# 2018 Joint Call
# Mid-Term Progress Report
# Closing the water cycle gap - Sustainable management of water resources

## Evidence based assessment of NWRM for sustainable water management – EviBAN

This document must be filled in by the project coordinator with the help of its project partners and must be sent to the WaterWorks2017 Follow-up Secretariat by **2020-10-31.**

The WaterWorks2017 Follow-Up Secretariat will ensure distribution to the concerned national funding agencies. The project coordinator is responsible for sending a copy of the report to its partners.

| PROJECT TITLE AND ACRONYM |
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Author of this report (Coordinator): Herman Helness Date of submission: 2020-10-29
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Duration of project:
Start date: 2019-04-01 End date: 2022-03-31

Period covered by this report: 2019-04-01 – 2020-09-30

1. Publishable Summary

EviBAN will combine results from Norway, Finland, France, and South Africa to help water managers chose the most sustainable way forward. The project will use case studies in the four countries to learn more about how to handle stormwater when it rains too much and increase water resources when it rains too little. The common ground will be the use of nature-based solutions.

In Finland and Norway, we will continue from existing projects on stormwater management using data from existing test sites, as well as generating new data from our own tests. In Finland there will be a PhD student that will participate in field campaigns and modelling of urban stormwater together with researchers from the other partners in the project.

In the French case study, infiltration, and further treatment in the soil of the effluent from the local wastewater treatment plant is used to protect the water quality in the sea. This is of great importance to local oyster production and may be of wider interest. The French partners will work with local stakeholders to increase the knowledge of this type of water management.

The French knowledge is also useful for increasing the groundwater resources by infiltration in the groundwater aquifer. This will be the case in South Africa where they are threatened by lack of water in dry periods. The project partners will study how infiltration during periods with heavy rain can be used to supplement the groundwater and increase the available water resources in dry periods.

All water management measures need to be adapted to local conditions and include the priorities of local stakeholders to be sustainable. In EviBAN we will work with local representatives and include governance measures in the evaluations. The different water management solutions will be compared in an integrated sustainability assessment which will be part of a toolbox for adaptive water management that will be useful for local water managers, policy makers, consultants and scientists.

Since the start-up meeting on 28-29 May 2019, seminars have been held in all partner countries with local stakeholders. Due to COVID-19, these have been conducted digitally with Teams as tool since March 2020. At the seminars, the local case studies have been discussed and information for the development of the integrated sustainability analysis (ISA) and the other tools developed in EviBAN have been obtained. During the French and Finnish seminars, the status of the work of the French and Finnish PhD students, respectively, was presented.

The Finnish PhD student visited SINTEF for a mobility period in the beginning of March 2020 to work on common issues in the Norwegian and Finnish cases.

One of the project's Finnish partners, Aalto University, arranged the first annual meeting of the consortium 2020-05-28 with participation from Finnish stakeholders as well as the research partners in EviBAN.

Work on the development of the toolbox for assessing NWRM (natural water retention measures) is ongoing and the various sub-tools will be tested in the different participating countries in 2021.

The project is described on the project's website: www.eviban-project.com

2. Work Performed and the Results achieved during the reporting period

### a. *Scientific and technological progress*

## Work package 2 – toolbox development

### *Governance assessment tool*

The ambition for the governance assessment tool is to provide a framework for systematic assessment of the governance context where implementation of NWRM/NBS is considered. The tool helps identify and assess conducive and unconducive factors that will affect the scope for NWRM/NBS in specific cases. It builds on the DROP governance assessment tool, which was further developed and applied in the DESSIN project, to assess factors facilitating and hindering uptake of sustainable innovation in the water sector. In EviBAN, the latter approach is expanded, to include not just the structural context, but wider trends at societal level and the socio-ecological interactions prevailing in the given case context. Following an initial mapping of socio-ecological system data for the case studies, an initial version of the tool has been developed. This takes the form of an Excel-based manual, which has been discussed in detail with the research partners from the different cases. The manual is ready to be tested in the Norwegian case. Due to the COVID-19 crisis it is estimated that this work will take the form of virtual rather than face-to-face interviews. Subsequently, it may be tested in the Finnish and South African cases, before it is refined and presented in the form of a Governance Assessment Guide.

### *Optimisation tool*

The optimisation tool in EviBAN is intended to serve as a screening tool to scout out and identify suitable good solutions before these are analysed and improved with more technical precision in the stormwater modelling and MAR tools. It will find suggestions for cost-optimal portfolio of nature-based solutions for stormwater management across a number of geographically spread-out nodes, taking into account hydrology, area restrictions and discharge restrictions. Work on the optimisation tool so far in the project was concerned with developing a mathematical formulation capturing the necessary features in a suitable manner. This includes a simplified hydrological modelling of the considered case area by way of nodes with flow directions. Further, a simulation set-up as an MS Excel file has been developed to test assumptions, level of detail, needed input (and format) etc., using the Norwegian case study as a basis. This led to the mathematical formulation of an optimisation model that is sufficiently general to capture relevant features of both the Norwegian/Finnish and the South-African case studies. For the latter study, some details need to be verified. Further, a format has been developed to structure the necessary input data efficiently. Finally, using the simulation set-up as a basis, the implementation of the optimisation model as a software tool has been started. This is an ongoing activity.

### *Stormwater tool*

The stormwater modelling in EviBAN is based on the two available modelling systems, Stormwater Management Model (SWMM) and PHREEQC. The SWMM supports catchment applications of precipitation-runoff processes at different scales. PHREEQC is the physics-based tool for assessing the geochemical processes in stormwater filter systems that are relevant for understanding their long-term behaviour. In the EviBAN toolbox, SWMM and PHREEQC represent the examples of freely available (open source) computation platforms that could be employed for understanding the processes governing the performance of NWRM and their potential behaviour in terms of climate change scenarios. The EviBAN case studies provide references to their parameterisation in the urban hydrology and stormwater context. Hydrological and geochemical modelling outputs generated using SWMM and PHREEQC complement each other in providing a more holistic assessment of the stormwater filter systems performance with respect to climate change scenarios. The preparation of the models is an ongoing activity in EviBAN.

### *MAR tool*

Antea Group-Imageau and BRGM have started to work on the Agon-Coutainville site in 2016 as part of the H2020 Aquanes project[1]. The EviBAN project is an opportunity to go further on a larger scale than the work done by the AQUANES project on this same MAR/SAT issue. The objective in EviBAN project is now to provide digital decision support tool that will enable a WWTP manager to determine the relevance of implementing a MAR-SAT system in its geographic context.

To do that, Antea Group relies on one of its software solutions called NORRMAN (Figure 1). The primary purpose of this tool is to enable the WWTP manager to assess the impact of discharges on stream quality. The scale is therefore wider than the site itself and covers the entire body of water affected by the discharge. This scale of work is perfectly suited to the objective set for the EviBAN project.

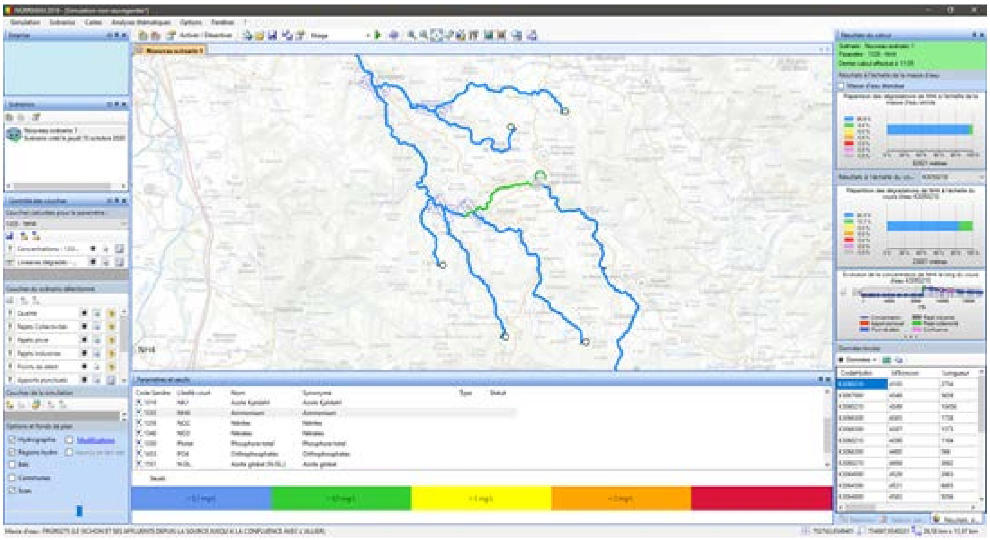

*Figure 1: Norrman App Interface.*

To enable the user to assess the potential for implementation of a MAR/SAT solution at the station level, it is necessary to provide the geographical context information at the level of its location. For this we are working on the creation of calculated map layers (Figure 3) that can be displayed on the background of the plan and indicating the degree of feasibility in the sector concerned. The complexity of this task lies mainly in the work of combining and processing spatial information throughout a wide water basin area (Loire-Bretagne). It is thereby necessary to determine the

[1] https://aquanes.lyxea.fr/
Login: eu-H2020; Password: 85p!cNq?FR7@

method of treatment and then to apply it on a large scale using powerful computational resources. Once the GIS layers are created, they are published on Antea Group's Geographic servers and made available in the Norrman tool via OGC web services.

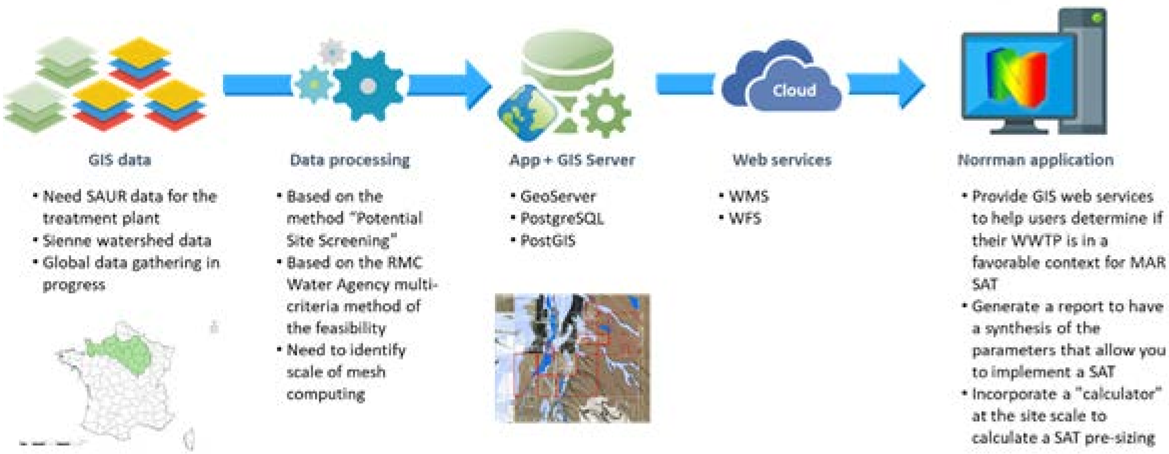


*Figure 2: EviBAN Data Process.*

At this stage of the project the preparatory phases have been carried out. Implementation and most of the technical effort will be carried outs in the second phase of the project and applied to datasets collected throughout the Loire Brittany Basin. Combined with this GIS approach, BRGM propose to implement a Soil Aquifer Treatment (SAT) module based on multiscale reactive transport modelling tools. The MAR-SAT implies natural attenuation for contaminants of environmental concerns (CECs) contained in treated wastewater, hence protecting groundwater quality. However, there is a necessity to develop tools to predict emerging contaminants fate and removal in MAR-SAT systems. At this stage of EVIBAN project, Quentin Guillemoto have made a review on the processes and designed a first conceptual model to explain water quality evolution considering MAR-SAT system (Figure 4).

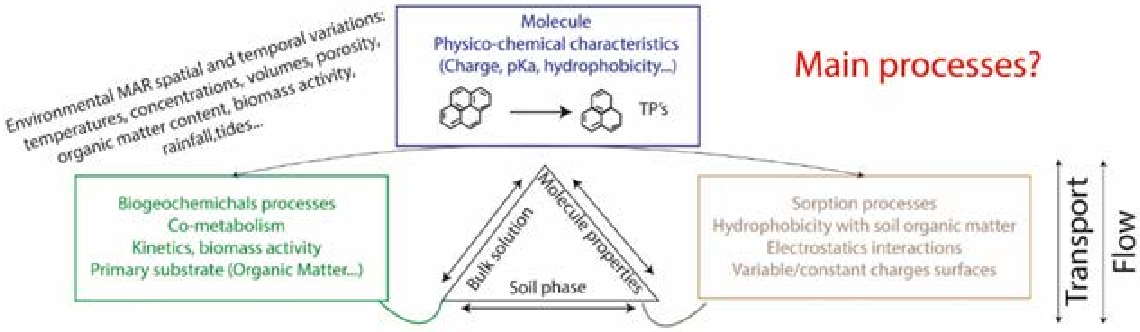


*Figure 3: Schematic description of the MAR-SAT system and major processes influencing fate and behaviour of emerging contaminants (Guillemoto et al., 2019)[2].*

[2] Guillemoto Q., Picot-Colbeaux G., Pettenati M., Valdes-Lao D., Devau N., Kloppmann W., Mouchel J-M. (2019) Numerical modelling: a tool for Managed Aquifer Recharge and Saturated Aquifer Treatment system in coastal area. AGU, San Francisco, USA.

The conceptual model combines the flow and reactive transport accounting for multi physical and chemical processes controlling fate of the CECs such as microbial degradation, adsorption, gas diffusion, aerobic respiration, nitrification and transition of redox states. This conceptual model is based on a set of parameters (salinity, temperature, chemistry and CECs) already monitored on the treated wastewater and groundwater in the MAR-SAT system of Agon-Countainville (Normandy, France) in a natural coastal hydro system (Figure 5).

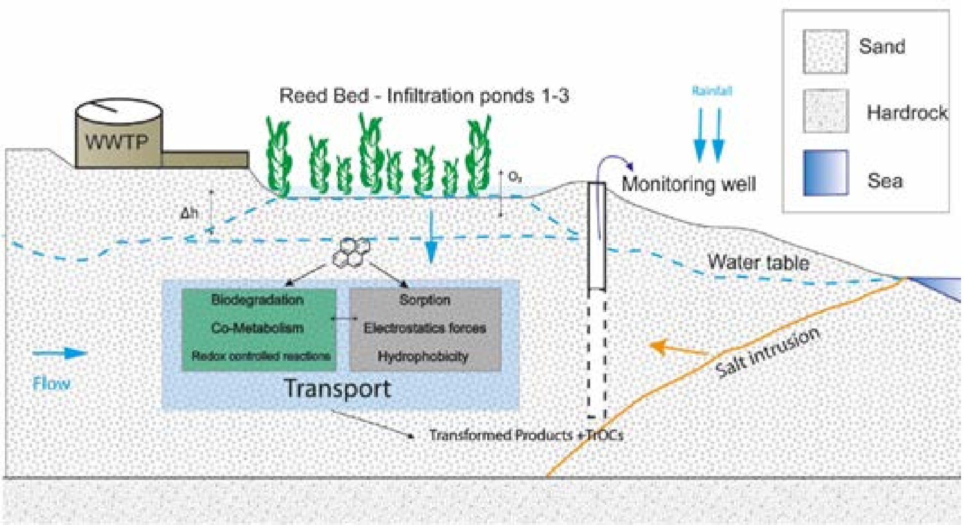


*Figure 4: Schematic description of the MAR-SAT system of Agon-Coutainville and major processes influencing fate and behaviour of emerging contaminants (Guillemoto et al., 2019).*

At this stage a hydrodynamic and hydro-dispersive modelling of groundwater flow in porous media with software MARTHE-PHREEQC has been designed and developed by BRGM for modelling infiltration of treated waste water in the sand dune aquifer and reproduce measurements taken during MAR-SAT operational conditions. The next step will be to use the model in Agon-Coutainville to validate CECs transfer and degradation on the long term before implementing numerically the detail processes involved in removal of contaminant of environmental concerns (CECs), the geochemical processes, with PHREEQC software.

### *ISA tool*

Development of the ISA tool is an ongoing activity in EviBAN. The ISA tool integrates the results from the other tools in the toolbox in a holistic assessment of sustainability. The ISA tool is based a framework where information to assess the sustainability of the NWRM is assessed systematically. This framework is implemented in a spreadsheet, where the ISA tool will have an input section, a section for the ISA assessment and an output section.

<u>The input section</u> will provide for case-specific input from stakeholders, e.g.: Define the case; Define NWRM alternatives; Relevant SDGs; Local objectives; Local adaptation of criteria and indicators. There will also be input from other tools in the toolbox, e.g.: Governance assessment tool outputs; Optimisation tool outputs; and selected results from the stormwater or MAR/SAT tools as detailed calculations have been performed. Finally, there will be some pre-defined input in the ISA tool, e.g.: List of (selected?) SDGs; List of standard objectives for NWRM; List of standard criteria and indicators.

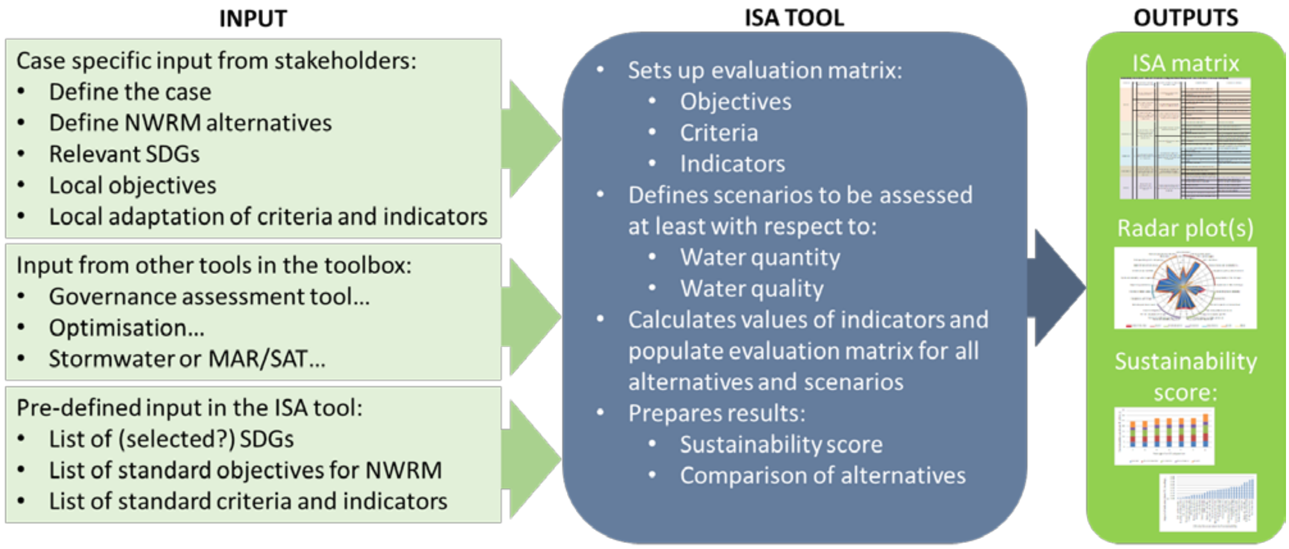


*Figure 5: Structure of Integrated Sustainability Assessment (ISA) tool*

The ISA section will provide for setting up the evaluation matrix. This will contain the objectives, criteria and indicators, and include scenarios to be assessed at least with respect to water quantity and water quality. The ISA assessment will calculate values of indicators and populate evaluation matrix for all alternatives and scenarios. The results will be given as sustainability scores which will enable comparison of alternatives.

The outputs section will provide for presentation of the results in tabular form and in charts.

Activity in the period has been developing linkage to the SDGs and assessing the balance between having a generic tool and local/case-specific input. The eventual need to differentiate between application for stormwater cases and MAR/SAT cases has also been part of the assessment. In addition to virtual meetings with the researchers in EviBAN, the stakeholders in the different case studies have been involved in the development by discussion and an exercise on defining relevant SDGs and objectives and criteria for the case studies. This has been done as part of the local case study workshops that have been organised in all cases.

## Work package 3 – case studies

### *French case study*

The MAR/SAT system in Agon (Normandie, France)[3] is based on a tertiary treatment of secondary WWTP effluent by an activated sludge process and by a combined reed bed and sand dune

[3] Picot-Colbeaux Géraldine, Mathurin Frédéric, Pettenati Marie, Nakache Frédérique, Guillemoto Quentin, Baïsset Matthieu, Devau Nicolas, Gosselin Mickaël, Allain Didier, Neyens Denis, Lartigaut Claire, Dufour Eric, Togola Anne, Depraz Olivier, Nauleau Fabrice. (2020). Case Study 16: Soil Aquifer Treatment system to protect coastal ecosystem in Agon-Coutainville (Normandy), France. in Zheng, Y., Ross, A., Villholth, K.G. and Dillon, P. (eds.). Managing Aquifer Recharge: A Showcase for Resilience and Sustainability. A UNESCO-IAH-GRIPP Publication. No: 4500386254 (in press). <Web URL>-to be advised.

filtration. Since 2016 (implementation in the H2020 Aquanes project), the imaGeau Subsurface Monitoring System (SMD) has provided real-time monitoring of saline intrusion. Water quality and quantity have been monitored and analysed by SAUR and BRGM for sending information and data towards an ICT tool (BRGM/Géo-Hyd) dedicated to assess efficiency of SAT in context of saline intrusion (implementation in the H2020 Aquanes project). Since April 2017, three SMD and two data loggers are continuously measuring water conductivity evolutions between coastline and water treatment plant. Now every hour, electric conductivity profile is recorded thanks to SMD, and electric conductivity is measured at a single point using data loggers. Water table elevation is also record in every piezometer every 15 min. All the measured data are accessible and shared with the ICT Tool. Data from the subsurface monitoring device (SMD) acquiring online water salinity and the water level of the Agon-Coutainville sand dune aquifer, will be directly implemented and searchable in the ICT tool. The monitoring systems are maintained in the EviBAN Project. For this purpose, field surveys and remote diagnostics have been performed to continuously have data. Analyses of the datasets allow to link measured electric conductivity evolution to the MAR system, tide effect and global recharge into the aquifer.

All these data will help to understand the ability of MAR/SAT system to push away salt intrusion into this coastal aquifer:

- **Analyses of data from SMD AQ1**

Until March 2020, the electrical conductivity of the water ranges from 500 to 3500 µS/cm (Figure 7). In December 2017, salinity reached more than 3000 µS/cm in depth. After this date, the salinity is almost below 1500 µS/cm.

- **Analyses of data from SMD AQ4**

Until March 2020, the electrical conductivity of the water ranges from 100 to 30000 µS/cm (Figure 8). High conductivity occurs in Summer - Autumn each year, after this date, considerable drop in salinity until September, when salinity rises again to 20000 µS/cm.

- **Analyses of data from SMD AQ3**

Until March 2020, the electrical conductivity of the water ranges from 500 to 35000 µS/cm (Figure 10). High conductivity occurs in Summer - Autumn each year when the groundwater level is low and the tide effect important. After this date, a drop in salinity and an increase in groundwater level occur during winter natural recharge. The drop in groundwater level leads to an increase in salinity in October 2018 & 2019 (salinity exceeds 40000 µS/cm). A marked influence of the tides is highlighted as well as winter natural recharge (winter natural recharge 2017-2018 higher than winter natural recharge in 2018-2019).

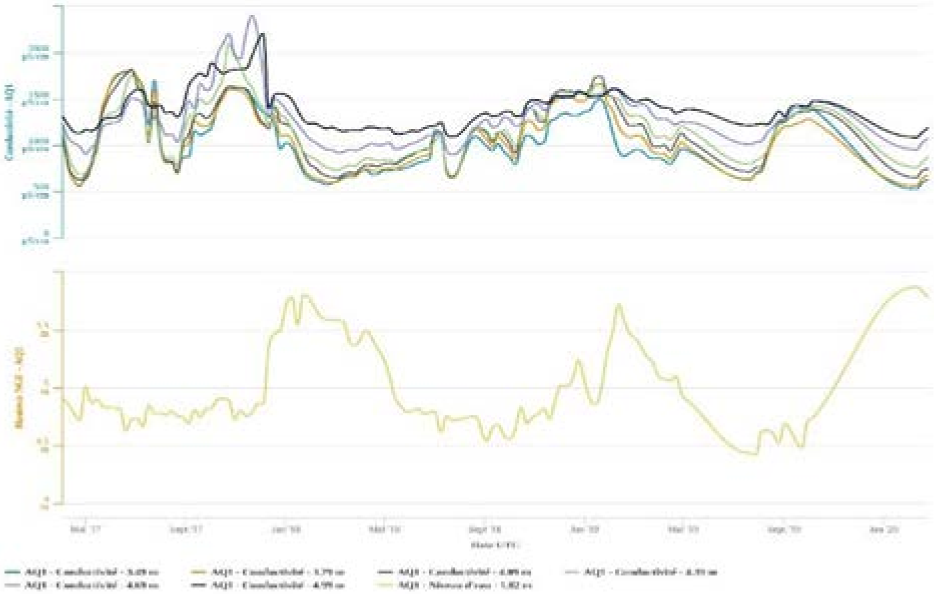

*Figure 6: Conductivity and level data acquired by the SMD-AQ1 from May 2017 to July 2020 (up: electric conductivity in µS/cm at different depths, below: groundwater level in mNGF).*


*Figure 7: Conductivity and level data acquired by the SMD-AQ4 from May 2017 to July 2020 (up: electric conductivity in µS/cm at different depths, below: groundwater level in mNGF).*

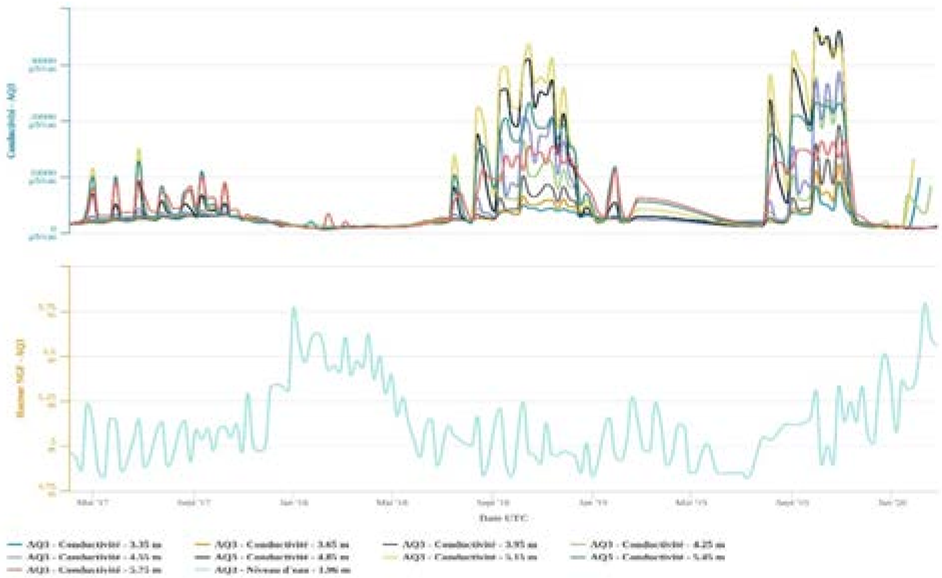

*Figure 8: Conductivity and level data acquired by the SMD-AQ3 from May 2017 to July 2020 (up: electric conductivity in µS/cm at different depths, below: groundwater level in mNGF).*

The database provided during the AQUANES project dedicated to the Agon-MAR-SAT ICT tool has been completed by the regulated data of the SAUR (Quentin Guillemoto PhD student works) and shared with the EviBAN's partners through Microsoft Teams "FR-EviBAN Project" (ANTEA group works). The available data at this mid-term stage are:

- Data available from AQUANES project 2016-2019
  - Water analysis in-outlet WWTP and after MAR-SAT (Groundwater)
  - Groundwater level (imageau sensors, manual measurements)
  - Electric conductivity (imageau SMD)
  - 2 Tracer test experiments (MAR-SAT residence time)
- Data available from WWTP operator (SAUR) from 2006-2020
  - Water volumes in- outlet WWTP
  - Water analysis in-outlet WWTP and after SAT (Groundwater)
  - Groundwater level (imageau sensors, manual measurements) from 2017
  - Groundwater salinity (imageau SMD) from 2017
- Data available from national databases
  - MNT, river network, …
  - Geology
  - Sea water level, rainfall, PET time series
  - WWTP stations and annual volumes on the Sienne Watershed

All the data acquired (water quantity and quality) by the PhD student, Quentin Guillemoto (BRGM), during the next months (2020-2021) will be integrated in the dataset shared for EviBAN.

All the existing data on the MAR-SAT system of Agon-Coutainville are organised in a dedicated MAR-SAT database. The bi-annual sampling campaigns and analysis performed at the site between 2016 and 2019 carried out for 31 emerging contaminants, trace metallic elements, major elements, pH, Eh and temperature, in addition to key chemical parameters required by French water legislation, have been assessed and shown two different behaviours in the Agon-Coutainville MAR-SAT (Figure 11): high biodegradable effect (as the propranolol) and low biodegradable effect (as the carbamazepine). Biodegradability of the molecules depends on the environmental conditions, the availability of a primary substrate, and its physio-chemicals characteristics.

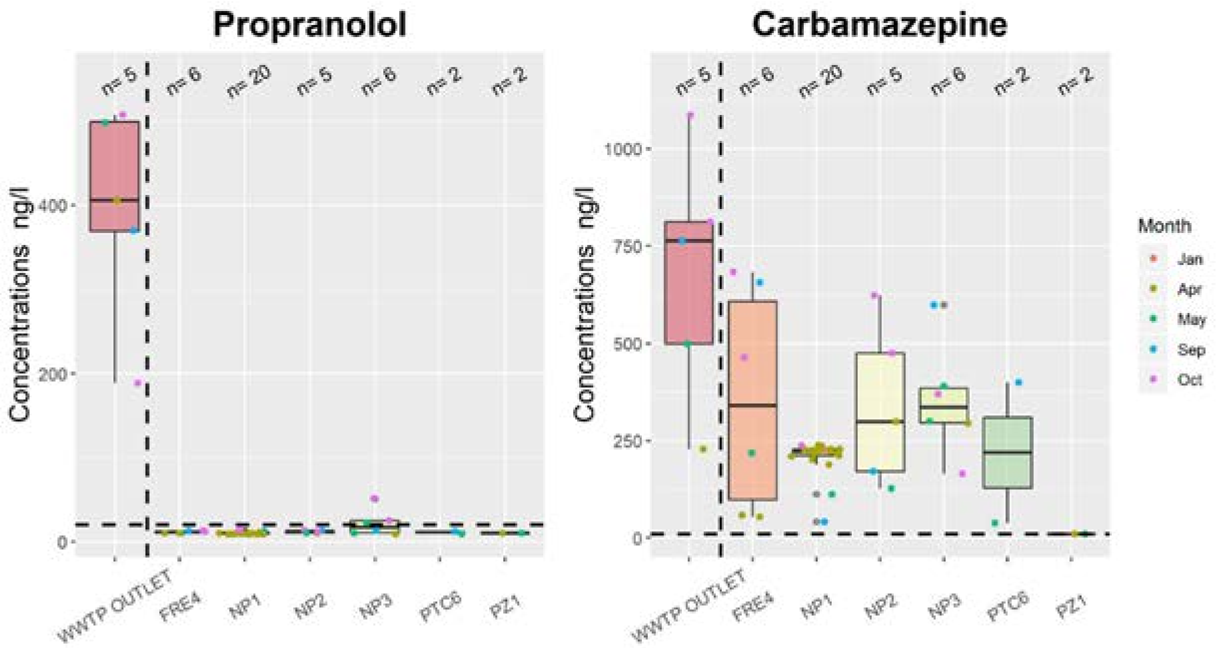


*Figure 9: Example of two different behaviour of CECs observed in the Agon-Coutainville SAT between 2016 and 2019.*

EviBAN Project information were gathered during one workshop in Agon-Coutainville with stakeholders in December 2019 and one other field visit was done to organise monitoring and to place new measurement points. Soil characterisations start in August 2020 and have to be completed in October 2020. Six new observation wells have been prepared and fully instrumented, three for monitoring groundwater and three for monitoring surface water in the reedbed (Figure 12 in collaboration with Sorbonne University for PhD Student Quentin Guillemoto).

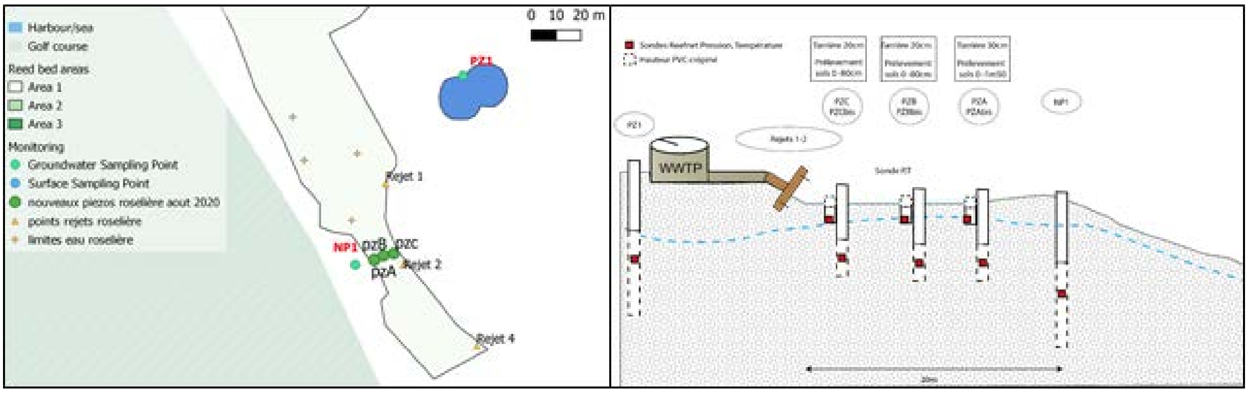


*Figure 10: Schematic description of the new monitoring points for increasing the understanding of the MAR-SAT system of Agon-Coutainville (PZC, PZB, PZA for groundwater and PZCbis, PZBbis and PZAbis for surface water in the reedbed). Left: observation points on map, Right: observation points on cross section.*

## *South African case study*

Local information about the study area was gathered during a workshop with stakeholders. During this workshop sites were identified to place weather stations. Three weather stations were subsequently installed on the properties – one in the mountains, one in Riversdale town, and one close to Stilbaai at the coast. Other data gathered include flow measurements, geology, land-types, soils and climate.


*Figure 11: Three weather stations were installed to capture data for hydrological modelling.*

A catchment delineation was done using the SWAT tool in QGIS. The process, as can be seen in Figure 14, based the sub-catchment delineation on second-order streams. This segmented the catchment in three catchment areas. The upper Goukou, including the mountain region is therefore represented in sub-catchment 1, while most of the coastal system is represented in sub-catchments 2 and 3.

From first field observations and through the effort that went into the catchment delineation process, the precipitation of the coastal system is possibly underestimated. There seems to be a poor hydrological link-up between the mountain system (sub-catchment 1) and the coastal aquifer system (sub-catchment 3). A further field observation indicated the bulk of the coastal aquifer water sits above the level of the estuary system. The first results therefore indicate that the contribution of the mountain system to the coastal aquifer is overestimated.

Efforts are now underway to set up the SPATSIM model for the catchment, and questionnaires are being finalised to interview farmers and gather information regarding land-use change and the river.

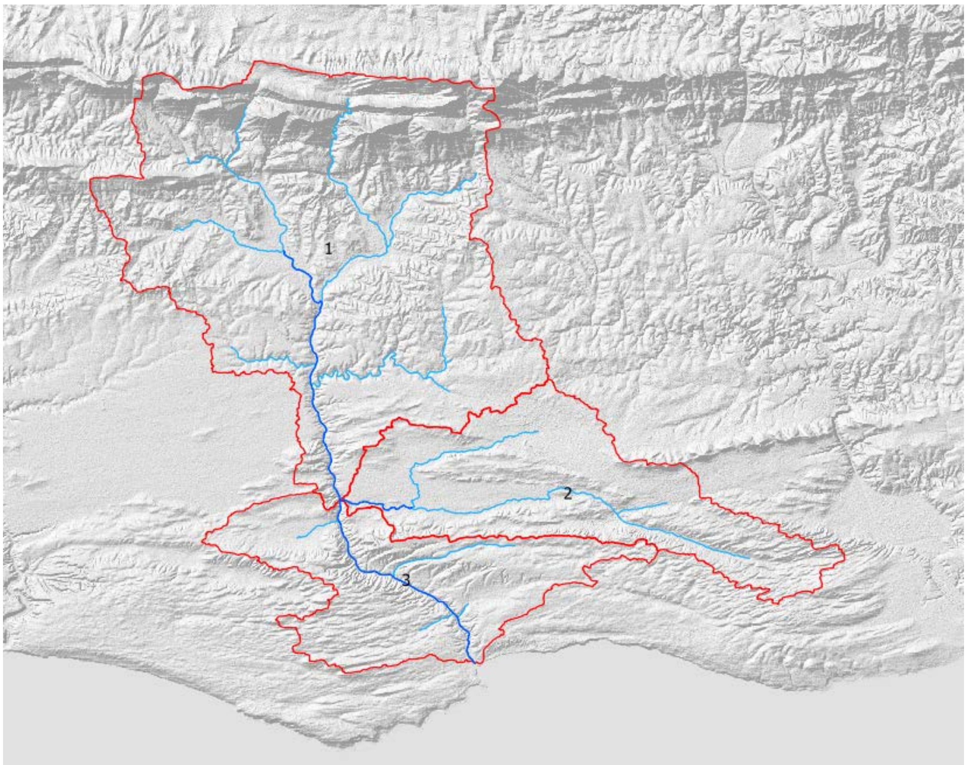

*Figure 12: Goukou Catchment delineation using SWAT in QGIS*

### *Norwegian case study*

The Norwegian case study is built around the Zero Emission Buildings (ZEB) laboratory that is currently being built in Trondheim. The ZEB laboratory will manage its stormwater through a set of nature-based solutions (NBS) where their efficiency will be documented in a pilot project in Klima 2050. The forthcoming Campus project at NTNU has proposed some new buildings close to the ZEB laboratory that may affect the stormwater management in the area, in particular at the ZEB laboratory site.

The EviBAN project will assess this effect, where the key question in EviBAN is what the optimal combination of stormwater measures on the new campus site would be to reduce the risk for flooding at the ZEB laboratory and in addition meet regulations.

Copies of two slides presenting the Norwegian case study at the local stakeholder workshop are included below.

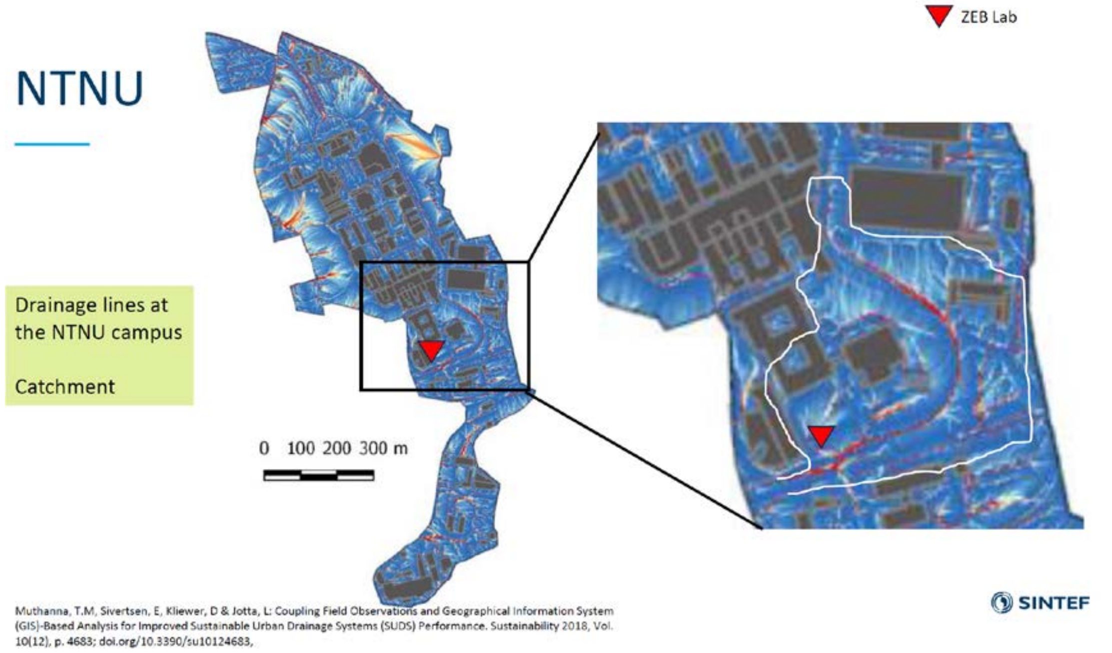


*Figure 13: Drainage lines at the NTNU campus from a previous study (Muthana et al., 2018).*

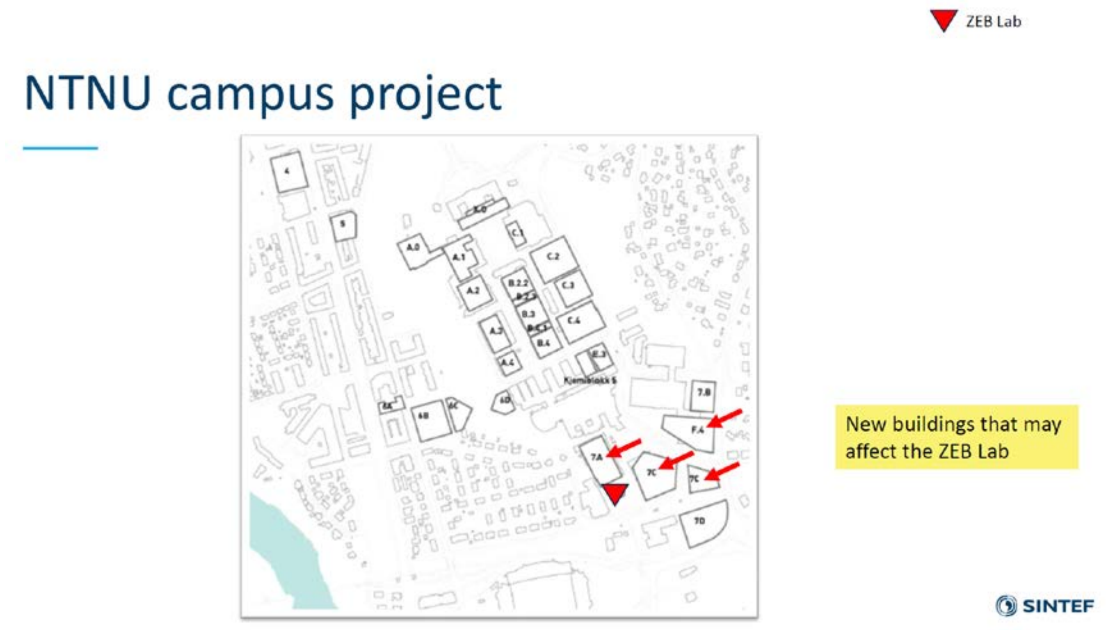


*Figure 14: Planned new buildings that may affect the stormwater management at ZEB lab.*

### *Finnish case study*

The first Finnish case study site has been two road filters installed in Tikkurilantie in the city of Vantaa (Figure 17). The filters are designed to gather stormwater runoff from vehicle road and bicycle road sections. One filter is constructed with sand material and the other one contains a layer of mixed sand and biochar. Both filters are subsurface drained and were instrumented with tipping buckets for recording the discharge at the drainage outlet. The discharge outlets were supplied with hoses to sample the filter outflows. A nearby bridge drainage outlet provided an observation point to sample the quality of road stormwater runoff. The site was instrumented with two precipitation gauges and reference meteorological data were gathered from the Helsinki-Vantaa airport.

*Figure 15: Tikkurilantie roadside filters, and their instrumentation for discharge (tipping buckets).*

In EviBAN the precipitation and flow data of the filters were gathered starting from 22 September 2019. Three intensive measurements campaigns were conducted in September-October 2019 to sample the water quality of the two filters and road runoff. The samples were analysed in a laboratory to measure the following parameters and concentrations: pH, Alkalinity, Electrical conductivity, Turbidity, Total Suspended Solids, UV absorbance, NH4, TN, NO2+NO3, TP, PO4, TOC, DOC, Cd, Cu, Pb, Ni, Zn, Mn, Si, Fe, SO4, Cl, Ca, Mg, K, Na, and Al. In addition to the new hydrological and water quality measurements in EviBAN, the filter dataset from an earlier study conducted directly after the construction of the filters in 2017 was prepared as reference data.

The Tikkurilantie filters have formed a case study setup for the PHREEQC application, which are used to simulate the geochemical processes theoretically occurring within the NBS. The fate of stormwater pollutants in the Tikkurilantie roadside filter were simulated using the water quality data collected during the two measurement campaigns in 2019. The interpretation of modelled data provided information about retention mechanisms (precipitation or dissolution) and the sorption capacity of minerals. These outputs are relevant for evaluating the longer-term filter performance and identifying the critical environmental changes (e.g., pH or salt influx) that may influence the pollutants retention mechanisms.

The climate change data were gathered for the Vantaa site from the Regional Climate Model results available from the CORDEX database. The scenarios included historical simulation from 1970 until 2005 and two projections from 2006 to 2100 characterising representative concentration pathways of 2.6 W/m2 and 8.5 W/m2. The climate series were hourly data.

The outputs of the climate change scenarios will form the basis for the geochemical analysis of the dilution and changes residence time effects on minerals dynamics within the Tikkurilantie roadside filter. This analysis is in the early phase.

The test site for simulation study of NWRM was searched with the city of Espoo. Plausible study sites were identified to be one of the Gräsanoja stream sub catchments in or one of the study catchments in western city. Construction and parameterisation of the SWMM model in the catchments is in the beginning phase.

### b. Collaboration, coordination and mobility

The most concrete form of collaboration has been the stakeholder meetings organised in all participating countries. The meetings were used to gather qualitative data by means of a dissemination exercises to identify the relevance of the sustainable development goals (SDGs) and define the objectives and criteria for measuring the contribution of MAR and stormwater management solutions to progress towards the identified SDGs.

The contributions of the partners have been clearly identifiable through the collection of case studies supporting EviBAN toolbox development.

The mobility was realised between Finland and Norway through a doctoral student's exchange from Aalto University to SINTEF in Trondheim. However, the exchange period was interrupted because of the global COVID-19 in March 2020.

Further mobility is planned between South Africa and France. A bilateral project proposal, SAFE-MAR, between France and South Africa (PROTEA call) has been submitted to complete JPI-EviBAN collaboration, dissemination and PhD Student mobility dedicated to MAR systems. The study will investigate the potential use of managed aquifer recharge to improve water security and to naturally reduce wastewater contaminants, using French and South African hydrological models. The work will be conducted at two sites: the Goukou catchment in the Western Cape Province of South Africa and Agon-Coutainville in Normandy, France. The PROTEA funding will be used to enable mobility between BRGM and SU, allowing them to share concepts, methodologies and applications of modelling techniques for managed aquifer recharge in France and South Africa. This collaboration will contribute significantly to the understanding of the two MAR sites and thereby facilitate faster implementation of MAR in the South African case, and more informed and accurate management in the French case. The work will also produce valuable lessons for MAR guidance and establish the foundations for long-term information and knowledge sharing between the institutions, municipalities at the study sites, as well as the countries.

### c. Impact and knowledge output

In South Africa, impact has been achieved through a renewed interest in the water supply problems and the health of the river, brought about by the local stakeholder workshop and ongoing engagements by the project team.

In Finland, interest in stormwater management issues has raised especially in local stakeholders (cities of Espoo and Vantaa) through stakeholder workshop and other separate meetings where the project content and targets have been presented. The project results will have an impact on more sustainable and effective stormwater management by providing knowledge about filter performance to be used for stormwater purification. Among cities, also designers and consultant companies will be able to utilize the results of the project. The gained knowledge can potentially impact also on political decisions especially on local level depending on the project results.

In France at Agon-Coutainville scale, stakeholders are clearly interested and involved in the EVIBAN project. Municipality want to facilitate EVIBAN actions and want to be sure the MAR-SAT system is optimal to protect downstream environment. They are very interested in the result of the project to plan other MAR-SAT system on the watershed where a such system is relevant.

In Norway there is a considerable interest in nature-based solutions or hybrid green – grey solutions, especially for stormwater management, and the focus on sustainable solutions is increasing. Municipalities and service providers in the water sector want to include sustainability as a criterion for decisions. However, a reoccurring challenge is how to assess the sustainability of solutions. In EviBAN we see synergies with other ongoing studies e.g. KLIMA 2050 in this respect.

3. Table of Deliverables

The deliverables that have been prepared are included in the table below. As reported in the table, there have been some delays compared to plan. However, there are no outstanding deliverables in the reporting period. All milestones due in the reporting period have also been achieved.

In general, the progress is therefore satisfactory even if there have been deviations from the original plan.

In the coming period it is foreseen that more time than originally planned will be needed for discussion between the research partners and also with the case study stakeholders. This is expected due to the coronavirus pandemic and the change to virtual meetings/workshops, which necessitates limiting the scope of each event to achieve good discussions.

*Table 1: Deliverables from EviBAN in the reporting period.*

| **Deliverable name** | **Lead partner (country)** | **Date of delivery (dd/mm/yyyy)** | **Changes, difficulties encountered, and new solutions adopted** |
|---|---|---|---|
| **WP1** | | | |
| D1.1_Risk Management Plan - EviBAN_20190705 | SINTEF (Norway) | 05/07/2019 | None |
| D1.2_Conceptual framework and KPIs, Learning Alliance | SINTEF (Norway) | 01/04/2020 | Delayed compared to plan due to time needed for feedback/discussions with partners and stakeholders |
| D1.31_Agon 191204 EviBAN workshop report | SINTEF (Norway) | 11/09/2020 | Delayed compared to plan due to template not developed at time of workshop and delayed feedback on draft. |
| D1.32_Riversdale 200211 EviBAN workshop report | SUWI (South Africa) | 21/04/2020 | None |
| D1.33_Note 101 EviBAN temasamling | SINTEF (Norway) | 28/04/2020 | None |
| D1.34_Finland 200402 EviBAN workshop report | Aalto Uni. (Finland) | 08/06/2020 | None |
| D1.35_200528 1st annual meeting EviBAN workshop report | Aalto Uni. (Finland) | 11/09/2020 | None |
| **WP2 and WP3** | | | |
| *No deliverables due in this reporting period* | | | |
| **WP4** | | | |
| D4.1 Project Website | SINTEF (Norway) | 20/05/2020 | Delayed compared to plan due to change of solution for service provider. The change was made to ease maintenance of the website. |
| D4.2_Dissemination plan | BRGM (France) | 30/09/2019 | None |
| D4.2_Dissemination_Event&Stakeholders_v2 - Month 12 update | BRGM (France) | 28/09/2020 | None |
| D4.3_EviBAN Data Management Plan | SINTEF (Norway) | 05/07/2019 | Updated 28/09/2020 |

4. Budget review

A summary of the accrued costs in the different WPs is given in Table 3. It should be noted that the period reported varied somewhat (+/- two weeks in October). The costs for reported here are therefore not fully accurate if one strictly considers a reporting period of 202019-04-01 until 2020-09-30 and should therefore not be taken as a substitute for costs reported by the individual partners to their national FPOs.

*Table 2: Summary of costs for EviBAN until October 2020*

| | WP1 | WP2 | WP3 | WP4 | TOTAL |
|---|---|---|---|---|---|
| **Personnel Costs** | 21 338 € | 102 893 € | 208 292 € | 46 057 € | 378 680 € |
| **Total expenditure** | 27 529 € | 110 846 € | 230 398 € | 51 000 € | 423 369 € |

The total cost represents 42% of the total requested funding in the budget for EviBAN. Considering that the kick-off meeting for EviBAN was in the end of May 2020 and that the activities reported here are for the period until end of September, there is a reasonable correspondence between the accrued costs and duration of the project so far.

5. Consortium Meetings

The table below lists the meetings involving two or more of the EviBAN consortium partners. In addition, several internal project meetings have been organised by each partner, but these are not registered by the coordinator and included in the overview here.

*Table 3: Meetings involving two or more of the EviBAN consortium partners*

| N° | Date | Location | Attending partners | Purpose/ main issues/main decisions? |
|---|---|---|---|---|
| **1** | 2019/05/28-29 | Trondheim, Norway | All EviBAN partners | Project kick-off |
| **2** | 2019/12/04 | Agon Countainville, France | BRGM, SINTEF, French case study stakeholders | Local case study workshop |
| **3** | 2020/01/31 | Virtual | All EviBAN partners | WP2 meeting to discuss tool development |
| **4** | 2020/02/12 | Riversdale, South Africa | SUVI, SINTEF, South African case study stakeholders | Local case study workshop |
| **5** | 2020/03/17 | Virtual | SINTEF, Aalto, Norwegian stakeholders | Local cases study workshop in collaboration with the SFI* KLIMA 2050 |
| **6** | 2020/03/27 | Virtual | SINTEF, Aalto, SUWI, BRGM | PMT meeting to discuss how to handle the coronavirus situation |
| **7** | 2020/04/02 | Virtual | Aalto, VTT, SINTEF, Finnish case study stakeholders | Local case study workshop |
| **8** | 2020/05/28 | Virtual | All EviBAN partners, Finnish stakeholders | Annual project meeting |

*: SFI = Centre for Research Driven Innovation

6. Stakeholder/Industry Engagement

The EviBAN case studies have been conducted in collaboration with the local stakeholders in each country. The results of the case studies will inform the best practices for the future local developments. From each of these workshops a workshop report has been prepared, which includes an overview of the participating stakeholders.

In Finland the local cities of Vantaa and Espoo in the capital area participate in field campaigns and act as data providers for the modelling studies. The EviBAN field campaigns in Vantaa have supplemented earlier data about the NBS performance. The consultant company SITOWISE participates in the simulation model applications regarding NBSs for stormwater management.

In South Africa stakeholders include farmers, town residents of Stilbaai and Riversdale and officials from government and nature conservation organisations. The project has been well-received, and all stakeholders have been forthcoming with data and information. Issues raised during the workshop by the local stakeholders are now included in the work plan and as such the engagement has positively influenced the anticipated project outcome.

In France at Agon-Coutainville scale, SAUR are clearly interested and involved in the EVIBAN project. SAUR facilitate EVIBAN actions. They are very interested in the result of the project to plan other MAR-SAT system on the watershed where such system is relevant.

In Norway the discussion at the local case study workshop involved and extended stakeholder group coming from a collaboration with the SFI KLIMA 2050. KLIMA 2050 is a centra for research driven innovation in Norway which involves stakeholders from industries and public entities. One of the topics covered by KLIMA 2050 is stormwater management, which made it natural to have a common workshop between EviBAN and KLIMA 2050 to discuss the Norwegian case study.

Due to the coronavirus pandemic, only the first two local workshops, in France and in South Africa, were organised as face-to-face meetings. The workshops in Norway and Finland were virtual using Teams as meeting venue. The change to virtual format necessitated some adaptation of the exercise used in the last two workshops. It is foreseen that more time will be needed to obtain enough feedback from the stakeholders on the developed ISA tool because one may need to have several iterations to limit the scope when using virtual meetings.

7. List of Publications produced by the Project - Open Access

There have been presentations to stakeholders in the different local cases study workshops. These are kept on file, but not included in Table 5 below.

There are publications produced in the reporting period that draw on data and results from other ongoing or previous projects. This applies especially to the French case study where the preceding AQANES project has a complementarity and/or synergy with EviBAN. Another example is the activity in the SFI KLIMA 2050 that is connected to the Norwegian case study. In such cases reference to the publication has also been made in connection with presentation in the sections above on results, collaboration, and stakeholder engagement.

*Table 4: List of publications and dissemination activities in the reporting period*

| | | |
|---|---|---|
| International | Peer-reviewed journals | 1.<br>2.<br>3. |
| | Books or chapters in books | 1. Picot-Colbeaux Géraldine, Mathurin Frédéric, Pettenati Marie, Nakache Frédérique, Guillemoto Quentin, Baïsset Matthieu, Devau Nicolas, Gosselin Mickaël, Allain Didier, Neyens Denis, Lartigaut Claire, Dufour Eric, Togola Anne, Depraz Olivier, Nauleau Fabrice. (2020): *Case Study 16: Soil Aquifer Treatment system to protect coastal ecosystem in Agon-Coutainville (Normandy), France*, in Zheng, Y., Ross, A., Villholth, K.G. and Dillon, P. (eds.). Managing Aquifer Recharge: A Showcase for Resilience and Sustainability. A UNESCO-IAH-GRIPP Publication. No: 4500386254 (in press). <Web URL>-to be advised.<br>2.<br>3. |
| | Communications (presentations, posters) | 1. Guillemoto Q., Picot-Colbeaux G., Pettenati M., Valdes-Lao D., Devau N., Kloppmann W., Mouchel J-M. (2019) *Numerical modelling: a tool for Managed Aquifer Recharge and Saturated Aquifer Treatment system in coastal area.* AGU, San Francisco, USA.<br>2.<br>3. |
| National (separate lists for each nationality) | Peer-reviewed journals | 1.<br>2.<br>3. |
| | Books or chapters in books | 1.<br>2.<br>3. |
| | Communications (presentations, posters) | 1.<br>2.<br>3. |
| Dissemination initiatives | Popular articles | 1.<br>2.<br>3. |
| | Popular conferences | 1.<br>2.<br>3. |
| | Others | 1.<br>2.<br>3. |

Finally, there are publications planned for the next period that will be partly based on the results presented in this mid-term report. Some of these are were originally planned in this reporting period but have been cancelled or delayed due to the COVID-19 pandemic.

One of these, the paper *Integrated Sustainability Assessment of Natural Water Retention Measures, Helness et al.* has been accepted for platform presentation at the IWA World Water Conference and Exhibition in Copenhagen. The conference was originally planned for 2020 but had been postponed to 2021.

8. Knowledge output transfer

The knowledge generated by EviBAN in the reporting period is embedded in the data generated and will be transferred through the publications that are planned to come in the second half of the project period.

At the time of reporting, the data and knowledge embedded in these have not been processed to a state where it is relevant to report separate knowledge outputs as outlined in the table provided in this section of the mid-term report template.

9. Open Data

PHREEQC modelling components will be available in the Open Data & Open Access platform during the final reporting as will the other results from EviBAN as described in the project description and preceding sections of this mid-term report.

10. Problems Encountered during Project Implementation

The collaboration between the project partners is good and there have not been any problems to implementation reported to the coordinator from the participants.

The biggest challenge for implementing the project activities as planned has been the COVID-19 pandemic which has changed completely the means of communicating and foreseen collaboration on activities since March 2019. The change from visits between project partners and face to face meetings and workshops to virtual venues has in many aspects worked fine, but it remains a challenge to get the same involvement and engagement in discussions in a virtual meeting compared to face to face meetings.

To date tis has not hampered the project execution but this is foreseen to be a larger challenge in the second half of the projects when testing of the tools at the cases studies and compiling the individual tools into a toolbox is planned.

11. Suggestions for improvement regarding project implementation?

To address the foreseen challenges described in the previous section, meetings in WP2 will be organised on a regular basis. Besides aiding the compilation tools into a toolbox, it will help spread knowledge about the different tools in the project group and by this aid in the testing of the tools in the different case studies, where the local R&D-partner may need to assist in a more direct manner that originally planned due to travel restrictions.