. Testing is currently ongoing, and post visit meetings have been arranged in Jan 2023 in order to

discuss the project outputs with James Shucksmith. One of these will be held in person at USFD and include staff from INSA-Lyon and one online with the larger project team.

- **USFD-02-ANNULAR-Regueiro. Temperature time series analysis for predicting sedimentation in sewer systems**

Alma Schellart of the University of Sheffield has contacted Manuel Regeiro in June 2022 regarding an update on the timings and to set up initial meetings on the project. Manuel Regeiro, and Jeroen Langeveld (TUDelft) and Alma Schellart met in person, with Henriette Jensen of University of Sheffield attending online, during the SPN10 conference in Graz, Austria in August 2022. Here the required laboratory equipment and consumables were discussed in detail. In this meeting, more detail on the required laboratory equipment was requested, and this information was provided by Manuel Regeiro end of August 2022. Since then, Henriette Jensen and Alma Schellart have discussed practicalities around the TNA project at Sheffield, to coordinate it with the other TNA project happening at the Annular Flume. In September and October 2023, details of the required health and safety training and other staff training and regulations in relation to temporary TNA visitors to Sheffield University's laboratory have been clarified for the first TNA to take place at A/B Flume. The templates and instructions for these will be used and discussed with Manuel Regeiro and team in early December 2023. Henriette Jensen, Alma Schellart and Chris Green have started the process of designing the specific thermostat pumping system and data acquisition system for the tests. Once these draft designs have been completed, a meeting will be organised to discuss the draft design and sign the User-Facility Agreement (UFA) and agree on the User Project Plan (UPP).

- **USFD-03-ANNULAR-Morato. Annular flume studies to test the effect on antibiotic resistant genes and use of CRISPR-Cas technology in E. coli from sediments affected by sewage pollution**

The initial exchange of information and ideas to organise research activities between USDF members and the users- team (Polytechnique University of Catalonia-Barcelona Tech) took place mainly by the exchange of emails. Afterwards, Isabel Douterelo at USDF conducted several online meetings with the user-project team from the Polytechnique University of Catalonia-Barcelona Tech led by Prof. Jordi Morato in order to organise the access period, the number of researchers visiting and the tasks to develop during the visit. The outcome of these initial meetings facilitated the drafting of the User Facility Agreement and the User Project Plan. After the initial online discussion, more technical and specific details related to the use of the annular flume were discussed in subsequent meetings with technical advice provided by Henriette Jensen and Simon Tait. The final planning and use of the microbial molecular laboratories was discussed between Isabel Douterelo, Dr Leonardo Martinez Perez and Dr Nury Gineth Infante by exchanging e-mails, both researchers are experts in molecular biology. Our final discussion to finalise the agreement was based on how to best use the genetic material obtained from the annular flume tests and how to develop the CrisprCas technology in the laboratory, including the consumables needed.

- **USFD-04-BURIED-Li. Hydraulic Analyses of the Toronto Exfiltration System (TES)**

There were initial discussions based on the proposal on 17/6 and 18/7 at which the underlying aims of the research were described, the types of measurements proposed listed and potential access periods were discussed. The project leader (Professor Li) has visited Sheffield, (03/08/22 to 05/08/22) to be given detailed information on the facility and potential sensing options and to indicate the key elements of the testing. An overall scope of the work was provisionally agreed and the concept for the experimental layout and programme agreed. Meetings have been held on August 18 and 30;

September 9 and 23; October 14; and November 3, 2022 to exchange information and agree full details of the pipe layout and character, the sensing requirements and the three phases of experimental work. A detailed sensor plan and experimental programme has been agreed with highlighted contingencies and options in the experimental programme. As regards the sensors most are available, others are being manufactured currently. A detailed work plan for the sensor data logging and arrangement has been drafted and is currently being progressed.

One physical visit by the team leader (Prof Li) to Sheffield (03/08-05/08) with Prof Tait, Mr Green and Ms Hopcroft. Several on-line meetings have been organised in the reporting period (May 2021-October 2022) with the users (Prof Li, Dr Fan, Dr Joksimovic) and University of Sheffield staff (Prof Tait, Mr Green)on June 17, July 18, August 18 and 30, September 9 and 23, October 14, and November 3, 2022.

- **EAWAG-01-HALL-Bares. Non-contact assessment of TSS and COD concentrations in wastewater with hyperspectral imaging**

The user group was contacted to confirm acceptance of the proposal as soon as EAWAG was informed. The User-Facility Agreement (UFA) has been drafted and circulated. It has not yet been signed until M18, due to administrative difficulties. Health and safety regulations and requirements have been included in the draft UFA. The group decided that it would be most effective to delegate the experimental work, which consist of first-time experimental trials with dedicated hardware, as well as first data analysis procedures to EAWAG. Therefore, the first user meeting was held on 16/11/2022 as a mix of face-to-face and online meeting. Up to 8 online meetings were held with user group to discuss the development and project implementation.

- **EAWAG-02-HALL-Langeveld. Characterisation of termal properties in drainage systems with temperature probes**

The user group was contacted to confirm acceptance of the proposal as soon as EAWAG was informed. The User-Facility Agreement (UFA) has been drafted and circulated. It has not yet been signed until M18, due to administrative difficulties. The group agreed that it was most effective that Manuel Regueiro, who was a visiting PostDoc at EAWAG, was performing the experiments on behalf of the other users group members. Manuel Regueiro, and the user group leader, Jeroen Langeveld (TUDelft), met in person during the SPN10 conference in Graz, Austria in August 2022

- **EAWAG-03-UWO-Dittmer. A probabilistic machine learning-based framework to improve urban drainage modelling reliability**

Karim Sedki of the University of Kaiserslautern has contacted Jörg Rieckermann in June 2022 regarding an update on the timings and to set up initial meetings on the project. It was agreed that the exchange of data was not immediately necessary, as the group of Kaiserslautern was busy on other projects. Jörg Rieckermann, Karim Sedki and Ulrich Dittmer from TU Kaiserslautern met during a visit to Zurich for several hours to discuss the needs and pitfalls of data-driven modelling of UDS, as well as practicalities of data exchange. It was agreed that the EAWAG team should first finish the completion of a comprehensive data publication. Unfortunately, this has been delayed due to Christian Förster leaving the Urban Water Management Department. Jörg Rieckermann and Karim Sedki met at the Aqua Urbanica conference in Glattfelden, Switzerland, on 15/11/2022 and discussed the implications of the delay of the project. As a mitigation measure, it was discussed to not wait for the final SQLdatabase, but exchange a preliminary set of data in csv format.

- **IKT-01-LTF-Verhulst. Investigation of the rehabilitated waste water pressure pipes in response to pressure surges in operation**

The user group was contacted to confirm acceptance of the proposal as soon as IKT was informed. The User-Facility Agreement (UFA) has been drafted and circulated. It has not been signed until M18 as both sides are awaiting the outcome of our final discussions on the technical aspects of the testing rig, before signing. We expect to sign the agreement by the end of 2022. The User Project Plan is included in the UFA. Health and safety regulations and requirements have been included in the draft UFA. Up to 8 online meetings were held with user group to discuss the development and project implementation. A face-to-face meeting was held between Vlario/Aquafin and IKT at the IKT facility on 26th August 2022 for the visitors to view the Large Test Facility.

- **IKT-02-LTF-Beenen. Assessment of Inspection tools for Rising mains (AIR)**

The user group for was contacted to confirm acceptance of the proposal as soon as IKT was informed. The User-Facility Agreement (UFA) has been drafted and circulated. It has not been signed until M18 as both sides are awaiting the outcome of our final discussions on the technical aspects of the testing rig, before signing. We expect to sign the agreement by be end of 2022. The User Project Plan is included in the UFA. Health and safety regulations and requirements have been included in the draft UFA. Up to 5 online meetings were held with user group to discuss the development and project implementation.

- **INSA-01-OTHU-Fuchs**

An existing swale was equipped with soil moisture sensors at different depths and "sprinkled" with different artificial precipitation events. The inflow and the soil moisture were measured during the experiments and the following week. The experiments were carried out at INSA Lyon. The User-Facility-Agreement was signed prior to the visit. An extended abstract related to this TA proposal was submitted to Novatech international conference.

1.5 Resources used to provide access to Research Infrastructures

Table 10 presents the information of the devoted resources in terms of PM reported in the partners financial statements used to provide access to Co-UDlabs facilities.

Table 10. Summary of resources to provide TA during RP1

Provider	Installation(s)	Project(s)	PM	Explanation of tasks
UDC	BLOCK	UDC-02-BLOCK-Zafra	0,14	Preparation of TA users visits meetings (logistics, scientific support, preparation of User Facility Agreement)
	STREET	UDC-03-STREET-Bellos	3	Preparation of TA user visits meetings (logistics, scientific support, signature of User Facility Agreement), construction of model setup for flood test, training (health and safety requirements, lab work), scientific and technical support in the preparation and development of the tests.
USFD	A/B FLUME	USFD-01-ABFLUME-Mignot	4	Design meetings with user team. Experimental design work. Facility preparation and modification. Planning, procurement, and H&S preparation activities. Preparation of user agreement and related documents.
	ANNULAR	USFD-02-ANNULAR-Regueiro & USFD-03-ANNULAR-Morato	1	Design meeting with both end user teams Facility testing and calibration in preparation of visits in first half of 2023. Procurement of consumables for microbial testing and analysis specified in user project plan. Experimental design work.

Provider	Installation(s)	Project(s)	PM	Explanation of tasks
	BURIED	USFD-04-BURIED-Li	3	Design meetings with James Li and colleagues. Engineering design. Preparing engineering documents for test rig to confirm user requirements. Sensor selection and design. Planning, procurement, and H&S preparation activities
	A/B FLUME – ANNULAR & BURIED	USFD-02-ANNULAR-Regueiro & USFD-03-ANNULAR-Morato & USFD-04-BURIED-Li	0,38	Academic time split between all 3 facilities not recorded in our timesheets against individual facilities but just against WP.
EAWAG	HALL	EAWAG-01-HALL-Bares	0,61	Built experimental setup with dark chamber and black cups, collection of 8 WW samples and corresponding dilutions, data acquisition with MX.V camera and data analysis
	HALL	EAWAG-02-HALL-Langeveld	2,10	Construction of lab setup, design, development and testing of sediment thermostat, integration of TP01 sensor (Hukseflux) into the sediment monitor, collection and characterisation of sediments, testing of thermal properties of the sediments under different water contents, data analysis and documentation of the trials,
	UWO	EAWAG-03-UWO-Dittmer	0,01	First discussion with user group on availability and quality of the data
IKT	IKT-LTF	IKT-01-LTF-Verhulst	0,22	Planning test rig and material procurement
	IKT-LTF	IKT-02-LTF-Beenen	0,14	Planning test rig and material procurement
INSA	OTHU-Suds	INSA-01-OTHU-Fuchs	1,38	A construction of an artificial sprinkler system had been done to feed the swale for the tests. Meetings and discussions with the Lyon Metropolis and among technicians and researchers were organised to design new devices and protocols.

Information of costs related with TA provision to users projects as well as individual subcontracting costs in RP1 are provided periodic financial report part of RP1.

2 Update of the plan for exploitation and dissemination of result

In addition to the continuous updating of the communication, dissemination and exploitation project results, the updated version of the PEDR includes a new section (section 1.5.8. Open Datasets created within JRA and TA activities) with the list of open datasets derived from the JRAs and TAs as reflected in the new version of the project DMP (see next section).

An updated version (v2) of the PEDR has been uploaded to Zenodo community in November 2022 (M19): https://zenodo.org/record/7457162. Minor updates were introduced in the PEDR (v2.1) during the last revision of DMP (M20): https://zenodo.org/record/7261592.

3 Update of the data management plan

During the first Co-UDlabs General Assembly a specific session was held to review project DMP and specific DMPs and datasets derived from TA and JRA activities. The main agreements implemented in the revised version of the project DMP were as follows:

- Datasets derived from coordinated NA which include participant lists of the different project activities are considered as confidential datasets and were included in project DMP Annex 1. These participants lists are managed with special attention in line with the Protection of Personal Data and the treatment procedures specified in Deliverable 11.1. Due to the sensitive nature of this

kind of data, these datasets are restricted to the consortium. The database of Co-UDlabs stakeholders is also considered as a dataset produced by the project. This database, managed by GRAIE and EURONOVIA, includes personal data and is therefore restricted to the Consortium.

- Project Deliverables, Grey literature (congress papers) and journal papers will be uploaded to Zenodo by UDC and will be reported in Deliverable 4.2 (Plan for Communication, Dissemination and Exploitation of results).
- Regarding internal procedures for JRA and TA Data Management Plan, the assembly agreed to maintain the structure of tasks and procedures defined in the project's overall DMP with the following remarks:
    - INSA, USFD and UDC, as WP6, WP7 and WP8 leaders, ensured that one specific Data management Plan for each JRA was created before the start of the experiments. DMP were allocated at DMPonline tool. Initial and intermediate versions of the DMP are available upon request. The final version of the DMPs will we made public one month after the end of each JRA.
    - Datasets from JRA and TA will include a Data Storage Report. The template was shared by UDC to partners in M17 and is included as Annex 3 in the project DMP (Deliverable 4.1)
    - A guide for uploading the datasets to Zenodo for internal and external users was drafted by UDC at M17 and is included as Annex 2 in the project DMP (Deliverable 4.1)
    - JRAs and TAs' DMPs and datasets will be reported in D4.2 revisions (Plan for Communication, Dissemination and Exploitation of results).

Two updated versions of the project DMP have been uploaded to Co-UDlabs Zenodo community after M18. The latest version was uploaded in December 2022 (M20): https://doi.org/10.5281/zenodo.7261555.

4 Follow-up of recommendations and comments from previous review(s)

Not applicable for Co-UDlabs during the first reporting period.

5 Deviations from Annex 1 and Annex 2

5.1 Tasks

The implementation workplan for Co-UDlabs during RP1 was especially successful. All Deliverables were submitted timely and all but one Milestones were achieved on time. These achievements notwithstanding, a European project with nine partners, seven Research Infrastructures and the responsibility to set up several global calls for project proposals was inevitably bound to meet specific, minor difficulties in the implementation process. The following is a per-WP list of the main recorded deviations from the schedules, workplans, and expected findings or outcomes of Co-UDlabs Work Packages, including, whenever available, a short description of the measures and initiatives that were carried out to address and solve them.

- **Work Package 1.** WP1 met unforeseen difficulties in developing and adapting the concept of "Research Infrastructure user" around which various deliverables were built. This implied that the expected list of surveyed UD community members and stakeholders provided underwhelming results. WP1 asked for an extension to Deliverable 1.1's schedule (from M15 to M17) in order to collect more input from a wider range of diverse users. The extension was planned with and accepted by the Project Advisor. As a mitigation measure, the individual and collective information that had been collected about the public consultation on the new EU UWWT Directive was also used to support survey results.

  One workshop foreseen as part of Task 1.2 and to be held within the framework of the Novatech international conference could not be organised due to the postponement of the conference because of COVID-related travelling restrictions. The Workshop will be held in July 2023 at Novatech 2023. This solution was regarded as effective considering that more partners will be able to provide results and evidence of progress in M27.

- **Work Package 2.** In Task 2.1, activities related to interoperability of UDS data by definition of common standards, protocols, and methods have been developed as expected. A data management template was developed but could not yet be distributed to the partners as scheduled. A unified metadata structure has not been fully defined for different hydraulic, pollution and asset deterioration variables, as proposed in the DoA. EAWAG met with these difficulties in particular due to unforeseen changes in team composition (key personnel left the institution during RP1). The key response to this deviation has been initiating the recruitment process for additional personnel. Deviation from expected schedule also derived from planned deliverables and goals being particularly ambitious in content. The recommended measure to address this deviation is to first consider data formats from the most available and/or promising data on water levels, flow measurements, and rainfall. Also considering the required time and resources to adequately train new recruitments, EAWAG recommends moving the Deliverable 2.1 deadline from M24 to M30.

  In Task 2.2 some of the mobility actions developed had a duration of less than 1 week, as originally indicated in the GA. An updated plan with the mobility of Co-UDlabs personnel will be submitted in M24 with Deliverable 2.3.

- **Work Package 4.** WP4 planned a Knowledge Portfolio to be prepared during the project's first year and to be updated yearly via a questionnaire. However, RP1 proved to be too early for partners to clearly identify knowledge outputs from the project and the portfolio will be created during RP2.

- **Work Package 6.** In Task 6.2 the main change with DoA is that free access pieces of individual source codes have been replaced by a single free access webapp (the Urban Drainage Metrology Toolbox) to facilitate the use of the methods and protocols by a diversity of potential users. In addition, and to be consistent with the above unification of source codes into a webapp, individual video tutorials have been replaced by a unified user manual, that will be enriched with more data and information until M24.

- **Work Package 7**. For Task 7.1 there will be less focus on the size of the CCTV database and more focussed on the quality and quality of the ML based software to ensure its usability for end users. We are aware of another open access CCTV database, but it is restricted to academic users only

and cannot be used by water utility end users. This WP has experienced delays. The recruitment of a researcher with strong ML expertise took longer than expected, however more recent progress has enabled some of the delays to have been caught up. An excellent researcher Dr Ehsan Kazemi was recruited, who is working on the project tasks associated with Task 7.1. Dr Kazemi will be able to support the project until M48. His strong ML and computational skills has allowed rapid progress to have been made, in Task 7.1 and to start some preparatory work for 7.3.

MS16 was not achieved in time (M18). The new date for the deliverable will be M26. An interim progress report is available upon request.

- **Work Package 8** experienced slight delays in the expected schedule of workplan and deliverables due to internal complications in the recruitment process at UDC and USFD. This has affected mainly Task 8.1.2, which has not begun according to the expected calendar because USFD has not been able yet to fill a PhD position to carry out its activities and UDC has not been able to hire supporting technician for project activities at least till M21 of the project. This would imply shifting Deliverables D8.1 and D8.2 from M24 to at least M30 to grant sufficient time for delivery and the collection of meaningful results.
- **Work Package 10.** There were no significant deviations from the expected workplan of WP10. All Deliverables were submitted when due, and the WP has so far achieved all the planned Milestones but one (MS16): this deviation is explained in detail in the WP7 report. A change was necessary in the organisation of the International Advisory Board's (IAB) activities within Co-UDlabs. To overcome severe travel restrictions because of COVID-19 pandemic regulations and minimise the logistical effort of bringing together IAB members from diverse locations around the world (one of the two members are not based in Europe, one is based in Australia, the other in Canada), the IAB chose to meet remotely. This choice represents a slight deviation from the wording of provision 3.2.1.e of the Grant Agreement:

  > *The IAB will meet annually to review the management, impact and outputs of Co-UDlabs.* ***Meetings will be held at the same location [as] GA meetings****.*

  It was logistically difficult for the IAB to be convened at UDC as part of the General Assembly of June 2022. The IAB, in agreement with the Co-UDlabs Steering Committee, chose instead to meet remotely in September 2022. This option was regarded as the most logistically effective, with considerable advantages in terms of involving members connecting from different time zones, as well as more environmentally sound, avoiding at least two long-haul plane travels for a ninety-minute activity in the programme of a two-day event.

5.2 Use of resources

5.2.1 Deviations in partners' structure and composition

On August 31, 2022, during RP1, François Clemens Meyer, principal investigator of the Co-UDlabs team at Deltares, left his position within the institution. Starting on September 1, 2022, Antonio Moreno Ródenas has become Deltares' new team coordinator and principal investigator. Deltares and Prof. Clemens Meyer have reached an agreement that allows Prof. Clemens Meyer to collaborate with Co-UDlabs by providing specific research services after M18. His appointment in this consultancy and collaboration role was required considering the non-transferable and unique expertise that Prof. Clemens Meyer provides to the project.

This change in structure has also affected the delivery of specific tasks and may have minimally impacted the implementation process of Deltares' tasks. However, since Dr. Moreno Ródenas has lower seniority than Prof. Clemens Meyer within the institution, the average cost of Deltares PMs has decreased since the change in the team's composition: accordingly, a larger amount of PMs for the stretched-out workplan could be spent on Deltares tasks with no additional expenditure on the overall partner budget.

5.2.2 Deviations in Work Package expected use of resources

All partners shared information on deviations from the expected allocation of PMs and workforce in specific tasks of their workplans. Ultimately, current figures in PM and budget remain within the limits of reasonable resource allocation and in line with the requirements of the Grant Agreement and Co-UDlabs' DoA (Figure 24).

However, there are a few Work Packages whose personnel resource allocation is above expected figures if PMs were distributed linearly and proportionally across each Work Package's duration. The core explanation for these deviations is that the workplan and schedule for these Work Package does not develop linearly throughout the lifetime of the project. They do have priority goals and deliverables that were concentrated in the earlier stages of the project. These deviations will be compensated by the fact that these Work Packages will not carry out as labour- and resource-intensive activities in the remaining reporting periods.

More specifically, **Work Package 5 (Transnational Access)** has recorded an approximate 33% increase in PM allocation if compared to a proportional distribution across its 48-month duration. However, WP5's main objective is the successful and consistent organisation and performance of Co-UDlabs' two global calls for Transnational Access proposals and applications. The first call was opened in October 2021 and finalised in January 2022 — fully within Reporting Period 1. The second call will be open from July 2023 until October 2023. That WP5 has used in RP1 exactly 50% of the overall PMs allocated to the WP is consistent with the fact that only another global call is planned to be carried out in the remaining lifetime of the project.

Work Package 6 (Smart Sensing and Monitoring in UD) has recorded an increase of approximately 37% of expected resources according to a linear planning. This deviation can be explained primarily because specific activities of WP6 and Task 6.1 in particular had to be developed at the earliest stages of implementation — their outcomes are in fact essential to develop additional work in other WP6 tasks as well as in other WPs. The workplan of WP6, accordingly, is not proportionally distributed throughout the 41-month duration of the WP, and deviations in RP1 are likely to be compensated by less-intensive resource allocation for the remainder of the project. More details about deviations in PM allocation in WP6 can be found below in the use-of-resource description for EAWAG and INSA.

Finally, **Work Package 10 (Project Management and Co-Ordination)** has recorded an increase of about 55% of allocated PMs if compared to linearly expected resources for RP1. WP10 has experienced a significant shortcoming of the resources originally allocated to management tasks because of the increasing complexity of guaranteeing consortium-wide collaboration, workplan consistency, support to all planned deliverables and milestones, as well as supporting the effective setting-up of the Transnational Access framework. More details are provided below in the use-of-resource explanations provided by UDC as WP10 leader. Mitigation measures, already successfully discussed with the Project

Advisor, will include an increased allocation of expected PMs to the Work Package, as well as improved consistency between WP10, WP4, WP5, and WP9 tasks and activities.

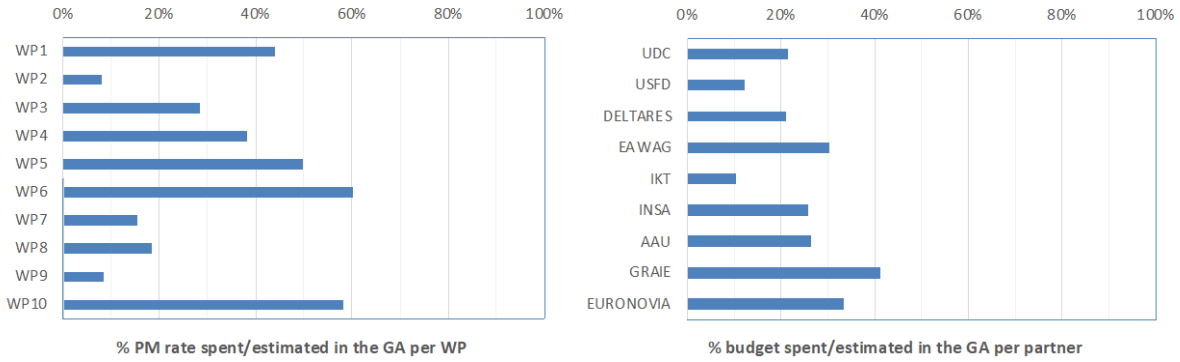


Figure 24. Percentage of PM rate spent in RP1 over the estimated PM in the GA per project WP (left) and percentage of budget spent in RP1 over the estimated budget per partner (right)

Following review by the European Commission's officers and the comments received from an external independent reviewer, the following deviations in the expected use of resources per partner are recorded and explained:

- **UDC.** In **Work Package 5 (Transnational Access)**, **UDC** has recorded an increase of approximately 47.3% of allocated PMs (8.23 PMs) if compared to a linearly expected effort over the project's first 18 months (5.58 PMs). This mismatch was necessary considering that: a) **UDC** is the leader of the WP and is therefore in charge of the overall consistent arrangement of the TA programme as a whole; and b) the core outcome of WP5 is the organisation of all administrative, logistical, and technical arrangements for the actual realisation of Co-UDlabs' Transnational Access programme. Since: a) Co-UDlabs' Description of Action includes two global TA calls to be organised throughout the entire lifetime of the project; and b) **UDC** has already awarded 3 accesses out of 6 available slots at their installations, it is reasonable that **UDC** — in their position as coordinators and as facility providers of three RI installations — has spent 55.6% of its total WP5 PMs in the initial 18 months of the project's lifetime. This is proportionally consistent with the remaining efforts in WP5 for the organisation of the second global call (expected to be open from July until October 2023). In **Work Package 10 (Project Management and Co-Ordination)**, **UDC** has allocated an effort of 10.82 PMs in the first 18 months of the project's lifetime, an increase of approximately 60% over a linearly expected effort of 6.75 PMs. This mismatch was mostly due to the significant amount of work required by the establishment of a working, common framework for the implementation of the Transnational Access programme, alongside the day-to-day follow-up on project activities, the integration of multi-beneficiary Joint Research Activities, and support to the project's communication tasks. The workload for WP10 in RP1 has highlighted a shortcoming in terms of resources originally allocated to the Work Package and to **UDC** as its leader. This is identified and singled out as a mild materialisation of Risk 13 in the Grant Agreement ("Failures in the project management"). In order to mitigate these effects, the Steering Committee has already received positive feedback from the Project Officer as regards an increase in PMs allocated to **UDC** for WP10, especially in order to upgrade the project management position (established at **UDC** as part of the Management and Support Team) from a part-time to a full-time position.

- **Deltares.** In **Work Package 3 (Training Activities)**, **Deltares** has recorded an increase of about 3 PMs compared to what was linearly expected according to budgeted resources (1.31 PMs over the first 18 months). This mismatch is primarily due to the fact that a significant amount of the WP3 tasks with which **Deltares** is charged were developed in the first reporting period, i.e., the workplan of WP3 is not developed linearly over the duration of the project, but rather has several peaks in the WP workflow that concentrated in the first part of the project's lifetime. Moreover, throughout RP1, **Deltares** was also tasked with unbudgeted activities included in the DoA that have required an additional use of personnel resources. These tasks, that affected both **WP3** and **WP8 (Improving Resilience and Sustainability in UD Solutions)**, are detailed below in this section. Additionally, on August 31, 2022 (M16, within the first reporting period), François Clemens Meyer, principal investigator of the **Deltares** team within Co-UDlabs, left his position within the institution. Accordingly, since September 1, 2022, Antonio Moreno-Rodenas has become **Deltares**' new team coordinator and principal investigator. **Deltares** and Prof. Clemens Meyer have reached an agreement that allows Prof. Clemens Meyer to collaborate with Co-UDlabs by providing specific research services after M18. His appointment in this consultancy and collaboration role was required considering the non-transferable and unique expertise that Prof. Clemens Meyer provides to the project. This change in structure and the resulting unforeseen alteration of the team's calendar and workplan schedules implied that additional work time was required to fulfil the expected outcomes of the tasks in which **Deltares** was involved. However, as the team re-settled following this change, this is not expected to impact the implementation of planned tasks. Additionally, since Dr. Moreno-Rodenas has lower seniority than Prof. Clemens Meyer within the institution, the average cost of **Deltares**' PMs has decreased since the change in the team's composition: accordingly, a larger number of PMs for the stretched-out workplan could be spent on **Deltares** tasks with no additional expenditure on the overall partner budget. Consistent with the opinion of Co-UDlabs' Project Advisor, the Steering Committee saw no need to require an amendment to implement the abovementioned changes.
- **EAWAG.** In **Work Package 6 (Smart Sensing and Monitoring in UD)**, over the first 18 months of project implementation EAWAG recorded an effort of 15.07 PMs, even though it was linearly expected of the institution to allocate an effort of 8.78 PMs, approximately 70% more than scheduled in the Grant Agreement. Research conducted for tasks of WP6 at this initial stage of the Co-UDlabs project was ultimately more complex than originally expected when planning the WP overall calendar. The selection of adequate tools for specific research on hyperspectral high-end devices, in particular, proved more labour-intensive than initially planned. On the other hand, positive output and feedback on specific parts of WP6 research tasks led to previously unplanned conference participation, peer-review submissions, and networking channels with peer research institutions. While this has been fruitful for research on specific sensors, more work in WP6 will be required to meet the expected output of Task 6.1.1 (a shortlist of maximum 6 sensors being tested for use in the other WP tasks). **EAWAG** will attempt to: a) re-coordinate effort across all tasks of WP6 so that all objectives can be successfully met by the end of the Work Package's schedule (M41); b) take advantage of positive spill-overs of initial research results to make a more efficient connection between WP6 and WP2 tasks, thus improving the effectiveness of resource use in WP6 while also feeding a virtuous circle between networking results in Co-UDlabs Networking Activities and

academic/scientific output in the Joint Research Activities; c) build on additional results obtained by fellow WP6 partners in Tasks 6.1, 6.2, and 6.3 to make coordination work more efficient in terms of devoted PM effort.

- **INSA.** In Reporting Period 1, **INSA** recorded an increase in PMs allocated to **Work Package 6 (Smart Sensing and Monitoring in UD)**, with an actual dedication of 19.08 PMs instead of the expected linear allocation of 7.68 PMs for the first 18 months of the project. The primary explanation in this case too is that WP6's workplan is not linear, i.e., the workload is not evenly distributed across the 41 months that are foreseen in the DoA for its implementation. In particular, Task 6.1 on the 'Evaluation of sensor and new data sources for hydraulics, pollutant load monitoring and asset inspection' is notably valuable for the actual development and implementation of other WP6 tasks, as well as activities in other WPs such as WP2, WP3, and WP4 (especially as regards dissemination and communication on the outcomes of Task 6.1 analysis and output). It was therefore inevitable that **INSA** gave these tasks specific priority in the earlier stages of project implementation, thus explaining why a larger personnel dedication was necessary, compared to what would be a proportional distribution of resources across WP6' planned duration. Allocating more resources to the earlier stages of the workplan was also essential for **INSA** researchers to be able to have a working prototype ready for public testing at the SPN10 international conference in Graz, in August 2022 (M16). Additionally, the work of Task 6.1 in particular was originally planned to be implemented with MathLab code. Preliminary developments showed immediately that a webapp to be made publicly available as part of the WP's output would have been significantly more valuable in terms of outreach and accessibility. This switch, however, implied an increase in **INSA**'s required PMs to develop the product within the new framework. This increase, however, will be compensated by the fact that a much lower amount of personnel resources will be required of **INSA** to complete the tasks foreseen in WP6's workplan and achieve the its expected results.
- **GRAIE.** In Reporting Period 1, GRAIE has recorded an increase in allocated PMs compared to the expected amount if workforce resources were proportionally distributed across the WP's 48-month duration — 8.14 PMs instead of a linearly expected 7.68 PMs (approximately 30% above the proportional amounts). In the development of Work Package 1 (Integration and Sustainability Strategy), GRAIE has dedicated a significant amount of resources to WP1 (about 66.7% of total PMs expected across the whole duration of the project) because the key deliverables of WP1 were essential to the development of the WP's remaining tasks as well as for tasks in other WPs, such as WP2 and WP5. More specifically, Task 1.1 on 'Mapping of RI users and community needs to transition to more sustainable and smart urban drainage systems' was key to identify a core of stakeholders who could effectively be engaged since the earliest stages of the project in the development of Co-UDlabs' training and dissemination activities. Importantly, the outcomes of the mapping process were also crucial to identify potential participants in the Transnational Access programme, with clear impact on how communication and advertisement strategy at project level had to be designed and carried out. This work had inevitably to be carried out at the earliest possible stage of project implementation, which justifies why a higher degree of personnel resources were allocated to this phase of GRAIE's workplan. This mismatch will be easily compensated considering that the remaining tasks for GRAIE's time plan will be significantly less resource-intensive.

- **IKT** has recorded an approximate 30% increase in the overall average monthly cost of personnel. This is due to the fact that IKT staff involved in Co-UDlabs activities during Reporting Period 1 was almost exclusively scientific staff. Compared to technical additions to Co-UDlabs staff, scientific personnel have – on average – a higher monthly cost. The partner's overall average personnel costs will probably be notably lower during the rest of the project's lifetime, considering that technical staff will be added to IKT's roster, in particular for the successful performance of the institution's accepted Transnational Access proposals and a set of initiatives within the framework of Co-UDlabs' Joint Research Activities — all of which will be carried out starting from 2023.

Considering all of the above and the fact that most mismatches and deviations can be reasonably explained when taking into consideration that the workplans of most Work Packages and partners cannot be expected to develop linearly or proportionally across the project's 48-month duration, the Steering Committee saw no requirement for a consortium-wide amendment of the Grant Agreement. What is more, meaningful portions of these deviations from the expected resource allocation are also attributable to the fact that partners had on occasions to take on project activities that — while foreseen or included in the project's DoA — were originally not budgeted in the Grant Agreement, since their realisation depended on specific circumstances and/or the specific agreement of involved partners. The following is a summary of such activities per affected Work Package:

- **WP2.** Since its inception, Co-UDlabs had targeted Water Europe as a key interlocutor and partner to strengthen dialogue with networks of stakeholders, utilities, and industry representatives. Water Europe (formerly Water Supply and Sanitation Technology Platform) is a major EU centre for strategy and research development in the area of water management, water supply, wastewater treatment, and drainage. Its diverse membership could be essential for Co-UDlabs' networking activities and to significantly enhance the outreach, visibility, and effectiveness of the project's initiatives. To fully engage with Water Europe and its membership, USFD has filed an application to become a member of the organisation. The related fee costs (a total amount of GBP 2,571.00 or EUR 3,019.70 paid via an invoice dated July 21, 2021) were an expense that USFD had anticipated within the project but was incurred earlier than expected (in RP1). It was therefore listed as unforeseen in the institution's RP1 Financial Statement. It does not require, any alteration of the original USFD budget for this kind of activity.
- **WP3.** Additional resources required for the organisation of the Co-UDlabs Introductory Webinar (October 2021) and the Co-UDlabs Hackathon — a two-day TA proposal contest for the promotion of the Co-UDlabs TA call and matchmaking activities among potential user-groups. While both activities were foreseen in the Grant Agreement, no budget or PMs were originally allocated to them. Deltares was selected to host and provide support for these activities because they were organised with the larger framework of the Deltares Software Days, an international online event which gathers thousands of researchers and practitioners over two months of activities. Both initiatives represented a combined effort of approximately 0.8 unplanned PMs in Deltares' WP3 tasks. Deltares incurred in additional direct costs not foreseen in the original budget for the organisation of hands-on sessions at the 25th European Junior Scientist Workshop (EJSW), an international early-stage researchers event coordinated by INSA. Costs incurred amount to EUR 602.

- **WP4.** Deltares took part in the SPN10 conference (Graz, August 2022), incurring in a series of travel-related direct costs that were not originally foreseen in the Grant Agreement. This addition to expected budget is easily explained by the added value that Deltares' current work and expertise provided to the Co-UDlabs workshop on the uncertainty quantification tool presented by INSA. Since partners such as UDC, USFD, and INSA also took part in the workshop, SPN10 was also an additional venue for internal strategic planning on JRAs.
- **WP5.** The consortium agreed to reward the best proposal submitted at the Co-UDlabs Hackathon with a prize. The applying team was awarded a visit to the RI facility of their choice, in order to encourage the visiting team to submit a full proposal for the TA call. Since no budget was originally allocated to the Hackathon, the prize was funded by UDC with resources originally allocated to the mobility of the International Advisory Board (IAB). Costs incurred amount to EUR 1898.09. As explained in Section 5.1, the IAB was always convened remotely due to pandemic restrictions on travel and to minimise the environmental impact of the body, so budgeted resources for its work were available. This change was agreed on with the Project Advisor.
- **WP8.** Deltares and UDC undertook a joint-research activity which was anticipated but not formally budgeted within WP8 (testing of new monitoring solutions to quantify the accumulation of Sediments in gully pots). This task required 0.95 PMs and EUR 2,569 in materials within RP1. Over the whole project lifetime and for the realisation of the task, this JRA is expected to require approximately EUR 5,500 (Goods and Services) and about 1.2 PMs in workforce.
- **WP9.** While no direct deviations were recorded, UDC incurred in a subcontracting expenditure for the preparation of the STREET facility (EUR 10,645) ahead of the TA visits which was higher than the subcontracting budget originally foreseen for this facility in particular (EUR 7,000). Since figures for the preparation of the other facilities will probably be lower than budgeted, these costs should be balanced at the end of the TA programme. Additionally, UDC intends to transfer a certain amount of money from subcontracting costs to internal invoicing in order to be able to perform analytics through its central services for access to the BLOCK facility. Once the budget is closed when the UFA of the project is signed, the Project Advisor will be informed.

5.3 Unforeseen subcontracting

Not applicable for Co-UDlabs during the first reporting period.

5.4 Unforeseen use of in-kind contribution from third party against payment or free of charges

Not applicable for Co-UDlabs during the first reporting period.

Annex 1. Key Performance Indicators

Dissemination or communication channel	Tool	Purpose and expected impact	When (and where, if relevant)	Target audiences: Academics and researchers	Industry / Practitioners	Government / Policy-makers	EU and international networks	National technology networks	EU projects	General public/advocacy groups	KPI	Target	Actual (October 2022)	Partner(s) in charge
Events to be organised by the project partners	2 Early-stage researchers seminars	Enhance interaction between academics, sharing ideas and the promotion of common experimental protocols	June 27-28,2022 and 2024	X							Number of participants	20	33	UDC, USFD
	25th European Junior Scientists Workshop (EJSW) on UD monitoring	Junior scientists to present and discuss their work with senior researchers	May 15-21, 2022	X							Number of participants	22	20	INSA
	PhD course on Sewer Processes	Give students insight and knowledge on the most recent advances of sewer process modeling and applications to real-world use.	2023	X							Number of participants	40	-	AAU
	Industrial workshop on flow rate determination of pumping stations and hydraulic structures (1 day)	Train Industry professionals and practitioners on UDS	November 17, 2022		X			X			Number of participants	20	-	DEL
	Uncertainty assessment in UD monitoring data (2 days)	Train Industry professionals and practitioners on UDS	2023		X			X			Number of participants	minimum 12	-	INSA
	Applied course on UD metrology (4 days)	Train Industry professionals and practitioners on UDS	2024		X			X			Number of participants	12	-	UDC
	2 IKT-association practice workshops (2 days)	Exchange of knowledge and experience between industry and public sewer network operators	November 3-4, 2021 and 2024	X	X			X			Number of participants	20	59	IKT
	Webinars and online lectures	Provide a better understanding of specific and emerging monitoring techniques in Urban Drainage	2022 to 2025 1) September 21, 2022	X	X		X	X	X		Number of webinars	6	1	IKT and all research institutions of the consortium
											Number of attendees	30	1st webinar: 18	
	Side event at the Sewer Processes and Networks (SPN) conference	Creation of a group of "early adopters" users	August 23, 2022 (Graz, Austria)		X		X	X			Number of participants	30	18	GRAIE
	Side event at the NOVATECH conference	Reinforcement of the group of "early adopters" users	July 2023 (Lyon, France)		X		X	X			Number of participants	30	-	GRAIE
	2 webinars and 2 hackathons	Launch the access campaigns and present the project. Promote the RI services and access to RIs programme.	Before the calls the access to the research infrastructures	X	X		X	X			Number of attendees	60	1st webinar: 100 1st hackathon: 61	UDC
	2 dissemination workshops on smart governance		Side events of IWA specialized working groups conferences or meetings 1) September 13, 2022		X	X	X	X	X		Number of participants	30	1st workshop: 40	EAWAG
	3 Workshops related with results of JRAs	Raise awareness of the scientific outcomes of the project	Side events of IWA specialized working groups conferences or meetings	X	X		X	X	X		Number of participants	40		INSA, USFD, UDC
	Final Info Day	Introduce the impact and further exploitation of the project results to a wider public	At the end of the project	X	X	X	X	X	X	X	Number of attendees	50	-	Euronovia, UDC
Participation in external events and conferences	Scientific conferences	Promote the scientific and technical results, raise awareness in the scientific and practitioners community, interact with other related technologies	2022, 2023, 2024, 2025	X	X	X	X	X			Number of conferences	15	7	All research partners
	National technical events	Disseminate Co-UDlabs products and services in the non-scientific UD community	2022, 2023, 2024, 2025		X			X			Number of events	10	7	All partners
	Fairs in innovation and technology related events	Disseminate project outputs and engage users, collect feedback	2022, 2023, 2024, 2025		X		X	X	X		Number of exhibitions	3	1	All partners

	Open-science events	Raise awareness of the project among the general public	2022, 2023, 2024, 2025						X	X	Number of events	10	1	All partners
Communication/dissemination material and activities	Project branding (logo, visual identity, communication templates, project leaflet, etc.)	Communicate about the project in a uniform, consistent, and professional manner	At the beginning of the project	X	X	X	X	X	X	X	1	1	1	Euronovia
	Communication package (ppt presentation, poster, project banner (kakemono) and a one-page project description)	Achieve a broader audience with water operators, utilities and other stake-holders	M6	X	X	X	X	X	X	X	1	1	1	Euronovia
	Flyer	Inform about the project and the TA	M6	X	X	X	X	X	X	X	Number of flyers distributed	2000	-	Euronovia
	Brochure	Inform about the project and its outputs	TBC	X	X	X	X	X	X	X	Number of brochures distributed	2000	-	Euronovia
	Newsletter	Inform about project updates and activities	Every 6 months, starting M6	X	X	X	X	X	X	X	Number of issues	8	2	Euronovia
											Number of subscribers	100/newsletter	132	Euronovia
	Press release	Inform about the project Promote the project	At the start and at the end of the project	X	X	X	X	X	X	X	Number of press releases	2	1	Euronovia
	Articles in specialized magazines	Inform about the project Promote the project	Whole project duration	X	X		X	X			Number of articles	2	0	All partners
	Timeline infography	Inform about the project main outcomes	At the end of the project	X	X	X	X	X	X	X	Number of infography	1	-	Euronovia
	1 Motion design video	Inform about the project	September 2022	X	X	X	X	X	X	X	Number of views on Youtube	500	-	Euronovia
	Website	Inform about the project Promote the project	Whole project duration	X	X	X	X	X	X	X	Number of visits	100/month	80/month	Euronovia
											Number of news	1 news/month = 48	37	
	LinkedIn page	To make science more accessible to a wider public, to engage the audience	Whole project duration	X	X	X	X	X	X	X	Number of members	200	228	All partners (leader: Euronovia)
											Number of posts	1/month = 48	37	
	Twitter account	To make science more accessible to a wider public, to engage the audience	Whole project duration	X	X	X	X	X	X	X	Number of followers	200	164	All partners (leader: Euronovia)
											Number of tweets	1/week= 208	142	
	Youtube channel with videos and interviews	To make science more accessible and inform the public	from M12	X	X	X	X	X	X	X	Number of videos	15	3	IKT and all research institutions of the consortium
											Number of views /videos	500/video	13/video	
	Media press kit	Inform about the project Massive communication about the outcomes and impacts of the project	M24 and M48	X	X	X	X	X	X	X	Number of press kit	2	-	Euronovia
	Public relations and media coverage	Inform about the project and its activities	Whole project duration			X	X	X	X	X	Number of external articles in the media	15	15	All partners
Publications	Scientific publications (peer-reviewed research papers) and related datasets	Promote the scientific and technical results of the project, transfer of knowledge, share the results in open databases	From 2022	X	X						Number of publications	15	0	All research partners
											Number of datasets	20	1	
											Average nber of views / downloads on Zenodo per dataset/publication	3000	17 10	
	Technical articles (international and national journals)		From 2022		X		X	X			Number of publications	8	0	All research partners
	Conference proceedings		From 2022	X	X		X	X			Number of publications	15	8	All research partners