# Groundwater Program Newsletter


## GROUNDWATER News

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**Editing : Alfonso Rivera**
**Coordination: Pascale Côté**


## Editor's MESSAGE

I measure timing of events by winters, Canadian winters, that is. To me, events happen *before* the winter or *after* the winter, my personal clock is tuned to that synchronization. Although this is my fifth year in Canada, I count it as being my sixth winter! As I write these lines from my office in Quebec City, watching the thick white layer outside and the struggle of my office windows to contain the cold, I see that we are still 5 to 6 weeks before this one ends. But I've learned that winters in Canada do not halt science activities, or any other activity for that matter, in fact they seem to increase! This winter brought a myriad of events since I last wrote this editorial in October 2004.

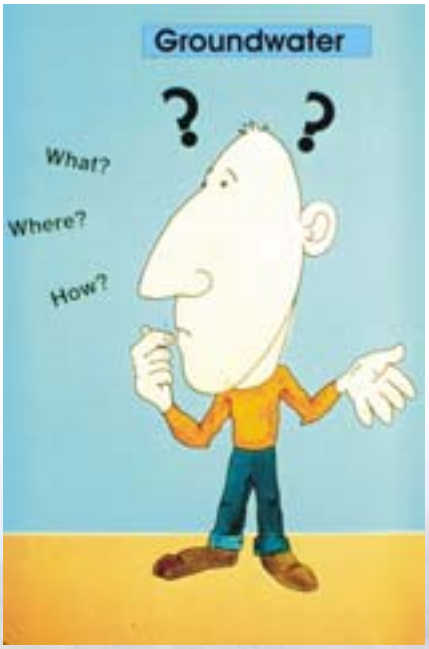
At the beginning of the winter, two events strongly linked to hydrogeology were held, one international and one national; members of the GW program's team participated in both. The IAH international Congress (Grasby and myself) held in Zacatecas, Mexico; and the IAH national conference in Quebec City where special sessions on regional groundwater resources attracted many excellent papers, including some with results from our projects. You will find a description of these in the Visibility section. My third year involvement with a Grant Selection Committee with NSERC was by far the most strenuous one this winter, fortunately my mandate ended there. Next winter will be NSERC-free! *RésEau*, the new EC-led initiative for Government-On-Line also was fully developed, proposals submitted, committees reviewed them, and budgets were allocated, all in a few weeks record time during December and January. You will read related successes of our program in the New Initiatives section below. Also during the winter, our program was reviewed by the Sector and the joint GC and GSC Advisory Committees in mid January with excellent results. And in the middle of all these, we embarked in the planning of a Groundwater book with our main partners, provinces and universities, and held a workshop for that purpose in early February. I encourage you to read below for more details.

So there you have it, a gleaming, vigorous, healthy winter; my sixth … and counting.

***Alfonso Rivera**, Chief Hydrogeologist and Groundwater Program Manager*

## IN THIS ISSUE





## Very positive review of the Groundwater Program

The Groundwater Program (GWP) was reviewed during the joint GC/GSC Advisory Committees meeting (January 20) along with two other programs (SDKI and Hazards). The GWP was highly praised. It was recognized that it is making an impact, given the high interest raised among stakeholders in the country, as well as the quality of its work. The joint Advisory Committees, composed of industry and university, strongly recommended that the program be continued. Susan Till, ADM, Agriculture and Agri-Food Canada (AAFC), and leader of the National Land and Water Information Service (NLWIS) was invited to present NLWIS and its relationships with the GWP. She emphasized that NLWIS will need the hydrogeological/geological frameworks developed under the GWP.

## New initiatives and funding successes

### Collaboration with Agriculture and Agri-Food Canada

The Annapolis-Cornwallis Valley Aquifer study (ACVAS), part of the «Assessment of Regional Aquifers: Towards a National Inventory» recently received two major contributions from Agriculture and Agri-Food Canada (AAFC). The first, an input of $50,000 from the National Water Supply Expansion Program, will fund field work and modelling of nitrates and bacteria in a sub-watershed of the valley. AAFC also contributed $22,000 for the purchase of specialized equipment, including a multi-parameter probe, automated pressure transducers and water level probes.

### RésEau

On January 18, as a member of the *RésEau* Management committee, I participated in the review of proposals. There were 44 in total from provinces, OGD, NGOs, consultants and universities, 8 % were related to groundwater. The management committee recommendations were approved by the steering committee and 4 of the total number of successful submissions were NRCan's projects to begin on April 1st under this initiative. The NRCan's successful proposals are:

- «Web Coverage Service for groundwater information». Project leader: Éric Boisvert, a member of the GWP team
- «The Canada Water Accounts: From Science to Information». Co-project leaders: Alexander Trichtchenko and Richard Fernandes, the second one a member of the GWP team
- «PW-Phoenix: web portal for decision support in sustainable water management». Project leader: Boyan Broderic, a member of both the SDKI and GW programs
- «Know-your-Watershed». Project leader: Peter Paul, GeoAcess Division, ESS-CCRS

The *RésEau* management committee recognized the role of groundwater and the leadership role NRCan is playing across the country. They seem to be «hungry» for groundwater information and actually asked me to submit specific proposals. They will officially request from NRCan a proposal by invitation related to groundwater.

## Visibility of the Groundwater Program

### Groundwater program contributes to Water Policy in Ontario

David Sharpe represented the program, as a co-author of a report released Dec. 6th 2004 by the Ontario Minister of the Environment, on Source Water Protection. He was invited to the Minister's Technical Experts Committee to provide advice on Ontario's groundwater resources and their protection. The technical experts, representing a range of disciplines, were mandated to advise the Minister on water policy within a 'threats assessment framework' aimed at watershed-based source protection. Central elements that the committee were also asked to assess included, for example, well and aquifer vulnerability, sensitive groundwater-surface water resources, ecological protection of waters not used as drinking water, permits to take water program and recommendations for priority actions for 2008.

The vision of the Environment Minister, who personally met with the committee on two occasions, is to ensure that Ontario has a comprehensive, science-based program to protect water resources, including the Great Lakes. The technical experts met monthly to review a wealth of water protection information and strategies from all sources, in support of pending legislation and implementation through conservation authorities and municipalities. The scope of this post-Walkerton initiative is IN creating interest in source water policy in provincial and state governments across Canada, the US and in the Canadian Council of Ministers of the Environment. Of special interest to the ESS groundwater program are the recommendations on water quantity issues. These include the issue of water budgets that are needed to achieve sustainable water use and protection in each watershed. Evaluation of recharge fluxes, groundwater dynamics as well as storage, discharge and underflow are important components to assess. Water budgets need to compare all current and forecasted water uses and withdrawals to the amount of water in the watershed. These are also needed to identify and quantify the fluxes and levels that are sustainable in each and adjacent watersheds.

*Members of the vulnerability sub-group of the Technical Experts Committee on Watershed-Based Source Protection Planning. From left to right: Ian Smith, Lorrie Minshall, Dave Rudolph, Eric Hodgins, Steve Holysh, Marg Evans, Michel Robin and David Sharpe*

Members of the Regional Hydrogeology of southern Ontario study contributed to the Source Water Protection effort through discussions and review of documents (e.g. Desbarats, Hinton, Logan, Pullan and Russell). This underscores the project's role in providing provincial partners and agencies with information in support of water and waste management issues**.** While the immediate focus of Source Protection is to 'protect the well head', future demands to better identify, map and characterize recharge areas and watershed-scale flow systems will be an enormous groundwater challenge.

The committees' reports are posted for a 60-day public comment period (from Dec. 14th 2004) on the Environmental Bill of Rights Registry at: http://www.ene.gov.on.ca/envregistry/024326ex.htm (technical report) and http://www.ene.gov.on.ca/envregistry/024324ex.htm (implementation). In addition, the final Water Taking and Transfer Regulation is also available on the Environmental Bill of Rights Registry.

## Water management in Quebec

Miroslav Nastev (GSC-Québec) participated in the public consultation held by the *Bureau d'audiences publiques sur l'environnement du Québec* (BAPE) on the proposed niobium mine in Oka. The consultation was held in Oka, from January 17 to 20, and addressed issues related to the qualitative and quantitative impacts of the operation of a mine on the region's groundwater resources and their interactions with surface streams. Expertise developed through the regional hydrogeology project in southwestern Quebec was drawn upon to specify the hydrogeological parameters to be considered, at both the economic and environmental level, with regard to development of the project. Representatives of the project proponent, Niocan Inc., attended the consultation, which attracted a large number of residents from the surrounding area and from the Kanesatake Indian Reserve, as well as members of ecological groups and the farming community, who were represented by the *Union des producteurs agricoles*.

This request represents a clear link between the GWP's outputs and two of its most important outcomes, namely: «*Information on aquifers at risk to aid governments and municipalities make decisions related to water and waste management questions*» and «*ESS Groundwater experts are consulted on questions of groundwater management*».

## International Association of Hydrogeologists

A. Rivera and Steve Gasby attended the IAH meeting, in Zacatecas, Mexico, October 9-15, 2004. The theme of the conference was «Groundwater Flow: Understanding from local to regional scales» a theme very much in line with the GWP's objectives. Alfonso made two presentations; one as invited keynote speaker on: «*Overview of groundwater flow in bedrock media: from site to regional scales*» and another one on: «T*rans-boundary water in Canada».* Steve Grasby presented an overview of current work being conducted through the Assessment of Regional Aquifers project, raising the profile of work being done in Canada on an international scale. This congress, aimed at hydrogeologists, water resources specialists, government administrators, educators, and those interested in groundwater and the environment, allowed the exchange of techniques, experience, knowledge, ideas and know-how in groundwater studies and investigations. One of the goals of the conference was to communicate more effectively with the general public and non-groundwater specialists.

## Commission for the Management and Application of Geoscience Information (International Union of Geological Sciences).

Éric Boisvert is a member of the «Model and Encoding Task» sub-group, which met in Perth, Australia, from December 3 to 11. Several countries, including Canada, have adopted OGC (Open GIS Consortium and ISO/TC211) standards as the basis for their geospatial data infrastructures. Establishment of such an infrastructure requires a common data model in order to permit the implementation of an exchange standard based on GML (*Geographic Markup Language*, an OGC standard). The sub-group is responsible for creating a common geoscience data model based on existing models, and for developing a GML application (compliant with OGC standards). The significance of this work to the groundwater database project lies in the creation of an international model based on standards supported by the Canadian government through the Canadian Geospatial Data Infrastructure (CGDI, led by GeoConnections). Other departments have begun to introduce OGC standards (CISE, ResEau at Environment Canada, NLWIS at Agriculture and Agri-Food Canada, etc.), and Geomatics Canada, in our department, is leading the initiative through GeoConnections.

## Canadian Society of Petroleum Geologists Service Award

Dr. Stephen Grasby, Leader of the Assessment of Regional Aquifers Project, was awarded the Canadian Society of Petroleum Geologists (CSPG) Service Award in recognition of the role he played in organizing and chairing the first CSPG Gussow Conference, which focused on 'Water Resources and Energy Development'. The meeting, held in March 2004, successfully brought together over 100 representatives from numerous sectors including industry, government, NGO's, and the general public to discuss the water needs for development of Canada's oil and gas industries and the associated conflict with traditional water use. This forum allowed scientists, regulators, lawyers, and laypersons to listen to each other and discuss issues of common concern. The meeting was focused on three themes:

1. Water resources for petroleum exploration and production,
2. Resource Conflict, and
3. Handling and disposal of produced water.

Participants heard new AEUB (Alberta Energy Utility Board) assessments showing that while conventional oil production is decreasing water use, oil sands production shows an increasing trend. Interestingly, it was demonstrated that recent climate variations has had a far greater impact on fresh water resources in Alberta than energy production.

The success of this first «Gussow Conference» has led to adoption of the format by the CSPG with a second meeting being held in March 2005 on Coal Bed Methane.

### The GWP receives letters of support from B.C. and CGWA

The Groundwater Program has received two letters of support from the Ministry of Water, Land & Air Protection of British Colombia and from the Canadian Ground Water Association. The BCWLAP confirms their commitment to support their shared vision with the GW Program respecting groundwater inventory and assessment as described in the *Canadian Framework for Collaboration on Groundwater*. A Memorandum of Understanding is currently under development to formalize their commitment to jointly working with the Earth Science Sector. The CGWA acknowledges the work completed by the ESS and its leadership with its Groundwater Program.

## Advances in Groundwater research

### Isotope geochemistry sheds new light on nitrification in agricultural soils

The team of scientists working on the Nitrogen cycle in Prince-Edward-Island under the leadership of Martine M. Savard has demonstrated for the first time that microbial nitrification takes place all year long in agricultural soils, by using Nitrogen and Oxygen isotopes in seasonal samples of groundwater and surface waters. Previously, the bacterial nitrification of residual soil nitrogen was thought to mostly take place during summer. This scientific finding has important impact on our way to conceive the modelling of nitrate transfer to groundwater and will help make recommendations to support decision making relative to sustainable development of groundwater. Martine Savard has been invited by the Department of Fisheries & Oceans and watershed managers from PEI to present the implications of these findings at the workshop on Ecological Implications of Nutrient Enrichment of Fresh and Coastal Water Systems.

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### Groundwater Book Workshop

On February 17 to 19, researchers involved in the Groundwater Program as well as external stakeholders from provinces and universities participated in a very successful workshop in Quebec City that set the stage for the preparation of a book on the current knowledge in groundwater resources in Canada. The objectives of the workshop were to discuss and reach consensus on the purpose, scope and contents of the book, as well as the intended audience and publisher. The workshop was very successful and consensus was reached on the contents, authorship, and timelines for the preparation of the book.

The purpose of the book will be to provide a science-based overview and a collective understanding of the groundwater resources in Canada to support sustainable use and protection. The scope will be to present the state of knowledge on groundwater resources at the regional scale, and gaps. The book will be aimed at interested public (anyone interested in groundwater), decision makers and science and professional communities.

This major collaborative effort will provide a «comprehensive» compilation of groundwater resources knowledge and information in Canada based on the ESS regional-scale aquifer assessments. Two main deadlines were decided upon; March 2006 to have a detailed and final outline for each chapter with associated authors; and March 2007 to have a completed full peer reviewed manuscript to be submitted to a publisher.

*Participants to the Groundwater book workshop in Québec City. From left to right: Alfonso Rivera, David Sharpe, Miroslav Nastec, Diana Allen, Michel Parent, Mike Wei, Martine Savard, Richard Fernandes, Stephen Grasby, Christine Rivard, Éric Boisvert, Yves Michaud and René Lefebvre.*

Look here for updates in the coming months.

## Laboratories

Last year the Hydro Lab of GSC-Quebec, acquired two new equipments that considerably improved effectiveness in the field. The first item is a 22 KW generator mounted on a trailer with lots of room to carry the pumping gear. This new trailer called the «Pump House», named after our favourite spot in Moncton, can provide three types of currents (600 v 3 phases, 220 v and 110 v) with an autonomy of 80 hours of diesel fuel. It also features two submersible pumps, tripods, a workbench and plenty of room to store tools and other equipments.

*Here is the GSC version of the «Pump House». The ultimate system for 72 hours groundwater pumping test.*

The second item is a set of wheels that complements our GPR unit. This kart is used to carry the 3 sets of antennas for the PulseEkko 100. On a flat surface, it multiplies by 10 the rate of data collection.

*PulseEKKO 100 with its kart and Odometer used on the Abitibi esker project, November 2004*

As reported above, the multi-parameter datalogger, standard dataloggers, and water level probes purchased with funding from AAFC will be available through the Hydro Lab for the Groundwater program teams.

This equipment will be available for the new field season and can be booked in SPS under 'Hydro Lab'. Hurry up for reservation!

## Information Dissemination

### Report from the Walter and Duncan Gordon Foundation

The Walter & Duncan Gordon Foundation has recently completed a study of the framework for groundwater permitting and pricing. Their report is titled: «Buried Treasure – Groundwater Permitting and Pricing in Canada» authored by Linda Nowlan.

In this study, researcher Linda Nowlan examined the current state of groundwater policy across the country. The report compares provincial permitting processes, pricing, public participation in decision-making, and access to information. Three case studies complete the report and include: Groundwater use across Canada, by West Coast Environmental Law. «How well do we understand groundwater in Canada» by Alfonso Rivera (Geological Survey of Canada); and «Pricing policies for groundwater withdrawals» by Sierra Legal Defense Fund.

The ultimate goal of the project is to provide momentum for the development of policy initiatives to improve groundwater management across the country. An Advisory Committee was formed for the project. It includes experts in hydrogeology, groundwater and environmental law and policy, environmental economics, and government regulation, and has representatives from the private sector, federal and provincial governments, universities and NGOs.

Information on this report is accessible at the Foundation's web site at http://www.gordonfn.org . It includes extended abstracts of the three case studies. The full report of the case study by A. Rivera will be placed in the Groundwater program web site in April 2005

## Suggested reading

Starting with this edition of the newsletter, I will be bringing a number of selected references to your attention from among those produced under the program. This time, my reading suggestions relate to the theme of ***hydrogeological characterization***. The next edition I will recommend readings on a different topic. If you are interested in obtaining copies of any of these references, please contact Isabelle Martineau, at (418) 654-2677 or mailto: gscq_bookstore@rncan.gc.ca


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Grasby, G., T. Hamblin, Z. Chen, A. Sweet, G. Stockmal, and P. Wosniak, 2004. **Regional groundwater water study of the Paskapoo Formation, SW Alberta.** Proceedings of the 57th Canadian Geotechnical Conference and the 5th joint CGS-IAH Conference, pp 13-16

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Journeay, J.M., Allan, D.M., Denny, S., Turner, B., 2003. **3-D Geologic Architecture and Vulnerability Mapping in Structurally-Controlled Aquifers, Gulf Islands, BC**, dans: Proceedings of the 56th Canadian Geotechnical Conference and the 4th joint CGS-IAH Conference.

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Nastev, M., Lefebvre, R., Rivera, A., Martel, R. (In Press), **Quantitative assessment of regional rock aquifers, south-western Quebec**, *Canada. Water Resources Management*.

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Rivera, A., 2004. **On the inventory of the groundwater resources of Canada and the concept of sustainable groundwater development**. Proceedings of the 57th Canadian Geotechnical Conference and the 5th joint CGS-IAH Conference , pp 2-9.

Ross, M., Martel, R., Lefebvre, R., Parent, M., Savard, M.M., 2003. **The use of a 3D geologic framework of surficial sediments to define bedrock aquifer vulnerability in the St. Lawrence Lowlands, Quebec, Canada**, dans: Proceedings of First International Workshop on Aquifer Vulnerability and Risk (Salamanca, Mexico, May 28-30, 2003), vol. 1 , p. 157-168.

Russel, H.A.J., Hinton, M.J., van der Kamp, G., Sharpe, D.R. 2004. **An overview of the architecture, sedimentology and hydrogeology of buried-valley aquifers in Canada**. Proceedings of the 57th Canadian Geotechnical Conference and the 5th joint CGS-IAH Conference, pp. 26-33.

Sharpe, D.R, Hinton, M.J., Russel, H.A.J., A. Desbarats, 2002. **The need for basin analysis in regional hydrogeological studies: Oak Ridges Moraine, Southern Ontario.** Geoscience Canada vol. 29, n° 1, pages 3-20.

## Buried Treasure, Liquid Gold

The largest freshwater sources of the planet Earth are found underground. In many cases they cross the boundaries of two or more countries and may be the subject of disputes. Some of the deserts of the world «hide» billions of liters of fresh, pristine, drinking water.
Below is a snapshot of some of the largest freshwater reservoirs (aquifers) of the world. The aquifers may be «alive» (dynamic) and renewable with yearly infiltration from precipitation; or they may be fossil, with water stored in the system for thousands to millions years.

### Note from the Editor to our Partners

It seems as if our Newsletter is having a wide distribution across Canada, as witnessed by the increasing number of readers. Because of this, I would like to extend a special invitation to our partners (provinces and universities) to publish a note, technical or other, in our Newsletter. I wish to expand our Newsletter beyond the limits of our Department to really show the true nature of our collaborative work across Canada; consequently, the notes are not restricted to work conducted under our program. Any groundwater-related note will be considered (photos and figures are welcome).

Please submit your story to Pascale Côté mailto: pacote@nrcan.gc.ca, our Newsletter coordinator, or to myself.

**Aquifers with very large Reserves**

| Name | Area km² | In Storage km³ | In Storage m³ | Exploitation m³/y | Recharge m³/y | % of P | Age (yrs) |
|---|---|---|---|---|---|---|---|
| Nubian Aquifer (Libya, Africa) | 2 500 000 | 1,35 X $10^5$ | 1,35 X $10^{14}$ | 1,5 X $10^9$ | Nil | | 20 000 |
| Great Artesian Basin (Australia) | 1 750 000 | | | 1,6 X $10^9$ | Practically Nil | | 5 X $10^6$ |
| Guarani Aquifer (South America) | 1 200 000 | 4 X $10^4$ | 4 X $10^{13}$ | Minimum | | | Present day |
| Saudi Aquifer (Saudi Arabia) | | | | 7,4 X $10^9$ | Practically Nil | | 33 000 |
| Ogallala, USA | 400 500 | 250 | 2,5 X $10^{11}$ | 7 X $10^9$ | 2,5 X $10^8$ | 5 | Present day |
| Mexico City Aquifer | 3 000 | | | 1,3 X $10^9$ | 7,3 X $10^8$ | 17-34 | Holocene |
| Groundwater in the Great Lakes Basin | | 4 160 | 4,16 X $10^{12}$ | unknown | unknown | | 12 000 |