DIVERSIFICATION OF WATER ORIGIN TO ENHANCE MAR. THE SAT-MAR CASE OF ALCAZARÉN; VALLADOLID, SPAIN

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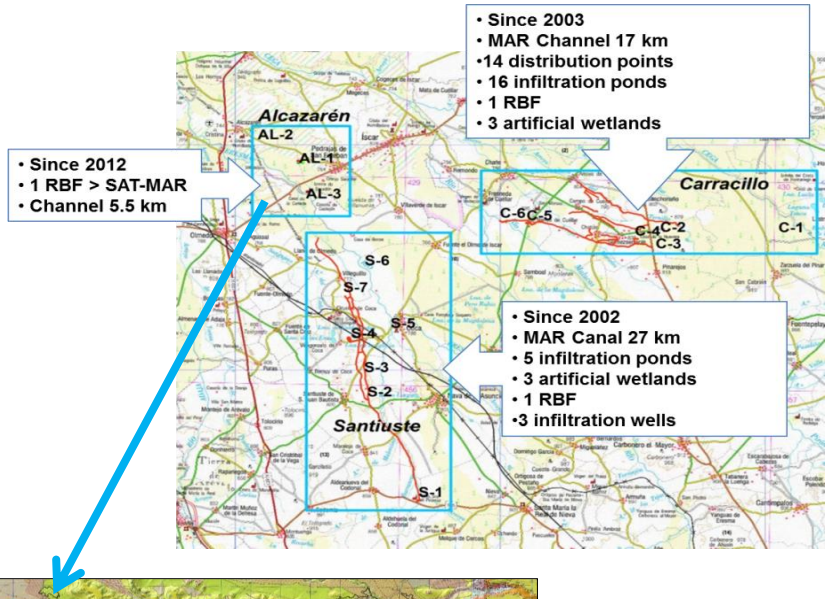
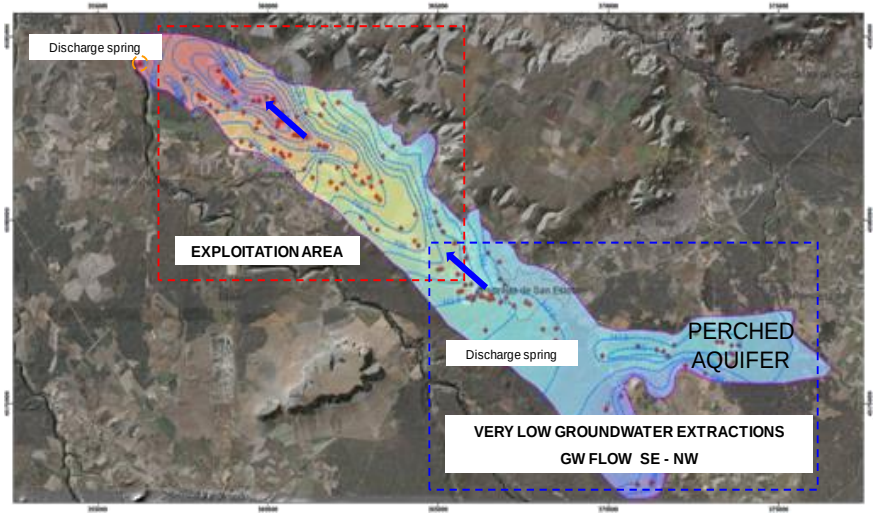
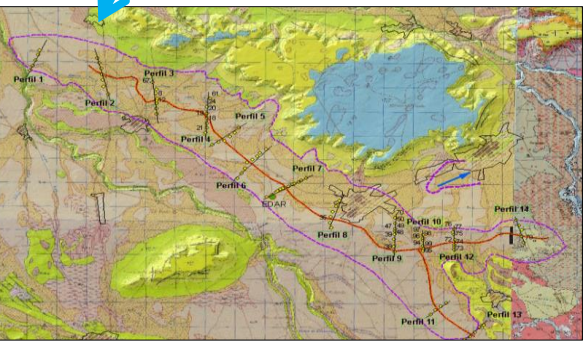
N°abstract

LOS ARENALES – ALCAZARÉN AREA



Los Arenales Water body: 7,754 km², 96 villages in Valladolid, Segovia & Ávila. 46,000 inhabitants. **Ie = 1,3**





ALCAZARÉN AREA

PROBLEM: Intensive exploitation decrease of phreatic levels up to 15 m in the last 30 years in some points

Total extension of the aquifer is 55 km², 23 km long by approximately 2.5 km wide.

SOLUTION: In 2012 a new MAR experience was implemented **to address this situation to preoperational stages and to ensure irrigation**

ALCAZARÉN AREA SCHEME

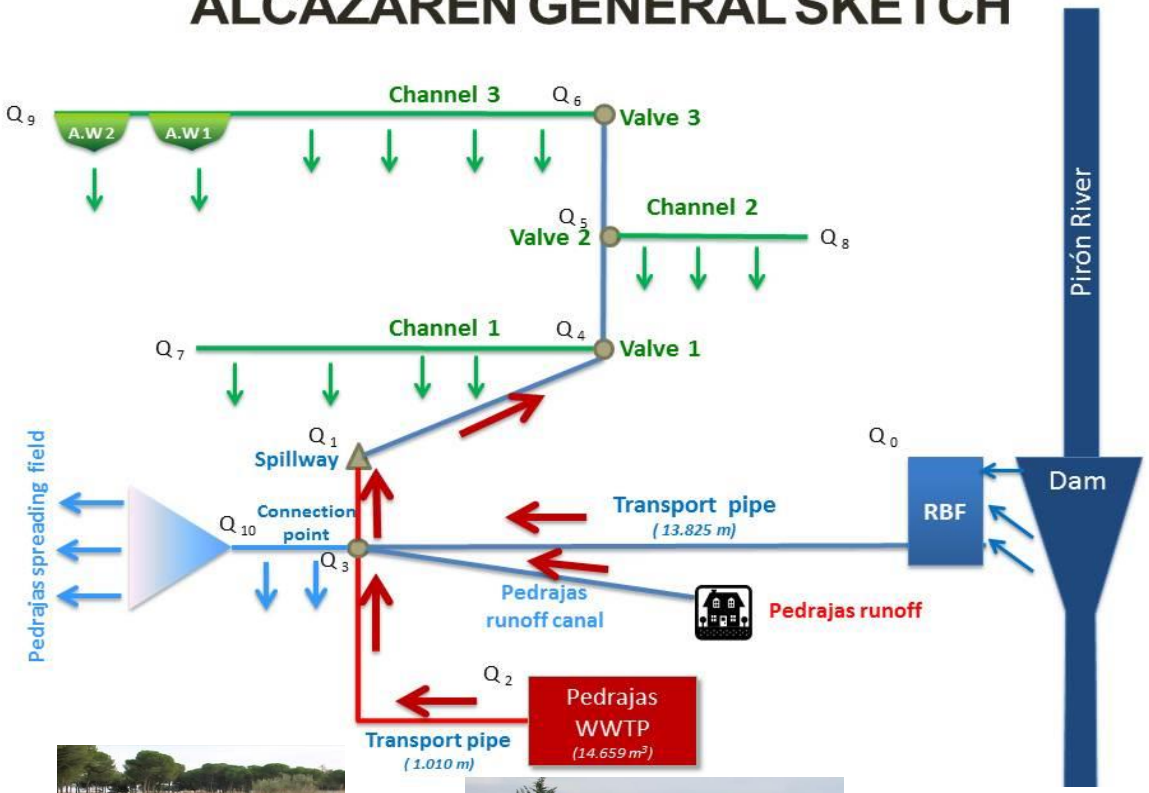
- ✓ Operability for 5 years
- ✓ 7 km of channels
- ✓ 2 degraded wetlands
- ✓ 1 infiltration pond
- ✓ 1 WWTP (SAT MAR)
- ✓ 1 RBF

A.W. 2

Infiltration channel 2

Spillway

ALCAZARÉN GENERAL SKETCH



Connection point

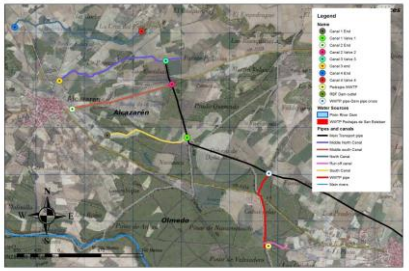
Pedrajas WWTP

Valve 2 monitoring cage

Runoff canal proceeding from Pedrajas village

WATER SOURCE DIVERSIFICATION

- ✓ **Novelty with respect to previous experiences in Diversification of water source from 3 different sources:**

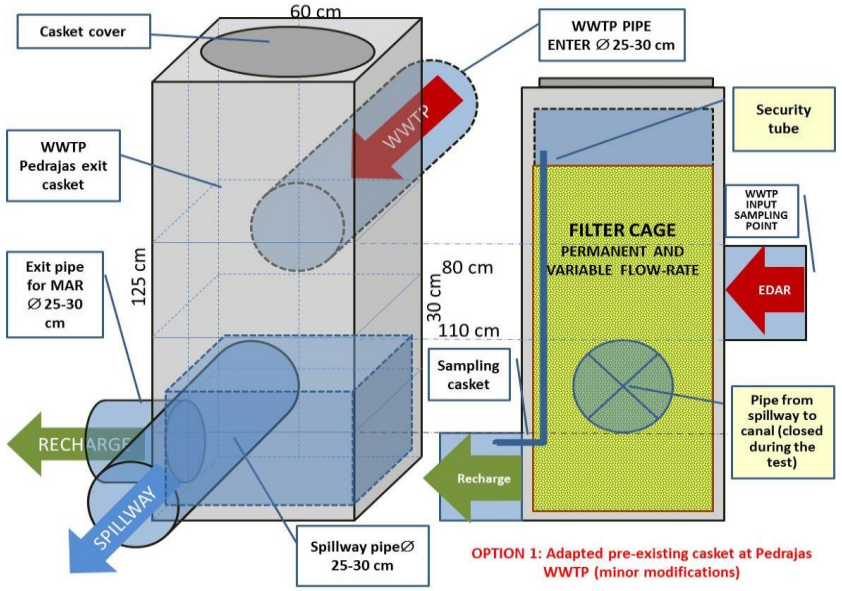


WATER FROM PIRON RIVER + RAINWATER HARVESTING FROM ROOF TOPS COLECTED IN A RUNOFF CANAL + RECLAIMED WATER FROM WWTP PEDRAJAS DE SAN ESTEBAN (ADVANCED SECONDARY TREATMENT)

DIVERSIFICATION OF WATER SOURCE GUARANTEES THE **CONTINUITY OF THE SYSTEM** FURTHER THAN WINTER SURPLUSSES AND **NON-RELIANCE ON RIVER CONCESSIONS FOR MAR**

Chemical assays and purification measures along the conductions (1)

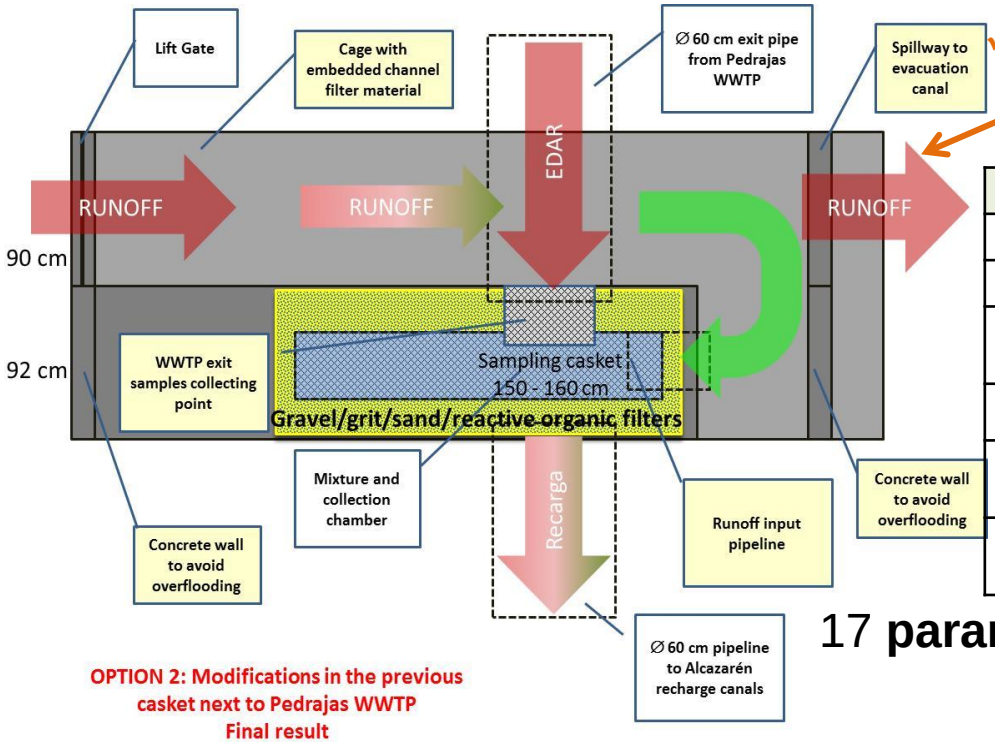
Within **MARSOL project,** a series of tests have been conducted **2016 March-August**, **straining the reclaimed water with inorganic and organic different reactive filters**.



- ✓ **Purpose:** to improve the recharge water quality and to monitor the evolution with the different mixes of water.
- ✓ **First stage:** 2016 February, some **modifications** were applied to the **previous casket** at the exit of the WWTP.
- ✓ **Gravel** filter was inserted inside the casket to enhance the filtration process.

Due to **over friction a new and specific construction 100 m down the pipeline** was conducted (convergence point of runoff, river and WWTP) was built (**2nd stage**).

Chemical assays and purification measures along the conductions 2



OPTION 2: Modifications in the previous casket next to Pedrajas WWTP
Final result

Second stage: FINAL SCHEME

Schedule of activities

Nº campaign	Date	Filter
1	15-mar-2016	12-20 Ø siliceous gravel
2	20-abr-2016	20-40 Ø calcareous gravel
3	09-jun-2016	6-12 Ø siliceous grit/gravel+ DBP 50 l Cl2
4	29-jun-2016	Pine bark + geofabrics
5	14-jul-2016	Pine bark + geofabrics + DBP 50 l H_2O_2
6	27-jul-2016	Pine bark + geofabrics + DBP 100 l Cl_2

17 **parameters** analysed in the laboratory:

- Temperature in situ
- O_2 (TDO)
- Conductivity
- BDO_5
- COD
- TDS
- ph
- SS
- Turbidity (NTU)
- DOC
- Nitrogen phases (total, Kjeldahl, nitrates, nitrites, ammonium)
- Nematodes
- *E. coli*

Chemical assays and purification measures along the conductions 3

❑ March 15th (**1st campaign**)

On March 10th was inserted the first filter in the final location, composed by 12-20 mm Ø **siliceous gravel**. Samples for chemical analysis were collected March 15th.

✓ April 20th (**2nd campaign**)

April, 6 and 7th the filter was replaced by 20-40 mm Ø **calcareous gravel**, proceeding with a new sampling campaign on April 20th.

✓ June 9th (**3rd campaign**)

May 27th, after a rainy period, a new filter was set up composed by 6-12 mm Ø **siliceous grit combined with sand inside geofabrics satchels**. The first DBP took place dropping 50 l of hypochlorite during 36 h June 8th.

Chemical assays and purification measures along the conductions 4

❑ June 29th (**4th campaign**)

The grit filter was replaced by an **organic reactive** one composed by 150 kg of **pine bark** (**reactive layers employing materials cheap and abundant in the area**) inserted into geofabrics sacks and compressed by gravel sacks.

❑ July 14th (**5th campaign**)

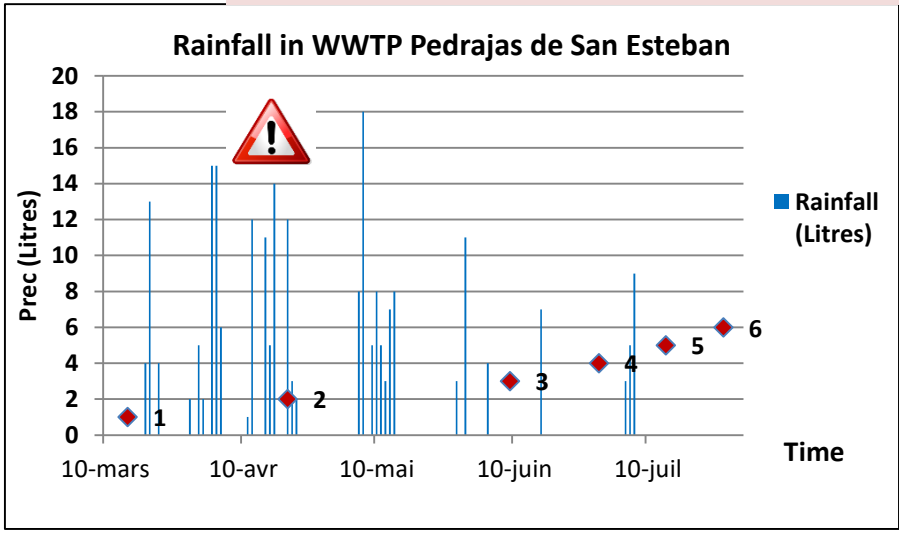
July 13th, maintaining the organic filter, the **second DBP took place, dropping 60 l of hydrogen peroxide** 60% concentration (71,46 kg) during 36 h.

❑ July 27th (**6th campaign**)

July 22th the reactive filter was replaced by **pine rachis instead**, also inserted into pressurized geofabrics sacks. **A third DBP took place, dropping 100 l of hypochlorite** during 36 h.

RESULTS AND DISCUSSION (1)

BE CAREFUL! RAIN AND DILUTION OF RESULTS



- The **scarce time of residence** (interaction processes have been very short in time) **represents a constraint in the study**. There have **not been observed important differences** in the **resulting chemical composition** of water using **calcareous or siliceous gravel packs.**

- Chloride doses dropped into the reclaimed water did **not retain any amount of residual chloride in the observation points.** This fact is attributable to the presence of **organic matter in some stretches inside the pipeline.**

- The use of **geo-fabrics** **has also retained a certain amount of suspended solids**, + scarce or unappreciable influence on the reclaimed water composition.

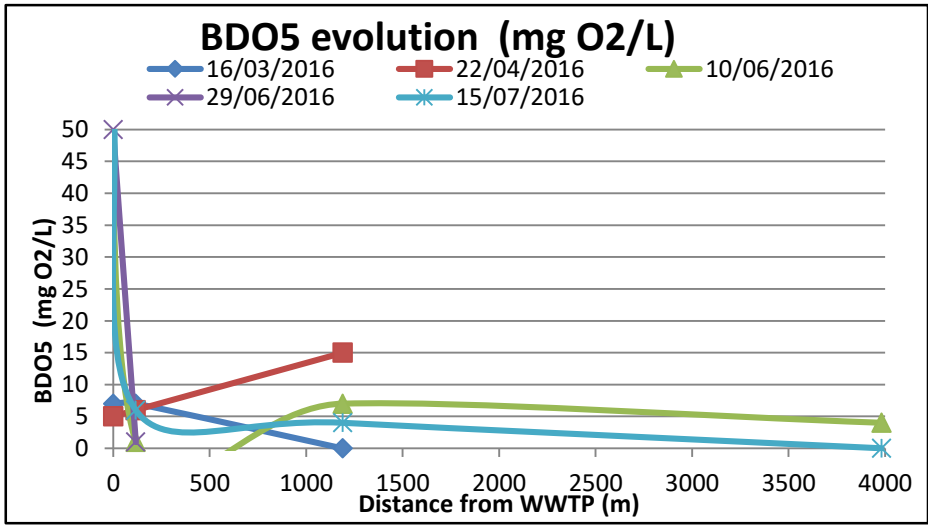
RESULTS AND DISCUSSION 2

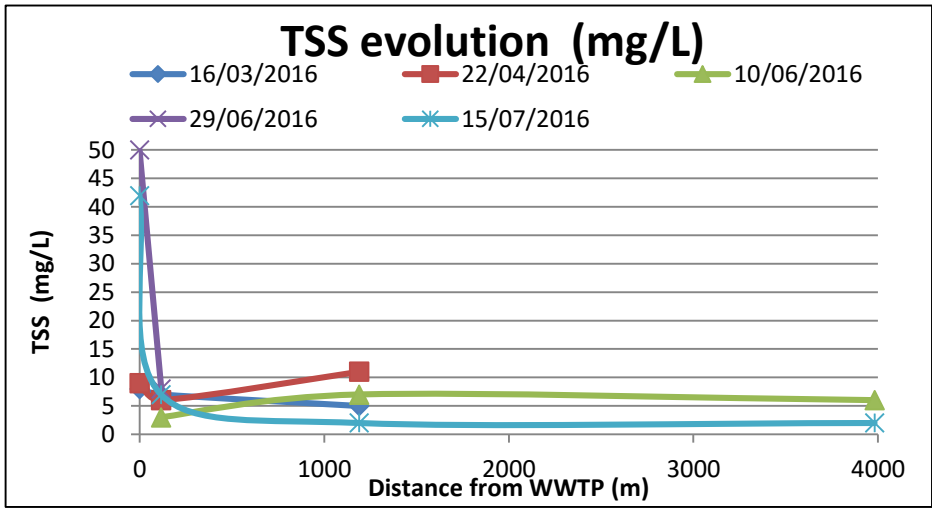
reclaimed water quality evolution

BDO_5: The effect on BDO_5 is **clearly positive. There is a general descent along the pipeline except for the 2nd, (calcareous gravel as a sifter)**. DBP test has conducted a progressive decline for this parameter.

COD: parallel behaviour.

TSS: Suspended solids and dissolved solids evolution do not keep a parallelism. **The general trend is to decrease, except for the 2nd campaign, using calcareous gravel as a filter,** when the tendency was opposite to the general behaviour.

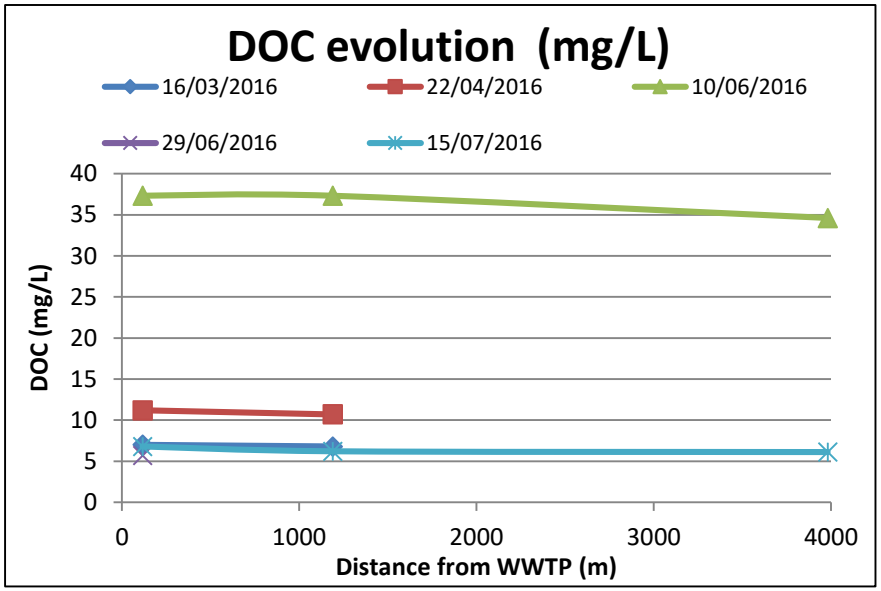


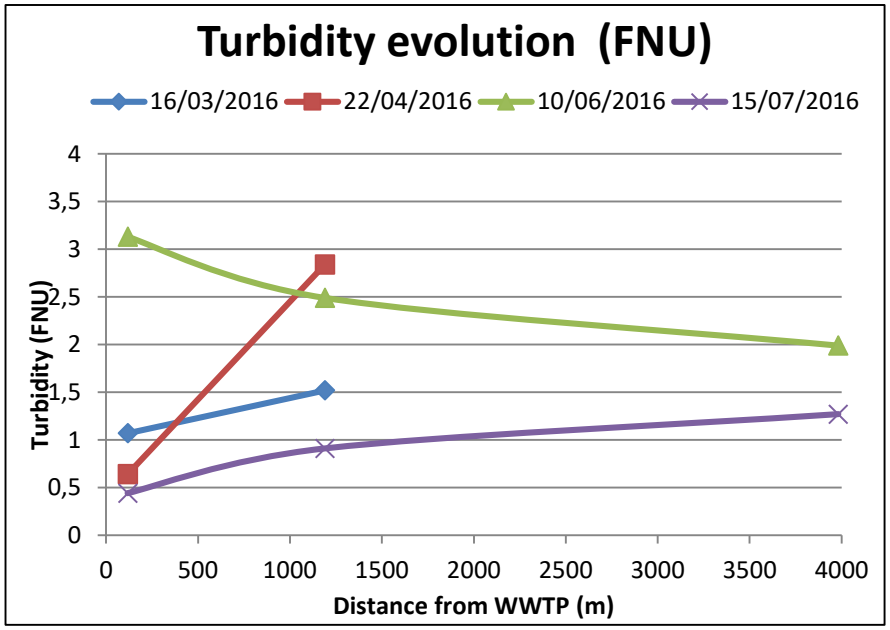


RESULTS AND DISCUSSION 3

DOC: This is the **unique parameter with a general trend to decrease**. The biggest slope was caused by the **finest filter**. The addition of **chloride** has also caused a direct **descent on DOC**,

- Still steeper with the addition of H_2O_2.



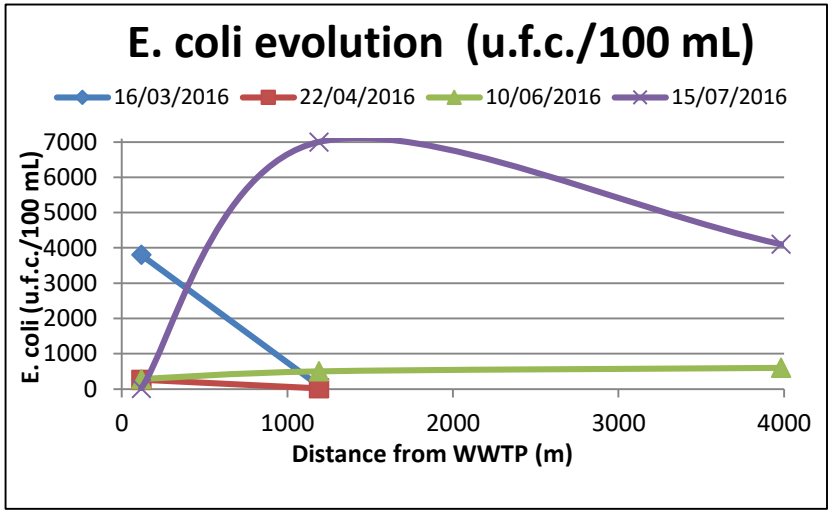


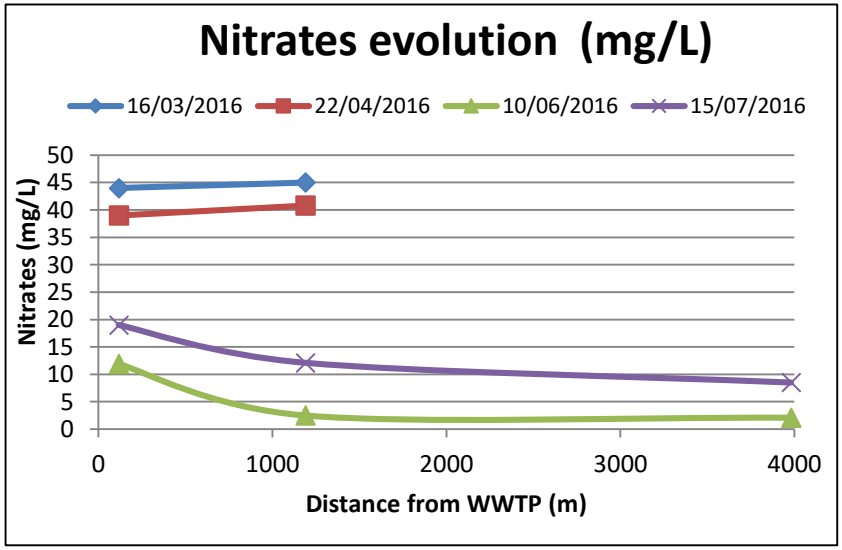
Turbidity (NTU): **Oddly enough, the trend tends to rise,** except for the 3th test, where the use of a finer filter constituted by **grit and gravel caused the expected effect**. Even the addition of Hydrogen Peroxide did not bring down the turbidity, therefore, it has a **high inorganic component**.

RESULTS AND DISCUSSION 4

E. coli: The trend has been clearly **descending during the spring**. Once the summer time began, this sort of bacteria has appeared with a certain intensification along the circuit. Obviously they were **removed in *itinere* by the addition of chloride.**

Total nitrogen: Trends are not very clear for most of the nitrogen phases, except for **nitrates, with a crisp descent** trend during the episodes when both,
disinfectants were dropped in the reclaimed water and,
reactive filter layers were employed.





CONCLUSIVE REMARKS… (1)

- All the filters had a certain effect on water quality, resulting obviously **maximum for the finest ones.**

- The treatment with both **disinfectants**, chloride and hydrogen peroxide, has been **powerful**, reducing the progressive TOC accumulation and its impact on the aquifer.

- The incorporation of a reactive layer prior recharge of reclaimed water has a positive effect on the reduction of groundwater pollutants, enhancing their biological degradation and, therefore, improving the water quality.

- After several weeks the reactive layer was still active. Therefore, this technology is likely to be useful for longer-term applications.

- Physical, chemical and biochemical processes associated with MAR plants represent a **natural, passive and affordable way to reduce the presence of certain contaminants,** with economic and environmental benefits.

- **Treatment *in itinere***: improving water quality at the same time that recharge occurs. For example, triplet schemes, gravel filters embedded along the pipeline.

…CONCLUSIVE REMARKS (2)

- MARSOL project has connected the practical technical solutions obtained along the project with **dissemination activities for the irrigation community's members.** In this sense**, different workshops has been organized at Los Arenales, such as, MAR4Farm and MARenales.**

- **Farmers receive technical support on Sustainable MAR Technical Solutions** (**SMARTS**) regarding their activity in order to make their impact on groundwater resources as low as possible, thanks to advises.

- The **design and post of metal posters** conceived to involve farmers in the best use of water in MAR areas **has been a direct contribution from MARSOL to rural development** at Los Arenales.

- The **diversification of water in the origin may be useful to improve the water quality if it is mixed wisely** +

- **D.S.P.**

THANK YOU FOR YOUR ATTENTION

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…See you in Madrid 2019

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