3 Searching the Waters — the Water Crisis

Dr. David Schindler greets you with a firm handshake and a warm smile. No lab coat, you might notice, or thick glasses, pliers, or pocket protector; just jeans, a green shirt, and, as one writer put it, "farmer's hands and wrestler's muscles."[1]

Cold winter light filters through the window of his office at the University of Alberta. On a crowded bookshelf sits a yellow plastic piggy bank labelled "Research Funds." Inside is a paper coin with "$1 million" written on it — a gag gift from his research students, he says.

But Schindler's work is no joke. Neither is the piggy bank; that coin represents a fraction of the funding he's received for his research into the boreal forests and lakes of Canada. Schindler is one of the world's most distinguished freshwater ecologists. His work on acid rain forced the Canadian and American governments to pass a string of fish-saving and water-cleaning legislation, and his studies of Ontario lakes pushed manufacturers to remove phosphates, a common pollutant and fertilizer, from laundry and dishwasher soaps.[2] So when he sounds the alarm on the state of Alberta's rivers, people listen.

Schindler isn't the only one worried about Alberta's waters. Scientists have been raising red flags on the subject for years, but it's only recently that people in high places have started

noticing them. “Today, [Alberta Premier] Ralph Klein will actually respond to my letters when I write to him . . . instead of phoning up the [U of A] president and telling him to fire me!” laughs Schindler.

He hands over a copy of his latest study, which examines changes in the summer flows of Alberta’s rivers. “We found big declines in pretty much every river in Western Canada we looked at,” he says. Flows in the Athabasca River in the north, for example, have fallen 30 per cent since the ‘70s, and flows in the North Saskatchewan were down 40 per cent relative to 1912, the first year Environment Canada started tracking them. “This is the worst case,” Schindler says, pointing to a downward-curving line graph, “the South Saskatchewan. It’s currently flowing at about 15 per cent of what it was at the beginning of the century [1900].”[3]

Other scientists have confirmed Schindler’s results. For various reasons, North America’s rivers have withered over the last century: one study of annual flows found that 21 out of 26 major rivers on the continent, including the North Saskatchewan and six other Alberta rivers, showed statistically significant declines in flow since the early 1900s.[4] Another review of rivers in northern Canada found that their flows to the Arctic and Atlantic oceans had dropped 10 per cent from 1964–2003, and warned that this could disrupt ocean currents critical to maintaining the north’s climate.[5] Alberta Environment released what is probably the most conservative of these studies in 2004. While its study did not spot any clear trend in the province’s rivers, it did find that six of the nine rivers it studied appeared to be on the decline in recent years.[6]

Shrinking Supplies

There are two reasons for the state of these rivers, and their names are supply and demand. The world does have a lot of water — about 1.4 billion cubic kilometres of it, or enough

to submerge the planet to a depth of three kilometres when spread evenly over its surface.[7] But that's a misleading number; it includes absolutely all the water on Earth, and people can't use most of it. You can't drink salt water in the oceans, for example, or ice and snow in icebergs, or vapour in clouds, or water held deep underground or in plants and animals. Subtract all that, and you end up with 90,000 cubic kilometres of fresh drinking water available from lakes, rivers, and aquifers — just 0.026 per cent of the total. This, then, is the water people have to work with. This amount of water would submerge the earth to a depth of 1.82 meters if spread evenly on its surface — shallow enough for some basketball players to stand in without getting in over their heads. If you somehow fit the world's water in a five-litre container, available water supply would barely fill a teaspoon.[8]

What's more, most of that freshwater is out of reach. Canada has about 94,300 cubic meters of water per person available per year, which is way above the UN minimum human health requirement of 1,700, making it the 11th wettest nation per capita on Earth.[9] Thing is, half of that water flows north to the Arctic, away from where four-fifths of Canadians live in the south. The distribution is even worse in Alberta, where just 0.1 per cent of freshwater flows go south to Calgary and its mega-farms while 87 per cent goes north to uninhabited forests.[10]

Most of the water we can reach, we pollute. Sewage from the City of Edmonton and surrounding municipalities (including St. Albert and much of Sturgeon County) raises the level of waste-borne bacteria like *E. coli* in the North Saskatchewan River about 32 times.[11] Silt dumped by St. Albert's storm sewers creates land-bridges across the Sturgeon, blocking fish and raising the river's peak flood level by about 10 centimetres.[12] And according to Alberta Environment, agricultural runoff adds so many nutrients and bacteria to rural streams and irrigation canals that most are in violation of provincial water quality guidelines.[13]

And as for the water we don't pollute, we can only legally grab so much of it. The 1909 Boundary Waters Treaty restricts Alberta to taking three-quarters of the flow of the St. Mary and Milk rivers (the rest goes to the U.S.), while the 1969 Master Agreement of Apportionment requires that the province let half the flow of the North and South Saskatchewan rivers and eight others flow over the border to Saskatchewan.[14]

The world has a lot of water. We humans, unfortunately, don't.

Rising Demands

We do, on the other hand, have a lot of demand. Overall demand for water has sextupled since the 1960s.[15] Hydrologists estimate that we are currently using 54 per cent of the world's available freshwater, and will use 70 per cent by 2025.[16]

We're also using more water per person, and adding to that total number of persons. Researchers say there'll be an additional 2.6 billion people on the planet by 2025. By one estimate, we'll need about 1,040 billion cubic meters of water to grow the necessary food for those people, or about 12 more Nile Rivers. Where all this water is to come from on a sustainable basis is anyone's guess.[17]

And we're concentrating this new demand in already dry regions. The South Saskatchewan basin, for example, is already over-allocated, meaning that the province has licensed people to use more water than actually exists in the region once you account for water needed for future growth and natural ecosystems. Yet due to the booming Alberta economy, the government expects the region's population to more than double by 2021 and water demand to rise by 47 per cent.[18] The demand situation is so bad that the province has taken the unprecedented move of banning all new water licenses in the region.[19]

Why Not Move the Water?

Alberta could solve the south's water shortages by moving water from the north, but the financial and ecological costs would be huge.

The Social Credit party proposed to do this in the '60s with its Prairie Rivers Improvement Management and Evaluation, or PRIME, program. The scheme would have diverted the Peace, Athabasca and McLeod rivers into the North Saskatchewan and the Sturgeon, which would then be diverted south to the Red Deer River. The cost? $1 billion in 1969, and by one estimate over $70 billion today (Struziuk and Brooymans).

Ecologically, such a diversion would almost guarantee the transfer of fish, plants, and parasites between watersheds, creating fox-in-the-henhouse situations where newly introduced species run rampant due to lack of natural predators. For example, zebra muscles introduced to the Great Lakes have reproduced so wildly that they're damaging pipes and ships, costing the U.S. $3 billion a year in repairs (Reeves).

Instead of moving water to people down south, say some scientists, we should move people to the water up north. Stewart Rood, professor of biological science and co-director of the Alberta Ingenuity Centre for Water Research at the University of Lethbridge, suggests it's cheaper in the long run to move Alberta's beef and forage farms north to water-rich regions (like the Sturgeon) than it is to build more dams and canals (Struziuk).

The Heat Is On

Climate change adds a whole new dimension to the supply and demand situation. Scientists predict that rising levels of atmospheric carbon dioxide will raise the average temperature of the Earth by 1–5ºC by 2100, radically altering the world's climate.[20] According to computer models, this will mean a hotter Alberta, one with more evaporation, less winter snowfall, less precipitation, and more droughts.[21] A recent study by Schindler and Donahue found that Alberta has already warmed 1–4ºC over the last century, and that parts of the province had 14 to 24 per cent less precipitation than they did in the 1920s, while none had more.[22]

Albertans will first feel the heat when they run out of ice, Schindler says. Rocky Mountain glaciers provide much of the water in Alberta's rivers. Add too much heat, however, and those glaciers melt faster than they can be renewed by snowfall. This is already happening, he says. The glaciers that fuel the North Saskatchewan have receded almost two kilometres since

the early 1900s, and scientists have noted big declines in its glacial flows since the mid-'50s.[23] "The Bow [River] glacier is clearly over the hill," Schindler says. "It can't supply any more water than it already is." Twenty-seven per cent of that glacier has vanished since the '50s, he says, and at this rate, it could disappear entirely in 40 years. That would be disastrous to the south — in dry years the glacier accounts for almost half the water in the Bow River, Calgary's source of drinking water.[24]

When those glaciers go, Schindler says, Alberta will have a water crisis of unprecedented proportions on its hands. "When the ice and the snow is gone in the headwaters and evaporation goes up . . . that's going to be the combination that kills us," he says, casually.

A Watershed Moment

This, in a nutshell, is the situation Alberta and the people of the Sturgeon face: decaying rivers, limited water, and unlimited demand. To deal with it, the Alberta government is turning to a concept that's existed for well over a hundred years: watershed management.

A watershed or basin is an area of land that drains into a single body of water. It can be as small as a park around a pond or as big as a continent — you can divide the whole Earth into two giant watersheds, the Atlantic/Arctic and the Pacific/Indian Ocean regions, if you like.

Watershed management is a scheme popularized by the Americans in the late 1800s, says Ernie Ewaschuk of the Land Stewardship Centre in Alberta. In 1878, John Wesley Powell, a one-armed Civil War veteran and explorer, laid out a scheme to populate the west without having settlers fight over scarce water. His plan was simple: people who lived in a watershed would share the water in it amongst themselves. The government would enforce this by forbidding any inter-basin transfers of water; so long as people couldn't steal water from other areas, they would

have to share it with their neighbours. The U.S. government discarded his plan in favour of a massive irrigation network, but today, says Ewaschuk, watershed management is coming back into favour.

A successful watershed management plan works like this. First, you figure out how much water you have and what condition it is in, cataloguing how you're using and abusing it. Next, you decide, as a community, how you want to use and protect your watershed in the future. This leads to a water budget that doles out water in a way that everyone agrees with and that doesn't destroy the supply in the future. Last, you implement the budget using various voluntary and legal controls (mostly land-use regulations), updating it as needs and conditions in the watershed change. Water for Life will create a series of Watershed Planning and Advisory Councils to make these management plans, and the province will later implement them.

The South Saskatchewan basin is pretty far along in this process, and the North Saskatchewan has just started it. Now it's the Sturgeon's turn. In these next few chapters, we'll survey the length and breadth of the Sturgeon to discover how farms, industries, and cities depend on the river to survive, and what they can do to protect it.

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[1] Andrew Nikiforuk, "Schindler's Warning: Will It Be Heard?" *Globe and Mail*, 24 February 2000, R5.

[2] See "Eutrophication and Recovery in Experimental Lakes: Implications for Lake Management" in *Science* 24 May 1974: 897–899 for an early example of this research. Phosphate is the naturally occurring form of phosphorous, an element.

[3] Schindler and Donahue, 7211–7212.

[4] Stewart B. Rood et al., "Twentieth-Century Decline in Stream Flows From the Hydrographic Apex of North America," *Journal of Hydrology* 306 (2005): 227–230.

[5] Stephen J. Déry and E.F. Wood, "Decreasing River Discharge in Northern Canada," *Geophysical Research Letters* 32 (2005), 3–4. Ocean currents move warm water around the world through a process called thermohaline circulation, also known as the global thermal conveyor belt. Salt water warmed at the equator travels north, cools, gets denser and sinks, circulating the ocean waters and keeping parts of Europe warmer than their latitude would normally permit. Scientists fear that global warming and

freshwater flows to the Arctic Ocean will change the density of water in the Arctic, bringing this cycle to a crashing halt. If that happened, Northern Europe's winters would be about 12–24ºC cooler than normal, turning Iceland into an uninhabitable iceberg and Norway into a land like Siberia (Suplee). The science-fiction film *The Day After Tomorrow* portrays a world where the belt has shut down, burying Manhattan in snow, but abruptly, which was the unreal part.

[6] Michael Seneka, "Trends in Historical Annual Flows for Major Rivers in Alberta," Edmonton, Alta.: Alberta Environment 2004, 14–20.

[7] Babkin and Klige, 13; de Villiers, 28.

[8] de Villiers, 29.

[9] World Water Assessment Program, *Water for People, Water for Life*, UNESCO: Berghahn 2003, 11, 70. Greenland has the most water per head at 10,767,857 cubic meters a year. The United States comes in second with 1,563,168 cubic meters, falling to 78th place if you exclude Alaska.

[10] Karen Wilkie, "Balancing Act: Water Conservation and Economic Growth," *Building the New West Report* 40 (2005), 6–7. The remaining 13 per cent flows east to Saskatchewan.

[11] Faecal coliforms are bacteria (like *Escheria coli*, which killed seven people in Walkerton, Ont. in 2000) carried in the excrement of warm-blooded animals that can make people sick. According to the NSWA, faecal coliform counts in the North Saskatchewan averaged 13 counts per 100 millilitres of water when measured upstream of Edmonton, and 412 counts/100 mL downstream. Alberta Environment attributes this increase to the city's two wastewater treatment plants and several combined sewer outlets along the river (Aquality Environmental Consulting Ltd., 84, 99).

[12] George Bontus and Larry E. Bodnaruk, *City of St. Albert Stormwater Management Plan*, Edmonton, Alta.: Associated Engineering 2004, v.

[13] David Schindler, "The Cumulative Effects of Climate Warming and Other Human Stresses on Canadian Freshwaters in the New Millennium," *Canadian Journal of Fisheries and Aquatic Sciences* 58 (2000), 21.

[14] International Joint Commission, *The International Joint Commission and the Boundary Waters Treaty of 1909*, (Ottawa, Ont.: International Joint Commission 1998), Article VI.

[15] Margaret Catley-Carlson, "The Turbulent World of Water: Threats and Implications for Canada's Foreign Policy," *Canada Among Nations 2004: Setting Priorities Straight*, Ottawa, Ont.: Carleton University 2004, 209.

[16] Oliver M. Brandes and Keith Ferguson, *Flushing the Future? Examining Urban Water Use in Canada*, Victoria, B.C.: POLIS Project on Ecological Governance 2003, 1.

[17] Sandra Postel, "Dividing the Waters: Food Security, Ecosystem Health, and the New Politics of Scarcity," *Worldwatch Paper* 132 (1996), 13–14.

[18] Alberta Environment, *South Saskatchewan River Basin Water Management Plan Phase Two Background Studies*, Edmonton, Alta.: Alberta Environment 2003, 4, 11.

[19] Alberta Environment, *South Saskatchewan River Basin Water Management Plan Phase One Water Allocation Transfers*, Edmonton: Alberta Environment 2002, 12. The ban started with tributaries to the Oldman River and was later expanded to cover the entire South Saskatchewan basin.

[20] Intergovernmental Panel on Climate Change, *Climate Change 2001: Synthesis Report*, Robert T. Watson, ed., New York, N.Y.: Cambridge University Press 2001, 8.

[21] Yves Filmon, "Climate Change: Implications for Canadian Water Resources and Hydropower Production," *Canadian Water Resources Journal* 25.3 (2000), 257.

[22] Schindler and Donahue, 7211.

[23] Mike Denmuth and A. Pietroniro, *The Impact of Climate Change on the Glaciers of the Canadian Rocky Mountain Eastern Slopes and Implications for Water Resource-Related Adaptation in the Canadian Prairies*, Saskatoon, Sask.: National Water Research Institute 2003, iv–vi.

[24] Chris Hopkinson and Gordon J. Young, "The Effect of Glacial Wastage on the Flow of the Bow River at Banff, Alberta, 1951–1993," *Hydrological Processes* 12 (1998), 1745.