

WORDS OF WATER WISDOM

A Q&A with Robert (Bob) Sandford.

Bob Sandford can carry on one fascinating conversation about water. He is the author of five books on the subject, with a sixth slated for publication in October.

by JULIE FITZ-GERALD

Sandford is also the EPCOR chair of the Canadian Partnership Initiative in support of the United Nations' Water for Life Decade, sits on the advisory board of Living Lakes Canada, and is a member of the Forum for Leadership on Water (FLOW). This Canmore, Alta., resident spent time on the telephone with *Ground Water Canada* to discuss the changing hydrological cycle and how it will affect Canadians and water well drillers.

Bob, have you always been intrigued by water or did something in your life spark this passion?

The first backpacking trip that I ever did was over the Columbia ice field when I was 20. The accident happened while we were descending the Saskatchewan glacier on the second day. I was so tired I'd given up trying to avoid the

big melt water streams that course across the glaciers surface. Seeking to take a direct line, I trekked across one of these and of course the water picked me up and carried me to the mouth of a huge crevasse. One moment I was looking in the splashing water and the next I was in the centre of a waterfall plunging into complete darkness beneath the ice. I have to say that never before or since have I ever heard from everywhere around me so many of the different sounds that water makes. There was only a few inches that separated the top of the water and the roof of the ice and in the darkness. I kept scraping against the underside of the glacier, but just as shock and wonder were beginning to evaporate, just as calm was about to become sheer terror the strangest thing happened. The ice above me began to glow. At first it was a faint green and as the

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river swept onward the glow intensified and gradually green merged into a pale blue and then I noticed that rocks were hanging out of the ceiling made entirely of light. Then I was washed out of the glacier into the full flood of the Saskatchewan River. So that was my initial inspiration to work with ice and water; that's why I continue to work on glaciers and continue to be reminded of how the hydrological cycle works and what a wonder it is.

What has it been like to be involved in the Canadian Partnership Initiative for the UN's Water for Life Decade?

The first and most important thing I must tell you is that it has been an honour and a great privilege to work with some of the very best water scientists in this country. It's through them and by way of their co-operation and sharing that I have been granted information and perspectives that have allowed our initiative to have some success and it's because of their commitment, their sharing, taking the time to teach me what I need to know about these often complicated water matters that has been the foundation of my work. Our goals are really threefold. We want to dispel the myth of limitless abundance of water in Canada. We want to translate scientific research outcomes into language the average Canadian can understand and that decision-makers can use to craft timely, enduring public policy and the third thing that we want to do is to bring international example to bear on Canadian water issues. So those are the three goals.

With respect to the flooding that's been taking place in various Canadian cities, is this something that we should expect to see more of?

This is one of the most important questions we should be asking in this country right now. The flooding in Calgary, Ontario and Manitoba should be viewed collectively as a 911 for every level of government in Canada and when supposed experts tell you not to worry because the earth has experienced higher concentrations of carbon dioxide and warmer temperatures in the past, what they don't tell you is that during those epochs, extreme weather events lasted for days and even weeks. We're

discovering evidence that increasing temperatures are accelerating the manner and rate at which water is moving through the global hydrological cycle. The evidence is now widely enough available for us to begin to connect the dots with respect to Canada's changing hydro-climatic conditions.

This is the point I really want to make: warming is causing the post glacial hydrological wealth of Canada to move to a different place in the hydrosphere and this is VERY interesting because we see clear evidence of this in Canada's western mountains where I live and in the domain which we have been examining glaciers for some time. We now know that we've probably lost as many as 300 glaciers in the Canadian Rockies in the last 85 years and we have good evidence that this is probably accelerating. The snowpack and snow cover patterns are changing and then you begin to look at what else is happening. This Lake Huron thing is really problematic for us as well. It's the second largest of the Great Lakes, a landscape relic left behind from the last major glaciations. Based on September averages, water levels of Lake Huron have declined by 115 centimetres between 1997 and 2012. Some say that it's the dredging of the St. Clair River outlet that plays a role, but we've also noted that these declines in water level are also related to a decline in the amount of precipitation falling as snow as opposed to rain in winter and also a decline in the extent and period during which the lake is frozen during winter and a trend toward greater evaporation brought about by higher atmospheric temperatures. So the same warming that's causing the Arctic to change is also causing water in the Great Lakes region to move to a different place in the hydrological cycle. Research suggests that as much as 67 cubic kilometres of water may have disappeared from that part of the Great Lakes system since 1997.

So where is all this water going?

Well, one of the places that it's going is into the atmosphere where it becomes available to fuel more frequent and intense extreme weather events. It's becoming very clear that rising temperatures and the increasing concentration of atmospheric vapor

are making what once were predictable natural events a lot worse. The algorithm upon which this assertion rests is called the Clausius-Clapeyron relation. It's one of the basic tenets of atmospheric science and establishes that the amount of water the atmosphere can hold increases by about seven per cent per degree Celsius. We know now that Canada is 12 per cent wetter on average than it was in the 1950s and more severe weather events are already a reality. We're seeing stuff out there that is just staggering, things like atmospheric rivers that we can see with satellite imagery, these huge volumes of water vapour aloft that can deliver between seven and 15 times the annual flow of the Mississippi upon contact with land or with cool funnel systems. So the big deal here is that our hydrology is changing and the hydrological cycle is becoming more energized and that is one of the elements contributing to increased flooding.

What kind of an effect will flooding have on Canadians in general and on the water well drilling industry?

There really is potential in some of these circumstances for aquifers to be recharged, depending on where they are. Looking at the Great Plains, we've observed an increase in precipitation, but it's not straightforward like you'd think. The pattern of rainfall is changing. Historically most rain came to an area from thunderstorms. A thunderstorm would rise up out of a hot prairie in the afternoon and maybe dump for a few hours and the water would improve soil moisture and recharge aquifers. What we're seeing now is that the systems are more often frontal and last for days. They bring a lot more precipitation and they mobilize up to 10,000 times more E. coli from manure and farmers fields, so you've got two elements here that you're going to have to be more cautious about with relation to contamination of wells. On the other hand, you may see some positive regeneration of or recharging of some aquifers. People who are on wells are going to have to be more cognizant that these longer-term events could produce situations where contamination is more possible, so diligence is definitely required.

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Are there any foreseeable issues that water well drillers in Canada should be bracing for in the coming years?

I just wish to say that I'm deeply concerned about ground water in Canada. First of all, we have contaminated aquifers from coast to coast to coast in this country. We have widespread ground water problems and one of the things we're trying to make very clear to governments is that it costs between 35 and 200 times more to remediate ground water contamination than it does to prevent it.

We need to do everything we can in this country to reduce the threat of ground water contamination because in 50 to 60 years from now when our population is much bigger and our reliance on ground water is greater, if we reach down there and we've contaminated these places, we will never be able to forgive ourselves. Now is the time to become very serious about ground water protection.

What needs to be done to help the situation?

First of all, we need accurate ongoing monitoring and also, accurate ongoing ground water mapping. We need to pay close, close attention to issues like fracking. We need to understand exactly what's happening with increasingly complicated substances that we find in agricultural runoff, because we're ending up with pharmaceuticals and stuff like this, so we need to pay very close attention. I'm not saying that's a serious problem yet, but it's certainly on our radar. We also have to start managing surface and ground water conjunctively. Surface and ground water is the same water and we keep managing ground water as if it's separate. We need to have better integration and conjunctive management of both surface and groundwater. It's going to require that municipalities and rural districts think carefully about that relationship and it's also going to require new and more earnest ground water protection legislation provincially and federally.

What kind of role do you see water well drillers having?

I think water well drillers have a responsibility, because of their knowledge, to communicate as much as they can about the well situations that they're creating and servicing. Also, I think it's very important that well drillers help those they serve to understand how to properly maintain wells so that they can minimize the risk of contamination. Also, I would really like them to be able to communicate whether or not these areas are effectively mapped so that we can start putting pressure on governments to make sure that this mapping is adequate and ongoing. Just to sustain that passion they have for understanding and sharing information about water, that's helpful to everybody.

This interview has been edited and condensed.

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