



MARSOL

Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought

Interim Report for the Project Period June 2015 - February 2016

Work Package No.	WP4
Lead Partner	LNEC
Version Date	30.03.2016
Authors	Teresa E. Leitão, J.P. Lobo Ferreira, Manuel M. Oliveira, Tiago Martins, Maria José Henriques, Rogério Mota, Ana Estela Barbosa (LNEC) Tiago Carvalho, José Martins de Carvalho, Rui Agostinho, Rita Carvalho, Raquel Sousa (TARH) José Paulo Monteiro, Luís R.D. Costa, Rui Hugman (UAlg)
Dissemination Level	CO
Status	Draft



The MARSOL project has received funding from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no 619120.

Contents

1	Executive summary	3
2	Activities and results	6
3	Subcontracting	20
4	Difficulties or problems faced during the reporting period.....	20
5	Plan of activities for the next reporting period.....	20
6	Assessment of the collaboration.....	20
7	Publications.....	21
8	Other dissemination activities	21

1 Executive summary

The work progress of WP4 between month 19 and 27 was conducted with the strong collaboration of the three Portuguese partners (LNEC, TARH and UAlg) as well as with the regional water authorities (APA Algarve and APA Alentejo), the water supply company (AdA, Águas do Algarve), and the General Direction for Agriculture (DRAPALG), some of the main potential users of MAR.

As reported before, the main purposes of three DEMO sites are:

- **PT1** (Figure 1), the rio Seco and Campina de Faro aquifer system (Algarve): this is the main groundwater quality demonstration area of the South Portugal (Algarve) DEMO study. Its aim is to demonstrate that groundwater quality can be improved by applying managed aquifer recharge through infiltration basins constructed in rio Seco bed using either the basins constructed during GABARDINE EU project (PT1_1), which were rehabilitated during MARSOL, or the new MARSOL basins (PT1_2) constructed in July/August 2014, as well as through large-diameter wells (PT1_3).
- **PT2** (Figure 2 and Figure 3), Querença-Silves limestone karst aquifer system (Algarve) DEMO site aims to: (1) develop a Soil Aquifer Treatment (SAT) system to improve the water quality of treated effluents from a Waste Water Treatment Plant (WWTP) (PT2_4), which discharges water into ribeiro Meirinho (PT2_5) and (2) increase groundwater storage using MAR to recharge the aquifer system with surface water surplus during wet years in Cerro do Bardo well (PT2_6), located next to a tributary of ribeiro Meirinho. This will contribute to increase the water availability in dry years, facilitating downstream water supply pumping.
- **PT3** (Figure 4), Melides aquifer, river and lagoon (Alentejo): the aim is to use SAT in infiltration basins in a lab facility to treat water contaminated from rice crops fields and from diffuse groundwater pollution.

The status of the **four tasks** of this WP4 is the following:

- **Task 4.1: Recharge water availability:**

This task was completed in month 12, as proposed in the DoW, and reported in the Deliverable 4.1 "Water sources and availability at the South Portugal MARSOL demonstration sites" (Oliveira *et al.*, 2015¹).

- **Task 4.2: Developing the (MAR) infrastructures:**

This task was completed for PT1 (with all infrastructures for PT1_1 and PT1_2 built), for PT2_6 and for PT3 (one site with infrastructure built in an experimental facility at LNEC campus), both within month 24, as proposed in the DoW. Sites PT2_4 is under construction and expected to be finished in

¹ OLIVEIRA, M.M., COSTA L.R.D., MONTEIRO, J.P., LOBO FERREIRA, J.P., LEITÃO, T.E., 2015 - Deliverable 4.1 Water Sources and Availability at the South Portugal MARSOL Demonstration Sites. Projeto UE MARSOL - Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought, January, 50 pp.

April/May 2016. All this information is partially reported in the Deliverable 4.2 "South Portugal MARSOL demonstration sites characterisation" (Leitão *et al.*, 2015²).

- **Task 4.3: Investigation and monitoring:**

This task has started much before scheduled and is predicted to finish by the end of the project. Results were partially reported in both Deliverables 4.1 and 4.2.

- **Task 4.4: Modelling:**

This task has started before scheduled and is predicted to finish in the end of the project. Results were mainly reported in the Deliverable 12.3 "Progress report on numerical models of the MARSOL DEMO sites" (Lobo-Ferreira *et al.*, 2015³).

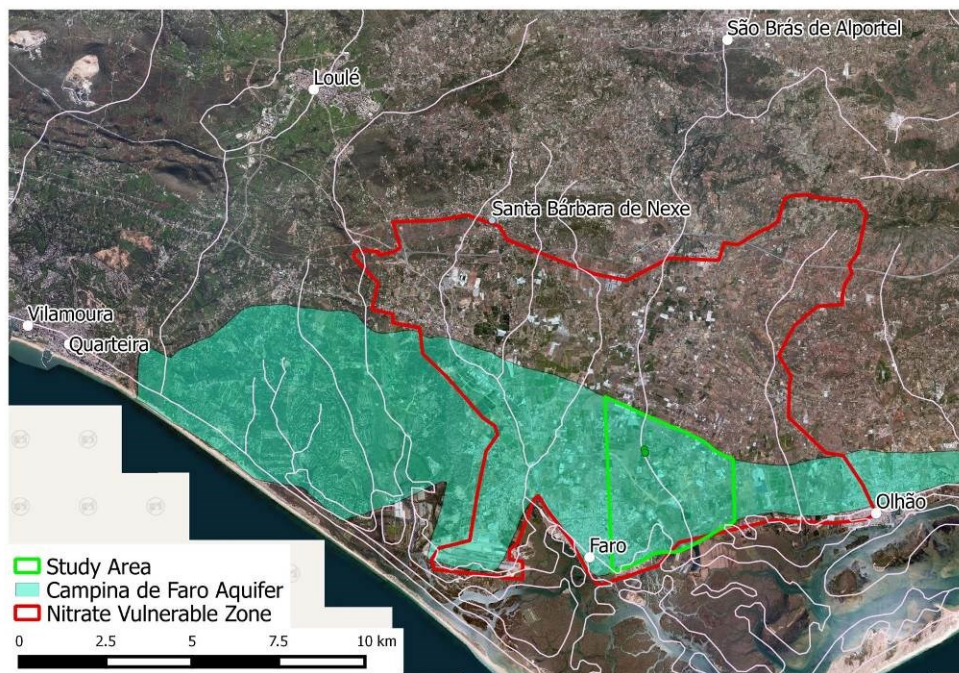


Figure 1 – Location of the PT1 MARSOL DEMO site (PT1_1, PT1_2 and PT1_3)

² LEITÃO T.E., LOBO FERREIRA J.P., OLIVEIRA M.M., MARTINS T., HENRIQUES M.J., CARVALHO T.M., MARTINS DE CARVALHO J., AGOSTINHO R., MONTEIRO J.P., COSTA L.R.D. (2015). Deliverable 4.2 South Portugal MARSOL Demonstration Sites Characterisation. EU MARSOL Project - Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought, 78 pp.

³ LOBO FERREIRA, J.P., OLIVEIRA, M.M., MARTINS, T., LEITÃO, T.E., ILLIE, A.M., MONTEIRO, J.P., COSTA L.R.D., ESCALANTE, E., SCARINCI, A., FERRI, M., ROSSETTO, R., BORSI, I., KATZ, Y., FOGLIA, L., POULIARIS, C., KALLIORAS, A., 2015 – Deliverable 12.3 Progress Report on Numerical Model. Project UE MARSOL - Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought, September, 95 pp.



Figure 2 – Location of the PT2_4 and PT2_5 MARSOL DEMO site

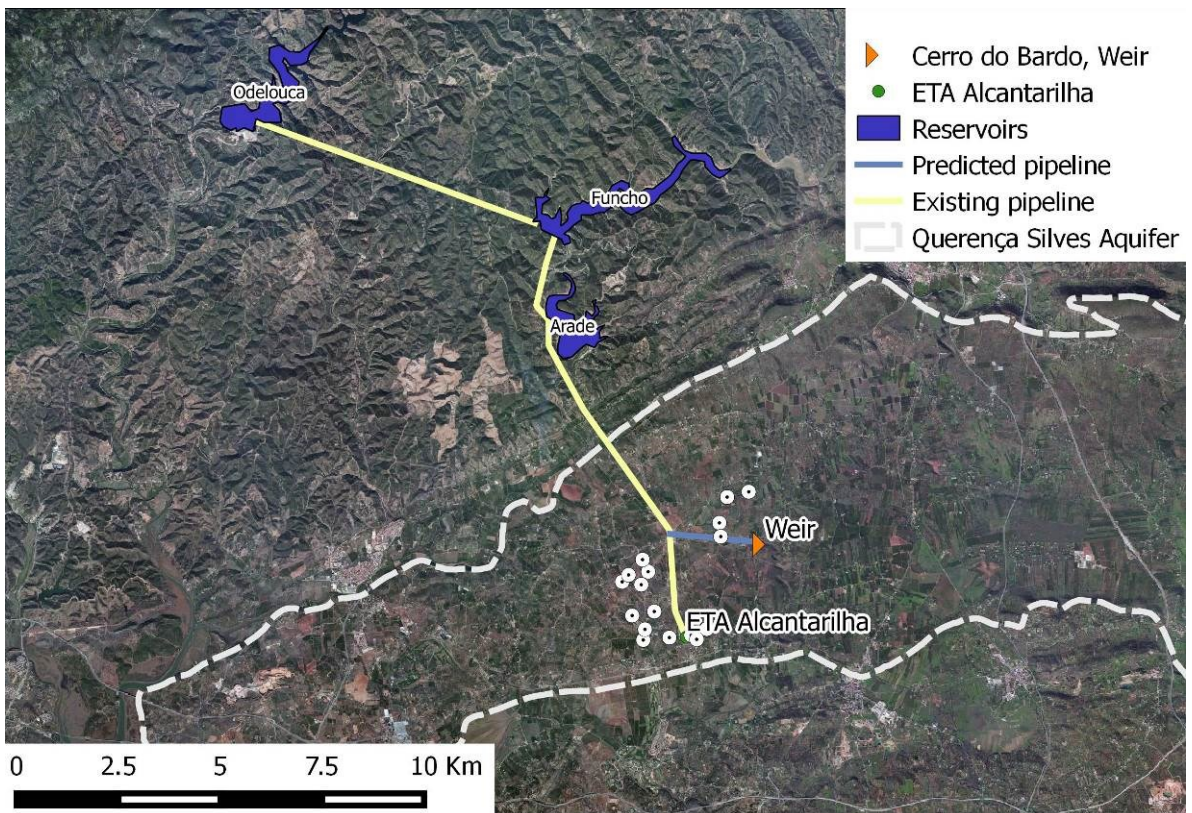


Figure 3 – Location of the PT2_6 MARSOL DEMO site

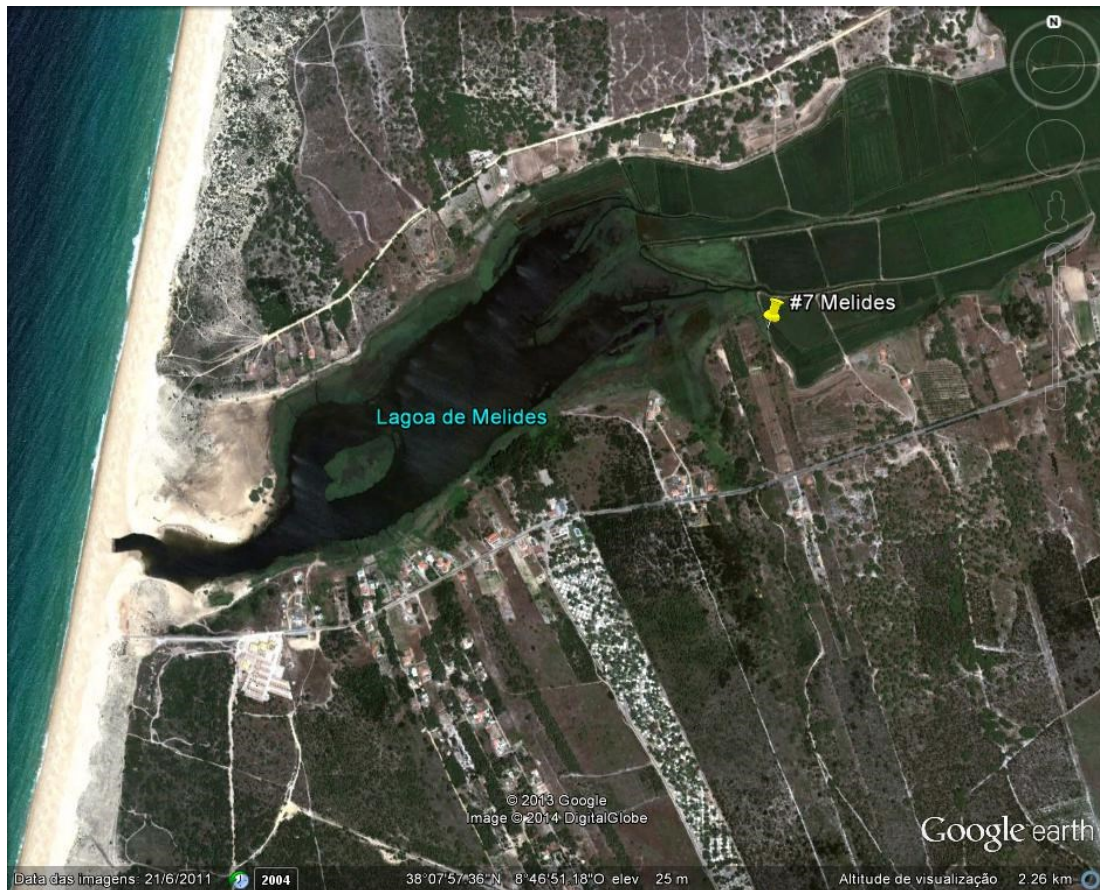


Figure 4 – Location of the PT3 MARSOL DEMO site

2 Activities and results

From the beginning of the project, a Road Map was built for each one of the four WP4 Tasks to ensure that all activities, results and deliverables described in the DoW were performed, and in time.

The Road Map contains their (1) General Characteristics and (2) Deliverables, both taken from the DoW, as well as a more detailed (3) Programming of activities and results, or Plan, to be implemented during the reporting period and beyond. The Plan was designed with the contribution of all involved partners from LNEC, TARH and UAlg. It was conceived in a table format, with the action step number, its description and date of achievement.

In Table 2-1 to Table 2-4, all planned activities and main results are presented, with a short description of what was achieved and the respective date.

Table 2-1 - Road map for Task 4.1

Task 4.1		Recharge water availability (Task leader LNEC)
General Characteristics		
Main Requisites	Assess the water availability for artificial recharge (water balance) and its distribution throughout the year. The amount of water available for aquifer recharge and its source has been estimated. The main sources are river floods and treated urban wastewater. Regional water balance models have been used to estimate natural water availability	
Start	DoW: 1Mar14; Done: 1Mar14	
Finish	DoW: 1Dec14; Done: 1Dec14	
Deliverables		
D4.1	Water sources and availability at the South Portugal MARSOL demonstration sites - all sites	
Nature	Report	
Dissemination level	Restricted to a group specified by the consortium	
Delivery date	DoW: 1Dec14; Done: 1Dec14	
Programming		
	Description	Date
Step 1	Evaluate models previously used and results concerning water resources and availability. Sources of information: technical reports and papers, river basin management plans.	May14
Step 2	Compile new data (not used by the previous models) and organize it in the site of the project. Data should allow computation of (1) watershed or groundwater basin upstream the study areas for the natural conditions, (2) water available in other areas in the case of imported water for artificial recharge Collect data from existing rain gauge stations, surface water gauge stations	Set14
Step 3	Calculate both natural water resources and imported water availability at the South Portugal MARSOL demonstration sites – all sites	Nov14
Step 4	D4.1 Report on water availability and possible water sources for artificial recharge at the South Portugal DEMO sites D4.1 (Oliveira <i>et al.</i> , 2015, cf. section 7) was published in January 2015. The report contains, for each one of the 3 PT DEMO sites, the natural water balances (Figure 5, Figure 6 and Figure 7), calculated both for the groundwater bodies receiving MAR and the river basins upstream the DEMO sites. The model used was BALSEQ_MOD (developed by LNEC). Besides, the water availability arising from non-conventional water sources for MAR was studied, including flash floods, water harvest in greenhouses, and wastewater from treatment plant, among others, depending on the location of each site	Dec14

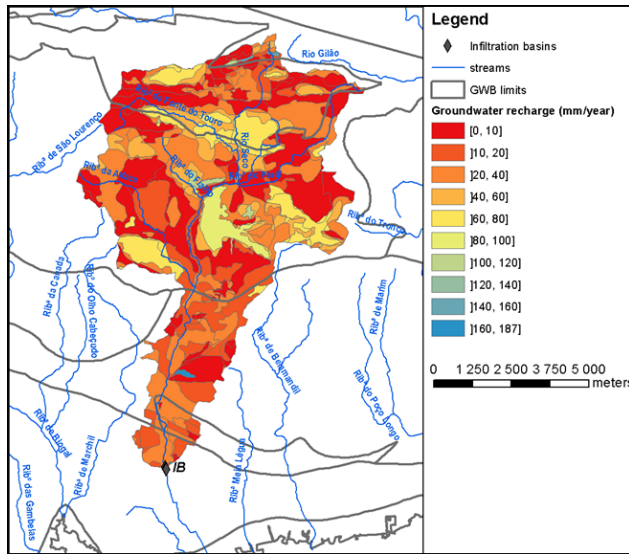


Figure 5 – Average groundwater recharge distribution in rio Seco river basin upstream the infiltration basins (Oliveira *et al.*, 2015)

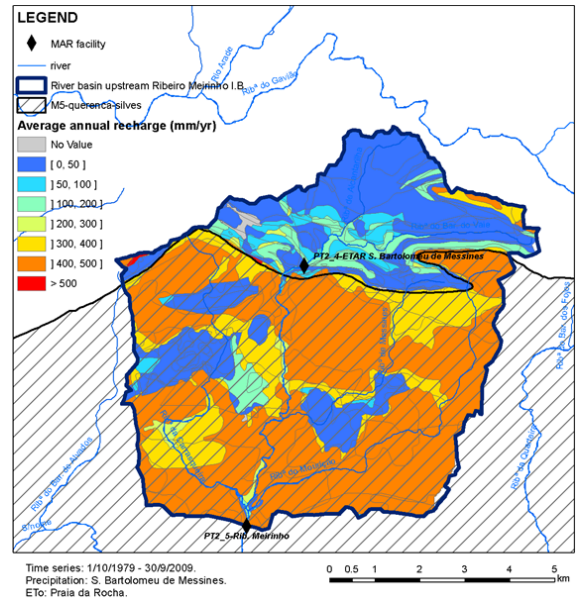


Figure 6 – Average groundwater recharge distribution in the river basin upstream ribeiro Meirinho potential MAR site (period 1979-2009) (Oliveira *et al.*, 2015)

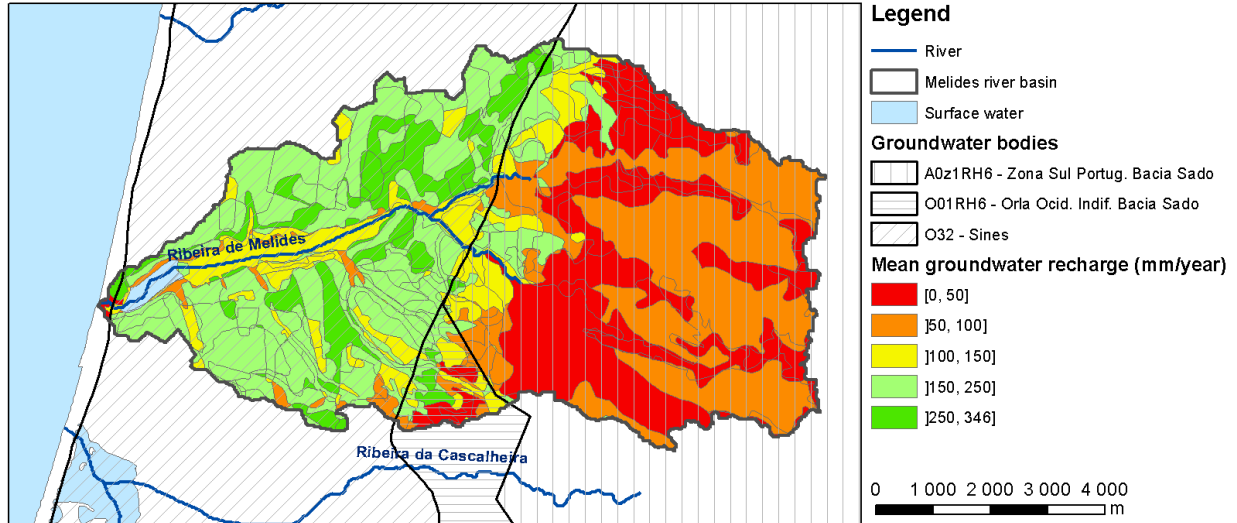


Figure 7 – Average groundwater recharge distribution in Melides river basin (source: adapted from Oliveira *et al.*, 2011)

Table 2-2 - Road map for Task 4.2

Task 4.2		Developing the infrastructures (Task leader TARH; support from LNEC and UAIG)	
General Characteristics			
	Assess the existing infrastructures and design the necessary new infrastructures for water recharge and water treatment management, as well as for monitoring PT1 and PT2 sites. Coordinate the monitoring net and the construction work and design the piezometers and treatment basins use. The piezometers construction aims at performing aquifer tests, in order to assess the aquifers systems main hydraulic properties, as well as monitoring the groundwater system during the foreseen tests and the recharge during the project and beyond. The data collected, both during aquifer tests and the monitoring, were integrated in the development of the hydrogeological conceptual model at the local scale for the DEMO sites		
Start	DoW: 1Dec14; Done: 1Dec14		
Finish	DoW: 1Dec15; Done: expected for Apr16		
Deliverables			
D4.2	South Portugal MARSOL demonstration sites characterization: Report on the South Portugal MARSOL demonstration sites investigation and description - all sites		
Nature	Report		
Dissemination level	Restricted to a group specified by the consortium (including the Commission Services)		
Delivery date	DoW: 1Dec15; Done: 1Dec15		
Programming			
	Description	Date	
PT1_1 – Campina de Faro			
Step 1	Evaluate the existing infrastructures	Abr14	
Step 2	Rehabilitation of the existing infiltration basins Rehabilitation of the access Rehabilitation of the piezometers	Jul14	
PT1_2 – Campina de Faro			
Step 3	Definition of a Hydrogeological Conceptual Site Modelling (local scale) Design and implementation of new monitoring piezometers	Jul14	
Step 4	Construction of a new infiltration basin (equivalent to 2 x old ones) (cf. Figure 8)	Ago14	
PT1_3 – Campina de Faro			
Step 5	Analysis of possible areas for connecting existing greenhouses with large wells “Noras” for infiltrating water (MAR) during storm events	Nov14	
PT2_4 – ETAR SB Messines			
Step 6	Visit to the test site for soil and water collection for WP14	Several times	
Step 7 (cf. Figure 9)	Assessment of the basins dimensions and best soil characteristics using the results from WP14.1 soil-column tests	Feb15	
Step 8 (cf. Figure 10)	Construction of the SAT basins Construction of the hydraulic structures – connection with the WWTP	April16	
PT2_5 – Ribeiro Meirinho			
Step 9	Definition of a Hydrogeological Conceptual Site Modelling (local scale)	Dec14	

Task 4.2 Developing the infrastructures (Task leader TARH; support from LNEC and UAlg)		
T2_6 – Cerro do Bardo		
Step 10	Evaluation of the existing infrastructures	Abr14
Step 11	Definition of a Hydrogeological Conceptual Site Modelling (local scale) Design of the new recharge structures	Oct14
Step 12	MAR infrastructures rehabilitation/construction: <ul style="list-style-type: none"> - Rehabilitation of the access to the site - Rehabilitation of the large well at Cerro do Bardo for future MAR purposes - Rehabilitation of the weir 	Dec14
Step 13	Tracer test with geophysics (cf. Task 4.3)	Dec14 and Apr16
Step 14 (cf. Figure 11)	Installation of two piezometers for aquifer properties assessment and for monitoring the MAR process	Feb16
Step 15	Preparation and coordination of the long term infiltration and tracer test to be held in April 2016, including the preparation of AdA's well from where water will be pumped and conducted to Cerro do Bardo's well where it will infiltrate	Apr16
PT3_7 – Melides		
Step 16	Visit to the test site and soil collection for WP14	May14
Step 17 (cf. Figure 12)	Construction of a prototype SAT-MAR basin with the "physical sand-box" facility constructed in LNEC	Dec15
Step 18	D4.2 South Portugal MARSOL demonstration sites characterisation (Leitão <i>et al.</i> , 2014)	Dec14



Basin ready: August 2014



Tracer test: October 2014

Figure 8 – PT1_2 Campina de Faro: new basin before and during a tracer experiment



Figure 9 – PT2_4 São Bartolomeu de Messines: SAT basins location (left) and soil-column laboratory experiments set-up to access the best soil for the SAT basins (right)

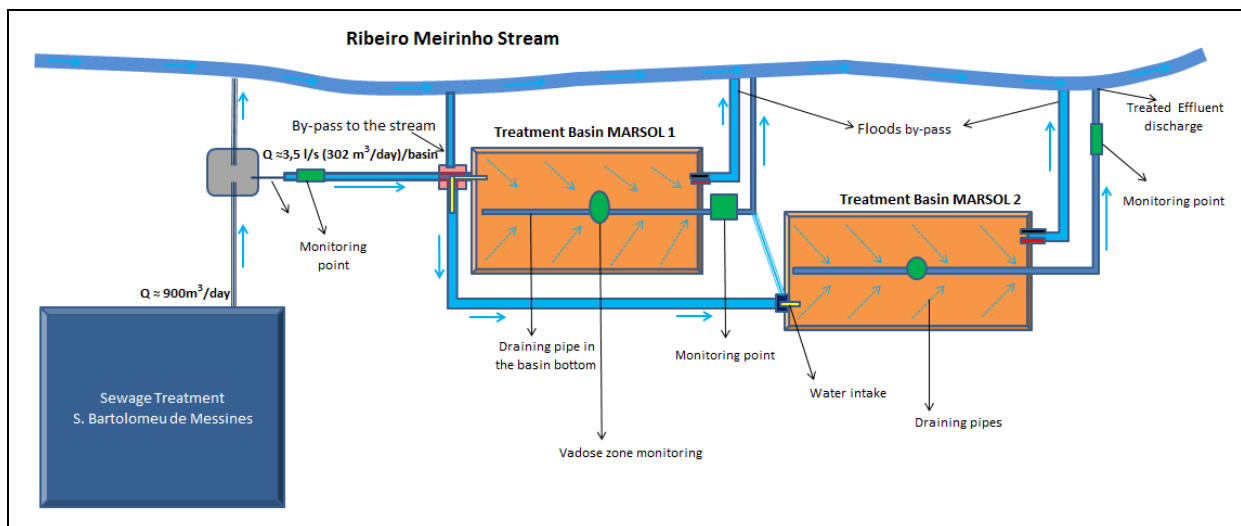


Figure 10 – PT2_4 São Bartolomeu de Messines: SAT basins construction scheme



Figure 11 – PT2_6 Construction of two piezometers at Cerro do Bardo DEMO site



Figure 12 – PT3_7 Melides: physical sand-box (see also Task 12.5) prototype of a SAT-MAR basin, constructed at LNEC. Right: detail of the piezometers, irrigation system and vadose zone sampling cups

Table 2-3 - Road map for Task 4.3

Task 4.3		Investigation and monitoring (Task leader LNEC; support from UAlg and TARH)	
General Characteristics			
Main Requisites	<p>Upon the completion of the infrastructures, several tests were performed in order to evaluate their MAR performance in terms of clogging, infiltration rates and its local influence in the groundwater quality improvement</p> <p>The following tests were performed:</p> <ol style="list-style-type: none"> PT1_1: Clogging test in one GABARDINE basin (total area of 100 m²) to assess the possible decrease in infiltration due to natural clogging between 2007 and 2014, 1st July, 2014 PT1_1 and PT1_2: Comprehensive test of all three basins (MARSOL, 201 m² and GABARDINE 2 x 100 m²) to evaluate total infiltration capacity of MAR system, 29-30th September, 2014 PT1_2: Tracer test in MARSOL basin using NaCl as the tracer to estimate the residence time, the permeability, and dispersion of the infiltrated water, 13-14th October, 2014 PT1_1: Infiltration test in GABARDINE upper basin in 24th June, 2015 PT1_1 and PT1_2: Impact of natural flash flood episodes in groundwater quality, 2014 to 2016 PT1_3: Recharge experiments in a large diameter well in the Campina de Faro area to assess its infiltration rate, 1st October, 2014 PT2_4: Laboratory soil-column experiments to determine the pollutants removal capacity of soils from SB Messines SAT-MAR area, 2014 and 2015 PT2_6: Infiltration test in a large well in Cerro do Bardo, 1st April, 2014 PT2_6: Infiltration test with tracer (NaCl) with geophysics support 15-19th December, 2014 <p>In PT3, there was a change in the initial programming. It was decided that the planned water quality control would be made using a SAT_MAR prototype basin not placed <i>in-situ</i> but at a large laboratory scale on a physical sandbox at LNEC. The investigation and monitoring was changed accordingly</p>		
Start	1Oct15		
Finish	1Nov16		
Deliverables			
D4.3	Monitoring results from the South Portugal MARSOL demonstration sites: Database on monitoring of South Portugal demonstration sites - all sites		
Nature	Report		
Dissemination level	Restricted to a group specified by the consortium		
Delivery date	1Nov16		
Programming		Description	Date
PT1_1: Campina de Faro (old IB)			
Step 1	Development of a <u>first</u> infiltration test to access clogging in the old south infiltration basin (IB), during a dry period (conditions: the infiltration basin ground surface must be normalised into a horizontal plane – and the piezometers must be rehabilitated)		Jul14
	<ul style="list-style-type: none"> - Define the water height in the IB (20 cm) - Define the time length of the test 		

Task 4.3 Investigation and monitoring (Task leader LNEC; support from UAlg and TARH)

- Control the water input in the IB (difference between abstracted water – 1 flowmeter – and rejected water – 1 flowmeter)
- Water is abstracted from the existing well LNEC#3
- Measure GWL, EC and NO₃ at LNEC#1, LNEC#2, the PVC tube, and one or two surrounding wells
- Material for the experiment: 2 flowmeters, 5 CTD probes

PT1_2: Campina de Faro (New IB)

Step 2 (cf. Figure 13)	Development of a <u>second</u> infiltration test in the new infiltration basin (IB), plus the two GABARDINE basins, during a dry period. The test is similar to the first step and allowed determining the overall infiltration capacity of the existing basins	Sep14
Step 3 (cf. Figure 14)	Development of a <u>third</u> infiltration and a NaCl tracer test in MARSOL basin	Oct14
Step 4	Development of a <u>fourth</u> infiltration test to access infiltration potential of old north infiltration basin, during a dry period.	Jun15
Step 5	Monitor GWL, EC and NO ₃ in the piezometers and wells during tests and during natural recharge due to flash flood episodes	May14- Nov16
Step 6 (cf. Figure 15)	Continuous monitoring of the basins and aquifer system aiming at assess the impact of natural flash flood episodes in groundwater quality	Oct14

PT1_3: Campina de Faro (large wells with “Nora”)

Step 7	Selection of wells to conduct artificial recharge experiments	Set14
Step 8 (cf. Figure 16)	Performance of the <u>fifth</u> infiltration experiment (1 well): <ul style="list-style-type: none"> - Define the origin of water to recharge the wells - Select nearby wells to control the GWL and EC including the injection well 	Oct14
Step 9	D4.3 Monitoring results from the South Portugal MARSOL demonstration sites - PT1: Campina de Faro	Jun16

PT2: Querença-Silves
PT2_4 : WWTP S.B. Messines

Step 10	In PT2 (Algarve, Querença-Silves - soil-aquifer-treatment (SAT) MAR Technique), infiltration and treatment basins will be constructed to reduce the nitrate and other chemical pollutants (e.g. pharmaceuticals) loads of the WWTP effluents, prior to water discharge into ribeiro Meirinho that further infiltrates in Querença-Silves aquifer	Nov16
Step 11	Soil-column lab experiments to study specific pollutants and their behaviour (LNEC with TUDa)	Nov14- Jun15
Step 12	<ul style="list-style-type: none"> - Define the soil material for the two SAT basins, capable of retaining the pollutants (from Task 14.1 and 14.3) - Define the time length of the test - Control the water input in the IB (difference between water intake from the WWTP and rejected water – 1 flowmeter) - Water is originated from S. B. de Messines WWTP - Measure GWL, EC and NO₃ and other important contaminants/pollutants/indicators at the IB's (from Task 14.1) - Material for the experiment: vadose zone capsules at 2 depths, 2 places and 2 SAT basins, 3 CTD probes 	Jul15- Nov16

Task 4.3 Investigation and monitoring (Task leader LNEC; support from UAlg and TARH)**PT2_5: Ribeiro Meirinho**

Step 13	The quality and quantity of the resulting rejected water from the WWTP SB Messines will be controlled along time at the piezometers and in the river	Jul15- Nov16
---------	--	-----------------

PT2_6: Cerro do Bardo

Step 14	Execution of the <u>first</u> infiltration test at Cerro do Bardo well	Apr14
Step 15 (cf. Figure 17)	Execution of the <u>second</u> tracer and infiltration test at Cerro do Bardo well	Dec14
Step 16	<ul style="list-style-type: none"> - Interpretation of the infiltration test using the appropriate analytical method - Simulation of the infiltration test using regional scale a local scale numerical models 	Sep15
Step 17	Pumping test to assess the hydraulic characteristics of the upper aquifer system	Mar16
Step 18	Long term infiltration and tracer test in the well and in the weir flood zone	Apr16
Step 19	D4.3 Monitoring results from the South Portugal MARSOL demonstration sites - PT2: Querença-Silves	Jun16

PT3_7: Lagoa de Melides

Step 20	Rice field water sample and analysis at Melides site	May14
Step 21	Experiments to determine the hydraulic characteristics of the local soils	Jun14
Step 22	Development of the infiltration and tracer tests in the “Artificial aquifer” to be used as a large scale laboratory SAT-MAR facility <ul style="list-style-type: none"> - Water infiltration capacity rate measurement - Water quality sampling in Prenart capsules to access SAT treatment (T, EC, pH, redox, NO₃, SO₄, hydrocarbons) - Soil sampling (close to Prenart) (T, EC, pH, redox, NO₃, SO₄, hydrocarbons) 	Dec15 to Jun16
Step 23	D4.3 Monitoring results from the South Portugal MARSOL demonstration sites - PT3: Lagoa de Melides	Jun16

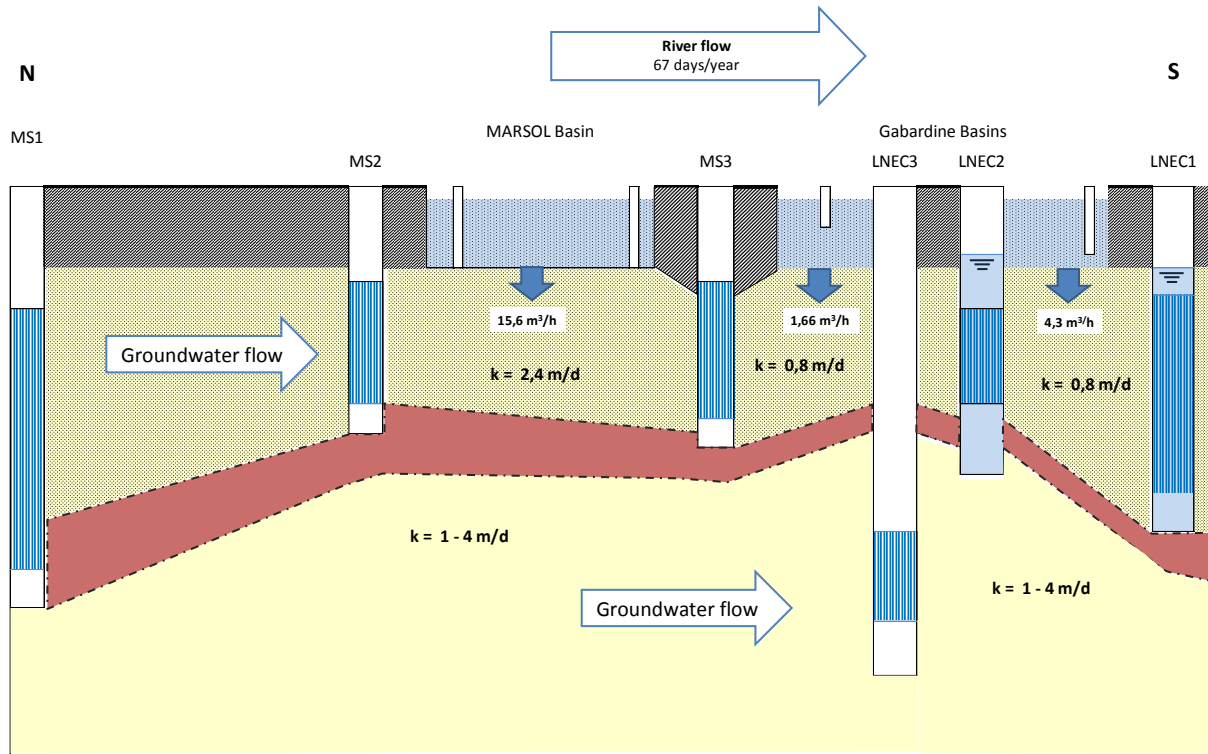


Figure 13 – PT1_1 and PT1_2 Campina de Faro: infiltration rates and permeability in the MAR basins

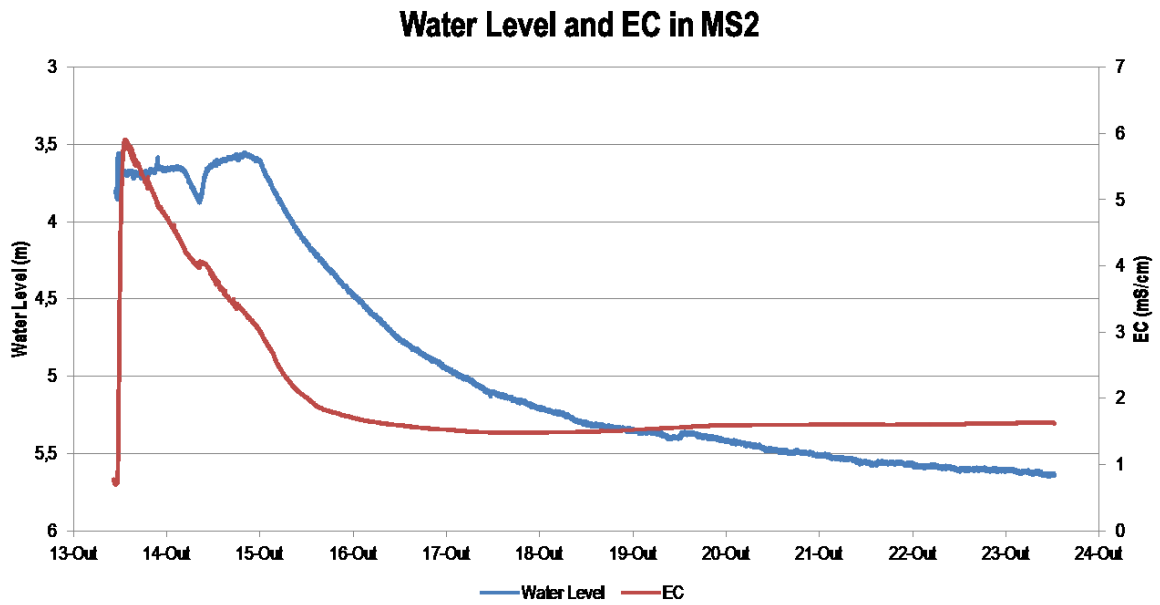


Figure 14 – PT1_2 Campina de Faro: tracer test and NaCl arrival to the MS2 piezometer

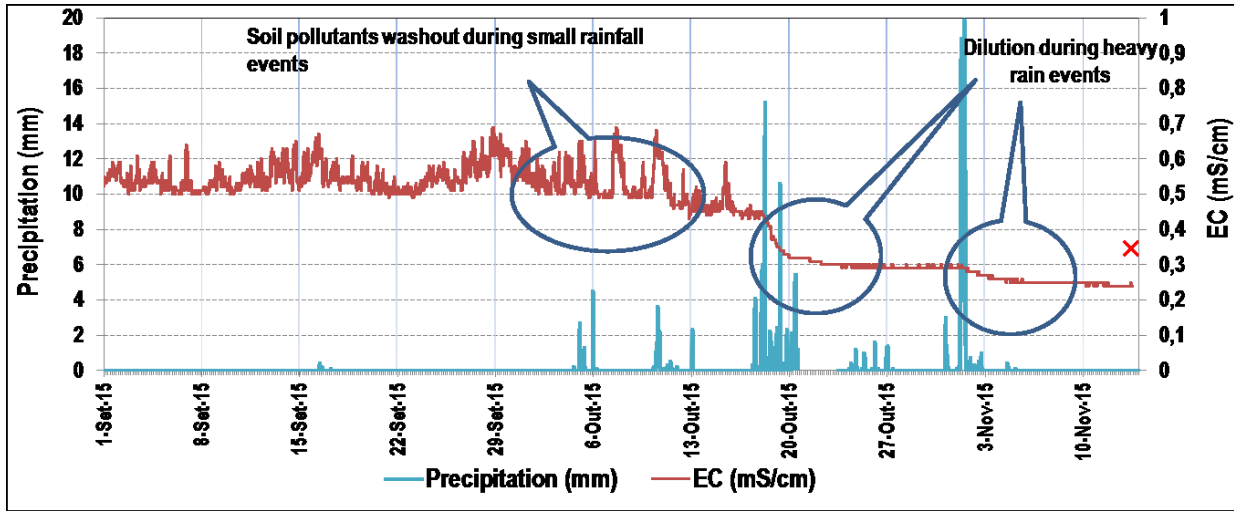


Figure 15 – PT1_2 Campina de Faro: changes in EC of piezometer MS2 due to natural recharge in the MAR basins

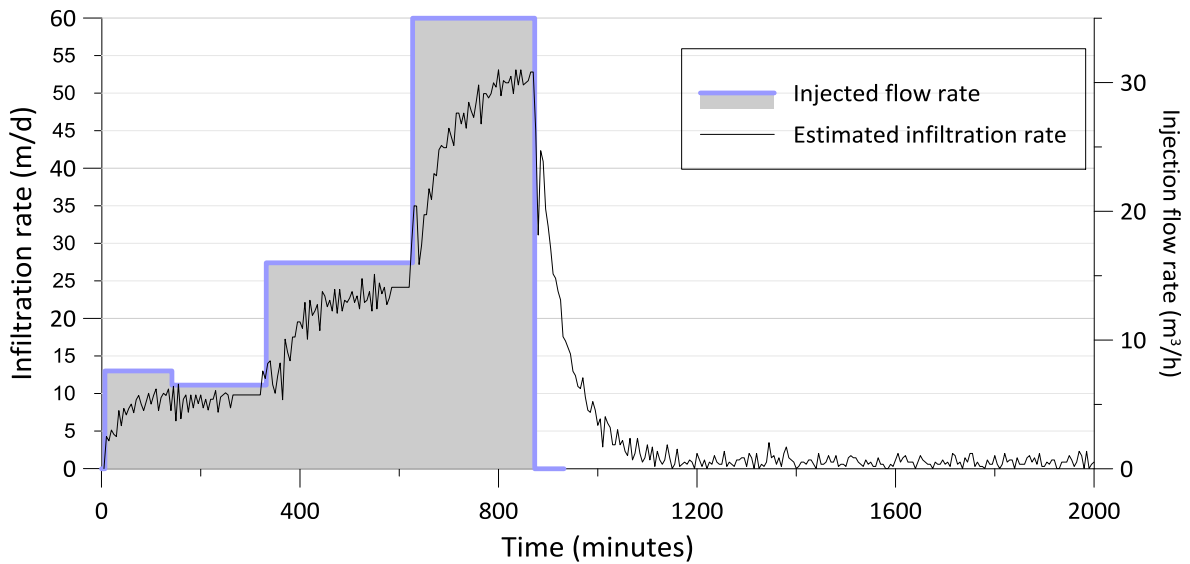


Figure 16 – PT1_3 Campina de Faro: infiltration test at large well, October 2014 (figures extracted from Leitão *et al.*, 2015)

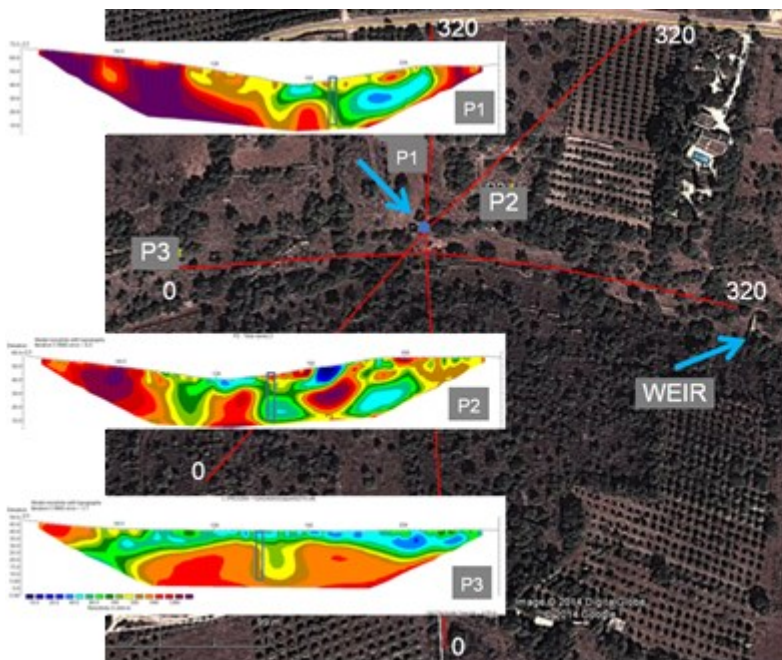
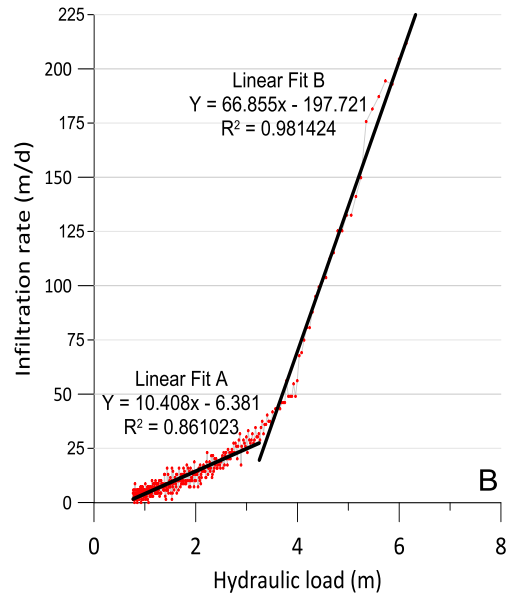


Figure 17 - PT2_6 Cerro do Bardo: infiltration and tracer test at Cerro do Bardo large well, April and December 2014 (figures extracted from Leitão *et al.*, 2015)

Table 2-4 - Road map for Task 4.4

Task 4.4		Modelling (Task Leader: LNEC; support from UAlg, TARH, TUDa)	
General Characteristics			
Main Requisites	Local and regional numerical modelling of the on-going DEMO and possible future scenarios will be used for demonstration of the viability of the solutions. Modelling will be used to extrapolate results to other situations different from the tested ones, for instance different artificial recharge locations or considering water shortage due to climate variability or change, including drought. Short movies presenting the modelling results will be produced (s. WP 12, Task 12.7)		
Start	1Dec15		
Finish	1Dec16		
Deliverables			
D4.4	Hydrogeological modelling at the South Portugal MARSOL demonstration sites: Hydrogeological models of South Portugal demonstration sites and extrapolation of results		
D4.5	MAR to improve the groundwater status in South Portugal (Algarve and Alentejo): Final report on the South Portugal MARSOL demonstration site including all activities and results		
Nature	Report		
Dissemination level	Public		
Delivery date	D4.4: 1jun16; D4.5: 1Dec16		
Programming			
	Description	Date	
Step 1	Definition of the hydrogeological conceptual model of the three demo sites (see Second Interin Report for WP12)	Dec14	
Step 2	Hydrogeological modelling at the South Portugal MARSOL demonstration sites (see WP12) <ul style="list-style-type: none"> - Regional groundwater numerical flow and transport model (NO₃ and NaCl) of Campina de Faro and Querença-Silves aquifer systems - Local DEMO groundwater numerical flow and transport model (NO₃ and NaCl) of Campina de Faro and Querença-Silves aquifer systems - Hydrogeological modelling of the DEMO tests conducted at the three demonstration sites (task dependent on WP4.3) 	Dec15	
Step 3	D4.4 Report on Hydrogeological modelling at the South Portugal MARSOL demonstration sites	Jun16	
Step 4	D4.5 MAR to improve the groundwater status in South Portugal (Algarve and Alentejo)	Dec16	

No deviations from the DoW are predicted, except the ones referred for site PT2_4. Nevertheless, this will not imply neither in the work plan nor deliverables. No further deviations are foreseen.

3 Subcontracting

There has been no subcontracting under WP4.

4 Difficulties or problems faced during the reporting period

The main difficulties arising during this period have resulted from the late payment of the second period financial report. The main consequence of this was a delay in the infrastructures development and construction in site PT2, foreseen to be concluded in month 24. This task should be fully completed in month 28, i.e. April 2016.

5 Plan of activities for the next reporting period

The activities and tasks planned for the next reporting period are described in

Table 2-1 to Table 2-4.

6 Assessment of the collaboration

The MARSOL Portuguese team has had several meetings, sometimes using video-conference Colibri system for connection with the UAlg partners. Very good cooperation is acknowledged and good synergy for the development of WP4.

Besides, various meetings have occurred with the Portuguese Water Authority (APA Algarve), Águas do Algarve (AdA), responsible for the water supply in the region, and Direção Regional de Agricultura e Pescas do Algarve (DRAPALG) (cf. Table 6-1). Moreover, several other encounters have occurred during the field tests.

Table 6-1: Summary of the MARSOL meetings (between June 2015 and February 2016) in Portugal with the regional authorities and water supply company

Date and Place	Entities involved	Purpose
June, 22 nd to 26 th 2015, Lisboa, SB Messines, Cerro do Bardo, rio Seco	LNEC, UAlg, TARH	Mid-Term, workshop and field trip of the "MARSOL Water Quality Workshop. Algarve Demonstration Site"
October, 8 th 2015, Lisboa	LNEC, TARH	Analysis of financial issues raised from the EU about the financial second period report and possible new time schedule and solutions for maintaining the DoW compromises
October, 9 th 2015, Lisboa	LNEC, TARH, UAlg	Analysis and reschedule of Task 4.2 Developing the (MAR) infrastructures compromises, and definition of a new plan
November, 10 th 2015, Lisboa	LNEC, TARH, UAlg	Analysis of PT2_4 SB Messines and PT2_6 Cerro do Bardo infrastructures development and settling new dates for monitoring
February 5 th 2016, Lisboa	LNEC, TARH, UAlg	Overall revision of WP4, WP12, WP10 and WP14 tasks. Analysis and definition of next steps in order to complete all predicted tasks in the DoW

7 Publications

LEITÃO, T.E., LOBO FERREIRA, J.P., OLIVEIRA, M.M., MARTINS, T., HENRIQUES, M.J., MOTA, R., CARVALHO, T.M., MARTINS DE CARVALHO, J., AGOSTINHO, R., MONTEIRO, J.P., COSTA L.R.D., 2015 – WP4 DEMO Site 2 Algarve and Alentejo. Second Interim report. MARSOL Demonstration Sites Characterisation. UE MARSOL Project - Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought, July, 18 pp.

LEITÃO, T.E., MARTINS, T., HENRIQUES, M.J., ILIE, A.M.C., 2015 - Ensaios em Coluna-de-Solo para Avaliar o Destino de Poluentes de ETAR Simulando Condições de Recarga Controlada de Aquíferos (SAT-MAR). 12.º SILUSBA, Brasília, November 22-27, 2015.

LEITÃO, T.E., LOBO FERREIRA, J.P., CARVALHO, T.M., MONTEIRO, J.P., OLIVEIRA, M.M., AGOSTINHO, R., COSTA L.R.D., MARTINS, T., HENRIQUES, M.J., 2016 – Gestão de Recarga Induzida de Aquíferos. Exemplos do Projeto MARSOL no Algarve. 13.º Congresso da Água, March 7-9, 2016, 15 pp.

MARTINS, T., 2016 - Contaminants retention in soils as a complementary water treatment method: application in soil-aquifer treatment processes. Master Thesis. Faculty of Sciences. University of Lisbon, 2016 (<http://hdl.handle.net/10451/23077>).

NEVES, M.C., COSTA, L., MONTEIRO, J.P., 2016 - Climatic and geologic controls on the piezometry of the Querença-Silves karst aquifer, Algarve (Portugal). Hydrogeol. J. doi:10.1007/s10040-015-1359-6 (<http://link.springer.com/article/10.1007%2Fs10040-015-1359-6>).

COSTA, L., MONTEIRO, J.P., HUGMAN, R., LOBO FERREIRA, J.P., CARVALHO, T., 2015 - Estimating harvested rainwater at greenhouses in south Portugal aquifer Campina de Faro for potential infiltration in Managed Aquifer Recharge. Manuscript submitted for publication on the special edition 'Environmental and socio-economic methodologies and solutions towards integrated water resources management' of the Science of The Total Environment on 31 December 2015.

8 Other dissemination activities

Several dissemination activities were held by the WP4 participants, namely during the presentation in events of the work developed under this WP. Those participations can be seen in Section 7.

Besides, the following oral presentations were given:

- Organization of "WP4 DEMO Site 2: Algarve and Alentejo, South Portugal", by LNEC/TARH/UAlg, Lisboa, June 22 – 23rd, 2015.
- "WP4 DEMO Site 2: Algarve and Alentejo, South Portugal", presentation during MARSOL Mid-Term meeting, organized by LNEC/TARH/UAlg, Lisboa, June 22 – 23rd, 2015.
- "WP 14 Water quality: Soil-column Experiments to Study the Pollutants Retention Capacity for Different Soils", presentation during MARSOL Mid-Term meeting, organized by LNEC/TARH/UAlg, Lisboa, June 22 – 23rd, 2015.
- "Introduction to Algarve DEMO Site, MARSOL project", presentation during MARSOL "Water Quality Workshop", organized by LNEC/TARH/UAlg, Lisboa, June 24 – 26th, 2015.

- "Removal of Some Nutrients, Metals and Pharmaceuticals from Wastewater Prior to MAR", presentation during MARSol "Water Quality Workshop", organized by LNEC/TARH/UAlg, Lisboa, June 24 – 26th, 2015.
- "WP12 Algarve, Portugal" (including information about WP4) presentation during MARSOL "Workshop on Legal Issues, Policy and Governance of MAR Activities", organized by Water Services Corporation Head Office, Luqa, Malta, 21-23rd October, 2015.

The EIP Mar to Market "MAR Solutions - Managed Aquifer Recharge Strategies and Actions (AG128)" (http://www.eip-water.eu/MAR_Solutions) was also a forum for transferring the knowledge and work developed in MARSOL, namely under WP4.