



Towards Effective Twenty-First Century Canadian Water Policy



A Comparative Summary Synthesis

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Towards Effective 21st Century National Water Policy

In a Warming World

By
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Executive Summary

This comparative summary synthesis seeks to offer international example as a guide to the creation of a Canadian Water Agency. Effective 21st century national water policy in this context is defined as that which proactively addresses the kinds of new and intensifying water challenges we know will demand new approaches to freshwater management for the rest of this century in Canada. These challenges include climate change, an increase in water-related climate disasters, biodiversity loss, fragmented water governance and unresolved and uncharacterized Indigenous water rights. This comparative assessment has arrived at the following preliminary conclusions.

21st Century National Water Policy in Australia

By the late 1990s, the depth of economic and social upheaval caused by the appearance of permanently persistent drought in Australia demanded changes in almost every institution in the country. Despite enormous resistance from interests that previously could not have conceived of such a development, it became clear that the only way the problem could be managed was to have individual states relinquish some of their powers to the federal government.

A National Water Commission was created in 2004. Under the independent NWC fragmented and territorial political jurisdictions were forced to work together. Even as the drought situation worsened, Australia was well on its way to creating an effective 21st century national policy. Then suddenly Australia decided to go backwards rather than forward.

After being elected, the Liberal National Coalition party led by Tony Abbot used his opposition to a proposed mining profits tax, emissions trading schemes and a carbon tax as an excuse to abolish the National Water Commission in 2014.

Since then Australia has experienced drought and fire extremes an order of magnitude beyond the very worst-case model scenarios. The habitable parts of Australia are now crowded with traumatized local climate refugees whose lives have been set back years, if not permanently.

A rapidly warming climate, in tandem with divisive, retrograde national water policy, compounded by the effects of the pandemic, have created circumstances in which the creation of a coherent 21st century national water policy has receded beyond Australia's grasp, perhaps permanently.

21st Century National Water Policy in the United States

Like Australia, the United States was well on its way in the 1990s to creating a coherent and effective national water policy.

By the early 2000s, it was recognized, as it was in Australia, that the problems with respect to water in the U.S. were too complicated for any one jurisdiction to address and that greater federal leadership was required. A U.S. equivalent of a national water agency was proposed.

For a time, it appeared that proponents of a 21st century U.S. water policy would get what so many wanted. In 2012, ground was broken for the construction of a U.S. National Water Centre in Alabama. The same year the importance of considering water in the context of national security was recognized in an assessment by the U.S. Intelligence Community. In early 2017, the federal government went so far as to release its U.S. *Global Water Strategy* which proposed that solutions to the country's water issues be co-ordinated through the creation of an Interagency Working Group comprised of representatives of 17 different U.S. federal agencies.

But then, suddenly, things went sideways. The reason? Donald Trump. Trump, burning to undo Barack Obama's legacy, rolled back more than 100 environmental policies and regulations. In this respect, it could be said that in terms of the capacity to deal with the growing pressures of managing water in a hotter, more crowded and more conflicted world, the situation in the United States is similar to that of Australia, but in reverse. While in Australia the primary threat to creating effective policy is seemingly out-of-control climate change exacerbated by social and political divisiveness.

During Donald Trump's presidency, it was as much social and political divisiveness as climate change itself that caused effective 21st century national water policy to recede, perhaps permanently, beyond the reach of the United States. The 2020 presidential election, however, has, once again, changed the landscape.

While the Georgia run-off election results were being confirmed, the electoral college outcomes were, after considerable drama in Washington, certified. Now, the new U.S. administration will have room to move on environmental and climate issues in a way that would've been difficult if the Republicans had held the Senate.

With the election of Joe Biden as president and the control that Democrats will possess in terms of majorities in Congress and in the Senate at least until mid-term elections in two years, slender as they may be, the potential now exists to halt and reverse the deregulation that has set the United States back decades in terms of protection and management of water in this young century. We should move in lockstep with them as they appear to want to create a national water agency also, the fact of which we should take note.

21st Century European Union Water Policy

Perhaps because of the reduced relative influence of the fossil fuel sector in Europe as a whole, the European Water Framework Directive has perhaps become the best example to which the world can turn in terms of the development of effective 21st century national and transnational water policy.

The European Water Framework Directive came into existence as a consequence of common desire of the 18 countries that share it to clean up the entire transboundary course of the Danube river so as restore the health of the Black Sea. The EU built a foundation upon which cooperation could flourish.

It did so first by establishing a strong legal basis for higher common management standards and then following up on those standards with strong enforcement while at the same time collaborating on the development of creative implementation mechanisms that it built into a common implementation strategy.

The EU solidified this foundation by forging trusting relationships between representatives of member states, setting highly ambitious goals based on measurable results and meaningful consequences for non-compliance while at the

same time establishing creative and reliable sources of funding to ensure every member state could ultimately improve water resource management at the same ever-improving high standard. No one has been left behind.

21st Century Canadian Water Policy

If the Saskatchewan River is our Danube, then Lake Winnipeg is our Black Sea. To respond to these kinds of problems, Canada must do everything possible to avoid both the social and political divisiveness and runaway climate impacts that will make coherent national water policy difficult if not ultimately impossible to achieve.

The only way forward toward a 21st century national water policy for Canada is through the creation of a strong, unifying federal focus on water governance and management. It will require what it required in Europe: active not passive trust building established through the building of strong and durable inter-personal relations; the establishment and adoption of ambitious common goals and targets, clearly measurable results with meaningful consequences for non-compliance and on-going help for those who have trouble keeping up. All of these goals can be achieved through the creation of a Canada Water Agency.

The Current Canadian Situation

This is a moment in history dominated by both possibility and emergency. There are some profoundly troubling matters backed up behind the COVID dam and only through careful understanding of water and what we can learn from what it is telling us will we be able to address them in time to avoid a turbulent future.

The transformational moment in which we presently find ourselves won't last long unless we act decisively now. We find ourselves in a transformational moment. The pandemic has created a great pause in which we, as a nation, have been forced to examine very carefully how we will advance into the future. Canada has vowed to learn from this pandemic and to "build back better." The federal government has also promised the people of Canada that it will effectively address the climate change threat. Neither of these goals can be achieved without enlightened understanding of how valuable our water resources are and how much more valuable they will be in the future. Again, this is a transformational moment – we should seize it.

**A Once-In-A Generation Geopolitical Opportunity:
The Canadian Water Agency & It's Links to Foreign Policy
&
International Development Aid**

Even a cursory examination of long-established perspectives on establishing better coordinated 21st century domestic water policy and the integrated extension of that policy into the domains of diplomacy and international development reveals enormous as yet unrealized opportunity. By linking the advancements in national cooperation on water with the goal of meeting new 21st century challenges to water management to foreign policy objectives, the Canada Water Agency can help Canada establish a new and very positive national image, or brand, abroad. Canada can re-invent itself on the world stage by using what we know about treating water as a vehicle for expanding trade while at the same time use our expanding expertise in water governance as a means of fulfilling Canada's diplomatic and international development aid objectives. But to realize the enormous potential before us in the transformational moment the pandemic has presented, we need, as a nation, to leave behind antiquated but deeply embedded habits of jurisdictional fragmentation and institutional territoriality that imprison us in water policy that may have served adequately in the 19th century but cannot possibly serve us now. There is work to be done, but the good news is that the time is right to do the work we need to do in linking what we do domestically with who we are recognized to be globally. We have all the pieces we need to re-define Canada as a water nation. All we need to do is assemble them differently.

Canada & the Global Climate Picture

There is a great deal backed up behind the COVID dam that is waiting for us as we wait for a vaccine against the virus to be distributed to all. We have shown that we can adapt to a crisis like the COVID pandemic. Can we do the same now for climate change? Carbon dioxide concentrations in the atmosphere continue to rise despite our unplanned and abrupt reductions in carbon emissions which suggests feedbacks have been initiated that will result in increases in carbon dioxide in the atmosphere unless we are able to get ahead of rising global temperatures now. All of these feedbacks are influenced by water.

**On Urgency:
Vaccines for COVID, Vaccines for Climate Change, Vaccines for National
Unity**

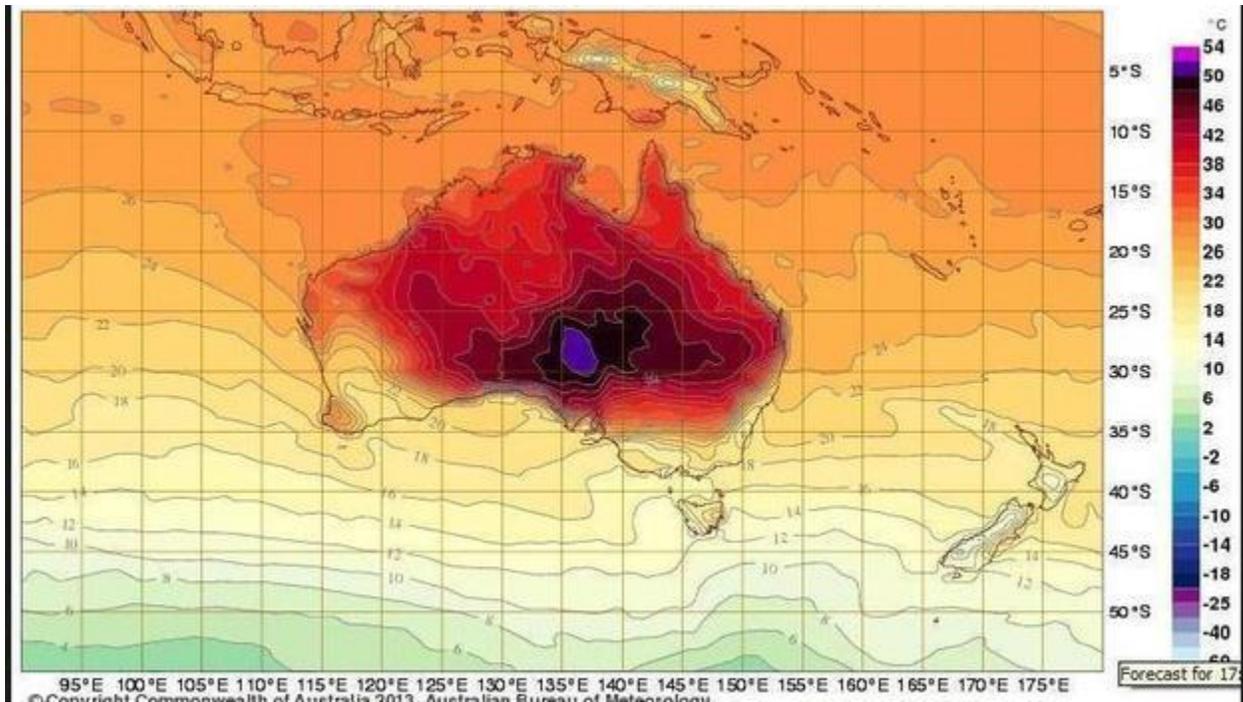
One such feedback has been identified right here in Canada; and that is the greenhouse release feedback caused by permafrost thaw in our Arctic. There is three times more carbon sequestered in permafrost than in all of the forests on Earth combined. In Canada alone there are an estimated 1500 billion tonnes of carbon sequestered in Arctic permafrost. There are a thousand billion tonnes in near-surface sediments which is about the same amount of carbon that we now have floating in our ever-hotter atmosphere. Unchecked, a warming Arctic could release the same amount of greenhouses gases as are currently being emitted by the entire United States each year. Let that much carbon loose and we stand to create a self-perpetuating feedback loop in which warming generates more warming

Because of permafrost thaw and other feedback releases, Canada's stated goal of exceeding our 2030 emissions reductions target and net zero carbon emission by 2050 will recede continually beyond our grasp. Stated bluntly, we are at – and perhaps past – the climate tipping point beyond which the option of carbon neutrality is no longer available to Canadians.

We cannot allow it to be too late. While it is true that in warming the Arctic, cutting down our forests and damaging the planet's soils we are releasing carbon dioxide, the converse is also true. The living Earth can be our ally and our partner in reversing the damage we have done to our only home. By renewing nature's processes for sequestering carbon, we can store carbon in life. This is the geoengineering we need, not madly pumping sulphur compounds into the upper atmosphere or installing mirrors in space. To refreeze the Arctic, we need to reduce our emissions of heat-trapping gases. If we take care of nature and nature will take care of us. We cannot halt permafrost thaw directly but we may be able to do it by restoring forests, restoring soil health, and rewilding the world. In the end, saving the Amazon could save the Arctic. We have no choice but to recognize that we are all in this together.

The highest priority of 21st Century National Water Policy must be to do something about it. So, where do we go from here? You can't defeat a global disease with local responses; but if there are enough appropriate local responses at the provincial and community you can slow and moderate its local effects until a vaccine is available to all and has been universally administered. A Canada Water Agency has to be in that vaccine.

Twenty-First Century Australian Water Policy



A Comparative Summary Synthesis

Twenty-First Century Australian Water Policy

Oddly it was in Spain that I first came face to face with the aridity that is at the fiery heart of the challenge of creating effective 21st century water policy in Australia. I first came into contact with first-hand evidence of what was happening in Australia on a field trip that was part of a water policy conference held in Zaragoza, which, at the time, was hosting the 2008 World's Fair, that had "Water" as its main theme.

Here at the frontier between Christian and Muslim worlds in the Middle Ages, conversation between people representing 20 countries was easy and natural. One of the conversations centred on the kinds of water supply problems that we emerging in Australia. This conversation was part of a continuing dialogue I have been having with Leith Bouilly, a mother, farmer and natural resource and water management expert from Dirranbandi, Queensland, since I met her four years earlier. Our common concerns related to appropriate public policy choices available to leaders in the event that persistent drought becomes permanent, as appears to have happened in the Murray-Darling River Basin in southwestern Australia.

What Leith Bouilly had and continues to experience as a farmer, as a founding member of the Wentworth Group of Concerned Scientists and as chair of the community advisory committee of the Murray-Darling Basin Ministerial Council speaks to what happens to communities and economies when droughts don't end and aridity becomes the new norm in a formerly rich agricultural landscape.

Not unlike parts of the interior of North America, much of Australia is arid or semi-arid. Just as in Canada, Australia's rainfall history features several distinctly dry periods of a decade or longer. As happened in Canada, the mid-to-late 1920s and the 1930s were periods of drought over most of Australia with low rainfall persisting over the eastern states through most of the 1940s. Another drought occurred in the 1960s over central and eastern Australia.¹

¹ See "It's about People: Changing Perspectives on Dryness," A Report to Government by an Expert Social Panel, Commonwealth of Australia, 2008.

As often happens in Canada during dry periods, not every year during these periods of prolonged drought was dry. The problem was that in most years, rainfall was below the long-term average, which compounded the effect of runs of years with recurrent dryness. Australia's drought of record – known as the “Federation drought” – persisted through the late 1890s until 1902. The drought of 1991 to 1995, which affected Queensland, northern New South Wales and parts of central Australia, and the most recent droughts that have hammered Australia for much of the past decade are further examples of this most severe kind of drought event in which one or two very dry years follow several years of generally below-average rainfall.

Despite nearly three decades of often deep and persistent drought, evidence suggests that the situation is not about to improve for Australian farmers. As part of the government's ongoing review of national drought policy, the Australian Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organization were commissioned to evaluate the impact of climate change on the nature and frequency of exceptional climatic events. The assessment examined past and future changes in the intensity and frequency as such events, with a specific focus on the impact of high temperatures, low rainfall and low soil moisture. Their joint report concluded that, compared to the past 100 years, there is an increased risk of severe dryness over the next 20 to 30 years, particularly over southern Australia. The reason: increased drought risk will be exacerbated by increasing temperatures – so that droughts in the future will be hotter. In other words, the dryness normally associated with drought in many parts of Australia is about to become the norm rather than the exception.

Researchers noted, however, that this does not necessarily mean the end of farming in Australia. It does mean, though, that farm families and rural businesses and communities are going to have to adapt to the new conditions, which isn't going to be easy. Some areas of Australia had at that time been experiencing what have been defined as “exceptional circumstances” for 13 of the past 16 years. In the middle of June, 2008, when Leith Bouilly and her colleague, water and rural policy expert Wendy Craik, departed Australia for the Rosenberg Forum in Spain, a significant portion of the entire Australian continent was once again experiencing persistent drought conditions. In some places, temperatures were regularly exceeded 50°C, or nearly 125°F.

The depth of the economic and social upheaval caused by the appearance of permanently persistent drought in Australia demanded changes in almost every institution in the country. There were systemic changes to values as idealistic imperatives such as environmental sustainability were challenged by the urgency of making real-life trade-offs in support of community survival. Australians quickly learned that history also matters, especially with respect to laws, policies, institutions and traditions. Unresolved Aboriginal issues stood out in immediate relief. Litigation soared along with buybacks and sales of land and water rights.

There were also interests that took to hoarding and profiteering. Established notions of jurisdiction soon came under attack. Individual states became unruly in defence of their own self-interest. As the crisis deepened Australians ceased to be moved by rhetoric. As community outrage focused more and more upon the failure of state governments to properly frame and address issues related to the emergency, central power ultimately emerged as a dominant influence on national direction. Despite enormous resistance from interests that previously could not have conceived of such a development, the only way the problem could be managed in the end was to have individual states relinquish some of their powers to the federal government. It was to that end that, in 2004, the Australian government created the National Water Commission.

The Creation of the National Water Commission

The National Water Commission (NWC) was an independent statutory authority in Australia established by the *National Water Commission Act 2004*¹ to implement the National Water Initiative and reform the broader national water agenda. The Commission reported to the Department of Sustainability, Environment, Water, Population and Communities portfolio, and provided independent, evidence-based advice to the Council of Australian Governments (COAG) and the Australian Government on national water issues.

The key function of the Commission was to advise the Prime Minister on expenditure of the Australian Government Water Fund between 2004 and 2010.² This included three programs: Water Smart Australia; Raising National Water Standards Program and Australian Water Fund Communities. The Commission managed more than 170 projects under the Raising National Water Standards Program. The Raising National Water Standards Program facilitated

investment in Australia's ability to measure, monitor and manage its water resources.:

The Commission also had an assessment role for National Partnership Payments. This task was undertaken under delegation from the COAG Reform Council. Under the *Water Act 2007*, the Commission had a new, ongoing function to audit the effectiveness of implementation of the Murray-Darling Basin Plan and associated water resource plans.

The Commission published biennial assessments of progress in implementation of the National Water Initiative. The 2011 assessment made 12 major recommendations to COAG to reinvigorate the water reform agenda and fully deliver its economic, environmental and social benefits.

In 2011, the Commission was delegated additional functions under the [*Carbon Credits \(Carbon Farming Initiative\) Regulations 2011*](#).

The Act was amended in June 2012 following an independent COAG Review of the Commission. Under the amended Act, the Commission had three core ongoing functions: monitoring, audit, and assessment. It was also empowered to undertake broader activities that promoted national water reform objectives. The Commission had additional functions under other Commonwealth acts and regulations.

Under the aegis of the National Water Commission previously fragmented and territorial political jurisdictions were forced to work together and even amalgamate their efforts and programs in ways that would have been unthinkable in the absence of the emergency. The very foundation of the country's laws had to change in order to accommodate shifts in agricultural practices, jurisdiction, power and decision-making. Both federal and some state governments fell, partly as a consequence of their perceived failure to move quickly enough in the right direction to address the impacts of the drought. It was certainly not going to be easy, but it looked like Australia was on its way to creating a cohesive and effective 21st century national water policy.

Lessons for Canada and for the rest of the world derive from the fact that, as a consequence of climate change, Australia was confronted with an unprecedented period of major upheaval in one of its most important economic sectors, to which the country's governments and major institutions, by virtue of the way they were structured, were unable or slow to respond. These same kinds of issues later began to present themselves in rural communities in British Columbia, where forestry

economies were devastated by the pine bark beetle. Not every community has the capacity to suddenly become a tourism destination. Given there was little action on climate change, it is no surprise that the devastation caused by pine bark infestations was followed by even greater devastation by wildfire. As we saw very well in 2017 and 2018, the impact of deep and prolonged drought and its impact on protracted and intensified wildfire seasons on already vulnerable communities could be the last straw. But as we saw in 2018, what has happened in British Columbia can't hold a candle to what happened in Australia.

Learning from Australia's Murray-Darling Basin

At that time Wendy Craik was the chief executive of the Murray-Darling Basin Commission. Her paper, submitted to the Rosenberg Forum on behalf of co-author James Cleaver, was entitled "Modern Agriculture Under Stress: Lessons from the Murray-Darling." In describing the system, Craik explained that the million square kilometre Murray-Darling basin covers roughly twice the area of Spain but only 14% of southeastern Australia. The basin's two million residents rely on the combined river system for all their water supplies as do the 1.2 million residents of the city of Adelaide, which is located on the south coast, adjacent to the mouth of the basin. The Murray-Darling, Craig explained, is Australia's "food bowl." The 2% of the Murray-Darling Basin that is irrigated once accounted for 70% of the value of Australia's irrigated agriculture output.

The Darling River region is very flat. Inflows in this system are unreliably tied to episodic rainfall events that lead to major flooding approximately every decade. In most years, however, most of the flows from the Darling are diminished by transmission losses and evaporation before reaching the Murray. Historically, the only reliable rainfall in the entire Murray-Darling system has occurred in the mountain regions of the Murray River. As is the case in so many watersheds, including those in western Canada, the rest of the system relies heavily on the disproportionate amount of precipitation that falls in upland regions.

So reliable were flows in the Murray-Darling system that they were taken for granted in the economic development of the region. Water rights were granted to 99 per cent of the long-term average annual river flows. When these highly reliable flows ceased, however, southeastern Australia found that while increasing agricultural and economic productivity to the full limits of the water supply made

for great short-term prosperity, it also left the region very vulnerable to the grief that drought and climate change have caused repeatedly throughout the entire history of settled human society. Rights had been granted for water that no longer existed.

When the drought began it was possible to make do for awhile, but as it wore on, the very institutions the region depended on for its integrity began to unravel under the weight of precedents that could no longer be honoured and governance structures that were not capable of meeting the demands of conditions far worse than anticipated by emergency drought plans.

Drought of Uncommon Intensity and Duration

The current Australian drought cycle began quite innocently, as many do, with diminished flows in important major rivers. During the early phase of the drought which began in 1996, the annual flows of the Murray-Darling system, though reduced, remained within the Murray-Darling Basin Commission's planning minimums, which is to say there were well within the historic variability of the system as accepted at the time. As happens in such circumstances, those with "high reliability" water licenses barely noticed the drought, as they had all the water they were entitled to, so that critical livestock, urban and domestic water supplies were assured.

The bulk of early impacts of the drought were felt by irrigators with "lower reliability" water licences. In some cases, water allocations to junior licence holders were cut by as much as 54% down from a long-term average reliability of 80%. In the beginning most were able to manage their way through.

It is important to note, however, that one valid customer that did not receive the water it was entitled to, even at the beginning of the drought, was the environment itself. As natural floodplain inundation had not occurred in the Murray Valley since 1993, widespread decline of floodplain ecosystems began at the very outset of the drought. This was to have serious implications later, implications that continue to this day.

Instead of letting up over time as the historical record suggested it would, Australia's droughts didn't just linger, they intensified. They got worse. By 2006

conditions had severely deteriorated throughout the Murray-Darling Basin. But even more difficult conditions were still to come. When the austral spring arrived in September of 2006, it became evident that the autumn, winter and spring flows had failed completely. It was as if the hydrological cycle had simply stopped. There was, literally, no water.

The Murray-Darling Basin Commission forecast that water storage behind the Murray River dams would be drawn down to extreme low levels by the end of 2006/07 growing season. Two months later allocations to even the most senior water licence holders were reduced throughout southeastern Australia.

Conservation efforts were redoubled; neighbours began reporting one another for water use violations; jealousies over who was allocated water for what purpose led to conflicts; and suicide rates in rural agricultural areas began to rise rapidly. By the end of the austral summer of 2006/07 total Murray River annual reservoir inflows had dropped to approximately 60 per cent below those recorded during the previous drought of record, which occurred in the austral summer of 1914/15. But since then things have gotten even worse. Storage levels at the beginning of summer 2007/08 were very low, and as a result, opening allocations even to senior licence holders fell to zero.

As there was no stored water to offer to licensed water users, all allocations were made entirely dependent upon how much rainfall fell and was stored during the summer season. Just as occurred during the southern Alberta drought of 2000 and 2001, Australian irrigators traded water allocation rights in order to reduce the economic impact of the drought. Preliminary estimates indicate that approximately 30 per cent of all available water has been traded during the extended period of the drought. Prior to 2006, when the drought intensified, “leased” water was traded at a maximum value of approximately A\$200 per transaction. During the 2007/08 growing season, however, the price of “leased” water was about A\$1,100 per transaction, a price increase of 550% in only two years.

In the meantime, annual Murray-Darling reservoir inflows remained in the bottom 5% of recorded years. In the entire 116 years during which instrumental records of streamflow have been kept in southeastern Australia, it had never been this dry, and as we were to see, the situation would get far worse in the next fifteen years.

During that period, it appears the climate of Australia may have crossed an invisible threshold into a new climate reality.



The fire season in Australia in 2019 was more extensive, damaging to life and ecosystems and more costly to the economy than any worst-case modelling scenarios projected. Based on reliable, peer-reviewed evidence it can be said that Australia has entered into a completely different hydro-climatic regime for which the country is not prepared in terms of extant water policy.

Why has the Australian drought been so severe?

The Murray-Darling Basin Commission examined very carefully all the factors that have contributed to the severity of the drought presently gripping southeastern Australia. The conclusions at which the Commission arrived could be seen as nothing less than frightening when viewed in the context of our own growing vulnerability in Canada to the same array of extreme conditions that presently persist in Australia. Five factors are seen to have made the Australian drought worse than those that have occurred in the past.

The first thing the Murray-Darling Commission thinks Australia did wrong was to permit overallocation of existing water resources. The Commission noted that the second half of the 20th century was significantly wetter than the first half. Wetter climate conditions in tandem with a 40-year period of dam construction between the 1950s and 1990 allowed Australians to arrive at the accepted wisdom of the day which held that only a small percentage of new water entitlements would actually be utilized. With this logic as an underpinning, irrigation and other water use entitlements were allowed to expand so as to permit the appropriation of almost every drop of surface water that flowed in the Murray-Darling system. Unfortunately, expansion of water rights exceeded levels of environmentally

sustainable extraction. The Australian example proves that even senior water rights can be meaningless if there is no water.

The overallocation of water rights also had – and continues to have – and huge impact on ecosystem vitality in Australia. As Israeli ecologist Uriel Safriel has illustrated, if we are to survive, we must recognize “nature” as equal in importance to people in terms of water allocation. It is impossible at this time to say just how much Australia’s drought has weakened the country’s overall ecosystem health. There can be no question, however, that a great deal of systemic damage has already been done. Even later caps on water use aimed at preventing further expansion of water diversions were unable to reverse the environmental damage caused by overallocation or to lessen the economic impacts associated with investment in business activities that failed when it was no longer possible to access the water these operations depended on for their survival.

Just like southeastern Australia, we have overallocated our southern Canadian rivers, often with little respect for in-stream flow needs or for the need to maintain other biodiversity-based ecosystem services on which we ultimately depend for the sustainability of our way of life, particularly in the dry parts of the West. We have done exactly what got Australia into trouble during droughts that have lasted and continue to last longer than the established record. They got caught. We haven’t, at least not yet.

The second factor making the current Australian drought worse than preceding ones is the fact that mean temperatures in southeastern Australia had been usually warm in recent years. The Commonwealth Scientific & Industrial Research Organization (CSIRO) in Australia estimates that each 1°C increase in mean annual temperature in the basin ultimately reduced runoff by 15%.

Wendy Craik observed that the impact of higher temperatures and a drier catchment has been evident since 2007. This suggests that the aridity generated as a consequence of the drought may in fact be irreversible. CSIRO also estimates that the largest impacts of climate change in the region will present themselves in the upland areas of the Murray River basin. The capacity of the Murray River to supply water at levels based on historic averages is now permanently in question.

Canada would do well to heed these Australian trends. Drought combined with the loss of environmental water flows can damage “natural” ecosystems to such an extent they are unable to provide normal adaptability to such extremes. As the capacity of natural systems to moderate the effects of extreme weather events diminishes, temperatures can rise and in so doing increase evaporation rates from the soil surface and subsurface. High temperatures also affect other hydrological patterns.

Though we can only speculate on what the exact effects will be, rising temperatures are expected to increase rainfall during the winter and spring in much of the Canadian West. Summers, however, are expected to be longer and hotter. Just as has been witnessed in Australia, higher temperatures are expected to increase evaporation and reduce soil moisture to such an extent in already arid regions that these factors will more than compensate for the small increase in rainfall that is projected in most climate change models. What we learn from the Australian example is that temperature and soil moisture changes projected by climate change models can be for real. Projections based on climate models suggest the same thing can be expected to happen in Canada. If it is happening there, it could happen here.

The third factor that influenced the intensity of the Australian drought was that rainfall patterns changed. Research clearly indicates that there has been a significant reduction in autumn rainfall over the Murray-Darling Basin. Researchers have indicated that the reason for this is the strengthening of a high-pressure “subtropical ridge” over the basin during the summer months. The persistence of this high-pressure ridge, which has been linked to climate change, results in the effective diversion of autumn storm systems to the south of the basin. It is not known how long this weather condition will persist into the future.

We have witnessed similar changes in precipitation patterns and snowpack accumulation in the upland regions of the mountain West. While there is no clear indication of what future changes might occur, snowfall is on average diminishing on the east slopes of the Rocky Mountains and also in parts of central British Columbia. While some years bear greater resemblance to established means, the trend appears to be toward more rain and less snow in the Rockies during winter and toward early peak snowmelt and longer, drier summers. If this pattern

continues, we should expect consistently lower average flows in some rivers and more tension over water rights and uses.

The fourth factor that made the current drought different from what Australians have experienced in the past is that dramatically reduced total Murray River system flows dramatically reduced reservoir storage.

The lesson for us in Canada is that it can take a very long time to recover from severe drought, especially if that drought is of an intensity or duration that exceeds the baseline conditions which drought protection infrastructure was meant to address. The Australian example suggests that we need to revisit the standards to which we build and operate our water-related infrastructure, so that we can be prepared for droughts of much longer duration than those upon which our drought protection strategies have been established.

The fifth trend that makes the current droughts in Australia different from any that have preceded them is that they violate all established drought patterns. In the midst of all this, Australia suddenly changed course away from the development of a 21st national water policy. The course it suddenly took was backwards.

The Australian Water Commission is Abolished

As Opposition Leader, Tony Abbott opposed the Rudd–Gillard government's introduction of a mining profits tax, and emissions trading scheme and carbon tax. When his Liberal National Coalition government was elected and he became Prime Minister he passed the National Water Commission (Abolition) Act which, in 2014, abolished the Commission and allowed for the the key functions of the Commission to be transferred to other existing Commonwealth agencies, such as the Productivity Commission and the Department of Environment.

Looking back at what has happened in Australia since, it is difficult to see how anyone could justify the claim the government claim that given that *“substantial progress already made in water reform and the current fiscal environment, there is no longer adequate justification for a stand-alone agency to monitor Australia's progress on water reform.”* The climate deniers, however, had gotten control of the government and there was no turning back. A coherent Australian national water policy was dead in the water.

There are many lessons for Canada in this. The first is that the past is no longer a guide to the future. What we took for granted about our climate patterns is no longer a reliable indication of what may happen in an era defined by a warmer and therefore more energetic atmosphere. We are already seeing this in Canada with the increase in tornadoes, the rising frequency and intensity of extreme rainfall and snowfall events and in rising nighttime and winter temperatures.

We do not have to wait for the drought in Australia to come to an end to derive valuable lessons for Canada. Given climate change and other factors, the climate and hydrological variability upon which we have built our western economy is very likely to be far more extreme than what we experienced during our established drought of record, the 1930s. What this suggests is that, in defining both our infrastructure standards and the often-invisible institutional arrangements and economic instruments we depend on for our ultimate adaptability to such events, we have likely proceeded from an inadequate baseline. Once again, we need to ask ourselves how we would deal with, not six years of moderate drought such as we experienced in the 1930s, but ten years of water scarcity followed by a drought half again more severe than anything North America has ever experienced before. This is exactly what has happened in Australia, and it is extremely useful from a public policy point of view to examine the Australian example with the goal of anticipating what we need to change now before we find ourselves in the midst of a drought that could test our very capacity to live in the places and in the manner we presently do, for example, in the Canadian West.

Getting Past the Talk to Take Some Action

It is hoped that British Columbia and the prairie provinces and other vulnerable regions in Canada will keep these lessons in mind as they plan for what we will be a hotter and often drier future. If we want to avoid turning the interior of the continent into a desert, we need to watch carefully to see how the vast regions devastated by pine bark beetle infestation recover in terms of the effects of invasive species and changes in the kinds of vegetative complexes that emerge as a result of higher temperatures and longer summers.

We need to understand the potential effects of polar warming trends, their influence on the further drying of polar deserts, their influence on evaporation rates of northern lakes and the potential hydrological influences of water suddenly

mobilized as a result of permafrost melt. We also need to project how rapidly the aridity of the Great Plains will advance northward to meet these other influences as temperatures continue to rise in the central part of the continent. We have to realize that although nature might not turn against us, what we are turning nature into might. This suggests that we also need to reduce our carbon dioxide and other greenhouse gas emissions so that we do not increase the threat of further aridity in the West.

Presently our public institutions are not up for such multi-jurisdictional analysis and public policy action. On the Canadian prairies climatic conditions are already at a threshold at which rising temperatures could create aridity as quickly as they did in Australia and in so doing could push our agricultural sector beyond its current capacity to adapt, with devastating impacts on our regional environment and economy. Our institutional arrangements with respect to water resources management in Canada are presently as territorial and jurisdictionally fragmented as Australia's were at the outset of the change in climatic circumstances that devastated that country's agriculture.

We may wish to advance reform of our institutional arrangements so as to enhance our adaptability to climate change effects before unforeseen events make our society vulnerable to the same social and economic catastrophe that befell Australia. One option is to create a regional drought preparedness plan that links jurisdictions, not just on the prairies but in all the western provinces and northern territories that draw their water from rivers that originate in the Rocky Mountains. A complementary option might be to move toward an overarching, pan-Canadian framework for sustainable management of our water resources on a watershed basis.

Viewed in the context of the good it might bring, climate change effects may in fact present an important, historic opportunity in Canada to redraw jurisdictional lines around watersheds. By being proactive in anticipating climate-related impacts on water quantity and quality, we may at least be able to consider the option of returning to the point in our history at which we drew artificial lines of jurisdiction on a map to create Canada as we know it today, and in so doing restore the watershed as the fundamental geographical and hydrological unit in the country.

Leith Bouilly had the last word in our conversation about the drought problem in Australia. In the direct, no-nonsense language that only an Australian mother could summon, she protested that in terms of the state of contemporary public policy with respect to water, “We have got to get past discussions of motherhood and get down to changing the nappie.” If we North Americans want to avoid turning the interior of our continent into a desert, there are quite a few nappies that need changing here too. And soon.

Towards a 21st Century Australian Water Policy

A great deal of future climate change impact can be minimized through proactive planning and adaptation. Long-term adaptation, however, cannot be achieved by simple short-term incremental public policy adjustments to climate disruptions. A fundamental shift in public policy framework is required that establishes water sharing arrangements not just for irrigation and other consumptive water uses but for environmental protection over the broadest range of climate change scenarios over the longest possible time frames.

It is important also to note that had Australia taken a different approach to the importance of natural ecosystem function, the results of the drought may have been different. If you believe not only that “natural,” biodiversity-based ecosystems deserve equal access to water but that the prospects of human sustainability will be diminished in direct proportion to our failure to supply water to nature so that it can continue to supply life-support services to us, then you may be unable to accept as reasonable Australia’s desperate decision to provide water to irrigation agriculture at any cost to natural ecosystem function. If you accept emerging ecohydrological perspectives with respect to the value of natural ecosystem function, you might not allow a country like Canada to use Australia’s response to its recent drought crisis as a basis for defining public policy responses to similar threats in this country.

In the face of land-use and warming induced ecological collapse, Australia chose to first save its irrigation community, if only because that community at the time had the greatest immediate political influence on the decision-making process at senior levels of government. Now it is saving the country’s coal sector. If there is a real lesson for Canada it may be that, in the end, you need to get ahead of hydro-climatic change before it gets ahead of you. That means taking climate action that

may be opposed by coal and other fossil fuel interests. In a perfect storm you need to save the ship in order to save the sailors. Save your farmers at the expense of natural ecosystem health and all you may get is ever more desperate farmers and more drought. Save your natural ecosystems, however, – especially the highly productive ones that clean and regulate water and climate – and just maybe they will save you and the farmers too. That said, once a drought reaches a certain level of intensity you may be lucky to save anything at all.

Current climate change impact models for Australia have projected that droughts of the current magnitude could become the norm by 2050 under business-as-usual global emissions scenarios. It is not something Australians want to come to pass. Drought of the intensity of the one currently baking Australia has left little room for speculation as to whether or not a warmer world might be more desirable than the one we presently inhabit. The three million people who rely on the Murray-Darling basin for the water they need to live have glimpsed what climate change might mean on their continent in their time. Climate change is not something that is happening somewhere else to someone else. It is happening to them. Many Australians are frightened by what the future might bring in an even warmer world than the one we live in today. Ultimately this will have political implications, but for now Australia finds itself in the ultimate climate change dilemma. Under the current government, climate change continues to be ignored in favour of continued support for massive coal exports to China.

One of the vehicles for creating a more robust, cohesive and responsive national water policy is to consolidate common elements of water policy in a single dedicated federal water agency. Australia did that in 2004 but then allowed a climate change denying government to dissolve it a decade later leaving the country without the policy structure and tools to move fast enough or efficiently enough in terms of coherent public policy to deal with the unexpected effects of a rapidly warming climate.

The question many Australian's are asking is this: How do you justify public policy that denies or ignores climate change when you clearly know that you have entered a completely different and dangerous hydro-climate regime in which drought and fire threaten the livelihoods and public health upon which other important elements of your nation's economy depend, and that through this policy

the very real threat now exists that the future of the country and its survival as a state may well be sacrificed in order to support the country's fossil fuel sector?

A rapidly warming climate, in tandem with a 19th century national water policy in combination with the effects of the pandemic have created circumstances in which a coherent 21st century national policy may be beyond Australia's grasp. How is that for a national security threat?

Appendix

Summary lessons for Canada

1. Pay attention to what is happening in your mountain headwaters

Historically, the only reliable rainfall in the entire Murray-Darling system has occurred in the mountain regions of the Murray River. As is the case in so many watersheds, including those in western Canada, the rest of the system relies heavily on the disproportionate amount of precipitation that falls in upland regions. We need to know what is happening to snow pack, snow cover and glacial recession in our high mountain headwaters before changes take place that affect water supply security.

2. New conditions are emerging that will make drought more severe in western North America

The drought in southeastern Australia was unlike any before it largely because of overallocation of water rights in the past 50 years. The impacts associated with overallocation were exacerbated by a measurable rise of atmospheric temperatures, changes in rainfall patterns, record low inflows and an historically unprecedented number of record dry years one after another. There are concerns that these conditions will persist or even become the norm under more extreme climate change scenarios.

What is presently happening in Australia offers insight into the kinds of difficulties Western North America has faced with droughts in the past and will inevitably have to address in the future with the more frequent, prolonged droughts that are projected.

3. The immediate past is no longer an adequate guide to the future

What happened in Australia suggests that we have likely defined both our infrastructure standards and the often invisible institutional arrangements and economic instruments upon which we depend for our ultimate adaptability to prolonged drought on an inadequate baseline. We need to ask ourselves how we would deal with, not six years of moderate drought such as we experienced in the 1930s, but ten years of water scarcity followed by a drought that was half again more severe than anything our prairie civilization has ever experienced before.

4. Water markets can alleviate some of the economic hardship of drought, and conservation can help, but neither is a panacea

Just as occurred in the southern Alberta drought of 2000 and 2001, Australian irrigators successfully traded water allocation rights in order to reduce the economic impact of lost production. In addition to encouraging water markets, governments at all levels contributed to public policy that permitted the carrying

over of allocation privileges from one season to the next, altered operating rules for dams and related water storage systems, changed emergency measures parameters and involved everyone in the basin in strictly enforced water conservation programs. Many of these programs have now become the norm rather than the exception. But while all of these efforts combined did allow adequate water sharing to meet human needs, they ignored or failed to address nature's need for equitable access to water supply.

5. Expect sustainability-threatening permanent ecosystem damage if water is not also supplied adequately to nature

While southeast Australia has survived the drought, it did not happen without long-term, even permanent, damage to natural ecosystems. The dedication of almost all water resources to human purposes intensified the effect of the drought on natural systems, which may, in part, have exacerbated the intensity and contributed to the extended duration of dry conditions that caused the drought to persist. Damage to aquatic and riparian ecosystems in the basin may be permanent, which will reduce natural adaptive capacity in the face of future droughts, thereby threatening long-term sustainability.

Given the recognized adaptive value of natural ecosystem function, western Canada may not wish to emulate Australia's public policy response to its recent drought crisis in the event of a similar threat. But given that Alberta in particular has already overallocated much of its water resources, we may not have any choice but to respond in a manner similar to the way Australia did, which would result in similar broader ecosystem damage and a consequent diminishment of the broader ecosystem health upon which our long-term sustainability ultimately depends.

6. It takes a long time to recover from extended drought

The impacts of prolonged drought persist long after rains return. Even if normal precipitation patterns are restored, it will take years for storage levels in basin reservoirs to return to levels that will permit reliable water supply during dry years. In the absence of adequate storage the region will remain vulnerable to further drought. Even after precipitation patterns return to normal, if indeed they do, damage to broader ecosystem function will continue if all water resources remain committed to human purposes and not enough water is made available to nature. Ecological circumstances may never be the same again after a prolonged drought. Inappropriate response to drought can put a region on the slippery slope that leads toward ecosystem decline and gradual desertification.

7. Simply doing more of the same will not allow for adaptability to long-term drought

Overallocation of water resources to human purposes is a serious mistake that can make entire societies and the natural systems that sustain them vulnerable to persistent water scarcity. As Australia discovered, a fundamental shift in public policy is required that establishes water sharing arrangements not just for irrigation and other consumptive uses but for environmental protection over the broadest range of climate change scenarios over the longest possible time frames. Without such protection, broader adaptability to drought conditions cannot be maintained.

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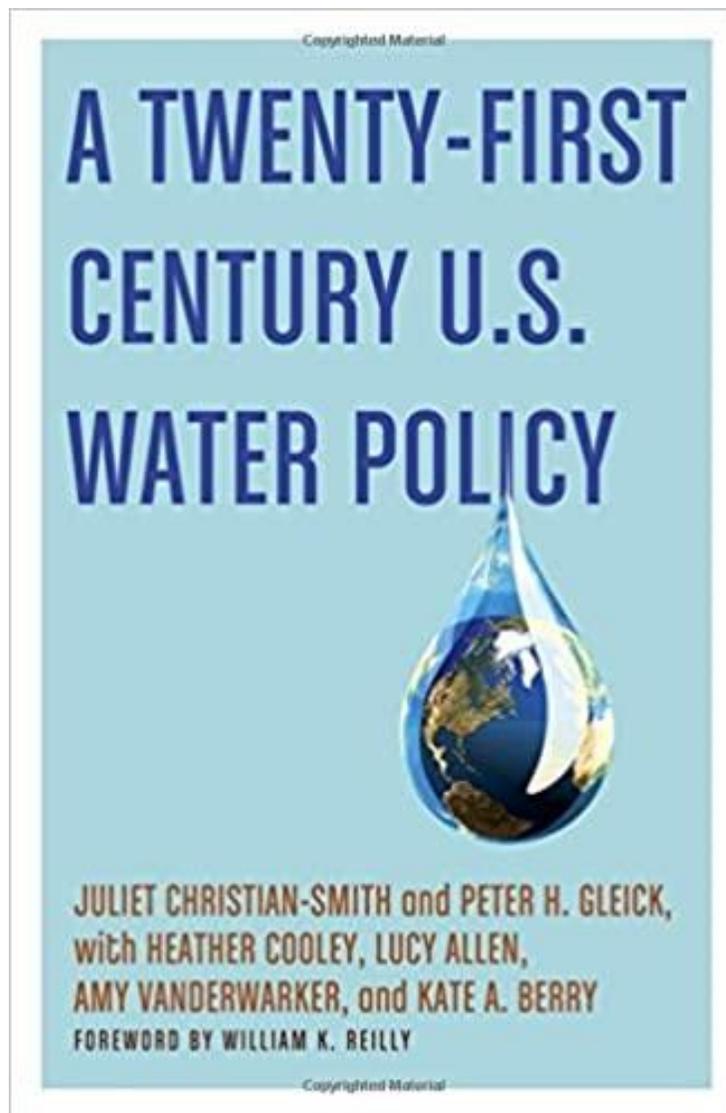


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Twenty-First Century U.S. Water Policy



A Comparative Summary Synthesis

21st Century U.S. Water Policy A Summary Synthesis

Given the country's size, the diversity of its bio-geophysical regions and the complications of legal and administrative jurisdiction over natural resources, it is not surprising that the United States faces huge water policy and management challenges. Though neighbouring Canada has many of the same problems, the scale is different. The number, range and sheer complexity of water and water-related climate threats that exist at any given moment in the United States appear overwhelming. In any given year the country will face deep and persistent drought in the South and Southwest; massive flooding on the northern plains; eutrophication of lakes and water courses as a consequence of agricultural runoff and inadequate municipal wastewater treatment; related issues of pharmaceutical residues in drinking water; inter-sex fish appearing in the watercourses of the Corn Belt, depletion of agriculturally critical aquifers such as the Ogallala; the arrival of new invasive species in the Great Lakes; the deteriorating health of many of the country's most important estuaries; the unpredictable behaviour of ever more powerful hurricane and extra-tropical storms as well as the impact of sea level rise on fresh surface waters and aquifers in a country with one of the longest coastlines in the world. Add to these challenges the growing realization that adequate supplies of clean water are not only vital for growing food and critical to the health of nation, but also to the vitality of its economy and, in the end, fundamental to national security.

Imagine waking up one morning to all these problems and then discovering that, just when you need it most, your critical water-related infrastructure across the entire country is crumbling and that, undermined by partisan divisiveness, the political avenues for addressing these problems are crumbling as fast as your infrastructure. Welcome to the real world of water policy in the United States in the 21st century.

The Federal Role in Water Management

If polls can be believed, Americans, like Canadians, hold water to be the country's most important environmental resource. That said, the management of water has received little attention in Congress, the White House or from U.S. federal agencies. As in Canada, most decisions related to water happen at local, state and

regional levels where jurisdiction resides and where a mix of public and private interests and watershed groups determine the course of management. That is not to say, however, that there is no role for the federal government. There is a clear role for the federal government in setting consistent national standards for water quality and watershed protection; for coordination of monitoring and collection and storage of hydrological, meteorological and climatic data both nationally and globally necessary for drought and flood forecasting and associated disaster planning and response. There is also a clear role for the federal government in funding of on-going basic and applied research; in the management of water on federal lands; in anticipating and resolving potential and actual legal disputes between states over water issues and in helping states and municipalities plan for and meet future water challenges. The federal government also has the sole responsibility for cooperation and diplomacy with respect to the crafting of treaties over the management of waters and watercourses it shares with neighbouring nations. Finally, it could be argued that the federal government also has a clear role to play in the development and evolution of international water policy.

It is widely held in the nation's expert community, however, that the federal government is not adequately fulfilling the role it should be playing in the management of the country's water resources. The federal agencies responsible for meeting these objectives are failing to do so for a number of reasons, many of which will be very familiar to Canadians. In some instances, federal agencies don't know what other agencies are doing. In many cases, the many federal agencies that have responsibility for managing water also have overlapping or conflicting authorities. There are so many such agencies that they have difficulty coordinating their policies. Under some administrations, the executive branch has failed to request adequate funding from Congress to allow federal agencies to adequately protect and manage the country's water resources, and even when adequate funding has been requested, the legislative branch of the federal government often fails to appropriate and allocate the funding federal agencies need to properly do their job. It is also important to note that one of the biggest problems the U.S. faces in terms of water security is that water policies and associated legislation have not be updated for decades, and in fact, under the Trump administration have been rolled back to the extent that the federal government now offers less protection of the nation's most valuable environmental resource than it did 50 years ago when the landmark Clean Water Act was passed. Instead of incorporating advancements in scientific knowledge and technology solutions to the nation's growing water

crisis, federal policy is going backwards. If any country in the world needs a new 21st century water policy, it may well be the United States.

Ten Critical Matters That Require Immediate Policy Attention In the United States

While it is true that the United States has made great strides in improving the efficiency of water use – total water use in 2005 was less than in was in 1975 and per capita use is less now than it has been since 1955 despite a huge increase in the country’s population and growth in its economy – the fact remains that many industries, cities and farms are not investing in improved technologies and practices that conserve and protect water. Energy production now demands huge amounts of water, and demand for water is growing to produce biofuels such as ethanol and to expand natural gas production with inevitable effects on already strained groundwater and surface water availability. In the meantime, climate change impacts are accelerating further altering the timing and extent of precipitation, putting ever more strain on current water supply throughout the country. The writing is on the wall. It will be harder and more costly to assure clean drinking water in the United States in the future. Moreover, because of the current economy and the fragmented politics of the country, this situation will not change soon. Meanwhile the threats to the nation’s water security continue to mount. Though there are many, the main threats can be reduced to ten.

1. Despite the myth of relative abundance, the United States is reaching what is called “peak water.” It is literally running out of enough water to meet the demand of all the uses to which it needs to be put to sustain the American economy and way of life as it exists today.
2. Water quality threats are not being adequately monitored widely across the country.
3. Groundwater contamination and overdraft are rampant widely often in regions where it is a vital source of supply.
4. Aquatic ecosystems, fisheries and wetlands are under threat widely.
5. Water laws are out of date or not effectively or equitably enforced.

6. Much of the nation’s water infrastructure is at or beyond its design life or is not adequately maintained.
7. New contaminants are appearing that seriously threaten water quality and raise the cost of ensuring public health.
8. Rising energy demands are creating unsustainable demands on water.
9. Climate change is shifting water availability and increasing the risk of costly extreme weather events.
10. Many of the institutions that were put in place in the 20th century to manage the nation’s water resources are inadequate, inefficient and un-coordinated.

Recommendations for a 21st Century U.S. Water Policy

In the final chapter of their landmark *A Twenty-First Century U.S. Water Policy*, principal authors Juliet Christian-Smith and Peter Gleick offer conclusions and recommendations that would help the United States address its growing water crisis. It is perhaps not surprising that these observations and recommendations would appear to apply almost verbatim to Canada, the only difference being that Canadians do not think they have arrived at the level of crisis faced by their southern neighbours and that there is little urgency because there is still room to move in terms of water policy. In examining the American situation, it would appear that Canadians should be far more concerned about the management of their country’s water resources than at present. The authors note that the kinds of problems the U.S. presently faces are being experienced worldwide, and in many cases, have become so severe that they have forced many governments, including Australia, the European Union and Russia, to revamp national policy frameworks by passing innovative water laws based on a shared commitment to more holistic “soft path” approaches to water management. Juliet Christian-Smith and Peter Gleick put forward that the soft path approach, unlike hard engineering solutions which often deal with one problem at a time, offers simultaneous solutions to multiple problems. Soft path approaches recognize limits to our ability to make more water available for human use while continuing to benefit from vital

ecological services such as nutrient cycling, waste dilution and removal, natural flood protection, and the concentration of biodiversity in aquatic habitats. The generation of soft path benefits, however, continues to be hampered, in the U.S. as in Canada, by the long-standing disconnection between human engineered solutions and natural ecosystem function, ineffective and in many cases counter-productive water pricing structures and market regimes; and the on-going segregation of agencies responsible for various aspects of water policy into silos. Effective 21st century water policy must aim to encourage better cooperation and integration of policy across agencies, economic sectors and jurisdictions; proper application of economic and other incentives for efficient use and equitable access to water supplies as well as the establishment of social objectives for aquatic ecosystem health and protection, water quality, delivery reliability and greater public participation in decision-making. The authors then outline their key recommendations for the improvement of water policy in the United States.

What Both the United States and Canada Need & Want In Terms of 21st Century Water Policy

The first step in development of a truly effective 21st Century Water Policy must address the problem of jurisdictional fragmentation and the resulting institutional territoriality that emerges through the lack of coordination of federal efforts. The growing water crises of the 21st century will demand that fragmented federal water policies and programs be combined and coordinated in a far more coherent way. In the United States, as in Canada, there are over 30 federal agencies and innumerable independent boards and commissions with water-related responsibilities and programs. The complicated legal and institutional framework that has allowed the current system to evolve over the past two centuries has never undergone a thorough review with the goal of better integration of policy and more efficient management of the nation's water resources. The result is the often inconsistent, incomplete and inefficient federal approach to water management. What needs to be done is that the vital water-related functions of each of the agencies and departments whose responsibilities overlap into water, need to be brought under one roof. In other words, what is being recommended in the United States is the same as what is being recommended presently in Canada: the creation of a national water agency.

The authors of *Twenty-First Century U.S. Water Policy* were also of the view, at least in 2012, that given the pressures on the nation's water resources that the time was ripe for a more integrated and comprehensive approach to national water policy. They noted that though many of the country's water issues would remain local and regional and need to be resolved at the community or county level, the federal government still had significant accountability with respect to broader national security matters. It was pointed out that this was particularly the case where water under federal jurisdiction is concerned; where states are in legal conflict over water allocation; where national standards for water quality are in question; and, vitally, where unsustainable water use threatens the American economy, ecological and environmental integrity or national security.

The authors also acknowledged that efforts in support of improved integration of water policy and management have been put forward in the past with limited success. What was different about the opportunity that presented itself in 2012 - and continues to present itself in 2020 - is that, on one hand, the water crisis in the country has become more severe but, on the other, new ideas and technologies have emerged that offer the potential to address the country's national water woes.

The authors of *Twenty-First Century U.S. Water Policy* go so far as to propose that ideally a national water commission or council would be authorized by Congress as a neutral third-party that could offer advice to both Congress and the Office of management and Budget on how to streamline the ways in which federal agencies fund and conduct water research and improve how the results of that research find their way into improved practice. They propose that the commission or council be comprised of government and nongovernmental interests, representative from the widest range of scientific disciplines related to the environmental and social aspects of water management and consideration, as well as experts in economics, water law and public policy. They also proposed that the specific responsibilities of such a commission include "guidance on national water science, research, and policy priorities; strategies for increasing protection of aquatic ecosystems; new approaches for financing water infrastructure and improving water use efficiency and conservation; steps to improve the physical security of the nation's water and reduce risks of international tensions over shared water resources; and strategies for helping prepare the nation's water resources systems for the risks of climate change." They also proposed a step-like process that would lead to the successful creation of such a commission.

They proposed that the first step in bringing solutions more effectively to bear on the nation's water issues was for the federal Office of Science, Technology and Policy's Committee on Environment, Natural Resources and Sustainability be tasked with developing a national strategy for ensuring the long-term sustainability of the water resources in the United States. The purpose of this strategy would be "to assess existing pressures and potential threats to interstate surface and groundwater resources, recommend amendments, new legislation, or improved administrative approaches to reduce pollution and manage interstate watersheds; develop a framework for systematic collection and dissemination of national water data; and serve as a focus for improved communications among federal agencies." If this sounds familiar in the context of current efforts to create a Canadian Water Agency it is because what we need in Canada very much mirrors what our southern neighbours also need: coherent, integrated water policy. This should surprise no one. We do, after all, share the same continent.

Another recommendation for the creation of a 21st century U.S. water policy that will resonate with Canadians is the acknowledged need to revive river basin commissions eliminated by President Reagan in 1981 and require integrated watershed planning on rivers shared by two or more states. It is held in the expert water community that while they existed river basin commissions did in fact prove functional and effective in serving a national purpose. Given increasing interstate and intra-basin tensions over water allocation and the many other water management challenges listed in this paper that have emerged in the nearly forty years since President Reagan abolished them, it is held that there is a good case for the reinstatement and revitalization of river basin commissions with a goal of providing a rational focus for prioritizing key projects and programs that address major threats that can then be put forward for federal funding. The broader objectives of these river commissions would be guided and coordinated through the proposed federal water agency, which would also be charged developing guidelines and requirements "to ensure that river basin management plans are scientifically rigorous and participatory, identify key threats and stressors to the basin's water resources, and recommend methods for selecting projects to address those threats."

It was also noted that, in order to protect the country's water resources in a time of growing water insecurity and climate change, better measurement, monitoring,

data collection and sharing were vital. In the United States the on-going measurement of flows in the nation's rivers has been the responsibility of the United States Geological Survey (USGS) which has been active in data collection and analysis since 1889. The equivalent in Canada is the Water Survey of Canada. Experts hold that critical data collection efforts have been underfunded in the United States for decades. That is an understatement. The capacity of the USGS to collect vital streamflow and other important hydro-meteorological data has, in fact, continuously reduced, with large numbers of long-term stream gauges being eliminated because of budget cuts to the USGS as well as cuts to the satellite observing systems that have created gaps in the availability of data necessary for advance warning of disasters. While, unlike Canada, the U.S. does have a national flood and drought forecasting system, its capacity has been hampered by budget cuts to monitoring and data collection. To ensure water security and the reliability of flood and drought forecasting in the 21st century, the U.S. has to address this shortcoming.

The failure to accurately monitor, measure and collect accurate data related to water resources is also the root of other water management challenges that need to be addressed in the 21st century. This failure undermines planning efforts, the crafting of effective policies and, ultimately, deleteriously impacts the nation's economic and environmental health. The authors of *Twenty-First Century U.S. Water Policy* note that the passage of the Secure Water Act in 2009 the U.S. established not just the means but the requirement for the USGS to enhance its monitoring and data collection capacity in order to complete an on-going National Water Census aimed at providing critical information to states with respect to water availability and water use. Recent funding cuts, however, have crippled these efforts. Full appropriation for the Secure Water Act is essential if the full value of the National Water Census is to be realized.

It is at the same time vital that a new generation of remote-sensing water monitoring technologies be more fully integrated into national water data collection. As NASA demonstrated with its Gravity Recovery and Climate Experiment (GRACE) satellites, we have entered a new age of expanded capacity to track the movement and storage of both surface and groundwater around the globe. Landsat satellites are able to collect data on thermal infrared radiation that can be used to calculate evapotranspiration, energy balances and water flows. The capacity also exists to use satellites to provide data useful for weather forecasting

and to determine changing hydro-meteorological data in polar regions, something that is of inestimable value in northern Canada where climate warming is occurring at a rate three times greater than the global average. An effective 21st century U.S. water policy has to support and advance satellite based remote sensing of all facets of the accelerating global water cycle.

Enhanced remote sensing in tandem with more comprehensive ground-truthing of data will make charging big users that rely on federally funded infrastructure, such as irrigation districts, what the water really costs to produce more practical.

Twenty-first century U.S. water policy must also address the estimated \$500 billion water and wastewater infrastructure maintenance and replacement deficit. Rather than recommending expanded federal investment the authors of *A Twenty-First Century Water Policy* suggest an approach that requires “increased local cost shares to reduce the amount spent on federal grants, continued federal capitalization of state revolving fund programs, better local cost recovery through appropriate water-pricing policies, and higher use and polluter fees.”

Despite the current political environment in the country, 21st century U.S. water policy must take climate change seriously. Better climate information and decision-support tools must be developed. The risks of climate change must be integrated in design, construction and operation of all existing and future water systems. In order to improve national disaster preparedness, response and recovery capacity, the federal government must require states to undertake on-going climate and weather vulnerability assessments.

The terms and conditions of the Clear Water Act continue to be violated; an alarming concern that worsened during the Trump presidency when many important regulations related to the protection of water quality were rolled back. Effective 21st century water policy demands that a great many federal laws be either restored, updated or brought into existence, and be enforced. As in Canada, many Indigenous tribes and reservations still lack access to safe, affordable water. There are also Indigenous water rights issues that remain to be characterized and resolved. Tribal water management institutions need to be supported. Congress needs to be educated about tribal water issues and meaningful levels of federal funding made available to address them. New approaches to demand management and alternate sources of water supply need to be encouraged so that the country’s water security is not further threatened. There is urgency in integrating national

water policy with other federal resource policies. Water and energy, for example, should be managed together. Water and agricultural policy must become better integrated. Evolving principles of environmental justice must be comprehensively incorporated into federal water law and policy.

Because they share a continent, Canada and the United States have many similar water resource management challenges. If there is a difference, it is matter of scale. The problems the United States faces are Canada's water problems writ large. The U.S. has a growing human population and with it, growing demands on water resources. Though Canada's population is smaller and growing slower, where it is trending is clear. The U.S. has unacceptable water quality in many places. So does Canada. Effective water management in the United States is hampered by weak or inadequate water data collection, outdated water laws and regulations. Canada is on par with the U.S. with respect to this failing. We are also on par with the United States with respect to vulnerability of our water supplies in terms of timing and reliability as a consequence of climate change and its potential impacts on the behaviour of the water cycle and weather patterns continentally.

The authors of *A Twenty-First Century U.S. Water Policy* note in conclusion that several countries around the world have reformed their national water policies in response to similar problems which are now so universal that together they are seen as the foundation for the claim that we face a water crisis globally. They argue that given that it continues "to rely on a fragmented and outdated approach to federal water management based on a patchwork of old laws, competing institutions, and aging infrastructure," it is time the U.S. did so also. What they see when they look at countries that have, indeed, substantially modernized their federal water laws and policies is a new focus on soft path solutions; greater attention to new concepts of water supply; enhanced efforts to improve water conservation and more efficient use; smarter water pricing strategies, a stronger focus on the role water plays in national economies; a more participatory approach to decision-making at all levels; and a recognition that climate change is going to make management of water resources more difficult for everyone as the 21st century progresses; all of which could be advanced through the creation of a federal water agency.

**Almost There:
The Goal of a National Water Commission Is Within Grasp**

The authors of *A Twenty-First Century U.S. Water Policy* very nearly got what they wanted. In 2012, ground was broken for the construction of a U.S. National Water Centre on the campus of the University of Alabama in Tuscaloosa. The centre was to be the first national water resources facility in the country to serve as a catalyst for the Integrated Water Resources Science and Services (IWRSS) partnership, or IWRSS. Toward that end, a new partnership has been launched IWRSS, which consists of NOAA; the US Geological Survey (USGS); and the Army Corps of Engineers as its initial members, will unify and leverage each agency's expertise and investments to improve water resource forecasts, understand how water moves across the land and rivers, and facilitate creative and informed decisions--all utilizing the best available science.

The complex has an Operations Centre complete with Situation Rooms similar to those that exist in the White House. Among many others, the goals of the centre include establishing protocols and standards for managing extreme events from floods to droughts; the development of the capacity of hourly summit-to-sea analyses and forecasts of soil moisture, evapotranspiration, and snow pack; and expand demonstration of Real-Time Dynamic Flood Inundation Mapping portraying the extent, depth, and impacts of flood waters to enhance community resiliency and enable decision makers to mitigate the impacts of floods. The centre also has a strong commitment to research and the sharing of research outcomes through distanced learning.



Even as the National Water Centre was under construction, its value, and the value of a 21st century national water policy continued to be enhanced by the realization that water security was becoming an ever more serious problem globally. In 2012, water security was first identified as an external and then, subsequently, as an internal national security threat.

As policy analysts have long stated, a national security threat as an action or sequence of events that does two things: it threatens to quickly and drastically degrade the quality of life of the inhabitants of a given state which in turn threatens to significantly narrow the range of policy choices available not just to the state but also to private interests such as corporation, and other nongovernment entities. Put simply, national security threats are that that capable of causing severe upheaval in a domestic economy that would result in its citizens suffering hardships that we as a society would deem intolerable. There can be little doubt that rapidly changing hydro-climatic conditions qualify as national security threats widely in a warming, more crowded world.

In 2010, the then U.S. Director of national intelligence Admiral Dennis Blair predicted before Congress that by 2030, only ten years from now, that nothing short of nuclear war, nothing that the great powers can do to each other compares to the extent that climate change threatens us all even in the medium term. Blair's testimony did not go unnoticed.

In 2012, the importance of considering water in the context of national security was also recognized in an Intelligence Community Assessment commissioned by the U.S. Department of State and undertaken by the Office of the Director of National Security. The Intelligence Community's Assessment was unequivocal:

Our Bottom Line: During the next 10 years, many countries important to the United States will experience water problems—shortages, poor water quality, or floods—that will risk instability and state failure, increase regional tensions, and distract them from working with the United States on important US policy objectives. Between now and 2040, fresh water availability will not keep up with demand absent more effective management of water resources. Water problems will hinder the ability of key countries to produce food and generate energy, posing a risk to global food markets and hobbling economic growth. As a result of

demographic and economic development pressures, North Africa, the Middle East, and South Asia will face major challenges coping with water problems.

The findings of the report were hardly surprising. A record drought had already weakened state stability in Syria and tensions were about to explode into one of most brutal wars in history, a war that, at the time of this writing, is still not over.

Peter Gleick was later invited by the influential Centre for American Progress to comment. Gleick made it crystal clear that the failure to address a growing number of water and water-related problems through diplomacy will lead to new and growing security risk around the world, including the U.S. Gleick also noted that instability and insecurity over water in a warming world were serious threat-multipliers and urged national and international leaders to take immediate steps to reduce the risks and threats associated with water insecurity. Gleick concluded by quoting the British politician, Tony Benn, who said, “War represents a failure of diplomacy.” A *Twenty-First Century Water Policy* will fail if it does not lead to the sustainable, strategic and effective management of water and the result of that failure will be conflict. The good news, according to one of the co-authors of *A Twenty-First Century U.S. Water Policy* “is that smart solutions exist if we have the foresight and initiative to pursue them.”

In 2017, the U.S. government released its *Global Water Strategy* which explicitly recognized that a growing global water crisis may undermine economic growth, foster insecurity and state failure, and have adverse effects on U.S. interests. To address this global challenge, the strategy put forward that the U.S. will aim to increase sustainable access to safe drinking water and sanitation services; encourage the sound management and protection of freshwater resources; promote science, technology and information; mobilise financial resources; engage diplomatically; and strengthen partnerships and intergovernmental organizations. The strategy stated that implementation of these goals will be coordinated through an Interagency Working Group comprised of representatives of 17 different U.S. federal agencies. If not in name, then certainly in function this Working Group would become the foundation for a national water agency. But then, suddenly, things went sideways, or perhaps more accurately backwards. As of 2020, if these goals of the U.S. Global Water Strategy have been achieved, no one is saying so. The reason? Donald Trump.

Then Suddenly: Disaster

It was not long into Donald Trump's presidency before serious concerns about the new administration's understanding of climate change and the associated security risks began being voiced. From the outset of his campaign President Trump vocally denied climate change. After his election he appointed several prominent fellow climate deniers to his Cabinet, announced deep budget cuts to government programs aimed at slowing or adapting to climate change. It was clear to see that the new administration had the very real potential do untold damage to the environment, human health and security, economic development, and global peace and stability.

The Trump administration's approach to water and water-related climate issues was very much at odds with the legacy of former President Barack Obama. Before leaving office, President Obama signed a Presidential Memorandum on Climate Change and National Security that aimed to elevate and address the national security implications of water insecurity and climate change. In what can clearly be seen now as an historic statement of national intention, the memorandum directed federal departments and agencies to "ensure that climate change-related impacts are fully considered in the development of national security doctrine, policies, and plans." Released alongside the National Intelligence Council report, prepared for the State Department, the memorandum reflected the consensus among U.S. national security experts that climate change was, in fact, a core national security concern and should be addressed as such. Some within the Trump administration agreed with this consensus, not the least of whom Trump's Secretary of Defense James Mattis, who, in his written testimony following his confirmation hearing, noted that climate change does, in fact, pose a serious threat to American interests abroad.

Both Obama's presidential memorandum and the National Intelligence Community Assessment argued that extreme and more frequent weather events, droughts, heat waves, rising sea levels, and ocean acidification—all driven or exacerbated by climate change—would increasingly threaten food and water security, energy and transportation infrastructure, and other crucial systems in the decades to come not just elsewhere in the world but in the United States. As was already obvious in Syria, these disruptions could seriously stress or overwhelm affected governments' ability to respond to crises, threatening human security and thus erode state legitimacy in ways that could quickly result in conflict. As such crises became more severe, they undermined economic livelihoods contributing to decisions to

migrate. And, as the Syrian and other crises have demonstrated, instability and violence in one country often cannot be confined solely within that country's borders. Both reports therefore concluded that it was in the United States' national interest to actively find ways to address the underlying drivers of crises abroad to prevent future instability and avoid more expensive crisis interventions by the larger global community.

By 2020, the Trump Effect was in clear view. On a Monday in late August of 2020, The Trump administration announced it was planning to grant the fossil fuel industry permission to drill in Alaska's Arctic National Wildlife Sanctuary. On the Thursday of the same week the U.S. Environmental Protection Agency formally lifted regulations that were intended limit methane leaks at fossil fuel wells. Those two smooth moves were only the latest of some 100 environmental rollbacks (see appendix) that the administration completed or was working on after only three-and-half years in office to eliminate protection of the nation's air and water. Meanwhile, water security issues in the United States had come to home to roost. It was recognized that because of the radical decline in important underground aquifers of the United States, states and communities were already having to make politically and socially wrenching choices between the needs of cities and the needs of agriculture. The situation is worsening. It is now seen that if water shortages become as severe as they are projected to become, that if the choice for upstream states is water diversion or state collapse, then all bets would be off. The fear is that by the time this point is reached a combination of internal stress and tension in combination with mass migration would have already brought the affected states concerned down in ruins. Put bluntly, if the U.S. gets to that point it will be too late to fixate much on water wars. By the time that point is reached the affected states are likely to have already collapsed.

The hostile reaction to these rollbacks has been muted by the pandemic, but the resistance is real. In early September of 2020, Lisa Friedman of the New York times spoke with Christine Todd Whitman and William K. Reilly, former Environmental Protection Agency administrators who served under Republican presidents and who recently said they were backing Joseph R. Biden Jr., President Trump's Democratic challenger, in the November election.

The Trump campaign derided their group, Republicans and Independents for Biden, as "has-been politicians," but, as Friedman reported, the former E.P.A.

chiefs brushed off the criticism. They told Friedman they felt strongly that the rule of law, respect for science and action on climate change were on the line in 2020. It is now anticipated that no matter which party takes power in the 2020 presidential election – or in any future election - the United States will need a coordinated and coordinating national water agency more than ever. Americans and others who fear that multilateral institutions like the United Nations are an avenue to world government should understand the pointlessness of their fears. The world as a whole is ungovernable. World government is simply not going to happen. Far more likely is the threat of universal chaos. In this respect it could be said the with respect to the capacity to deal with the growing pressures of managing water in a hotter, more crowded and more conflicted world, that the situation in the United States is similar to that of Australia but in reverse order in terms of obstacles. At present it is social and political divisiveness as much as, or in tandem with climate change, that will continue to keep effective 21st century national water policy beyond the reach of the United States. In Australia, it is the other way around.

The threat to U.S. national security abroad and at home is not imaginary. It is a threat for which the United States has become a global poster child: nations that have become divided in their own national identities and have fractured political system can become paralyzed in their efforts to do anything serious about anthropogenic climate change. Unless Western democracies can summon the will to address the global climate emergency they will suffer like the rest of the world and could ultimately face a choice between authoritarian rule and complete political and social collapse.

It Is Not Over Until It's Over: The End of the Trump Reign

While at the time of this writing there was much controversy over Trump's refusal to cooperate with the process of transition between his administration and that of President-Elect Biden, informed observers like Washington D.C. lawyer and expert on the U.S electoral system, Mace Rosenstein, do not believe this is the real danger in that, in terms of water policy, Biden's transition team has nothing to learn from the climate change deniers and corporate interests that Trump installed in the U.S. Environmental Protection Agency. The immediate risk is that Trump

and his Republican supporters will make a determined effort to blow up as much as possible of what is left of America's environmental protection policies as possible before Trump leaves office on January 20th, 2021. As one Republican leader said, Trump can "set so many fires that it will be hard for the Biden administration to put them all out." That setting of fires has already been rapidly advanced. Even with presidential powers, Biden has a lot of work to do to halt and reverse the damage.

For his part, Biden, even though as a result of Trump's policies over the four years of his term the U.S. will likely fail to meet its commitment to lower carbon emissions to roughly 25% below 2005 levels by 2025, has promised to rejoin the Paris Accord as his first action when he takes office. Biden has also promised to find a way to halt and reverse Trump's sale of oil leases on more than 1.5 million acres of the Arctic National Wildlife Refuge. He will also have to halt the road construction, logging and commercial development Trump has approved by executive order without any pretense of environmental review, across nearly 200 million acres of national forest. At the time of this writing the EPA was also expected to relax allowable levels of lead and copper in drinking water while at the same time the Department of the Interior is expected to weaken protections under the Endangered Species Act before January 20th, again as per Trump's executive order.

All that said, Biden appears undaunted. He has already very publicly characterized climate change as an existential threat and appears ready to embed climate policy not just in traditional environmental agencies but in all cabinet-level departments. Biden's \$2 trillion climate platform ambitiously proposes to put the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050.

From this we see that, *if* the Democrats take control of the Senate by winning both of the Georgia run-off elections on January 5th, the Biden presidency could be a transformational moment in terms of climate action in America. *But*, if the Republicans hold the Senate, all bets are off. As Mace Rosenstein has noted, Republicans publicly insist they want bipartisan climate legislation, but if they control the Senate, any legislation would need the support of Majority Leader Mitch McConnell, who has a long history of opposition to any federal action on climate change. We may get to see, Rosenstein observes, if Biden's strength as a

builder of bipartisan consensus is any match for McConnell's legendary obstructionism.

21st Century U.S. Water Policy In the Biden Era

With respect specifically to what Biden might do to put 21st century water policy back on the table in the United States, we turn again to Peter Gleick, the lead author of *A Twenty-First Century U.S. Water Policy*, the landmark 2012 framework for creating such policies federally. In the wake of the November 3rd, 2020 U.S. election, Gleick made public an Issue Brief in which he picked up again where he had left off and where the Trump administration began to annihilate existing federal water. Gleick began his open letter to the Biden transition team by reminding the president-elect that the United States still faces many severe and worsening water problems and that continuing to neglect these problems will impoverish and sicken this and future generations and threaten American food supply as well as the country's economy. There is opportunity through smart water policies, however, Gleick explained, to simultaneously create hundreds of thousands of jobs and assure and improve public health while at the same time speeding up economic recovery in the United States. Gleick went on to identify four key problems and to offer recommendations for addressing them.

Problem 1: Tens of millions of Americans do not have access to safe, affordable drinking water and sanitation. The COVID-19 pandemic has revealed the stark health and economic consequences of this failure.

Solution: Improve federal water programs to expand access to water services and protect public health, especially in low-income communities and communities of color. Priorities include expanded federal funding for better water infrastructure, improved enforcement of water laws and regulations, and updates to those laws.

Problem 2: Climate changes are already negatively affecting U.S. water resources and the consequences will worsen in coming years.

Solution: The impacts of climate change must be integrated into water planning and management at all levels. Emphasis must be on both reducing greenhouse-gas

emissions associated with our nation's water systems and helping to adapt to the now-unavoidable impacts of climate change.

Problem 3: Water resource problems pose threats to U.S. national and international security.

Solution: Appropriate federal agencies, including the defense and intelligence communities, should expand efforts to identify and analyze threats to vital U.S. interests related to water and commit appropriate diplomatic, technical, and other resources to address them.

Problem 4: The lack of a U.S. National Water Strategy threatens the reliability and quality of water supply and wastewater services and ultimately public health, ecosystems, and our economy.

Solution: The next president should immediately **create a new National Water Commission** for the 21st Century to evaluate and recommend specific federal actions to improve national water policy.

While it will take time to halt and reverse the damage done to the potential for the realization of 21st century water policy during the Trump administration, it is still held in expert circles in the United States that the best way of achieving that policy is through the creation of a new National Water Commission.

It will be interesting to see if Canada, with its current head start, can get there first, or, given its internal bureaucratic machinations, if it can get there at all.

Appendix

Partial List of Environment Rollbacks since January 20, 2017

In the space of less than four years, the Trump administration has weakened over 100 environmental regulations, some of the Obama era and others that have been in place for decades. Just a *partial* list includes the following:

1. Weakened Obama-era fuel economy and greenhouse gas standards for passenger cars and light trucks.
2. Revoked California's ability to set stricter tailpipe emissions standards than the federal government.
3. Weakened Obama-era rule that limited mercury emissions from coal power plants.
4. Repealed the Obama-era Clean Power Plan, which set strict federal limits on carbon emissions from coal- and gas-fired power plants.
5. Canceled a requirement for oil and gas companies to report methane emissions.
6. Withdrew a Clinton-era rule designed to limit toxic emissions from major industrial polluters.
7. Revised a program designed to safeguard communities from increases in pollution from new power plants to make it easier for facilities to avoid emissions regulations.
8. Relaxed rules that govern how refineries monitor pollution in surrounding communities.
9. Weakened an Obama-era rule meant to reduce air pollution in national parks and wilderness areas.
10. Repealed rules meant to reduce leaking and venting of hydrofluorocarbons from large refrigeration and air conditioning systems.
11. Directed agencies to stop using an Obama-era calculation of the social cost of carbon.
12. Revoked an Obama goal of cutting the federal government's greenhouse gas emissions by 40 percent over 10 years.
13. Withdrew a proposed rule aimed at reducing pollutants, including air pollution, at sewage treatment plants.
14. Relaxed some Obama-era requirements for companies to monitor and repair leaks at oil and gas facilities, including exempting certain low-production wells altogether.
15. Made significant cuts to the borders of two national monuments in Utah and recommended border and resource-management changes to several more.
16. Lifted an Obama-era freeze on new coal leases on public lands.
17. Approved construction of the Dakota Access pipeline, less than a mile from the Standing Rock Sioux Reservation. (The Obama administration had halted the project, with the Army Corps of Engineers saying it would explore alternative routes.)
18. Rescinded water pollution regulations for fracking on federal and Indian lands.
19. Rescinded a proposed rule that required mines to prove they could pay to clean up future pollution.
20. Withdrew a requirement that Gulf oil rig owners prove they can cover the costs of removing rigs once they stop producing.
21. Revoked an Obama-era executive order designed to preserve ocean, coastal and Great Lakes waters in favor of a policy focused on energy production.
22. Loosened offshore drilling safety regulations implemented by the Obama administration after the 2010 Deepwater Horizon explosion, including reduced testing requirements for blowout prevention systems.
23. Weakened the National Environmental Policy Act by, among other things, no longer requiring federal agencies to account for a project's cumulative effects on the environment, such as climate change.

24. Revoked a directive for federal agencies to minimize impacts on water, wildlife, land and other natural resources when approving development projects.
25. Changed the way the Endangered Species Act is applied, making it more difficult to protect wildlife from long-term threats posed by climate change.
26. Overturned a ban on the hunting of predators in Alaskan wildlife refuges.
27. Amended fishing regulations to loosen restrictions on the catch of a number of species.
28. Removed restrictions on commercial fishing in a protected marine preserve southeast of Cape Cod that is home to rare corals and a number of endangered sea animals.
29. Proposed revising limits on the number of endangered marine mammals and sea turtles that can be unintentionally killed or injured by fishing nets on the West Coast.
30. Loosened fishing restrictions intended to reduce bycatch of Atlantic bluefin tuna.
31. Scaled back pollution protections for certain tributaries and wetlands that were regulated under the Clean Water Act by the Obama administration.
32. Revoked a rule that prevented coal companies from dumping mining debris into local streams.
33. Weakened a rule that limited toxic discharge from power plants into public waterways.
34. Weakened a portion of the Clean Water Act to make it easier for federal agencies to issue permits for federal projects over state objections if the projects don't meet local water quality standards, including for pipelines and other fossil fuel facilities.
35. Stopped payments to the Green Climate Fund, a United Nations program to help poorer countries reduce carbon emissions.

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For an overview on the U.S. National Water Centre see:

water.noaa.gov



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Twenty-First Century European Union Water Policy



A Comparative Summary Synthesis

21st Century European Union Water Policy

Though I didn't realize it at the time, my first exposure to truly successful 21st century policy anywhere in the world occurred at a water policy conference in Turkey in 2004. While our driver steered our tour bus toward Ataturk Dam, I had the pleasure of sitting next to Philip Weller who at the time served as executive director of an organization I had not heard of created to preserve and protect the Danube. While I had yet to be properly introduced to what the European Union was doing in terms of water policy and had only just met Weller, I was immediately impressed by what had to say about the value of public engagement within their own watersheds. The first of the methods he mentioned was what he called "Danube Day", an annual celebration in the eighteen countries through which the Danube flows. In addition to dozens of events held in communities along the river, ports show their solidarity with the Danube by sounding their sirens in sequence celebrating how each of the eighteen countries is linked by Europe's most important waterway. Another outstanding example he offered was a program his organization created in public schools in association with the annual Danube celebration. This program took the form of a competition to identify the annual "Danube Art Master", the student whose work best portrayed the spirit and nature of Europe's great river.

Beyond our discussion of public programming, Weller also offered some important observations on the mechanisms of potential cooperation between sovereign nations sharing the course of the Danube. His most important observation was that it was very difficult to change the fundamental legislation that frames international law defining rules and regulations concerning how the waters of the Danube should be managed. This would later become a theme that ran throughout the forum. Legislation for managing water resources is, in many instances, outdated and inadequate to the challenges faced in terms of integrated watershed management issues almost everywhere in the world. In this regard, it could be said that imbedded legislation, or perhaps more accurately the inability to readily change that legislation, is an "infrastructure trap" in its own right, comparable to the more concrete infrastructure traps we have created through built form. Weller argued that his efforts would be wasted if he committed himself only to altering legislation. Real gains could be made, however, if he could find ways to make it possible for the eighteen countries that share the Danube to employ legislation as a

backstop to efforts to work voluntarily and collaboratively toward more efficient overall watershed management in the Danube Basin.

Weller went on to say that a river can be a source of common interest that transcended historical conflicts between nations. Even after the terrible Bosnian conflicts, the River Danube proved to be the first and best way for war-torn countries to begin to relate to one another normally again. The river proved a useful vehicle for finding ways to cooperate with one another with the aim of ending, instead of beginning conflict, and establishing regional peace.

Twenty-first Century water policy in the European Union begins with the Danube River. Philip Weller, a Canadian, was for many years the Executive Director for the International Commission for the Protection of the Danube River. In the presentation to the Rosenberg International Forum on Water Policy held in Turkey in 2004 and in later conversations with the author, Mr. Weller repeatedly stressed that the essential foundation of evolving successful water policy in the European Union and elsewhere in the world is cooperation. In Europe the highest level of cooperation is exemplified by the management of the Danube.

The Danube is the second largest river basin in Europe, covering some 801,463 square kilometers. At that time nearly 80 million people resided in the basin which is the most international of all the world's rivers. Countries sharing the Danube include Albania, Austria, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Italy, Macedonia, Moldavia, Poland, Romania, Serbia and Montenegro, Slovakia, Switzerland and the Ukraine; a total of eighteen nations. Besides being a major river basin in its own right, the Danube also possesses a number of sub-basins that in themselves are among the most important international river basins in Europe.

The Danube is not only impressive because of its size, but because of the river and diverse history of the peoples who live in the basin. There are also big differences in the economic prosperity of the countries through which the Danube flows. On one extreme are Moldavia and the Ukraine, with average per capita incomes of less than 1000 Euros per year. On the other end of the continuum are Germany and Austria; whose economies are among the strongest in all of Europe. This great disparity in prosperity has a great influence on the basin wide management of water resources and the effectiveness of pollution reduction and restoration efforts,

which are important priorities in the Danube basin. The extent of the problem of economic inequality can be seen in the relative percentage of populations connected to water supply and proper sewage from west to east along the river.

A unique feature of the Danube is its remarkable delta, which forms the world's largest reed-bed complex. This extraordinary natural feature is largely situated in Romania with a portion in the Ukraine where the Danube enters the Black Sea. This area is an important bi-national biosphere reserve. This reserve covers some 679,000 hectares including flood plains and marine areas. The core of the reserve, some 312,400 hectares, has been designated as a World Nature Heritage Site. The protection of the Black Sea, it is interesting to note, was the initial common concern behind clean-up efforts along the entire transboundary course of the Danube, and one of the main reasons for the creation of the International Commission for the Protection of the Danube River.

The problems facing the Danube were substantial. Surface and groundwater quality in the basin have deteriorated over time as a result of the cumulative consequences of a number of human impacts. A transboundary analysis identified no fewer than 513 pollution hot spots. Analysis also revealed that about 80% of historical flood plain habitat had been lost to development or other impacts.

The Danube, despite its compromised state, is a river that binds and connects people. Because it connects a large part of Europe, its waters have been used to bring disparate and sometimes warring nations together. The Danube nations began sharing water quality data long before the fall of the Iron Curtain. With the fall of the Berlin Wall, and the terrible wars that followed, the Danube was one of the common threads that allowed war torn countries to establish a foundation of cooperation with neighbouring riparian states. The deteriorating quality of the Danube and the rising number of catastrophic chemical spills provided both an impetus and an incentive to international cooperation. Efforts began to formalize cooperation through the development of a convention signed in Sofia, Bulgaria, on June 29th, 1994.

Six years later, on December 22nd, 2000, the European Union Water Framework Directive came into force. European Union States in the Danube Basin, which at the time included only Germany and Austria, were obliged through the Directive to make major changes in the way they managed water. Looking back, it is possible

to see how a highly specific directive aimed at improving water management practices in only two of the Danube's eighteen riparian states became a crystal around which the entire region was, over time, able to begin cooperating toward the same high water quality standards as a basis of sustainable development.

The European Union Water Framework Directive demanded a great deal. It set uniform standards for water policy throughout the European Union and integrated different policy areas involving water. It introduced the river basin approach for the development of integrated and coordinated river basin management for all European river systems (something the author would like to point out, that has yet to be done in Canada let alone for the continent of North America.) It stipulated a defined time-frame for the achievement of acceptable ground and surface water quality. It introduced the economic analysis of water use in order to estimate the most cost-effective combination of measures with respect to water uses. Finally, it included public participation in the development of river basin management plans encouraging active involvement of interested parties including stakeholders, non-government organizations and others.

What made the implementation process in the Danube Basin a real challenge, however, was that only some countries are European Union members bound by the Framework Directive. This, combined with the considerable economic disparity among the countries sharing the river, added to the costly challenge of meeting improved water quality objectives.

In addition to Germany and Austria, four other Danube countries became European Union members on May 1st of 2004. At that time three other Danube countries were in the process of applying for entry and in so doing were preparing to conform with the complete body of European Union legislation in order to qualify for membership status. At the time that left half the Danube states not bound to European Union water quality and management standards.

This did not mean, Weller pointed out, that commitment to work together in support of specific actions that will lead to coordinated management of water resources wasn't continually being advanced. A Trans-National Monitoring Network had been created. Danube nations also created an Accident Early Warning System that continues to provide accidental pollution warning. Commitments were also made to measurably reduce pollution inputs into the

Danube. Coordinated efforts were also advanced to minimize and respond to floods.

Maturing institutional arrangements under the European Union Convention were further strengthened by the financial support provided to Danube Countries by the United Nations Development Program, under GEF, the Global Environment Facility. The combination of strong institutional commitment, the legal and procedural framework of the European Union Water Directive, and financial support provided by the UN provided a solid basis for achieving integrated river basin management in the most international river basin in the world.

Clearly considerable progress in advancing the goals of the European Union Water Framework had already been made by 2004. But just as in other great river basins in the world, such as the Nile, Columbia and Tigris-Euphrates basins, very much remained and still remains to be done.

In terms of the evolution of 21st century water policy the question is this: What could Canada have learned as early as 2004 from the Danube Case Study about the evolution of our institutions charged with managing transboundary water issues more effectively and productively? The first thing we might have learned is that there is value in comparing the multi-jurisdictional circumstances of Europe to the state, provincial and federal jurisdictions that exist in North America. The realization that transboundary cooperation was not really optional was driven by urgency and in this case emergency. It was in no one's interest to let water quality in the Danube or the ecological health of the Black Sea to continue to deteriorate. The cooperative process got off to a new start when two of the Danube states led the way with the introduction of higher standards for water quality improvement and with procedures for integrating water resource management. The next step in the process was to fund support for countries unable to meet the new higher standards on their own.

What is important about Philip Weller's 2004 case study is that it suggested that new directions and the progress toward the establishment of new institutions does not have to come from on high. The idea can come from any trusted combination of partners who share approaches and expertise in ways that will allow other riparian neighbours, whether they are sovereign states or simply provinces, to find

and fund their way to success. The key was that someone had to initiate the commitment.

From this cursory examination of the European Union Water Framework Directive it was possible at the time to derive a number of other lessons for Canada that were put into relief by the European Union Water Framework Directive nearly 20 years ago that still pertain today.

1.

We Have Yet to Define the Terms of True Sustainability

The problems the world is facing are growing at an exponential rate. We are arriving at solutions at a linear rate. Making the leap from environmentalism to true sustainability is the greatest intellectual challenge presently facing humanity.

2.

Acting Unilaterally Doesn't Work In The Long-Term

Over the long-term, self-interested unilateral actions create more grief than good. Strategies and frameworks not agreed upon by all partners are unlikely to produce win-win results over the long term simply because unilateral actions perpetuate disparity which in turn promotes dispute which results in conflicts that lead to lose-lose situations for everyone involved.

3.

Cooperation Is Not Optional

Attitudes and habits are hard to change. Where cooperation does not exist, progress economically, socially and environmentally is difficult. Unless you can afford to waste time, money and energy canceling one another's efforts out, cooperation is a must.

4.

We Need To Change Our Most Basic Institutions

Established precedents including laws and treaties are increasingly inadequate to the circumstances we are facing. To adapt to change we need new institutional frameworks. Such frameworks are most often products of cooperation.

5.

We Must Build Trust If We Want to Build Sustainability

It takes time to permit cooperative processes to produce the kind of trust that generates results. Trust doesn't happen overnight. Successful cooperation often requires a foundation that takes years to build.

6.

It Is Important To Build Trust Before You Build Anything Else

It is more difficult to build trust with others if you come forward with a *fait accompli*. Cooperation has to precede framework development. It is important to put participatory processes in place before projects are already determined.

7.

Strong Political Will and Support Are Vital

Successful prolonged cooperation is not possible without strong political will working in full support of the common good. Institutional change is not possible without political dialogue and support.

8.

Broad Dialogue Is Necessary for Trust and Effective Action

Setting up a dialogue is necessary for bringing people together. It isn't just high-ranking business people and politicians who have to be engaged in this dialogue. The widest possible range of *bona fide* stakeholders has to be engaged in an on-going way.

9.

Tested Solutions Exist

A great deal of knowledge of past and present water management practices exists and many of the problems are well understood. International example provides huge opportunity for the adoption of successful strategies in local circumstances.

10.

**Conclusion:
We Should Have Acted Then**

We already had clear example at the turn of this young century that to be successful in addressing serious interlocking environmentally related economic decline, that it was time for Canada to act. To stay ahead of our growing water resource issues, we knew that we had to overhaul our institutions locally, regionally and nationally. It is important to build on cooperation that has already yielded successful results.

We already knew then that there was slack in many of our systems which meant we still had room to move in terms of solution options, but we have to act if we were going to stay ahead of changes that would limit our future social, economic and environment potential. We also knew that it wouldn't be easy but that fortunately we had international example to provide clear instruction on what we had to do. Moreover, if a major river basin in Europe with 27 member states encompassing literally thousands of jurisdictions, three times the population, 23 different official languages, far greater economic disparity between the jurisdictions; and environmental problems even more serious than ours could figure out a way to work together in the interests of coherent 21st century water policy – then surely a country with only ten provinces, three territories and only two official languages can, too. All we had to do was want to.

**Is the European Union Water Framework Still
Meeting Its Goals?**

In 2019, the author travelled down the Danube to observe if the promise of the European Union Water Framework Directive continued to be realized. There are many lessons about managing water and similar resources that surfaced on that journey, and I am sure will continue to surface, as a result of examining and experiencing how management of the Danube reflects the goals and success of the European Water Framework Directive. All of these lessons relate, as Philip Weller

said they would, to the critical importance of cooperation and the cascade of sometimes surprising benefits such cooperation makes possible.



In following the downstream course of the river from Germany, through Austria, the Czech Republic, Slovakia and Hungary, it is impossible not to come face to face with the region's long and often violent history. The countless castle ruins attest to the fact that there were few periods in all the centuries of the human history of the basin when someone wasn't warring against someone else. This, of course, culminated in the horrors of World War I and the great waste and loss of life that was World War II. Now, however, peace, open borders and free trade prevail creating the most secure and prosperous period in all of the history of Europe. This peace and prosperity are the gifts of cooperation. In this regard, the creation of the European Union must be seen as the greatest public policy achievement in Europe in the last thousand years.

Since my last in-depth examination of the status of the European Water Framework Directive, the level of cooperation of which Philip Weller was such an advocate has resulted in the creation of a new European water ethic. The European Declaration for a New Water Culture provides four broad categories for ethical action with respect to water management. The first category is "water for life," both human and non-human.

This is interesting in that it places water for people and water for nature on par as the foundation of a new European water ethic, whereas our water ethic in North America does not grant water to nature until all human needs have been met. No matter what policy instruments we ultimately employ, the institutional challenge of freeing more water for natural ecosystem function demands we do more than simply insist that nature compete with past precedents in water allocation.

The Declaration also stands on the foundation of a citizen-based water ethic which aims to ensure that water becomes an instrument for maintaining not just adequate supply and sanitation for health, but also for well-being, social cohesion, social capital and capacity-building. The Declaration further recognizes the “water industry” as an essential element in economic growth, but this is a third level of priority. Unlike in Canada and the US, it is considered unethical under the terms and conditions of the European Water Framework Directive to allow business concerns to interfere with water for life.

Finally, the Declaration takes a firm ethical stance against crimes against water, which include destructive withdrawal practices, toxic spills and other actions that threaten the planet’s precious and irreplaceable water systems. This is radically different from the water ethic that presently informs water management decisions in North America, where, in the absence of adherence to the precautionary principle, the burden of proof for demonstrating why ongoing water allocations or operational practices threaten the sustainability of water systems is placed entirely upon those who would oppose them.

With respect to the on-going effectiveness of the European Water Framework one only has to look at the degree of cooperation with which the river is managed. Passing through one of its many locks, it is impossible not to notice that the river is run with the precision of a Swiss watch. All movements on the water are carefully coordinated. This same precision radiates out from the river to the shore and far beyond, establishing the timed movements of tens of millions of people who live in the catchment, the movements of millions of tourists, and all the freight and supplies locals and visitors alike rely upon to sustain them. From this one could surmise that the European Water Framework is the foundation of the entire region’s social stability, unimagined economic prosperity and environmental sustainability. Water is holding Europe together and making it prosperous.

The most important lesson a Canadian might confront from following the course of the river and interviewing many of those Europeans whose livelihoods depended on the Danube and its health, is the extent to which Canada was failing itself and ultimately the continent by its inability to establish a national policy on water and to assist others in the country in seeing the value of following that policy. That fact was put into clear relief when I realized that we had our own Black Sea in Canada, and unlike the Black Sea in Europe its protection is not considered a measure of the presence of coherent and effective 21st century water policy in our country.

Canada's Own Black Sea

Canada would do well to look to again at what Europe discovered about itself and its future by examining its most important river. Flowing through eighteen nations, the Danube is world's most international water course. Representatives from the Danube River Commission explain that water is the engine that drives industrial and agricultural prosperity in all the jurisdictions through which it flows.

Members of the Danube River Commission recognize that water also provides, free of charge, valuable services related to the absorption of the wastes that are by-products of European prosperity.

As the European Union could never afford to provide all these services itself, it is working ensure the health of the Black Sea and its wetlands, for it is into the Black Sea that everything that somehow found its way into the Danube ultimately comes to reside.

If were considered the Saskatchewan River as our Danube — then Lake Winnipeg is our Black Sea. Lake Winnipeg is an indicator of how well we are managing the water that flows through the centre of the continent.

In the case of Lake Winnipeg, it is held in many international circles that, at this moment at least, we have the potential to create a fresh water catastrophe of continental proportions. This is not what we want Lake Winnipeg to say about how we manage fresh water in Canada. There is absolutely no reason for this to happen anywhere in Canada. But the first thing we have to realize is that safe, clean water in southern Canada is no longer a slam dunk.

While we think we are very good in North America at engineering solutions to water availability and quality problems that we have created, there is at least one overriding problem with the way we manage water. That problem resides in the fact that jurisdictions often isolate themselves; rules and regulations are not always followed; the best mechanisms for maintaining and replacing treatment and distribution infrastructure are not always employed; and affected interests do not always share information or collaborate effectively on better water management solutions that are already available that could serve the long-term common good in a more enduring way.

We cannot fix a system as fragmented as this. It has to be overhauled. One of the principles of a new Canadian water ethic has to be the restructuring, streamlining and reformation of a federal-provincial-territorial-Indigenous water governance system.

Without leadership nationally, and only self-interest at most provincial levels, it will be very difficult for any kind of vision to emerge that will be strong enough to change our institutions so that they can change our future. One would hope that Lake Winnipeg doesn't have to die before any real change in national water policy will be possible.

In this context, one is drawn to ask if, in the interests of creating a 21st century water policy for Canada, it might not be worthwhile to again consider creating a national water agency that could be charged with implementing programs in Canada similar to those undertaken by the European Union and its member states by means of the Water Framework Directive. Why? Because we know the European Union Water Directive is working, and the national water policy that exists in Canada is not.

**Shared Water, One Framework:
What Canada Still Has Time to Learn
from EU Water Governance in The Creation of Its Own
Canadian Water Agency**

A comprehensive and scholarly examination of what Canada might learn from the European Union Water Framework Directive that can be directly applied to the creation of a Canadian Water Agency and 21st century national water policy was

funded by the Walter & Duncan Gordon Foundation and undertaken by Émilie Lagacé through the auspices of Canada's Forum for Leadership on Water in 2011. Lagacé's briefing note entitled, *Shared Water, One Framework: What Canada Can Learn from EU Water Governance*, remains highly regarded today not just because it is one of the most thorough and most concise comparisons between two continental scale geographies in terms of water governance, but because it puts into clear relief how poorly Canada has acted upon positive international example and how little it has done to date to craft a 21st century national water policy.

In 2011, Lagacé reported that more than 84% of Canadians were concerned about the long-term supply and quality of freshwater in Canada. Lagacé cited scientific evidence, as many others had done and even more have done since, demonstrating that this concern was justified. Both the quantity and quality of our water resources were under threat and have been under ever accelerating threat since Lagacé published her report. Lagacé reported that Statistics Canada had found that the amount of renewable water available in Canada's most populated areas had dropped the equivalent of 3.5 cubic kilometres (or 8.5%) per year from 1971 to 2004, evidence suggesting that Canada, as we certainly know now, is not in any way immune to warming-induced loss of stationarity in the global hydrological cycle. Lagacé also cited Environment Canada reports that water quality had been rated "fair" or worse at 61% of its monitoring sites from 2005 to 2007.

Lagacé then made a claim that is just as true today as it was when she made it in 2011. Despite clear and growing threats to water quality and quantity, Canada does not have a consistent, coherent, integrated national approach to the management of the nation's precious water resources. Lagacé did not hold back in stating the seriousness of the failure to respond to the urgency of creating a national water strategy in time to get ahead of what were clearly accelerating threats to what is arguably the country's most important natural resource. "The lack of real intergovernmental collaboration on water across Canada," she wrote, "has resulted in severely fragmented water policy, turf-wars and one of the lowest levels of environmental performance in the developed world." Lagacé went on to warn that, as the climate warms and the global hydrological cycle continues to accelerate the failure to act on growing pressure on the nation's water resources could negatively impact Canada's national economy, jeopardize the health of citizens and put further pressure on fragile ecosystems that are already under threat across the country. It is time, Lagacé argued in 2011, that federal, provincial, territorial and

Indigenous governments in Canada must start working more closely together in response to the clear fact that water played an essential role in sustaining both our lives and our quality of life, in perpetuating our prosperity and in protection of the ecosystems under our stewardship. The failure to act immediately on threats to our nation's water security constituted an abrogation of leadership responsibility that needed to be addressed while the growing challenges with respect to maintaining water quality and ensuring reliable quantity were still within our capacity control and manage. Lagacé then noted that other jurisdictions, and in particular, the European Union were doing just that and that paying attention to what the EU was doing could not only offer valuable insights into improvements in cooperative management of water resources but also offer, by example, opportunities to fast-track the evolution of Canada's own 21st century water policy.

Lagacé based the contents of her briefing note on the results of an extensive literature review and over 40 interviews in Canada and Europe. The first questions she asked are obvious ones: why compare Canada and the EU in terms of water governance and if there are good reasons to do so, what can we learn from the comparison? It could be said, a decade later, that the answers that were given to those questions then have become more pressing than ever, especially in the vital context of Canada's urgent need to transform its current 19th century approach to managing the country's water into one capable of addressing the challenges we face two decades into the 21st century.

Why compare Canada and EU water governance?

Lagacé offers a number of very good reasons why comparing water management in Canada to the European experience is useful in the Canadian context. Although the EU is not a true federal system, Lagacé notes that responsibilities for water management are often shared between two levels of government (supra-national and national). In the same way jurisdiction over environmental issues is shared between the federal, provincial, territorial and aboriginal governments in Canada the same jurisdiction is shared between member states and the central European Government. As this author has already noted, Canada is similar to Europe in that both are geographically and socially diverse. Both possess a vast array of different northern hemisphere landscapes and climatic zones and there are similarly vast cultural differences between regions. It should not be surprising then, that the

nature of the threats to water quality and quantity are remarkably similar on both sides of the ocean that separates our two landmasses.

Lagacé is of the view that, in stark comparison to the little progress that has been made in Canada in terms of our static national water policy, water management in the European Union has improved considerably across EU member states since the implementation of the Water Framework Directive. Lagacé cites five primary expressions of that improvement, the first being improved transboundary cooperation. In that it requires that water resources be managed on a river basin scale, the European Union Water Framework Directive would have no force without the cooperation of member states. While international river basin commissions did exist before the WFD, the directive greatly expanded their mandates and refined their objectives and the benefits are obvious as this author can directly attest. Citing the Devil's Lake Diversion decision in which North Dakota acted in its own interest against the wishes of downstream Manitoba, Lagacé notes that, in comparison, transboundary cooperation on water issues in Canada during the same period moved in the opposite direction, toward unilateralism. She goes on to note that while many of the most pressing water issues exist in basins Canada shares with the United States, the effectiveness of our oldest and most significant international transboundary water institution – the International Joint Commission - has been hampered by cuts to its capacity and limits placed upon its function imposed by political obstacles to referring emerging and pending issues to its jurisdiction for resolution. This situation persists still today.

The second domain in which Lagacé observed that Canada could learn from the European Union example was in the on-going development of effective working relationships. Improved communication and partnerships between member states was facilitated by the WFD through what is known as the Common Implementation Strategy, process through which working groups were created composed of international delegates whose function it was to facilitate the flow of information and joint research, in much the same way the proposed Canadian Water Agency in Canada might do. Until such an institution is created, however, Lagacé assessment of relationship across Canadian jurisdictions remains valid. While there have been some breakthroughs in cooperation with upstream riparian neighbours facilitated by the government of Northwest Territories with respect to co-management of the Mackenzie River Basin, Lagacé's ten-year-old observation

that the situation in Canada could be characterized as one of inter-jurisdictional distrust and broken relationships still stands. Lagacé noted that the era of relationship building between federal, provincial and territorial governments that occurred in the 1970s had stalled. Cuts to federal monitoring and other national cost-sharing agreements in areas such as the coordinated acquisition and exchange reliable data across between jurisdictions had led to distrust between different levels of government and confusion over responsibilities for managing water. Ten years later that is still the case, but with one additional complicating factor – the rise in profile and importance of issues related to uncharacterized and unaddressed Indigenous water rights.

The third area in which Lagacé observed that the European Union outshone Canada in terms of water management was in the capacity to protect water quality. The strengthening of cooperation between member states has resulted in the creation of stronger interpersonal networks across the entire European Union which has facilitated accelerated timely sharing of information and expertise as well as greater shared support for those countries lagging behind leaders because they possessed less technical capacity in specific areas of water management. Among the many benefits of this cooperation is a leveling of capacity among the member states and more rapid common progress toward achievement of ever higher water quality and related goals and targets.

Lagacé observed that in Canada vital information about water resources remained isolated in silos, making it harder for water resource managers to keep abreast of innovative approaches to water quality issues adopted by other jurisdictions and other nations. While research networks like Global Water Futures, and programs created by the Federation of Canadian Municipalities, the Canadian Water & Wastewater Association, the Canadian Water Resources Association and others have sought to break down those silos, there is no unifying national institution in Canada that serves in the way the European Union Water Framework Directive does to create stronger inter-personal relations and raise all boats simultaneously in terms of meeting ever higher water quality standards from coast to coast to coast.

The fourth domain in which Lagacé maintained Canada could learn from the European Water Framework Directive was in improved understanding of water resources. The WFD, she noted, is a results-based policy that vitally depends upon data collection and reporting undertaken and shared individual member states and

the on-going development of online platforms that provide information on the state of water quality and quantity across the entire continent, namely the EU's Water Information System for Europe.

In her 2011 briefing note, Lagacé noted that in 2010, the federal Commissioner of the Environment and Sustainable Development found that Environment Canada was not adequately monitoring the quality and quantity of Canada's surface water resources. A year earlier Canada's Council of Canadian Academies Expert Panel on Groundwater observed that it wasn't just surface water quality that was being inadequately monitored in Canada. Data collection with respect to groundwater, the panel concluded, was rarely done in a way in which it could be compared across provinces and territories or river systems. In addition, the expert panel also observed that groundwater data collection programs where they existed across Canada tended to respond to a specific purpose at a specific time and are thereafter discontinued, thereby interrupting observational records and undermining and limiting their value.

The final domain in which Lagacé maintained Canada could learn from the European Water Framework Directive was in the critical domain of efficiency in water protection. Lagacé put it this way: "In the EU collaboration on a common operational approach has prevented 'reinventing of the wheel' in each jurisdiction, saving considerable resources in the development of common solutions to similar problems. Member states have also achieved economies of scale by collecting and analyzing environmental quality data centrally." It was obvious ten years ago that there would be great advantage for Canada to improve the efficiency of efforts to protect the nation's water resources. Though some jurisdictions tried, the government of Canada did little or nothing. Now, as we enter the third decade of what is likely to be a century of upheaval, it is no longer merely advantageous but crucial that Canada stop taking its water resources for granted and take immediate steps to reform its outdated, unclear, fragmented and comparatively inefficient national water policy. We are not without example to which we can turn. Others, like the European Union, have shown us the way.

What could we have learned and what can we learn now from the EU Water Framework Directive? The EU built a foundation upon which cooperation could flourish. It did so first by establishing a strong legal basis for higher common management standards and then following up on those standards with strong

enforcement while at the same time collaborating on the development of creative implementation mechanisms that it built into a common implementation strategy. The EU solidified this foundation by forging trusting relationship between representatives of member states, setting highly ambitious goals based on measurable results and meaningful consequences for non-compliance while at the same time establishing creative and reliable sources of funding to ensure every member state could ultimately improve water resource management at the same ever-improving high standard. No one has been left behind.

One of the experts in Europe that Émilie Lagacé interviewed and quoted in her briefing note was the same Philip Weller this author had interviewed four years before. Weller told Lagacé exactly what he told me: “The cooperation that came through the river basin planning process of the WFD reinforced what was already there but in essence ... it was the glue that solidified the initiatives that were underway.” As Weller maintains, success in creating national water policy in this or any other century is all about cooperation.

Émilie Lagacé’s briefing paper concludes, as this author has again ten years later, that there are clear and tangible benefits to collaborative water governance in the EU and that comparable benefits could be achieved in Canada through the adoption of similar approaches.

The only way forward toward a 21st century national water policy for Canada is through the creation of a strong, unifying federal focus on water governance and management. It will require what it required in Europe: active not passive trust building established through the building of strong and durable inter-personal relations; the establishment and adoption of ambitious common goals and targets, clearly measurable results with meaningful consequences for non-compliance and help for those who need it to catch up and keep up all made possible reliable long-term funding. All of these goals can be achieved by the creation of a Canada Water Agency.

Ten years ago, Émilie Lagacé put a sparkle on her call to action. All you need to do, she wrote, is instill “a dose of European-inspired political will and collaborative philosophy, and we could have a more coordinated and effective approach to water management in Canada.” A decade later, that sparkle has burst into flame.

The question now is not whether we need to reform Canada's national water policy but whether or not we want to wait until we face a calamitous "Danube Moment," like the chemical spill that led to the creation of the European Union Water Framework Directive, or does Canada want to create a 21st Century national water policy before a similar disaster or a chain of water-related extreme climate events forces us to do so?

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For Shared Water: One Framework

What Canada Can Learn from EU Water Governance

By Émilie Lagacé

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The Current Canadian Situation

Since the Gordon Water Group published their landmark *Changing the Flow: Blueprint for Federal Action on Fresh Water* in 2007, the Forum for Leadership on Water and dozens of other members of Canada's highly informed water community have published report after report calling for water policy reform at the federal level.

While a forty-year-old Canada Water Act has served the country well, evolving circumstances with respect to the breakdown of self-regulating biodiversity-based Earth system life support function and the accelerating impacts of climate disruption have underscored the need for national and continental watershed and climate monitoring and data assimilation without which the ultimate prize of reliable flood, drought and disaster forecasting will remain out of our reach. None of these goals can be achieved by provinces acting on their own.

That is not to say, however, that individual provinces are not on their way to achieving 21st century water policy within their own jurisdictions. Some, clearly, are. The Northwest Territories has crafted its own water strategy from the ground-up making theirs one of the most comprehensive and inclusive water policies in the country. The NWT went on to demonstrate the power of 21st century water policy to alter the management of even the very largest river systems through the signing of ground-breaking bilateral management agreements with its upstream riparian neighbours, Alberta, British Columbia and Saskatchewan, that now protect water quality and quantity in the entire Mackenzie River Basin.

Manitoba, faced with decades of ineffective action on the growing eutrophication of Lake Winnipeg, took a 21st century approach to collaboration between the communities and First Nations in the south basin of the lake by way of the Collaborative Leadership Initiative. For the first time in more than 150 years this ground-breaking process of trust-building tied to common action brought the mayors, reeves and First Nation chiefs to the same table to determine how, by working together, they could finally restore the health of lake. In so doing they discovered that the ecological threat to the health of the lake, in fact the health of all watercourses in Manitoba, cannot be assured unless the water governance structure in the province was reformed, and that such reform cannot happen without reconciliation with First Nations. Through reconciliation, this Manitoba initiative aims not just to protect the waters of the province, but to build a stronger

economy and a post-colonial culture that will create a fair, just and sustainable future for the province.

The water community in Quebec is of the view that a Canadian Water Agency could be a hub that could advise all provincial and territorial governments on many of the serious water issues that are presently unknown to Canadians. There are, for example, more than 100 municipalities in Quebec alone without any sewage treatment at all and that in these communities, raw sewage is simply discharged into local watercourses. There are also 56 First Nations – some 200,000 people – in Canada that have no access to safe drinking water, except in bottles. It is also anticipated that the cost of flooding events, a serious issue in Quebec, is expected to triple by 2030. The Quebec water community is of the view that Canada could be guided in its effort to create 21st century national water policy by the European Union Water Framework Directive.

British Columbia has been moving for some time toward 21st century water policy beginning with its Water Act Modernization initiative. Some regions in B.C., such as the Okanagan Basin, have been particularly effective in terms of establishing inclusive collaboration that has not only led to better protection of the basin's precious water resources but to the advancement of meaningful reconciliation with equally progressive First Nations.

In British Columbia, the momentum in the direction toward effective 21st national water policy is also seen to inform the reconsideration of the Columbia River Treaty. During the Trump presidency, the negotiations did not advance quickly. Canada wants an updated treaty that is ecosystem-based as opposed to the current agreement that is utility-based. The current treaty, which focuses on electrical generation and flood control, does not even remotely resemble ecosystem-based governance. The Americans, however, do not appear to be interested in including ecosystem-based consideration in the reconsideration of the treaty. Quite the contrary. American negotiators wanted to drastically reduce the Canadian entitlement, the amount of money the U.S. pays Canada for its role in controlling water in the upper reaches of the Columbia watershed. The Canadian negotiators, however, observe that much has changed since 1964 when the treaty was signed. Because of the move to renewables, energy sources are more important than they were in 1964. This makes the Canadian entitlement more important than ever. Canadian negotiators also note that impacts on ecosystems that were only projected 50 years ago have been fully realized, and they are as bad or worse than projected,

especially as they relate to salmon. In addition to changes in ecosystem health, there have also been equally or at least commensurately significant changes in citizen engagement and in sovereign influence and standing with respect to Indigenous peoples. It is also important to acknowledge that climate impacts, which were largely unknown in 1964, are now centre stage. What was fifty years ago a predominately snow-dominated climate system in the basin is now a rain-dominated system, which changes the electrical production dynamics of the entire basin. All of these matters have significant bearing on what have, until the change in administration, been increasingly delicate negotiations. With a new president and administration in place, however, 21st century national policy could be in reach for both countries, at least in terms of management of the Columbia, based not on a win-lose negotiation but on the understanding that the most desirable treaty outcome will be defined on the extent to which the treaty brings optimal benefits to all.

Not every province is moving forward, however. The Province of Alberta is proposing to permit Australian mining interests to extract metallurgical grade coal from vast areas at the mountain headwaters of the South Saskatchewan River with the intention of exporting it directly to China. In exchange for the damage this mountain top mining will cause, the Province of Alberta intends to rake in a whopping 1% royalty

Permitting open pit mining in the headwaters of one of the most productive food producing regions in the entire world is something that might have been considered reasonable water policy in the 19th century. Today it is considered madness, especially given the province's shameful record of failed promises to remediate thousands of orphaned and abandoned oil wells and the province's shocking failure at achieving promised goals of remediation in the vast areas of the province that have been sterilized by oil sands mining. This a movement backwards not forwards; this is Alberta repeating itself rather than re-inventing itself.

Rolling back 50 years of hard-won social and environmental policy just to briefly create a few jobs is a bad idea. The water that flows from the headwaters of this basin doesn't just belong to Albertans. This is clearly not the time to be damaging the upper regions of one of the most important watersheds in the country. Let's go forward, not backward.

The problem on a national scale is that while we do have excellent regional examples of the movement in the direction of 21st century water policy, no single

jurisdiction has all the solutions and no single jurisdiction has capacity to address all the current and emerging water and water-related climate issues on its own. The federal government needs to catch up with provincial leaders. If we gathered all the solutions in one place – a Canada Water Agency – each of the provinces and the entire country can advance toward national water security together. The benefits that could accrue by doing so go far beyond Canada’s borders. By aligning all of our domestic efforts with water policy commensurate with the problems we are facing and will face in this century, an image of a new image of Canada on the global stage also begins to quickly take shape.

We know what to do. Four paths have been put forward in a document entitled *Water Security for Canadians* which was put forward jointly by Global Water Futures program, the Centre for Indigenous Environmental Resources, the Forum for Leadership on Water and the United Nations University Institute for Water, Environment and Health on behalf of the broader Canadian water community in 2020.

The Path to Solutions

Most water management decisions are made locally, through provincial or Indigenous jurisdictions, yet the majority of our major river and lake basins are transboundary. A balanced way to strengthen the health and protect the ecosystem services of these shared waters is through a more integrated river basin level management approach. This approach requires all orders of government, including Indigenous governments, to work together. Importantly, because these waters cut across jurisdictional boundaries, rights and responsibilities, this approach requires a meaningful federal role, particularly in four key areas:

1. Creating and mobilizing the knowledge needed to predict and respond to water problems – by providing centralized and harmonized collection and dissemination of water information; water predictions including flood and drought forecasting; and decision-support services through a Canada Water Security Centre.
2. Strengthening transboundary water management and cooperative federalism – by prioritizing healthy and intact watersheds, as well as capacity and commitment to anticipate, investigate, avoid and resolve disputes through a National Water Commission. The Commission would also guide water management and water-related climate mitigation and adaptation strategies through the 21st century. This role includes understanding and making recommendations regarding evolving

public opinion and best international practices, for example fiduciary duty and public trust concepts articulated in a modernized law.

3. Strengthening reconciliation with Indigenous peoples – by ensuring the Canada Water Act is consistent with the United Nations Declaration on the Rights of Indigenous Peoples and adopting a consent-based, co-drafting approach to renewing the Canada Water Act in partnership with Indigenous governments, and support implementation of Indigenous inherent, Aboriginal and treaty water rights and roles in water governance and management.

4. Improving collaborative river basin planning – by building durable partnerships for water management and decision making with provinces, territories, municipalities, and Indigenous governments with a clear outcome of building resilience to extreme events, identifying priority areas for watershed restoration, and ensuring effective environmental flow regimes are in place across levels of jurisdiction and authority.

Enabling these specific water solutions can save Canada billions of dollars by preventing damage to infrastructure and ecosystems and reducing disaster payments. The federal government can carefully target existing expenditures and realize new efficiencies between federal departments with water portfolios to financially support changes to a modernized Canada Water Act. The solutions identified here will make our industries, communities, and the places we live more resilient and less vulnerable to climate change and will make Canada shine on the global stage by showing the world how to build lasting water security in an increasingly uncertain world.

Conclusion

Taken as a whole, the water sector in Canada continues to conduct itself in a compartmentalised manner, focusing primarily on processes rather than on achievements and results without a sense of urgency for change or coordination of existing capacity. Harnessing and fully realizing the Canadian water sector's substantial capacity will need federal government coordination and support. While advancing coordination and effectiveness of its domestic water management and governance capacity, Canada should also be innovative in selecting the means and avenues to significantly enhance its visibility and impact on the global water stage. Current geopolitical uncertainties; the urgency of responding to the climate change induced acceleration of the global water cycle; Canada's commitment to its own Federal Sustainable Development Strategy, and Feminist Foreign Assistance

Strategy, and a newly started Water Action Decade for Sustainable Development, provide impetus for government at all levels, but especially federally, to work harder to coordinate and orchestrate the significant capacity in Canada's water sector for the benefit of the country and the world. And if Canada is to develop a global water strategy similar to that of the United States, even if for different reasons and ambition, it will be necessary to create a national water agency.

But the transformational moment in which we presently find ourselves won't last long unless we act decisively now. We find ourselves in a transformational moment. The pandemic has created a great pause in which we, as a nation, have been forced to examine very carefully how we will advance into the future. Canada has vowed to learn from this pandemic and to "build back better." The federal government has also promised the people of Canada that it will effectively address the climate change threat. Neither of these goals can be achieved without enlightened understanding of how valuable our water resources are and how much more valuable they will be in the future.

The creation of a Canada water agency was promised in the 2020 Federal Throne Speech. How such an agency should be structured and what its mandate should be is presently being debated across the country. It is anticipated that funding for the creation of such an agency will be in the next federal budget in 2021. Again, this is a transformational moment – we should seize it.

A Once-In-A Generation Geopolitical Opportunity: The Canadian Water Agency & It's Links to Foreign Policy & International Development Aid

Tom Axworthy, who directs the Public Policy Program at Massey College at the University of Toronto, has asked how a Canada Water Agency could be a driver of international leadership in other federal government priorities such as trade, diplomacy and international development. As it falls out this is both an important and very timely question that invites some very positively compelling answers.

Even a cursory examination of long-established perspectives on establishing better coordinated 21st century domestic water policy and the integrated extension of that policy into the domains of diplomacy and international development reveals enormous as yet unrealized opportunity. By linking the advancements in national cooperation on water with the goal of meeting new 21st century challenges to water management to foreign policy objectives, the Canada Water Agency can help Canada establish a new and very positive national image, or brand, abroad. Canada can re-invent itself on the world stage by using what we know about treating water as a vehicle for expanding trade while at the same time use our expanding expertise in water governance as a means of fulfilling Canada's diplomatic and international development aid objectives. But to realize the enormous potential before us in the transformational moment the pandemic has presented, we need, as a nation, to leave behind antiquated but deeply embedded habits of jurisdictional fragmentation and institutional territoriality that imprison us in water policy that may have served adequately in the 19th century but cannot possibly serve us now.

How we manage water is critical to Canada's future. It also matters greatly to the rest of the world with which we realize now we are inextricably inter-connected by what water has come to mean globally in terms of the quality of life of all; and the role water plays in defining the behaviour of our planet's self-regulating Earth and climate systems. There is work to be done, but the good news is that the time is right to do the work we need to do in linking what we do domestically with who we are recognized to be globally. We have all the pieces we need to re-define Canada as a water nation. All we need to do is assemble them differently.

The Current Picture

Colleen Sklar, who is one of the architects of the groundbreaking Collaborative Leadership Initiative that has brought First Nations Chiefs, Mayors and Reeves for the first time in 150 years in Manitoba, has talked about the difficulty of going the last mile in terms of realizing 21st century water policy and practice in this country. She makes a good point. Whenever we get close to the finish line, we drop the baton.

All across this country, I have heard governments and private engineering firms proclaim respectively that they are world class in terms of water governance and practice. So, if we are world class, then why are we not world famous? Why are we not thought of as global leaders?

We can't complete that critical last mile because the relay runners aren't in the same lanes and cannot connect to pass on the baton so we can finish the race. We get close, but we always seem to stumble, and we never seem to want to admit why. But everyone in the water community knows why.

As it stands now, the institutional structures are not in place that will allow us to go that last mile and achieve our goals. We remain in a deep rut of jurisdictional fragmentation, institutional territoriality and numbing bureaucratic paralysis.

That said, the opportunity that is before us now is to get our water sector out of its silos and into the same running lane.

What is needed is a carefully orchestrated flow of energies upward and outward from the water sector focused on how much we know about and how much we respect water, and how valuable to others what we have to offer might be.

What might such a new flow of energy like this look like?

Let's examine what it looks like when Canada gets its act together domestically and then in terms of foreign policy and the effect this has had in the past on our reputation on the world stage.

Remember the last time we were highly regarded globally, when the entire world thought warmly of us? Remember how we spent decades building a world-

renowned reputation for peace-keeping and peace-making? Let's reflect for a moment on how Canada did that. What Canada did was create, not a vicious, but a virtuous circle. Political leaders convinced the Canadian public that though we are a small nation, there were important things we could do on the world stage. Successive governments and a proud public supported a well-trained military and its deployment to conflict zones abroad.

These interventions were informed by Canada's foreign affairs objectives that included strong links to the United Nations and to NATO. Our peacekeeping commitments were also seen as an effective instrument for advancing Canada's international development and foreign aid investments. We were seen as different from our southern neighbours and friends to the world.

Our reputation grew to such an extent that Canadians abroad were treated with respect and deference everywhere, and envious young travellers seeking to be welcome abroad put Canadian flags on their backpacks.

So, does Canada have an opportunity to create the same kind of virtuous circle domestically and internationally through water? Absolutely, but we had better get moving as the new administration in the United States is about to revive a 2017 national security strategy to do just that, if they can, in order to restore their own flagging reputation abroad. The first step in the revival of the proposed U.S. Global Water Strategy is for the U.S. to create a National Water Commission. Building on the century-long relationship we have built by way of the International Joint Commission with respect to anticipating and then acting upon potential disputes between our two countries, Canada needs to keep up with this. Because we are neighbours on the same continent, we need to be in lockstep with their own efforts to create, at last, a 21st century water policy for the United States.

Water security is becoming a huge issue in the United States, which means it could soon be a national security issue to Canada. We cannot even contemplate dealing with the national security issues of our thirsty southern neighbour without first getting our own house in order with respect to the 21st century national water policy we need to put in place to ensure that management of water is a contributing, not a limiting factor in terms of our country's future prosperity.

At present we are not structured to close a virtuous circle linking domestic action and Canadian identity abroad on water, but we could be. So, what might that look like? It might look something like the following.

Political leaders inspire a fuller public recognition of the importance of water to national identity and our prosperity now and in the future. A Canadian Water Agency is created.

The agency acts on the research outcomes and recommendations of the Global Water Futures program and other research networks. The Canadian public begins to see that we really do rely on water for our way of life but that we also have knowledge we can trust and build upon to create a just, safe, sustainable and prosperous future. Our youth are similarly engaged across the country as a result of enhanced water education and citizen science.

As a result of references to the International Joint Commission, transboundary issues related to nutrient flows and heavy metals in water have been resolved and protocols for dealing with contaminants of emerging concern have been put in place. Both countries move beyond the legacy of the Trump administration. Canada and the United States are again proactively cooperating over water issues of mutual concern.

The UN's 2030 Sustainable Development goals, particularly as they relate to water, are identified and celebrated as something Canada and Canadians are proud to achieve. Canada begins to see that, informed as this nation is by a legacy of outstanding scientific research, we really are worthy of an international reputation for technology and innovation.

This confidence, in itself, informs better governance and better last mile choices by jurisdictions which allows Canada's trade commissioners to take even greater pride in what they are promoting and greater confidence in what they can promote in the future.

We not only respect but celebrate and act upon Indigenous wisdom as it relates especially to the sacredness of water. All of these domestic advancements, in tandem, inform and then drive what we do in terms of international development, which builds on the reputation of CIDA and other efforts abroad.

It is recognized that the Canadian military is already well respected for supplying mobile water treatment and purification capacity in disaster situations, which builds on our legacy of peace-keeping, which casts Canada in a positive light once again on the global geopolitical stage. Providing safe water to those in crisis could, in fact, be our new form of peace-keeping and peace-making.

Next, we ourselves as a country begin to meet the targets of the United Nations 2030 *Transforming Our World* global Sustainable Development Goal 6 linked to water. Through our example and our aid, we facilitate poverty reduction elsewhere and achieve Canada's already established goals in support of the Feminist International Assistance Policy. We also help developing countries and the rest of the world to do the same.

Canadians are now proud of our country's growing reputation with respect to water and commit ever more deeply to meeting our water goals domestically so we can shine abroad, where everyone everywhere is again happy to see us. The virtuous circle is complete.

In the creation of this virtuous circle, a newly created Canadian Water Agency could be the unifying and coordinating force that helps us go that last mile in the race to create a 21st century national water policy.

Canadian participation in the UN's current *Decade of Action "Water for Sustainable Development"* might at the right time be a perfect platform for announcing Canada's bold new intentions. Efforts to revive Canadian participation in that International Decade have already been initiated through the Global Water Futures program.

We should not ignore either, that this is an opportunity to align a sagging and combative cooperative federalism with the common good nationally and globally in a way that strengthens our country. And perhaps, just perhaps, by shoring up cooperative federalism over water, we can strengthen a common desire to get us all into the same lane with respect to the climate threat.

In summary, if we want to cross the finish line at the far end of that critical last mile, we need to continue supporting further research and translating research outcomes into ever more refined technologies and advancements in practice.

We need to make water governance reform a part of meaningful reconciliation with the Indigenous peoples among whom we all live and with whom we are all signatory to treaties that need, not just to be honoured, but whose intent, it is recognized, is to make ours a stronger, more sustainably prosperous country now and in the future.

Federal, provincial, territorial and Indigenous governments have to work more effectively together to govern water in a collaborative way based on cooperation between jurisdictions on the river basin basis so to reduce the costs of mismanagement, reduce resource development conflicts, establish ways to agree on how sustainable development should proceed in a changing climate. At the same time Canada has to use its re-energized focus of water to increase opportunities for sustainable development of water resources and provide developing countries abroad with the same opportunities. This would make Canada shine again on the global stage by showing the world how we won, and the rest of the world can win, with water.

There is urgency here. The virtuous circle we want to create is a powerful chemical reaction that wants to happen all on its own. This is a virtuous circle that yearns to complete itself. This could be the best thing that comes out of this terrible pandemic. So, while circumstances still permit, let's get out of our own way and let it happen.

Canada & the Global Climate Picture

As we shall see in the final two sections of this report, this is a moment in history dominated by both possibility and emergency. There are some profoundly troubling matters backed up behind the COVID dam and only through careful understanding of water and what we can learn from what it is telling us will we be able to address them in time to avoid a turbulent future.

It is important to move perspectives on 21st Century Water Policy out of the domain of the domestic and self-referential so that we can see ourselves in a global context. Most Canadians hold, consciously or unconsciously, that the standard at which we presently live is an entitlement. An entitlement, it is not. While we tend to rely on our relatively small population and huge landmass to ignore larger realities, there are realities that, in an ever more crowded and connected world, we cannot ignore. It starts with our numbers and our collective impacts. We have, at present, become the most dominant and most dangerous species on Earth. We have only one serious competitor – and that one happens to have been around for more than 2 ½ billion years before the appearance of multi-cellular life. That is the virus and, but for vaccines, it could still win.

But this is not our only problem. Presently we are doubly infected globally. Not only is the virus killing us, we have also made the planet sick with fever. That planetary fever is no longer just causing us headaches. Planetary temperatures are so high and rising so fast that they threaten the fundamental function of the biogeochemistry that permits human presence on Earth.

In terms of climate action globally, what we are doing presently is not what we want. It is circumstantial and temporary. What we need is a lasting commitment to decarbonization and protection of biodiversity that does not come at a huge human cost in terms of lives and livelihoods. What we are doing presently has shown is that the quality of life we can have can be better.

The pandemic has exacerbated global inequality and poverty and increased the inequality gap between rich and poor countries. This inequality is the greatest weakness in the current neoliberal economic model. This inequality has also put into relief the fact that it will be the poorest and the world's have-nots who are going to suffer most as a consequence of climate disruption.

This transformational moment is not about shutting down the world; it is about address issues of inequality. We have created a global economy in which the richest 1% have more than twice as much wealth as 4.6 billion people in the rest of the world's population. This moment should be about fixing the economic model not shutting down the economy.

One crisis does not end because of the arrival of another. The COVID crisis is now colliding with the climate crisis. Many of the same actions that can help slow climate disruption, such as stopping deforestation and rampant industrial agriculture will help address both issues of inequality and climate instability. We need transformative policies to end the burning of fossil fuels and restore the capacity of ecosystems to stabilize Earth system function. We need to affirm responsibility to our children by investing in the health of our planet.

COVID has slapped us in the face with lesson upon lesson. We are on the steepest learning curve we have ever been on. The meta-lesson is this: Human health = planetary health. But when the vaccines are available, will we remember what we have just learned? Will we translate the lessons into policy? Will we apply the lessons we have learned and incorporate them into individual behavioural change? How do we ensure the changes we make are not just sustainable but just, so that they can affect meaningful social change rather than becoming mere one-time actions that pretend to be change?

We have shown that we can adapt to a crisis like the COVID pandemic. Can we do the same now for climate change?

Yes, we can. All we have to do is want to. And now is the time to want to. But to do so, we have to be clear about what we are up against.

We know that, even if we stopped greenhouse emissions tomorrow, our legacy load of carbon of 1000 gigatons (a gigaton being a thousand million metric tonnes) will keep driving warming. We are now in totally uncharted territory with respect to climate disruption. Different climate impacts have begun to interact with one another. Two immediate climate interactions are particularly worrisome. First, as extreme events become more intense and more frequent, they will more often occur closer together in time and place, which will worsen their overall impact. Alone, a single extreme event – such as a hurricane, a major flooding event or a

mega-wildfire – can devastate wide areas. But back-to-back climate catastrophes compound the misery caused by each.

In the coming decades, as temperatures continue to climb, seemingly isolated climate disasters will begin to overlap and their impacts will no longer simply be additive. Climate scientists expect to see more intense tropical cyclones and more heat waves. Each disaster could compound the danger of the next, with less and less time for people to recover in between.

The second type of climate interaction we can expect in climate change's dangerous next phase is longer term. It happens when one of the Earth's mechanisms for regulating the climate – systems involving air, the ocean, land, water, or ice runs amok, setting off a chain reaction involving other such mechanisms.

It's Coming, Get Ready

Even if the nations of the world come coherently together on the climate threat, we can expect that soon some once-in-a-lifetime catastrophes will become annual disasters. As temperatures rise, the odds that such events will occur at any specific place in a given year are rising. Scientists are now warning that such events have a tendency to cluster around some places on the globe. By 2050, many such areas around the world will face flood levels every year that only recently occurred once in a century.

When extreme events strike the same place more frequently, the confluence can be more devastating than the sum of its parts. Consider a string of extremely hot days in one particular city or region – the odds of which, computer models confirm, are growing steadily both in duration and frequency.

A few consecutive days of unusually hot days is manageable, but a week or longer less so. As a heat wave goes on, the electrical grid struggles to supply enough power for all the air conditioning being used. Blackouts follow. With no air conditioning - that is assuming you even have air conditioning - the human body's own system for surviving heat breaks down. People begin to die of heat stroke and respiratory disease. Multiply the number of such heat waves, and these effects are compounded.

Clearly the intensification and interaction of extreme events creates societal risks of an entirely new kind and of a different magnitude than humanity has ever faced before. Using computers to predict when and where such events may occur is of little immediate help, since modelling of these events is still in its development stage. Nor can we extrapolate from past experience, since our climate is evolving well outside of what humanity has ever experienced. It is not that a confluence of risky climate events is an entirely new concept. But what is new is the likelihood that some confluences will occur is growing rapidly globally.

Tipping Points

In addition to the prospect of extreme events coinciding or overlapping, scientists have long worried about tipping points – thresholds beyond which small increases in the global temperature can lead to rapid disruptive effects.

We do not know, however, when a tipping point will be crossed in terms of when these impacts might actually undermine the stability of the global climate system; and, because these changes are occurring faster than science can measure them, we are unlikely to be able to identify where we crossed actual tipping points were until after we have crossed them.

We do know, however, that if such thresholds exist and they can be crossed at relatively low temperature increases, that the result will be disastrous. There would be widespread dislocation of ecosystems with huge impacts on whole societies with little time to adapt.

Even more frightening is evidence which suggests that several of these tipping point phenomena could interact. If a threshold in one system is crossed, there exists the possibility of a ripple effect, causing thresholds in others to be crossed, too.

What Should We Do?

These new risks to the planet should challenge the conventional wisdom on fighting climate change. Most countries are approaching the climate problem as though it was a linear problem. Reduce emissions and we will solve the problem. That may have been true twenty years ago, but it isn't so now. We need solutions

that will address multiple Earth system impacts, including biodiversity loss, the loss of our forests and ocean acidification as well as climate change. We are presently trying to use arithmetic to solve what has become a calculus problem.

The global focus on reducing carbon emissions is understandable, since if greenhouse gas emissions are not reduced, successful adaptation to climate disruption will be impossible for most of humanity. Adaptation has also seen to be less attractive than mitigation because it involves no global silver bullets. But policymakers no longer have the luxury of downgrading the importance of adaptation, because we have already entered climate change's dangerous next phase. The effects that scientists warned were in the future twenty years ago have arrived just as predicted.

As the above examples suggest, although governments can learn through experience with individual disasters, they are almost never ready for a new combination of them. This does not offer much of a case for optimism when it comes to preparing for long-term climate disruption. Indeed, even in a world where climate risks rarely interact, governments are already inadequately planning for potential disasters. As these risks increasingly compound one another, governments will lag ever further behind. This suggests many government climate strategies have to change, if only out of the recognition that humanity has waited too long to address the threat of climate disruption before it got away on us. In the circumstances in which we now find ourselves emphasizing emissions reductions but not focussing at least equally on adaptation is a recipe for catastrophe, because no matter what happens to emissions over the next 30 years, the planet will get significantly hotter. Trapped heat that has been absorbed by the global ocean over decades is bound to emerge, warming the Earth. Years of emissions that accumulated in the atmosphere will have a lag effect on the heating of the climate. No matter what we do, we are in for warming, how much depends entirely on what we do now.

The Bottom Line

Even achieving the targets of the Paris Accord will not allow humanity a free pass to avoid adaptation. While achieving those goals would certainly give humanity some breathing room, there is no escaping that the warming will be on-going. We already know that the amount of carbon dioxide we have already spewed into

atmosphere will have serious consequences. We even know what some of those consequences will be. Even if the world stopped emitting carbon dioxide and methane next Monday morning, the amount presently in the atmosphere remains poised to generate a 100-fold increase in the frequency of floods along many of the world's coastlines.

It is true that no amount of adaptation will be enough if emissions remain unconstrained, because that would lead to warming that would go far beyond what humanity has experienced. But it is also true that even the greatest possible reduction of emissions reductions will be enough to spare communities that don't adapt.

The bottom line is that few if any countries are sufficiently prepared to deal with what is coming. A yawning gap has opened up between what they know about the risks of climate change and what they are doing to reduce them. In the riskier new era of climate change, the longer countries take to close the gap, the more painful and deadly the outcomes.

On Urgency: Vaccines for COVID, Vaccines for Climate Change, Vaccines for National Unity

What might the painful and deadly outcomes of accelerating climate change mean to Canadians? Let's begin with the known climate and related risks that a high planetary fever poses, here and now and will pose in the future here in Canada and abroad. In other words, let's take a look at what is backed up behind the COVID dam and is waiting for us as we wait for a vaccine against the virus to be perfected and distributed.

The first thing that awaits us behind the COVID dam is the effect of warming atmospheric temperatures on how much water the global atmosphere can transport. More water vapour in the atmosphere is making storms more powerful; heat waves more intense and drought deeper and more persistent. The rate and manner in which water moves through the global hydrological cycle is also accelerating.

Warming atmospheric temperatures have caused a cascade of impacts including rapid Arctic warming, disappearing sea ice, changes in jet stream behaviour and destabilization of the global climate, all of which are beginning to take a big toll. We are already seeing the mounting economic costs of that destabilization in Canada.

It is now estimated that the total indexed cost to this country of damage caused by extreme weather events from Confederation in 1867 to the year 2000 – a period of 133 years – was \$1 billion. The cost of extreme weather damage to from 2000 to 2020 – that is to say the last two decades – was \$32 billion.

It is also interesting to note that in 2020, while the national attention in the United States was focused on COVID and all the political drama associated with the presidential election, at more than \$100 billion, the United States suffered the most expensive year in terms of damage from natural disasters in the country's history.

We continue year after year to tempt fate with respect to global climate disruption. We have yet, for example, come to fully appreciate the link between a rising planetary fever and food production.

We know what food shortages do. They incite involuntary human migration. When food production decreases in the face of lost hydrological stability, it isn't long

before you can lose social and political stability as well. That is happening, but we ain't seen anything yet. The UN expects there will be 200 million refugees globally by 2050.

There is already growing involuntary climate related human migration even on this continent. The habitable zone in the United States is already shrinking northward toward Canada. Much of south Florida, the Carolina's, the American west and Southwest are projected to soon be barely habitable. Where will these people go? Many of them will want to come to Canada. This movement northward will occur globally. They are coming. Get ready.

COVID is bad and it is going to get worse – until enough are vaccinated. In the meantime, climate change and its symptoms will also get worse.

There is an interim vaccine for climate change, too, but for it to work, we have to take it and there are a lot of anti-vaccers who don't want to and many who won't.

Has enough had been done to make carbon neutrality a reality? There has been some preliminary testing of carbon neutrality as a vaccine already. One of these tests was accidental. Earth Overshoot Day is the date each year when humanity will have used all of the biological resources that Earth can renew during the entire year. Fifty years ago, the planet could sustain our population and provide for its needs for just over the entire year.

In 2017 it fell on August 2nd. That year it was calculated that we needed the equivalent of 1.7 Earths to sustain our population at current levels of need and demand. It looked like we were on our way to plundering ourselves out of house and home. But this year, something very different happened. Earth Overshoot Day in 2020 fell on August 22nd, more than three weeks later than it did in 2019.

The later day reflects the 9.3% reduction in humanity's ecological footprint from January 1st to Earth Overshoot Day compared to the same period last year.

This of course, is a direct consequence of the unfortunate, painful and completely unplanned economic and other costs associated with coronavirus-induced lockdowns around the world. But even that painful reduction is not enough. Carbon dioxide concentrations in the atmosphere continue to rise despite our unplanned and abrupt reductions in carbon emissions which suggests feedbacks have been initiated that will result in increases in carbon dioxide in the atmosphere unless we are able to get ahead of rising global temperatures now.

One such feedback has been identified right here in Canada; and that is the greenhouse release feedback caused by permafrost thaw in our Arctic. There is three times more carbon sequestered in permafrost than in all of the forests on Earth combined. In Canada alone there are an estimated 1500 billion tonnes of carbon sequestered in Arctic permafrost. There are a thousand billion tonnes in near-surface sediments which is about the same amount of carbon that we now have floating in our ever-hotter atmosphere. Unchecked, a warming Arctic could release the same amount of greenhouse gases as are currently being emitted by the entire United States each year. Let that much carbon loose and we stand to create a self-perpetuating feedback loop in which warming generates more warming

Because of unprecedented warming in the past two decades, the staggering scale of thawing of permafrost has turned the Arctic into a carbon source instead of a carbon sink. As one scientist put it, because of permafrost thaw, the Arctic has become an enormous carbon chimney.

Though you can't see it, the carbon chimneys that thawing permafrost has created, have in effect "industrialized the Arctic." The same amount of carbon is escaping unseen into the atmosphere as would escape from an industrial park in a southern city. By way of global warming have turned the tundra into the equivalent of a planetary internal combustion engine.

The only way this problem has a hope of being addressed is if the eight Arctic countries can press for full Russian, American and Canadian cooperation to address the climate threat in time to halt catastrophic permafrost thaw to prevent runaway global heating. That cooperation, however, doesn't yet exist.

As it happens, however, art is playing a role in bringing Russia and Canada together on the permafrost thaw issue. In late 2020, Russian-born U.K. artist Gennadiy Ivanov held an exhibition on climate change in the Arctic at the Russian Embassy in London, England. The exhibition brought Russian and Canadian diplomats into the same sphere over the climate change threat, especially as it relates to the potential for runaway methane releases brought about permafrost thaw.



Methane Releases and Permafrost Thaw in the Arctic
Gennadih Ivanov

This exhibition was followed by another held in Moscow. Even if Putin is downplaying the risks associated with climate disruption, the diplomats who presided over the opening of this exhibition did not. In opening remarks that noted that 65% of Russia is subject to permafrost thaw and committed to cooperation on the problem of permafrost thaw. As part of the opening, Canada's High Commission to the United Kingdom, whose office had hosted Ivanov's exhibition in London who observed that the rate of warming in the Arctic was already having deep and lasting impacts on northern peoples and landscapes. She noted that Canada through the Arctic Council, will be profiling climate impacts on northern peoples and putting forward solutions after May of 20121 when Russia takes over the Chair of the Council. We live in hope.

Following the High Commissioner's presentation, Dr. John Pomeroy, the Director of Canada's Global Water Futures research program took the virtual floor to present data that showed warming of 1.5°C to 4.9°C in the high latitudes of both Canada and Russia since 1960. Both Canada and Russia are warming at twice the

global average, and three times faster at higher latitudes. Without active greenhouse controls, Dr. Pomeroy said, we are heading to the worst-case scenarios with respect to the impacts of global heating.

But the arctic is not just warming, Pomeroy added, it is also wetting. Extreme precipitation events have starting to “cluster” across in both Canada and Russia. There are also terrible fires in both countries. Fire, he said, is now a global warming shock wave.

This isn't the first time the potential for fire to get out of human control has been a concern. Two centuries ago, the Comte de Buffon saw cooling as the project of civilizations during what he contemplated as the “seventh and last epoch” of Earth history when he predicted that humanity would have the power to secure for itself an optimal global climate. There was a proviso, however. Here is what he said:

... man can modify the influences of climate in which he lives, and can secure, so to speak the temperature to the level at which it suits him. And there is something that is singular: it is more difficult to him to cool the Earth than to heat it. Master of the element of fire, which he can augment and propagate at his will, he cannot do the same with the element of cold, which he can neither grasp nor communicate.

Buffon was right. Cold matters. He was wrong, however, about us being the master of fire. For three thousand years the occupation and agricultural development of new land often meant burning it first. While natural wildfire used to be comparatively rare and patchy – and most often caused by lightning – greater human use of fire has brought about a new era in which natural history, including climate, have become a sub-set of fire history. A fire age was in the making. Now catastrophic fires are part of human existence in states like California and countries like Canada and Australia and in vast regions like the Amazon Basin. Some have gone so far as to rename the Anthropocene, the Pyrocene, an age in which we no longer master fire, fire masters us.

It is not just what is happening on land in the Arctic that should concern us. In the Canadian Arctic everything related to climate change is going wrong all at once. Researchers on board the Multi-Disciplinary drifting observatory for the Study of Arctic Climate known as MOSAiC project, have found that under the sea ice the Arctic Ocean is a gigantic heating system bringing energy from the south. That

warmth breaks through to the surface to warm the polar night through cracks in the ice. We are beginning to find out how less and thinner ice will impact this under-ice heating system and the effects that will have on climate change. It appears that less and thinner ice affects cloud formation. More clouds in the sky trap heat which leads to warmer temperatures. As the atmosphere continues to warm the types of clouds that are forming are precisely those that capture heat and result in warmer temperatures. This appears to be another positive feedback, another way in which climate change drives itself forward.

Another discovery MOSAiC researchers made was that fine dust from human sources and forest fires, carried by winds from North America and Siberia also pollutes the Arctic atmosphere. Black carbon soot particles heat up the surrounding atmosphere, while sulphur particles cool it at least temporarily, thereby masking warming.

The also found that microplastics have made their way into even the remotest parts of the Arctic Ocean. Not only are they in the ocean they are in the air, in rain drops and snowflakes. MOSAiC researchers also found that because a warming atmosphere can transport more water vapour, a warmer Arctic will produce more snow. Snow, as the Inuit know, is an effective heat insulator. Snow lies on the ice like a protective cover, insulating flows from the cold Arctic air, which prevents more ocean water from freezing. The more snow that falls, the thinner the sea ice becomes. In the 1980s Arctic sea ice on average covered area of over 7 million square kilometers in September, roughly the area of the continent of Australia. It now routinely covers barely half that area. Its thickness, which in the 1960s averaged three meters has now diminished to less than a metre.

MOSAiC researchers also studied phytoplankton, marine microalgae that form the base of the food chain in the Arctic and the rest of the world's oceans. What they found is frightening almost beyond imagination. Because the sea ice is disappearing, the outlook for ice algae, and all the creatures that rely on it, is bleak. Phytoplankton, however, may have a different fate. It appears that extreme algal blooms under the ice may have become more frequent in recent years due to the thinning of seas ice and its earlier perforation by melt ponds. And this is happening at the same time phytoplankton concentrations in most other oceans in the world have declined, because of warming and pollution, by 40%. It should be noted that half of the oxygen in the global atmosphere derives not from plants on land but

from marine phytoplankton. In other words, in one of every two breaths, we are taking in oxygen that comes from the sea. But now the world's other oceans are generating less oxygen.

For now, the Arctic Ocean absorbs carbon dioxide and generates oxygen. If you warm the Arctic Ocean, what will happen? Will it absorb less carbon dioxide? Yes. Will a warmer Arctic ocean generate less oxygen? We don't know. What is climate change doing to the global atmospheric oxygen cycle? We don't know. Could we suffocate ourselves by warming the Arctic Ocean? We don't know.

We are, however, beginning to understand the extent to which microorganisms can be co-responsible for the formation of clouds and that sea-ice mediates gas exchange between the ocean and the atmosphere. In terms of the world's oceans, the Polar Sea has a much greater influence on the global climate than its surface area suggests. From a planetary perspective Arctic sea is a paper-thin layer of cold that thermo-regulates the climate of the entire planet. The growing warmth of the Pacific and Atlantic oceans is enough to result in an ice-free Arctic Ocean. Without polar ice, Canada is going to be a very different place. So will the rest of the world.

Unfortunately, we still have a long way to go even in Canada to understand the full threat climate disruption poses. In direct response to the latest science rapid climate warming in the Arctic, which was put forward in a webinar organized by Massey College, Canada's Minister of Environment said that he acknowledged that "Canada has the largest store of carbon in all of nature, and that the federal government has some responsibility here."

So, if carbon neutrality is to climate change as a vaccine is to the pandemic, how are we doing with the development of the climate vaccine? Well, on a federal level not so good. The Liberal's recently announced climate emergency plan does not have any penalties for failing to meet targets. It is voluntary, which makes it meaningless. The federal climate action plan does not come into effect in 2023 with the first report on progress in 2025.

When we can't even get the provinces to get on board with any climate plan let alone a Liberal Plan, what do you think the chances are that we will be on top of the climate problem by 2030 and be totally carbon neutral by 2050? Federally, all we have done is kick the can down the road.

What they have offered is an absence of political accountability and an admission that cooperative federalism isn't working in this country because the provinces have the option always to do whatever is in their immediate interests rather than what is good for the country or for the world.

So, what are the consequences of this? Former Yukon Premier Tony Pennikett offered a response to the federal Environment Minister's Massey College remarks on the government's responsibility to deal with the growing climate threat. Pennikett pointed out that if permafrost thaw continues to occur at even current rates, the national goals for carbon emissions reductions will continue to be moving targets. Because of permafrost thaw and other feedback releases, Canada's stated goal of exceeding our 2030 emissions reductions target and net zero carbon emission by 2050 will recede continually beyond our grasp. Stated bluntly, we are at – and perhaps past – the climate tipping point beyond which the option of carbon neutrality is no longer available to Canadians.

This, however, does not have to mean the end of the world. We cannot allow it to be too late. While it is true that in warming the Arctic, cutting down our forests and damaging the planet's soils we are releasing carbon dioxide, the converse is also true. The living Earth can be our ally and our partner in reversing the damage we have done to our only home. By renewing nature's processes for sequestering carbon, we can store carbon in life. This is the geoengineering we need, not madly pumping dangerous sulphur compounds into the upper atmosphere or installing mirrors in space. To refreeze the Arctic, we need to reduce our emissions of heat-trapping gases. If we take care of nature and nature will take care of us. We cannot halt permafrost thaw directly but we may be able to do it by restoring forests, restoring soil health, and rewilding the world. In the end, saving the Amazon could save the Arctic. Our individual futures now depend on the behaviour of all of the human family and on planetary health. We have no choice but to recognize that we are all in this together.

So here is where we stand. You notice you have got a fever. You discover it is getting worse. How long can you go before you go to the doctor? How sick do you have to become before you do something about it? How sick do you have to become before you can't do anything about it?

The highest priority of 21st Century National Water Policy must be to do something about it. So, where do we go from here? You can't defeat a global disease with local responses; but if there are enough appropriate local responses at

the provincial and community you can slow and moderate its local effects until a vaccine is available to all and has been universally administered. A Canada Water Agency has to be in that vaccine.

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Appendix

Water Security for Canadians

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This concept note explains how the federal government can provide leadership and better exercise its jurisdiction to help solve Canada's worsening national water crisis. This analysis proposes a number of activities that will position Canada as a global leader in water prediction, management and sustainability.

Modernization of the Canada Water Act (1970) – the federal government's primary freshwater legislation – is central to the comprehensive approach outlined in this note. A modernized Act will support the creation of a collaboratively built Canada Water Security Centre and a National Water Security Commission; support implementation of Indigenous inherent, Aboriginal and treaty water rights and roles in water governance and management; and, catalyze renewed funding and capacity for freshwater monitoring, prediction, planning and management.

The Water Crisis

Canadians can no longer be assured our waters are abundant, safe and secure. As global temperatures continue to increase, glaciers melt, permafrost thaws, river flows become unpredictable and lakes warm and fill with toxic algae. Science is telling us that the rate at which water moves through the water cycle is accelerating, which is fundamentally changing weather and precipitation patterns. Evidence of such change in Canada is mounting, with more frequent and extreme floods, droughts, and fires. A changing climate and a disrupted hydrologic cycle also amplifies the negative effects of development and pollution on watersheds and are damaging aquatic life in our waterways from coast to coast to coast.

The impacts of these rapid changes in water availability and quality are costly. The implications include undermining the health and function of world-class heritage parks and ecosystems, traditional subsistence ways of life, our built infrastructure

and food and energy production. Concern and conflicts over water are central in the public's resistance and lack of trust around resource developments, with significant economic and social consequences. Meanwhile, the cost of floods and droughts for families, towns and cities, the insurance sector, businesses, and ultimately the federal government, are skyrocketing and unsustainable.

The Path to Solutions

Most water management decisions are made locally, through provincial or Indigenous jurisdictions, yet the majority of our major river and lake basins are transboundary. A balanced way to strengthen the health and protect the ecosystem services of these shared waters is through a more integrated river basin level management approach. This approach requires all orders of government, including Indigenous governments, to work together. Importantly, because these waters cut across jurisdictional boundaries, rights and responsibilities, this approach requires a meaningful federal role, particularly in four key areas:

1. Creating and mobilizing the knowledge needed to predict and respond to water problems – by providing centralized and harmonized collection and dissemination of water information; water predictions including flood and drought forecasting; and decision-support services through a Canada Water Security Centre.
2. Strengthening transboundary water management and cooperative federalism – by prioritizing healthy and intact watersheds, as well as capacity and commitment to anticipate, investigate, avoid and resolve disputes through a National Water Commission. The Commission would also guide water management and water-related climate mitigation and adaptation strategies through the 21st century. This role includes understanding and making recommendations regarding evolving public opinion and best international practices, for example fiduciary duty and public trust concepts articulated in a modernized law.
3. Strengthening reconciliation with Indigenous peoples – by ensuring the Canada Water Act is consistent with the United Nations Declaration on the Rights of Indigenous Peoples and adopting a consent-based, co-drafting approach to renewing the Canada Water Act in partnership with Indigenous governments, and support implementation of Indigenous inherent, Aboriginal and treaty water rights and roles in water governance and management.
4. Improving collaborative river basin planning – by building durable partnerships for water management and decision making with provinces, territories, municipalities, and Indigenous governments with a clear outcome of building

resilience to extreme events, identifying priority areas for watershed restoration, and ensuring effective environmental flow regimes are in place across levels of jurisdiction and authority.

Conclusion

Enabling these specific water solutions can save Canada billions of dollars by preventing damage to infrastructure and ecosystems and reducing disaster payments. The federal government can carefully target existing expenditures and realize new efficiencies between federal departments with water portfolios to financially support changes to a modernized Canada Water Act. The solutions identified here will make our industries, communities, and the places we live more resilient and less vulnerable to climate change and will make Canada shine on the global stage by showing the world how to build lasting water security in an increasingly uncertain world.

Global Water Futures: Solutions to water threats in an era of global change

Global Water Futures is a University of Saskatchewan-led research program that is funded in part by a \$77.8-million grant from the Canada First Research Excellence Fund. The overarching goal of the program is to deliver risk management solutions - informed by leading-edge water science and supported by innovative decision-making tools - to manage water futures in Canada and other cold regions where global warming is changing landscapes, ecosystems, and the water environment.

Our water is at risk.

In Canada and globally, we are facing unprecedented water-related challenges. Canada has some of the world's highest rates of warming, which impacts infrastructure, institutions, ecosystems and human health. Given that half the world's population and all of Canada are dependent upon water from cold regions, the grand challenge for water science in Canada and globally is: *"How can we best forecast, prepare for and manage water futures in the face of dramatically increasing risks?"*

GWF's overarching goal is to deliver risk management solutions—informed by leading-edge water science and supported by innovative decision-making tools—to manage water futures in Canada and other cold regions where global warming is changing landscapes, ecosystems, and the water environment. End-user needs will be our beacon and will drive strategy and shape our science.

GWF aims to deliver the following **outcomes and impacts**:

1) Improved disaster warning



Currently, we lack the scientific knowledge, monitoring and modeling technologies, and national forecasting capacity to predict the risk and severity of potentially catastrophic events in Canada. These knowledge gaps and technology barriers have resulted in significant loss of life and property in recent years. GWF will create Canada's first national water disaster warning system by creating robust forecasting tools capable of warning stakeholders of impending floods, seasonal water flows, droughts and water quality. Apps, underpinned by our models created in other pillars, will be developed to deliver these systems in a user-friendly manner. These solutions will save lives and infrastructure and provide operational efficiencies to stakeholders and industries such as water managers and hydropower companies.

2) Predicting water futures



The world lacks water data on a scale to make informed decisions, and we cannot forecast future climate impacts without better models to assess changes in our human/natural land and water systems. These limitations create risks for water supplies, water quality and sustainability. Though a comprehensive research program that integrates multiple disciplines, GWF will establish a more holistic understanding of our changing climate, land, water and ecosystems. This expansive knowledge will create more robust mathematical models that will increase accuracy of our future predictions of water quantity and quality, as well as landscape and ecosystem change for all major Canadian river basins, allowing for scenario modeling of land and water futures. Apps and software that incorporate these models will be developed with the end user in mind for integration into daily decision-making.

3) Adapting and managing risk



Nationally and globally, we lack the governance mechanisms, management strategies, and policy tools needed to reduce the risk of water threats, design adaptive strategies to cope with uncertainty, and take advantage of economic opportunities that arise as change unfolds. GWF will provide decision-makers in government and across industries and agriculture the necessary risk-management models tools to make evidence-based decisions that result in optimal socioeconomic outcomes. These scenario-based tools will be informed by our transdisciplinary research program and will be customized by sector. For example, GWF will provide government with evidence and guidance on adaptive governance; Indigenous communities with decision-making tools to adapt to changing water quality; urban communities with evidence to adapt and respond to flood risk; agriculture with tailored weather inputs for precision farming and tools for beneficial management practices; industry with guidance on risks and sustainability, and tools to better assess and manage water and environmental risks and liabilities.

In sum, GWF will position Canada as a

- a) *global leader in water science for the world's cold regions***, where snow, ice, and frozen soils control the storage and release of water,
- b) *global partner of choice for transdisciplinary water research***, and
- c) *a provider for Canada and the world*** of strategic tools to manage water futures.



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