International Association of Hydrogeologists

COMMISSION ON MANAGING AQUIFER RECHARGE

ANNUAL REPORT 2013

Chair: **Peter Dillon (Australia)** - peter.dillon@csiro.au
Co-Chairs: **Weiping Wang (P.R China) -** stu_wangwp@ujn.edu.cn
Also: **Enrique Fernández Escalante (Spain)** - efernan6@tragsa.es (from Jan 2014)

Web sites: English: www.iah.org/recharge
Spanish: www.dina-mar.es/
Chinese: http://china-mar.ujn.edu.cn/

Aims of the Commission

The Commission promotes the securing and expanding of water resources and improving water quality in ways that are appropriate, environmentally sustainable, technically viable, economic and socially desirable. It encourages research, development and adoption of improved practices for management of aquifer recharge and improving knowledge, skills and capabilities of practitioners, water resources managers and regulators. The Commission facilitates exchange of information between members internationally (e.g. via a web page and an email list), by disseminating results of research and practical experience (e.g. via conferences and workshops), raising awareness of MAR among IAH members, related professions and the community, and through its members undertaking projects and activities identified by plenary participants as important.

The highlights of 2013 were ISMAR8 in Beijing (our 8th approximately triennial symposium), the publication of a monograph on clogging (edited by working group leader, Russell Martin), and the reinvigoration of working groups with targeted activities for completion in 2014. A series of MAR events from around the world in 2013, are also reported, including a symposium in Mexico City as a prelude to ISMAR9 in 2016. On July, 28 2013 the most influential international figurehead in MAR, Dr Herman Bouwer, died, and a tribute to him is included.

ISMAR8, Beijing 15-19 Oct 2013:

In 2013 the stand out event supported by the Commission along with UNESCO and ASCE was the 8th International Symposium for MAR (ISMAR8) Beijing, 15-19 Oct 2013. A strong local organising committee, chaired by Prof Xuan Zhao, (Tsinghua University) and including Weiping Wang (Commission Co-Chair, Univ of Jinan) and Jordy Yin (Conference Manager) attracted about 150 people, of whom 50 were from China. More than 85 oral papers and 37 poster papers were presented, and a number of these have been selected for publishing in special issues of three journals; ASCE J Hydrological Engineering, Environmental Earth Sciences, and the open access journal Water. Other reviewed papers and volunteered powerpoint slides are available on www.iah.org/recharge. Poster papers were documented or photographed by Enrique Fernandez Escalante and uploaded for all to see at http://www.dina-mar.es/post/2013/11/27/P-ISMAR-serie-Titulo-5-P-ISMAR-8-(descarga-gratuita-del-Ebook-Free-download).aspx Six half-day workshops were run on the first day (titles given below) and more details and info on the technical tour field trip to the Zhangjiawan Groundwater Science observation base are on the web site. A summary of the conference prepared by Gerd Cachandt (Arup, UK) was published in the IAH Newsletter and is on the (English) web site.

A plenary of the IAH-MAR Commission resulted in rejuvenation and formation of a number of new working groups (more information is given below). In addition IAH Certificates of Appreciation for contributions to the work of advancing MAR were awarded to: Devinder Chadha (India), Ricky Murray (South Africa), Enrique Fernandez-Escalante (Spain), Russell Martin (Australia), and Xuan Zhao (China). Each had made significant sustained contributions to the advancement of MAR.

Working Groups

1. Monograph on Clogging and its Management

Based on requests at IAH Congress in Krakow and ISMAR7 in Abu Dhabi, Russell Martin rmartin@agwt.com.au received and edited 15 contributions from an international spread of authors on clogging and its management in MAR (infiltration systems and wells). This is a fundamental issue for the viability of MAR and assembling information systematically is expected to reduce uncertainty surrounding this topic. The document was web-published and launched at ISMAR8 (Oct 2013):

Martin R (ed.) (2013) Clogging issues associated with managed aquifer recharge methods. IAH Commission on Managing Aquifer Recharge. www.iah.org/recharge/clogging.htm At the plenary session Russell opened the way for additional contributions where there were gaps, particularly on management of clogging, with a view to a 2nd edition. Anyone interested please contact Russell at rmartin@agwt.com.au

2. Governance of MAR – A targeted specific action is to compile papers for a Special Issue "Policy and Economics of Managed Aquifer Recharge and Water Banking" for a thematic edition of (intl open access J. Water) – Editors: Sharon Megdal and Peter Dillon- A joint activity of IAH Commissions on MAR and on Groundwater Outreach. Papers were selected, several are published and remaining papers are in review or awaiting final submission. http://www.mdpi.com/journal/water/special_issues/MAR

3. **Economics of MAR** – Working group on synthesis of information on the economics of MAR and to adopt or develop a standard framework and measures to account for the costs (and benefits), of MAR, compile a set of case studies that include financial and economic analysis of MAR and compare with other forms of water supply or water security. Andrew Ross led a kick-off meeting at ISMAR8. Some of this work will fall within the scope of the Governance Working Group and more could be done in support of the MAR for Development Working Group.

4. **Water storage for managing climate extremes and change** – Bridget Scanlon (U. Texas at Austin) and Vladimir Smakhtin (International Water Management Institute) will lead the editing of a Special Issue of Environmental Research Letters. This will be done jointly with the IAH Commission on Groundwater and Climate Change. http://iopscience.iop.org/1748-9326/focus/Water%20Storage%20for%20Managing%20Climate%20Extremes%20and%20Change

5. **Managed Aquifer Recharge for Development** – Yan Zheng (City U New York/ UNICEF) offered to lead this group and ten others present expressed interest in contributing and others interested are welcome. Potential activities include: Information sharing- Make contact with those already working in developing countries – successes and problems – what do they think is needed?; sources of funding for MAR projects and what info to development banks need to invest in MAR; run workshop at ISMAR9 seeking UNESCO help; advancing low tech MAR, internet locations of where there are MAR projects and who is working on them. Yan will help facilitate a plan for one or more activities of the working group.

6. **Possible new working groups** - Other emergent or potential activities were discussed and working groups could be formed in future if there are volunteers wishing to lead and participate in these. Topics mentioned were: land management to enhance recharge; an inventory on MAR (building on existing initiatives in EU and IGRAC); and communications and awareness raising on MAR. We also need to build links with other groups who have interests in relevant topics such as fate of pathogens in aquifers. New working groups can be initiated at any time, and this is easiest at a plenary of the Commission. The next plenary will be in IAH Congress at Marrakech.

Proponents interested in establishing and leading a working group within the Commission are invited to develop a distinct concept, bearing in mind existing working groups and the Commission's objectives, nominate a specific task achievable in less than two years (eg before ISMAR9) by a small group of volunteers acting in concert, and contact a Co-Chair of the Commission. Co-chairs will then help with polling ideas of co-chairs, relevant working Groups and other IAH Commissions and related organisations with a view to forming and helping to populate the working group with motivated people with relevant skills.

Conferences and Workshops 2013

11-12 February 2013 Alternative Water Resources for Southern California, Conference, Ontario, California
Organised by the American Ground Water Trust (AGWT) in partnership with the Association of Ground Water Agencies, Groundwater Resources Association of California, California Groundwater Coalition, IAH Commission – Groundwater for Decision-Makers, and Southern California Water Utilities Association.
This conference had two sessions focussing on innovation in stormwater harvesting and water recycling via aquifers. Contact Andrew Stone, AGWT Executive Director (astone@agwt.org). CDs of the PowerPoint presentations made at all of these events are available for purchase – www.agwt.org

Groundwater Resources Association of California Webcasts on MAR

GRA webcast series on Managed Aquifer Recharge continued in 2013.
Jan 16, 2013 – MAR No. 5 – Recycled Water Recharge
Feb 6, 2013 – MAR No. 6 – Tracers and Recharge
Mar 6, 2013 – MAR No. 7 – Recharge Outside California
Further information and web link is at www.grac.org. This information was provided by Tim Parker of GRAC.

Groundwater Resources Association of California Symposium
Managed Aquifer Recharge in the Urban Environment: Technical and Policy Challenges
May 22-23, 2013 Crowne Plaza San Francisco Intl Airport, Burlingame, California

Approx 100 attendees and 25 papers were presented. California is a hotbed of technical innovation in groundwater recharge, based on a history of entrepreneurship over 75 years in response to severe water challenges. There is a culture of water agencies planning 20 years ahead, facing up to large uncertainty in supply due to climate change and lack of certainty in water entitlements as well as in approval processes. This horizon allows time for development of highly creative solutions by utilities who actively seek out and engage with a gifted pool of researchers from a number of universities and national agencies. California has an interesting dichotomy of exceptionally high levels of protection for groundwater quality yet no state-wide protection of groundwater quantity. In this lawyers' paradise, there are adjudications on water sharing in 23 basins that require court rulings for changed allocations. Only 4 special groundwater districts have negotiated agreements so far. Groundwater levels in many southern basins are in decline and the extent of innovation and investment by utilities, exceeding $100Mpa, in the absence of state-wide policies to secure water resources is paradoxical. This speaks volumes for the pioneering spirit in this frontier state that should be watched closely by utilities around the world. This symposium benefited from the participants of ReNEWIT (Reinventing the Nations Urban Water Infrastructure), a partnership between academics and industry that includes the role of groundwater recharge in urban areas as a means of bridging stormwater management and aquifer replenishment. In California it has been given a boost from permitting of this process under MS4.

Victoria, Australia. Smart Water Fund Innovation and Knowledge Transfer Seminar: Aquifer Storage and Recovery (ASR). 16 May 2013

Papers were presented by Simon Robertson (East Gippsland Water), Attila Gaal (City West Water) and Craig Parker (Southern Rural Water) on implementing Mitchell River ASR project, Werribee 3GL/yr recycled water ASR project, and an iterative approach to licence conditions for monitoring and mitigation triggers.

2nd Symposium on Artificial Recharge and Water Reuse, Mexico City, 28-29 Aug 2013

The main objective was to exchange experiences among a multidisciplinary group of professionals and researchers to discuss the advantages and disadvantages, applications and recommendations for managed aquifer recharge, water reuse and groundwater management. An additional significant objective was to fully consider the potential and seek commitment for Mexico to be the host country for the next International Symposium on Managed Aquifer Recharge (ISMAR 9 in 2016).

More than 100 attended from Mexico, USA and Spain covering a wide range of organizations and branches of government. The main conclusions derived from the 16 technical presentations and 2 keynotes included:

- MAR is now a key element in integrated water management to address the timing mismatch of water supply and demand, to increase water supply and reliability, and improve water quality. Artificial recharge provides a more rational approach to maximize the overall water resource potential in integrated water management on regional or watershed basis, wherever it is technically and economically feasible. Artificial recharge is a widely accepted technology and requires a simultaneous multi-disciplinarian approach including hydrology, geology, chemistry, biology, engineering, ecology, economics, and policy and management considerations.

- Additional objectives of artificial recharge include reduce seawater intrusion, minimize or avoid land surface subsidence from groundwater exploitation, and for the use of aquifers as water purification and conveyance systems.

- Water management will be integral but the problems are site specific. Solutions and designs are "*a la carte*" or locally-based.

- Alternate water sources provide different water qualities that can be focused on different uses besides involving potential new users.

- Incidental artificial recharge must be carefully managed as well, as mixing with the source water may degrade the water quality in the receiving aquifer.

- Source water quality may be limiting factor in MAR from rivers, and it is mandatory to evaluate the geochemistry of the source water, receiving water, aquifer matrix, and purification capacity of the receiving environment or aquifer.

- Artificial recharge may have direct impact on the management of floods and extreme water events within the framework of comprehensive management.

The presentations and general information can be found at:
http://www.agua.unam.mx/jornadas2013/resultados_acuiferos.html

ISMAR 8 Workshops, Beijing 15 Oct 2014

Six workshops were run Beijing 15 Oct 2014 at ISMAR8, with average attendances of 30 each,

1. State of the Art Techniques in Identifying and Characterizing Optimum Surface Spreading Groundwater Recharge Projects (Michael Milczarek)
2. MAR with Stormwater – water quality issues (Declan Page, Weiping Wang and Peter Dillon)
3. Geothermal resource exploitation and recharge (China Geological Survey)
4. Well Recharge: Science, Technology and Operational Experience, Aquifer Storage Recovery (David Pyne)
5. Application of Geochemical Techniques in MAR Studies (Jordan Clark)
6. MAR to MAR-ket. Strategies to bring Managed Aquifer Recharge technique to the industry. Some examples for Mediterranean countries (Enrique Fernández Escalante, Christoph Sprenger and Adriana Palma Nava)

An IAH-MAR plenary, an invited talk, and several sessions with scientific papers on various aspects of MAR ensured that the Commission made a substantial contribution to the success of the IAH Congress in Perth in September 2013.

Publications and Resources

Clogging monograph – see Working Group on Clogging
Selected ISMAR8 papers - ASCE J Hydrological Engineering, Environmental Earth Sciences, and the open access journal Water to be published in 2014. A technical resources base is currently being established on our Spanish web site, as indicated in an IAH Newsletter in 2013.

Activities coming up: ISMAR9

2016, Mexico City, ISMAR9 – More information coming out in 2014. Will be a very special conference. Chairperson is Adriana Palma Nava.

The next plenary of the Commission will be held at the IAH Congress in Marrakech, Sept 2014.

Ongoing Activities

1. IAH- MAR Websites

In 2013 the Spanish website IAH-MAR website has continued to be run actively by Enrique Fernandez-Escalante, TRAGSA, Madrid. The Chinese website is is maintained by Weiping Wang, University of Jinan, China. The English language website was maintained by Jan Mahoney and Anne McKenzie of CSIRO Land and Water. The three sister websites are found at:
www.iah.org/recharge http://www.dina-mar.es/ http://china-mar.ujn.edu.cn

2. Email List

IAH Australian Chapter and Flinders University of South Australia have maintained this list, which has a relatively stable number of 300 members in 33 countries. A number of emails were sent during 2013 advising of new conferences, workshops, reports and opportunities. We hope non-members of IAH find this helpful and we encourage you to join IAH and enjoy the full benefits of membership. The email list can be joined from the web site (www.iah.org/recharge).

Vale Herman Bouwer

Herman Bouwer, one of the world's leading researchers in water management and groundwater, died on July 28 at age 86 of complications from Parkinson's Disease. He was a native of The Netherlands, where he survived World War II and the Nazi occupation. He received his MS from Wageningen University in drainage and irrigation in 1952, and his Ph.D. in 1955 from Cornell University in soil and water management. After five years in the Agricultural Engineering Department of Auburn University, Alabama, he joined the U.S. Water Conservation Laboratory, U.S. Department of Agriculture in Phoenix, Arizona where he worked for 42 years, the last 18 years as Director. He retired in early 2002.

He was best known for his work on artificial recharge of groundwater, especially with sewage effluent to get the benefits of soil-aquifer treatment (SAT) for water reuse, including potable use. Herman was also an adjunct faculty member of the University of Arizona, Tucson and Arizona State University, Tempe, where he taught ground water hydrology courses. He has authored more than 300 publications including 12 book

chapters and the textbook Ground Water Hydrology. He served on several US National Academy of Sciences - National Research Council committees, consulted on numerous recharge projects, received an OECD Fellowship in 1964 for studying recharge in The Netherlands and Germany, and gave seminars and short courses on artificial recharge in the U.S., India, Jordan, Tunisia, and Morocco.

In 2004, Herman received the Prince Sultan Bin Abdulaziz International Prize for Water for his work on underground water movement with emphasis on artificial recharge, water reuse, and surface and groundwater interactions. Outside of the lab, field projects, and the classroom, Herman's favorite avocations were tennis, swimming, and bicycle riding.

Herman is survived by his wife, Agnes Bouwer, daughter Annette Flegenheimer of Chandler, AZ, two sons, Edward Bouwer of Baltimore, MD and Herman Bouwer of Portland, OR, and 5 grandchildren.
(by Ed Bouwer)

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Herman was a giant in the field of managed aquifer recharge, called artificial recharge through most of his career. He encouraged a scholarly view of hydraulic, chemical and biological processes and at the same time was very practical, as can be seen in his text book 'Ground Water Hydrology'. He was a great teacher and mentor and inspired many to study MAR. His eyes sparkled and his face lit up when he gave talks on artificial recharge such was his joy in the subject and his passion for helping others learn. With David Pyne he ran countless ASCE training courses on MAR. He was active in asking hard questions and encouraging people to dig deeper. He had a wonderful sense of humour. Back in 1994 Herman told me 'he had stopped buying green bananas because he didn't know how long he had left'. Later that day he thrashed me in tennis by slicing the ball to all parts of the court. I asked him about the beneficial nexus of groundwater and wastewater that he pioneered. He explained in simple terms 'the heart of recycling and sustainability are treatment and storage. Soil and aquifers, if you don't overload them, can do both'. He attended part of ISMAR6 in Phoenix in 2007, a joint meeting organised by Arizona Hydrological Society, and received a certificate of appreciation signed by the President of IAH. Herman humbly expressed satisfaction that the foundations for MAR that he had laid, along with his good colleagues Mario Lluria, and in USGS Ivan Johnson (since deceased Aug 2011), were sound and have supported ongoing growth in impact, geographic spread, knowledge, innovation and in the number of engineers and scientists involved in MAR.

On behalf of the Commission on Managing Aquifer Recharge, we express our sympathy to Agnes and family. We share in your loss and we hope that the knowledge of the great admiration and gratitude felt around the world by Herman's colleagues and beneficiaries of his work and mentoring will be of some comfort. Herman has left a global and enduring imprint on his profession and his work underpins provision of safe water to many millions of people who otherwise would not have a supply.
(by Peter Dillon)