

# MANAGED AQUIFER RECHARGE (MAR) TO OVERTHROW SOME ADVERSE CLIMATE CHANGE IMPACTS

*How ISMAR 10 can transform opportunities into actions*

By Dr. Enrique Fernández Escalante (TRAGSA-PTEA)

# Water management and climate change...

- **Water** is considered **most important vector climate change** (CEDEX C.C. Conference, Madrid 2011)
- **90%** used for **agriculture** in developing countries (FAO)
- Every year **83 Million people** are born
- Expectations of **“future water scarcity”** (WB)
- **Deep aquifers not** considered **renewable resource** any longer (FAO)
- Groundwater quality worsens by effect of C.C. in about 5.400 hm<sup>3</sup>/year (e.g. the Mexican case)
- The mean price of water rose **4,5% in 2010**
- **30.000 M \$** yearly invested to cover **the M.D.G. for water supply in developing countries** (UN)



sources: OCDE, UNESCO

[http://www.unesco.org/water/news/newsletter/93\\_es.shtml](http://www.unesco.org/water/news/newsletter/93_es.shtml)

-Adverse panorama

-The current context require *Advanced technological solutions* in I.W.R.M. schemes

# M.A.R. to face frontally extreme water-related events

*Ant vs cicada*



Vs



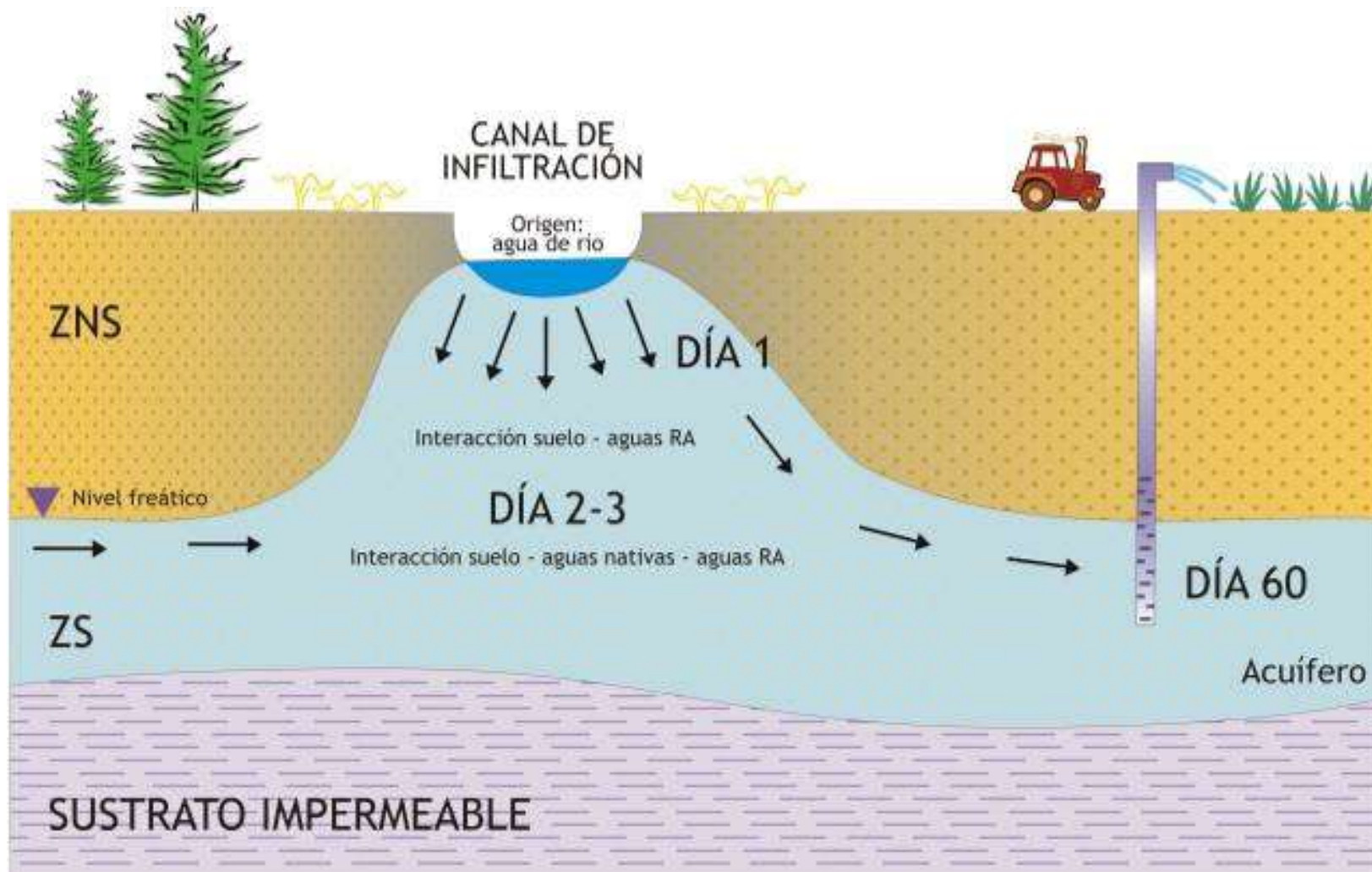
## Droughts and water scarcity

There are not many options to alleviate water scarcity periods: Store or starve?

- M.A.R. to increase the groundwater **secured storage** as a reserve to face water scarcity periods
- Aquifers **replenishment** for their sustainable **regular exploitation**
- Water **preserved** from contamination and evapotranspiration
- **Strategic reserves** for eventual needs
- **Multi-scale activity**: from a house's SUDS to river basin sizes

# Managed Aquifer Recharge or artificial recharge

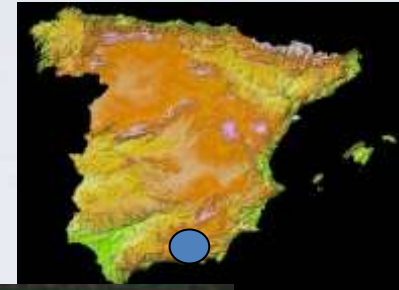
**Driving Force activity** (i.e. able to cause an impact on quantity and quality of water resources) according to European Water Framework Directive 2000/60/EC, annex 2 and its guide IMPRESS (EC, 2002) to analyze pressures and impacts includes “artificial recharge”.



# M.A.R. is not a new technique...

## “Careo” canals since XII century (at least)

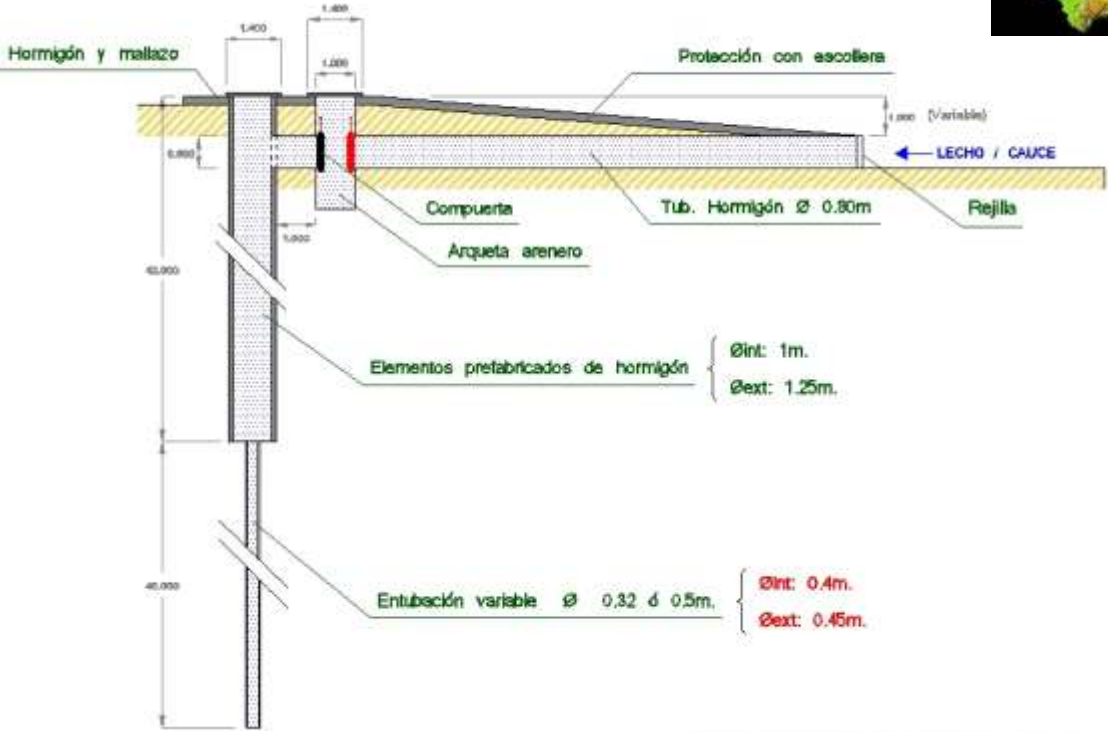
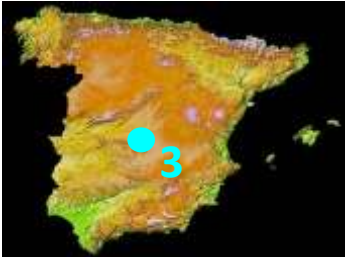
Alpujarra, Sierra Nevada (Granada-Almería, Spain)



- Written chronicles of intentional M.A.R. from the XII century
- 14 “Careo” canals (125 km) for M.A.R. well preserved and still operative



# M.A.R. for secure irrigation

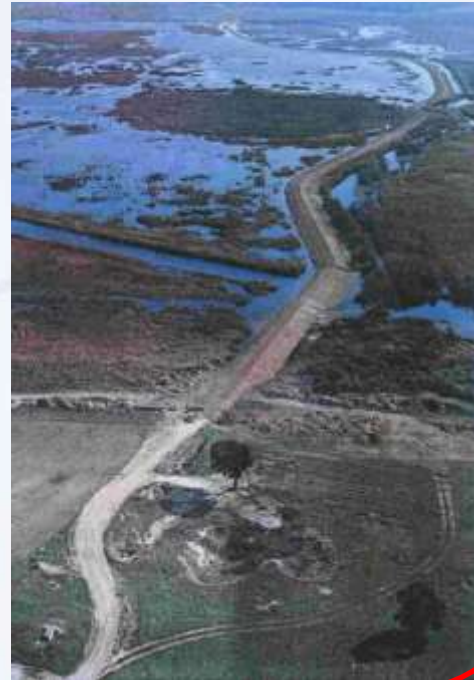


# Wetlands regeneration

e.g. Daimiel National Park (Spain)



2 hydraulic devices

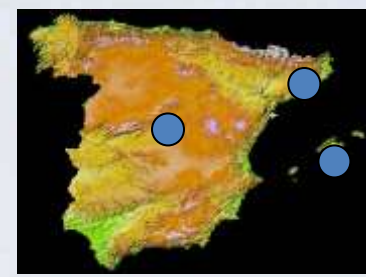


8 boreholes for  
M.A.R.



- Recovery of the ecosystem function
- Wetlands guaranteed during periods of drought

# Deep M.A.R. for water supply in big cities



**Water supply guarantee increased up to 99% in big cities thanks to new groundwater storage cells, decreasing water shortage threat**

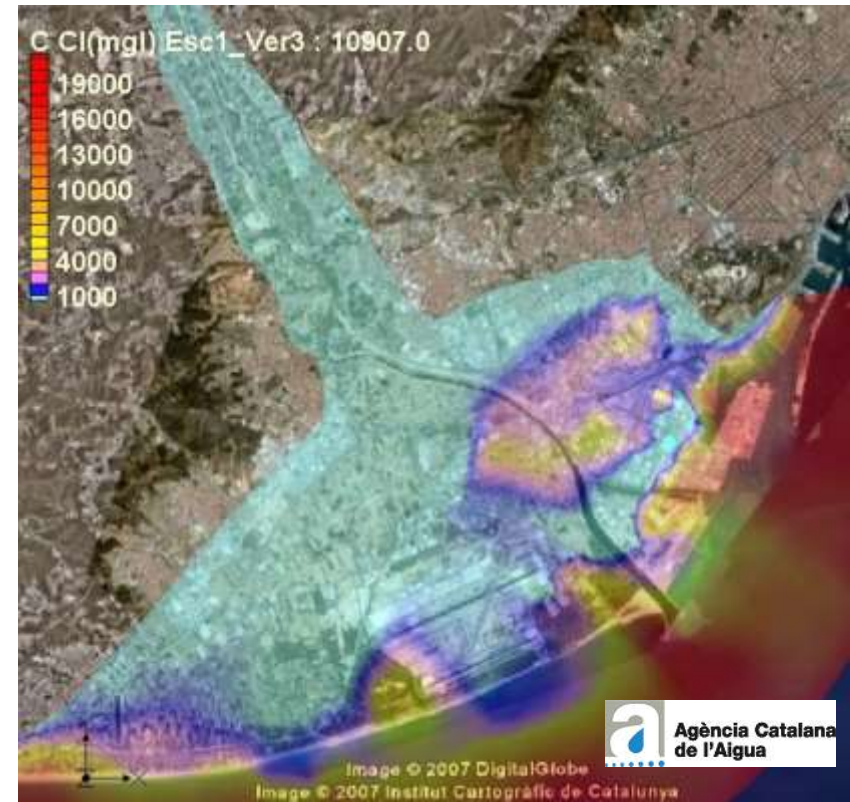


# Hydraulic barrier to combat marine intrusion (Barcelona)

Positive barrier by means of injection of reclaimed and post-treated water



**WITHOUT** Hydraulic barrier



**WITH** Hydraulic barrier

Model for chlorures concentration evolution in the aquifer, Horizon 2036



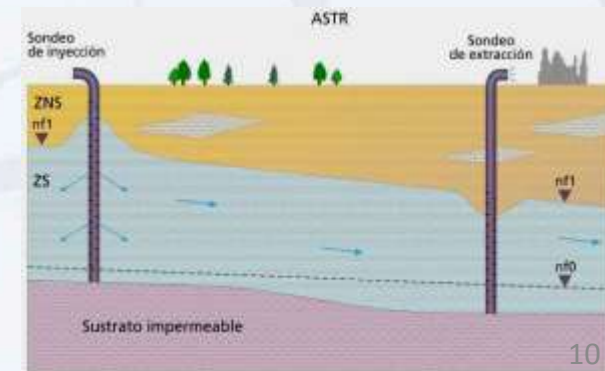
# M.A.R. with reclaimed water (“SAT-MAR”)



Technology for deep injection of reclaim water by means of bores & wells, in general located close to Waste Water Treatment Plants

- Use of **tertiary** reclaimed water to be injected into the aquifers
- **24x7 availability guarantee**
- Subject to concession (ambitious quality standard)
- About to be regulated in Europe, **draft Directive for aquifers recharge and reuse for agriculture**

**REUSE WILL NOT BE AN OPTION BUT A NECESSITY  
IN THE MEDITERRANEAN AREA VERY SOON**



# M.A.R. against over-floods

A recurring problem in the Mediterranean area since 6 million years ago

-Another option to be combined with integrated water management techniques for the whole basin plus forest management plus territorial planning



1980

Temporal retention of water for its latter infiltration and reuse



2012

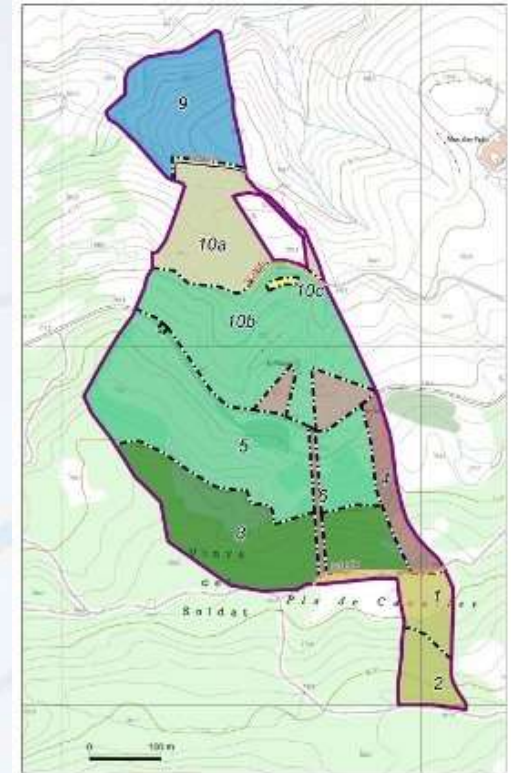


*Divide et impera*

# M.A.R. against over-floods (2)



## Forest management plus territorial planning



***What we didn't manage in the basin,  
We'll have to manage in the aquifer***

# Actions in urban areas (*Smart cities*)

- To reduce the surface runoff volume
- To break the *heat island* effect

Three “*s*” rule:

- Slow it down*
- Spread it off*
- Soak it in*

## Good practices in cities:

- **Drainage towards green areas**
- **Storage rainwater** for a latter use
- Bigger presence of **S.U.D.S.** in cities
- Minimize the use of agro-chemicals in parks...
- **Education** directed at **agents** involved in cities design and management, etc.

Runoff traps



Concave edification



Permeable paving



**ACTING LOCALLY, BUT DESIGN GLOBALLY**

# ISMAR 10 conference as a key element to boost M.A.R. activities in Europe

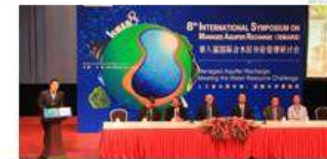


## MAIN OBJECTIVES OF ISMAR10

- Enhance the impact of previous ISMARs
- Provide a point of connection for all agents involved in MAR
- Consolidate the existing Managed Aquifer Recharge group
- Provide a Forum of debate of MAR
- Motivate students and young researchers...
- Disseminate existing and new knowledge on MAR<sup>R</sup>
- Etc.

International Symposia on MAR

1.	1988 Anaheim California, USA (ASCE)	
2.	1994 Orlando, Florida, USA (ASCE)	
3.	1998 Amsterdam, Netherlands (IAM, ASCE & UNESCO)	
4.	2002 Adelaide, Australia	
5.	2005 Berlin, Germany	
6.	2007 Phoenix, Arizona, USA	
7.	2010 Abu Dhabi, UAE	
8.	2013 Beijing, P.R. China	
9.	2016 Mexico City, Mexico	
10.	2019 ?????????? .. **	



# SEVEN MOTIVATING REASONS TO HOLD ISMAR 10 IN EUROPE



Notice: this logo is provisional

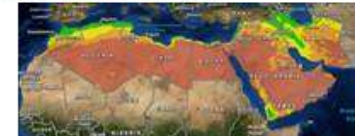
1- *Time for an ISMAR to come back to Europe*



2- *Increasing awareness in European decision maker*



3- *A helping initiative to get over the crisis in the European Union*



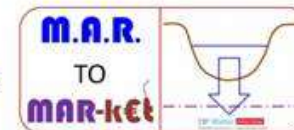
4- *Enhance the participation from MENA region and South America countries in MAR actions*



5- *Grouping and support from Pan-European projects related to MAR*



6- *Pan-European supporting action groups and water technological platforms related to MAR*



7- *Increase the H2020 interest for water management*



# ISMAR 10 PAN-EUROPEAN NETWORK



**...M.A.R. IS ORGANIZED (SOMEHOW) IN EUROPE**



# Thanks, EIP, for your confidence

## EIP Water Secretariat

Boosting opportunities - Innovating water

Dr. Enrique Fernández Escalante  
 Grupo Tragsa - SEPI  
 C/ Conde de Peñalver 84 2P- 28006 Madrid

Dear Dr. Fernández Escalante: Brussels, 17 June 2015

hereby, the European Innovation Partnership on Water (EIP Water), established by the European Commission in 2012 in order to facilitate the development of innovative solutions to address major European and global water challenges, expresses its support to Madrid's candidature for hosting the Symposium on Managed Aquifer Recharge (ISMAR 10 – 2019).

EIP Water is an initiative within the EU 2020 Innovation Union. EIP Water supports the creation of market opportunities for water-related innovations, both inside and outside of Europe; and aims to remove barriers by advancing and leveraging existing solutions. In its implementation phase, the EIP Water will promote and initiate collaborative processes for change and innovation in the water sector across the public and private sector, non-governmental organisations and the general public.

Managed Aquifer Recharge is one of the relevant topics within the priorities of the partnership, and different activities are being developed in this frame, including at our past EIP Water Conference 2014.

EIP Water involves currently over 650 European institutions, companies and networks; and works with 29 Action Groups, addressing 5 key barriers to innovation in the water sector. EIP Water works closely and shares its learned lessons with the EIP on Sustainable and Productive Agriculture, within the same EU 2020 Innovation Union framework.

Best regards,



Guido Schmidt  
 Head of the EIP Water Secretariat



Brussels, 17<sup>th</sup> June 2015

Letter of support of WIRE to ISMAR 10 2019 coordinated by SEPI as ISMAR 10 International Symposium on Managed Aquifer Recharge to be held in Madrid by 2019 May

Dear Dr. Escalante,

I, Dr. Tânia Ferguz, as the coordinator of WIRE Action Group under the EIP Water, hereby confirm our strong interest with regards to the organization of the 10<sup>th</sup> International Symposium on Managed Aquifer Recharge (ISMAR 10) in Madrid in June 2019, initially promoted by Tragsa Group with the co-leadership of ISMAR 10.

We acknowledge the importance and capacity of the organizers to build such an event in order to spread ISMAR technical knowledge, experience, advantages and accompanying issues outlined in the water management framework at a European and international level. WIRE in coordination with ISMAR 10 group is also getting to developed status of further and ground water.

Our involvement, potential collaboration and willingness to cooperate in this event are related to the following activities and objectives:

- Facilitate WIRE partners in the different activities, in particular collaboration through the experts involved in water technical sessions and construction research field studies.
- Use our channels of communication to share ISMAR 10 findings.

We would like to take this opportunity to express our interest in being informed of the candidature evolution.

Yours faithfully,



Dr. Tânia Ferguz

WIRE, the coordinator



Brussels, 17<sup>th</sup> June 2015

Letter of support of MARR TO 2019 coordinated by SEPI as ISMAR 10 International Symposium on Managed Aquifer Recharge to be held in Madrid by 2019 May

Dear Dr. Escalante,

I, Dr. J.P. Lobo Fonseca, as the coordinator of MARR TO 2019 Action Group under the EIP Water, hereby confirm our strong interest with regards to the organization of the 10<sup>th</sup> International Symposium on Managed Aquifer Recharge (ISMAR 10) in Madrid in June 2019, initially promoted by Tragsa Group with the co-leadership of ISMAR 10 and WIRE.

We acknowledge the importance and capacity of the organizers to build such an event in order to spread MARR technical knowledge, advantages and accompanying issues outlined in the water management framework at a European and international level.

Our involvement, potential collaboration and willingness to cooperate in this event are related to the following activities and objectives:

- Encourage of technical workshops at the beginning of the conference to express and share our MARR project's objectives.
- Monitor all the participating project's activities in the different activities.
- Use our project channels of communication to share ISMAR 10 findings.
- Collaborative in technical sessions and contribution towards them success.
- Provide support to the scientific leadership according to the agreement made with the organizing committee.

We would like to take this opportunity to express our interest in being informed of the candidature evolution.

Yours faithfully,



Dr. J.P. Lobo Fonseca

MARR, Lisbon, Portugal

EIP Water MARR is 2019 MARR TO 2019 coordinator



# ISMAR 10

INTERNATIONAL SYMPOSIUM ON  
MANAGED AQUIFER RECHARGE



Madrid, May 2019

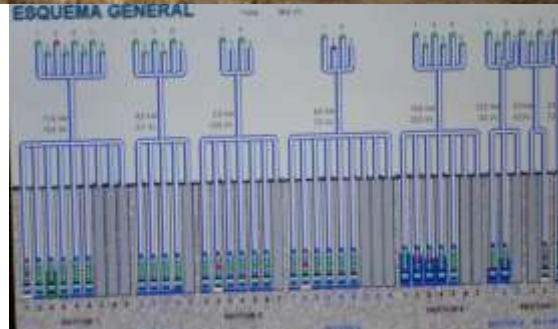


***If you are interested in water management, please, consider your attendance***

***See you in Madrid 2019!***

# Summary and conclusions

1. Mediterranean climatic conditions require specific schemes for I.W.R.M., aggravated by climate change now
2. For prolonged drought periods, *"Storage is key"*
3. *Prevention of damage from its origin*
4. *Divide et impera. Multiple retentions of water in the heading of the basins*
5. *Acting locally, but designing globally*
6. Urgent & integrated actions (C.C. is a reality, not a threat)
7. *What we didn't manage in the basin, We'll have to manage in the aquifer*
8. Reuse will not be an option any longer, but a necessity
9. ISMAR 10 will help transforming any opportunity into an action.



## Welcome



ISMAR9 Mexico City June 2015

Welcome to the website of the International Association of Hydrogeologists Commission on Managing Aquifer Recharge (IAH-MAR). Here you can discover what our working groups are doing and contribute to their current projects, you can contact with people and resources, get information on symposia coming up, and join our email list to stay informed of latest news. We also have sister sites in Spanish and Chinese.

## Managed Aquifer Recharge

Managed aquifer recharge, also called groundwater replenishment, water banking and artificial recharge, is the purposeful recharge of water to aquifers for subsequent recovery or environmental benefit. It embraces methods such as riverbank filtration, stream bed weirs, infiltration ponds and injection wells, and uses natural water courses and appropriately treated urban stormwater, sewage and other waste waters to increase groundwater storage, protect and improve water quality and secure drought and emergency supplies. Its growing scientific base supports its rapidly increasing use as a vital management tool in the sustainable use of the world's water resources.

### VALE IAN GALE

We are very sad to announce the sudden death of Ian Gale on 13 August 2017 in Exeter, Devon, at the age of 67. Ian was a long time IAH member and founding co-chair of the IAH Commission on Managed Aquifer Recharge, 2002-2011. Tribute to Ian Gale.



Ian Gale

### MEDIA RELEASES

Scientists wade into Murray-Darling pipeline debate – Australia Aug 2017

### JOIN OUR MAILING LIST

Register with our large email group to share information, ideas and news concerning recharge enhancement. Join IAH-MAR email community.

## Contacts

### IAH email list

[Click here to access the IAH Email List.](#) By clicking on this link you can join a large group of people with interests in recharge enhancement. We hope you will contribute ideas and news of interest to this scientific community, and benefit from the contributions of others to this email list.

### Contact a Co-Chair

**Peter Dillon**  
Co-Chair, IAH Commission on Managing Aquifer Recharge  
CSIRO Land and Water, Australia  
[peter.dillon@csiro.au](mailto:peter.dillon@csiro.au)

**Weiping Wang**  
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**Enrique Fernandez Escalante**  
Co-Chair IAH Commission on Managing Aquifer Recharge  
TRAGSA Group, Spain  
[efernan6@tragsa.es](mailto:efernan6@tragsa.es)



### Selected publications



### Clogging Monograph