



Groundwater News

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Editor's Message

Dear Friends and Colleagues, this may be my next-to-last editorial! Maybe...

In six months from now, our groundwater program will complete the 3-year mission for which it was funded in 2003. Come fiscal year 2006-2007, the groundwater program may or may not continue; if it does, it might not be in the same format, with the same vision, same staff and same budget. Unfortunately, as I have learned, the times we live do not allow for long-term commitments. We will have to adapt to new government issues and priorities, and will likely have to share our expertise in other domains (energy, environment, health).

But we are not quite there yet. First, we have to complete a gating process through which our program will be scrutinized to determine whether its "Logic Map" is still the best ESS response to the Public Policy Objectives and priorities of the federal government, or whether some adjustments need to be made.

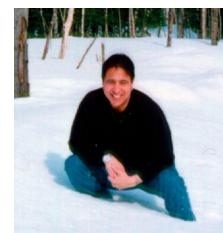
I am confident now that our agenda and main goals of this phase of the program will be completed on time and on target come March 2006. There will be successes to celebrate, as well as promising opportunities to pursue.

Walkerton, water crisis, climate change, land use, droughts, water-energy, water bulk transfers, urbanization, transboundary aquifers... these are all keywords and issues in the front page of every newspaper. They affect the lives of Canadians and they all fall in the domain of groundwater studies. Thus, it would be astonishing to lose ground at the ESS table, if our program was not renewed. I trust that, at the end, the obvious will prevail and our program will continue - perhaps even with an enhanced scope.

It is clear as we look back that we have much to celebrate, and celebrate we will! I am planning the 5th Hydrogeology Day for next winter as a wrap up of our activities of the last three years and to celebrate the science successes of the program. This meeting will be a special one because we will open it to the whole ESS and to our partners; you will find more details in the visibility section below.

The next newsletter will provide details of the new design, scope and vision of the next phase of our program. Hopefully.

Alfonso Rivera
Chief Hydrogeologist and Groundwater
Program Manager



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"Gating" of the Groundwater Program

Gating of most ESS programs will take place over the next few months. The GW program will be scrutinized to determine whether its Program Logic Map is still the best ESS response to the Public Policy Objectives and priorities of the federal government or whether some adjustments need to be made.

The GW Program is part of the ESS response to a range of Environment and Health issues facing Canadians and which need to be supported by Earth Science knowledge and information. Daniel Lebel, Director of GSC-Quebec is responsible for updating the strategic framework within which ESS programs can contribute, where appropriate, to Environment and Health related issues. This strategic context will form the basis of any adjustments that may need to be made to ensure that the GW program, together with the Metals in the Environment (MITE) and Legislated Environmental Resource Assessment (LERA) programs continue to be the best ESS contribution to public policy objectives. The results of this process are due in the fall with any changes to be initiated April 2006.

A group formed by the three "Environment and Health" Program Managers (Alfonso Rivera, Margo Burgess and Andy Rencz), together with Mark Williamson, Director of the Environmental, Safety & Security Portfolio, Programs Branch, is providing support and recommendations to Daniel Lebel to prepare the E&H logic model to be submitted to EXCOM (ESS Executive Committee).

Advances in groundwater research

Groundwater book next steps

In our last Newsletter (March 2005), I wrote about a major initiative to prepare a comprehensive book on the groundwater resources of Canada, in association with our partners, the provinces and universities. Since then, we have consolidated lead authors and co-authors of the book chapters, the book content, as well as the book design. A second workshop is scheduled next winter to complete the planning process and begin preparation of the chapters. We have planned to begin writing the chapters in April 2006 in order to have a full manuscript of the book by March 2007 for submission to the publishers. Stay tuned! If you wish to know more on this initiative, please contact me directly.

New Book on the World's Water

Peter H. Gleick et al. 2005. *The World's Water 2004-05: the Biennial Report on Freshwater Resources*. Washington, D.C., Island Press.

For over a decade, Peter H. Gleick, president of the Pacific Institute for Studies in Development, Environment, and Security based in Oakland, California, has been editing a book series on the world's water. Produced biennially, *The World's Water* provides a timely examination of the key issues surrounding freshwater resources and their use. Each new volume identifies and explains the most significant current trends worldwide, and offers the best data available on a variety of water-related topics. *The World's Water* is the most comprehensive and up-to-date source of information and analysis on freshwater resources and the political, economic, scientific, and technological issues associated with them. It is an essential reference for water resource professionals in government agencies and nongovernmental organizations, researchers, students, and anyone concerned with water and its use. For the first time in a decade, this 2004-2005 edition features one chapter on groundwater Issues: Chapter 4: "Groundwater: The Challenge of Monitoring and

Management" authored by Marcus Moench. This reflects, I think, the growing worldwide importance of groundwater.

According to this new publication, the average annual groundwater recharge in Canada is 370 cubic km (see table 3 below for the 3 NAFTA Countries). Supposedly, this is the sum of all groundwater flows, including base flow (as a constituent of surface water flow). I wrote to the authors and found, surprisingly, that most data relative to Canada are from external sources! For instance, the groundwater recharge numbers are extracted from an international database "Earthy Trends" maintained by the World Resources Institute. Whereas the sector share of groundwater use data in Canada is cited as a French source (Margat, 1990)! This huge number of 370 cubic km of annual recharge dramatically dwindles the overall groundwater extraction in one given year of approximately 1 cubic km (Statistics Canada 2004). However, it would be inappropriate to use that large value as a measure for evaluating the sustainable use of groundwater resources of Canada.

For comparison, the table below shows annual recharge for some of the regional-scale aquifers we have studied in our program, estimated at about 0.6 cubic km:

	Surface	Exploitation	Recharge		
Regional scale aquifer	(km ²)	(m ³ /y)	(m ³ /y)	(mm)	% of P
Carboniferous Basin-Moncton	11000	5.00 X 10 ⁷	1.40 X 10 ⁸	130	10
Lowlands Quebec	1500	1.80 X 10 ⁷	8.50 X 10 ⁷	70	8 to 9
Portneuf	525	3.3 X 10 ⁶	1.30 X 10 ⁸	250	
Oak Ridges Moraine	2500		8.75 X 10 ⁸	350	
ORM Lower Sediment	11000			200	
Gulf Islands, B.C.	475			104-528	
Châteauguay	2500	1.50 X 10 ⁷	2.00 X 10 ⁸	80	9
Annapolis	1600	1.47 X 10 ⁸		245	30
TOTAL			5.6 X 10 ⁸		

Table 1: Annual recharge for some regional-scale aquifers.

As we advance with our national inventory of the groundwater resources of Canada, I hope that perhaps one day we will be able to provide updated and more precise numbers ourselves.

And how do we compare with other countries in groundwater use? Below is a list of selected countries ordered with increasing amounts of groundwater use.

km ³ /year	Groundwater use in :
1	Canada
6	Spain
40	Western Europe
50	Mexico
75	China
110	USA
250	India
1000 km ³ is the approximate amount of the global groundwater abstraction in the world. It represents 1.5% of the world's annually renewable freshwater supplies, 8.2% of annually renewable groundwater and 0.0001 percent of global GW reserves estimated to be between 7-23 million km ³ .	

Table 2: Other numbers in the world (From Shah, 2004).

	Average Annual Groundwater Recharge		Annual Groundwater Withdrawals						
	Total (km ³) Years vary	Per Capita (m ³) Year 2000	Year	Total (km ³)	% Annual Recharge	Per Capita (m ³)	Sectoral Share (percentage)		
							Domestic	Industry	Agriculture
Canada	370,0 c	11,879	1990	1.0	0.3	37.3	43	14	43 ff
United States	1514,0	5,439	1990	109.8	7.3	432.3	20	5	62
Mexico	139,0 c	1,406	1995	25.1	18.1	275.4	13	23	64

c : Sum of all groundwater flows, including base flow (as a constituent of surface water flows).

ff : Sectoral data for Canada are calculated using a groundwater withdrawal value of 1.6 km³ from 1985 (Margat 1990)

Table 3: Groundwater resources for the 3 NAFTA countries

Finally, the two tables below show numbers for bottled water consumption in the NAFTA countries and a comparison with other regions of the world. It is interesting to note the large increase in bottled water consumption in North America in the last 6 years (40% for Mexico, 62% for the USA and 189% for Canada!), whose origin is essentially from groundwater.

Country	Year (thousand cubic meters)					
	1997	1998	1999	2000	2001	2002(P)
United States	14,362	15,635	17,348	18,563	20,535	22,893
Mexico	10,484	10,883	11,579	12,424	13,244	14,767
Canada	541	651	754.6	848	938.6	1,027

P : Preliminary

Table 4: Bottled Water Consumption, NAFTA Countries, 1977-2002

Region	Year (Thousand cubic meters)					
	1997	1998	1999	2000	2001	2002(P)
Europe	34,328	36,074	39,367	41,507	43,546	45,955
North America	25,398	25,822	29,932	32,338	34,87	38,707
Asia	12,472	14,82	17,647	21,17	24,824	29,783
South America	5,484	6,362	7,31	8,508	9,903	11,432

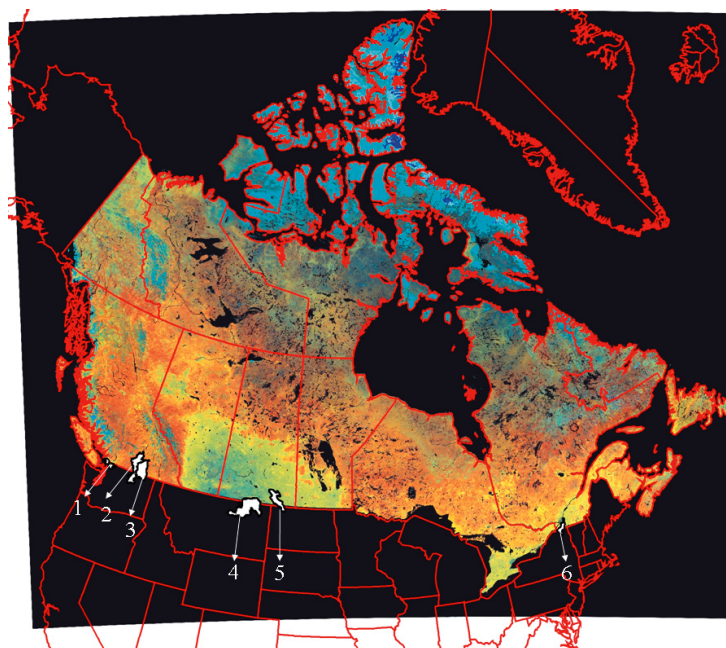
P : Preliminary

Table 5: Global Bottled Water Consumption, by region, 1977-2002

WHYMAP'S new map

WHYMAP (World Hydrogeological Mapping) is an international project funded and supported by UNESCO, IAH and various other international groups. It is led by BGR (German Geological Survey) and its main objective is to create a map of the groundwater resources of the world at the scale of 1:50 million (Special Edition, August 2004). I was invited to be a member of the WHYMAP Steering Committee in 2004 and since then I have tried to provide information on groundwater in Canada. A pdf file of the latest version of the map, and additional information on this project can be found at: <http://www.whymap.org>

One of the latest decisions of the WHYMAP Steering Committee was to prepare a global map of trans-boundary aquifers, to be published in time for the 4th World Water Forum in Mexico City, March 2006. I collected, summarized and provided existing information on 6 transboundary aquifers between Canada and USA (see map below). Some data are from our own assessments, other are provided by some of our main partners. I will appreciate input from our partners on other transboundary aquifers that should be added to this map.



Canada-USA transboundary aquifers :

- 1 - Abbotsford-Sumas, British Columbia / Washington State
- 2 - Okanagan-Osoyoos, British Columbia / Washington State
- 3 - Grand Forks, British Columbia / Washington State
- 4 - Poplar (Eastend to Ravenscrag), Saskatchewan / Montana
- 5 - Estevan - Saskatchewan / North Dakota
- 6 - Châteauguay, Quebec / New York state

Visibility/Outreach

Hydrogeology Day n° 5

The 5th Hydrogeology Day is now in the planning process. We should hold this event in the middle or end of next winter and it will be opened to the whole sector and to our partners from the provinces and universities to celebrate the program's successes.

The event will be organized as a 2-day workshop. We intend to showcase the main outcomes of our program during the last 3 years, including up-to-date knowledge on Canadian key aquifers, what we have learned, and what we now know compared to our knowledge gaps of five years ago. But, this time we will not only present our scientific results, we will also show how this knowledge is transferred and where this knowledge can be easily found through our interactive National Groundwater Database. So, stay tuned! External stakeholders should contact Pascale Côté for more information and early registration.

International Workshop on Groundwater Governance and Management

This workshop was held in Cairo, Egypt, April 3-8, 2005. A. Rivera presented a keynote talk entitled "Overview of Groundwater in Canada: Perspective of Data & Information" and chaired the session on "Groundwater Information and Access". This workshop sought to discuss and debate on international practices, sustainable development and Integrated Water Resources Management (IWRM) principles. The term "*Triologue*" was coined, which represents a three-party dialogue: Government, Society and Science, as well as the recognized need for as many interfaces between the three. The workshop had provided opportunities to present work from the ESS Groundwater Program and discuss current and future management of groundwater data and information, one of the main objectives and vision of the current ESS Groundwater program.

International Association of Sedimentologists

David Sharpe and Hazen Russell attended a 6-day field study of the coastal alluvial plains of Iceland, August 15-21, 2005, as part of a conference on Glacial Sedimentary Processes and Products in Wales. This is significant because present day physical earth processes in Iceland are very good analogues for an important set of aquifer systems under assessment in southern Ontario and other parts of Canada. Process analogue models (e.g. Anderson, M.P., 1989) are an under-utilized aspect of groundwater assessments in Canada and they require improved development to provide sustainable groundwater supply to Canadians reliant on groundwater systems in glacial sediments. For example, "*Jökulhlaup*" is an Icelandic term derived from the words "*jökull*" (glacier) and "*hlaup*" (literally meaning sprint or burst). "*Jökulhlaup*" events involve a sudden release of meltwater from a glacier, and in Canada, such events formed coarse aquifer sediments found in tunnel channels and stratified moraines.

The Wales conference and local trips, August 21-28, was attended by some 120 presenters, including Russell and Sharpe. A number of talks highlighted the impact of technology, notably, marine swath bathymetry, 3-D seismic, and GIS analysis on understanding glacial landforms and sedimentary systems. Of particular interest to the Groundwater Program were talks on buried valleys (bedrock and sediment-hosted tunnel valleys), and sedimentology. Talks related to buried valley aquifers detailed both the geometry and sediment fill of tunnel valleys. Tunnel valleys are of significance in Denmark, Germany, and the Netherlands for ground water resources. Improved aquifer delineation and characterization is being aided by the use of 3-D seismic data to study the complex geometries in tunnel valley networks. Fieldtrip participation also improved understanding of aquifer geometries and heterogeneity for ongoing work in southern Ontario. Overall, the conference illustrated the application of 3-D geological mapping techniques to buried valleys and the importance for understanding aquifer geometry and inter-aquifer connectivity.

Potential Canadian-American cooperation in Groundwater Monitoring Networks

The Groundwater program was invited to participate in a joint USGS – MSC (Meteorological Service of Canada) discussion towards the preparation of a Memorandum of Cooperation for sharing of hydrological practices, procedures and technology, including exchange of data, modelling and monitoring of groundwater.

A workshop organized by the USGS to discuss these issues, was held in New Orleans on February 23 to 25. The GW program was invited to participate in the discussions and Yves Michaud attended on our

behalf. Alfonso and Yves prepared a presentation on the current state of groundwater monitoring in Canada and the current regional-scale studies.

Laboratories

An initiative is presently underway to operate ESS scientific labs in a manner that better coordinates with the issue driven process. This implies restructuring some 20 facilities into 6 thematic labs:

- PaleoLab – Art Sweet (GSC-C)
- Isotope Geochemistry and Geochronology Group – Bill Davis (GSC-CCD)
- Organic Geochemistry and Petrology – Vern Stasiuk (GSC-C)
- Environmental Geochemistry and Sedimentology – Yves Michaud (GSC-Q)
- Analytical Chemistry Research Laboratories – Conrad Grégoire (GSC-CCD)
- Mineralogical and Physical Properties Laboratories – Jeanne Percival (GSC-NCD)

The lab leaders will report to Mike Villeneuve (GSC-CCD), who will conduct an evaluation on the operation of lab facilities, for implementation in 2006-2007. The study will focus on the level and source of services, the need to rationalize, and the evaluation of demand. This approach has been presented to the GSC management committee on September 9 and will soon be submitted to ESS Excom.

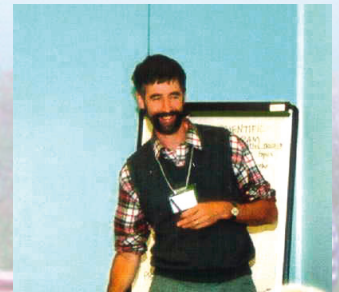
If this initiative is approved, it is expected to have a positive impact on services to programs since it would diminish the current burden of coordination, costs and location of specific services, sometimes a real puzzle for project leaders and managers alike. The new structure would have a proper corporate-wide planning, it would be results-delivery driven, and it should be more in tune with the issues-driven programs, which since 3 years now, operate horizontally across the organization. Note that this reorganisation does not involve the hydrogeology laboratory which will continue its current way of operation.

People in the news

2005 Robert Farvolden Award

The *Robert N. Farvolden Award* is given jointly by the CGS (Canadian Geotechnical Society) and IAH-CNC (International Association of Hydrogeologists -Canadian Chapter) to honor outstanding contributions in the discipline of Earth Science and Engineering that emphasize the role and importance of groundwater. The recipient of this year's *Robert N. Farvolden Award* is Dr. Garth van der Kamp. His nomination is a recognition of his long-standing involvement in the development of hydrogeology in Canada and for his internationally recognized and varied scientific contributions. In selecting Dr. van der Kamp, the committee recognized his handling the torch of Canadian hydrogeology for so many years while the importance of groundwater resources was not recognized as it is today.

Dr. van der Kamp's has provided advice to the Geological Survey of Canada during the early years of hydrogeological characterization of regional-scale aquifer systems back in the 90s. The award was presented to Dr. van der Kamp during the 58th Annual Canadian Geotechnical Conference and 6th Joint CGS & IAH-CNC Groundwater Specialty Conference in Saskatoon, September 19, 2005. Bravo Garth!



Groundwater expertise at INRS

Through a collaborative agreement between the Geological Survey of Canada and the "Institut national de la recherche scientifique (Université du Québec)", INRS professors René Lefebvre and Richard Martel were instrumental in developing 2 of the first GSC hydrogeological studies, namely the Laurentian Piedmont hydrogeological characterization and the fractured aquifer study in the St. Lawrence lowlands of southwestern Quebec (http://www.nrcan-rncan.gc.ca/media/archives/newsreleases/2002/2002131a_e.htm). Their expertise, collaborator network and broad student base were crucial in establishing the GSC mandate in groundwater studies and remains an asset in activities conducted under the current program, such as the Châteauguay, Abitibi Esker and Canadian military bases. Dr. Claudio Paniconi is also a professor in hydrogeology who joined INRS in 2003. He is a collaborator to the Annapolis-Cornwallis Valley Aquifer study where he contributes his expertise in surface and groundwater modeling and simulation.



Left picture: Richard Martel (left) and René Lefebvre (right) receiving INRS 2002-2003 Excellence Award.



Right picture: Claudio Paniconi

Well received talk in Nova Scotia

Dr. Christine Rivard (leader of our Annapolis-Cornwallis project, N.S.) was invited to present a conference at the K.C. Irving Environmental Science Centre Auditorium of the Acadia University on July 27, 2005. This presentation was part of a series of conferences aimed at introducing environmental projects conducted in the Annapolis Valley, to enlighten professors, students, local consultants, and interested residents. This type of conferences allow people from various horizons to be aware of what is being done in the region, and to encourage joint efforts to carry out such very important studies. The presentation was very well received, and it raised a high degree of interest amongst the different groups who attended the conference. Dr. Rivard was invited to return to the area, after the end of the project, to provide a more accurate synthesis and knowledge of the groundwater project in the region.

Suggesting readings

My reading suggestions for this edition are in relation with the theme of **water resources management**, with emphasis in groundwater. My list includes either internal publications (Earth Sciences Sector), or external publications in relation to groundwater resources:

sustainability and vulnerability concepts; use and overexploitation; and linkages with environment, social and political issues. If you are interested in obtaining copies of some of these references, please contact Isabelle Martineau, at (418) 654-2677 or Email to: Isabelle.martineau@nrcan.gc.ca.

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