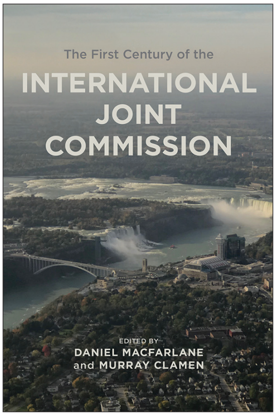

THE FIRST CENTURY OF THE INTERNATIONAL JOINT COMMISSION

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ISBN 978-1-77385-108-2

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The International Joint Commission and Great Lakes Water Levels

Murray Clamen and Daniel Macfarlane

The magnitude of the Great Lakes water system, comprised of Lakes Superior, Michigan, Huron, Erie, and Ontario, is difficult to appreciate, even for those who live in the basin. The lakes are the largest system of fresh surface water on earth, covering more than 94,000 square miles, draining more than twice as much land area, and holding an estimated 6 quadrillion gallons of water. Including its outflow, the St. Lawrence River, the lakes are surrounded by part of eight US states and two Canadian provinces, containing more than one-tenth of the population of the United States and one-quarter of the population of Canada. Some of the world's largest concentrations of industrial capacity are located in this region. The lakes have been a significant part of the physical and cultural heritage of North America and have provided water for consumption, transportation, power, recreation, ecosystem services, and a host of other uses.

For most of the twentieth century, governance of the Great Lakes–St. Lawrence basin revolved around the International Joint Commission (IJC), which was created by the Boundary Waters Treaty in 1909. Although in terms of governance there are literally thousands of local, regional, and special-purpose governing bodies with jurisdiction for some management aspect of the basin or the lakes, the IJC is of particular importance in the Great Lakes. Primarily, water governance and environmental diplomacy issues in the basin centre on water quantity (e.g., lake levels), water quality (e.g., pollution), and biomass issues (e.g., fisheries and invasive species). In spite of their size, the Great Lakes are sensitive to the effects of a wide range of pollutants, including those from the air. Growing public concern about the deterioration of water quality, especially in the 1960s, led governments to respond with the signing of the first Great Lakes Water Quality Agreement in 1972 (and subsequent agreements, protocols, and annexes) to protect and restore the lakes. However, for the first half of its existence the IJC was generally much more concerned with apportioning water resources. These included water levels and diversions in and out of the Great Lakes (see the map of diversions included in chapter 17 of this volume). Water level variations, both annual and seasonal, are based mainly on precipitation and run-off, and long-term trends have resulted in both high and low water periods over the last century of recorded data. Limited regulation of flows from Lake Superior into the St. Marys River, from Lake Erie into Lake Ontario via the Niagara River, and from Lake Ontario into the St. Lawrence River, are the responsibility of the IJC.

This chapter examines the historical evolution of transboundary IJC water governance in the Great Lakes basin over the course of the twentieth century. The management of Great Lakes water has been examined by scholars from various fields, though with a heavy emphasis on water quality and fisheries/invasives issues. However, this chapter will focus on water quantity—that is, water levels as affected by diversions, canals and navigation improvements, hydroelectric developments, remedial works, consumptive uses, and natural causes (and the scientific understanding of these causes).

Great Lakes governance is, on the one hand, difficult and fragmented because of the various jurisdictions. However, the IJC, though certainly not perfect, has provided a unique means of addressing transboundary problems and adjudicating between various interests. In fact, a comparison of the IJC's first hundred years of operation shows that its behaviour, role, and function has changed significantly over time, not only in general but in relation to governance of the Great Lakes–St. Lawrence basin. Indeed, flexibility has been one of the hallmarks of the IJC. At the same time, the successes of the IJC, and the concomitant high regard for it as an organization, are, we argue, more of a post–Second World War, or even a post-1965, development. The history of the IJC reveals an initial half-century of mixed results, followed by a period lasting from the 1940s to the 1960s of partisan politics resulting in large-scale endeavours with dubious environmental impacts, followed by a period of more noticeable success continuing nearly to the turn of the twenty-first century, if not all the way to the present.

Pre-IJC Water Levels

A number of diversions and alterations of water levels had taken place before the Boundary Waters Treaty of 1909, though they had next to no impact on the Great Lakes in terms of water levels.[1] The Erie, Oswego, and Welland Canals were built in the 1820s and '30s to circumvent Niagara Falls, and subsequently improved numerous times over the nineteenth century. The Erie Canal connected the Niagara River with the Albany River, then to New York Harbour. The Welland Canal, through its various iterations and routes, connected Lake Erie with Lake Ontario. Both were essentially intra-basin water transfers, which meant that the water stayed within the Great Lakes–St. Lawrence basin, as opposed to inter-basin transfers, which move water into a different water basin.[2] Beginning in the late nineteenth century, other connecting channels in the Great Lakes basin, particularly the St. Marys, St. Clair, and Detroit Rivers, were dredged and reconfigured for navigation (and for hydro-power production in the case of the St. Marys River and rapids). This cumulatively lowered lake levels slightly by expanding the volume of water these channels held, though without diverting water out of the basin. A great deal more engineering work of this type was performed in connecting channels over the course of the twentieth century. Deep-draught channels were etched into the Detroit River and Lake St. Clair, for example, which involved removing islands and parts of islands, while also creating new land masses such as dikes and training walls. The scale of this reconfiguration only accelerated after the opening of the St. Lawrence Seaway to accommodate larger vessels. By 1968, over 46,200,000 cubic metres of material was removed from the bottom of the Detroit River alone, while some 4,050 hectares of underwater area was covered by dredge spoils.[3] Consequently, in the twenty-first century there were accusations that the greater depth and flow rate of the St. Clair River–Lake St. Clair–Detroit

River stretch caused lower water levels on the upper lakes, particularly the interconnected Lakes Michigan and Huron.

One of the first large-scale diversions from the Great Lakes began in the late nineteenth century and was completed in 1900: the Chicago Sanitary and Ship Canal, which enables the Chicago (or Illinois) Diversion. This stands as the first major alteration of the twentieth century to Great Lakes water levels. Moreover, it was a project that took water out of the Great Lakes basin on a large scale. It reversed the flow of the Chicago River *away* from Lake Michigan, and thus out of the Great Lakes watershed, eventually to the Mississippi, in order to provide sewage disposal for the city of Chicago as well as navigation (and small-scale hydro production). However, plans for this canal to serve as a deep-draught navigation route from Chicago to the Gulf of Mexico using the Mississippi River never really materialized. Since the Chicago Sanitary and Ship Canal lowered the water levels in the Great Lakes–St. Lawrence system, it received opposition from Canada and other US states bordering Lake Michigan. Ottawa protested many times in subsequent decades, as did other US Great Lakes states, but this diversion was not subject to the Boundary Waters Treaty (BWT) since it predated it and the diversion was entirely within the United States, as is Lake Michigan (and there is indirect evidence that one of the main reasons for leaving Lake Michigan levels out of the BWT was that Illinois was unwilling to have the Chicago Diversion subject to the treaty).[4] Well into the second half of the twentieth century the Chicago Diversion was a major sticking point in environmental diplomacy concerning other water developments in the Great Lakes–St. Lawrence basin, particularly discussions about developing the Niagara and St. Lawrence Rivers.

Among other features, the Boundary Waters Treaty of 1909 settled the outstanding issues of Niagara Falls, Sault Ste. Marie, and the St. Mary and Milk Rivers, and created the IJC, which held its first meeting in Washington, DC, on 10 January 1912. Securing the agreement was a significant coup for Canada, since the much more powerful United States was agreeing to a commission within which the two countries were equal. The development of Niagara Falls was the single most important issue bringing the two nations to the table, for without Niagara the International Waterways Commission (IWC) would not likely have taken place, and without that, the Boundary Waters Treaty almost certainly would not have occurred;

rather than a wider settlement for general principles along border waters, a series of discrete agreements, or continued disagreement, for individual waterbodies might well have occurred.

The first few IJC cases (or dockets) did not involve the Great Lakes–St. Lawrence basin. In its third docket, the Canadian and US governments referred levels of Lake of the Woods (which is divided between Minnesota, Ontario, and Manitoba) to the IJC, later resulting in a treaty.[5] The fourth docket, in 1912, was about the general pollution of boundary waters, mostly in the Great Lakes basin (covered in the Benidickson chapter in this volume). In 1914 the IJC approved the building of the binational Compensating Works (a sixteen-gate structure with eight gates on each side of the boundary) in the St. Marys River (near Sault Ste. Marie), and hydro-power plants are near the shore in each country. At the same time, the IJC established the first of its joint boards, the International Lake Superior Board of Control, to regulate the water levels and flows of Lake Superior.[6]

The St. Lawrence

Negotiations for a St. Lawrence deep waterway and hydroelectric project dated back to the 1890s—in fact, the deep waterway was a factor leading to the Boundary Waters Treaty—but it took over half a century for an agreement.[7] This megaproject was both a hydroelectric project (power dams) and a navigation project (locks and canals), with the former submitted to the IJC by the governments for approval, while the latter was agreed to via a separate Canada-US agreement. Since the upper St. Lawrence River is a border water, under the BWT the concurrence of both countries and the IJC is necessary to change its water levels. Canada and the United States signed St. Lawrence diplomatic agreements in 1932 and 1941, but neither received congressional consent, in part because of railway, coal, and East Coast port interests.[8] In the immediate post–Second World War years a variety of economic and defence factors brought further pressure to bear on a St. Lawrence seaway and power project: in particular, the ability of a deep waterway to transport the recently discovered iron ore deposits from the Ungava district in Labrador and northern Quebec to the steel mills of the Great Lakes.

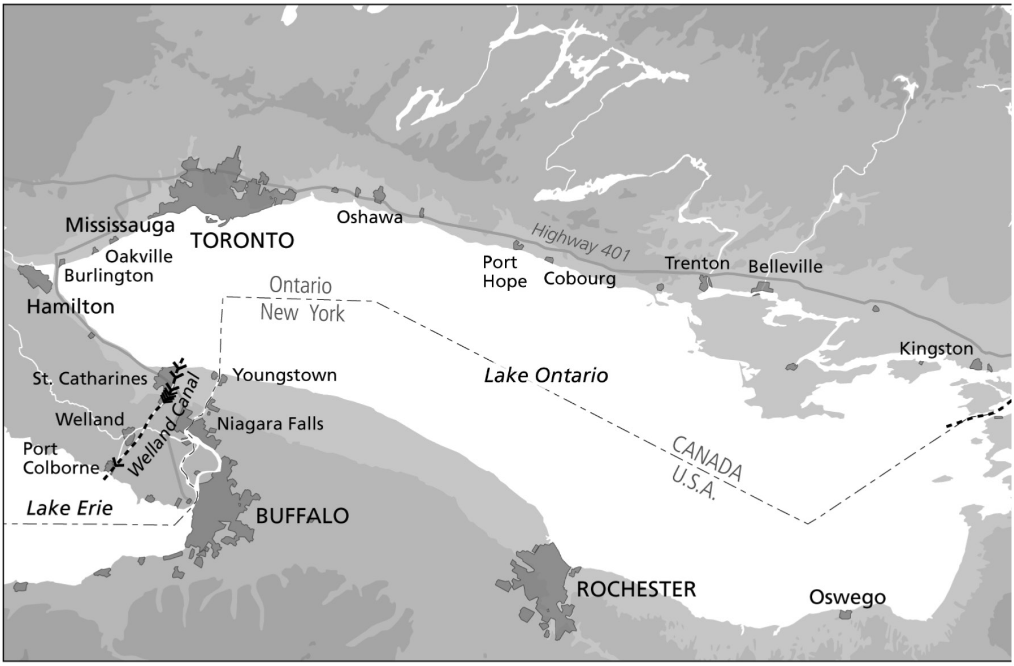
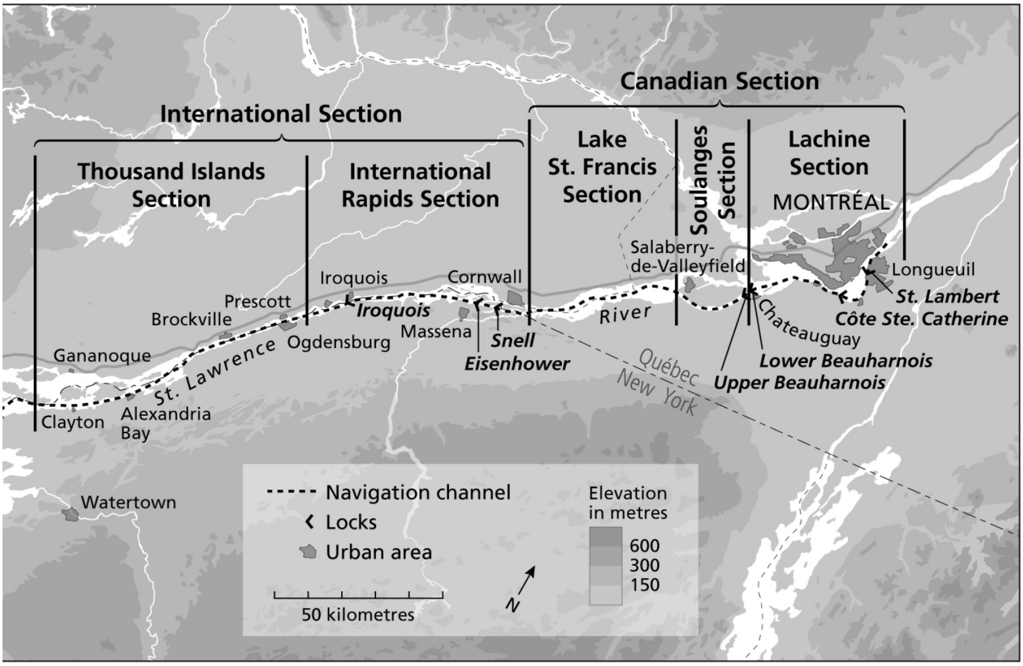


FIGURE 9.1. Map of the St. Lawrence Seaway. Map by Eric Leinberger, used with the permission of UBC Press.

Canada attempted to pursue an all-Canadian seaway, but the United States blocked a solely Canadian waterway, which was deemed to be inimical to American economic and security interests. In the early 1950s the IJC approved the plans for a transnational St. Lawrence power project and created the International St. Lawrence River Board of Control.[9] Then, through a 1954 bilateral Canada-US agreement, Canada reluctantly acquiesced in the construction of a joint seaway with the United States.

The construction of the St. Lawrence Seaway and Power Project had an enormous environmental and social impact on the St. Lawrence basin. It required a massive manipulation of the river and its environs, as part of a process that Daniel Macfarlane labels *negotiated* high modernism.[10] In excess of 210 million cubic yards of earth and rock—more than twice that of the Suez Canal—were moved through extensive digging, cutting, blasting, and drilling, using a litany of specialized equipment and



enormous machines. The St. Lawrence power project required three dams in the international stretch of the St. Lawrence between Ontario and New York: the Moses-Saunders powerhouse, the Long Sault spillway dam, and the Iroquois control dam. These dams created Lake St. Lawrence, which inundated some 20,000 acres of land on the Canadian side, along with another 18,000 acres on the US shore. On the much more heavily populated Canadian side, 225 farms, 7 villages, and 3 hamlets (often referred to as the Lost Villages), part of an eighth village, 18 cemeteries, around 1,000 cottages, and over 100 kilometres of the main east-west highway and main line railway were relocated. So as not to create navigation and other difficulties in the new lake, *everything* had to be moved, razed, or flattened, including trees and cemeteries.

The bill for the entire project was over $1 billion. Despite toll revenue the Seaway was never able to be self-financing, as traffic on the Seaway

Figure 9.2. St. Lawrence Seaway lock across from Montreal. Used with permission of Library and Archives Canada.

never came anywhere close to predictions. Environmental issues were of virtually no concern to the various agencies and governments involved and any potential side effects were generally considered necessary collateral damage. On top of reconfiguring a river basin, the waterway allowed invasive species to come in via the ballast water of vessels.[11]

Measures to regulate Lake Ontario water levels had been part of the IJC's engineering plans for the St. Lawrence power project, but the issue of Lake Ontario levels was turned into a separate IJC docket in the early 1950s after shore owners complained about the effects of fluctuating water levels. Thus, as part of the St. Lawrence dual project engineers had to establish a "river profile" and develop a "method of regulation" for the St. Lawrence River and Lake Ontario. The "method of regulation" referred to the levels between which the water would be maintained by dams and control works in order to meet prescribed goals. The main future users of the St. Lawrence Seaway and Power Project at the time it was designed—power production, navigation, shoreline property, and downstream interests—wanted different minimum and maximum water levels or varying ranges of stages (i.e., difference between high and low levels), and pleasing everyone seemed impossible.

The engineering goal between 1954 and 1959 was to maintain the water levels at an average that equated to "natural levels," but also to improve on nature by removing the extremes of high and low flows in order to create a predictable and orderly river and lake. "Natural" was defined as that which had existed in the nineteenth century before the first human alterations to water levels—i.e., what existed before Canada installed the Gut Dam in the St. Lawrence River between Galops and Adams islands in the early twentieth century. Yet establishing exactly what constituted a "state of nature" was problematic from the outset. Not only did representatives of the two countries disagree upon the historic impact of the Gut Dam, partly for partisan reasons, but it was also difficult to find information regarding the natural levels to use as a baseline. There were concerns that past measurements were unreliable, a problem that exacerbated by the geological phenomenon of earth tilt, as well as a 1944 earthquake centred between Cornwall and Massena. Indeed, engineering studies were showing that natural factors must have played a much larger role in the recent rise in Lake Ontario water levels than had anthropogenic factors (i.e., diversions into the Great Lakes basin)

Along the way, there were many engineering miscalculations, assumptions, compromises, and partisan preferences. Part of the problem stemmed from the faith that the engineers placed in their models. The experts essentially admitted behind closed doors that they did not know what natural conditions were, and in many ways were guessing. Granted, hydraulic engineers have always used incremental "cut and try" methods. They kept revising the method of regulation and debating what the water levels should be kept at—ultimately, the idea of 248 feet "as nearly as may be" prevailed. In July 1956 the IJC issued a supplementary order directing that Lake Ontario levels be maintained between 244 and 248 feet, again adding the "as nearly as may be" rider. Yet soon after, method 12-A-9 was replaced by another method, 1958-A. The method that stood for over half a century was arrived at, and was titled 1958-D (eventually the qualifier "with deviations" was incorporated). The precise technical differences between these methods are not important here—rather, it is the frequency of changes and the decision-making manner that are noteworthy because they betray how messy and reactive the process of regulating the river levels actually was. As will be discussed below, a new method of regulation was finally enacted in 2017.

Ogoki–Long Lac Diversions

These two diversions are technically separate but they are often considered together because they both divert into Lake Superior water that originally drained north to James Bay. Combined, they constitute the largest anthropogenic diversion into the Great Lakes basin, putting in roughly the same amount of water as the Chicago Diversion takes out. Ontario had first proposed these dual diversions in the 1920s as part of diplomatic discussions about Niagara Falls and other Great Lakes–St. Lawrence water issues. In 1940, the federal governments did conclude an arrangement, through exchanges of notes, for Ontario to use water diverted from the Albany River basin into the Great Lakes for power generation, chiefly on the Niagara Frontier.

The Long Lac Diversion, completed in 1941, connects the headwaters of the Kenogami River with the Aguasabon River, which naturally discharges into Lake Superior about 250 kilometres east of Thunder Bay, Ontario. The Ogoki Diversion, completed in 1943, connects the upper portion of the Ogoki River to Lake Nipigon and from there flows into Lake Superior, 96 kilometres east of Thunder Bay. These diversions were primarily developed to generate hydroelectric power.[12] Article iii of the 1950 Niagara River Diversion Treaty (see below) provides that waters diverted by Long Lac and Ogoki shall continue to be governed by diplomatic notes. This arrangement provides flexibility in operation because no diversion amounts are specified, but initial use at Niagara Falls was to be 5,000 cubic feet per second (cfs). The actual diversion rates vary frequently (maximum and minimum annual combined diversions have been about 8,000 cfs and 2,500 cfs, respectively) so the governments continue to use the constant figure of 5,000 cfs as a pragmatic way to calculate shares instead of actual diversion amounts as permitted by the notes. Although the diversions are controlled by Canada, examples of mutual co-operation occurred in 1952, 1973, and 1985 when, in response to a request by the United States, Canada reduced or stopped both diversions in an attempt to alleviate problems created by high lake levels. The amount of water diverted into Lake Superior by these diversions is reported by Ontario Power Generation (formerly Ontario Hydro) to the IJC through its International Lake Superior Board of Control.

These diversions increase the mean level of each of the Great Lakes: Lake Superior by 6.4 centimetres (0.21 feet); Lakes Michigan-Huron by 11.3 centimetres (0.37 feet); Lake Erie by 7.6 centimetres (0.25 feet); and Lake Ontario by 6.7 centimetres (0.22 feet).[13] Together they have had significant local environmental effects on fish spawning areas and habitat as a result of the original construction and operation of diversion structures on the main stem rivers, the construction and alteration of diversion channels, the creation of reservoirs, the greatly altered flow regimes, and the use of waterways for log transportation. As is usually the case when water is manipulated on a large scale in the Great Lakes–St. Lawrence basin, particularly for hydroelectric developments, Indigenous Peoples bear the brunt of the direct impacts since they historically utilized sites conducive to hydroelectric developments—thus it is possible to discern a pattern of "hydraulic imperialism" on the part of North American governments.

Niagara Falls

Niagara Falls was itself another major water issue that had been included in the half-century of St. Lawrence Seaway discussions.[14] Large-scale hydroelectric production and distribution from a central station had its birth at Niagara Falls in the late nineteenth century. By the 1920s, there were multiple hydro-power stations operating on both sides of Niagara. Water was diverted away from the Horseshoe and American Falls (the two main cataracts that make up Niagara Falls) in order to supply the various power houses. Before the end of the nineteenth century public concerns were raised about the aesthetic impact of decreased water levels on the Falls, as well as the industry that crowded the shoreline to take advantage of the water power.

Both the American Burton Act (1906) and the Boundary Waters Treaty put restrictions on the amount of water that could be diverted away from the Falls. In response to public worries about the scenic grandeur and diversions, Canada and the United States formed the International Niagara Board of Control in 1923, followed by a Special International Niagara Board in 1925. In an interim report that utilized photographs and aerial surveys, the Special International Niagara Board proposed the use of weirs (submerged barriers) designed to strategically divert water from the middle part of the Horseshoe Falls to the edges. This would improve the appearance of the crestline, both in quantity and colour. Based on the Special International Niagara Board's interim report, the Niagara Convention and Protocol was signed in 1929 by both countries. However, this Niagara convention was not able to make it through the US Senate.

In 1931 the Special International Niagara Board released a report titled "Preservation and Improvement of the Scenic Beauty of the Niagara Falls and Rapids." The report examined whether it was the height, width, volume, colour, or lines that made Niagara such a spectacle. The report's sections on water colour were fascinating, and a special "telecolorimeter" was developed to test for the desired "greenish-blue" colour, which was considered superior to the whitish colour resulting from a thin flow over the precipice. The excessive mist and spray at Horseshoe Falls was considered a turn-off since it obscured the view and, unsurprisingly, got people wet. The denuded bare rock at the flanks of the Horseshoe Falls was labelled as one of the greatest detriments to the visual appeal, and erosion threatened to ruin the symmetry of the Falls (the lip receded upstream several feet per year). The report concluded that a sufficiently distributed volume of flow, or at least the "impression of volume," which would create an unbroken crestline, was most important.

The board therefore recommended that the riverbed above Niagara Falls, and the Falls themselves, be manipulated in order to apportion the necessary volume of water to achieve the desired effect. Remedial works, in the form of submerged weirs and excavations, would achieve that while allowing for increased power diversions. Such measures had been included in the failed 1932 Great Lakes Waterway Treaty and the 1941 St. Lawrence executive agreement. During the Second World War the two countries agreed that the limits on the amount of water diverted at Niagara Falls

FIGURE 9.3. Proposed Niagara Remedial Works. Library and Archives Canada.

for war-time needs could be temporarily increased. Subsequently, further withdrawals were allowed during the war, rising to a total diversion of 54,000 cfs for Canada and 32,500 cfs for the United States (out of a total river flow of about 200,000 cfs). Canada and the United States agreed to split the cost of constructing a stone-filled weir—a submerged dam—above the Falls, which would raise the water level in order to facilitate greater diversions without an apparent loss of scenic beauty.

What were initially wartime diversions continued on an indefinite—and technically illegal—basis after the end of the Second World War. The two countries separated the Niagara diversion issues from the repeatedly stalled St. Lawrence negotiations, and the Niagara River Diversion Treaty was signed in February 1950. This Canadian-American accord called for further remedial works, to be approved by the IJC, and virtually equalized water diversions while restricting the flow of water over Niagara Falls to no less than 100,000 cfs during daylight hours of what was deemed the tourist season (8 a.m. to 10 p.m. from April to mid-September, and from

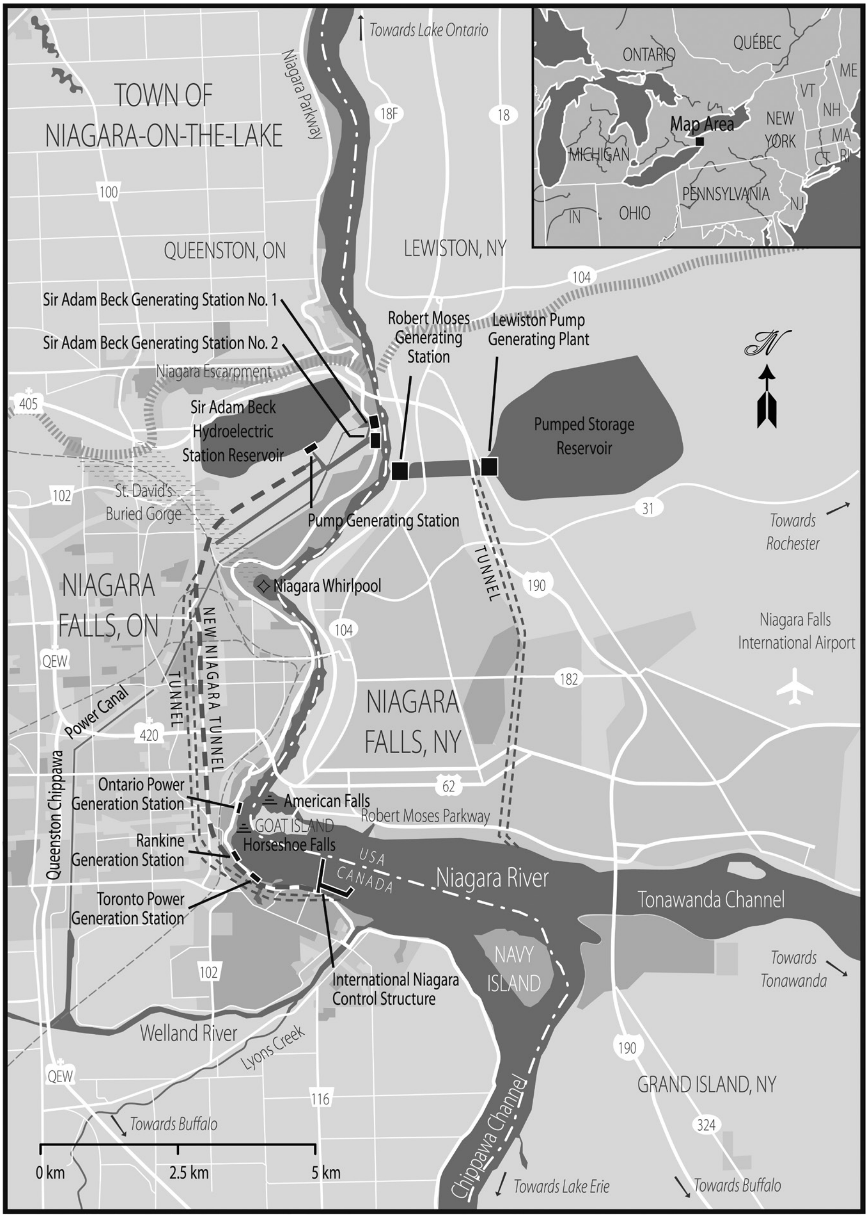


Figure 9.4. Niagara waterscape. Map by Rajiv Ravat, Anders Sandberg, and Daniel Macfarlane.

8 a.m. to 8 p.m. during the fall), and no less than 50,000 cfs during the remainder of the year. This worked out to Canada and the United States together taking about one-half of the total flow over the Falls during tourist hours, and three-quarters the remainder—and majority—of the time.

IJC engineering studies showed that, without remedial works, the diversions authorized in the 1950 treaty would have a very negative impact on the scenic beauty of the area: the Chippawa–Grass Island Pool level would drop by as much as four feet, exposing areas of the riverbed, lowering levels on Lake Erie, turning the American Falls into an unsightly spectacle, and greatly reducing the appearance of the flanks of the Horseshoe Falls.[15] In 1953 reports by the IJC and its International Niagara Falls Engineering Board, the objectives remained basically the same as they had been in the 1920s and '30s: to ensure the appearance of an unbroken and satisfactory crestline while allowing for the diversion of water for power production. A 1,550 foot control dam was built from the Canadian shore, parallel to and about 225 feet downstream from the weir built in the 1940s, featuring 13 sluices (5 more were soon added) equipped with control gates. The purpose of this structure was to control water levels and spread out the water, both for appearance and because flows concentrated in certain places caused more erosion damage. The diverted water went to the hydroelectric stations downstream. To create a better distribution of flow and an unbroken crestline, 64,000 cubic yards of rock were excavated on the Canadian flank, and 24,000 cubic yards on the American flank. To compensate for erosion, crest fills (55 feet on the Canadian shore and 300 feet on the American side) shrunk the Horseshoe Falls, with the reclaimed edges fenced and landscaped in order to provide prime public vantage points.

The Ontario and New York public power utilities, with the blessing of the IJC, soon tried to further increase the amount of water diverted from the Niagara River. But public opposition proved too big of an obstacle. Then local interests in Niagara Falls, New York, began a public relations effort of sorts to "save" the American Falls (and increase tourism to the American side). This campaign to preserve and enhance the American Falls formally began in 1965 and stretched into the 1970s; ultimately, the IJC and involved governments decided not to remove the talus at the bottom of the smaller Niagara waterfall and let "nature take its course."[16] This represented a significant shift in philosophy and approach, from both the IJC and the hydraulic engineering profession.

The various water control works installed in the Niagara River, along with other channel modifications such as bridge piers, channel filling, and shoreline reclamation, collectively constrict the river and raise the level of Lake Erie in the neighbourhood of half a foot.[17] Currently, the IJC's International Niagara Board of Control monitors operation of the control works by the power entities, Ontario Power Generation and the New York Power Authority, under an IJC directive.

Chicago Redux

Because of its importance in the history of Great Lakes diversions, we now return to the issue of the Chicago Diversion through the Sanitary and Ship Canal at Chicago, which is not subject to the Boundary Waters Treaty since it predated the 1909 accord. This diversion consists of three components: 1) water supply withdrawn directly from Lake Michigan for domestic and industrial purposes and then discharged into the Illinois River as treated sewage; 2) run-off that once drained to Lake Michigan but is now diverted to the Illinois River; and 3) water diverted directly from Lake Michigan into the Illinois River and canal system for navigation and dilution purposes in the Chicago area.

The Chicago Diversion was effectively limited by a 1930 US Supreme Court decision to 3,200 cfs on an annual basis. The United States appealed for an extension due to worries that low water levels would threaten public health conditions in Chicago, as financial difficulties stemming from the Depression had caused work to cease on sewage disposal work. Capping the Chicago Diversion had also figured prominently in Niagara and St. Lawrence Seaway negotiations over the first half of the twentieth century (in fact, the Chicago Diversion may have indirectly killed US legislative approval of the 1932 St. Lawrence treaty). At several times in the 1950s, the Chicago Diversion was allowed to be increased temporarily. In 1967, a US Supreme Court ruling put the diversions back to 3,200 cfs. In the 1980s, the Corps of Engineers looked at tripling the volume of the diversion, and then the State of Illinois requested the diversion be upped to 10,000 cfs. In the 1990s, it turned out that Chicago was often exceeding the diversion limit, though sometimes by accident; that was apparently taken care of, and the diversion has of late been kept within its legislated bounds. According to the IJC, the diversion reduces the mean level of Lakes Michigan and Huron by 6.4 centimetres (0.21 feet), Lake Erie by 4.3 centimetres (0.14 feet), and Lake Ontario by 3.0 centimetres (0.10 feet).[18] Although the average diversion rate remains constant, the potential for increases remains a concern for Canada and those living nearby in the United States who could be impacted by higher water levels or velocities.

Current debate about the Chicago Diversion tends to focus on it as a vector for invasive species—Asian carp specifically. There is a long history of foreign organisms entering the Great Lakes basin, both before and after the creation of the St. Lawrence Seaway. Since the 1950s, the majority of pernicious, accidentally introduced species—such as zebra and quagga mussels—have arrived via the ballast water of Seaway vessels. But now the looming worry in terms of invasives is that Asian carp will enter the Great Lakes basin through the Chicago Sanitary and Ship Canal.[19] Biodiversity and invasive species are an issue that the IJC has not addressed for most of its history, though Annex 6, which addresses aquatic invasive species, was added to the Great Lakes Water Quality Agreement in 2012, along with other annexes on contemporary concerns such as climate change.

Understanding Great Lakes Water Levels

Levels in the Great Lakes have always fluctuated under the influence of natural forces, including the major ones of precipitation and evaporation and also winds, barometric pressure, ice jams, glacial rebound, aquatic weed growth, and, to some extent, tides. There are of course long-term fluctuations, seasonal fluctuations, and short-term fluctuations due to storms, winds, and pressure changes. Humanity has progressively intervened in the natural regime of the Great Lakes system, including the direct regulation of Lakes Superior and Ontario, dredging in the connecting channels, diversions, and consumptive uses. Over the last century, scientific understanding of "natural" lake levels has itself fluctuated.

The vast surface area of the Great Lakes, combined with the natural restrictions of their connecting channels, makes it possible for the system to cope with huge water supply variations while maintaining water level fluctuations of one to two feet in any one year. Depending on which lake one considers, the maximum range of water level fluctuations has only been about four to seven feet in the 150 years since records have been kept. Older records are not as accurate as current observations, since both countries did not develop a wide network of level gauges until the early twentieth century. By the First World War the Canadian Hydrographic Service had installed 27 automatic gauges in the Great Lakes–St. Lawrence basin, though only 11 were open year-round (by 1926 there were 40 Canadian gauges open year-round).[20] The US Army Corps of Engineer's Lake Survey was busy doing the same. Even with these improvements, which were primarily aimed at benefitting navigation, the limited dispersal of gauges as well as their technological limitations meant that knowledge about water levels was still subject to a great deal of uncertainty. Nonetheless, gauges, soundings, and charting were necessary for establishing the baseline information upon which later engineering manipulations could be based. It is clear that, by the immediate post–Second World War period, at least some engineers and government experts had a solid understanding of the natural causes of Great Lakes fluctuations.

Long-term fluctuations occur over periods of consecutive years and have varied dramatically since water levels have been recorded for the Great Lakes. Continuous wet and cold years cause water levels to rise. Conversely, consecutive warm and dry years cause water levels to decline. The Great Lakes system experienced extremely low levels in the late 1920s, mid-1930s, in the mid-1960s, and in the early 2000s. Extremely high water levels were experienced in the 1870s, early 1950s, early 1970s, mid-1980s, mid-1990s, and currently. While various cycles of low and high water levels follow a variable schedule that is not entirely predictable, climate change already seems to be introducing even more uncertainty into these cycles. In the early 2000s Lakes Michigan and Huron experienced record lows, but now *all* the lakes, including Lake Ontario, are now experiencing record highs.

Over the last fifty years, the IJC has completed several reference studies on Great Lakes water level issues. In 1964, when water levels were very low, the governments asked the IJC whether it would be feasible to maintain the waters of all the Great Lakes at a more constant level. This study was completed in 1973, when lake levels had risen to record highs. The

IJC then advised the governments in its 1976 report "Further Regulation of the Great Lakes" that the high costs (economic and environmental) of engineering further regulation of Lakes Michigan and Huron could not be justified by the benefits.[21] The same conclusion was reached during another IJC study in 1983 on regulating outflows, specifically from Lake Erie.

In 1985, the IJC submitted its report under a reference on consumptive uses and diversions—especially the effects of existing diversions into and out of the Great Lakes system, as well as on the possibility of adjusting these diversions to help regulate water levels. Prior to this IJC study, consumptive use (e.g., agriculture, bottled water, and pop) had not been considered significant because the volume of water in the system is so large. The study concluded that climate and weather changes affect lake levels far more than existing anthropogenic diversions and uses, and it recommended that governments not consider the manipulation of existing diversions to either raise low levels or decrease high levels. In 1986, during a period of record high water levels, governments asked the IJC to examine and report on methods to alleviate the adverse consequences of fluctuating water levels in the Great Lakes–St. Lawrence River basin. The IJC's final recommendations, delivered in its 1993 report (when the high levels had receded), included a range of actions such as promoting shoreline management measures; a recommendation that five as well as three lake regulation not be further considered; establishing a binational information centre; and improving data gathering and analysis.

Primarily as a result of public outcry over a proposal to export water from Lake Superior by tanker in 1999, governments asked the IJC to examine and report on how the consumptive use and removal of water, diversions, and management and policies regarding water resources affect the levels, flows, and sustainability of water supplies in transboundary basins. Governments are using the findings, conclusions, and recommendations of the IJC's 2000 and 2004 reports as they address the many issues related to water use in the Great Lakes basin. The governments asked the IJC to review its recommendations again at ten-year intervals unless conditions dictate a more frequent review. The governments have not responded to the IJC's recommendation that they consider adopting a plan of work for the IJC on the rest of the border beyond the Great Lakes.

Large Diversion Threats

As the ability to move water long distances expanded in the last half of the twentieth century, so too did the threat of large-scale transfers. As a result, a number of major diversions at several locations on the North American continent have been propounded over the past decades.[22] There is a perception in the Great Lakes basin of a need for water elsewhere, especially in the arid US Southwest. However no major diversion from the Great Lakes basin is under formal consideration at the present time, and none of these concepts is currently proposed or endorsed by any government directly involved in the management of the water. Two schemes in particular have received some attention over the years and are noted briefly below.

The Great Recycling and Northern Development (GRAND) canal concept was first advocated in 1959 by Thomas Kierans. In this proposal, James Bay was to be diked, creating a freshwater lake, the waters of which could be diverted/recycled to the Great Lakes and on to the western United States and even Mexico. Stepped pumping and flow control structures would be required in the transmission system. The distribution system from the Great Lakes would include new two-way channel and pump transfer arrangements connecting the major rivers that drain the mid-continent and the Canadian Prairies. Reliable estimates of costs and benefits have never been available, although Kierans estimated the costs would be $79 billion with a construction time of eight years. While a few officials, such as former Quebec premier Robert Bourassa, asserted that the proposal would have multiple economic and other benefits, most argue that the direct costs are astronomical and that the project is likely to have devastating and irreversible ecological effects.

The North American Water and Power Alliance (NAWAPA) scheme was first presented in 1963 by Ralph M. Parsons and Co., a firm of engineering consultants. It involved diverting water from major rivers in Alaska, British Columbia, and the Yukon to a reservoir in the Rocky Mountain Trench. From there it would be redirected for consumption in the western United States and Canada. In 1963 NAWAPA's total cost was estimated at about $100 billion with construction taking about twenty years. Hostile public reaction and the question of feasibility quashed the idea in its infancy and, as far as can be determined, the scheme is not now being seriously considered by any government or proponent.

Recent Charters, Annexes, and Agreements

Water management in the Great Lakes basin is governed by a network of legal regimes, including international instruments and customs, federal laws and regulations in both Canada and the United States, the laws of the eight Great Lakes states and the provinces of Ontario and Quebec, and the rights of Indigenous Peoples under Canadian and US laws.[23] A number of diversion threats were mainly within US borders, and resulting legal and legislative steps to prevent such diversions were thus internal US matters that were not subject to IJC approval. In 1985, the eight states and two provinces bordering the Great Lakes–St. Lawrence basin adopted a new policy resolution: the Great Lakes Charter. The purpose of the Great Lakes Charter, which was a non-binding, good-faith agreement, was to provide the opportunity for basin-wide management. Any plan proposed in any Great Lakes state or province that involved major consumptive use or diversion had to give prior notice to, and seek approval from, all other states and provinces. However, as noted above the charter was not binding, and holes soon appeared. For example, the possibility of bulk exports out of the Great Lakes basin surfaced, as did the transfer of water to smaller communities in the United States straddling or just outside of the Great Lakes basin.[24]

The 2001 annex to the charter committed the parties to develop binding regulations to ensure no net loss to the waters through diversion or consumption or through adverse impacts on water quality, with a commitment to ensuring public input. In 2005 the Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement (a non-binding agreement that included Ontario and New York) was inked; it was the international companion to the binding Great Lakes–St. Lawrence River Basin Water Resources Compact, which exclusively involved American jurisdictions and came into effect in 2008. These new agreements, which do not involve the IJC, ban new or increased water diversions out of the Great Lakes–St. Lawrence basin, with some strictly regulated exceptions.[25] The states and provinces also pledged to use a consistent standard to review proposed uses of basin water and a decision-support system to manage withdrawals. In addition, each state and province is to develop and implement a water conservation and efficiency program. The Council of Great Lakes Governors serves as secretariat to the Great Lakes–St. Lawrence River Basin Water Resources Regional Body and the Great Lakes–St. Lawrence River Basin Water Resources Council, both of which were created to coordinate implementation and follow-through of the agreement and compact.

Another legal issue that has been raised is whether international trade obligations, in particular the relevant World Trade Organization agreements, including the General Agreement on Tariffs and Trade, as well as the Canada–United States Free Trade Agreement and the Canada–United States–Mexico North American Free Trade Agreement (NAFTA), might affect water management in the Great Lakes basin and, in particular, commodify water. The IJC, in its 2000 and 2004 reports, concluded that international trade agreements do not prevent the governments of the United States and Canada from protecting water as it resides in the Great Lakes and their tributary rivers and streams if there is no discrimination against persons from other countries and undue expectations are not created. The governments of Canada and the United States supported this conclusion. However, because the IJC believed some concern still remained in the public's opinion, the commission recommended that the governments need to make a greater effort to clarify this issue for the public, including continuing to demonstrate that future trade agreements will not affect the ability of governments to protect water resources like the Great Lakes. The current draft of the new United States-Mexico-Canada Agreement, intended to replace NAFTA, contains a chapter on the environment; what this will mean for the Great Lakes–St. Lawrence ecosystem is difficult to predict at this point.

The IJC is now in the process of transitioning, in a way, to a new approach under the Boundary Waters Treaty. For approximately the last fifteen years, the IJC has been developing its International Watershed Initiative (IWI) as a new means of transboundary governance that allows for flexibility. The IJC is well positioned to contribute to effective, multi-layered, adaptive governance. The development of the IWI, and the creation of international watershed boards, illustrate the fact that the IJC (and transboundary water governance in general) is at a crossroads in terms of meeting the environmental challenges of the twenty-first century within the framework of the 1909 Boundary Waters Treaty. After a century of addressing many issues arising under the treaty, the evolution to international watershed boards by the IJC is one of the new concepts in transboundary environmental governance and holds great promise to help "prevent and resolve" transboundary disputes between Canada and the United States in the next century. Successful implementation is requiring the IJC to reconsider the Boundary Waters Treaty's essential purpose, as well as new and emerging natural-resource management trends in and between the United States and Canada.

St. Lawrence–Lake Ontario Levels Revisited

As far back as the 1990s, in response to recommendations in IJC board reports and growing public dissatisfaction with Plan 1958-D and the IJC Order of Approval, the IJC seriously began investigating the regulation of water levels and flows in the Lake Ontario–St. Lawrence River system. After a number of false starts the IJC finally received approval and funds from both governments to begin a five-year, $20 million study in December 2000. However this government approval and funding was predicated on an IJC commitment to *not* make any changes without the concurrence of both governments. An IJC study board was appointed and reported in May 2006. In 2008, after considering the study board's report, the IJC invited comment on a proposed new order and regulation plan known as Plan 2007, which was based on one of the three options recommended by the study board.

But Plan 2007 received widespread opposition and the commissioners decided something new was needed. In 2009 a working group was established with senior officials appointed by the two federal governments and the sub-federal governments of New York, Ontario, and Quebec. This was a clear indication that some political as well as technical and scientific expertise would be needed to resolve this matter. Of the many regulation plans developed, the working group determined that a variation of a plan called Bv7, resulting in more natural flows and lake levels, was preferable. The group worked to refine this plan, which the IJC then developed into Plan 2014 (hoping it would be implemented by that year). The existing plan (Plan 1958-D with deviations) unnaturally compressed water levels and harmed coastal ecosystems, impacts which were not understood when the project was initially approved. Plan 2014 aimed to help restore plant diversity and habitat for fish and wildlife by allowing more natural variability in water levels while continuing to moderate extreme high and low levels. After seeking public input, and further IJC study, Plan 2014 was approved in December 2016 and enacted the following month.[26] Unfortunately, the initiation of Plan 2014 coincided with record precipitation throughout the Lake Ontario–St. Lawrence basin, in both 2017 and 2019, which resulted in extreme flooding on Lake Ontario, the Ottawa River, and the upper St. Lawrence River. Residents on the south shore of Lake Ontario were outspoken in their criticism of the new regulation plan; but these criticisms are mostly misplaced, since in instances of extreme natural supply any method of regulation can have only a minimal impact on water levels and flooding would take place regardless.

Conclusion

Legal scholar Marcia Valiante identifies a number of factors that have enabled the successful management of Great Lakes water quality and quantity, most of which are reflections of the IJC's role: equality; common vision and common objectives; different scales of action; strong scientific foundation; active community participation; good governance mechanisms; accountability and adaptability; partnerships; binationalism.[27] However, while those conclusions may be valid for the period from the 1960s to the present, the first half-century of the IJC's existence do not warrant many of these positive assessments.

As this chapter has shown, the IJC's behaviour, role, and function in terms of Great Lakes governance has changed significantly over time. Up to about the time of the Second World War, the IJC focused mainly on apportioning water resources, with mixed results. A number of large-scale endeavours, during which the politicization of the IJC was apparent, characterized the two postwar decades. Beginning with notable successes, such as facing Great Lakes water pollution, the IJC transitioned into a period—which arguably continues to the present—in which it has successfully dealt with a wide range of issues. The IJC's flexibility and anticipatory ability, the trust it has engendered among the public and activist groups, combined with its invocation of scientific and engineering expertise, give it a unique character and quality that resists easy theoretical generalization. The IJC continues to blend aspects of the bureaucratic and post-bureaucratic models, though it has increasingly moved toward the latter. Likewise, the IJC has displayed elements of both a capacity-building and regulatory institution. It also stands as an example of "fragmented bilateralism" and the "rational-legal authority" approach to international relations. While the history of the IJC does not fully support the sub-state actor hypothesis, the future of Great Lakes governance (Great Lakes–St. Lawrence River Basin Water Resources Council) may well run in that direction.

Looking to the future, although the historical perspective provided in this chapter demonstrates the importance of utilizing scientific expertise through the IJC, we also should be cautious about the extent to which the two nations should even be attempting to "manage" extremely large and complex ecosystems such as the Great Lakes, particularly given uncertainty about the future impacts of climate change on water levels in the basin. History shows that there are always unintended consequences, and often these are as bad, or worse, than the original problem.

Notes

1 On Canadian-American border waters generally, see Lynne Heasley and Daniel Macfarlane, *Border Flows: A Century of the Canadian-American Water Relationship* (Calgary: University of Calgary Press, 2016). For an overview of border hydro developments, see Daniel Macfarlane, "Fluid Relations: Hydro Developments, the International Joint Commission, and Canada-U.S. Border Waters," in *Towards Continental Environmental Policy? North American Transnational Environmental Networks and Governance*, ed. Peter Stoett and Owen Temby (Albany: SUNY Press, 2017).

2 Note that the Erie and Oswego Canals did take a small amount of water out of the Great Lakes basin.

3 D. H. Bennion and B. A. Manny, "Construction of shipping channels in the Detroit River—History and environmental consequences," *US Geological Survey Scientific Investigations Report* (Washington: US Geological Survey Scientific Investigations Report 2011–5122), https://pubs.usgs.gov/sir/2011/5122/. On the Detroit River, see

also John Hartig, *Waterfront Porch: Reclaiming Detroit's Industrial Waterfront as a Gathering Place for All* (Lansing: Michigan State University Press, 2019); Ramya Swayamprakash, "Dredge a River, Make a Nation Great: Shipping, Commerce, and Territoriality in the Detroit River, 1870–1905," *Michigan Historical Review* 45, no. 1 (Spring 2019): 27–46.

4 See Daniel Macfarlane and Lynne Heasley, "Fish, Water, and Oil: The Chicago River as a Transnational Matrix of Place" in *City of Lake and Prairie: Chicago's Environmental History*, ed. Kathleen Brosnan, Will Barnett, and Ann Keating (Pittsburgh: University of Pittsburgh Press, forthcoming).

5 On this region see Jamie Benidickson, *Levelling the Lake: Transboundary Resource Management in the Lake of the Woods Watershed* (Vancouver: UBC Press, 2019).

6 On the environmental history of Lake Superior, see Nancy Langston, *Sustaining Lake Superior: An Extraordinary Lake in a Changing World* (New Haven, CT: Yale University Press, 2017).

7 This section on the St. Lawrence Seaway and Power Project is derived from Daniel Macfarlane, *Negotiating a River: Canada, the US, and the Creation of the St. Lawrence Seaway* (Vancouver: UBC Press, 2014).

8 The 1941 St. Lawrence accord was actually an executive agreement, and it was a comprehensive St. Lawrence–Great Lakes agreement that covered many transborder water bodies in the basin.

9 This was not the first time that the IJC had formed a board or investigation on a St. Lawrence issues—e.g., a dam at Waddington, New York, and the Massena Power Canal attracted the IJC's attention around the time of the First World War.

10 Daniel Macfarlane, "Negotiated High Modernism: Canada and the St. Lawrence Seaway and Power Project," in *Made Modern*: *Science and Technology in Canadian History*, ed. Edward Jones-Imhotep and Tina Adcock (Vancouver: University of British Columbia Press, 2018).

11 On invasive species, see Jeff Alexander, *Pandora's Locks: The Opening of the Great Lakes-St. Lawrence Seaway* (Lansing: Michigan State University Press, 2009); Dan Egan, *The Death and Life of the Great Lakes* (New York: Norton, 2017).

12 In the case of the Long Lac Diversion the transportation of the pulpwood logs southward was also a minor consideration—aspects of this diversion had actually begun operating in the late 1930s for the purposes of moving wood.

13 International Joint Commission, *Great Lakes Diversions and Consumptive Uses: Final Report* (1985).

14 Information in this section is derived from Daniel Macfarlane, "Creating a Cataract: The Transnational Manipulation of Niagara Falls to the 1950s," in *Urban Explorations: Environmental Histories of the Toronto Region*, ed. C. Coates, S. Bocking, K. Cruikshank, and A. Sandberg (Hamilton, ON: L. R. Wilson Institute for Canadian Studies-McMaster University, 2013); Daniel Macfarlane, " 'A Completely Man-Made and Artificial Cataract': The Transnational Manipulation of Niagara Falls,"

Environmental History 18, no. 4 (October 2013): 759–84; and a forthcoming book on Niagara Falls by Macfarlane.

15 The method of regulation was later revised because it became apparent that the operation of the Niagara remedial works and levels in the Chippawa–Grass Island Pool lowered Lake Erie levels by a few centimetres.

16 See Daniel Macfarlane, "Saving Niagara from Itself: The Campaign to Preserve and Enhance the American Falls, 1965–1975," *Environment and History* 25, no. 4 (November 2019): 916-943.

17 Frank F. Quinn, "Anthropogenic Changes to Great Lakes Water Levels," *Great Lakes Update* 136 (1999): 3.

18 IJC, 1985.

19 Andrew Reeves, *Overrun: Dispatches from the Asian Carp Crisis* (Toronto: ECW Press, 2019).

20 O. M. Meehan (edited by William Glover and David Gray), "The Canadian Hydrographic Service: From the time of its inception in 1883 to the end of the Second World War," *The Northern Mariner/Le marin du Nord* 19, no. 1 (January 2004): 1–158.

21 International Joint Commission, International Great Lakes Levels Board, *Report on Further Regulation of the Great Lakes* (1976).

22 IJC, 1985.

23 IJC, "Protection of the Great Lakes Report," February 2000.

24 Peter Annin, *Great Lakes Water Wars*, 2nd ed. (Washington, DC: Island Press, 2018).

25 Exceptions include communities that straddle the water basin divide that will use the diverted water for public water supply purposes, potentially having to return it to the basin. On the charter/agreement and its history, see Daniel Macfarlane and Noah Hall, "Transborder Water Management and Governance in the Great Lakes-St. Lawrence Basin," in *Transboundary Environmental Governance Across the World's Longest Border*, ed. Stephen Brooks and Andrea Olive (East Lansing: Michigan State University Press, 2018).

26 In the summer of 2013, the IJC invited public comment and convened public hearings on the proposed Plan 2014. The vast majority of stakeholders were supportive of Plan 2014 and the new order with the exception of a group of a few hundred shoreline property owners based in New York State and their local political leaders. In June 2014 the IJC then submitted a report to governments summarizing its fourteen-year effort to study improved management of water levels and flows in the Lake Ontario–St. Lawrence River system. The report recommended Plan 2014 and working with the governments in the basin to develop adaptive management as an important tool for improving management of the Lake Ontario–St. Lawrence River regulation plan. In similar letters dated 6 December 2016, both governments concurred with the IJC's proposals. The IJC appointed a new International Lake Ontario–St. Lawrence River Board and charged it with implementing the new order and directive. See Murray Clamen and Daniel Macfarlane, "Plan 2014: The Historical Evolution of Lake Ontario-

St. Lawrence River Regulation," *Canadian Water Resources Journal/Revue canadienne des ressources hydriques* 43, no. 4 (December 2018): 416–31

27 Marcia Valiante, "Management of the North American Great Lakes," in *Management of Transboundary Rivers and Lakes*, ed. O. Varis, C. Tortajada, and A. K. Biswas (Berlin: Springer, 2008): 258–60.