



# NEWS AND INFORMATION

## International Association of Hydrogeologists

The international groundwater organisation

Since 1956 a world-wide forum on the management of groundwater for the benefit of mankind and the environment

## Groundwater Community Responds to December 2004 Tsunami

Not least among the massive international effort in response to the 26 December Indian Ocean tsunami, the groundwater community has been active in providing technical assistance both in the immediate relief effort and in the planning for recovery and rehabilitation. Using reports from IAH members both from the region and those who have visited as part of the international assistance programme, in this edition of IAH News and Information we bring a first and partial assessment of the issues.

We still have only a limited picture of the implications for current and future water resources and the long-term impact on groundwater resources. The technical issues are complex, the source data for many of the regions are poor and survey work after the event has been selective. The International Groundwater Resources Assessment Centre based in the Netherlands has tried hard to be a focus for this effort but has found many difficulties and much missing information. Water resources impacts are not the only area where the tsunami has highlighted the inadequate state of environmental monitoring and information systems in the region to provide warning and target remedial effort.

There are lessons to learn from the evaluation of the

impacts on the countries affected and also lessons about better emergency awareness and response. All these issues are reflected in our review on pages 5-8.



*Village of Bang Baen near Leam Son National Park (40 km south of Ranong) Thailand, about 2 km from the coast. The tsunami wave (about 7 m at the coast) flooded this village to a depth of about 1.5 m, salinizing all local dug wells. Despite efforts to bail out the contaminated water, this well was still not useable 4 weeks after the disaster. This family saw the oncoming wave and drove inland to safety. A relative refused to join them in order to find her cousin and neither survived*

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To join IAH please visit the web site and either join on-line or download the membership application form

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## President's Column FROM THE WATER TABLE

The 'new-look' IAH Executive, which took up office at the Zacatecas Congress in October 2004 (Miran Veselic - Secretary General, Jack Sharp - Honorary Treasurer, Jiri Krasny - Scientific Coordinator with the President in the Chair, and skillfully supported by Andrew Skinner - Executive Manager and Christine Watson - Secretariat), had its first full working meeting in Paris during 27-29 January 2005, at the helpful invitation of Alice Aureli of UNESCO. Being at UNESCO headquarters provided an excellent opportunity for direct interaction on areas of common interest with UNESCO-IHP and UN-WWAP staff in general - and with Andras Szollosi-Nagy (UNESCO-Deputy Assistant Director General) and Gordon Young (WWAP Coordinator) in particular.



*IAH President, Stephen Foster*

The role of the IAH Executive is to operationalise and give momentum to the general directions set by the IAH Council. So during this meeting what issues were principally on their minds? The short answer to this question can be summed-up as: expanding groundwater advocacy, intensifying scientific capability, extending association outreach, achieving financial security, improving member and charitable services and controlling operating costs. But certain items received special attention.

Jiri Krasny has embarked on the complex job of taking stock of the IAH Commissions, partly to look for opportunities to enhance their operation, impact, productivity and coverage and partly in response to

some constructive comments received from various quarters of the UN system. We will need your fullest cooperation in this task.

Hydrogeology Journal and IAH Book Publications progressed greatly in the 1990s and currently play a pivotal role in delivering our scientific mission, providing member services and thus generating Association revenue. Andrew Skinner has been working with our respective Chief Editors, Cliff Voss and Ian Simmers, to chart the best course for the future - more on this in due course, but we will certainly need a supportive and flexible response from the membership to get this right.

In attempting to insure against future financial risks, there are very strong arguments in favour of trying to diversify our sources of income from the current situation in which individual membership subscriptions (intimately related to Journal provision) predominate. Jack Sharp is, therefore, taking an in-depth look at alternatives, from broadening corporate membership and sponsorship to the creation of an endowment facility.

With fuller recognition of the global importance of water issues, the UNESCO-IHP is now running at considerably higher funding levels than in the 1990s, but these resources are much more decentralized to its various Regional Offices around the world. Miran Veselic is actively investigating the best way to mobilise the IAH Regional Vice Presidents, in unison with the IAH Commissions, to ensure that groundwater plays a very prominent role in the IHP be it at regional or global level.

The President and Executive will also put great emphasis on advocacy for groundwater and the importance of its scientific understanding and professional management, within international policy fora and declarations such as the UN-Water Standing Coordination Committee, the 4th World Water Forum (Mexico City/March 2006) and the 2nd World Water Development Report.

One special activity which merits our undivided support, maps closely to the 'charitable component' of our mission and will put us in the political spotlight, is how best we can focus the newly re-constituted Burdon Commission to make an appropriate and significant input to international efforts to achieve the MDGs for water-supply, in particular Sub-Saharan Africa where the challenge is unquestionably greatest.

## UN-Water and IAH

### Miran Veselic - IAH Secretary General

A new UN-Water programme was set up in September 2004, approved by the UN Secretary General's Advisory Board on Water and Sanitation, to strengthen the inter-agency coordination within the UN-System. UN-Water may be called upon to provide the necessary substantive support and information on key issues in the "Water for Life" UN Decade. UN-Water is now the focal point for coordinating United Nations system activities in the area of water resources. It is the interagency mechanism to follow up on the UN Millennium Development Goals (MDGs) concerning freshwater and the water-related decisions adopted at the World Summit on Sustainable Development.

UN-Water has for the period 2005-2007 defined the following thematic priorities for the UN System and allocated initial responsibility to the various agencies as follows:

*Issues:* Scarcity (FAO), Sanitation access (WHO and UNICEF), Disaster prevention (ISDR and WMO), Pollution (ESCAP; with UNEP and WHO), Transboundary water issues (ECE, ECA, ESCAP), Water sanitation and gender (IATF on gender and water);

*Responses:* Capacity building (UNESCO), Financing (UNDP; with WB), Valuation (UNDP and DESA);

*Conceptual Framework:* IWRM (DESA and UNEP);

*Geographical focus:* Africa: a region for priority action (ECA)

UN-Water invites a number of non-UN System partners with special expertise to join its meetings and in this capacity IAH joined the 2<sup>nd</sup> UN-Water meeting, hosted by UNESCO in Paris in February 2005 along with representatives of IAHS, GWP, IWA, WWCI, IPTRID and the Ramsar Convention Secretariat. Both the IAH President and Secretary-General attended.

Throughout the meeting UN-Water sought to define an operational strategy in order to maintain coherence in the UN-System water-related actions on a regional, national and international scale. This is particularly important in view of the up-coming UN Decade for Action, "Water for Life" 2005-2015, which will open this year on World Water Day.

The role of IAH was noted and highly regarded in the FAO-UNESCO report on Water Scarcity and specially mentioned with respect to non-renewable groundwater resources, internationally shared transboundary aquifer resources management, guidelines to assess impacts of recharge enhancement systems for irrigated agriculture and groundwater dependent ecosystems. Again, with respect to ISDR disaster prevention programme report, the role of IAH post-tsunami groundwater resources reactivation was highly appreciated. Finally, it should be noted that with regard to Joint Monitoring Programme, GWP and IAH were invited to help the UN System provide the necessary relevant statistical data on water and groundwater, since data scarcity is seen as one of the major integrated water resources management (IWRM) problems.

### Memorial to F. Larry Doyle



We are sorry to announce the death of Frank "Larry" Doyle on 26 February 2005, in San Antonio, Texas. A professional groundwater hydrologist with an internationally renowned career spanning more than 50 years, Larry served the US Chapter of IAH from 1980 to 1988 as Secretary/Treasurer and Chairman. He played a major role in organizing the 12<sup>th</sup> IAH Congress in Huntsville, Alabama (1975), the 17<sup>th</sup> IAH Congress in Tucson, Arizona (1985) and the 22<sup>nd</sup> International Geological Congress in Washington DC.

Larry began his career with the USGS in 1960 and worked in Arizona and Colorado. He taught at St. Mary's University in San Antonio, State University of New York, and the University of Connecticut in Storrs. Larry had a varied career working for Geological Survey of Alabama, Dames and Moore, Metcalf and Eddy, as Senior Hydrologist U.S. Nuclear Regulatory Commission, U.S. Department Interior Office of Project Review, and MITRE Corporation (Brooks AFB). He carried out geologic and hydrologic investigations in Panama, Nicaragua, Algeria, and Spain.

## European Groundwater News

### Groundwater quality in Switzerland

A complete overview of the quality of groundwater is now available in Switzerland for the first time. A report published by the BUWAL (Swiss Agency for the Environment, Forests and Landscape) and the BWG (Federal Office for Water and Geology) in January 2005 concludes that better management of ground water is necessary. Although quality is generally good, the presence of pollutants in many of the samples taken is worrying. In 60% of the ground water examined, traces of agricultural products were found, 45% contained hydrocarbons, and 20% an excessive proportion of nitrates. Over 80% of Swiss drinking water comes from ground water sources. Despite the satisfactory water quality, traces of pollutants are seen as a warning. One positive development is that in two-thirds of the samples, the nitrate content had reduced significantly since the 1990s, thanks to economic and ecological changes in Swiss farming, as well as measures taken by cantons and local authorities to protect water at risk from human activity. The report, Groundwater Quality in Switzerland 2002/03, is available on line in French and German from [www.buwalshop.ch](http://www.buwalshop.ch)

### New EU Groundwater Directive Update Groundwater Working Group (2C) meeting 28 January 2005

#### Status of Groundwater 'Daughter' Directive

The EC Coordinator, Dr Philippe Quevauviller, reported that 165 amendments to the new Directive as proposed had been tabled, mainly relating to chemical status, thresholds and implementation timetable, and that it had also been discussed by the EU Parliament on three occasions during October-November 2004. These amendments had to be dealt with and the GWP Directive re-submitted via the EC Environment Commission (earliest in March 2005), and the Directive was now unlikely to be ratified before 2006. The drafting of the main Water Framework Directive had experienced the same difficulties over groundwater status and different management philosophies across the EU which was

why they had been deferred to a Groundwater "Daughter" Directive. It has been observed that many of the problems derive from the new proposals being 'too prescriptive in some areas and not prescriptive enough in others'.

#### EC Groundwater Conference 2006

The Commission and the FEA-Austria are working on the possibility of celebrating a major European Conference on Groundwater Policy in Vienna probably in June 2006, which would promote the implementation of emerging policies and the scientific knowledge underpinning them. It will be necessary to highlight practical cases of successful ('win-win') changes to more 'groundwater-friendly' land use. The IAH Executive is exploring with the Commission ways to collaborate actively in this event. A fuller version of this report is on the IAH web site <http://www.iah.org/News/2005/048.html>

#### Groundwater Working Group (2C) Mandate 2005-06

The delay in ratification of the Directive presents chronic scheduling and synchronisation problems for the provision of definitive formal guidance to governments, given that some issues relating to the on-going implementation of the WF Directive are closely intertwined with the approaches of the GWP Directive and cannot be fully and rationally addressed until it is approved.

Nevertheless, the EC Water Directors (at their meeting in Amsterdam in December 2004) approved the mandate for the Groundwater Working Group (GWVG) for 2005-06, charging it with preparing guidance or specifications on the themes indicated in the table below to the timeframe indicated.

Those senior IAH members indicated have been (or are likely to be) nominated by other organisations to participate in topic Drafting Groups, and it was agreed that (given constraints on group size and IAH travel funds) they should represent IAH also - networking with the IAH President/Vice-President (Western Europe) who would retain a seat on the main GWVG.

No	Sub-group Title	Likely duration	Likely IAH Representative
GW1	WFD Groundwater Monitoring	Mar 2005-Dec 2005	John Chilton
GW2	WFD Groundwater Protected Areas	Jun 2005-Dec 2005	Donal Daly
GW3	GWD Groundwater Discharge Controls*	Jun 2005-Dec 2005	Didier Pennequin
GW4	GWD Groundwater Status and Trends	Oct 2005-Jun 2006	Hans-Peter Broers

\* does not include diffuse pollution from agricultural land-use

## December 2004 Tsunami and Groundwater Impacts

This issue of news and Information goes to press twelve weeks after the tragic events of 26 December. There are many issues to resolve and priorities to evaluate. The United Nations Environment Programme (UNEP) has just published its report *AFTER THE TSUNAMI - Rapid Environmental Assessment with country summaries*. Among the conclusions of the report are comments which groundwater specialists working on the issue will easily recognise.

UNEP's rapid assessments have identified gaps including:

- (i) the lack of vulnerability mapping and comprehensive risk assessment;
- (ii) minimal field assessments to date, mainly restricted to areas of high population density;
- (iii) the historic lack of environmental baseline data;
- (iv) the lack of environmental quality assessments and data on toxic and hazardous wastes that may be mixed with other debris;
- (v) the lack of environmental guidelines in national disaster plans, where they exist at all.

The recently formed International Groundwater Resources Assessment Centre in the Netherlands has been active in trying to collate the available hydrogeological databases and reference information. Many national and international organisations immediately took action and information, such as situation reports and damage area maps were available on the Internet more or less immediately to inform about the damages and to streamline the relief effort.

From the information collected by IGRAC the following major impacts on the groundwater resources were identified: salinization of shallow fresh groundwater, reduction in volume of freshwater lenses, landward shift of freshwater/saltwater mixing zones, pollution of groundwater by chemicals and other contaminants mobilized by flooding seawater. The processes involved are not unfamiliar to the groundwater specialist. It is believed that the pressure of the wave was transmitted underground through the coastal aquifer ahead of the surface wave. Reports from Sri Lanka mention geysers appearing just before the land was flooded. Reports from the Maldives mention wells filled with sand from below. Both events indicate a vertical upward pressure during the tsunami. More investigations are needed to understand the effects caused by these differences in pressure. Groundwater pressure effects were observed worldwide, as shown by the groundwater hydrograph of a borehole in Northern Ireland on page 6.

IGRAC also report suggestions that freshwater lenses have decreased in size due to the subsurface pressure wave. The pressure caused an upward and lateral movement of the groundwater, which resulted in a larger freshwater/saltwater mixing zone and a smaller freshwater volume. Baseline data is needed to confirm this conclusion.

### COUNTRY REPORTS

#### Thailand

The most extensive information and assessments are available from Thailand where both USGS and BGS scientists have been active in support. (See the report from the USGS on page 7-8). Observations along the Thai coast have confirmed how local differences in topography, of the sea bed, the shoreline and inland control have modified the tsunami impact. Beaches where the natural dune systems had been preserved were generally free of damage and loss of life was minimal. In nearby developments where the dunes had been removed the impact was much worse. The source earthquake also had its groundwater impacts. In Thailand and also in Malaysia there are reports of the activation of a large number of sinkholes in karstic regions which is attributed either directly to the seismic impact or more likely seismically induced fluctuations in groundwater.

#### Indonesia

In Indonesia, an estimated 60,000 wells and 15,000 hand pumps have been contaminated, damaged or destroyed. From the heavily impacted Banda Aceh area there have been extensive impacts on groundwater, overtopping of wells, contamination by mud and debris as well as by saline water, and serious concerns about impacts from overflows from damaged sewerage systems, because of the lack of wellhead protection or natural protection to the aquifers. Remedial work has led to some early conclusions that groundwater characteristics - not only quality but also yield - have been affected. As in Thailand, areas where coastal mangrove vegetation has been preserved have had the benefit of natural protection. It will be an interesting area of study to discover to what extent, as seems likely, this has also protected groundwater resources.

#### India

The tsunami, caused extensive damage to the lives and property in the Indian coastal regions of Andhra Pradesh, Tamilnadu, Kerala, Pondichery and in the Andaman and Nicobar islands. In the Andaman and

Nicobar islands 1-3m subsidence along the east coast have been reported with the loss due to subsidence of the southernmost island, known as Indira point. In affected areas, the main sources of drinking water are ponds and dug wells. These sources are contaminated due to mixing of seawater, leading to the scarcity of drinking water. Reports from the tsunami affected coastal areas of Tamil Nadu reflect information from the other side of the Indian Ocean where near shore and coastal topography, geomorphology and vegetation had a significant impact on the degree of inundation. The groundwater near the coastal area (up to approx 500m) has become highly saline and salinity has increased 10 to 100 fold and the open wells are completely overwhelmed.

### Sri Lanka

In Sri Lanka it is estimated that there are up to 60,000 shallow dug wells in the affected coastal settlements and many of these, depending on location, are impacted and are no longer useable. Saline impacts that have been investigated have proved to be complex and hard to interpret in the absence of information on the aquifer characteristics. A better understanding is urgently needed because other water sources are often not available and new wells have to be sunk in the least affected regions. The impacts of pumping on the salinised water body will be critical for the long term success of these remedial measures.

### Maldives

Reports suggest that the flooding did not do much damage to the well structures, but it made the water saline in many wells. Reports were also received of

wells which overflowed and of wells in which the sandy well bottom was raised. The pressure wave which came with the tsunami was transmitted through the sub-surface and most probably will have upset the equilibrium between the fresh and saline groundwater below the islands.

### Groundwater and Emergency Planning

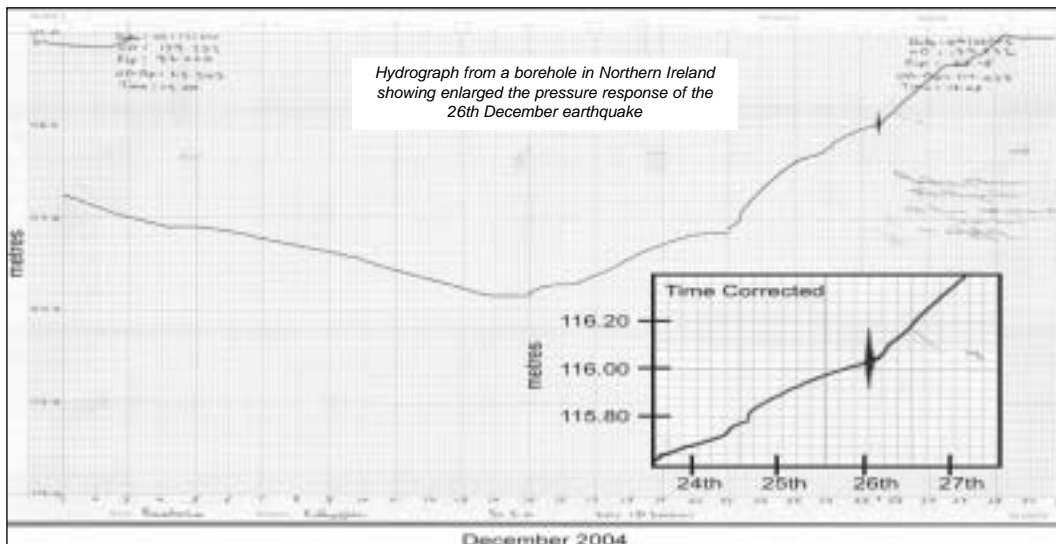
The issues raised by the analysis of the tsunami have given additional impetus to the ongoing GWES (Groundwater Resources for Emergency Situations) project of UNESCO. It addresses the issues arising from climatic (floods and droughts) and geological (earthquakes, landslides, volcanic activities) disasters which in many regions of the world often generate serious emergency to secure drinking water supply for the affected population. The project is managed by an International Working Group from UNESCO, IAEA and IAH and experts from different regions of the world. The IAH contact and group chair is Jaroslav Vrba [javr@mymail.cz](mailto:javr@mymail.cz)

### Links

- [http://www.unep.org/tsunami/tsunami\\_rpt.asp](http://www.unep.org/tsunami/tsunami_rpt.asp)
- <http://www.iwmi.cgiar.org/tsunami>
- <http://igrac.nitg.tno.nl/tsunami1.html>

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- Shivendra Nath Rai, IAH Vice-President, Asia.
- AI Ramanathan, JNU, New Delhi, India.
- Cliff Voss and Holly Michael, USGS.



**HOLLY MICHAEL AND CLIFF VOSS OF USGS CARRIED OUT A RECONNAISSANCE GROUND-WATER APPRAISAL OF THE EFFECTS OF THE TSUNAMI IN THAILAND. HERE ARE EXTRACTS FROM THEIR REPORT**

**Tsunami Flooding Impacts on Groundwater Quality in Southwest Thailand**

The tsunami of 26 December 2004 impacted the 200km coastline and several islands from Ranong to Phuket Island in southwest Thailand. Small villages and beach resorts line this coast, with an economy based on resort services, fishing, and tin mining. The tsunami floodwater extended inland 1km - 3km, damaging or destroying many of these resorts and villages and salinizing local water resources. Although there are obvious major impacts of the tsunami on infrastructure, economy, health and society, a reliable fresh water supply is a fundamental necessity and is therefore a priority in the recovery effort.

Many households rely on water supply from private shallow dug wells (about 1m in diameter, cased with concrete) while schools and other institutions are often supplied by deeper drilled tubewells (PVC cased and screened wells). The tsunami immediately filled and salinized the water in dug wells and unsealed tubewells. Sealed tubewells may be adversely impacted in the future due to their greater depth and initial isolation from the overtopping saline water. Currently, the Government of Thailand is supplying bottled water and pumping water from unaffected wells into tanker trucks for distribution to villages and to temporary housing camps.

**Survey Visit**

We were able to spend two days on this tsunami-affected coastline during a seven-day visit with the Department of Groundwater Resources, Bureau of Groundwater Conservation and Restoration of the Government of the Kingdom of Thailand, from January 21-27. This brief assessment is based on discussions with hydrogeologists in the Department and on our preliminary impressions and initial understanding of the situation. We have attempted to estimate the extent of saline contamination in shallow and deeper aquifers and to qualitatively predict the evolution of water quality with and without remediation efforts.

Recommendations are made for short-term and long-term remediation and the establishment of a water quality monitoring program to follow the future evolution of contamination. While we can recommend some immediate actions (e.g. removal of bodies of standing saline water and purging of wells), our understanding of the long-term evolution of water quality and the need for remediation or alternative

imported water supply is limited by a lack of current detailed knowledge of the size of the subsurface saltwater source and hydrogeologic structure. Further data and analysis is needed for a more definitive assessment. These evaluations and recommendations may apply equally well to impacted areas of other countries.

**Initial Tsunami Impact Assessment**

The aquifers of the southeastern coast of Thailand consist of unconsolidated beach sand, potentially separated by clay-rich confining units. The superficial material is primarily very fine unconsolidated sand, partially consolidated beach sand and silty to clayey fine sand in some areas. The recharge to these superficial units occurs as direct rainfall (approximately 2m - 4m per year, concentrated during the monsoon season, from May - October), and deeper units are likely recharged from above and through connections to nearby upland areas. Natural discharge from superficial aquifers likely occurs along the coast and inland to low-lying areas, including streams and marshes, while discharge from deeper units likely occurs offshore. Discharge also occurs to household dug wells, community tube wells, and larger municipal production wells, which are screened at different depths within the aquifer systems.

Tsunami floodwaters inundated coastal areas to depths of several meters, submerging hundreds of square kilometers for a period of several hours. There are three primary modes through which the saltwater may have entered the underlying aquifers. The first is direct contamination of wells, both large-diameter dug wells and small-diameter tubewells that were either open at the top or damaged during the flooding. The second contamination pathway is widespread infiltration of seawater into the aquifer from the land surface through the unsaturated zone, the quantity controlled by the permeability of the surface sediments and the depth to the water table. Following drainage to the sea, some seawater remained inland as surface-water bodies in local low-lying areas. Those that remain are the third mode of contamination: long-term point sources of saltwater to the surficial groundwater system.

**Saltwater Contamination**

Currently, there are varying levels of saltwater contamination in drinking-water wells. Of the dug wells visited and tested for salt content with a conductivity probe, those that produce a greater volume of water are fresher than those that have been used less frequently or are bailed by bucket rather than pumped. This would seem to indicate that the primary source of contamination for these wells was the volume of seawater that filled the casing. The tubewells visited have generally lower salinities than

dug wells, and these vary in depth, location, and potability. However, without a careful inventory, it is not possible to assess the true condition of these wells.

### Possible Future Impacts

The total volume of seawater that infiltrated the surficial aquifers along the coast of Thailand is the primary control on the expected extent and duration of contamination. If the source of contamination was only the seawater volume that filled well casings, then the total contaminant volume is low. This would imply a small, short-term impact on the quality of water resources. However, if a significant amount of seawater infiltrated the unsaturated zone over the entire inundated area, then a more significant and long-term impact is possible. The distribution of saltwater within the aquifers is also important. If infiltrated saltwater is currently well-mixed with fresh aquifer water, well salinity levels will fall monotonically to pre-tsunami levels.

Similarly, if the bulk of saltwater has already migrated below the screen, well salinity levels should continue to fall unless pumping causes upconing. However, if the contamination is still above the current well screens in the unsaturated or saturated zone, a slug of saline water may drop vertically toward the well screen causing poor water quality at some point in the future. This may occur particularly following the first few major recharge events which will flush the unsaturated zone (i.e. the monsoon season May-October 2005). Deterioration of water quality will continue until the slug is deeper than the well screen or until saltwater mixes with freshwater, diluting it to a potable level.

Lastly, if ponded saltwater bodies remain, the contamination source is constant rather than instantaneous. In this case, the high-salinity water will continue to be pumped in localized areas until the saline ponds are eliminated and the contamination flushes from the aquifer.

### Potential Remediation Approaches

Widespread infiltration of a dense non-reactive contaminant is difficult to remediate. A few mitigation approaches are possible. The first is passive response, allowing natural recharge to flush salt from the aquifer. This could imply long recovery times, and alternative drinking water must be supplied until well salinity levels decrease. Well purging is important to both well recovery and elimination of point sources of saline water. The water that entered the well casings immediately upon inundation may be removed by pumping for a period of time until concentrations become steady, although not necessarily to pre-tsunami levels. If the seawater is isolated in a

particular aquifer horizon, it may be pumped out of the aquifer and discarded. This is technically difficult to apply, as the contaminated horizon must be determined by careful measurements (both direct and geophysical), and application of this method near the coast may induce classical seawater intrusion. Lastly, if saltwater contamination is contained in shallow aquifers which are isolated from deep aquifers by confining units, the deep confined aquifers may become an alternative source of fresh water through installation of deeper tubewells.

### Future Action

Data collection and long-term monitoring is necessary to assess the status of groundwater quality and drinking water availability and to monitor water quality changes with time. A program of regular sampling is the only means to objectively assess and manage the impact of the tsunami-induced saltwater contamination. Measurements of well salinity levels over time as well as salinity profiles with depth at selected locations should be obtained. Hydraulic conductivity estimates would also be useful in calculations and may be obtained from slug tests, grain size analysis, or laboratory permeameter tests, for example. Analytical modeling may be carried out, including simple calculations to estimate local contaminant volumes and stirred-tank models to approximate saltwater residence times in the aquifers. Generic cross-sectional or three-dimensional numerical groundwater models of variable-density flow and solute transport can be constructed to better understand contamination mechanisms and the effectiveness of different remediation strategies. Such modeling may constrain possible evolutions of water quality.



Four weeks later, these houses 250 m from the ocean at Pakwib Beach in Khaolak, Thailand, stood as the tsunami left them. The floodwater depth is clearly marked by the highest location of debris on the rooftops

## IAH News

The **Portuguese National Chapter** held elections and the newly constituted management board is:

President: António Chambel  
Vice-President: Luís Ribiero  
Secretary: Teresa Melo  
Treasurer: J. Paulo Monteiro

The National Chapter of IAH for **Serbia and Montenegro** and Institute of Hydrogeology, Belgrade University jointly organized a workshop on "Modeling of Groundwater Contamination and Remediation" from 25 November to 1 December, 2004. The workshop, led by Dr. Neven Kresic (USA) and Dr. Dusan Polomcic (Institute of Hydrogeology), was held at the Institute. Conceptual hydrodynamical model, hydrogeological parameters, model discretization, boundary conditions, calibration and sensitivity analysis, fate and transport parameters, and model error were discussed during the first part of the workshop. Groundwater remediation modeling was focused on pump-and-treat containment systems, particle tracking applications, injection of oxidants, circulation wells, horizontal wells and drains, permeable barriers, and monitored natural attenuation. 39 participants were selected among senior and graduate students, as well as researchers from leading national organisations and companies such as Municipal Water Supply System of Belgrade, Energoprojekt, National Institute for Water Management, Geological Survey of Serbia etc. The course is part of a programme of reorganization of higher education in Serbia and Montenegro, undertaken by the Institute of Hydrogeology, with active participation of the IAH National chapter.



From left to right: Neven Kresic, lecturer, Zoran Stevanovic, Chair of Department of Hydrogeology, Dusan Polomcic, lecturer, Borivoje Mijatovic, President of National Committee of IAH, Ivan Matic, Prof of Groundwater Protection are closing the Workshop

### CREATION OF THE IAH CENTRAL AMERICAN CHAPTER

On 10 March, in Managua, Nicaragua, during the Congress CARA (Central American Water Resource Management Network), "Hydrogeology and Water Resources Management", supported by CIDA (Canadian International Development Agency), the IAH Central American Chapter was created. The ceremony had the participation of the IAH President, Dr. Stephen Foster, the IAH Vice President in Latin America and the Caribbean, Prof. Emilia Bocanegra, the Past President, Dr. Emilio Custodio, the Scientific Program Coordinator, Dr. Jiri Krasny and the Coordinator of the CARA Network, Dr. David Bethune. The Provisional Executive Committee was constituted by Valeria Delgado (Nicaragua), Karla Mora (Costa Rica), Tomás Padilla (Guatemala), Mario Guevara (El Salvador), Roberto Avalos (Honduras) and Domingo Espinoza (Panama).



From left to right: Emilio Custodio (IAH-Past President), Valeria Delgado (Nicaragua) the host, Mario Guevara (El Salvador), Emilia Bocanegra (IAH-VP Latin America), Roberto Avalos (Honduras), Karla Mora (Costa Rica), Stephen Foster (IAH President), Karen Christie (CIDA Rep), David Bethune (CARA-Canada Coordinator)

The main functions of the Committee are:

- To promote the creation of the IAH Central American Chapter in their countries;
- To prepare the Statutes for the new Chapter;
- To organise scientific and technical congresses, workshops and meetings related to groundwater in the region;
- To link the Regional Chapter to the IAH Council and to the Regional Vice Presidency;
- To strengthen the relationship between the IAH and the regional organisations or agencies related to groundwater.

## IAH Sponsored Conferences 2005

**Belgrade and Kotor, Serbia and Montenegro**

**International Conference and Field Seminar on  
Water Resources and Environmental Problems  
in Karst**

**14 -19 September 2005**

Organised by the IAH National Chapter for Serbia  
and Montenegro

Closing date for early registration 31 May 2005

**Web: [www.cvijic-karst2005.org.yu](http://www.cvijic-karst2005.org.yu)**

**Email: [jemcov@ptt.yu](mailto:jemcov@ptt.yu)**

**Alicante, Spain**

**International Workshop - from Data Gathering  
and Groundwater Modelling to Integrated  
Management**

**4 - 8 October 2005**

Organised by IAH Spanish National Group

Closing date for early registration 1st July 2005

**Web: [www.fcih.org/PUB/INFO/AIH-GE.HTM](http://www.fcih.org/PUB/INFO/AIH-GE.HTM)**

**Email: [gerencia@fcih.org](mailto:gerencia@fcih.org)**

**Auckland, New Zealand**

**International Conference - Where Waters Meet**

**28 November - 2 December 2005**

Organised by New Zealand Hydrological Society  
and IAH Australia

Closing date for paper submission 30 May 2005

Closing date for early registration 25 July 2005

**Web: [www.wrl.unsw.edu.au/iah-auckland](http://www.wrl.unsw.edu.au/iah-auckland)**

## The Burdon Commission team emerges

IAH Council has been reviewing the objectives and mode of operation of the Burdon Commission first established in the early 1990s.

The long process of re-establishing the IAH Burdon Commission has come to an end - now the hard work of trying to do something useful can begin. The purpose of the commission is to provide support to those involved in helping to implement the Millennium Development Goals for water, with sub-Saharan Africa as the area of initial focus. Specifically the commission aims to:

- support and extend local, national and international networks of African groundwater expertise;
- offer information support through improved publications and the Internet.

The team to help coordinate this work is largely in place and is drawn from IAH members across the world:

Alan MacDonald (UK)  
Segun Adelana (IAH VP Sub-Saharan Africa)  
Morgan Burke (Ireland)  
Tamiru Alemayehu (Ethiopia)  
Atle Dagestad (Norway)  
Serigne Faye (Senegal)  
Ralf Klingbeil (Germany)  
Gideon Tredoux (South Africa)  
Callist Tindimugaya (Uganda)

For more information, or if you would like to help, contact Alan MacDonald ([amm@bgs.ac.uk](mailto:amm@bgs.ac.uk)) or any of the team members directly.



*Three women in rural Nigeria carrying water back to their village from a distant source*

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	<b>Contaminated Site Risk Assessment and Groundwater Modeling:</b> Transport Processes, Natural Attenuation and Risk Assessment	<b>Aquifer Test Analysis:</b> Principles of Pumping Test Design and Techniques for Data Analysis
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# Conference Listing

Summary details of conferences with e-mail or web addresses are given below. For a fuller list of conferences and more details, including links to web sites visit [www.iah.org/confs/](http://www.iah.org/confs/)

## 2005

May 4-6, Quito, Ecuador. I Congreso Ecuatoriano de Hidrogeología organised within the XII Congreso Latinoamericano de Geología. Web: <http://www.cigmyp.org/congreso/index.htm>.

May 10-13, Mendoza, Argentina. CONAGUA 2005. XX National Water Congress and III Symposium on Water Resources of the Southern Cone. Web: [www.congresosdelagua.org](http://www.congresosdelagua.org).

May 18-21, Evora, Portugal. Second Workshop of the Iberian Regional Working Group of the IAH Commission on Hardrock Hydrogeology. Web: <http://www.eventos.uevora.pt/hardrockhydro/>

May 23-25, Lyon, France. Geoline 2005. International Symposium on Geology and linear infrastructures. E-mail: [geoline2005@brgm.fr](mailto:geoline2005@brgm.fr);

May 25, San Jose, California, USA. "Subsurface Vapor Intrusion to Indoor Air-An Update". Web: <http://www.grac.org>

May 26-27, Darwin, Northern Territory, Australia. Groundwater Surface Water Interaction in the Tropics. Seminar organised by the Northern Territory Branch of IAH. Web: <http://www.iah.asn.au/conference.html>

June 11, Berlin, UNESCO-IAH Workshop on 'Implementing Appropriate MAR in Developing Countries. : Web: <http://www.ismar2005.org/>

June 11-16, Berlin, 5th International Symposium on Management of Aquifer Recharge. Web: <http://www.ismar2005.org>

June 12-17, Prague, Czech Republic. 7th International Conference on Acid Deposition "Acid Rain 2005". Web: [www.acidrain2005.cz](http://www.acidrain2005.cz)

June 12-17, Berlin, Germany. ISAR5 - 5th International Symposium on Management of Aquifer Recharge. Web: <http://kompetenz-wasser.de/>

June 20-23, Bergen, Norway. HeadWater 2005: "Hydrology, Ecology and Water Resources in Headwaters". Web: <http://www.nve.no/headwater05/>

August 28-September 2, Lake Bled Slovenia. 10th International Symposium on the Interactions between Sediments and Water. Web: <http://www.iasws.com>

September 1-3, Rhodes Island, Greece. 9th International Conference on Environmental Science and Technology-2005 (9CEST 2005). Web: <http://www.gnest.org/cest>

September 4-8, Ghent, Belgium. International Symposium on Wetland Pollutant Dynamics and Control (WETPOL). Web: <http://biomath.ugent.be/wetpol>

September 7-10, Menton, France. EWRA 2005 - 6th International Conference, European Water Resources Association. Web: <http://www.cig.ensmp.fr/ewra2005>

September 7-11, Zaragoza, Spain. Sixth international conference on geomorphology. Web: <http://wzar.unizar.es/actos/SEG/index.html>

September 11-16, Freiberg, Germany. Uranium Mining and Hydrogeology IV. Web: <http://www.geo.tu-freiberg.de/umh/index.htm>

September 11-19, Beijing, China. Use of Water and Land for Food and Environmental Sustainability. 19th Congress of ICID. Web: [www.icid.org](http://www.icid.org)

September 14-19, Belgrade, Yugoslavia. International Conference on Environmental (Geoecological) Problems in Karst. Organised by the Serbia and Montenegro Committee of IAH. Web: <http://www.cvijic-karst2005.org.yu/>

September 18-21, Saskatoon, Canada. 58th Canadian Geotechnical and 6th Joint IAH-CNC and CGS Groundwater Specialty Conferences. Web: <http://www.geosask2005.ca>

September 19-22, České Budejovice, Czech Republic. 12th National Hydrogeologic Congress. Web: <http://www.cah.cz>,

October 4-8, Alicante, Spain. International Workshop "From data gathering and groundwater modelling to integrated management". Web: <http://www.fcihis.org/PUB/INFO/AIH-GE.HTM>

October 5-6, Athens, Greece. 7th Hellenic Hydrogeological Conference and 2nd MEM Workshop on Fissured Rocks Hydrogeology. Web: [www.iah-hellas.geol.uoa.gr](http://www.iah-hellas.geol.uoa.gr)

October 23-25, Río Cuarto, Córdoba Province, Argentina. IV Congreso Argentino de Hidrogeología (IV Argentine Hydrogeology Congress) and II Seminario Hispano-Latinoamericano sobre Temas Actuales de la Hidrología Subterránea (II Spanish-Latin American Seminar on Current Issues in Hydrogeology). Web: [www.unrc.edu.ar](http://www.unrc.edu.ar). E-mail: [congreso-hidroorioiv@exa.unrc.edu.ar](mailto:congreso-hidroorioiv@exa.unrc.edu.ar).

November 7-10, Seattle, USA. AWRA 2005 National Conference. Web: <http://www.awra.org/meetings/Seattle2005/index.html>

November 22-25, New Delhi, India. XII World Water Congress of the International Water Resources Association. Web: [http://www.iwra.siu.edu/conferences/new\\_delhi2005.pdf](http://www.iwra.siu.edu/conferences/new_delhi2005.pdf)

November 28-December 2, Auckland, New Zealand. Joint conference organised by the new Zealand Hydrological Society and the IAH Australian National Chapter Web: <http://www.hydrologynz.org.nz/society-conferences.html#nzhs05>

## 2006

February 1-4, New Delhi, India. International Groundwater Conference on Groundwater E-mail: [alr\\_jnu@yahoo.co.in](mailto:alr_jnu@yahoo.co.in)

April 24-28, Malaga, Spain. AQUAinMED International Congress "Ground Water in Mediterranean Countries". Web: <http://www.igme.es>

May 23-25, Marrakech, Morocco. Integrated Water Resources Management and Challenges of the Sustainable Development. Web: <http://www.fstg-marrakech.ac.ma/gire3d>

June 20-24, Mexico City, Mexico. As2006: Natural Arsenic in Groundwaters of Latin America. Web: [http://www.lwr.kth.se/Personal/personer/bhattacharya\\_prosun/As-2006.htm](http://www.lwr.kth.se/Personal/personer/bhattacharya_prosun/As-2006.htm)

September 4-10, Yogyakarta, Indonesia. Volcano: life, prosperity and harmony. Web: <http://vig2006.recent.or.id/>

September 14-17, Nottingham UK. Engineering geology for tomorrow's cities. 10th Congress of the International Association of Engineering Geology. Web: [www.iaeg2006.com](http://www.iaeg2006.com)

October 9-13, Beijing, China. XXXIV Congress of IAH. Details from [nizengshi@tom.com](mailto:nizengshi@tom.com)

October 16-18, Bangkok, Thailand. 3rd Asia Pacific Association Hydrology and Water Resources (APHW) conference. E-mail: [choosri@thirdaphw.org](mailto:choosri@thirdaphw.org); Web: to be launched soon <http://www.thirdaphw.org>