D5.2 First updated roadmap for the implementation and monitoring of actions at the Case Studies

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Introductory Table

Project Ref. No.	HORIZON-CL6-2023-CLIMATE-01-2; GA No. 101136598
Project Title	Reliability and effectiveness of integrated alternative water resources management for regional climate change adaptation
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Deliverable Information Sheet

Version	Date	Author	Document history/approvals
1.0	03-06-2025	Lydia Vamvakeridou-Lyroudia (KWR)/Contributions from the Case Studies	Draft version (V1) completed, with contributions from the Case Studies
2.0	20-06-2025	Lydia Vamvakeridou-Lyroudia (KWR)	New version (V2) completed and compiled, including the updated Gantt Charts.
2.1	23-06-2025	Digu Aruchamy (EUT)	Provided review comments
3.0	24-06-2025	Lydia Vamvakeridou-Lyroudia (KWR)	Final Quality check and minor formatting changes included (version V3)

Executive Summary Section

This deliverable (D5.2) is related to Work Package (WP) 5 of the RECREATE project, which focuses on the Case Studies (CS). There are four diverse and complementary CS in RECREATE:

CS#1: North Holland (Netherlands); CS#2: Kalundborg (Denmark); CS#3: Syros Island – South Aegean (Greece); and CS#4: Costa Brava (Spain). Details about them are included in this deliverable.

In terms of actions, WP5 is structured into three Tasks: Task 5.1. Development of a roadmap for the implementation, testing and monitoring of actions in all the CSs [M1-M48]; Task 5.2 Implementation and testing of actions at all the CS, structures in four subtasks running in parallel (one subtask for each CS), [M4-M45]; Task 5.3. Validation of solutions for each CS, evidence-based knowledge, and recommendations at EU level [M37-M48].

This Deliverable (D5.2) is following Deliverable D5.1 (M6), which described the initial roadmap of the Case Studies. D5.2 is reporting the progress (actions, i.e., activities and plans) related to Task 5.1 and to Task 5.2, which are running in parallel, from M7 to M18. It will be updated by D5.3-M36, with the final version to be submitted at the end of the project as D5.4-M48.

The Deliverable D5.2 includes updated information about each of the CS. A detailed description of each CS has been included in D5.1 covering also the CS goals, ambitions and barriers regarding Alternative Water Resources (AWR) use, data and modelling needs, possible gaps, etc. This Deliverable (5.2) includes only a short description of each CS, especially if there are any changes with regard to the content. Instead, this Deliverable is focusing on actions, especially modelling actions and progress, which has taken place from M7 to M18. It also includes actions related to the other WPs of the project (i.e. WP2, WP3, WP4 and WP6), as well as the main Key Performance Indicators (KPIs). Ambitions and barriers have been updated, which D5.2 also includes an updated list of risks, specifically for each CS. These topics have been collected in a template for each CS, so as to help also in determining and defining the future steps for the coming months and the comparison of the content and progress among the CS. The document also includes information about the monitoring of the activities through a bi-weekly teleconference, as well as information about the planned actions in the coming months at each CS, as updated Gantt charts (from D5.1), concluding with the next steps.

Related Deliverables:

- D5.1 (Submitted in M6)
- D5.3, D5.4 to be submitted in M36 and M48 respectively.
- D4.1 (Submitted in M16). It includes the Conceptual Models for each CS- Chapter 2, at larger scale with more details.

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List of Abbreviations

ABM	*Agent Based Model*
AI	*Artificial Intelligence*
ASR	*Aquifer Storage and Recovery*
ASTR	*Aquifer Transport and Recovery*
AWR	*Alternative Water Resources*
CoP	*Community of Practice*
DoA	*Description of the Action*
ESR	*Ethics Summary Report*
GA	*Grant Agreement*
KPI	*Key Performance Indicator*
LCA	*Life Cycle Assessment*
MAR	*Managed Aquifer Recharge*
PE	*Population Equivalents*
QMRA	*Quantitative Microbial Risk Assessment*
QCRA	*Quantitative Chemical Risk Assessment*
RO	*Reverse Osmosis*
RWH	*Rainwater Harvesting*
SDM	*System Dynamics Model*
UWOT	*Urban Water Optioneering Tool*
WP	*Work Package*
WWTP	*Wastewater Treatment Plant*

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1. Introduction

This deliverable is related to Work Package WP5 of the RECREATE project. WP5 focuses on the Case Studies (CS) of the project. It aims to describe the planning, implementation and monitoring of all the actions and activities at the CS. There are four diverse and complementary CS:

CS#1: North Holland (Netherlands)

CS#2: Kalundborg (Denmark)

CS#3: Syros Island – South Aegean (Greece)

CS#4: Costa Brava (Spain)

The objectives of this WP are:

(i) to develop a roadmap of actions for all the CS;

(ii) to coordinate the activities and actions in all the CS and the interactions with the other WPs;

(iii) to guide and monitor the implementation of the aforementioned actions, i.e., testing and monitoring actions, installation of sensor equipment, data collection, stakeholder engagement, etc.;

(iv) to assess the impact of the AWR solutions (including technical, social, economic and cultural aspects);

(v) to develop and coordinate the validation procedures (by the stakeholders) for the solutions in all the CS;

(vi) to provide evidence-based knowledge, lessons learnt and recommendations at EU level (horizontally from all the CS).

Several activities and actions are implemented at the CS. Some are specific for each CS, and some horizontally across all of them. Moreover, the actions and activities at the CS are interlinked with activities in other WPs. IN this Deliverable, the activities directly related to other WPs are explicitly stated for each CS. Figure 1 shows the links and interactions of WP5 with the other WPs

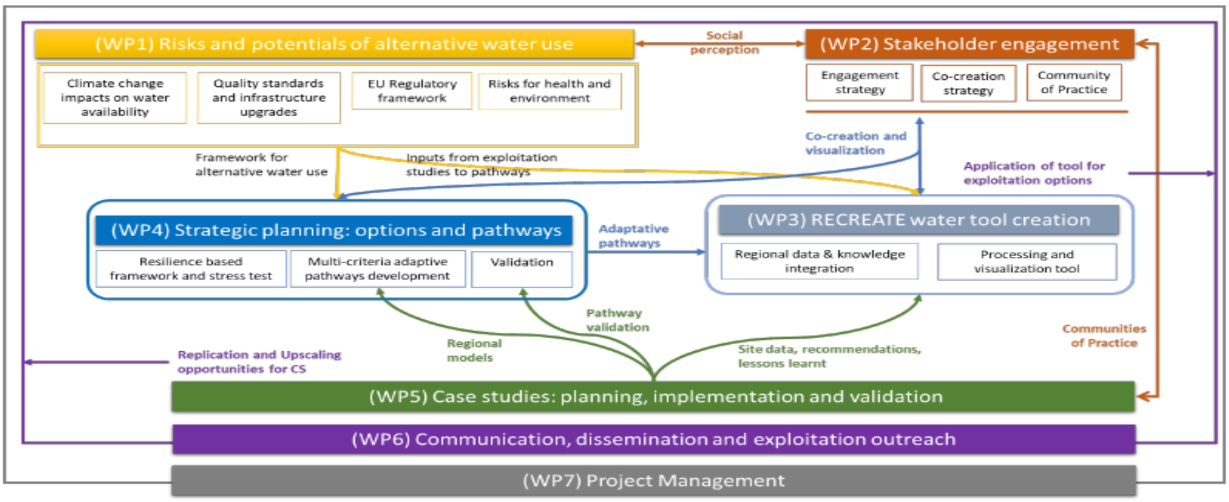


Figure 1: WP5 Interlinkages with the other WPs

In terms of actions, WP5 is structured in three Tasks:

Task 5.1. Development of a roadmap for the implementation, testing and monitoring of actions in all the CSs [M1-M48];

Task 5.2 Implementation and testing of actions at all the CS, structures in four subtasks running in parallel (one subtask for each CS), [M4-M45];

Task 5.3. Validation of solutions for each CS, evidence-based knowledge, and recommendations at EU level [M37-M48]

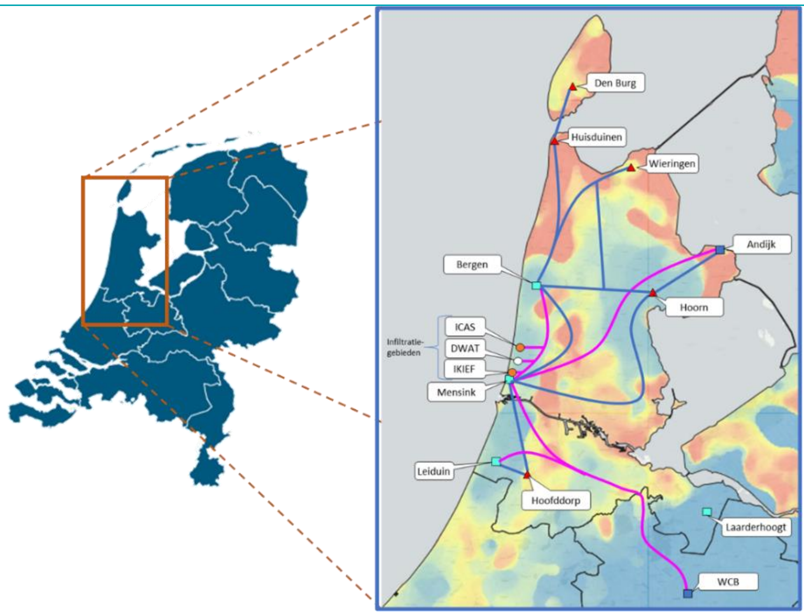
This Deliverable (D5.2) is reporting actions (activities and plans) related to Task 5.1 and to Task 5.2. It is following the initial roadmap, which is included in Deliverable D5.1 (M6). It will be further updated in Deliverable D5.3-M36, with the final version to be submitted at the end of the project D5.4-M48. It is structured as follows: Chapter 2 includes detailed information about the actions and activities at each CS, which took place from M7 to M18, in related subsections. These include also a short description, ambitions and goals, barriers and risks. Chapter 3 includes the overview and monitoring actions performed so far, as well as the planned actions for each CS, as Gantt charts, updated from Deliverable 5.1. Finally, Chapter 4 includes conclusions and next steps.

2. Case Studies: Progress in detail (short description, partners, avtivities, ambitions, barriers, risks)

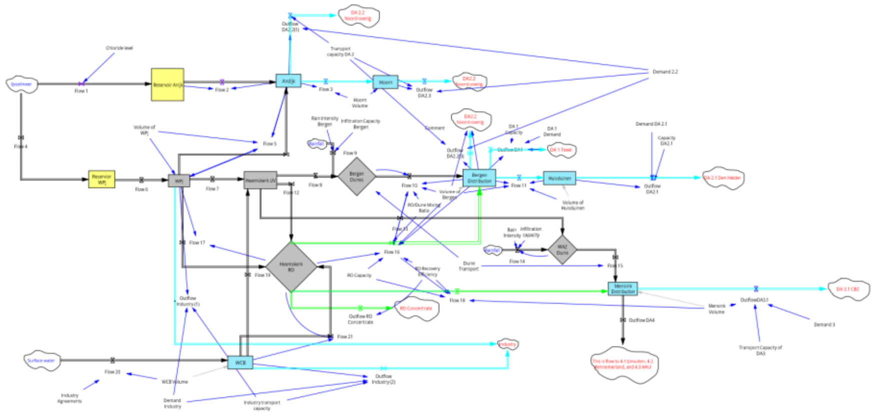
The following sections present the details about each Case Study, focusing on the actions and activities that took place from M7 to M18. The type of information needed by each CS has been defined with the cooperation of all the WPs of the project, as it happened also for Deliverable 5.1. By contrast to Deliverable 5.1, which included a detailed and lengthy description of each CS, this document includes only a short description (especially to point out potential changes, if any). This Deliverable is focusing on actions, especially modelling actions and progress, which has taken place from M7 to M18. It also includes actions related to the other WPs of the project (i.e. WP2, WP3, WP4 and WP6), as well as the KPIs for each CS. Ambitions and barriers have been updated, which D5.2 also includes an updated list of risks, specifically for each CS. These topics have been collected in a template for each CS, so as to help also in determining and defining the future steps for the coming months and the comparison of the content and progress among the CS. These topics have been collected in a template for each CS, so as to help also in determining and defining the future steps for the coming months and the comparison of the content and progress among the CS. It should be noted that that activities related to WP7 (Management) and WP8 (Ethics) are not reported in these templates, because they are not research activities that promote the CS itself, but refer to the whole project (e.g. the fact that two CS – North Holland and Syros- have successfully organised one project General Assembly each).

2.1 CS#1: North Holland- The Netherlands

CS#1 North Holland, Netherlands	**Leading partner: PWN, KWR Leading person: Iverna Créton (PWN) and Klaasjan Raat (KWR)**
Title	Case study 1: Atlantic region – North Holland (Netherlands)
Biogeographical region	Atlantic
Water system type	Drinking water, industrial, agriculture
Area (km^2)	4,000 km2 (Province of North Holland, the Netherlands), Focus on management area of water authority HHNK (i.e., water authority north of the Noordzeekanaal).

Map image/photo	
Goals/challenges	Framework already in place to support PWN in strategic thinking and action, developed jointly with regional stakeholders. This joint framework will support PWN in making long-term investment planning (with a focus on 2030 – 2050) to make the water system resilient to the future climate (2050 and beyond), taking into account rising salinity levels in Lake IJssel and an increasing water demand due to population increase and a growing economy. The framework will help to navigate in an uncertain future, with multiple AWR options considered.
Project partners involved (institutions and names)	PWN: Iverna Créton, Koen Zuurbier KWR: Mollie Torello, Sija Stofberg, Klaasjan Raat, Lydia Vamvakeridou-Lyroudia, Lennart Brokx
Short Description (1/2 page)	The water demand in North Holland is expected to increase in the coming decades due to population growth and increasing economic activity. At the same time, climate change is putting pressure on the supply of freshwater, especially during long dry periods. In response, PWN wants to transform its current linear water system, developed from the 1950s onwards, to a more robust and resilient circular system. Key components in the foreseen water transition in North Holland are the use of alternative water resources, e.g. by incorporating brackish groundwater desalination, treated wastewater effluent reuse, and the creation of additional storage capacity. The question is how and where to add these different new components to the current (drinking) water system and how to integrate them with the natural existing water systems. The work in RECREATE will support PWN and its regional stakeholders through developing tools and strategies that support resilient, adaptable and forward-looking water management. A system dynamics model (SDM) of the regional water system is developed to explore multiple AWR management scenarios. These include future climate and water demand projections, as well as the co-creation of adaptation pathways. In close cooperation with the regional

	stakeholders, a custom Serious Game will be developed to support learning, decision-making and wider stakeholder engagement. Using this framework of adaptation pathways and serious gaming PWN and it regional stakeholders will co-develop adaptation strategies for the North Holland water (supply) system. These will support PWN in making its long-term investment planning.
Deviations in the description from the GA	n/a
Conceptual model, modelling activities related to WP1 and KPIs	
Conceptual model	System dynamics modelling forms the basis for the work, tools and approached deployed in this case study (adaptation pathways, serious gaming). SDM is a powerful tool to gain high-level insights in the functioning of complex systems, such as water systems. SDMs are flexible in their setup, and thus capable of integrated modelling of various systems that are generally modelled “stand alone” (e.g. surface water model, groundwater model, drinking water distribution model). SDMs generally have a much shorter computing time than stand-alone detailed models, making them explicitly suited to quickly evaluate multiple scenarios for AWR management and to provide insights on how adaptations and interventions may propagate through the regional water system and its different subsystems. A working group has been established with PWN, KWR and regional stakeholder HHNK to guide the development of the regional SDM. Together, the conceptual design of the PWN drinking water system, the regional water system and their connections has been sketched, which forms the basis for the SDM to be developed. This SDM is being setup using the Vensim simulation software by Ventana Systems, Inc. The current version 1.0 (see figure) encompasses the (current) PWN system, including its water resources, main networks, treatment facilities and demand areas. This version will later be updated to include the wider regional water system (surface water, wastewater treatment), and its interconnections with the drinking water sytem. Scenarios to be evaluated (following the stress testing framework in D4.1) will include compound risks / combinations of stresses, to provide a realistic insight in risks and challenges for (future) water supply in North Holland. Scenarios for chloride levels in Lake IJssel will be derived by coupling the national climate scenarios and national Delta Scenarios (SSP1, SSP2 and SSP5) to a local model from Lake IJssel. Water demand scenarios will be developed jointly with regional stakeholders, following the socio-economic approach of the national Delta Scenarios. The SDM will subsequently be used to explore multiple AWR management scenarios, the co-creation of adaptation pathways, and it will form the computing basis for the Serious Game that is developed.

	 This diagram is included at larger scale in Deliverable 4.1. It is only included here, as part of this template, to make the information about the modelling activities for this CS complete.
KPIs	**<u>Society</u>** 1. Operational buffer: percentage of operational drinking water buffer with respect to total supply. How long can water supply be maintained without usage of the main source Lake IJssel? (t) 2. Relative use of surface water from Lake IJssel (%) 2.1 Intake surface water for drinking water 2.2 Intake surface water for regional water management (water authority) 3. Relative usage of surface water from Lake IJssel (conventional source) for drinking water production (%) 3.1 Production of drinking water from Lake IJssel surface water (Mm3/yr) 3.2 Production of drinking water from AWR (Mm3/yr) 3.2.1 i.e., wastewater reuse, brackish groundwater, water stored in times of surplus (ASR, climate buffer), and rainwater **<u>Environment</u>** 1. Environmental costs (Euro/m3) 1.1 Energy usage 1.2 Materials and resources 1.3 Waste streams **<u>Economy</u>** 1. Water production costs (Euro/m3) 1.1 Total Costs of Ownership (TCO)
Performed modelling activities	• Established working group for model development with PWN, KWR, and regional stakeholder HHNK. • Developed conceptualized model for PWN North Holland water system. • Translated conceptualized model into Vensim. Vensim selected because it is a visual, structured modelling tool which is easily used by

	non-programmers and it is utilized throughout literature for the water sector. • Collected past demand and production data from PWN and other relevant stakeholders. • Developed first version of SDM in Vensim (drinking water system only). • Developed chloride scenarios for Andijk (Lake IJssel) with new climate scenarios (SSP1, SSP2, SSP5).
Planned modelling activities	• Validation of SDM version 1.0 using historical data (2010 – 2025). • Extend SDM to include the wider regional water system (surface water, waste water treatment) and its connections to drinking water system • Fine tune existing demand scenarios (with PWN), derive additional scenarios with stakeholders. • Stress testing current system (SDM + climate scenarios + demand scenarios) • Evaluate Alternative Water Resources options and scenarios • Introduce reinforcement learning for developing adaptation pathways (with WP4).
Activities related to WP2	
Performed activities	• Working Group established with PWN, KWR and water authority HHNK, to guide the development of the System Dynamics Model • Community of Practice (CoP) established with the Province, regional water authorities, industry and utilities. The serious game will be developed in co-creation with the CoP, and the CoP will be included in the joint strategy development for North Holland. • Contributed to D2.1 through stakeholder mapping and development of the CoP and Working Groups. • Working Group meetings: October 18, 2024; and January 17, 2025 • CoP meeting: November 22, 2024 • Meeting with HHNK, PWN and KWR strategists (introduction of RECREATE, discussion on regional water challenges, looking for synergies) • Introduction of RECREATE to the board members of HHNK, during their working visit to PWN site Andijk.
Planned activities	• CoP meeting 2: 2025 Q3 • Working Group meeting 3: 2025 Q3
Activities related to WP3	
Performed activities	• Supported the development of the RECREATE_WT, by providing • Two Case Study User Stories (#1 System Dynamic Model; #2 Serious Game) • Information on the Data Sources used
Planned activities	• Support WP3 leaders with implememtation of selected work package tools in RECREATE_WT

Activities related to WP4	
Performed activities	• Provided case study input for the resilience framework laid out in D4.1 • Participated in knowledge transfer on System Dynamics Modelling approaches, based on the SDM experiences and plans for North Holland
Planned activities	• The development of the Adaptive Pathways and the Serious Game in North Holland are fully conjoined with the development of both methodologies / tools in T4.2 (Adaptive Pathways) and T4.3 (Serious Game).
Activities related to WP6	

Performed activities	• Provided input for the website (D6.2), brochure, and video developed in WP6
	• Published news item for KWR-webiste 'RECREATE: a system-wide look at the water system' (https://www.kwrwater.nl/en/actueel/recreate-systeembreed-kijken-naar-het-watersysteem/)
	• Connect to relevant European initiatives and projects:
	  ○ Meet-up with Horizon RETOUCH project (HHNK)
	  ○ Exchange on serious gaming with EU LIFE Watersource

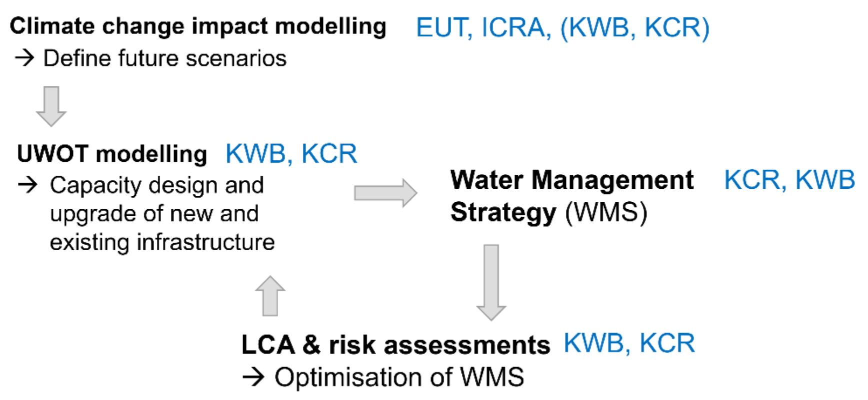
Planned activities	• Dissiminate RECREATE results when appropriate, among relevant networks such as the Waterwijs joint research programme and the national Deltaprogramme, and through a symposiums, conferences, and publications.
Other activities not included in the above	
Description of activity	n/a
Updated ambitions, barriers and risks	
Ambition during the project	The RECREATE project will support PWN in making informed choices for investment decisions (with a focus on 2030 – 2050) to make the water system future-climate resilient (2050 and beyond). The project will provide insights into the effectiveness of, and added system resilience by various solutions, including brackish groundwater desalination, WWTP effluent reuse and the creation of additional storage capacity, especially through natural-based solutions such as ASR. Also, the project will support in PWN in aligning its agenda with its regional stakeholders.
Ambition after the project	PWN has already started evaluating AWR which could be realized in the next 10 – 15 years, including the climate buffer near the surface water intake at Andijk, ASR of drinking water in Hoorn, MAR inland near Hilversum (WAAG project), and ASTR near the coast in Overveen. RECREATE will support PWN in

	making informed choices for (further) realization of these AWR solutions, and the need for additional solutions on the long term (2050 and further).
Outscaling potential	PWN and KWR are both members of the Waterwijs (formerly 'BTO', the joint research initiative of water utilities across the Netherlands and Belgium). These utilities, both coastal and more inland, face similar challenges as PWN (climate change, demand increase, salinity). Many of them are working on strategic plans to become more resilient (regional scale), and are al looking at AWR. The work, methods and results from RECREATE will be reported and disseminated to the other BTO members. The SDM approach may help to make (better) informed decisions, while the Serious Game approach will help to align better with stakeholders, supporting implementation.
Potential barriers	Most important potential barriers foreseen now are governance and legislation. Not only PWN, also other sectors are faced with water resources challenges and increasing demands. How to solve these in society, governance and also legal setting that has become increasingly complex? The Serious Gaming in the case study is dedicated to connecting with regional stakeholders, including the water authority HHNK and the provincial authority, and will help to reach mutual understanding of the water supply challenges that PWN faces. This mutual understanding is the basis for developing adaptation strategies together. Through other routes, apart from RECREATE, potential legal barriers may be addressed or communicated, for example via VEWIN, i.e., the branch organization of the Dutch water utilities.
Risks	• <u>Risk</u>: Lack of stakeholder engagement. • <u>Mitigation</u>: Proper stakeholder mapping and management. Water authority HHNK willing to cooperate and share data so far • <u>Risk</u>: Data availability: access to all relevant data required to complete modelling. • <u>Mitigation</u>: Proper stakeholder mapping and management. Water authority HHNK willing to cooperate and share data so far • <u>Risk</u>: Cyber security: Data management and transfer. • <u>Mitigation</u>: Follow best practices and data management plan written within RECREATE. • <u>Risk</u>: Staff availability at KWR and PWN (e.g. maternity leave, sickness) • <u>Mitigation</u>: We have involved alternative researchers and personnel from KWR and PWN such that they can take over tasks in the project.

2.2 CS#2: Kalundborg, Denmark

CS#2: Kalundborg, Denmark	Leading partner: KCR, KWB Leading persons: Preben Thisgaard and Anne Kleyböcker
Title	Kalundborg Industrial Symbiosis
Biogeographical region	Continental
Water system type	Coastal, Urban, Industrial
Area (km²)	575 km²
Map image/photo	 
Goals/challenges	**Challenges** • Rapid expansion of the Kalundborg Industrial Symbiosis

	• Longer drought periods in summer, more precipitation in winter • Limitation of groundwater availability • Water from nearby lake may no longer be used for water supply in the near future • Uncertainty about the price of fit-for-purpose quality and how to finance new distribution systems for fit-for-purpose water **Goals** • Engage RECREATE to gain, develop, and access knowledge and methods • Modelling as a tool to reduce uncertainty on price and systems for distribution of "fit-for-purpose" water • Conceptual investigation of AWR: rainwater harvesting, water reclamation and reuse and seawater desalination • Set up an integrated water management strategy for water supply of industries in the Kalundborg Symbiosis via multiple AWR to provide the industries with the quality of water needed for different industrial processes in a long-term, sustainable way. • Minimize the overall environmental impact both from water abstraction from traditional sources such as groundwater, lakes, and streams etc. and from wastewater emissions.
Project partners involved (institutions and names)	• KCR (Preben Thisgaard) • KWB (Anne Kleyböcker, Pia Schumann, Malte Zamzow)
Short Description (1/2 page)	The Kalundborg Industrial Symbiosis Association links 17 private and public companies. Various water, energy and materials circular economy approaches are already being implemented. A new industrial area is now being developed in the north-eastern part of Kalundborg. New companies will become part of the Kalundborg Industrial Symbiosis, which not only creates opportunities for the local economy, but also challenges to ensure the sustainable use and reuse of resources such as water. Currently, the biotech sector uses groundwater and treated surface water sources (4-5 million m^3/a) and operates a large industrial wastewater treatment plant (2.3 million PE). Wastewater is treated in the industrial WWTP and the effluent is then sent to the municipal WWTP operated by KCR for further treatment. The WWTPs are interconnected and controlled by an innovative joint control system for an energy efficient operation (Schütz et al. 2024). To meet the projected water demand in the future (up to 20 million m^3/a, a 300-400% increase from today) and to make the industrial water supply more climate resilient, the use of several different water sources is envisaged, including reclaimed water and desalinated seawater, rainwater, and existing sources such as lake water and groundwater. Different water supply scenarios (see 5.2.2 in D4.1) will be modelled and

<table>
<tr><td></td><td>evaluated in order to propose an appropriate water management strategy for the future.</td></tr>
<tr><td>Deviations in the description from the GA</td><td>WP5, Task 5.2.2 and 4.2/4.3:
"UWOT" is used instead of "system dynamics model" to stress-test baseline and future configurations of the water systems under different climate and socio-economic scenarios. This was an error in the GA which was not identified during the GA preparation, and will be corrected in the next amendment expected in early part of the next reporting period. The exact timeline for amendment is to be further confirmed with the project officer.</td></tr>
<tr><td colspan="2">Conceptual model, modelling activities related to WP1 and KPIs</td></tr>
<tr><td>Conceptual model</td><td>


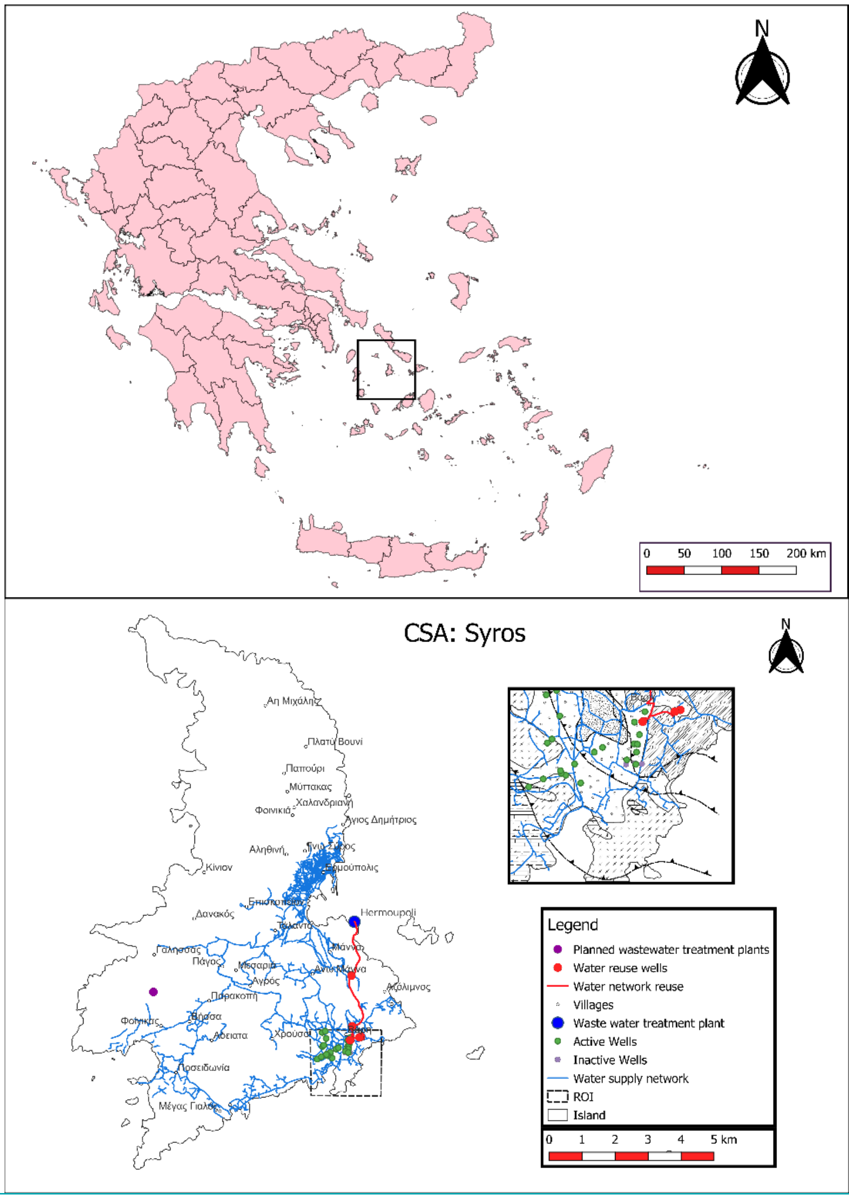
UWOT (Makropoulos et al, 2018) is used to model the current and potential future water management systems. Therefore, the modeling results of the impact of climate change on surface water and groundwater (D1.1) will be used to predict future water demand and availability. Two general cases will be distinguished: one in which lake water is used as a water resource in addition to groundwater, and one in which it is not due to the possibility of prohibition. Different scenarios will be investigated and compared in both cases (see 5.2.2 in D4.1) using alternative water resources, such as reclaimed water, desalinated water, and harvested rainwater. Water from bank filtration will not be investigated because Lake Tissø is the only source of bank filtration in the Kalundborg area, and its water is already in use. As previously mentioned, it may be restricted or prohibited in the future.
The scenarios (see 5.2.2 in D4.1) will be evaluated using life-cycle and risk assessments (QMRA; QCRA) in order to determine the optimal technology configuration in terms of environmental impacts and economic viability and to derive important hints for the future water management strategy of Kalundborg.
</td></tr>
<tr><td>KPIs</td><td>The key performance indicators for Kalundborg for the outcome of the modelling approaches and assessments are (see also D4.1):
Environment</td></tr>
</table>

	• Direct water availability footprint (freshwater use vs. use of AWR) (%) • Environmental impact (CO_2 footprint) (t) **Economy** • Cost efficiency of different AWR scenarios (determined by assessing operational costs for energy consumption, personnel and chemicals) (Euro/m3) **Society** • Number of jobs in the industry counted as "full-time person equivalents" (Number) • Security of water supply (estimated by sufficient filled water buffer tanks per water source in UWOT) (%)
Performed modelling activities	• Water demand narrative has been developed • Status quo model has been implemented in UWOT
Planned modelling activities	• Identify synergies between existing infrastructures and alternative water resources implementation (T1.5) • Optimizing cost efficiency of existing and proposed processes via a life cycle assessment (LCA) paired with the UWOT model (WP1 + ST5.2.2) • Identify risks and perform evaluation of AWR supply systems and technologies deployment (T1.3)
Activities related to WP2	
Performed activities	• COP #1 "Learning from ULTIMATE": conducted – 28.10.2024 • Local water group meetings with industry: ongoing • Stakeholder mapping: completed
Planned activities	Next COP #2 in autumn 2025: • Discussing results of climate change impact modelling • Connect to NextGen (Gotland, SE): water reuse, rainwater harvesting (to be confirmed) • Connect to WaterMan (Bornholm, DK): water reuse (irrigation, Power-to-X, to be confirmed) COP #3 in 2026 and COP #4 in 2027
Activities related to WP3	
Performed activities	Selection of 2 interesting tools for CS2 (see D3.1): • Climate scenario simulation • Evaluation of future treatment trains as strategic planning tool
Planned activities	Data delivery and test of RECREATE_WT
Activities related to WP4	
Performed activities	• Key performance indicators selected (see D4.1) • Scenarios defined (D4.1) for UWOT modelling (T1.5)

Planned activities	• Stress-testing baseline and future configurations of the water systems under different climate and socio-economic scenarios (T1.1, T4.4, ST5.2.2) • Testing and feedback to WP4 methods and tools
Activities related to WP6	
Performed activities	• Exchange with ULTIMATE • Contribution and feedback to brochure • Contribution and feedback to video narrative • Newsletter article about COP #1 • Posts at LinkedIn
Planned activities	• Scientific publication, when results are available • Newsletter articles • Further exchange with EU projects: NextGen, WaterMan • Planning of replication and upscaling of AWR technologies at regional level
Other activities not included in the above	
Description of activity	Contribution to T1.2: • Identification of drivers and barriers to implement AWR • Analysis of governance structures to enable water reuse implementation in CS2 • Analysis of regulations and policy in Denmark to support AWR implementation
Updated ambitions, barriers and risks	
Ambition during the project	Set up an integrated water management strategy for water supply of industries in the Kalundborg Symbiosis via multiple AWR. Provide the industries with the quality of water needed for different industrial processes in a long-term, sustainable way. Minimize the overall environmental impact both from water extraction from traditional sources such as groundwater, lakes, and streams etc. and from wastewater emissions. • Engage RECREATE to gain, develop, and access knowledge and methods • Modelling as a tool to reduce uncertainty on price and systems for distribution of "fit-for-purpose" water
Ambition after the project	• Expand the Kalundborg Industrial Symbiosis to be a Water Smart Industrial Symbiosis • Reuse water to reduce need for groundwater pumping and reduce effluent discharges to recipients • Use the existing collaborative setup and market drive • Transition from "only groundwater" to "fit-for-purpose" water produced from different sources including surface water and desalinated seawater • Increase security of supply to the end-users

	• Step-by-step approach for collaboration with the industry: water for cooling towers, water for flushing, steam production, specific industrial purposes, etc.
Outscaling potential	In Rostock, Germany, Power-to-X will be implemented and supplied with water from AWR, including desalinated seawater. A first meeting was held in June 2025 to explore how the two sites could be connected and how Rostock could learn from and benefit from the Kalundborg case study. A visit from a Rostock delegation to Kalundborg is planned for Autumn 2025.
Potential barriers	• Uncertainty of brine treatment requirements • Potential obligation to treat the brine from water reclamation • Uncertainty about financing mechanisms of new distributions systems • Uncertainty if industrial reuse of reclaimed water will be permitted, however, a new Danish act is in preparation allowing the use of reclaimed water for technical processes such as cooling purposes or PtX. • Lack of fit-for-purpose quality standards for industrial use in both EU and Danish regulations and guidelines
Risks	**Data required for modelling will change continuously** due to the expansion of the industrial symbiosis --> Data are updated, and assumptions are discussed in very close collaboration with KCR on a regular basis **Data sharing is restricted due to confidentiality** (industrial partners) --> Assume reasonable data for modelling and/or use clustered data (not industry-specific) --> Update models at a later stage with specific data and share the results only within CS2

2.3 CS#3: Syros Island-South Aegean, Greece

CS#3	Leading partner: DEYAS Leading person: Dimitrios Vakondios
Title	Mediterranean Self-Sustained Area - Syros South Aegean (GR)
Biogeographical region	Mediterranean
Water system type	Island, Coastal
Area (km^2)	83.6 km^2
Map image/photo	

Goals/challenges	• Creation of supply interconnections among the 5 (currently separate) regions to increase system resilience through integrated multi-source interregional water management. • Extension of treated wastewater reuse for irrigation and ASR, instead of using desalinated sea/brackish water for agriculture. • Investigation of applicability and upscaling of long-term traditional rainwater harvesting (RWH) methods under different socio-technical and climatic scenarios. • Investigation of improvements in operational efficiency and energy footprint and sustainability of existing desalination plants.
Project partners involved (institutions and names)	• DEYAS (Dimitrios Vakondios, Leonidas Zannis) • NCSRD (Ioannis Zarikos) • NTUA (Sotirios Moustakas, George Moraitis, Dionysios Nikolopoulos, Archontia Lykou and Christos Makropoulos)
Short Description (1/2 page)	Syros is a Greek island in the Cyclades with a population of 21,124 people (2021 census). The island's water management is handled by DEYA Syros, which oversees the entire water cycle, from drinking water supply to wastewater treatment and production of reclaimed water. The region is supplied with water from desalination plants with RO, with a total supply of 1.7-2.2 Mm^3/year. The system is divided into five sub-systems based on the desalination plants that feed the water supply network. The island is affected by climate change, with severe droughts and heatwaves expected to increase in the future. The tourism industry, which brings in many people during the summer months, poses additional challenge for water supply, as consumption increases drastically during this period.
Deviations in the description from the GA	None.
Conceptual model, modelling activities related to WP1 and KPIs	
Conceptual model	The modelling approach for the CS is based on the following components: • UWOT (Urban Water Optioneering Tool) (Makropoulos et al, 2018) is applied in Syros to consolidate current water and wastewater infrastructures at the CS level for simulating water fluxes. Different AWR interventions will also be simulated via this model. • A System Dynamics (SD) model is used for the estimation of water demand components (see e.g., the domestic and the seasonal rise of touristic water demands) at higher scales by considering the effects of external drivers such as macroeconomics indices, climatic conditions, pricing mechanism as well as internal drivers, such as the water supply system state and resources capacity. • An agent-based model (ABM) will be investigated as a sub-component of the modelling scheme to explore consumers' behaviours and how those can change due to external factors, such as raising awareness campaigns, different pricing policies,

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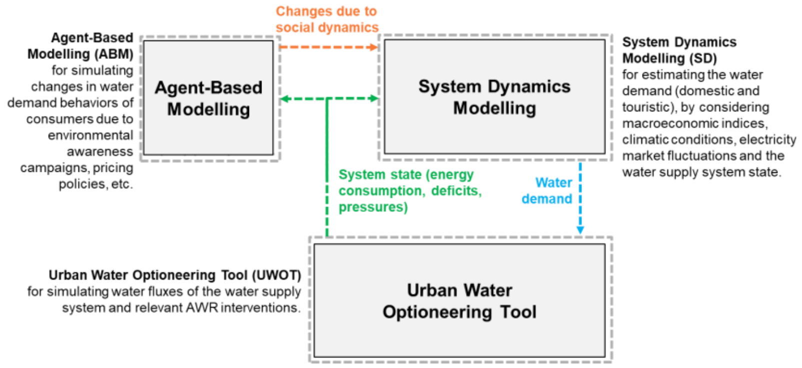
education and outreach programs which encourage water-efficient behaviours.

- A MODFLOW model has been developed to simulate groundwater flow at the MAR site. Utilizing the results obtained from this model, an optimal distribution of injection wells will be achieved alongside a strategic injection plan.

In the Figure below, a schematic on the information exchange architecture between the UWOT, SD and ABM model is shown.



The modelling investigations consider the current conditions as the baseline configuration. Future scenarios to be investiaged will be based on 3 axes: system configuration/topology that will involve different AWR, climatic scenarios (RCP) and socioeconomic scenarios related to SSPs (aligned with T1.1 work, documented also in D4.1)

The modelling work implemented for Syros CS will be documented as part of D1.4.

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<tr>
<td>KPIs</td>
<td>

The key performance indicators that will be used for the case study of Syros are the following (more detailed descriptions including mathematical equations are provided in D4.1):

Society

- Ratio of the desalinated water demand and the production capacity of the desalination plants (%).
- Ratio of the desalinated water demand that exceeds the desalination plants capacity (deficiency) and the desalinated water demand (%).
- Water supply deficiency expressed in terms of its duration (months)
- Alternative Water Resource Supply Ratio (AWR Ratio) - Contribution of AWR interventions as fractions of the water consumption (%)

Environment

- Groundwater Exploitation Index- (Number)
- Change in groundwater depths (%)
- Chemical/ecological status of groundwater index (Number)

Economy

- Operational cost related to the water consumption (Euro/m3)
- To decouple the operational cost from the population size, the unit cost of water (€/m^3) will also be assessed.

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Performed modelling activities	• Prepared the conceptual model for the CS of Syros. • Collected relevant data (e.g. permanent population, touristic fluxes for the island distributed in time, overall water consumption, water demands by individual elements such as marinas and pools, population connected to the wastewater treatment plant). • Set up, calibrated and validated the UWOT model for Syros (using the historical water consumption data provided by DEYAS). • Set up the SD model components for Syros and calibrated the underlying dynamics based on historical data at local and regional scale (e.g., monthly patterns of tourists' arrivals and accommodation, capacity and water use of marinas, pools, etc., monthly water production from desalination units, NRW, etc.). • Set up a MODFLOW model for a part of the island. • Conceptual mapping of the agent-based modelling (ABM) components and underlying dynamics/social patterns (e.g., based on education, income etc.) for water use and conservation and explored the potential integration of the ABM directly within the Syros SD, to allow the simulation/interplay of more complex socio-technical dynamics.
Planned modelling activities	• Prepare the meteorological model inputs needed in line with the SSP scenarios to be considered. • Prepare the socioeconomic model inputs needed in line with the SSP scenarios to be considered. • Finalize of the scenarios regarding the AWR interventions' extent (e.g. the extent of the roofs to be considered regarding rainwater harvesting). • Elaborate on the interaction between the UWOT and SD models for achieving the desired model accuracy with computational demands that are as low as possible. • Enhance the link between interventions and models' parameterization (e.g., water-saving campaigns via ABM/SD, and how those are translated/mapped into UWOT's daily simulations etc.). • Further explore (technically) the integration of ABM within the SD model for direct socio-technical interactions under various scenario configurations. • Investigate potential additional data or data sources, to ensure well calibrated/validated models (e.g., information over the deployment of water-related campaigns by EDEYAS during summer). • Update MODFLOW model based on 2025 field work.
Activities related to WP2	
Performed activities	CS3 already established a Community of Practice. Two CoP meetings have taken place in 2025. A variety of stakeholdes were invited such as:

<table>
<tr><td></td><td>Public entities, such as the local water utility (DEYA Syrou), the Municipality of Hermoupolis and the South Aegean Regional Authority
Organizations like farmers' associations.
Stakeholders from the research and academic sector include the National Centre for Scientific Research (NCSR) "Demokritos" and the National Technical University of Athens.
Additonal stakeholders included the fire service and the local hotel association.
In more details, the stakeholder mapping is reported in D2.1.<table><tr><th>CoP Meeting #1</th><th>CoP Meeting #2</th></tr><tr><td>Completed in January 2025</td><td>Completed in May 2025</td></tr></table></td></tr>
<tr><td>Planned activities</td><td>Further meetings are currently being planned for Autumn 2025 and 2027. Close considetation will be given to the above list of stakehodlers and with the aim to expand the list if possible.<table><tr><th>CoP Meeting #3</th><th>CoP Meeting #4</th></tr><tr><td>Planned for autumn 2025

(feedback for the 1st year of MAR implementation – Summarize first impressions / validation of expect MAR performance)</td><td>~~Tbd~~ Planned for autumn 2027

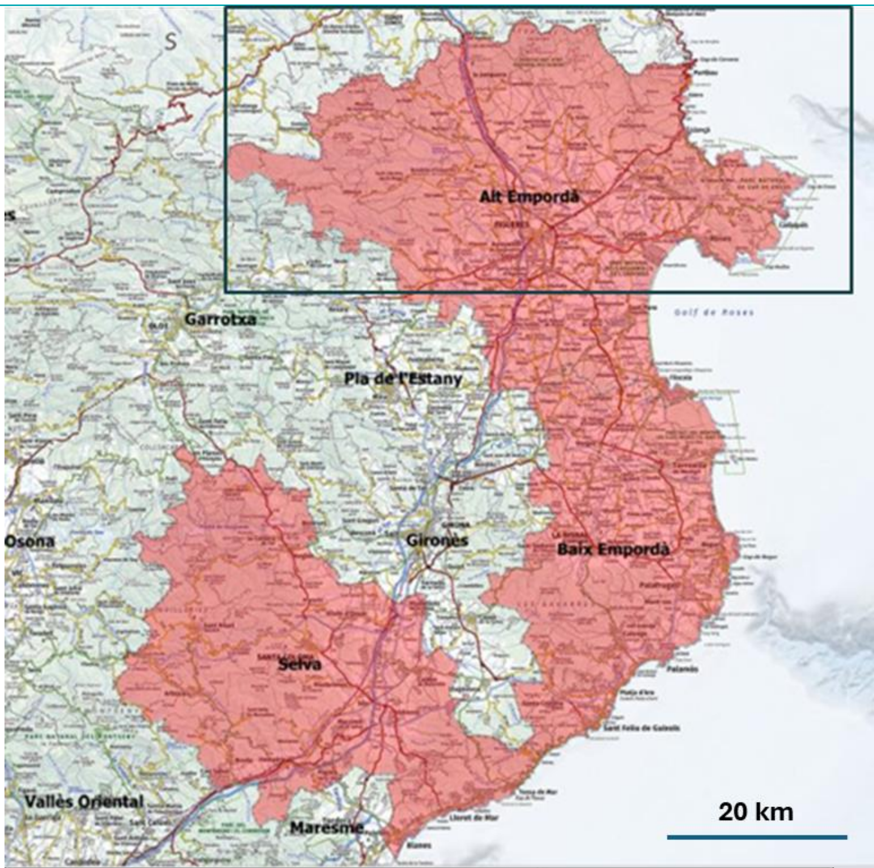
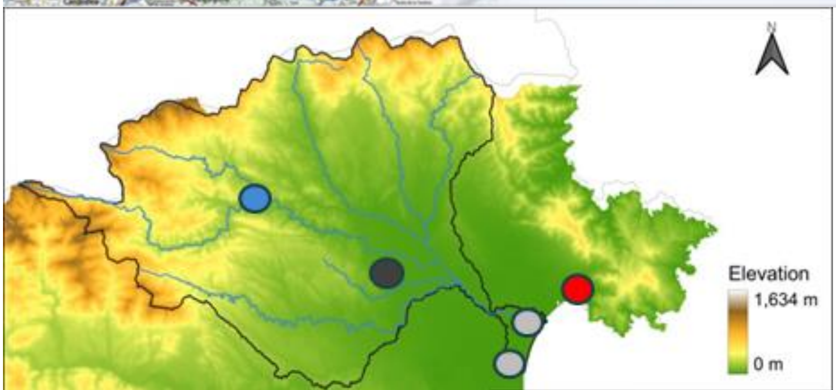
(feedback for the MAR implementation after 2.5 years of implementation – Summarize of impressions / validation of expect MAR performance)</td></tr></table></td></tr>
<tr><td colspan="2">Activities related to WP3</td></tr>
<tr><td>Performed activities</td><td>Georeferenced all water storage facilities
Georeferenced all groundwater wells in the MAR sites and measured water depth
Communicated Data Requirements and Outputs of UWOT model
Brainstorming/technical meetings for the integration of UWOT with RECREATE_WT
Datasets' information shared
Defined user stories</td></tr>
<tr><td>Planned activities</td><td>Measure water quality at all wells, already mapped, to log the improvement of goundwater quality
Follow up WP3 activities and continue discussion on UWOT/RECREATE_WT integration and Syros related use cases/functionalities that will be available via the RECREATE_WT.</td></tr>
<tr><td colspan="2">Activities related to WP4</td></tr>
<tr><td>Performed activities</td><td>Joined WP4 monthly meetings and discussions on WP4 related tools and frameworks.
Direct communication & synergies with Syros stakeholders (system understanding, data collection, scenario identification, etc.) – as a</td></tr>
</table>

	preparatory work for the stress-testing activities and the pathways delineation approach (also related to WP1). • Defined KPIs for the CS of Syros (in terms of societal, environmental and economic dimensions of resilience), first version of KPIs documented in D4.1. • Early definition and alignment of stress-testing scenarios defined in D4.1 (also as part of T1.1 activities) • Conceptual design of modelling interactions necessary for resilience assessment & parallel enhancements to models, e.g., re-design SD scheme to account for SSP scenarios that will be used for the stress-testing process and the delineations of alternative pathways.
Planned activities	• Explore direct integration of ABM to the SD structure. Enhance the SD and UWOT models' interaction for maximum flexibility and data interoperability, as well as for reducing the computational cost/time with respect to the adaptation pathways exploration and related module. • Stress test the studied system under different climatic and socioeconomic scenarios, as well as for different system configurations (e.g., without AWR, with AWR of different implementation extents) and evaluate its resilience. • Refinement of KPIs upon need based on the modelling activities and stakeholders' input. • Testing and feedback of WP4 methods and tools.
Activities related to WP6	
Performed activities	1) DEYAS and NCSRD organized and delivered a 3 hour seminar at "De La Salle" junior high school focusing on: • The effects of climate change in water availability and drought • The importance of alternative water resources (AWR) • The water resources of Syros island and how desalination plays an important role in everyday life 2) The importance of AWR and the interventions, which take place through RECREATE, were reported by the local newspaper. https://www.koinignomi.gr/news/politiki/politiki-syros/2025/05/12/hrysafi-gia-tis-kalliergeies-i-epanahrisimopoiisi-neroy.html 3) NCSRD participated at the "SCOTLAND'S FLOOD RESILIENCE CONFERENCE 2025" to present and discuss the importance of AWR in arid and semi-arid regions. In addition, they were introduced to a variety of methodologies and techniques, which were presented at DEYAS and the agricultural sector, as potential measures to collect and utilize water run-off or flood proofying they agricultural sector. 4) DEYAS and NTUA participation in a workshop on innovations in water infrastructures management, April 10th, 2025, at NTUA premises. The Athens water supply and sewerage company, EYDAP S.A. and representatives from the Hellenic Association of Municipal Water and Sewerage Utilities (EDEYA) were also present and participated. DEYAS

	presented the RECREATE project and the added value of the explored AWR solutions. 5) Contribution and feedback to brochure 6) Contribution and feedback to video narrative
Planned activities	• DEYAS and NCSRD plan to host the next seminar at Vari village primary school, where the MAR site is operational. • Work on journal publications and participation in conferences.
Other activities not included in the above	
Description of activity	Installation of water quality sensors in the distribution network of MAR application.
Updated ambitions, barriers and risks	
Ambition during the project	• Assess AWR (e.g., RWH), their potential of upscaling at the island level. • Increase awareness and acceptance of AWR. • Assess impact of aquifer recharge using treated wastewater. • The AWR to be examined foresee to enhance climate change adaptation/mitigation. • Produce methods and tools that can be resused and expanded to future needs (adaptable) and other projects (expandable).
Ambition after the project	• Upscale and transfer the AWR to other neighboring islands (CoP). • Expand MAR to the rest of the island. • Seek funding opportunities within EU to continue and expand RECREATE's applications.
Outscaling potential	High potential of the upscaling and transfer of AWR to other neighboring islands (utilizing/adopting the modelling schemes developed and the adaptation pathways delineation methodology).
Potential barriers	**Governance**: delay in project planning and implementation due to bureaucratic reasons. **Legislation**: gaps in existing legislation on water reuse. **Funding**: limited public funding. **Social acceptance:** is needed for sustainable and reliable water supply to be increased.
Risks	• Incomplete, not adequately representative (temporally or spatially) and or confidential data for modelling (low to medium). • Water quality sensors availability (low). • Stakeholder engagement and diversity of group (low). • Inadequate computational resources for the adaptation pathways (medium)

2.4 CS#4: Costa Brava, Spain

CS#4	**Leading partner: ICRA** **Leading person: Wolfgang Gernjak**
Title	Costa Brava, Catalonia, Spain

Biogeographical region	West Mediterranean
Water system type	Coastal, inland, groundwater recharge, indirect potable reuse
Area (km^2)	Costa Brava (3072km^2), Muga catchment (853km^2)
Map image/photo	  Roses, pilot plant; Figueres; St. Pere de Pescador, Empúries; Boadella Reservoir

Goals/challenges	• Implementation of an integrated water management strategy considering multiple water sources. • Investigate new desalination treatment systems for cost-efficiency improvement based on historical data and bench scale tests. • Support and demonstrate the potential use of reclaimed water for MAR to protect groundwater bodies. • Infrastructure consolidation and integration of AWR into the water system. • Engage relevant stakeholders on a local, regional and national level to co-create a management plan and to promote the social acceptance of reclaimed water.
Project partners involved (institutions and names)	**Partners**: • ICRA (Institut Català de Recerca de l'Aigua): Nikolaus Klamerth, Wolfgang Gernjak, Lluis Corominas • EUT (Eurecat): Queralt Plana Puig, Digu Aruchamy, Eloy Hernández Busto, Aissam Daaboub, Laura Vinardell Magre **Stakeholders:** • CACGBi (Consorci d'Aigües Costa Brava - Girona) • ACA (Agència Catalana de l'Aigua) • ATL (Aigües Ter-Llobregat) • DDS-GDC (Department de Salud – Generalitat de Catalunya) • Fisersa • Aigües de Catalunya • CatSalut (ApsCat) • AgBar • Aigües de Barcelona
Short Description (1/2 page)	The region of the Northern Costa Brava is devided into three counties (Alt Empordà, Baix Empordà and La Selva) and its water management is provided by Agència Catalana de l'Aigua (ACA) and the Consorci d'Aigües Costa Brava - Girona (CACBGi). CACBGi manages the infrastructure, drinking water and wastewater treatment, and the supply of reclaimed water to cover non-potable reuse. The case study focuses on the Alt Empordà county, home to approximately 140,000 inhabitants, due to its distinctive hydrological and economic characteristics. The region's water supply is sourced from both a reservoir and a shallow aquifer, forming an ideal configuration for application of the Urban Water Optioneering Tool (UWOT) model. Tourist accommodations in Alt Empordà have a capacity of approx. 150.000 beds, which are fully booked during summer, leading to an actual increase in population of 100%, which requires the water utility facilities to provide adequate service during the peak period. The water network of the region supplies up to 12.5 hm^3/year coming from groundwater and surface water. Several communities in Alt Empordà consumed more than double the allowed quantity of 230 l/person during

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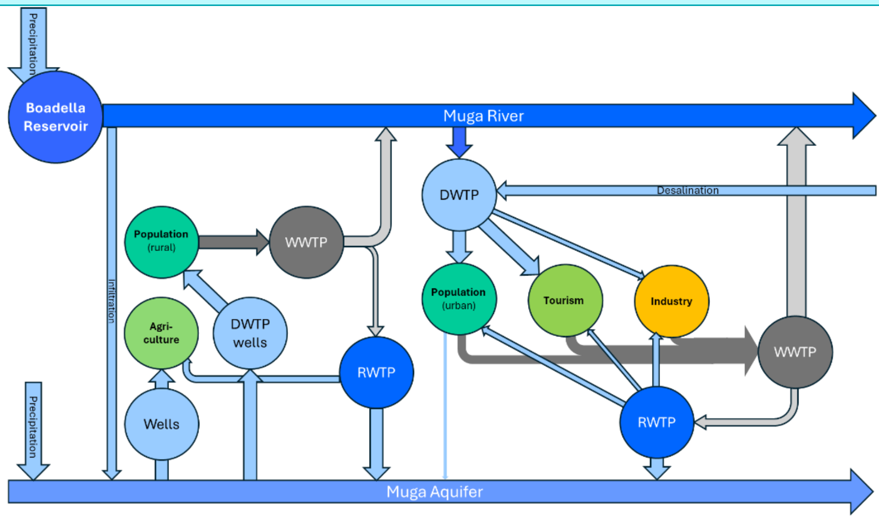
<tr><td></td><td>drought conditions. This overconsumption can be attributed to local industry, which consumed approx. 5.2 hm^3/year in 2023.
The demand for water is expected to increase in the coming decades due to increase in industry, agriculture, tourism and general population growth. The main objective for the future is the transition into a circular based economy in the water cycle management and increase of treated effluents for irrigation, urban and environmental use as well as supply water from several different sources (treated wastewater, desalination, rainwater harvesting) for indirect potable reuse via managed aquifer recharge. To provide an adequate water supply management strategy for the future, different water supply scenarios will be modelled and evaluated (see 5.4.2 in D4.1).</td></tr>
<tr><td>Deviations in the description from the GA</td><td>Positive deviation is the inclusion of Groundwater into the UWOT model of the Costa Brava region.

Initially, the whole Costa Brava Nord region was planned to be included in the Case Study. Investigation into the aquifer and surface water distribution showed that the application of a simple model for such a complex background is not feasible. The decision was made to focuse solely on the Muga aquifer and the Muga catchment with its main population and tourism hubs for UWOT simulation. Additionally, the presence of only one main Reservoir and surface water (Muga River) and a simple aquifer facilitates modelling and description of this area.</td></tr>
<tr><td colspan="2">Conceptual model, modelling activities related to WP1 and KPIs</td></tr>
<tr><td>Conceptual model</td><td>

Using UWOT to model the current system, which includes the reservoir, Muga River, Muga aquifer and 5 different water users (rural population, urban population, Tourism and Industry and agriculture), which draw their water from either the Aquifer or the Boadella Reservoir. The baseline model focuses on the current water use, provision, distribution and treatment data. The AWR model will use Alternative water resources like</td></tr>
</table>

	treated wastewater, desalination water and rainwater to provide additional water resources and use these resources for managed aquifer recharge. Different socioeconomic and climate scenarios (5.4.2 in D4.1) will be investigated and compared in the baseline model and AWR model. The scenarios will help identify strengths and weaknesses in the current water supply management and will show possible configurations to meet the water demands of the future and assure a resilient water supply under increasingly difficult circumstances.
KPIs	The key performance indicators for Costa Brava for the outcome of the modelling approaches and assessments are (see also D4.1): **Environment:** • The **Groundwater Change Index** expresses the qualitative and quantitative status of groundwater bodies (Groundwater Change Index)- (Number) • **Overall Water Availability Indicator** expresses the overall available water as a sum of reservoir reserves and groundwater reserves relative to a benchmark for water demand or an optimum storage level (% change) **Society**: • **Potable Water Supply-Demand Indicator** expresses the demand for potable water in relation to the production capacity of wells (%) • The **Drought** adjusted **Water Use Efficiency Factor** (DWUEF) expresses the amount of water that is available for essential use (m3) • **Water Use Efficiency Factor** (WUEF) captures the extent to which the three key sectors, population, industry and agriculture adopt to water saving policies (Number) • **Alternative Water Resource Supply Ratio** (AWR Ratio) expresses the share of water from AWR interventions relative to the total water consumption (%). • **The Managed Aquifer Recharge (MAR) Efficiency Index** is a key performance metric that quantifies how effectively recharged water is retained within the aquifer (Number) **Economy**: • The cost per **Unit of Water Reuse indicator** quantifies the economic efficiency of a water reuse project (Euro/m3) • The **Composit Economic Factor** uses the Levelized Cost of Water (LCOW) for the water reuse portfolio (Euro/m3)
Performed modelling activities	• Water demand narrative has been developed • Baseline UWOT model of the Muga region has been developed and implemented

	• Detailed sub-models for 3 different population centres have been developed (Figueres, predominantly urban; Roses, 100% population increase in summer; St.Pere de Pescador, 600% population increase in summer (Tourism))
Planned modelling activities	• Develop a rural sub-model, with water abstraction covered mostly from the groundwater. • Develop an industry sub-model with high water use (500% over the per capita allowance during drought restrictions). • Unite all sub-models into one and test it under the current water supply/demand scenario. • Implementing AWR into the baseline model (AWR model). • Change supply based on climate change models. • Change demand based on socioeconomic scenarios.
Activities related to WP2	
Performed activities	• Regular meetings with CACBGi (synergy with AIGUANEIX project) • Individual meetings with CACBGI and DIPSalut • Stakeholder mapping and identification completed • Contact of mapped main stakeholders and invitation to CoP#1 • CoP#1 meeting successfully conducted in June 2025

Planned activities	• CoP#2 meeting with local mayors and water utility providers (September, Octobre 2025) as an initial local stakeholder meeting
	• COP#3 meeting with main stakeholders in November, December 2025 to discuss:
	  ○ main findings of Pilot Plant in Roses
	  ○ Modelling of climate change impact on current status
	  ○ Change in water availability dure to use of AWR
	• CoP#4 in 2026 and CoP#5 in 2027

Activities related to WP3	
Performed activities	• Download of Climate Data, provision and cleanup of climate data and scenarios. • Supply of Data source descriptions for 3.2

Planned activities	1. Access to Climate data via API key 2. Translate and upgrade Suggereix tool for inclusion into RECREATE_WT 3. Combine Suggereix and Decideix for a potent decision-making tool 4. Improve “Frontoffice” and “Backoffice” 5. Update of Database 6. Promote RECREATE_WT fool in CoP meetings
Activities related to WP4	
Performed activities	• Key performance indicators selected (see D4.1) • Scenarios defined (baseline, SSPs, Climate change) (D4.1) for UWOT modelling (T1.5)
Planned activities	• Modelling the baseline by identifying water supply and demand through a steady state model where the main supply comes from the reservoir, river and wells and the main demand is attributed to the current socio-economic state (stable population, tourism, industry and agriculture). • Identify water supply throughout the system and evaluate where risks and vulnerabilities lie to impose possible future AWR. Identify possible wastewater streams as future AWR sources for indirect potable reuse. • Stress-testing baseline and future configurations of the water systems under different climate and socio-economic scenarios. • Design and deliver pathways of deployment for AWR (desalination, WWTPs) interventions at different phases and quantitatively assess the gains in water systems resilience.
Activities related to WP6	
Performed activities	• Contribution and feedback to brochure • Contribution and feedback to video narrative • Newsletter article about COP #1 • Posts at Social Media (ICLEI) • Queralt Plana (EUT) presented the CS at the Water Market Europe event organised by Water Europe in Girona in February 2025

Planned activities	• Newsletter about CoP#1
	• Technical communications (Papers and presentations)
	• Synergies with other projects
	  ○ NextGen (2018-2022)
	  ○ Suggereix (2020-2022)
	  ○ INVENTWATER, MSCA, (2021-2026)
	  ○ InnWater (2022-2026)
	  ○ IntoDBP (2023-2027)
	  ○ Decideix (2025-2027)
	  ○ Aiguaneix (2025-2026)
	• Newsletters and Social Media posts

Other activities not included in the above	
Description of activity	• Identification of drivers and barriers to implement AWR • Analysis of regulations and policy in Catalonia and Spain to implement AWR. • Governance approach on AWR • Basic cost-benefit analysis of AWR
Updated ambitions, barriers and risks	
Ambition during the project	Implementation of an integrated water management strategy considering multiple alternative water resources like treated wastewater, desalination plants and rainwater for indirect potable reuse in the Northern Costa Brava region of Alt Empordá, Muga catchment. In this project, the main objective is to demonstrate the feasibility and potential of reclaimed water for managed aquifer recharge, the consolidation of water infrastructure and the successful integration of AWR into the water distribution system. For this, the RECREATE project will: 1. develop the models to create knowledge how to tackle future water scenarios and water demands and how to engage them. 2. Evaluate novel desalination strategies for low-energy consumption 3. Consolidate the current infrastructure and investigate the possibility to integrate AWR 4. Engage relevant stakeholders on a local, regional, and national level to co-create an integrated water management system and to promote the social acceptance of reclaimed water
Ambition after the project	• Integrate fit-for purpose water produced from AWR in the current water management tools. • Show a successful story (Roses pilot plant) as a case study to promote future installations of AWR treatment plants in the region. • Develop water management strategies that ensure supply to the entire population even in situations of extreme drought.

	• Transition from "only Reservoir water and Groundwater" to a circular water economy including MAR and desalinated water.
Outscaling potential	Planning of an industrial AWR treatment plant for Managed Aquifer Recharge at Llançà in the nothern Alt Empordá region. This plant will significantly benefit from RECREATE. In a similar way, future AWR plants in Catalonia and Spain will benefit from the findings of RECREATE, especially when tackling barriers on AWR and stakeholder engagement.
Potential barriers	• Aligning Water Reuse Directives with Drinking Water production, so to ensure a safe water resource. • Unclear legislation, policy gaps and fragmented rules. • High capital, investment, and maintenance cost. • Uncertainty if reclaimed water will be accepted by the population, industry and tourism. • Complex implementation and bureaucratic processes. • Lack of fit-for-purpose quality standards for direct water reuse and guidelines. • There is no 'data restriction' due to confidentiality, but sensitive data (critical infrastructure) will not be shared outside the CS stakeholders' community.
Risks	• Data for modelling not sufficiently detailed, difficulty to encounter accurate data for water loss in pipes and obsolete infrastructure, gaps in historical data, etc. -> we are working closely with water utility providers to get as detailed water data as possible. • Lack of Stakeholder engagement and stakeholder action -> Proper stakeholder mapping and inclusion in the project, incentives to work with ICRA in this project

3. Monitoring the Case Studies and overview of planned activities

3.1 Monitoring, Guidance and Coordination

The monitoring, guidance and coordination of the activities at the Case Studies is being carried out through Task 5.1. This task is developing a roadmap to foster and guide collaboration and coordination of activities to implement the solutions in each CS. The updated roadmap (reported in this document) focuses on: (a) the modelling activities; (b) the KPIs; (c) the activities related directly to each WP; (d) the ambitions, barriers and risks, which are specific for each CS. In addition, Under Task 5.1, the CS maintain and update a timeline of performed and planned activities (i.e., a Gantt chart). The first version of this Gantt chart was included in D5.1. In this deliverable, an updated version is included (Section 3.2), which will be further updated as the project activities progress.

As already mentioned, this task monitors and reports about the specific KPIs for each CS. At this stage (M18), the main KPIs have been defined and included in Section 2.2 for each CS.

This task is also monitoring potential risks and the need for amending actions (e.g. delayed work, unforeseen difficulties, lack of data, emergencies, bureaucratic issues with local authorities etc.) and reports about them to WP7 (Project Management). The specific risks have been included in Section 2.2, but also are regularly reported to the Project Management team during the fortnightly WP5 online meetings and the monthly Project Management Board online meetings.

Monitoring is being carried out through bi-weekly teleconferences. These teleconferences have started early and are scheduled to continue and take place throughout the project duration, until the end (M48).These teleconferences are being organised by the WP Leader (KWR) and take place every 2 weeks on Thursdays (11.30-12.30 CET). All the CS are required to be present with at least one representative, as well as all the other WPs, with one person (at least).

The agenda (and the Teams link for the teleconferences) are always the same, as follows:

- Each CS updates on their activities (5 min)
- Each WP communicated to the CS any matter related to them (relevant for WP1, WP2, WP3, WP4, WP6 and WP7), if any (3-5 minutes each).
- There is no need for preparing presentations. We'll discuss and keep short minutes online.

As mentioned also in D5.1, these scheduled meetings started on Frebruary 29 2024, a few weeks after the project kick-off meeting, where a discussion about them took place. The minutes for the period M7-M18 are kept online at the project common folder (SharePoint) managed by the project coordinator. However, since internal and sensitive matters have been often discussed during this period, it is not considered appropriate to include them in a public Deliverable. All the project partners have access to them. Access to authorised persons (e.g. to the EC and/or the project reviewers) can be provided by the coordinator at request, as needed.

These fortnightly meetings have been very helpful for the communivcation among the partners and the overview of the project as a whole. They have evolved into a miniature GA (general assembly), where announcements about the whole project and informal discussions take place, not just about the CS matters exclusively. Based on experience from previous projects with similar monitoring practices for the CS, these meetings help also in strengthening the interactions and synergies among the project partners overall, hence contributing also to a successful outcome for RECREATE as a project.

3.2 Performed and Planned activities – Timeline (Gantt charts)

This section presents in Gantt charts the timeline of performed and the planned actions for the CS. The timeline is updated, compared to the initial version included in Deliverable D5.1. It should be pointed out that there are no significant changes for any of the CS. The Gantt charts are now more detailed, adding activities and the Deliverables that each Activity will be reported, but overall they are similar.

Timeline CS1- North Holland

WP	Task(s)	Activities	Partners involved	Deliverable
2	2.1	Stakeholder mapping	PWN	D2.1
2	2.2	COP & WG Planning	PWN, KWR	D2.2
2	2.2	COP assemblies	PWN, KWR	D2.2
2	2.2	WG Meeting	PWN, KWR	D2.2
1	1.3	Risk Assessment- Barriers for Reuse	PWN, KWR	D1.2
1	1.5	Input/Feedback for SDM	PWN, KWR	D1.2, D4.2, D4.3
2+5	5.2.1	Experience mapping	PWN, KWR	D5.1, D5.2, , D2.2
3	3.1	Data Needs/Sources	PWN, KWR	D3.1
3	3.2	User Stories	PWN, KWR	D3.1
5+1+4	5.2.1	Develop system dynamics model	PWN, KWR	D1.2, D4.2, D4.3, D5.2
5+1+4	5.2.1	Future climate demand scenarios	PWN, KWR	D1.2, D4.2, D4.3
5+1+4	5.2.1	Stress-testing SDM	PWN, KWR	D1.2, D4.2, D4.3
4+5	5.2.1	Evaluation of outcomes	PWN, KWR	D1.2, D4.2, D4.3
5+4	5.2.1	Investigate adaptations and interventions	PWN, KWR	D4.1
4+5	4.3	Serious Game development	PWN, KWR	D1.2, D4.2, D4.3
2+4+5	4.2, 4.3	Adaptation strategies- with Stakeholders	PWN, KWR	D4.2, D4.3, D2.2
4+5	4.2, 4.3	Adaptation Pathways	PWN, KWR	D4.3
6	6.1	Exchange with other case studies	PWN, KWR	D6.1/D6.3/D6.4
6	6.1	Interview Klaas/Iverna	PWN, KWR	D6.1/D6.3/D6.4
6	6.2	Fostering case study impact	PWN, KWR	D6.1/D6.3/D6.4
6	6.3	Contact with RETOUCH project	PWN, KWR	D6.1/D6.3/D6.4

Table 1: Gantt chart of activities for CS#1-North Holland

Timeline CS2 -Kalundborg

WP	Task(s)	Activities	Partners involved	Deliverable
1 + 5	1.1	Narrative definition for CCIM	KWB, KCR	D1.1
1 + 5	1.2	Drivers, barrieres, cost-benefit-analyses	KWB, KCR	D1.2
1 + 5	1.2, 1.3	Risk assessments	KWB, KCR	D1.2, D1.3
1 + 5	1.5	Life cycle assessment	KWB, KCR	D1.4
1 + 5	1.5	UWOT: upgrades of existing infrastructure	KWB, KCR	D1.4
1 + 5	1.5	Aera description and data collection	KWB, KCR	D1.4
1 + 5	1.5	Establish model	KWB, KCR	D1.4
1 + 5	1.5	Simulate current status	KWB, KCR	D1.4
1 + 5	1.5	Simulate scenarios	KWB, KCR	D1.4
2	2.1	Stakeholder mapping	KWB, KCR	D2.1
2	2.2	COP assemblies (1/a)	KWB, KCR	D2.2
2	2.1	Local water group (CS2 only) discussions	KWB, KCR	D2.2
2 + 5	2.4	Recommendations to EC	KWB, KCR	D2.3
3 + 5	3.2, 3.3	Data delivery for tools	KWB, KCR	D3.3
4 + 5	4.4	Testing & feedback regarding tools	KWB, KCR	D4.5
5 + 1	5.2.2	Optimizing cost efficiency (LCA & UWOT)	KWB, KCR	D1.4, D5.5
5 + 1	5.2.2	Assess potential for rainwater harvesting	KWB, KCR	D1.4, D5.5
6	6.3	Exchange with sister projects	KWB, KCR	D6.5
6	6.4	Upscaling & replication at regional level	KWB, KCR	D6.5

Table 2: Gantt chart of activities for CS#2-Kalundborg

WP	Task(s)	Activities	Partners involved	Deliverable
Timeline CS3- Syros				Project Month
1	T1.1	Climate Change Narratives, RCP and SSP scenarios	NTUA, NCSRD, DEYAS, ICRA	D1.1/D4.1/D4.2
1	T1.2	Barriers and Drivers	NCSRD, DEYAS	D1.2
1	T1.5	Modelling approach: baseline & upgrades of existing infrastructure	NTUA, NCSRD, DEYAS	D1.4/D4.1/D4.2
1	T1.5	Data collection, processing, parameterisation	NTUA, NCSRD, DEYAS	D1.4
1	T1.5	Modelling approach conceptualisation and design	NTUA, NCSRD, DEYAS	D1.4
1+5	T1.5+T5.2.2	Set up and simulations/application of models	NTUA, NCSRD, DEYAS	D1.4
1+5	T1.5+T5.2.2	Set up future scenarios (SSP/RCP, AWR)	NTUA, NCSRD, DEYAS	D1.4/D4.1/D4.2
1+4	T1.5+T4.1	Establish and enchance modelling interactions	NTUA	D1.4/D4.1/D4.2
2	T2.1	Stakeholder mapping	NCSRD, DEYAS	D2.1
2	T2.2	CoP organisation and implementation	NCSRD, DEYAS, NTUA	D2.2
3	T3.2	"Integration" with WP3 RECREATE_WT	NTUA, NCSRD, DEYAS	D3.1/D3.3
3	T3.2	Communication of data requiemrents and datasets definition/sources	NTUA, NCSRD, DEYAS	D3.1
3	T3.2	Defining user stories	DEYAS, NCSRD	D3.1
3	T3.2+3.1	Intergration of modelling tools with RECREATE_WT	NTUA, NCSRD, DEYAS	D3.1/D3.3
4	T4.1/T4.4	Aligment with stress-testing framework	NTUA	D4.1/D4.2
4	T4.1/T4.4	Definintion of KPIs	NTUA, NCSRD, DEYAS	D4.1/D4.2
4+1	T4.1/T4.2+T1.5	Resilience Assessment via model-derived indicators	NTUA, NCSRD, DEYAS	D4.1/D4.2
4	T4.1/T4.4	Stress-testing (climatic changes, future water needs) using the integrated modelling approach	NTUA	D4.1/D4.2/D1.4
4	T4.3	Developing adaptation pathways	NTUA, NCSRD, DEYAS	D4.1/D4.2/D4.3
4+1	T4.1+T1.5	Enhance model interaction to minimise computational time for adaptation pathways exploration		D4.1/D4.2/D1.4
4 + 5	T4.4+T5.3	Testing, validation & feedback regarding tools and frameworks	NTUA, NCSRD, DEYAS	D5.2-D5.5/D4.5
5	T5.2.2	Recommendations for MAR operation	NCSRD, DEYAS	D5.2-D5.5
5	T5.2.2	Optimizing MAR application	NCSRD, DEYAS	D5.2-D5.5
5	T5.2.2	Planning (and installation) of secondary piping network for MAR	NCSRD, DEYAS	D5.2-D5.5
5	T5.2.2	Monitoring for water reuse (sampling and analysis)	NCSRD, DEYAS	D5.2-D5.5
5	T5.2.2	Installation of water quality sensors	NCSRD, DEYAS	D5.2-D5.5
5+1	T5.2.2+T1.5	Update groundwater model	NCSRD, DEYAS	D5.2-D5.5/D1.5
6	T6.1	Support in the production of dissemination material (brochure, videos, publications, participation in conferences, etc.)	NTUA, NCSRD, DEYAS	D6.1/D6.3/D6.4
6	T6.3	Exchange with sister projects	NTUA, NCSRD, DEYAS	D6.1/D6.3/D6.4
6+5	T6.4	Upscaling MAR application to the rest of the island	NTUA, NCSRD	D6.5-D6.6/D5.5

Table 3: Gantt chart of activities for CS#3-Syros Island

WP	Task	Tasks for CS4	Partners involved	Deliverable
		Timeline CS4-Costa Brava		Month
1	T 1.1	Water Supply Mapping	**ICRA, EURECAT**	**D 1.1**
1	T1.1	Copernicus data download	**ICRA**	**D 1.1**
1	T1.1	Copernicus data integrity check	**ICRA**	**D 1.1**
1	T1.1	Data availability	**ICRA**	**D 1.1**
1	T 1.2	Water reuse options mapping	**ICLEI, ICRA, KWB**	D 1.2
1	T 1.2	Barriers, Drivers, Risks for AWR	**ICLEI, ICRA, KWB**	D 1.2
1	T 1.3	Risk Assessment	**KWB, ICRA, ICLEI, Adelphi**	D 1.2
1	T 1.5	Modell approach: concept	**NTUA, ICRA**	D 1.4
1	T 1.5	Data collection for moddeling	**NTUA, ICRA**	D 1.4
1	T 1.5	Modell approach: baseline and AWR model	**ICRA, NTUA**	D 1.4
1	T 1.5 , T 5.2.4	Future supply scenatios (SSP, RCP, AWR)	**ICRA**	D 1.4, D 4.2
2	T 2.1	**Stakeholder Mapping**	**ICLEI, Adelphi**	D 2.1
2	T 2.1	Stakeholder Engagement	**ICRA**	D 2.1
2	T 2.1	Local Water Agency meetings	**ICRA**	D 2.1
2	T 2.1 & 1.1	Data gathering from water agencies	**ICRA**	D 1.4
2	T 2.2	CoP meetings	**ICRA, EURECAT**	D 2.2
3	3.1	Update of tools for RECREATE_WT implementation	**ICRA, EURECAT**	D 3.1
3	T 3.2, T 3.3	Data delivery of tools	**ICRA, EURECAT**	D 3.1
3	3.2	Integration of tool into RECREATE_WT	**ICRA, NTUA**	D 3.1
4	T 4.1, T 4.4	Definition of KPIs	**ICRA, NTUA**	D 1.4, D 4.2
4+5	T 4.4	testing and feedback regarding tools	**NTUA, ICRA**	D 4.5
4	T 4.1, T 4.4	stress testing using the model approach	**NTUA, ICRA**	D 1.4, D 4.2
5	T 5.2.4	Pilot Plant Planning, Installation	**ICRA**	D 5.1-D 5.5
5	T 5.2.4	Pilot Plant Monitoring and Operation	**ICRA**	D 5.1-D 5.5
5	T 5.2.5	Pilot Plant treatment tools testing	**ICRA, EURECAT**	D 5.1-D 5.5
5	T 5.2.4	Virtual Sensor development and implementation	**EURECAT, ICRA**	D5.1-D5.5
5	T 5.2.4	Aquifer recharge assessment	**ICRA, EURECAT**	D5.1-D5.5
5	T 5.2.4	Evaluation of novel desalination processes	**EURECAT**	D 5.1-D 5.5
5	T 5.2.4	Optimization of Membrane desdilation at bench-scale	**EURECAT**	D 5.1-D 5.5
5	T 5.2.4	Optimization of Low salt Reverse Osmosis at bench scale	**EURECAT**	D 5.1-D 5.5
5	T 5.2.4	Optimization of MCr at bench scale	**EURECAT**	D 5.1-D 5.5
5	T 5.2.4	Integration of Membrane destillation, low salt Reverse Osmosis	**EURECAT**	D 5.1-D 5.5
5	T 5.2.4	Modelling of the treatment scheme	**EURECAT**	D 5.1-D 5.5
5	T5.2.4	Comparison of novel process with conventional process	**EURECAT**	D5.1-D5.5
6	T6.1	Exchange with other CS	**ICRA**	D 6.2,6.3,6.5
6	T6.3	Collaboration / Contact with AIGUANEIX and MARCLAIMED	**ICRA**	D 6.3
6	T6.4	Replication, crosslink and upscaling in the region	**ICRA**	D 6.5, D6.2

Table 4: Gantt chart of activities for CS#4-Costa Brava

4. Conclusions and next steps

This document presented the updated details about the monitoring and the activities at the CS of the project RECREATE for the period M7-M18. There are four CS (details presented in Section 2). A number of activities are planned for the following months at the CS. This deliverable follows an earlier version (D5.1) submitted in M6. During this period, emphasis has been given in the modelling activities and the definition of the KPIs, as well as activities with the stakeholders in the CoP activities. Various types of information have been collected and presented in this report, referring to all these aspects, as well as the ambitions, barriers and specific risks for each CS.

Moreover a detailed timeline for performed and planned activities (Gantt Chart) is included for each CS.

In the coming months - up to M36, when the next version (D5.3) of this document is due, the CS will progress and complete the modelling activities (WP1), including any related activities on the ground for monitoring purposes (e.g. for CS#4). They will also need to complete the stakeholder activities (WP2) and contribute to the activities of the other WPs (WP3, WP4 and WP6) as needed.

The monitoring of all activities will continue in a similar way as for D5.1 and D5.2, i.e., via bi-weekly teleconferences. Special attention will be given in the monitoring and reporting of risks.

5. References

Makropoulos, C., Nikolopoulos, D., Palmen, L., Kools, S., Segrave, A., Vries, D., … Medema, G. (2018). A resilience assessment method for urban water systems. *Urban Water Journal*, *15*(4), 316–328. https://doi.org/10.1080/1573062X.2018.1457166

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