DESSIN

DEMONSTRATE ECOSYSTEM SERVICES ENABLING INNOVATION IN THE WATER SECTOR

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MS34a Third periodic report

Scientific progress and project management
M37 – M48

Lead : IWW, David Schwesig, March 2018

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 619039

TITLE OF THE REPORT

MS34 Third periodic report
Scientific progress and project management M37 – M48

SUMMARY

DESSIN demonstrated and promoted innovative solutions for water scarcity and water quality, and thus the implementation of the Water Framework directive (WFD). The project showed the value of those solutions for the water sector and society by demonstrating a methodology for the valuation of ecosystem services (ESS) as catalyser for innovation. By this twofold approach, DESSIN was able to show how innovative solutions in the water cycle can increase the value of the services provided by freshwater ecosystems, enabling a more informed selection of the most promising solutions in regards to their impact on the water body and their economic implications. Scientists, public and private water management organisations and end-users, technology providers (SMEs), supporting RTD experts and relevant public authorities were collaborating within DESSIN to test, validate and demonstrate innovative solutions at five demo sites across Europe with special focus on urban areas. The solutions included technological, monitoring, modeling and management approaches for a more resource-efficient and competitive water sector in Europe, such as decentralized water treatment units, real time control of large scale systems, sewer mining and storage of freshwater in aquifers, among others. The demo sites Emscher (Germany) and Hoffselva (Norway) focussed on ecosystem services related to water quality/Water Framework Directive and the demo sites Westland (Netherlands), Athens (Greece) and Llobregat (Spain) to water scarcity. During the third reporting period , DESSIN has

- Transformed the ESS evaluation framework (Work Area 1) into a software tool (Work Area 2, WP 23),
- Completed all RTD work (Work Area 2) as a precondition and support for the demonstration case studies
- Completed the actual technical demonstration at the case studies (Work Area 3)
- Applied the ESS evaluation framework at the five demonstration sites to qualitatively and quantitatively assess the benefits and co-benefits provided by the demonstrated solutions (Work Area 3)
- Continued dissemination of results and support of SMEs for proper exploitation and market uptake of DESSIN solutions (Work Area 4).
- Managed organisational and contractual matters related to the implementation of the project (Work Area 5)

MILESTONE NUMBER	WORK PACKAGE
MS34	WP51, WP52
LEAD BENEFICIARY	**DELIVERABLE AUTHOR(S)**
IWW	David Schwesig, with comprehensive contributions by all WA and WP leaders

QUALITY ASSURANCE

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List of Acronyms and Abbreviations

AMI	Advanced Monitoring Infrastructure
ASR	Aquifer Storage and Recovery
ASRRO	Aquifer Storage and Recovery – Reverse Osmosis
BE	Belgium
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CICES	Common International Classification of Ecosystem Services
CLS	Cross-flow lamella settler
COD	Chemical Oxygen Demand
CSO	Combined Sewer Overflow
DE	Germany
DoW	Description of Work, i.e. Annex I to the Grant Agreement (GA)
DPSIR	Drivers, Pressures, State, Impact, Response
DSS	Decision Support System
Dx.y	Deliverable number y of work package number x (x,y: variables)
EC	European Commission
EEA	European Environment Agency
ES	Spain
ESS	Ecosystem Services
GA	Grant Agreement (No 619039 for DESSIN)
GHG	Greenhouse Gas
GR	Greece
HGGI	Hybrid Grey-Green Infrastructure
HRF	High Rate Filtration
ICT	Information and Communication Technology
IUPAC	International Union of Pure and Applied Chemistry
MAR	Managed Aquifer Recharge
M+E	Monitoring and Evaluation
MBR	Membrane Bioreactor
MSx	Milestone X (X: variable)
Mx	Project Month X (X: variable)
NBS	Nature-Based Solutions
NL	Netherlands

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NO	Norway
PAC	Project Advisory Committee
PES	Payment for Environmental Services
PLC	Programmable Logic Controller
PM	Person Month(s)
PSB	Project Steering Board
PT	Portugal
PTRO	Partial Transfer of Rights and Obligations
RO	Reverse Osmosis
RTC	Real Time Control
RTD	Research and Technical Development
SE	Sweden
SI	Système International d'Unités, i.e. International System of Units
SME	Small and Medium-sized Enterprises
SS	Suspended Solids
Telco	Telephone Conference
TIC	Total Inorganic Carbon
TMP	Transmembrane Pressure
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorous
TSS	Total Suspended Solids
TSS fine	Fraction of TSS < 63 µm
Tx.y	Task number y of work package number x (x,y: variables)
US-EPA	United States Environmental Protection Agency
UV	Ultra-Violet (Radiation)
WA	Work Area
WAMT	Work Area Management Team
WFD	Water Framework Directive
WP	Work Package
WssTP	Water Supply and Sanitation Technology Platform
WWTP	Waste Water Treatment Plant

Nomenclature of chemical substances according to IUPAC, metrological SI units and acronyms of DESSIN beneficiaries are used throughout the document without further definition.

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Executive summary

Project context and main objectives

What is the context and background of DESSIN?

Water scarcity and water quality are important issues in urban areas across Europe and beyond. New technology or management approaches to tackle these issues are needed. Those approaches are more likely to turn into real innovations that are actually implemented and taken up by the market if there is evidence of their benefits or added value in economic, environmental and societal terms. Therefore, a method to prove the value of new solutions is needed in addition to new technology and management approaches.

What are the main objectives of DESSIN?

DESSIN aimed to demonstrate and promote innovative solutions for water scarcity and water quality / the implementation of the Water Framework directive (WFD), and to show the value of those solutions for the water sector and society by also developing and demonstrating a methodology for the valuation of ecosystem services (ESS) as catalyser for innovation. By this twofold approach, DESSIN was able to demonstrate how innovative solutions in the water cycle can increase the value of the services provided by freshwater ecosystems, enabling a more informed selection of the most promising solutions in regards to their impact on the water body and their economic implications.

How do we do it?

Scientists, public and private water management organisations and end-users, technology providers (SMEs), supporting RTD experts and relevant public authorities within DESSIN tested, validated and demonstrated innovative solutions at five demo sites across Europe with special focus on urban areas. The solutions included technological, monitoring, modeling and management approaches for a more resource-efficient and competitive water sector in Europe, such as decentralized water treatment units, real time control of large scale systems, sewer mining and storage of freshwater in aquifers, among others. The demo sites Emscher (Germany) and Hoffselva (Norway) contributed to ecosystem services related to water quality/Water Framework Directive and the demo sites Westland (Netherlands), Athens (Greece) and Llobregat (Spain) to water scarcity.

Additionally, DESSIN developed and applied an Evaluation Framework to assess the sustainability aspects of the mentioned solutions and to valuate changes in ecosystem services (ESS) of water bodies that result from the implementation of these solutions. The ecosystem services approach is a method that enables a standardised evaluation of impacts and benefits from technology and governance innovations in multiple sectors. One of its main advantages lies in its capacity to integrate the economic, environmental and societal dimensions. That means, the ESS methodology enables a monetary valuation of the impact of water management measures based on the new solutions, which makes a direct comparison of measures possible and generates arguments for market uptake and practical implementation.

Work performed and main results achieved

DESSIN has developed an Ecosystem Services Evaluation Framework. The framework consists of the DESSIN Cookbook, the Companion Document, a Supplementary Material File and a Case Reporting Template. A preliminary version of this framework was tested and validated at three mature case studies. After this feedback loop and fine-tuning, we have applied the framework at five DESSIN demonstration sites across Europe, and transformed it into a software product to enable ESS and sustainability assessment of different scenarios, supporting better decision making. DESSIN has also delivered two guidance documents to businesses and water innovators on one hand, and to practitioners and policy makers on the other, about governance regimes and financing options conducive to innovation in the water sector.

Technical solutions to tackle water quality and scarcity challenges have been developed, tested and improved, in order to prepare and support the demonstration of these solutions in the demonstration sites. These were A) solutions for local treatment and regulation of Combined Sewer Overflow: a new system with modular cross-flow lamella settling units for application in CSO holding tanks, a high-rate filtration (HRF) system for CSO, and a Real Time Control (RTC) system for reducing overflow volumes. Significant results are: 1) extension of the online monitoring system of the lamella settler plant with online turbidity sensors and automatic samplers with remote control actuator; 2) a removal efficiency of about 50% on average and up to 70% by HRF during the first CSO flush; 3) successful implementation and testing of the RTC system to reduce CSO volume in real time; B) Solutions for tackling water scarcity challenges aimed on distributed reuse technologies with focus on sewer mining technologies and Aquifer Storage and Recovery systems (ASR, in one case combined with Reverse Osmosis RO) as potential sources for drinking water, agricultural or industrial water. Results achieved are: 1) the completion of a system architecture with sewer mining software and hardware components and of the communication solutions for collecting, processing and visualizing data; 2) the identification of formation of fine particles in the aquifer's pores as main threats during the RO treatment; 3) a numerical model to simulate the impact of ASR on groundwater quality and quantity including the interaction between surface and groundwater for the Llobregat demonstration case.

These solutions were demonstrated at five sites across Europe (Emscher, DE; Hoffselva, NO; Westland, NL; Athens, GR; and Llobregat, ES). Their benefits and co-benefits were quantified and assessed by using the DESSIN ESS Evaluation Framework. All demo sites have been tranformed into showcases e.g. by production of videos, on-site showboards or a walkable route across the demo site with tangible components and information boards. A wide portfolio of additional dissemination tools, strategies and materials has been developed and produced. To support the DESSIN SMEs on their route to market, DESSIN has developed e.g. a market analysis, two business environment reports, and a cooperation document for route to market support established with the individual SMEs. A series of events has been carried out such as individual workshops with the SMEs to further detail the commercialization of the DESSIN products and to support the SMEs in using the ESS Evaluation concept to identify benefits and co-benefits of their technologies (to use them as additional selling proposition). The final event of DESSIN was organised as a public joint workshop together with the two working groups “Ecosystem Services” and “Green Infrastructure” of the European Water Supply and Sanitation Technology Platform (WssTP) in Brussels on 28 Nov 2017, to discuss how Ecosystem Services, Nature-Based Solutions and Hybrid Grey-Green Infrastructure can contribute to innovation in the water sector and help tackle water-related challenges.

Final results and their potential impact and use

The main final results of DESSIN are:

1. An analytical framework to evaluate and account impacts from changes in ESS suitable to the water sector, finally resulting in a ready-to-use ESS evaluation module for practitioners - validated, demonstrated and transformed into a software module.

2. Guidance for practitioners and policy makers linking good practice and lessons-learned for innovation-friendly governance regimes and financing options, within an ESS framework.

3. Solutions for Water Quality / WFD challenges, implemented and evaluated by use of the ESS approach: (i) enhanced efficiency of decentralised treatment of combined sewer overflow by a new cross-flow lamella settlers and innovative high-rate filters, (ii) a fully automated real-time control system to minimize combined sewer overflow.

4. Solutions for Water Scarcity, implemented and evaluated by use of the ESS approach: (i) new combination of sewer mining technology with distributed ICT to enable decentralised sewer treatment for irrigation e.g. of urban green; (ii) a solution for sustainable freshwater supply from brackish/saline aquifers by combining Aquifer Storage and Recovery (ASR), desalination and innovative well design; (iii) a flexible ASR system to increase freshwater availability in Mediterranean coastal regions by deep injection systems able to deal with variable water qualities.

5. Maximised market reach of DESSIN solutions by (i) Market analyses for DESSIN technologies; (ii) a sample commercialisation process for DESSIN SMEs; (iii) business environment reports for technologies to tackle water quality and scarcity; (iv) a monitoring & evaluation system for innovations; (v) visitable showcases at five sites in Europe; (vi) promotional and educational material such as videos and leaflets on key results.

We expect that the DESSIN ESS framework will have the following impact:

- Progress in applied ESS science by balancing theoretical and practical elements of the ESS approach and making it useable for the objectives of the WFD;
- Enable more informed decision-making by water managers;
- Promote uptake of innovative solutions for water challenges through transparent and well-structured assessment of their benefits and co-benefits.

We expect that DESSIN solutions for Water Quality Challenges / WFD implementation will have the following impact:

- Reduced pollutant load and volume from CSO overflows;
- Improved water quality in water bodies receiving CSO overflows;
- Facilitate mitigation measures through incremental implementation of local treatment and upgrading the efficiency of existing infrastructures with RTC, rather than large scale expansion of sewer systems;
- Improved aesthetic value of urban water bodies enabling improved recreational and cultural services;
- Safeguard of habitats and protection of aquatic species;

We expect that DESSIN solutions to tackle Water Scarcity Challenges will have the following impacts:

- Enhancing groundwater resources through improved ecological, chemical and quantitative status;
- Safeguarding water supply to areas with intermittent availability and peak demands;
- Reducing ecological and chemical pressures caused by high abstraction;
- Increase operators' competitiveness in the drinking water treatment by substantial reduction of cost and environmental impact of injected water;
- Provision of irrigated urban green spaces in arid/semi-arid regions leading to better microclimate and energy savings for household airconditioning;
- Increased resilience of water supply systems under extreme conditions (scarcity and drought periods, imbalances between demand and resources);
- Service sectors such as tourism, trade or leisure will break water availability constraints;
- Increase reliable fresh water resources of high quality for a sustainable urban, agricultural and industrial development;
- Enhanced potential to supply fresh water from brackish (coastal) areas to decrease the negative effects on surrounding freshwater ecosystems.

1 Project objectives for the period

The main objectives of DESSIN were

- to demonstrate and promote innovative solutions to water-related challenges with a focus on: (i) water quality issues related to the implementation of the Water Framework Directive (WFD) and (ii) water scarcity;
- to develop and demonstrate a methodology for the valuation of ecosystem services (ESS) as catalyser for innovation in water management;

To this purpose, DESSIN has launched demonstration projects of innovative solutions to challenges related to (i) the effective implementation of the Water Framework Directive (WFD) and (ii) water scarcity with a special focus on urban areas. The solutions were integrating technological, monitoring, modeling and management approaches for a more resource-efficient and competitive water sector in Europe.

As a second key feature, an Evaluation Framework to assess the sustainability aspects of the mentioned solutions and to valuate changes in ecosystem services (ESS) of water bodies that result from the implementation of these solutions has been developed and applied .

By adopting this twofold approach, we have demonstrated how innovative solutions integrated in the water cycle can increase the value of the services provided by freshwater ecosystems while assuring sustainability, thus generating additional incentives and arguments for their market uptake and practical implementation. This will support innovation and competitiveness in water management by enabling a more informed selection of the most promising solutions, as regards their impact on the water body and their economic implications.

The whole project was centered around a suite of carefully selected sites across Europe, (Emscher - Germany, Hoffselva – Norway, Westland – Netherlands, Athens – Greece, Llobratag – Spain), representative of global major water challenges, where we brought together public and private water management organisations and end-users, technology providers (SMEs), supporting RTD experts and relevant public authorities to demonstrate this approach.

Main objectives for the third reporting period were

- to continue with RTD activities needed as constant support to those demonstration case studies (Work Area 2)
- continue and finalise the actual technical demonstration at the case studies (Work Area 3)
- apply the ESS evaluation framework at the five demonstration sites to qualitatively and quantitatively assess the benefits and co-benefits provided by the demonstrated solutions (Work Area 3)

- Continue dissemination of results and support of SMEs for proper exploitation and market uptake of DESSIN solutions (Work Area 4).

1.1 Objectives of Work Area 1 (WP 11-13)

Work Area 1 completed its activities by end of the previous (second) reporting period.

Solely, a revision of the deliverables D11.2 and D13.1 took place, as well as the preparation of publications and the presentation of the ESS evluation framework and the mature case studies at conferences.

1.2 Objectives of Work Area 2 (WP 21-23)

Work Area 2 aimed at developing and enabling innovative solutions to improve water quality in receiving waters and to handle water scarcity across the demonstration sites in DESSIN.

The effect of these solutions on the ESS at the different demonstration sites was evaluated in WA3 with the standard methodology developed in WA1. The development of the software to work with the ESS evaluation methodology of WA1 in WA3 was developed in WA2.

The innovative solutions developed in WA 2 were:

- Two solutions for local treatment of CSO overflows (WP21): a new system with modular cross-flow lamella settling units for application in CSO holding tanks (T21.2), a high rate filtration system for implementation on the overflow pipe from a CSO (T21.2). Additional two tasks focus on ICT technologies for integration of local CSO treatment units (T21.3) and for reducing CSO overflow volumes by Real Time Control (RTC) (T21.4).
- Distributed reuse technologies (both modular and mobile) (WP22): sewer mining technologies (T22.1) and Aquifer Storage and Recovery (ASR) systems as potential sources for drinking water (T22.3), and agricultural or industrial water (T22.2).
- Software framework for ESS valuation (WP23).

1.3 Objectives of Work Area 3 (WP 31-35)

The objective of Work Area 3 was to demonstrate at five representative sites across Europe the potential of a range of innovative solutions

- to tackle two major water challenges (water quality and water scarcity)
- to increase the value of ecosystem services of the water bodies

Work Area 3 integrates the technology solutions developed in Work Area 2 as well as the Ecosystem valuation approach from Work Area 1.The five full scale demonstrations including their main objectives are listed in the table below.

Table 1: DESSIN demonstration sites and work packages and their specific objectives

Demonstration WP	Objective
WP31 Emscher (DE)	Improved water quality in strongly urbanised areas by implementing novel and cost efficient treatment and regulation solutions for existing CSO facilities that increase value of the ESS and serve as pilot for a possible implementation following the reconversion process of the whole Emscher system.
WP32 Hoffselva (NO)	Improved water quality in peri-urban areas using innovative decentralised CSO treatment solutions that enable cost efficient, sustainable mitigation of an overloaded sewer system and increased value of the ESS.
WP33 Westland (NL)	Enhanced fresh water availability in brackish coastal zone through novel ASR systems.
WP34 Athens (GR)	Enhanced urban water availability through decentralised sewer mining solutions
WP35 Llobregat (ES)	Increased fresh water availability in Mediterranean coastal region using flexible ASR systems.

1.4 Objectives of Work Area 4 (WP 41-42)

The objectives of the WP41 during this final period of the project were mainly focused on producing the planned communication materials for the final dissemination of DESSIN to all relevant stakeholders and target audiences, with special focus on the project's results. Hence, new materials have been produced and distributed, as new numbers on old ones, and different workshops have been organized in order to present the project results to interested audiences.

On the other hand, another objective was to finalize the establishment of the showcases, which has been successfully accomplished. During this 12 months, the in the five demonstration sites have been presented to different target audiences and all their videos have been produced and delivered.

Finally, regarding WP42, the overall objective of this WP is to maximize the market reach and impact of the water technologies, methodologies and innovative solutions developed in WA1 and WA2 and demonstrated in WA3. WP42 has worked in order to achieve market readiness of products/services developed with regard to water quality (WFD), water scarcity and ESS assessment.

1.5 Objectives of Work Area 5 (WP 51-52)

The objective of this Work Area was to co-ordinate and to manage the progress of the project, in order to ensure that the objectives will be met. This included the coordination of activities among the Work Areas and Work Packages, facilitation of the internal communication, organization of meetings, guidance of the decision-making processes, reporting to the European Commission, monitoring of progress, quality control of the project deliverables, re-adjustment of the work if necessary and taking care of contractual matters.

2 Work progress and achievements during this period

2.1 Work progress and achievements, general picture

2.1.1 Work Area 1 (WP11-13) – Evaluation Framework

Work Area 1 had completed its activities by end of the previous (second) reporting period.

2.1.2 Work Area 2 (WP21-23) – Development and Enabling of Innovative Solutions

Work Area 2 activities have been finalized. WP21 and WP23 progressed according to the revised plan reported in M36, while WP22 was finalized in the previous reporting period.

In Work Package 21 the focus has been on solving research needs of solutions for local treatment and regulation of Combined Sewer Overflow (CSO): a new system with modular cross-flow lamella settling units for application in CSO holding tanks, a high rate filtration (HRF) system for implementation on the overflow pipe from a CSO, and a Real Time Controln (RTC) system for reducing CSO overflow volumes. The tasks have been progressing according to the revised plan reported in M36, and the site-specific tests in WP21 to support comparison of the high rate filter (HRF) and lamella settler solutions have been completed. Site-specific testing of the high rate filter (HRF) solution alone was reported in M37. The results and design recommendations have been reviewed after the end of the demonstration period in M46, and were reported at the final seminar at Oslo VAV, the 2017-11-23 as planned.

The focus of WP21, during this reporting period, has been on site-specific tests to support the comparison of the HRF and lamella settler solutions in the Hoffselva site. The relevant deliverables have been achieved with a minor delay of one month for D21.3 (from M36 to M37). Significant results achieved are related to the demonstrated removal efficiency for the tested solutions which resulted in the following values:

- up to 80% of suspended solids during the first flush and of about 47% as overall removal;
- chemical oxygen demand removal was documented up to 75% during first flush and 56% as overall value;
- nutrient removal is relatively low because of the major soluble nitrogen and phosphorus compositions in CSO. However, 6.3% total nitrogen (TN) and 15% total phosphorous (TP) were retained together with particles;
- the HRF system also shows promising treatment efficiency of heavy metals with 48% Al, 48% Zn, 57% Cu, and 31% Cr removed, respectively;

- test results indicate that the HRF solution is a promising technology to reduce emissions of particulate pollutants from CSO.

Work Package 22 tackled the water scarcity challenge with innovative solutions both on the clean water and waste water side of the water cycle. The solutions proposed include distributed reuse technologies with focus on sewer mining technologies and Aquifer Storage and Recovery (ASR) systems as potential sources for drinking water, agricultural or industrial water. The WP progressed according to plan and all the planned deliverables and milestones have been achieved in the previous reporting period (M19-M36). The significant results achieved are: 1) the completion of the system architecture with sewer mining software and hardware components and of the communication solutions for collecting, processing and visualizing data: the communication solution and the software platform are enabled with local and remote management capabilities based on standards, low cost solutions and open source implementation; 2) the identification, from monitoring of the ASRRO, of formation of fine particles in the aquifer's pores as main threats during the RO treatment. This result provides importat inputs for the future succesfull development and use of ASRRO; 3) the numerical model to simulate the impact on groundwater quality and quantity including the interaction between surface and groundwater. The model is based on Llobregat delta aquifer.

Work Package 23 aimed at implementing the ESS methodology, developed in WA 1, in a software framework. Work on WP23 was completed with delivery of D23.2 (Windows installer for the ESS evaluation software) at M39 instead of M28, as reported at M36 and D23.3 (user guide and documentation) delivered at M39 instead of M29, as reported at M36. The software was then used by all demo site partners to carry out the DESSIN ESS evaluation and Sustainability Assessment, as part of WA3 activities, thereby fulfilling the objective of the work package within DESSIN.

The significant results of this reporting period are: 1) the completion of software, which has been made available to the demo site partners to perform the ESS valuation and sustainability assessment as part of WA 3; 2) development of the user guide and documentation made available within the software tool as context-sensitive help; 3) the software tool will continue to be maintained by DHI and available to the public for free.

2.1.3 Work Area 3 (WP31-35) - Demonstration

Work Area 3 activities have been finalized according to plan and schedule. Only minor delays occurred during this reporting period which did not affect the final delivery of the results.

We originally started the project with a challenging objective to develop five demonstrations across Europe, in which researchers needed to cooperate with site owners, authorities and stakeholders to set up real scale pilot plants showing the potential of innovative technological solutions. At the end of the DESSIN project lifetime we have successfully demonstrated the innovative DESSIN technologies to improve water quality and enhance freshwater availability at five demonstration

sites in Germany (Emscher), Norway (Hoffselva), the Netherlands (Westland), Greece (Athens) and Spain (Llobregat).

Work Package 31 has demonstrated the feasibility and effect on ESS of different innovative solutions (Local treatment of CSO overflows to reduce the impact on recipient water quality. Measurements show that the lamella settler may effectively remove particles from CSOs. Projected COD overflow load reductions of 5.9 to 17.2 % may be achieved in large scale systems. RTC of holding volumes in the sewer system have shown a high potential to reduce overflow volumes from CSOs. Reductions of overflow volume of up to 37.3 % were detected during the demonstration activities.) to mitigate the negative effects on the water quality in the Emscher river system caused by CSOs. Both solutions have been evaluated with regard to their effects on ESS. ESS are expected to be enhanced via an improvement of water quality.

Work Package 32 has demonstrated the feasibility and effect on the ecosystem services of different innovative local solutions for CSOs (cross-flow lamella settlers, high rate filter, data communication) developed to improve water quality in Hoffselva. It has been demonstrated that HRF and cross-flow lamella settler (CLS) technologies together with on-line monitoring can be a solution for distributed treatment of CSO. Results from the demonstration indicate that the HRF can achieve a removal efficiency of particulate material of 50% on average. For the CLS the average removal will be lower (10%) when the CLS is designed for a surface loading of 4 m/h on projected surface. The efficiency is therefore dependent on the size of the storage volume in the solution. The evaluated ESS in the Hoffselva demo case are all expected to be positively affected by a wider implementation of the demonstrated solutions for local CSO-treatment.

Work Package 33 has demonstrated freshwater supply from brackish aquifers with a combined ASRRO system. The results at the Westland Demo site indicate that ASRRO is technically viable and beneficial. Freshwater surpluses up to 70 000 m^3/ 6 months could be treated, stored, and partially recovered for direct use (22.5% of the stored water). Additional freshwater could be produced by abstracting the mixed freshwater and saline water and subsequently treating this with RO. This created a high-quality freshwater stream and a waste stream having a quality comparable to the native groundwater in a deeper aquifer. The ESS evaluation and sustainability assessment showed that the implementation of the ASRRO system at the Westland demo case has resulted in strong mitigation of the salinization of the subsurface. Furthermore, it can contribute to the reduction of flood risks in the region by providing stormwater retention volume in the rainwater collection basins. If the measure would be upscaled to the whole region, the intrusion of sea water in coastal regions could be mitigated as well. The economic valuation shows that BWRO (the original technology) allows cheaper production of irrigation water. However, when mitigation of environmental effects is taken into account, ASRRO will become competitive.

Work Package 34 has integrated and validated two promising new technologies: minimal footprint packaged treatment plants and advanced monitoring infrastructure as a new solution to distributed reuse within the city. The experimental results support the conclusion that the application of sewer mining practice through the implementation of an on-site compact treatment system consisting of

a *pre-treatment unit* followed by a *membrane bioreactor* and a *UV disinfection unit* can reliably meet all the national and international criteria set for all types of non-potable wastewater reuse at a rather moderate cost. The monitoring and supervisory system that has been successfully completed allows dynamic, real-time measurement display, supports alerting functionality and historical data display Groundwater scarcity cost mitigation ranges between € 0.40-0.50/m^3, depending on the sewer-mining unit's technology (MBR-UV or MBR-UV-RO) and the cost reduction rate (learning curve) per year.

Work Package 35 has demonstrated the potential increase of fresh water availability in the Mediterranean coastal region by deep injection systems (ASR) with variable water qualities. Results show the benefits of the pre-potable water recharge without any operational problems. A broadly applicable roadmap for a managed aquifer recharge safety plan has been developed in order to tackle associated environmental risks. ESS are expected to be enhanced due to an increase in groundwater recharge reducing the need for mitigating measures during periods of droughts.

2.1.4 Work Area 4 (WP41-42) – Bringing Innovation to Society and Market

All the dissemination materials planned for the final period of the project have been produced according to the proposal (Task 41.3). During this last months, two newsletters have been developed, together with the 3rd Annual Magazine. Besides, two versions of the DESSIN Final Video have been produced. Regarding the distribution of the materials, all the newsletters and the 3rd number of the Annual Magazine have been sent through online channels.

In addition, an extra material has been prepared. During the last months of the project, a Final Magazine was produced, printed and distributed among the project partners, together with a high-quality online version. This material serves to ensure the final dissemination of the project, especially to interested audiences and stakeholders.

Likewise, the DESSSIN Final Video, which is available in both short and long version, contributes to the objective of ensuring the final dissemination of the project. It offers a general overview on the project context, objectives, evolution and main results, and it also includes a description of the research developed at each demo-site. This video aims to illustrate the ESS concept and approach, and the key importance of ESS Evaluation as a catalyser for innovation in the water sector to general public.

The DESSIN website (Task 41.2) (www.dessin-project.eu) has continued to serve as an information source for the DESSIN project and the encounter point between DESSIN and its audience. It has also served as a principal outlet of informational products about or coming from DESSIN, such as news, deliverables or the DESSIN newsletters, Annual Magazines or videos. The news section has been updated during this period with a total of 19 articles, including project's achievements, new milestones reached, informative videos and dissemination materials.

At the website, also the internal area has kept its purpose of letting members share information about work in progress, and to provide project partners with internal documents, minutes, presentation, project templates, internal documents, final deliverables and results, etc.

Progress of Task 41.4 has been successfully completed according to plan. In this reporting period, the showcases have been established in each of the DESSIN demonstration sites. Continuing the work developed in the previous period, each showcase was set up in a distinct way, reflecting the local conditions, target audiences and wishes. The videos from all the demo-sites have been produced and distributed through the DESSIN website. These films show the research developed in each demo-site, the demonstrated innovation and the main results and conclusions obtained. The establishment of the showcases serve to promote the uptake of the innovative solutions enhancing ecosystem service, developed in DESSIN, and show relevant stakeholders, authorities, decision makers, researchers and the general public their potential. The showcases also provide a playground for new technologies to be demonstrated in a real life environment. The showcases had a clear role during the DESSIN project, but we also foresee active showcases beyond the DESSIN lifetime to endorse the uptake of the innovative solutions.

2.1.5 Work Area 5 (WP51-52) – Project Management

Activities and progress of Work Area 5 are described in chapter 3 of this report (Project Management during the period).

2.2 Work progress and achievements per Work Package in detail

2.2.1 Work Package 21 – Innovations for Water Quality / WFD implementation

Objectives

Develop innovations that improve water quality in urban water bodies and thereby facilitate and improve the implementation of the WFD in urbanised areas by:

- Enabling enhanced particle removal in CSO tanks with innovative cross-flow lamella settlers.
- Enabling local treatment of CSO overflow with an innovative high rate filter.
- Enabling integration of local CSO treatment by innovative monitoring and data communication.
- Enabling RTC of CSOs with innovative control algorithms and communication protocols.

Progress

The tasks have been progressing according to the revised plan reported in M36, and the site-specific tests in WP21 to support comparison of the high rate filter (HRF) and lamella settler solutions have been completed. Site-specific testing of the high rate filter (HRF) solution alone was reported in M37. The results and design recommendations have been reviewed after the end of the demonstration period in M46, and were reported at the final seminar at Oslo VAV 2017-11-23 as planned.

Table 2: WP 21 – Progress on deliverables and milestones due during this reporting period.

D / MS nunber	Title	Delivery date (project month) according to Annex I	Status
D21.3	Technical conclusions from testing during site specific development and specifications for final designs	M36→M38	submitted

Significant Results

- Test results indicate that HRF solution is a promising technology to reduce emissions of particulate pollutants from CSO.
- Up to 80% of suspended solids (SS) removal and 75% of chemical oxygen demand (COD) removal were documented during the first flush. The overall removal of SS and COD were about 47% and 56%.
- Nutrient removal is relatively low because of the major soluble nitrogen and phosphorus compositions in CSO. However, 6.3% total nitrogen (TN) and 15% total phosphorous (TP) were retained together with particles.

- The HRF system also shows promising treatment efficiency of heavy metals with 48% Al, 48% Zn, 57% Cu, and 31% Cr removed, respectively.

Reasons for deviations from Annex I and impacts on resources and planning

There were no deviations from the revised plan reported in M36.

Reasons for failing to achieve critical objectives and impacts or for not being on schedule

All critical objectives for this reporting period were met. The work has been completed.

Corrective actions needed

No corrective actions needed.

Task 21.2 Local treatment of CSO overflow by High Rate Filtration (M1-M36)

The report (D21.3) with the results from Technical conclusions from testing during site specific development and specifications for final design was submitted in M37 on 2017-02-02.

Site-specific tests to support the comparison of the HRF and lamella settler solutions have been performed during the spring and autumn of 2017, and been reported in the seminar at VAV on 2017-11-23. The results will also serve as input to the report from WP32 (D32.1).

2.2.2 Work Package 22 – Innovations to tackle water scarcity

Objectives

Develop innovations to tackle (temporal) water scarcity in urban areas facilitating sustainable use of available water by:

- Enabling technologies for distributed sewer mining in large urban areas, integrating membrane treatment and ICT/AMI state-of-art for fast and efficient deployment by SMEs and/or water companies;
- Enabling a robust and sustainable freshwater supply from brackish and/or saline aquifers by combining Aquifer Storage and Recovery (ASR) and desalination with an innovative well design;
- Enabling improved aquifer water quantity and quality with flexible ASR systems to deal with different quality injection waters.

Progress

All contractual items (deliverables, milestones) have been achieved and submitted in the previous reporting period (M19-M36).

2.2.3 Work Package 23 – Software framework for ESS valuation

Objective

- To develop a software framework for working with the ESS evaluation standard methodology developed in WA1 in an efficient and user-friendly environment.

Progress

Work on WP23 was completed with delivery of D23.2 (Windows installer for the ESS evaluation software) and D23.3 (user guide and documentation). The software was then used by all demo site partners to carry out the DESSIN ESS evaluation and Sustainability Assessment, as part of WA3 activities, thereby fulfilling the objective of the work package within DESSIN.

The software development was carried out according to specifications described in D23.1, which was submitted in the previous reporting period. The specifications were developed in cooperation with the demo site partners, as well as other partners involved in the development of the DESSIN ESS framework and Sustainability Assessment (D11.2). The specifications outline how the software should look and function in order to assist users implementing the ESS framework and Sustainability Assessment.

A beta version of the software was made available to partners for testing in January 2017, and feedback from the testing was used to refine the tool and eliminate defects. Partners were also provided with a trial version of the documentation, which was also revised based on user feedback. The final version of the documentation is available as a context-sensitive help file in the software tool.

To contribute to the legacy of DESSIN, the software tool will be continue to be maintained by DHI, and will be available to the public for free. Instructions for downloading and installing the software have been made visible to the general public through the DESSIN home page.

Table 3: WP 23 – Progress on deliverables and milestones due during this reporting period

D / MS nunber	Title	Delivery date (project month) according to Annex I	Status
D23.2	Windows installer that can be used to install the software	M28→ M39	Submitted
D23.3	User guide and system documentation	M29→M39	Submitted

Significant Results

- Software development completed, and software made available to demo site partners.
- User guide and documentation completed, and available within the software tool as context-sensitive help.
- Software tool used by all demo site partners to carry out ESS evaluation and sustainability assessment as part of WA3 activities.
- Software tool will continue to be maintained by DHI and available to the public for free.

Reasons for deviations from Annex I and impacts on resources and planning

There were no deviations from Annex I.

Reasons for failing to achieve critical objectives and impacts or for not being on schedule

All critical objectives for this reporting period were met.

Corrective actions needed

No corrective actions needed.

Task 23.2 ESS valuation software framework – Development of the ESS valuation software framework

Development of the ESS valuation software tool took place in Task 23.2. Development began in October 2016, after delivery of software specifications (D23.2). A beta version was distributed to

WP23 partners in January 2017 for testing and feedback, and the final version was distributed in April 2017.

The tool was developed to guide and assist users implementing the DESSIN ESS evaluation framework and Sustainability Assessment, as described in D11.2. After the tool was finalized, it was used for this purpose by all demo site partners.

The beta version of the tool was introduced to the DESSIN consortium at the M36 project in meeting in Barcelona, which took place in January 2017. Afterwards, the beta version was distributed to demo site partners and other partners in WP23 for feedback and testing. Feedback received from partners was used to identify defects and refine the tool as part of the finalization process. The final version was completed and distributed to demo site partners in April 2017.

The software tool was made part of the standard release of DHI's MIKE Workbench software system in October 2017. The software is available for free and can be downloaded from DHI's website. Instructions for downloading and installing the software are now available on the DESSIN website.

Task 23.3 ESS valuation software framework – End-user and system documentation

A user guide and documentation were written as part of Task 23.3. The user guide and system documentation explain to work with the DESSIN tool. The guide is available as a pdf document as also as context-sensitive help within the tool.

The guide was distributed to partners in draft format at the time of the beta release in January 2017, and was revised and updated based on feedback from demo site owners and other partners.

2.2.4 Work Package 31 – Emscher Demonstration: Improving water quality in the strongly urbanized Emscher area

Objectives

To demonstrate the feasibility and effect on ESS of different innovative solutions developed to mitigate the negative effects on the water quality in the Emscher river system caused by CSOs. The solutions are:

- Local treatment of CSO overflows to reduce the impact on recipient water quality
- RTC of holding volumes in the sewer system to reduce overflow volumes from CSOs

Progress

MS31 has been achieved. The water quality monitoring and data gathering for the lamella settler has been completed in May 2016, when the container was shipped to Norway. The ADESBA-Real Time Control was activated in April 2017. Water quality monitoring and data gathering has been conducted since then. In order to enlarge the data set, monitoring has not been ceased in M42, as indicated in the M36 report, but was continued until November 2017.

Two deliverables have been completed in M50. D31.1 is a rather technical report on the results of the two Emscher demonstration cases. D31.2 is an evaluation of the two demo cases with regard to ESS and sustainability. Table 4 shows the status for the milestones and deliverables for WP31.

Table 4: WP 31 – Progress on deliverables and milestones due during this reporting period

D / MS nunber	Title	Delivery date (project month) according to Annex I	Status
MS31	Completed water quality monitoring and data gathering	M36 →→ M42	achieved
D31.1	Conclusions from successful demonstration, and specifications for final design	M42 →→ M50	achieved
D31.2	Final evaluation of the technological solution in terms of ESS and sustainability	M42 →→ M50	achieved

Significant Results

- Cross-current lamella settler (Figure 1)
  - After data collection has been completed in May 2016 and laboratory analysis in December 2016, data were evaluated in 2017.
  - The following were the main parameters measured and evaluated at inflow and overflow of the lamella settler container: Filterable substances and fine-grained filterable substances (Total suspended solids (TSS)), fine total suspended solids (TSS fine), chemical oxygen demand (COD) and total organic carbon (TOC).
  - Additionally, flow time, sedimentation velocity and metal concentrations were assessed.
  - The highest efficiency (i.e. reduction of TSS, TSS fine, COD and TOC) were detected at a flow rate of 10 l/s and lower. The recommended surface load is thus about 1 m/h.

- The container starts to be efficient at an inflow concentration threshold of approximately 300 mg/L COD.
- The average efficiency ranges from 5 to 17 % for COD.
- The maximal potential efficiency that can be reached with the lamella settler in its current setup is 37 % (TOC), 17 % (COD), 22 % (TSS fine) and 19 % (TSS).
- The particle concentration and type is of high importance for the efficiency.
- The efficiencies detected were scaled up from container scale to large-scale CSO, predicting overflow load reductions of 5.9 to 17.2 % for COD (Figure 2).

Figure 1: Container in action, located at CSO Ohmstraße in Castrop-Rauxel.

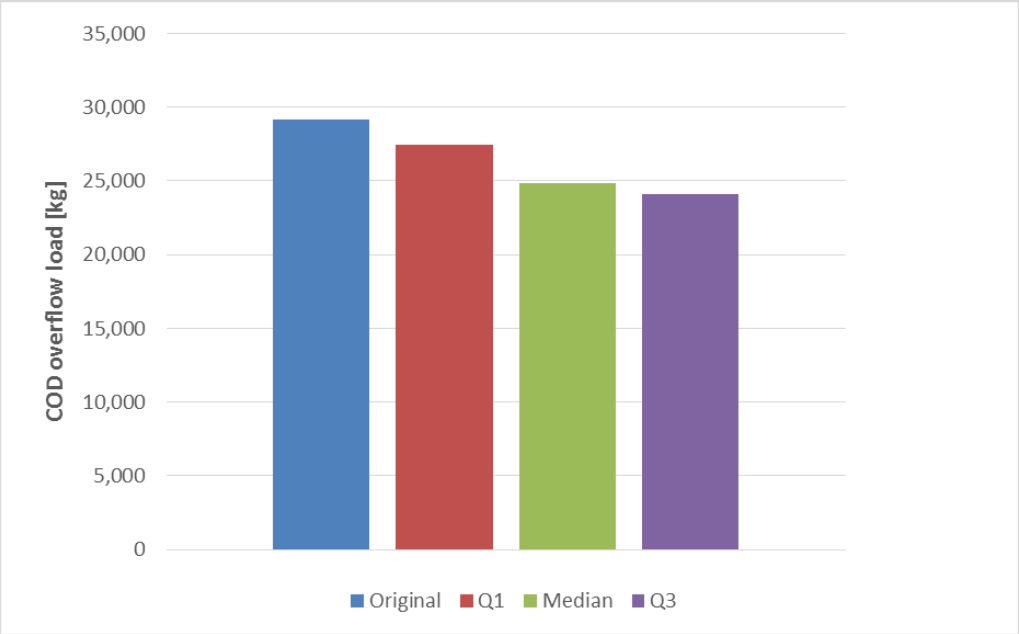

Figure 2: Theoretical COD load in the overflow of a large-scale CSO facility in one year (2014). "Original" refers to the overflow without lamellae, "Q1", "Median" and "Q3" represents the overflow with lamellae (storage volume equipped with lamellae by 50 %) modelled with the 25th, 50th and 75th percentile of the efficiencies determined in the container test, respectively.

- RTC of sewer network
    - After ADESBA was run in simulation mode and several corrections and adjustments have being conducted, ADESBA was fully activated in April 2017. Target throttle settings by ADESBA were, since then, applied in reality at the five pilot tested CSO facilities.
    - After a short period of running ADESBA with a narrow throttle range, the range was increased to 100 % between minimum and maximum throttle flow.
    - Newly developed visualization interfaces served to monitor the RTC of the full system, i.e. the five ADESBA-controlled CSO facilities, at a glance and online at any time from the central office.
    - Furthermore, templates for raw datasets and graphical reports were developed which were populated with data of the monitored rain events (Figure 3).
    - Eight rain events with CSO overflow have been recorded between July and November 2017 and four of these have been evaluated in the analysis of success.
    - In the analysis of success, the controlled system was simulated in the Simba# model (Figure 4) and the ADESBA-derived throttle settings were backcounted to standard settings (i.e. nominal throttle flow) in order to simulate the system without ADESBA.
    - The monitored overflow behavior (volume and duration) with ADESBA was compared to the overflow behavior simulated in Simba#, which calculates the situation without ADESBA. Reductions of overflow volume of up to 37.3 % were detected.
    - Furthermore, an analysis of potential was conducted for the entire sub-catchment of the WWTP Dortmund Deusen, i.e. 36 CSO facilities, simulated in Simba#. Potential reductions of overflow volume of 3.8 to 7.5 % were determined.
    - An extension of the testing period beyond DESSIN is planned and the approving agency has already accepted the request for elongating the test period.

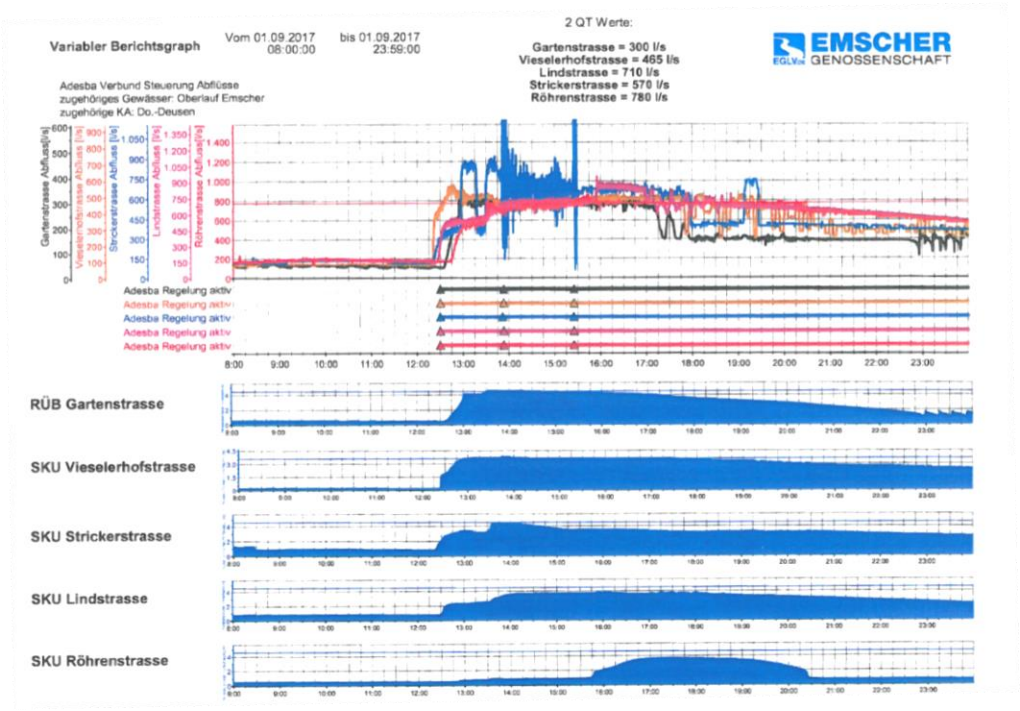

Figure 3: Graphical report from ACRON visualizing the outflow and filling level in all five CSOs during an exemplary rain event.

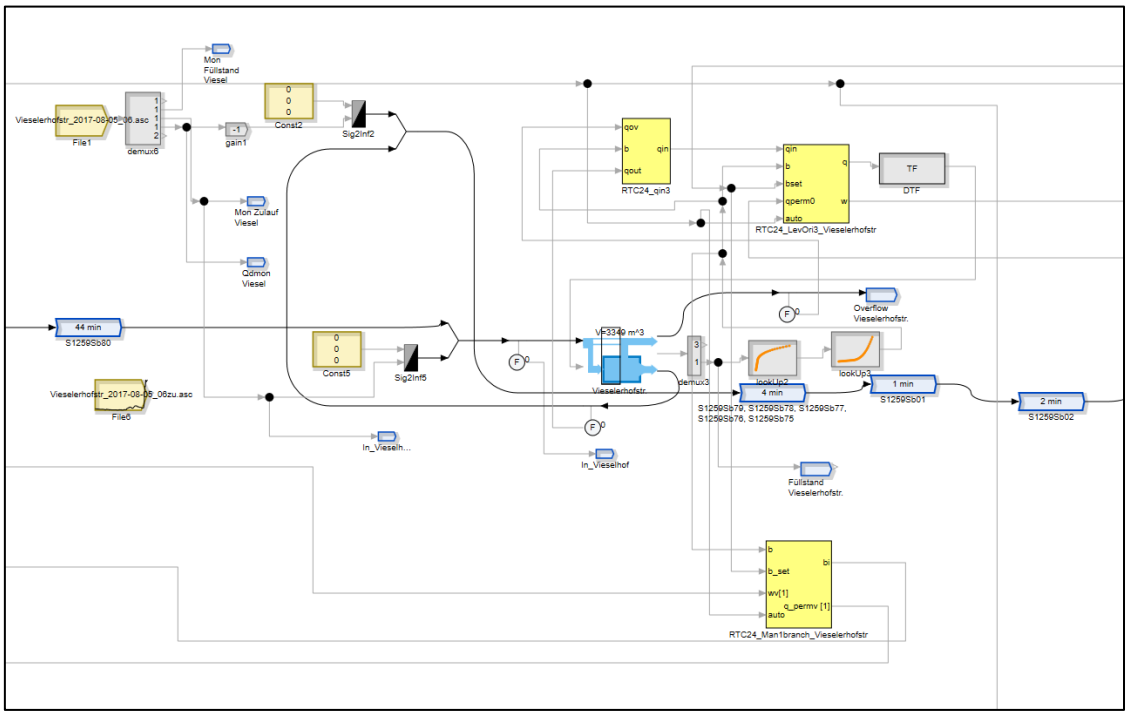

Figure 4: Excerpt from the Simba# model for the five pilot-tested CSO facilities.

Reasons for deviations from Annex I and impacts on resources and planning

There were no deviations from Annex I.

Reasons for failing to achieve critical objectives and impacts or for not being on schedule

All critical objectives for this reporting period were met. Work is on schedule.

Corrective actions needed

No corrective actions needed.

Task 31.1 Decentralized water treatment (M1-M42, EG, UFT, UDE)

The cross-current lamella settler as an example of decentralized water treatment was tested from July 2015 to May 2016. Thus, the testing period was longer than initially planned. The reasons were outlined in the previous reports. Information on set-up and testing procedure can be obtained from the M36 report. Data aquisition was completed in time, laboratory analyses were completed in December 2016, while data evaluation and upscaling to large-scale was conducted in 2017. The main results obtained are outlined above in the section “significant results”. The maximal potential efficiency obtained with the lamella settler in its current container setup was 37 % (TOC), 17 % (COD), 22 % (TSS fine) and 19 % (TSS). Scaling these efficiencies up to a real CSO facility resulted in predictions of e.g. COD reduction of 5.9 to 17.2 %. We, however, recommend repeating the testing phase with combined sewage at another test site, i.e. different concentration and different sediment type. Furthermore, more test runs of the container without lamellae are needed to identify the share of the lamella on the sedimentation effect in the container. Suitable sites for such a second testing phase have been identified in the Emscher region and it is planned to conduct such further testing after the DESSIN project.

Task 31.2 Case Emscher – Real Time Control of sewer network (M1-M42 EG, SEGNO, UDE)

The ADESBA RTC was installed at five CSO facilities in the Emscher sub-catchment of Dortmund Deusen. Full ADESBA operation and data collection started in April 2017, following a thorough testing period in simulation mode, various corrections and adjustments and a short control period with a narrow throttle range to minimize any risks of malfunctioning. Eight rain events with CSO overflow have been recorded between July and November 2017 and four of these have been evaluated in the analysis of success. In the analysis of success, the overflow behavior of the system without ADESBA was simulated in Simba# and was compared to the monitored overflow behavior of the system with ADESBA. Reductions of overflow volume of up to 37.3 % were detected. In parallel, an analysis of potential has been conducted for the entire sub-catchment of Dortmund

Deusen, i.e. 36 CSO facilities. Potential overflow volume reductions of 3.8 to 7.5 % have been determined. The main results are outlined more detailed above in the section “significant results”. It is planned to continue the ADESBA testing phase after the DESSIN project. The approving agency has already given their consent to the elongation of the demo operation.

Task 31.3 Evaluation of solutions (M1-M42, EG, ECOL, DHI, ADELPHI, IWW)

Both demo case solutions have been elvaluated with regard to their effects on ESS. ESS are expected to be enhanced via an improvement of water quality. This means that pressures on the ecosystem are reduced via the two technologies.

The lamella settler reduces the particle concentrations in overflowing water. This again reduces particle, organic cabon, nutrient and contaminant input into receiving streams. The RTC minimizes the overflow volume and frequency. Thus, in-stream flow peaks are shortened and potentially even avoided. Going along with a reduced overflow volume, a reduction of the overflow load is predicted.

For both technologies, a thorough sustainability analysis has been conducted in order to appraise further criteria which have not yet been examined in the ESS assessment. Here, criteria like investment and operational costs and effort have been estimated as well as potential risks and probability of failure. Furthermore, energy consumption and compliance with the WFD have been predicted and discussed.

2.2.5 Work Package 32 – Hoffselva Demonstration: Improving water quality in the peri-urban Hoffselva area

Objectives

The main objective is to demonstrate the feasibility and effect on the ecosystem services of different innovative local solutions for CSOs developed to improve water quality in Hoffselva.

- Enable enhanced particle removal in CSO tanks with innovative cross-flow lamella settlers.
- Enable local treatment of CSO overflow with an innovative high rate filter.
- Enable integration of local CSO treatment by innovative monitoring and data communication.

Progress

The testing and demonstration of the HRF plant, and the water quality sampling has been performed according to the revised plan. The comparison tests with the lamella settling plant and the HRF plant, and the data gathering and water quality sampling during these tests have been performed in the period from March to October 2017. The deliverables D32.1 and D32.2 have been prepared and submitted in M48.

Table 5: WP 32 – Progress on deliverables and milestones due during this reporting period

D / MS number	Title	Delivery date (project month) according to Annex I	Status*
MS32	Completed water quality monitoring and data gathering	M36→M46	Achieved
D32.1	Design criteria and documentation of performance for local CSO overflow treatment	M32→M48	Submitted
D32.2	Conclusions from the demonstrations with projected effects on water quality, ESS and sustainability	M32→M48	Submitted

Significant Results

- It has been demonstrated that HRF and cross-flow lamella settler (CLS) technologies together with on-line monitoring can be a solution for distributed treatment of CSO.
- Results from the demonstration indicate that the HRF can achieve a removal efficiency of particulate material of 50% on average. The removal efficiency is dependent on the influent particle concentration. For the CLS the average removal will be lower (10%) when the CLS is designed for a surface loading of 4 m/h on projected surface. The efficiency is therefore dependent on the size of the storage volume in the solution.
- The evaluated ESS in the Hoffselva demo case: Surface water for non-potable use; Maintenance of environment (physical, chemical, biological conditions); Experience from the use of landscape (transparency of the river water); and Experience from the use of landscape (visual impression of water and riverbank) are all expected to be positively affected by a wider implementation of the demonstrated solutions for local CSO-treatment.

Reasons for deviations from Annex I and impacts on resources and planning

There were no deviations from the revised plan reported in M36.

Reasons for failing to achieve critical objectives and impacts or for not being on schedule

All critical objectives for this reporting period were met. The work has been completed.

Corrective actions needed

No corrective actions needed.

Task 32.1 Demonstration of cross flow lamella settling for local treatment of CSO overflow - Case Hoffselva (M21-M42)

The cross-flow lamella settler was operated from March until October 2017. During this period results were collected for 5 CSO events and 1 dry weather flow test. The results have been evaluated together with results from T32.2, T32.3 and 32.4, and reported in the seminar at VAV on 2017-11-23 and in the report from WP32 (D32.1).

Task 32.2 Demonstration of High Rate Filtration for local treatment of CSO overflow - Case Hoffselva (M9-M42)

The HRF was operated from March until October 2017. During this period results were collected for 10 CSO events. The reason for the larger number of CSO events with the HRF (10 vs. 5) was that the CSO discharge was only high enough to trigger the automatic start of both plants in 5 of the events. The results have been evaluated together with results from T32.1, T32.3 and 32.4, and reported in the seminar at Oslo VAV on 2017-11-23 and in the report from WP32 (D32.1).

Task 32.3 Demonstration of monitoring and data communication for local CSO treatment units - Case Hoffselva (M9-M42)

The demonstration of the solutions for monitoring, data communication and control have been performed in parallel to the demonstration of the lamella settler solution and HRF solution in T32.1 and T32.2, respectively. The results have been evaluated together with results from T32.1 and T32.2, and reported in the seminar at VAV on 2017-11-23 and in the report from WP32 (D32.1).

Task 32.4 Monitoring water quality in Hoffselva and evaluation of solutions (M12-M42)

In addition to the demonstration of the treatment solutions and data monitoring and communication, monitoring and water quality sampling have been performed during CSO events. In parallel water quality sampling has been performed downstream the demo site in Hoffselva at Oslo VAV's sampling station (HOFF5), and local stakeholders have observed the conditions at pre-determined sites along Hoffselva as part of the ESS evaluation. The sampling and data gathering was completed by October 2017.

The river model was further developed and calibrated hydraulically with flow measurements from Oslo VAV's station HOFF5. This yielded satisfactory results with respect to flow, however, the water quality results were not accurate showing concentrations that were much (10 times) lower than analysed from water samples. This is probably a du to inaccuracies in the mass-input to the river.

The combined results from the technical measurements of the plant performances, water quality and flow conditions in Hoffselva, and the observation study have been used in the ESS evaluation and sustainability assessment at Hoffselva. The results have been reported in the seminar at VAV on 2017-11-23 and in the report from WP32 (D32.2).

2.2.6 Work Package 33 – Westland Demonstration site: Freshwater supply from brackish aquifers by combining ASR and desalination

Objectives

To demonstrate freshwater supply from brackish aquifers with a combined ASRRO system.

Specific objectives are:

- To quantify freshwater recovery by an ASR well design.
- To demonstrate the added value of an ASRRO system on freshwater recovery.
- To demonstrate the effect of enhanced subsurface iron removal on membrane clogging.
- To demonstrate the impact of freshwater supply from brackish aquifers on regional groundwater quality and Water Framework Directive goals.
- To evaluate innovative solutions to enhance freshwater supply from brackish aquifers

Progress

From 2014 to 2017, a pilot was conducted at the Westland Demo site in order to integrate ASR, the Freshkeeper, and desalination in one system. The objective was to create a sustainable and robust freshwater supply, using the characteristics of the aquifer as an ecosystem service. This integrated 'ASRRO' system must improve the freshwater recovery upon conventional ASR, while mitigating the negative impact of brackish water reverse osmosis.

The results at the Westland Demo site indicate that ASRRO is technically viable and beneficial. Freshwater surpluses up to 70 000 m^3/ 6 months could be treated, stored, and partially recovered for direct use (22.5% of the stored water). Additional freshwater could be produced by abstracting the mixed freshwater and saline water and subsequently treating this with RO. This created a high-quality freshwater stream and a waste stream having a quality comparable to the native groundwater in a deeper aquifer.

The biggest operational threat during ASRRO in a sand aquifer (as present at the Westland site) is clogging of RO-membranes and potentially also the saline water re-injection well(s). This is caused by mobilization of clay particles (during freshening) and formation of Fe-colloids (by infiltration of oxic water in an area with adsorbed Fe around the ASRRO wells), both in the infiltration stage.

The ESS evaluation and sustainability assessment showed that the implementation of the ASRRO system at the Westland demo case has resulted in strong mitigation of the salinization of the subsurface. Furthermore, it can contribute to the reduction of flood risks in the region by providing stormwater retention volume in the rainwater collection basins. Contamination of the injected water with pesticides and zinc is, however, an adverse effect. This contamination can be prevented by adding other technological solutions. If the measure would be upscaled to the whole region, the intrusion of sea water in coastal regions could be mitigated as well. The economic valuation shows

that BWRO (the original technology) allows cheaper production of irrigation water. However, when mitigation of environmental effects is taken into account, ASRRO will become competitive Figure 5).

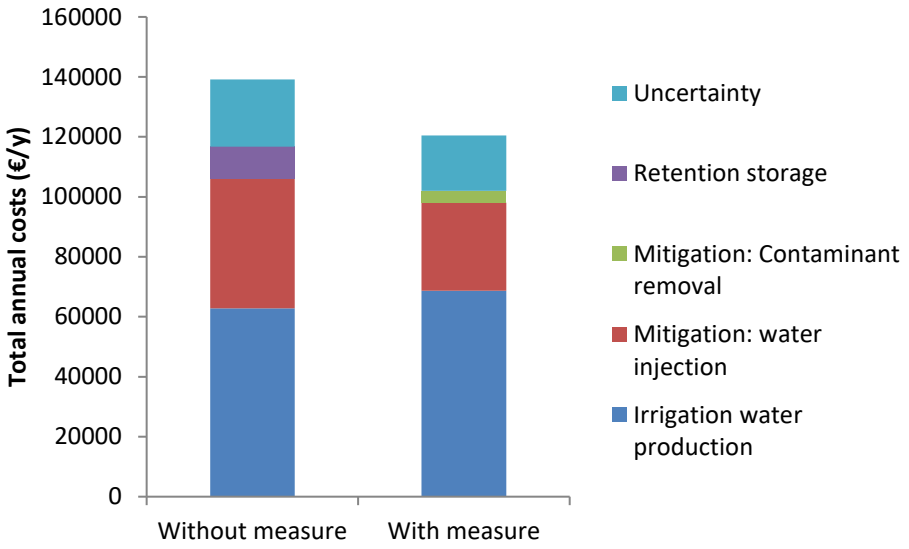

Figure 5: Comparison of total costs per year with and without the measure for irrigation water production at the Westland demo site, and potential costs of mitigation of environmental effects, as well as the additional costs to create retention storage when the measure is not implemented. Uncertain costs include the value of retention storage (without measure) and the costs of contaminant removal which may vary depending on the chosen method and dimensions (with measure).

Table 6: WP 33 – Progress on deliverables and milestones due during this reporting period

D / MS number	Title	Delivery date (project month) according to Annex I	Status
D33.1	Valorisation and demonstration of an ASRRO application in a first, well-monitored field application	M42→M48	Submitted
D33.2	Evaluation of the improvement of Ecosystem Services as a result of ASRRO application to increase freshwater supply from brackish aquifers	M48	Submitted

Significant Results

- Conventional ASR in the typical Westland saline aquifer results in recovery efficiencies <30%. This can be lifted to >50% with the innovative well design and even more by the use of RO
- The advanced ASRRO system showed capable of 1) enlarging the recovery of unmixed freshwater upon storage, 2) provided a more robust water supply thanks to the use of RO and 3) can attain a neutral water balance to prevent mining of water from a coastal aquifer
- Clogging of membranes (and potentially: re-injection wells) during ASRRO appears to be driven by mobilization of clay particles and Fe-colloids. This can be mitigated by regular flushing of the RO-membranes with permeate and regular cleaning of the re-injection well
- ASRRO application creates value for three types of ecosystem services (ESS), availability of groundwater for irrigation (provisioning), groundwater quality (regulation and maintenance), and stormwater retention (regulation and maintenance)
- Model predictions show that upscaling of ASRRO application to the whole region could mitigate the intrusion of sea water and subsequent salinization of coastal aquifers
- Based on the limited difference in cost price per m^3 (taking into account mitigation costs and costs for creating storage capacity in the case of BWRO) ASRRO is considered competitive with the original BWRO application.

Reasons for deviations from Annex I and impacts on resources and planning

The risk of clogging of RO-membranes by Fe in the recovered water was not observed. Instead, clogging will probably be driven more by mobilization of clay during freshening (D22.3). Potential mitigation strategies will be explored, but could not be tested in the field because of the extensive modifications required and permitting.

Reasons for failing to achieve critical objectives and impacts or for not being on schedule

All critical objectives for this reporting period were met. Work is on schedule.

Corrective actions needed

No corrective actions needed.

Task 33.1 Quantification of the freshwater recovery by an innovative well design (M1 - M16; KWR)

This task has been finalized. Various ASR cycles are monitored to quantify freshwater recovery. The monitoring data from the full scale demonstration setup (freshwater recovery with Multiple Partially Penetrating Wells -MPPWs- and injection/recovery schemes) were evaluated with the previously developed calibrated groundwater transport model.

Task 33.2 Demonstration of the added value of an advanced ASRRO system (M16-M36, BdB, KWR)

This task has been finalized. The Freshkeeper including installation of RO membranes at the ASR field pilot is completed by Bruine de Bruin (SME) and KWR, upgraded after one year, and tested for two years (in total).

Task 33.3 Demonstration of the effect of enhanced subsurface iron removal on membrane clogging (M24-M42, KWR, BdB)

This task has not been executed as originally planned. The reason for this is that during the operation and interpretation (D22.3), it was concluded that iron was not impacting the membrane performance, but clay mobilization was. This task was therefore replaced by an evaluation of mitigation strategies for clay mobilization.

Task 33.4 Demonstration of the impact of the Westland ASRRO pilot on the regional groundwater quality (M1-M42, KWR)

This task has not been executed as originally planned. The quality development of the brackish water target aquifer was monitored, and the impact of the ASRRO system on the regional water quality was evaluated using a regional groundwater quality model. A cost comparison was made between the use of aquifer storage and recovery in combination with RO (ASRRO) and the conventional brackish water RO (BWRO). The results are reported in D33.1.

Task 33.5 Evaluation of innovative solutions to increase freshwater supply from brackish aquifers

This task has been executed as originally planned. ASRRO application creates value for three types of ecosystem services (ESS), availability of groundwater for irrigation (provisioning), groundwater quality (regulation and maintenance), and stormwater retention (regulation and maintenance). The results are reported in D33.2.

2.2.7 Work Package 34 – Athens Demonstration: Sewer mining for urban re-use enabled by Advanced Monitoring Infrastructure

Objectives

To integrate and validate two promising new technologies: minimal footprint packaged treatment plants and advanced monitoring infrastructure as a new solution for distributed reuse within the city. Specific objectives are:

- To setup an AMI-enabled packaged plant and optimise its performance.
- Implement a hardware and a software platform to record data in real time, orchestrate, process and visualize the data and provide intelligent and timely info-support for key application decisions.
- Integrate both aspects of the solution (treatment and ICT) and monitor their performance.
- Propose a quantifiable plan for the upscale of the solution to the city level and demonstrate its impact using the Ecosystem Service tool.

Progress

During the reporting period, Pilot unit has been has been successfully operated and further updated. The SW and HW platform, as well as, the communication networks for collecting, processing and visualizing the measurements of the field sensors installed at the Athens Pilot has been further updated. The front-end and back-end of the ICT/Monitoring solution that have been implemented using a low-cost solution (small sized single board computer), adopting OGC standards supporting interoperability, and a user friendly cloud based User Interface (UI) has been completely developed according to the updates performed in HW and SW components of the system. Furthermore, the HW and SW platform has been further extended in order to connect to a weather station installed at Pilot's site and incorporate real-time weather sensor data into the cloud-based UI. For the integration of the weather data the same communication interoperability layer (based on OGC standards) has been used, extending the UI to visualize the respective data. Additionally, the economic analysis was finalized on three (3) main pillars: (a) the estimation of *water scarcity mitigation*, (b) the valuation of *water-enhanced ecosystem services* (microclimate regulation) and (c) a discussion on *derived economic activities* as well as the *business model* for the sewer mining unit's sustainable operation in a market environment.

Table 7: WP 34 – Progress on deliverables and milestones due during this reporting period

D / MS number	Title	Deliverydate (projectmonth) according to Annex I	Status*
D34.2	A demonstratedintelligent software-hardware platform for monitoringand control of smallpackaged plants for urbansewermining	M24	Submitted
D34.3	Evaluationandguidelinesandrecommendation for transfer to otherWaterScarcitysites	M48 → M49	Submitted
MS24	Completedinstallation of AMI-SM technologies	M18 → M20	Achieved

Significant Results

- The experimental results support the conclusion that the application of sewer mining practice through the implementation of an on-site compact treatment system consisting of a *pre-treatment unit* followed by a *membrane bioreactor* and a *UV disinfection unit* can reliably meet all the national and international criteria set for all types of non-potable wastewater reuse at a rather moderate cost.
- The use of additives reduced membrane fouling –as expected- but the reduction was not radical enough to justify the entrance of additives into the maintenance protocol.
- In order to observe their impact on both effluent's quality and greenhouse gas emissions (GHG) different Sludge Retention Times (SRTs) were examined. From those, the optimal one was the 20 days.
- Such a dual membrane scheme in the context of a sewer mining application has proven to be a viable solution for water reuse in combination with fresh water saving in highly urbanized, space-limited environments.
- The application of the integrated MBR-RO process is financially justified in the case of saline wastewater or in the case of very strict threshold values for chemical micropollutants.
- The monitoring and supervisory system that has been successfully completed allows dynamic, real-time measurement display, supports alerting functionality and historical data display (user can select desired time-range), data exporting features in various image formats (PNG, JPEG, SVG) and text formats (PDF, EXCEL, SCV) as well as configuration features for modifying (add/update/delete) sensors. The web platform is accessible through a web browser (i.e. from Desktop PCs, Tablets and Smart Phones). Security features have been integrated into the platform for allowing access only with specific user credentials. Furthermore, the developed monitoring solution can be easily adapted and integrated by the other systems implemented at the DESSIN demo sites.

- The monitoring and supervisory system has been further extended to display data from the weather station installed at pilot's site (KEREFYT).
- The Dashboard was revamped, whereby work included updating the backend server to the latest Spring Boot technology, adding new error reporting/notification mechanisms, overhauling the security mechanisms, and improve the timeliness and responsiveness of the platform. The end result is a faster, more secure, more responsive and less error-prone user interface. –[Note: this activity was conducted as part of WP22, as it involved revisiting development work, and deemed necessary due to progressions in the technology used.]

- Establishment of a collaboration network with the local public administration of the study area that selected to demonstrate the impact of the solution at the city-as-a-catchment scale.

- Two generic simulation-based methodologies have been developed that can function as decision support tools for the solution (i.e., sewer mining) in an up-scaled level (i.e., city).

- Finalized the economic methodologies for the monetary valuation of ecosystem services, in three levels: (1) water resources scarcity mitigation (especially of groundwater resources) from sewer mining and subsequent water reuse, (2) water-enhanced ecosystem services, with focus on micro-climate services and (3) evaluation of derived economic activities in the area as well as the business model for the sewer-mining unit's market diffusion.

- Microclimate regulation benefits for a model household of 4 people (parents and 2 children) may range between € 130-180 annually, depending on the sewer-mining unit's technology (MBR-UV or MBR-UV-RO).
- Groundwater scarcity cost mitigation ranges between € 0.40-0.50/m^3, depending on the sewer-mining unit's technology (MBR-UV or MBR-UV-RO) and the cost reduction rate (learning curve) per year. Specifically, this is achieved for an average total cost reduction rate of the sewer-mining unit ranging from € 0.08-0.09/m^3/year so that within the first five (5) years the major part of the scarcity cost will have been mitigated by both technologies.

Reasons for deviations from Annex I and impacts on resources and planning

There were no deviations from Annex I.

Reasons for failing to achieve critical objectives and impacts or for not being on schedule

All critical objectives for this reporting period were met. Work is on schedule.

Corrective actions needed

No corrective actions needed.

Task 34.1 Installation of small footprint packaged treatment plant (M6-M12, EYDAP, Chemitec)

Completed. See also previous progress report.

Task 34.2 Optimize the operation of the membrane wastewater treatment system (M8-18, NTUA, EYDAP, Chemitec)

Completed and reported during the previous progress report. However, below we summarize the previous activities in combination with improvements made during the time-period under consideration. The Athens Demo commenced operation in 2015, with a small delay as described in a previous project report (1st). Overall, the optimization of the system lasted 370 days. During this period, transmembrane pressure (TMP) was monitored and chemical additives were inserted into the MBR tank in order to examine whether additives moderate membrane fouling or if the cleaning protocol followed is sufficient. Moreover, different SRTs were examined in order to observe their impact on both effluent's quality and greenhouse gas emissions (GHG). More specifically, from 10/10/2016 until 22/12/2016 the system operated with SRT=20 days, from 25/12/2016 until 11/02/2017 the system operated with SRT=15 days and from 14/02/2017 until 7/03/2017 the system operated with SRT=10 days. In addition, from 10/06/2017, TMP started being monitored with the system operating with SRT=20 days again and with higher daily capacity, 17 m^3/day instead of 12 m^3/day, in order to create more harsh conditions in terms of membrane fouling. Up until 14/09/2017 membranes were maintained with the standard protocol and on that day, chemicals started being added daily to the system, specifically 68 g/day of polyaluminiumchloride 14 % in Al_2O_3, in order to achieve a concentration of 9mg Al/L.

Furthermore, during this reporting period improvements of the pilot unit took place according to the tasks specified in the recent amendment. These improvements are described in detail below.

- The PLC was re-configured. More specifically, ALARM and ALERT levels of digital level indicators were re-programmed, an interface with timer for automatic regulation of the units feed (**Figure 6**A), and a timer for the coagulant dosing pump were installed. Furthermore, the PLC was connected with the HACH controller and therefore, historical data can now be recorded.
- A second fine bubble diffuser was installed in the aeration pipe to increase the Dissolved Oxygen (**Figure 6**B) and a new TMP pressure gauge with greater accuracy was installed as well (**Figure 6**C).
- A coagulant dosing pump and coagulant tank with a volume of 100 Liters were installed.
- A UPS system was installed for the unit's protection (**Figure 6**D)
- Three T-shaped plastic supports were welded between the membrane and the anoxic tank walls (**Figure 6**E).
- Finally, an automated feeding system was installed and in order to cope with the new system, previous control boards were replaced by a more advanced one. In addition, a connection with the PLC was established via cables, thus allowing the control, automated operation and remote monitoring of the new system. Last but not least, a new floater valve and a flow switch were installed in the feed pipeline for the protection of the pumps (**Figure 6**F).

Additionally, other improvements that were not specified by the amendment took place, according to the needs or problems that arose. Some of them are:

- The replacement of the sodium hypochlorite dosing pump.
- The installation of overflow control in the concrete feed tank.
- The lobe pump was serviced twice, while the shaft seal and lobes were replaced.
- One of the two blowers of the air-line was serviced and the corresponding valves were replaced with bigger-diameter ones, while the air compressor of the pneumatic valves and he instruments of air-line were also replaced.
- The plastic piping was fully reconstructed with galvanized steel components of bigger diameter.
- Finally, a container ventilation fan with variable speed levels and reverse flow control with a thermostat was installed.

Figure 6: (A) Interface with timer for automated regulation of the units feed. (B) Second fine bubble diffuser. (C) New TMP pressure gauge. (D) UPS for the unit's protection. (E) New plastic supports. (F) Flow switch for pump protection.

Task 34.3 Implement the monitoring and supervisory system (M12-M24, TELINT, NTUA)

The work in T34.3 has been completed according to plan and has been reported during the previous progress report. However, several improvements have been made that were part of the amendment. Specifically, the HW and SW platform has been further extended in order to connect to a weather station installed at Pilot's site (KEREFYT) and incorporate real-time weather sensor data into the cloud based User Interface. For the integration of the weather data the same communication interoperability layer (based on OGC standards) has been used, extending the User Interface to visualize the respective data. It is remarked that the end result was a 'plug-and-play' configuration, meaning that no further development was required in the dashboard to accommodate the newly-added sensors. The data displayed is: rainfall, air temperature, relative humidity, and wind speed.

Task 34.4 Demonstrate the impact of the solution at the city-as-a-catchment scale and identify opportunities/barriers (M12-M48: NTUA, Ecologic, DHI, Adelphi)

Beside the methodologies developed to support the decision making process of up scaling sewer-mining technology at a city-level (reported in the previous progress report) during this period we completed the work related with the ESS valuation framework. Specifically, we finalized the estimation of groundwater scarcity mitigation. Groundwater extraction was the "business as usual" scenario -and alternative to the sewer-mining unit- for watering a park. With constant extraction cost, we estimated the *scarcity cost* in time as more groundwater was extracted, not being available in the future. When the total extraction price met the price of the sewer mining technology, the latter became the main solution (**Figure 7**A) (see also Deliverable 34.4 for detailed analysis). In addition we completed the simulation on the impact of the park's watering on local temperature and further on the household energy budget for heating and cooling, as the main ecosystem service based on a U-shaped relationship (**Figure 7**B), which reflected increased energy use for cooling or heating across external temperature deviations from a bioclimatic optimum. After identifying the relationship between temperature and electricity use, *before* and *after* the park's watering of the we calculated the benefits that a model household's (parents and two children) would have in its energy bill. These savings were also a bulk estimation of the maximum annual amount that this model household would be willing to pay for microclimate regulation services via sewer-mining.

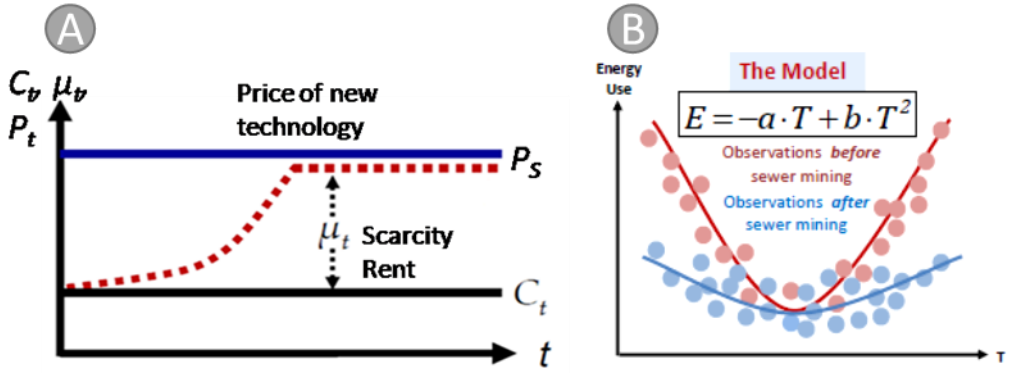

Figure 7: (A) Theoretical depiction of groundwater scarcity pricing; (B) theoretical depiction of microclimate regulation services as distribution of observations before (red) and after (blue) sewer-mining.

Finally, we concluded the discussion on the possible economic benefits for the area as well as the unit's business model. The main benefit from the local environment's upgrade was estimated to the higher number of tourists for recreation. Secondary benefits concerned the development of new economic activities, such as urban bio-farming and environmental education. For the sewer-mining technology's business model, we identified two (2) candidates, which were mutually exclusive: (1) A centralized operation from the municipal water company that would offer the full range of sewer-mining services and take all business benefits and risks. (2) A public-private partnership, where private companies (eg. SMEs) offer the full range of services taking all business benefits and risks, while the public company continues to hold property of the network, receiving a rent for its use.

2.2.8 Work Package 35 – Llobregat Demonstration: Flexible ASR system to recharge different water qualities

Objectives

To demonstrate increase of fresh water availability in the Mediterranean coastal region by deep injection systems (ASR) with variable water qualities. Specific objectives are:

- Validate the pre-potable water suitability at full-scale using the existing facilities of the drinking water operator (AB) in the Llobregat basin.
- Assess the beneficial effect of this technique in terms of ESS enhancement and economic approach to include these services in a regulated payment system.
- Adapt the methodology of flexible ASR systems to be applicable to other European sites to provide ASR facilities with a most versatile operation to cope with global change in water scarcity regions.

Progress

The data gathered during the one year that the injection system was in operation (from July 2015 until July 2016) was considered enough and therefore this last reporting period has been used mainly to analyze it and extract conclusions and share it to stakeholders. The collected data from the sampling campaigns of the piezometers was analyzed using statistic methods in order to evaluate the benefits and potential risks. The results have shown the benefits of the pre-potable water recharge without presenting operational problems in the demo well and therefore Aigües de Barcelona as owner of full-scale recharge plant, is convinced of applying the project results and start recharging with pre-potable water when the facility will be ready in 2021.

As it was done in the previous reporting periods, the project advances has been presented to the local stakeholders: Catalan Water Administration, Public Health Administration and Aquifer Users Community. Catalan administration it is the responsible to give the permit in near future to Aigües de Barcelona in order to be able to inject pre-potable water so it is of special interest their final agreement of project results.

Although the suitability of pre-potable water for aquifer injection, in order to tackle the associated environmental risks it was also developed a roadmap for a managed aquifer recharge safety plan implementation, that could be applied in the full-scale implementation and will serve as a guidelines for future aquifer recharge projects around Europe.

It was also evaluated the changes in ESS resulting from a full-scale injection of pre-potable water in the Sant Joan Despí and Cornellà area using the DSS Module developed in WP23 and the aquifer modelling of the full-scale implementation impact. It was also developed the economic analysis and payment regulation of the identified ecosystem services in the Barcelona demo site including the main characterizations: biophysical (including the whole hydrogeological media) and social aspects (analysing the population and the stakeholders).

Table 8: WP 35 – Progress on deliverables and milestones due during this reporting period

D / MS number		Title	Delivery date (project month) according to Annex I	Status*
D35.1		Evaluation of the results and impacts on ESS of a flexible ASR system in Barcelona (ES) demo site. Guidelines and recommendations for transfer this innovative solution.	M48	submitted (see list of partial deliverables)
Subdivisions D35.1	D35.1(A)	Conditioning of existing network of observation wells: Hydrogeological information acquired during field works in Sant Joan Despí.	M48	Submitted
	D35.1(B)	Numerical Model of flow and conservative transport: Evaluation of the impact of the injection and extraction regime in the ASR system in the aquifer of Lower Valley and Llobregat River Delta.	M48	Submitted
	D35.1(C)	Hydrogeochemical impact of ASR using pre-potable water in Barcelona.	M48	Submitted
	D35.1(D)	Guidelines and recommendations for ASR implementation using pre-potable water.	M48	Submitted
D35.2		Economic analysis and proposed payment regulation of the identified ecosystem services in the Barcelona demo site.	M48 → M50	Submitted
MS29		Completed installation of ASR pipelines and potential pre-treatment pilot plant.	M15	Achieved
MS30		Identification of beneficial impacts and its role as ecosystem services in the Llobregat case study.	M30	Achieved

Significant Results

- Statistical analysis of all measured groundwater parameters (both physical and chemical) and the comparison between native groundwater, potable water recharge and pre-potable water recharge allowed to assess the innovation benefits, especially in aquifer salinity reduction, and their compliance with reference aquifer quality values.
- Development of the concept of Managed Aquifer Recharge Safety Plan in order to assess the environmental and risks of the pre-potable water injection and as an adaptable methodology to be applicable to other European sites to provide flexible ASR.

- Validation from the facility operator (Aigües de Barcelona) and administration authority (Water Catalan Agency) of the demonstration positive conclusions and achievement of their willingness for bring the innovation to the full-scale implementation when the facility will be ready in 2020.
- Final workshop was held on December 12th in Barcelona with more than 100 people from different public and private companies where demonstration results had been presented and where international experts like Emilio Custodio and Enrique Fernandez Escalate (also reviewer of DESSIN) has been invited to discuss about the topic.
- Evaluation of ESS in Llobregat Demo site and economic analysis and payment regulation approach

Reasons for deviations from Annex I and impacts on resources and planning

There were no deviations from Annex I.

Reasons for failing to achieve critical objectives and impacts or for not being on schedule

All critical objectives for this reporting period were met. Work is on schedule.

Corrective actions needed

No corrective actions needed.

T35.3 Evaluation of the impact of the injection with pre-potable water by groundwater and recharge water monitoring (M26-M40, CETaqua)

Within this reporting period all the data analysis work from the one year pre-potable injection was carried out. Physicochemical parameters (TOC, TIC, hardness, conductivity, suspended solids, turbidity, heay metals…), Microbiologic parameters (E.Coli, C.Perfringens, Virus, Aeromonas…) and Organic pollution parameters (BTEX, Halogenated compounds and emerging pollutants) sampled in the different control points, have been evaluated by time and space and compared with native groundwater, potable groundwater. The conclusion is that pre-potable water fulfill with all existing quality thresholds and diminish aquifer salinity. However, as pre-potable water could contain some traces of disinfection by-products or emerging pollutants, we developed a concept of managed aquifer recharge safety plans in order to control all the environmental associated risks.

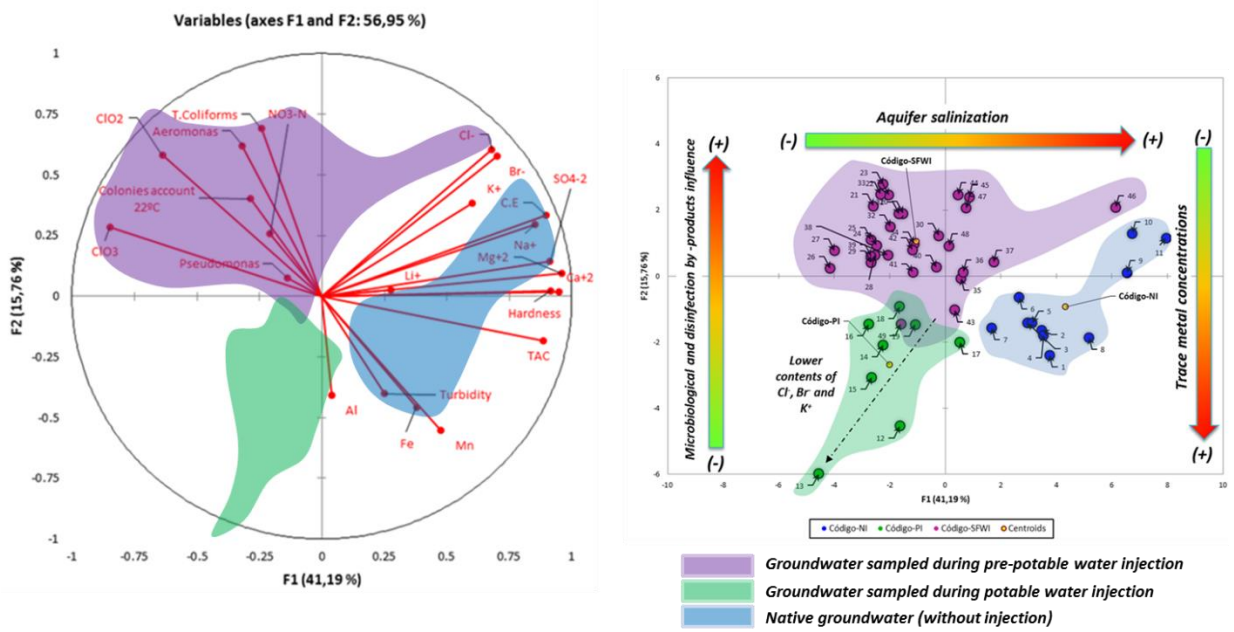

Figure 8: Impact evaluation of the injection with pre-potable water

T35.4 Advanced hydrogeochemical modelling: application to the case study and calibration with real data (M20-M44, CETaqua)

After the modelling of two first regional scenarios with the VISUAL TRANSIN software (described in deliverable D.22.4.C), and the modeling and calibration of local model with MODFLOW software, in the present reporting period has been modelled two other hypothetic regional scenarios considering an Aquifer Storage, Transfer and Recovery approach (ASTR). Although this scenario is not viable in the near future, it represents a possible integrated water management strategy for the future.

T35.5 Valuation of the changes in ESS resulting from a full-scale injection of pre-potable water in the Sant Joan Despí and Cornellà area using the DSS Module developed in WP23. (M36-M48, CETaqua, A21).

In this task, Amphos 21 has evaluated the changes in ESS using numerical models. Hydrogeological media is a very complex and the groundwater flow and transport of contaminants are governed by different equations, which are affected by several local disturbances. A DSS do not allow to take into account all these aggregated effects and DSS is used only to evaluate time series where existing. Most important ESS services changes in full-scale injection of pre-potable water are related with provisioning ESS (water for human and non-human consumption and Regulation ESS (groundwater storage as a reservoir). The injection of water in the aquifer will reduce water salinity

from 0 to 70% depending on the point location. The water levels will increase in nearby wells around 4 to 7 meters. As a result, some related wetlands will improve their quantitative and qualitative status. The main beneficiaries are industries. These will need less energy to pump groundwater and the treatments that they will require in water for industrial processes will be less reducing the costs. On the other hand, local water agencies will become an important beneficiary as the increase in groundwater recharge will reduce the pressure in the need of having an additional strategic resource in case of drought. These changes in ESS will bring economic savings higher than the measure investment costs.

T35.6 Development of a methodological approach for economic analysis and payment regulation of the identified ecosystem services in the Barcelona demo site (M36-M48, A21).

This task has included two main characterizations: biophysical and social. Biophysical analysis has included the whole hydrogeological media in order to evaluate all biophysical changes in the delta area once the measures are implemented. On the other hand, the social aspects have been evaluated analysing the population and the stakeholders. The objective is to define the potential social barriers to the implementation of this measure and the aspects to be reinforced. One of the barriers of the measures implementation is economic, the investment cost. The implementers are not the only beneficiaries of the measure and the fact that other users or competitors can result positively impacted can put the measure back away. In this task, as a consequence, the payments for environmental services (PES) have been evaluated. As the payments provide incentives to land owners and managers, PES is a market-based mechanism, similar to subsidies and taxes, to encourage the conservation of natural resources. A total of 104 semi-structured interviews have been conducted to evaluate the population knowledge on groundwater and water resources together with the level of importance that they give to natural ecosystems and their maintenance. The questionaries' asked also about their willingness to pay ecosystem restorations (and changes in ESS) in order to evaluate the measure potential acceptability. The project analyse different payment structures and strategies to better implement MAR in the Llobregat Delta Area.

2.2.9 Work Package 41 - Dissemination of DESSIN and development of its demo-sites as showcases

Objectives

The objectives of the dissemination and exploitation of the project results towards the scientific and commercial sector are:

- Ensuring a successful run-time and final dissemination of project results to all relevant stakeholders.
- Facilitating the market deployment and exploitation of the technologies through the organization of different events at the participating utilities and tailored workshops.

To achieve these goals, the methodology followed within WP41 consists of:

- Project Branding: A strong and recognizable brand is essential for a European research project. Recognition value and a consistent appearance remarkably help to transport the important results and outcomes of the project.
- Setting up and maintaining the website and its contents: These days the internet is one of the most powerful communication vehicles and one of the main sources for information. The project will have its own project-specific website domain.
- Public project correspondence and dissemination material: In order to ensure a widespread uptake of project results by relevant end-user groups and in order to reach the different target audiences, there is a need to translate scientific understanding and knowledge into convincing messages that are specifically tailored for the respective target audience. The preparation of dissemination materials will be coordinated on the basis of a concise communication strategy for DESSIN outcomes, consisting of a thorough target audience analysis and an exploitation strategy. This consists of editorial and publishing activities such as the release of an annual DESSIN Magazine, articles, general and specialized press releases, a suite of promotional material, etc.
- Establishing demo-sites as showcases: This will help to establish DESSIN demo-sites as reference sites for lighthouse-solutions that can be presented to various audiences such as interested water managers from other regions with similar challenges.

Progress

Table 9: WP 41 - Progress on deliverables and milestones due during this reporting period

D / MS number	Title	Delivery date (project month) according to Annex I	Status*
D41.2	Website news	continuously	Produced
D41.3	Annual Magazine #3	M40	Produced
	Newsletters #5 and #6	M43; M47	Produced
	Final Magazine	M48	Produced
	Final Video	M48	Produced
D41.4	Established showcases at five demo-sites	M48	Completed

Significant Results

During the 36th to 48th month period of the DESSIN project, the communication and dissemination activities have been focused on developing different materials for the final dissemination of the project results. Following the project progress, materials such as 2 newsletters, 1 Annual Magazine, 1 Final Magazine, 2 Final Videos or the news at the website have been used to explain the steps made by the DESSIN team, the main achievements and results of the project.

Reasons for deviations from Annex I and impacts on resources and planning

There were no deviations from Annex I.

Reasons for failing to achieve critical objectives and impacts or for not being on schedule

All critical objectives for this reporting period were met. Work has been on schedule.

Corrective actions needed

No corrective actions needed

Task 41.2 – Setting up and maintaining the website and its contents (Setting up M1-M3; maintaining M3-48)

The DESSIN website (www.dessin-project.eu) has been maintained and served as an information source for the DESSIN project and as a principal outlet of informational products about or coming from DESSIN, such as deliverables or the DESSIN newsletter and magazine.
The internal area was used by DESSIN members to allow them to share their work in progress, and to be able to receive minutes, presentations, project templates, internal documents, among other things. The continuously updated blog on the DESSIN website has updated and informed DESSIN members and interested readers about the progress of the project and served as a comprehensive source of information and motivation.

Task 41.3 – Public project correspondence and dissemination material (M1-48 CETaqua)

Each produced dissemination material has served a different purpose:

- **Website news**: The news available at the project website (dessin-project.eu) are used to be aware of DESSIN evolution and to disseminate the communication materials and deliverables of the project.
- **Newsletter:** Newsletters are an online material used to explain the progress of the project to interested audiences. In particular, each newsletter includes information about one demo-site, an interview to the demo-site leader, the latest news on the project and a list with the upcoming events.
- **Annual Magazine**: The Annual Magazine is an online material (can also be printed) explaining the progress and works of the project.
- **Final Magazine:** The Final Magazine is an online and printed material based on the Annual Magazine that gives an overview of the project context, objectives, the ESS Evaluation Framework and includes an explanation of the five demo-sites and its main results referring to Ecosystem Services. It is used for the final dissemination of the project to interested audiences and different stakeholders.

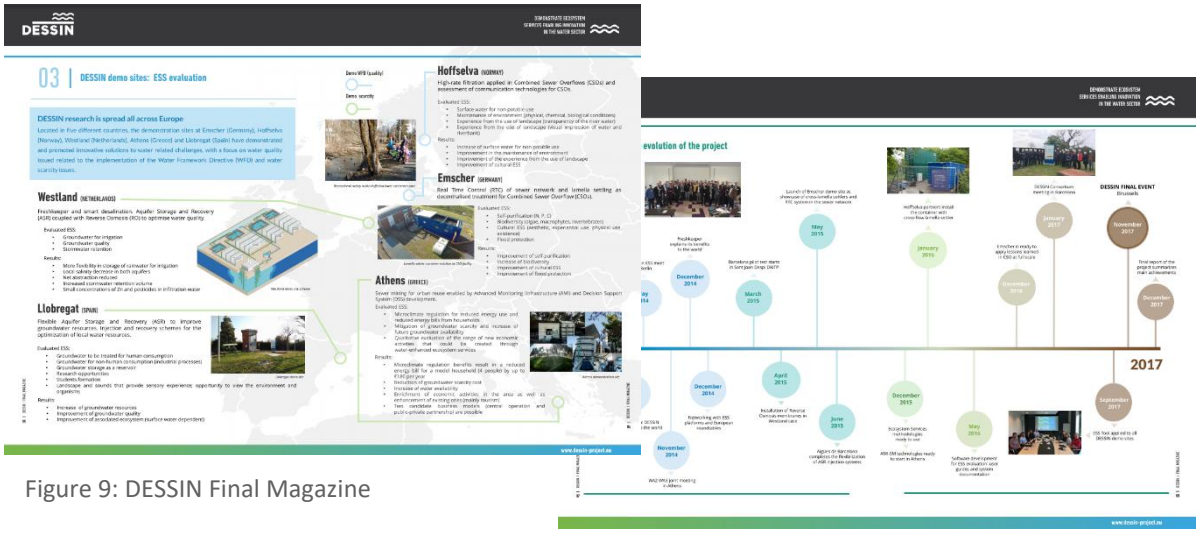

Figure 9: DESSIN Final Magazine

DESSIN Video: The DESSIN video serves to show the context, the objectives and the research developed within the project, as the ESS concept and the ESS Evaluation Framework, to a general audience. Two version of the video have been produced:

- **Long version:** this version includes an explanation of the solution demonstrated at each demo-site and the main results obtained.
- **Short version:** the short version only offers a general overview of the project context, objectives and main results. This version has been produced for online distribution through online channels, such as social media.

Figure 10: Frames from DESSIN Final Video

Task 41.4 – Establishing demo-sites as showcases (M1-48 KWR)

During this last period, the showcases have been successfully implemented at all demo-sites. The videos from the Athens, Llobregat and Hoffselva demo-sites have been produced and are available in the DESSIN website.

For the Emscher case, three movies have been produced and are presented in the M36 report.

The video from the Hoffselva demo-site shows the local treatment solutions for the overflow from

Figure 11: Frames from the Hoffselva demo-site video

CSOs to the Hoffselva river. (https://dessin-project.eu/?p=2490)

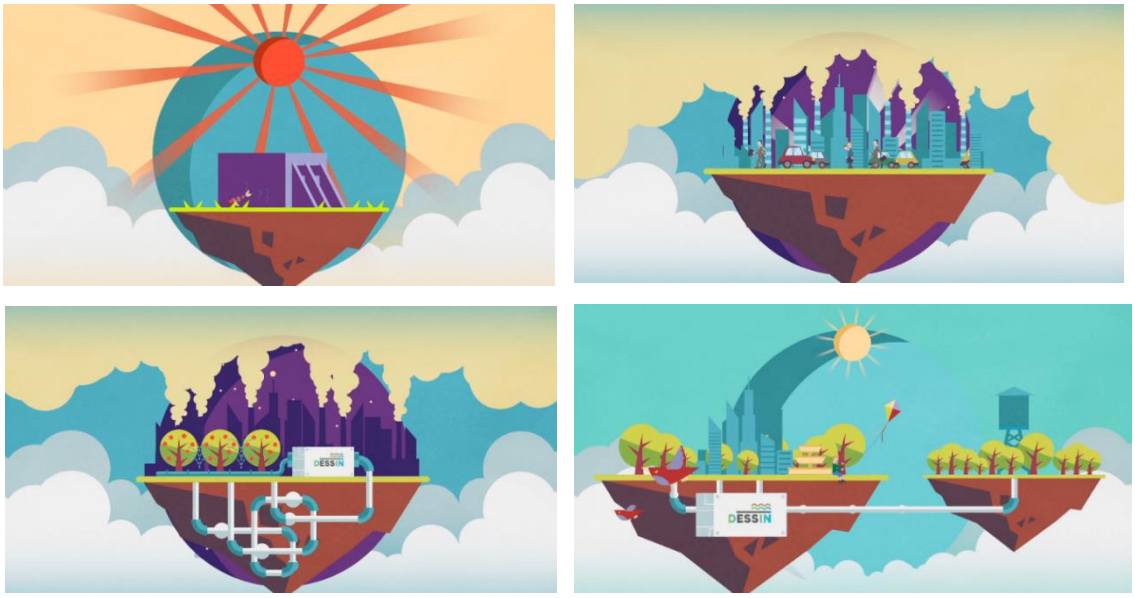

Figure 12: Frames from the Athens demo-site video animation

In the case of Athens, an animation of the concept of sewer mining has been made in order to explain the proposed solution to a general public. (https://dessin-project.eu/?p=2232)

The animation video from the Llobregat demo site shows the pre-potable injection system proposed within DESSIN, which has been successfully tested in Aigües de Barcelona facilities. (https://www.youtube.com/watch?v=4WQOXtZanww&t=14s)

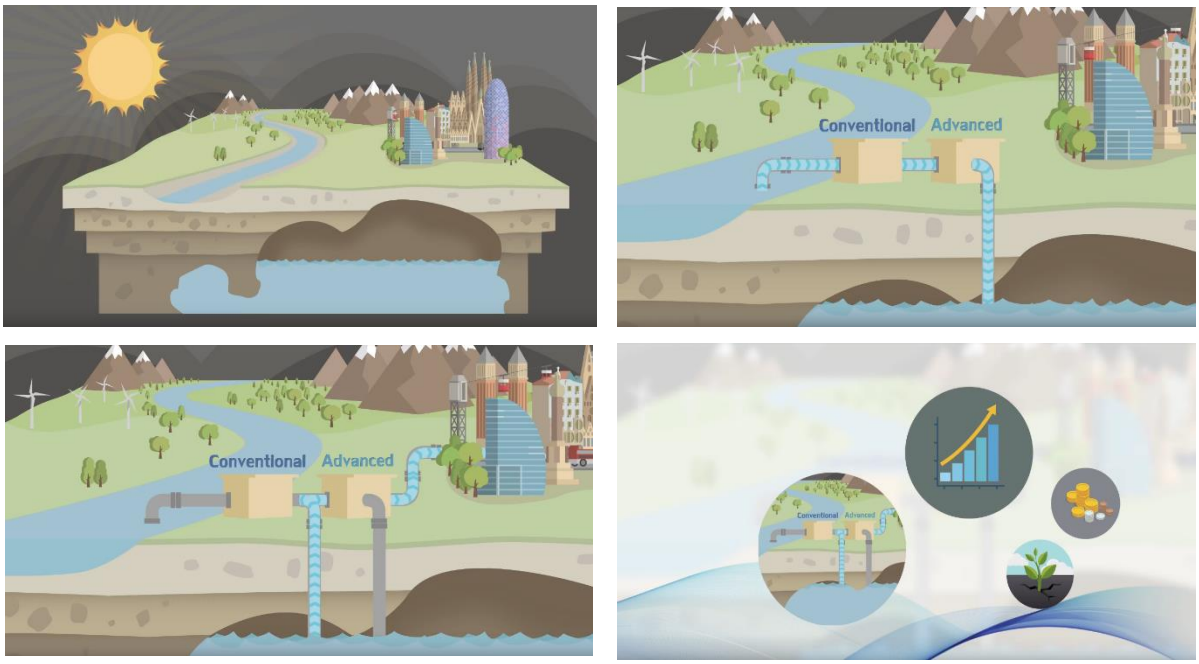

Figure 13: Frames from the Llobregat demo site video animation

2.2.10 Work Package 42 – Route to Market

The overall objective of this WP was to maximize the market reach and impact of the water technologies, methodologies and innovative solutions developed in WA1 and WA2 and demonstrated in WA3. WP41 will work in order to achieve market readiness of products/services developed with regard to water quality (WFD), water scarcity and ESS assessment.

Due to resource constraints and for lack of capacity, SMEs are particularly challenged by this step. Assistance in the area has long been proven to be necessary and effective (e.g., German technology support fund), by promoting an approach of prototyping, testing and verifying solutions in the water technology field, SMEs' capacities to develop marketable products and services can be built. DESSIN further seeks to identify entry points to the market and pave the road to market (by addressing and overcoming typical market barriers and proactively promoting the uptake of these solutions among potential clients).

On the other hand, decision-making support will be made available to the demand side which demonstrates the long-term superiority of ESS based approaches. To this end, the ESS valuation methodology itself needs to be promoted, establishing a new standard in water management decisions. This step will also create positive innovation dynamics by the supply side, demanding further solutions in the field. This in turn further incentivizes SMEs to innovate.

Objectives

- To support supply side push for water technologies by developing sample development approaches
- To assure international (European and beyond Europe) market uptake of water technologies, by addressing and overcoming market barriers and promoting solutions
- To create demand side dynamics to further stimulate water technology innovation

Progress

According to the grant agreement, four tasks, two deliverables and one milestone are relevant for the third project reporting period (M 36-48). No major delays are caused by WP42. In fact, all tasks have been completed in due time. The tasks 42.2, 42.4, 42.5 and 46.6, which were *active* for 36 months or longer, come to an end with month 48. Milestone 42.2 which was already due in month twelve and to be reviewed in month 25, has finally been fully implemented as required by the grant agreement ("*finalized and implemented at M 30-48"*) and an up-to-date version (as of November 2017) of the *Monitoring and Evaluation Platform* is freely available via https://dessin.adelphi.de/. A summary of all tasks, deliverables and milestones that are relevant for the third reporting period is given in the following table.

Table 10: WP 42 – Progress on deliverables and milestones due during this reporting period

D / MS nunber	Title	Delivery date (project month) according to Annex I	Status
D42.2	Sample commercialization process maturity models and capacity building on strategies for SMEs	M48	Submitted
D42.4	Recommendations from the open ESS channels: European platforms, roundtables, conferences and web platform	M48 → M49	Submitted
D42.5	M+E system for innovation and continuous monitoring of framework conditions and outcomes	M48 → M49	Submitted

Significant Results

- A freely accessible online platform (https://dessin.adelphi.de/) for monitoring and evaluation of selected countries for a prospective market entry has been developed. The platform serves as a tool for small-and medium sized enterprises to assess the suitability different countries for a market entry based on a set of indicators (e.g. market conditions, governance and finance).
- Upon the SMEs' request, specific market studies were conducted for Berlin, Hamburg, Cologne as well as the Sauerland and Ruhr areas (*Ruhrverband*) in which specific challenges for the respective water utilities are scrutinized.
- DESSSIN has been presented and promoted at the European water sector's major international events e.g. the EIP Water Week, WSSTP and the European Week.

Reasons for deviations from Annex I and impacts on resources and planning

There were no deviations from Annex I.

Reasons for failing to achieve critical objectives and impacts or for not being on schedule

All critical objectives for this reporting period were met. Work is on schedule.

Corrective actions needed

No corrective actions needed.

Task 42.2 Develop Sample Commercialization Process Maturity Models and capacity building on strategies for SMEs (M 6-48)

Task 42.2 stretched over 42 project months and captured various activities that have been conducted within DESSIN in order to support SMEs in commercializing their technologies and services that relate to water-related ESSs. Based on these activities, a six-step sample commercialization approach was deducted consisting of a (1) business environment analysis, (2) market analysis, (3) monitoring and evaluation of the business environment (4) capacity building and training of SMEs, (5) lobbying for ESSs valuation and (6) promotion of innovations based on water-related ESSs.

In addition, upon request, SMEs were supported with a framework analysis about combined sewer overflows in Cologne (Germany) and cities in Northern Germany. Individual consulting services on intellectual property rights and capacity building trainings posed further support for SMEs in commercializing their services and technologies. Moreover, commercial goals of SMEs were partially supported through involvement of DESSIN SMEs in new proposals for research projects.

Task 42.4 Support ESS lobbying for efficient modes of governance and finance (M 12-48)

Task 42.4 summarizes experiences on ESSs lobbying for efficient modes of governance and finance that were gathered during the DESSIN project. It pursues the ultimate objective of maximizing the market reach and impact of water technologies, methodologies and innovative solutions from work package 1 which were put into practice as part of work package 3. The strategy paper covers aspects pertaining to the marketization of the proposed ESS valuation methodology within the European Union (with a particular focus on Germany and the Netherlands).

Due to resource constraints and lacking capacities, SMEs are particularly challenged by commercialization of innovative technologies. Therefore, decision-making support needs to become available to the demand side which demonstrates the long-term superiority of ESSs-based approaches. To this end, the ESS valuation methodology itself was promoted through participation in European knowledge exchange platforms and ESSs roundtables in which the success of DESSIN approaches was highlighted in order to promote a new standard in water management decisions. This step also aimed to create positive innovation dynamics by the supply side, demanding further solutions in the field, - which in turn incentives SMEs to innovate.

Task 42.5 Create demand side dynamics by promoting standardized ESS-based assessment framework for new technology and management (M 8-48)

The main objective of task 42.5 was to promote inclusion of ESSs-based assessments into decision making processes of prospective end-users of DESSIN technologies as well as relevant decision

makers. Based on these promotion activities, demand-side dynamics were created for DESSIN solutions.

The task built upon the developed assessment framework for ESSs valuation that demonstrates the benefits of water-related ESSs among prospective end-users and decision makers.

Task 42.6 Establish a monitoring & evaluation (M+E) system for innovation and continuous monitoring of framework conditions and outcomes (M 5-48)

Task 42.6 strongly supported setting up an indicator system to keep track on both, progress and impediments of framework conditions for marketization of innovative products and services which were demonstrated within DESSIN.

The objective of the monitoring and evaluation platform (https://dessin.adelphi.de/) is an online tool which supports entrepreneurs in identifying opportunities for applying their innovations in selected target regions (*country level*). In order to ensure uninhibited dissemination of the monitoring and evaluation platform, it is freely accessible to anyone with internet access. The underlying indicator data base ash been reviewed as of November 2017 (month 47).

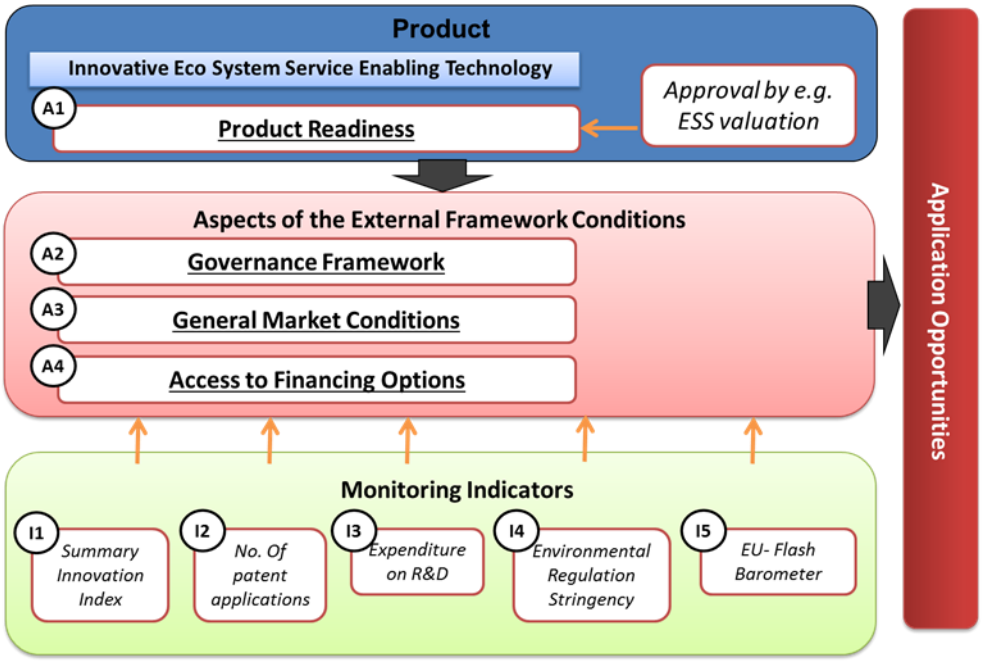

Figure 14: Monitoring and Evaluation platform

3 Project Management during the period

Management activities in DESSIN serve to co-ordinate, monitor and guide the progress of the project, in order to ensure that the objectives are met. To achieve these aims, a simple and efficient management structure has been used, with clearly defined roles and responsibilities, a transparent decision making process, clear reporting lines and strong progress monitoring. DESSIN has the following main internal management structures:

- Project Steering Board with representatives of all project partners.
- Project management with the Project Coordinator and the Project Management Team.
- Work Area Management Team (WAMT) with leaders of the 5 Work Areas
- Work Package Management with 9 Work Package leaders for 14 Work Packages (some partners lead more than one Work Package).

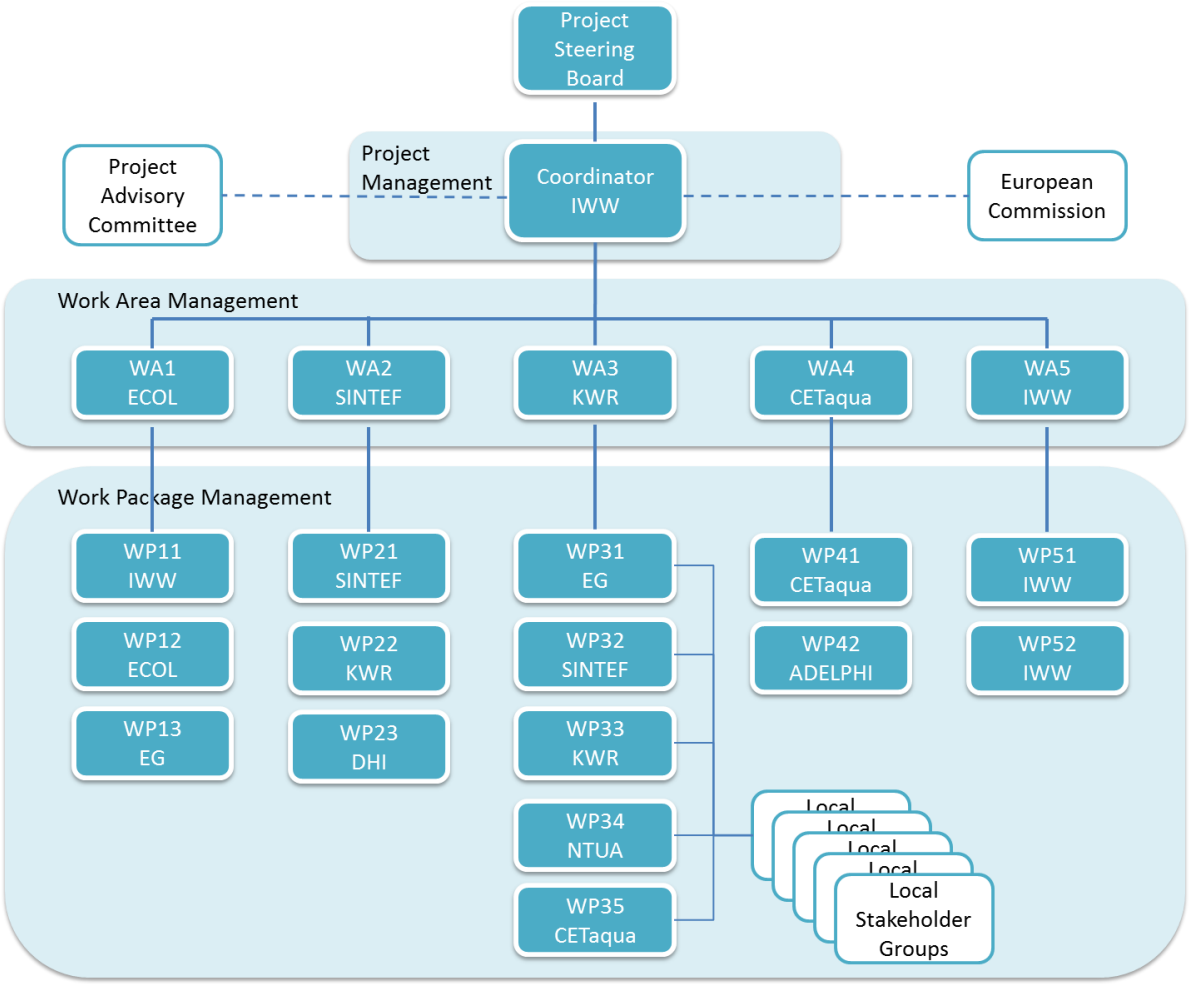

Figure 15: Project management structures of DESSIN

The Project Steering Board (PSB, chaired by the coordinator) is a representative body of all DESSIN beneficiaries, and the ultimate decision-making and arbitration body. Each beneficiary has one representative with voting rights in the PSB. It discusses and makes decisions on issues related to the general progress of the project, e.g.: Project implementation and evaluation of milestones and deliverables; overall course of the project and strategic changes if required (contingency plan); Review, if necessary, of the initial work plan and reallocation of resources and tasks; Publications, exploitation and dissemination of results; Administrative, legal, contractual and financial status and development; Intellectual Property Right (IPR) matters that go beyond regulations laid down in the consortium agreement; Approval of the contractual reports before submission to the EC services.

The Project Coordinator (David Schwesig, IWW) is responsible for the day-to-day coordination of the project and is the main interface between the Consortium and the European Commission. He ensures that work progress is in accordance with the timetable, and carries out the following tasks:

- Coordination of all project activities.
- Monitoring of progress and collection / compilation of scientific and financial reports.
- Communication with the EU Commission.
- Information management and facilitation of internal communication.
- External communication.
- Organisation (and chairing) of PSB meetings and WAMT meetings.

The Project Coordinator is supported by a Project Management Team composed by other members of the Project Coordinator's organisation, for support in administrative, financial, contractual and organisational matters.

The Work Area Management Team (WAMT) consist of Work Area (WA) leaders who are also leaders of at least one Work Package (WP) in their WA. They have an overview of the WP activities and maintain close communication with the WP leaders. In particular, the WA leaders carry out the following tasks:

- Synchronisation between the WP leaders in the same WA.
- Supporting the Coordinator in co-ordination of all horizontal activities among the WAs.
- Providing input to the Coordinator for the contractual reports to the EC.

Together, the WA leaders form the Work Area Management Team (WAMT). They have monthly meetings (usually as phone conferences chaired by the Project Coordinator) to discuss progress within the WAs and the need for any corrective measures. Two meetings per year are face-to-face meetings, preferably back-to-back with other DESSIN events. The WAMT discuss progress, budget and arising issues in more detail than can be done by the PSB, e.g. down to the WP and task level. They discuss and propose solutions in case of:

- Foreseeable difficulties in a WA / WP to achieve the planned deliverables.
- Need for harmonisation of activities between and across WAs.
- Obstacles and barriers causing delays in progress, in particular if this is likely to affect other WPs / WAs that need the output of another WP / WA as a starting point.
- Need for reallocation of tasks within or among the WPs / WAs if needed.
- Weak performance or malfunctioning of a partner.

WA and WP leaders are the first source of intervention when there is a lack of progress in a WA or WP. Together with the Project Coordinator, the WAMT decides whether an issue can be tackled internally or will have to be communicated to and decided by the PSB.

In matters where a decision by the PSB is required such as a reallocation of budget and tasks or the request for an amendment of the Description of Work (DoW), the WA leaders support the Project Coordinator in developing a proposal that can be made to the PSB for decision.

For the sake of maximum transparency of project management and decision-making, minutes of WAMT meetings are made accessible to all partners at the internal members' area of the project website (www.dessin-project.eu).

3.1 Consortium management tasks and achievements

During the reporting period, the following achievements were made with regard to the project management and consortium management tasks:

3.1.1 Organization of meetings

Smaller meetings at the level of tasks, Work Packages or Work Areas were usually organized and carried out by the leader of the respective activity. Larger meetings involving more than one work area were organized by the Work Area Management Team with strong support by the Project Coordinator. A table of all project meetings is provided inTable 11.

During the third reporting period, the following larger meetings involving a larger number of Work Areas were organized:

- The second periodic meeting (PSB36) which actually took place in M37 (25-27 January 2017, Barcelona, Spain) was organized and prepared by the coordinator and the WAMT, in close collaboration with the local hosts (beneficiary CETaqua and its linked third party Aigües de Barcelona).
- A meeting of all Work Area leaders with the EC project officer and two external reviewers took place as part of the mid-term review process in March 2017 (see section 3.1.6).
- The third periodic meeting (PSB48) and final project event took place in M47 (28 Nov 2017, Brussels, Belgium) and was organized and prepared by the coordinator and the WAMT. The final event also had a public part (half-day afternoon workshop) that was jointly organized together with the working groups "Ecosystem Services" and "Green Infrastructure" of the European Water Supply and Sanitation Technology Platform (WssTP). For this workshop, not only DESSIN results were presented, but also other projects working in the same field were invited to present their results. The main objective of the workshop was to discuss how Ecosystem Services, Nature-Based Solutions and Hybrid Grey-Green Infrastructure can support innovation in the water sector and help tackle water-related challenges.

3.1.2 Coordination across Work Areas and Work Packages and progress monitoring

This was mainly taken care of by the Work Area Management Team (WAMT) during its monthly phone conferences and the 1-2 face-to-face meetings per year. The monthly meetings were usually carried out as 60-90 minutes meetings, prepared by the Project Coordinator. They were following a standardized agenda. As a main tool, a simple Excel-spreadsheet (Project Management File) was used to keep track of a) all tasks agreed at the WAMT, b) all decisions taken by the WAMT, c) progress, status, delivery date, QA/QC measures and corrective measures with regard to all contractual items (deliverables and milestones) and d) project events and dissemination activities. Minutes of the meeting and an updated version of the (Project Management File) were prepared by the coordinator and circulated for approval within 10 working days. After approval, file and minutes were uploaded to the internal area of the project website, accessible to all project partners.

3.1.3 Facilitation of internal communication

DESSIN was a large and complex project with 20 beneficiary institutions, and about 100 people directly involved in the project work. So there was a clear need for structured and facilitated communication in order to ensure a smooth collaboration. Several measures have been taken in order to facilitate internal communication among the project partners.

As the most important measure, general communication in the project was organized in a hierarchical way according to the project management structure. Decisions at the level of the Work Area Management Team were communicated by the Work Area Leaders to the Work Package Leaders, and from there to the leaders or teams that were responsible for Deliverables, Milestones or Tasks. Information that was of general interest to all partners (e.g. reporting tasks for the first periodic report, invitation to general meetings, information about general agreements) were distributed on a case-to-case basis by the Project Coordinator directly to all partners. Furthermore, the monthly WAMT teleconferences both allowed the coordinator to maintain a watching brief on unscheduled bilateral initiatives between partners and provided a forum for the discussion of immediate challenges which WA Managers face, providing opportunities for collaborative problem solving.

The project used an Excel-based contact list that was continuously updated by the coordinator and available at the DESSIN intranet part of the project website. This contact list contained names and contact details (e-mail, phone and fax number) of all project participants, and each person was linked to the items (Work Areas, Work Packages) which he/she was leading or participating in. For any given item, the responsible team could therefore be easily identified and contacted.

Furthermore, the website's internal area also contained sections for downloads, results, events etc., where additional material could be provided (e.g. minutes and slides of meetings, announcements of events, internal guidance documents on project rules or common definitions, publications, project templates according to the DESSIN brand and style guideline, contractual documents and reports). A regular e-mail newsletter summarizing new uploads, events, results and developments etc has been set up and was regularly sent to all project partners (unless they unsubscribe) and other interested external contacts.

3.1.4 Reporting to the European Commission

The Project Coordinator handled the reporting to the European Commission. In addition to the preparation of the official reports and amendment procedures for the Grant Agreement, he has been in contact on a less formal basis with the responsible EC project officer by mail and phone contacts. The EC project officer was invited to attend the kick-off, M18, M36 and M48 PSB meetings. During the third reporting period, the contractual reports for the second reporting period were prepared and submitted in time (on 28 Feb 2017). The first version of the report was rejected by the EC on 15 March 2017, because of the need for additional justification or explanation of a few cost items in the financial reports of some beneficiaries, but no critical points in the scientific/technical report. The financial issues were quickly solved and a modified version of the second periodic report was formally approved by the EC on 30 May 2017. The coordinator also managed the preparation and submission of the third and final report, based on comprehensive contributions from all beneficiaries and in particular the Work Area and Work Package leaders.

3.1.5 Handling of the financial contribution

Following the interim payment of the commission after the approval of the first periodic report, the coordinator has distributed the interim payment to the other beneficiaries. Distribution mode was based on a procedure that had been presented by the coordinator and approved by the Project Steering Board at the PSB18 in June 2015. The coordinator has prepared a procedure for distribution of the final payment that was presented at the PSB48 meeting on 28 Nov in Brussel, and was approved by unanimous consent. This proposal covers the mode of compensation between overspending and underspending partners as well as the timing of instalments, in case some EC contribution has to be recovered from 'underspending' partners prior to the final distribution.

3.1.6 Quality control of project deliverables

Two measures for quality control were implemented during the reporting period. First, the WAMT agreed on clear rules for the scientific review of deliverables prior to their submission. Each deliverable is reviewed by two independent reviewers. They can both be from the same Work Area that produces the deliverable, but one needs to be from another organization than the one responsible for the deliverable. Neither of the reviewers are an author or co-author of the deliverable. For milestone documents, it was decided by the WAMT that the responsible Work Area leader can decide on a case by case basis about the adequate quality control measures. For each document, the reviewers involved in the quality control are named in the document.

A second implemented quality control measure is the assignment of a Project Advisory Committee (PAC). The PAC consists of independent experts representing different categories of stakeholders.

The PAC provides independent external advice on the project operation and outputs, instigates or facilitates links to other initiatives and reviews the outcomes of the project. The Project Coordinator organised for the attendance of PAC members at the project kick-off meeting and also at a separate meeting of the PAC members during the kick-off.

Selected PAC members were invited as reviewers of some project outcomes (e.g., deliverable D11.2), and similar as in the PSB18 meeting, the PAC was invited to attend the 2nd periodic meeting (PSB36 meeting) in January 2017. Only one PAC member was able to attend, but he volunteered to organize discussion and consolidated feedback of the PAC to the project consortium based on the results provided so far, available deliverables and progress presentations from the PSB36 meeting.

For the 3rd periodic meeting (PSB48) none of the PAC members were able to attend the meeting.

The costs of PAC member attendance at these meetings (including reimbursement of travel costs for PAC members) were paid from the coordination and management budget within DESSIN.

As an additional quality control measure, an external review of the project progress and results was initiated by the EC services, involving two external reviewers.

The interim results of their review were discussed in detail in a face-to-face meeting in Brussels on 23rd March 2017 where the reviewers, the responsible EC project officer, the coordinator and the other WAMT members participated. The reviewers provided their consolidated review report on 11 April. The project officer decided that no formal actions need to be taken, but based on the comprehensive and valuable comments and suggestions of the reviewers (on non-critical issues), the project consortium decided (on a voluntary basis) to revise 16 deliverables. Submission of revised versions of these 16 deliverables was completed by 18 December 2017 (M48).

3.1.7 Re-adjustment of the work and amendments of the contract

The Project Coordinator was responsible for organizing the re-adjustment of tasks, re-allocation of budget, amendment of the contract with the EC and maintenance of the consortium agreement resulting from any problems like the ones described in more detail in section 3.2 (if any).

During the 3rd reporting period, there were some small changes in the work that required an adjustment (already indicated in chapter 3.2 of the 2nd periodic report), and this was solved by an amendment procedure to the Grant Agreement, approved by the EC on 30 October 2017.

The main topics of this GA amendment were:

- Budget shifts between the partners of the Athens demonstration case (WP34)
- Change of duration of WP22 and in particular T22.1 from M24 to M48
- Change of duration of T34.3 from M24 to M48
- Inclusion of beneficiary EYDAP in T34.3 and T34.4
- Budget shift from beneficiary TELINT to beneficiary DHI the software development in WP23.
- Changes in subcontracting budget for beneficiaries EYDAP, DHI, SINTEF, SEGNO and CETaqua.

All these budget changes were carried out without changing the overall maximum EC contribution as defined in the original version of the Grant Agreement.

Furthermore, there had been a request to postpone delivery date of deliverables D31.1, D31.2, D32.1 and D32.2 from M42 to M48. The project officer approved this request on 06 June 2017 without an amendment procedure.

3.2 Problems and how they were solved or envisaged solutions

There were no critical problems endangering the achievement of the project objectives or its impact. There were a number of minor challenges that were quickly solved as explained in chapter 3.1.7.

3.3 Changes in the consortium

During the third reporting period, there were no changes in the consortium.

3.4 List of project meetings, dates and venues

Table 11: Project meetings, dates and venues during the 3rd reporting period

Meeting	Date [yyyy-mm-dd]	Location
WAMT Meeting	2017-01-25	Barcelona, ES
PSB36 Meeting	2017-01-26 – 2017-01-27	Barcelona, ES
WP4 Meeting	2017-01-26	Barcelona, ES
SME Peer Exchange Workshop	2017-01-29	Barcelona, ES
WP21/WP32 project meeting	2017-02-14	Oslo, NO
CSO-run and sampling at demo plants	2017-02-15	Oslo, NO
WAMT Meeting	2017-03-07	Telco
WAMT Meeting	2017-03-21	Telco
Start of UFT demo plant	2017-03-22	Oslo, NO
EC Review meeting	2017-03-23	Brussels, BE

Llobregat WP35 Aigues de Barcelona - Cetaqua Meeting	2017-03-29	Barcelona, ES
UFT plant test and stakeholder meeting with Hoffselvens venner	2017-04-05	Oslo, NO
DESSIN presentation at Norsk Hydrologiråd and visit at demo plants	2017-04-24	Oslo, NO
Llobregat WP35 Aigues de Barcelona - Amphos21 - Cetaqua Meeting	2017-05-12	Barcelona, ES
CSO-run and sampling at demo plants	2017-05-19	Oslo, NO
Dessin's workshop for undergraduate and postgraduate students	2017-05-23	EYDAP, Athens, GR
Dessin's workshop for municipal water supply and sewage companies	2017-05-25	EYDAP, Athens, GR
CSO-run and sampling at demo plants	2017-06-13	Oslo, NO
WssTP meeting to present DESSIN at WG meeting and plan joint final event	2017-06-15	Brussels, BE
CSO-run and sampling at demo plants	2017-06-21	Oslo, NO
WP31.2: 2nd seminar at ifak	2017-07-17 – 2017-07-18	Magdeburg, DE
CSO-run and sampling at demo plants	2017-07-18	Oslo, NO
WAMT Meeting	2017-07-19	Telco
CSO-run and sampling at demo plants	2017-08-11	Oslo, NO
CSO-run and sampling at demo plants	2017-08-21	Oslo, NO
Stakeholder intervievs	2017-08-21	Oslo, NO
Presentation at SIWI World Water Week	2017-08-28	Stockholm, SE

WAMT Meeting	2017-08-30	Telco
WA3 meeting	2017-09-04	Telco
CSO-run and sampling at demo plants	2017-09-14	Oslo, NO
Llobregat WP35 Amphos21 - Cetaqua Meeting	2017-09-19	Barcelona, ES
WA3 Meeting: ESS evaluation of demo cases	2017-09-21 – 2017-09-22	KWR, Nieuwegein, NL
ESS Evaluation Meeting	2017-09-21- 2017-09-22	Nieuwegein (NL) + TelCo
Llobregat WP35 Aigues de Barcelona - Cetaqua Meeting	2017-09-27	Barcelona, ES
Llobregat Local Stakeholders Meeting	2017-10-02	Barcelona, ES
WA3 meeting	2017-10-09	Telco
European Week	2017-10-9 – 2017-10-12	Brussels, BE
Dismantling equipment at demo plant	2017-10-12	Oslo, NO
WAMT Meeting	2017-10-16	Telco
WA4 coordination meeting	2017-10-19	Telco
Dismantling equipment at demo plant	2017-10-19	Oslo, NO
Workshop Water banking in the Westland area	2017-10-28	Westland, NL
WAMT Meeting	2017-11-08	Telco
WP42 Meeting	2017-11-08	TelCo
WA3 meeting	2017-11-13	Telco
Llobregat WP35 Aigues de Barcelona - Cetaqua Meeting	2017-11-20	Barcelona, ES
Final DESSIN seminar at Oslo VAV	2017-11-23	Oslo, NO
EIP Water Innovation Week, several presentations of DESSIN	2017-11-24 – 2017-11-30	Porto, PT
PSB48 Meeting and joint workshop with WssTP	2017-11-27- 2017-11-29	Brussels, BE

Llobregat WP35 Aigues de Barcelona - Cetaqua Meeting	2017-11-30	Barcelona, ES
Llobregat WP35 Aigues de Barcelona - Cetaqua Meeting	2017-12-11	Barcelona, ES
Round table with DESSIN local partners	2017-12-12	Athens, GR
Llobregat final Workshop	2017-12-12	Barcelona, ES

3.5 Project planning and status

Project planning was facilitated by use of a simple project management spreadsheet containing all WAMT tasks and decisions, a detailed schedule for each contractual item (deliverables and milestones) with information about responsibility, expected delivery date, QA planning and status, corrective measures required etc. This was checked and updated during the monthly WAMT phone conferences and available to all project partners via the internal area of the project website. Short-term planning was mainly done during the monthly WAMT meetings.

At the date of this report, DESSIN has

- Delivered all its contractual deliverables
- Achieved all its milestones.

Hence, the project planning and status was well on track. Some contractual items were delivered or achieved with slight delays, but in all cases without critical impact on the overall project or its expected objectives and impact. Detailed information on the status of specific work packages and deliverables as well as information on their timeliness or any delays are given in the WA descriptions in sections above.

3.6 Impact of deviations from planned milestones and deliverables

See above sections on:

- “Problems and how they were solved or envisaged solutions”
- “Project planning and status”.

3.7 Changes to the legal status of beneficiaries

None during this reporting period. In November 2017, beneficiary Stiftelsen SINTEF informed the coordinator about a change of legal status immediately after the end of DESSIN (effective date 01 January 2018). The nature of the change is a partial transfer of rights and obligations (PTRO) from Stiftelsen SINTEF to a new entity SINTEF AS (PIC 910945140), which is a subsidy of Stiftelsen SINTEF. The new entity is already fully validated in the EC beneficiary register. The responsible EC project officer analyzed the situation in consultation with the financial unit. On 2nd February 2018 the EC project officer informed the Coordinator that no amendment of the Grant Agreement is necessary in this case.

3.8 Development of the project website

Detailed information on the project website (www.dessin-project.eu) is given in chapter 2.2 section on Work Package WP41. The website is continuously updated by a news blog with reports about progress and achievements of the project, and posting of public deliverables in the public download area of the website. The website will be active for five years after the end of the project, to ensure sustainability and long-term accessibility of our results and achievements. However, after the

formal end of the project, the DESSIN team will re-structure the website, e.g. remove the dynamic elements such as the news blog, and give more room to the presentation of results, tools, outcomes and success stories.

3.9 Possible co-operation with other projects and initiatives

DESSIN has established formal links to organizations, which are called “associated organizations”. This was initiated by key partners from the Athens case study (WP34, EYDAP and NTUA) who suggested to formalize collaboration with three technology companies that were associated in different ways with the setup and operation of the pilot in Athens, to become more involved in the project by conferring to them an appropriate project "status" or affiliation. This is not a matter of budget - simply improving their interest and buy-in as the case study partners think that these tech providers would be good partners in any post-project up scaling of the sewer mining technology. The coordinator was supportive of this idea and proposed a template for a LoI defining clear rules for this sort of interaction. The WAMT agreed with the procedure and the proposed LoI template in. These “associated organizations” are linked to a specific task or work package that is specified in the LoI. They do not receive any budget from the project but can participate in selected project meetings (except formal ones with voting and decisions), and can get first hand access to the results of the work, provided all partners involved in the generation of these results agree. The associated organizations will get additional visibility via the DESSIN website in a dedicated area where ‘associated organizations’ are highlighted. In the meantime, two organizations have entered into this agreement to become ‘associated organizations’ of DESSIN.

On a less formal basis, DESSIN has established links to some sister projects with a similar scope, in particular with the EC funded projects OpenNESS, AQUACROSS, MARS and SUBSOL. To all projects there are personal links, because DESSIN staff are either key partners or even coordinator of these other projects. Furthermore, these project have participated in joint events such as an ES meeting organized as side event during the EIP annual conference in Leeuwarden (Netherlands) in early February 2016, and by joint participation in a dedicated workshop on Ecosystem services organized by EC services on 29 Feb 2016 in Brussels. A draft of the ESS valuation framework developed within WA1 was presented to and discussed with the coordinator of the EU funded project OpenNESS to receive external feedback during the developmental phase. Via the partner UDE a direct exchange between the projects DESSIN and MARS was ensured. This allowed aligning the approaches developed in each project into the same direction, avoiding conflicting developments. SUBSOL is a Horizon2020 funded project that focuses on bringing subsurface water solutions to market. DESSIN partners KWR (as coordinator), NTUA and adelphi are involved in SUBSOL. Also, the Westland pilot is further developed in SUBSOL as reference case.

Furthermore, DESSIN has strengthened its link to the European Water Supply and Sanitation Technology Platform (WssTP). Links had already been established from the very beginning of DESSIN through making the WssTP director Durk Krol a member of the project advisory board. During the final year, DESSIN has made more concrete links to the WssTP working groups on

"Ecosystem Services" and "Green Infrastructure". This has materialized in a joint DESSIN-WssTP workshop "Water innovation through ecosystem services, nature-based solutions and hybrid grey-green infrastructure" on 28 Nov 2017, back-to-back with the WssTP "Water Knowledge Europe" event on 29-30 Nov 2017. This workshop with about 60 participants from the water sector, academia, regulators, technology providers and EC policy makers has also been the final event of the DESSIN project and a good measure to ensure further dissemination of DESSIN results through WssTP communication channels to its members.

4 Explanation on the use of resources: overall use and deviations

The explanation on the use of resources was removed from the scientific periodic reports and has now to be entered in the cost statement forms in FORCE instead (for each beneficiary).

However, some information on the use of resources aggregated at the level of Work Areas will be given in this section, because the FORCE templates do not easily allow an aggregated view across several beneficiaries on Work Packages or Work Areas.

The analysis of the use of resources in this chapter will not focus on period 3 only, but provide a cumulative view of the resources used during all reporting periods (1+2+3), because this is the most reasonable way to assess the use of resources against the overall progress of DESSIN.

4.1 Overall use of resources at the project level

In summary, DESSIN has almost exactly used the budget defined in the Grant Agreement:

- The maximum EC contribution defined in the Grant Agreement is EUR 5,980,942.31.
- The total requested EC contribution (sum of all three periods) is EUR 6,008,412.97.

This is a deviation of EUR +27,470.64 which is less than 0.5% of the contractual budget.

Hence, the project has been well on track in financial terms, and resources have been adequately used to achieve the expected results. Although there is a nearly perfect match of the contractual and actual budget from the overall project perspective, there were some deviations at the level of Work Areas, Work Packages, and individual beneficiaries. The following sections give an overview of these deviations and provide background information and justification where significant and relevant.

The most obvious deviation is the deviation in terms of person months used for the project. For the overall effort of DESSIN in terms of person months, an indicative value of 768.11 PM was given in Annex I of the Grant Agreement. The total number of person months as reported by the beneficiaries amounts to a higher number of 902.51 PM, which is about 17.5% more than the indicative value.

As the overall use of resources within DESSIN is not significantly higher than the contractual budget (see above), this means that there is a systematic deviation in the way beneficiaries have used staff resources. But as by this deviation DESSIN has been able to deliver all contractual items and achieve all its objectives, this deviation seems to be well justified and adequate.

It is mainly caused by the following effect which have already been outlined in the 1st and 2nd periodic report:

PM estimates at proposal stage are often made following a conservative approach, calculating time (and staff rates) of permanent (and experienced., i.e. more costly) staff the beneficiary is confident to have available at project start. Involvement of more junior and temporary staff (e.g. PhD candidates or Post-Docs) is often aimed at and hoped for, but can not be guaranteed, because the availability of suitable candidates is not under the full control of the beneficiaries prior to the project. In DESSIN, for most beneficiaries the involvement of more junior and hence cheaper staff has been possible, and involvement of senior staff has been shifted to a more supervisory function.

This results in higher working time needed, but not in a higher EC contribution needed. All partners are aware of the need to maintain excellent quality of work (through involvment of senior staff in supervisory role) and of the need to keep their project budget and expenditure within the maximum EC contribution defined in the grant agreeement.

4.2 Deviation tables on use of Person Months per Work Package

In the following tables, the planned and actual reported Person Months (PM) per partner and Work Package are listed, and according to the reporting guideline a deviation (%) is calculated.

4.2.1 Work Area 1 (WPs 11 to 13)

Table 12: Deviation table on the use of person months in Work Area 1 (WP11 to WP13)

	WP11			WP12			WP13		
Benef.	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %
IWW	11	24.31	+121%	2.00	0	-100%	2.00	0,00	-100%
KWR	2.0	1.58	-21%	6.00	5.57	-7%	-	-	-
CETaqua	2.0	4.18	+109%	6.50	8.99	+38%	3.50	6.98	+99%
DHI	3.00	4.91	+64%	2.00	1.47	-26%	5.00	5.33	+7%
EG	4.00	4.40	+10%	2.00	2.58	+29%	15.00	14.03	-6%
Ecologic	15.00	27.4	+83%	18.00	20.1	+12%	2.00	1.41	-30%
SINTEF	6.00	4.93	-18%	3.00	2.39	-20%	3.00	1.16	-61%
UDE	4.00	3.92	-2%	-	-	-	3.00	4.83	+61%
Sum	**47.00**	**75.63**	**+61%**	**39.50**	**41.11**	**+4%**	**33.50**	**33.74**	**+1%**

Sum across all three Work Packages of WA 1 and all involved beneficiaries:

Planned: 120 PM actual: 150 PM deviation +25%.

Explanation:

Within WA1 there have been shifts in use of resources between the three WPs. In particular WP11 required more and WPs 12 and 13 slightly less than previously estimated. As stated in the previous report, the strict sequential separation of WP11 and WP13 turned out to be a bit artificial, and so these two WPs followed a joint approach and schedule (without changing the overall objective and deliverables/results of this WA). This also led to some shifts in the reporting of use of resources between these two WPs. For example, this is the main reason for partners IWW and Ecologic reporting either no or very few PM within WP13 (- 100% and -30%), but concentrating their use of resources in WP11 (+121% and +83%, respectively). However, these were only formal changes, without affecting the overall objectives and results in terms of deliverables of these Work Packages and Work Area 1 as a whole. In general, use of PM resources within WA1 is well within the general picture: due to the effect mentioned for the whole project, the amount of PM is about 25% above the value estimated at grant preparation stage, because cheaper staff was involved but required more working time.

4.2.2 Work Area 2 (WPs 21 to 23)

Table 13: Deviation table on the use of person months in Work Area 2 (WP21 to WP23)

	WP21			WP22			WP23		
Beneficiary	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %
IWW	-	-	-	-	-	-	0.50	0.20	-74%
A21	-	-	-	28.00	21.70	-23%	-	-	-
BDB	-	-	-	18.00	49.00	+172%	-	-	-
CHEMTEC	-	-	-	15.50	16.83	+9%	-	-	-
Ecologic	-	-	-	-	-	-	2.00	4.48	+59%
INRIGO	4.50	5.00	+11%	-	-	-	-	-	-
LKI	1.20	1.40	+17%	-	-	-	-	-	-
SEGNO	43.00	42.8	-0%	-	-	-	-	-	-
TELINT	-	-	-	9.50	18.83	+98%	-	-	-
UFT	2.75	3.46	+26%	-	-	-	-	-	-
EG	3.00	4.60	+53%	-	-	-	0.50	0.67	+18%
EYDAP	-	-	-	2.00	6.02	+201%	-	-	-
CETaqua	-	-	-	20.5	27.95	+36%	0.50	0.91	+82%
DHI	-	-	-	-	-	-	8.00	6.47	-14%
KWR	-	-	-	4.00	3.52	-12%	0.50	0.33	-34%
NTUA	-	-	-	23.50	28.84	+23%	0.50	0.21	-58%
SINTEF	12.00	13.59	+13%	-	-	-	2.00	1.48	-51%
UDE	8.00	9.52	+19%	-	-	-	-	-	-
Sum	**74.45**	**80.37**	**+8%**	**121.00**	**172.69**	**+43%**	**14.5**	**14.75**	**+2%**

Sum across all three Work Packages of WA 2 and all involved beneficiaries in period 1 + period 2:

Planned: 209.95 PM actual: 267.81 PM deviation: +28%

Explanation:

Despite some deviations for single partners, WP21 and WP23 have used nearly exactly the estimated use of resources. Considering the above mentioned effect that in general cheaper staff needing usually more working time was used, this means that in WP21 and WP23 the necessary RTD work went extraordinarily smoothly. WP22 used significantly higher PM than planned. This is because some of the monitoring that was planned to be over by M24 of the project was continued in order to support the pilot demonstrations and its success, as explained already in the 2nd periodic report and accepted by the responsible project officer. This was compensated by more efficient work in the demonstration cases in WA 3 and hence did not affect the overall project budget.

4.2.3 Work Area 3 (WPs 31 to 35)

Table 14: Deviation table on the use of person months in Work Area 3 (WP31 to WP35)

	WP31			WP32			WP33			WP34			WP35		
Beneficiary	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %
IWW	1.00	1.79	+79%	-	-	-	-	-	-	-	-	-	-	-	-
A21	-	-	-	-	-	-	-	-	-	-	-	-	34.00	24.66	-27%
ADELPHI	1.00	0.00	-100%	1.00	0.00	-100%	1.00	0.00	-100%	1.00	0.00	-100%	1.00	0.00	-100%
BDB	-	-	-	-	-	-	32.00	0.00	-100%	-	-	-	-	-	-
CHEMiTEC	-	-	-	-	-	-	-	-	-	33.38	33.39	+/-0%	-	-	-
Ecologic	0.50	0.56	+12%	0.50	0.63	+26%	0.50	0.53	+6%	0.50	0.52	+4%	0.50	0.52	4%
INRIGO	-	-	-	4.00	9.00	+125%	-	-	-	-	-	-	-	-	-
LKI	-	-	-	1.00	0.70	-30%	-	-	-	-	-	-	-	-	-
SEGNO	27.00	34.60	+28%	-	-	-	-	-	-	-	-	-	-	-	-
TELINT	-	-	-	-	-	-	-	-	-	3.69	1.37	-63%	-	-	-
UFT	3.50	3.25	-7%	0.50	2.02	+304%	-	-	-	-	-	-	-	-	-
EG	28.00	22.44	-20%	0.50	1.33	+166%	-	-	-	-	-	-	-	-	-
EYDAP	-	-	-	-	-	-	-	-	-	28.35	25.02	-12%	-	-	-
VAV	-	-	-	2.00	7.49	+275%	-	-	-	-	-	-	-	-	-
CETaqua	-	-	-	-	-	-	-	-	-	-	-	-	38.00	58.26	53%
DHI	0.50	0.30	-40%	0.50	0.53	6%	0.50	0.58	+16%	0.50	0.44	-12%	0.50	0.44	-12%
KWR	-	-	-	-	-	-	28.00	35.35	+26%	-	-	-	-	-	-
NTUA	-	-	-	-	-	-	-	-	-	26.74	25.67	-4%	-	-	-
SINTEF	-	-	-	16.50	17.26	5%	-	-	-	-	-	-	-	-	-
UDE	26.00	45.18	+74%	-	-	-	-	-	-	-	-	-	-	-	-
Sum	**87.50**	**108.12**	**+24%**	**26.50**	**38.96**	**+47%**	**62.00**	**36.46**	**-41%**	**94.16**	**86.41**	**-8%**	**74.00**	**83.88**	**+13%**

Sum across all five Work Packages of WA 3 and all beneficiaries:

Planned: 344.20 PM actual: 353.83 PM deviation: +3%.

Explanation

In summary, total resources spent in WA3 are very close to the expected ones, although resources spent by individual partners may deviate. Deviations in WP33 and WP34 are related to activities of individual partners. In WP33 BdB has not reported any resources. Similarly, in WP34, TELINT has reported much lower resources so far.

The activities of BdB have focused mainly on RTD activities in WP22, where more resources were reported. This is due to the fact that unforeseen results on clogging of membranes by particles required additional research, which has been mainly carried out by BdB. This has been internally compensated by within the Westland case by KWR carrying out more of the DEMO activities in WP33. After the technical difficulties have been solved through significant efforts in WP22, the actual demonstration in WP33 went very smoothly, requiring less resources than originally planned.

On the other hand, demonstration activities in WP32 turned out to be more resource-intensive. This was partly due to the more complicated transfer of the lamella-settler solution from the Emscher demo (WP31) to the Hoffselva demo (WP32), with more support needed from the German partners than originally planned.

There are some partners with very high deviations if expressed as %-value (e.g. UFT in WP32 with +304%, but in total numbers, these deviations are rather small (e.g. in case of UFT less than 1.5 PM). Such deviations are therefore not explained or justified in more detail at WP level. Only for those partners where the overall requested EC contribution across all work packages is significantly higher than calculated at grant preparation stage, this will be further explained and justified (chapter 4.3).

There is one partner (Adelphi) who did not use any of their budget within Work Area 3, which may need some explanation. The key task of Adelphi (also as leader of WP42) was to provide support to the SMEs involved in WA3 on their route to market (to ensure smooth interaction between WA 3 and WP42). In order to ensure good interlinkage of Adelphi with all five demo cases, at proposal stage we allocated a small amount of PM for Adelphi to each of the case studies.

However, during the course of the project it turned out that the interlinkage of Adelphi with the SMEs was already excellently established through their WP42 activities. So all the support of SMEs by Adelphi was carried out under WP42. This makes also sense from the formal point of view, because although it is supporting a demonstration activity, the nature of Adelphi's activity is still better categorized as "other" rather than "demonstration". Hence, it was decided to formally keep all activities of Adelphi accounted under WP42, because all their activities to support the demo cases are fully covered by and fully in line with their task descriptions in WP42 anyway.

4.2.4 Work Area 4 (WPs 41 to 42)

Table 15: Deviation table on the use of person months in Work Area 4 (WP41 and WP42)

	WP41			WP42		
Benef.	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %
IWW	6.00	9.93	+66%	-	-	-
Adelphi	-	-	-	40	52.36	+31%
CETaqua	16.00	29.27	+83%	-	-	-
KWR	8.00	7.70	-4%	-	-	-
Sum	**30**	**46.90**	**+56%**	**40**	**52.36**	**+31%**

Sum across all two Work Packages of WA 4 and all beneficiaries:

Planned: 70 PM actual: 99.26 PM deviation: +42%.

The deviation in terms of PM is about 42% for this Work Area. Nevertheless, we do not consider any of the deviations between planned and actual use of resources in need of detailed explanation: with regard to the requested EC contribution all four partners are very close to the estimated budget at proposal stage (about +2% deviation for IWW and KWR, about -2% deviation for Adelphi and CETaqua. Deviations in PM are clearly caused by use of cheaper staff (requiring more working time) than estimated at the time of contract preparation. In case of Adelphi, some increase in PM is also due to the shift of their activities from WA 3 (see previous section) to the more adequate WP42.

4.2.5 Work Area 5 (WPs 51 to 52)

Table 16: Deviation table on the use of person months in Work Area 5 (WP51 and WP52)

	WP51			WP52		
Benef.	Planned PM	Actual PM	Deviation %	Planned PM	Actual PM	Deviation %
IWW	5.00	5.71	+14%	15.00	18.25	+22
Ecologic	0.50	0.80	+60%	0.50	0.66	+32
CETaqua	0.50	1.42	+184%	0.50	1.32	+164%
KWR	0.50	0.03	-94%	0.50	0.43	-14%
SINTEF	0.50	2.18	+336%	0.50	0.34	-32%
Sum	**7.00**	**10.14**	**+45%**	**17.00**	**21.00**	**+24%**

Sum across all two Work Packages of WA 5 and all beneficiaries:

Planned: 24.00 PM actual: 31.14 PM deviation: +30%

The overall resources used for Work Area 5 (Project Coordination and Management) is about 30% above the PM effort defined in the grant agreement, but not in terms of requested EC contribution. Large deviations [in %] by single partners are misleading, because the absolute value of the deviations is very small (below +/- 1.5 PM for all except the coordinator IWW). In summary, the total effort for scientific coordination (RTD activity type) in WP51 and for the formal, contractual and financial coordination and management (WP52) required only about 3% of the total PM effort (31 of 902 PM), which seems to be a very reasonable relation.

4.3 Deviation in terms of requested EC contribution

Table 17: Deviation table on contractual vs. requested EC contribution per beneficiary

Beneficiary	Contractual EC contribution	Requested EC contribution	Deviation in EUR	Deviation in %	SME beneficiary
IWW*	574,000.00 €	582,272.58 €	8,272.58 €	+1,4%	X
A21	154,980.00 €	154,766.82 €	-213.18 €	-0,1%	X
Adelphi	437,200.00 €	426,566.58 €	-10,633.42 €	-2,4%	X
BdB	199,412.00 €	258,299.58 €	58,887.58 €	+29,5%	X
Chemitec	220,312.00 €	220,304.46 €	-7.54 €	0,0%	X
Ecologic	341,510.80 €	345,244.42 €	3,733.62 €	+1,1%	X
Inrigo	180,000.00 €	207,151.50 €	27,151.50 €	+15,1%	X
LKI	41,520.00 €	59,168.00 €	17,648.00 €	+42,5%	X
SEGNO	364,142.00 €	399,116.20 €	34,974.20 €	+9,6%	X
TELINT	131,216.00 €	134,563.61 €	3,347.61 €	+2,6%	X
UFT	115,000.00 €	86,754.59 €	-28,245.41 €	-24,6%	X
EG	459,520.00 €	433,789.20 €	-25,730.80 €	-5,6%	
EYDAP	146,555.00 €	145,801.16 €	-753.84 €	-0,5%	
Oslo VAV	25,100.00 €	96,400.00 €	71,300.00 €	+284,1%	
CETaqua*	527,905.10 €	498,513.96 €	-29,391.14 €	-5,6%	
DHI	213,176.56 €	229,141.00 €	15,964.44 €	+7,5%	
KWR	562,435.00 €	580,108.82 €	17,673.82 €	+3,1%	
NTUA	247,695.37 €	247,536.93 €	-158.44 €	-0,1%	
SINTEF*	765,262.50 €	582,613.43 €	-182,649.07 €	-23,9%	
UDE	274,000,00 €	320,300.13 €	46,300.13 €	+16,9%	
Total	**5,980,942.33 €**	**6,008,412.97 €**	**27,470.64 €**	**0.46%**	

*including the budget of linked third parties

The overall project budget as well as the individual resources used by most of the partners are very close to the values defined in the grant agreement. Only a few partners claim costs and EC contributions with more than 10% deviation from the contractual values.

These are explained and justified as follows:

- UDE used approximately 17% more resources, because the first application of the ESS framework on the mature Emscher case (WP13) required more effort than foreseen at proposal stage, as well as the field investigations during demonstration of the lamella settler (WP31).

- UFT used approximately 25% less resources. The person months used in WP 21 for the model tests on the lamella settler including the reporting were slightly more than estimated, but the construction of the test container of the lamella settler (for WP 31 and WP 32) used less material, was simpler and could be completed more efficiently than planned. Hence, in the 3rd and 4th year of the project, UFT had only little remaining work in DESSIN.

- BdB used significantly more resources (about 30%), because in the RTD work in WP22 (to prepare the Westland demo case) an additional installation was needed in order to get rid of fine sand that was hindering performance of the ASRRO-system.

- Inrigo used about 15% more resources, because additional resources were necessary for the operation of the HRF demonstration plant beyond 2016 (WP32 Hoffselva demo case). The test period for the HRF system was extended by 9 months from December 2016 to the end of September 2017 to obtain comparing tests with the cross-flow lamella settler that was installed in parallel.

- LKI used about 42.5% more resources for work needed to enable the use of the cross-flow lamella settler after it had been transferred from the Emscher demo case to the Hoffselva demo case. The container arrived at Hoffselva without the monitoring equipment used at the Emscher case, because the monitoring equipment used at the Emscher had been a loan from beneficiary UDE and had to remain in Germany for other purposes. Hence, LKI had to install and adjust turbidity measurements in the inlet and outlet of the container, level control, solenoid valves for cleaning water control, extend a logger unit to receive new signals and to combine with the control unit from SINTEF in order to operate the system remotely from Trondheim whenever necessary.

- Oslo VAV used nearly three times as much resources as planned, because the practical preparation and handling of the demonstration site at Hoffselva was much more complex and demanding than initially planned. Examples of activities at the site that were either not foreseen or required more effort than planned are: removal of intrusive species and safe disposal of earth, construction of a robust basin, and installations to provide power and clean water to the demonstration facilities. As a percentage value, this additional use of resources may seem large, but in total numbers (+71,300 EUR) it is a rather tiny part of the overall project budget (1.1%), and this could be fully compensated within the Hoffselva demo case. The sum of EC contribution needed by all Norwegian partners involved in the

Hoffselva demo was even lower than planned: the total contractual EC contribution for SINTEF, LKI, INRIGO and Oslo VAV was EUR 1,011,882.50 whereas they actually request only EUR 945,332.93 (see also next paragraph, explanation by SINTEF).

- SINTEF used approx. 24% less resources than originally planned, partly because of the effects of personnel category described in the sections above. In addition, SINTEF calculates costs in Norwegian currency (NOK), which is converted to EUR when reporting to the EC. Since the exchange rate between NOK and EUR has changed since planning the project (the Euro has become stronger compared to NOK), the cost in EUR of SINTEF's activity has decreased even if the overall person months used for DESSIN match well the originally planned amount for SINTEF (43.3 PM vs. 43.5 PM).

4.4 Use of resources per partner type (in particular SMEs)

The FP7 Call DESSIN was applying for was explicitly asking for strong involvement of SME, and an important eligibility criterion was to allocate at least 30% of the EC contribution of the project to SMEs.

From the very beginning, DESSIN has been very ambitious with regard to this criterion, and at proposal stage has allocated an EC contribution of 2,759,293 EUR to SMEs (cf. Grant Agreement Annex I part B). This is about 47% of the total EC contribution of DESSIN.

Based on the cost statements of the partners after completion of the project, this value has even been exceeded (cf. table in chapter 4.3):

- The EC contribution claimed by all DESSIN SMEs now at the end of the project amounts to EUR 2,874,208 which is about 48% of the maximum contractual EC contribution of DESSIN.

This is a strong indicator that DESSIN has selected actually promising technologies, economically stable SMEs, relevant and attractive test cases to demonstrate new technologies, and ensured a working environment with fruitful collaboration between academia, technology providing SMEs and potential end-users that kept SMEs committed and convinced of the added value this project can have for their own innovation potential and competitiveness.

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