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North American Environmental Law and Policy

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Commission for Environmental Cooperation

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PROFILE

In North America, we share a rich environmental heritage that includes air, oceans and rivers, mountains and forests. Together, these elements form the basis of a complex network of ecosystems that sustains our livelihoods and well-being. If these ecosystems are to continue to be a source of life and prosperity, they must be protected. Doing so is a responsibility shared by Canada, Mexico, and the United States.

The Commission for Environmental Cooperation (CEC) is an international organization created by Canada, Mexico, and the United States under the North American Agreement on Environmental Cooperation (NAAEC) to address regional environmental concerns, help prevent potential trade and environmental conflicts, and promote the effective enforcement of environmental law. The Agreement complements the environmental provisions of the North American Free Trade Agreement (NAFTA).

The CEC accomplishes its work through the combined efforts of its three principal components: the Council, the Secretariat and the Joint Public Advisory Committee (JPAC). The Council is the governing body of the CEC and is composed of the highest-level environmental authorities from each of the three countries. The Secretariat implements the annual work program and provides administrative, technical and operational support to the Council. The Joint Public Advisory Committee is composed of 15 citizens, five from each of the three countries, and advises the Council on any matter within the scope of the Agreement.

MISSION

The CEC facilitates cooperation and public participation to foster conservation, protection and enhancement of the North American environment for the benefit of present and future generations, in the context of increasing economic, trade and social links among Canada, Mexico and the United States.

NORTH AMERICAN ENVIRONMENTAL LAW AND POLICY SERIES

Produced by the CEC, the North American Environmental Law and Policy series presents some of the most salient recent trends and developments in environmental law and policy in Canada, Mexico and the United States, including official documents related to the novel citizen submission procedure empowering individuals from the NAFTA countries to allege that a Party to the agreement is failing to effectively enforce its environmental laws.

North American Boundary and Transboundary Inland Water Management Report

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FOREWORD

In the often complex, sometimes polemic, realm of regional environmental policy, one issue stands virtually alone in capturing the attention and concern of the public, governments and experts—the quantity and quality of freshwater in North America. This *North American Boundary and Transboundary Inland Water Management Report* examines the legal and policy underpinnings of the management of water in border regions in North America, including key policy options for enhancing freshwater management of this vital resource. It is intended to introduce the ecological, economic and sociopolitical realities germane to freshwater resources and ecosystems in Canada, Mexico and the United States and focuses on the legal and management regimes that have evolved for boundary and transboundary surface waters and ecosystems. The regimes available for addressing groundwater—especially that in transboundary aquifers—are much less well developed.

This report is intended to introduce the ecological, economic and sociopolitical realities that have shaped the way that freshwater resources and freshwater ecosystems have been "managed" in Canada, Mexico and the United States. It focuses primarily on the legal and management regimes that have evolved for boundary and transboundary surface waters and ecosystems. The regimes available for addressing groundwater—especially that in transboundary aquifers—are much less well developed.

The freshwater in the world's streams, lakes and rivers makes up a tiny fraction (about one part per 10,000) of the water on earth. Yet this freshwater and these freshwater ecosystems support a multiplicity of life-sustaining services that are intimately linked to human activities and to the long-term sustainability of human societies and civilizations.

Throughout history, people have built their communities and great cities along the shores of lakes and rivers. From ancient times, cultures and civilizations have evolved and adapted to the annual cycle of renewal of the world's mighty river systems. But the human stresses now placed on freshwater ecosystems and freshwater resources around

the world are increasingly complex, increasingly pervasive, and increasingly threatening to the sustainability of these systems and resources. People like to live, work, consume near, and release their wastes —directly or indirectly—into streams, lakes and rivers. Similarly, they have, with good intentions, dammed, diverted, channeled, impounded, reclaimed and regulated lakes and rivers for many purposes, including municipal water supplies, energy production, industry, navigation and, especially, irrigation of agricultural crops.

For millions of years, freshwater ecosystems also have provided the "stuff of life" in which the process of evolution worked to produce a proliferation of species that flourished over millennia, often in geographically isolated and protected freshwater ecosystems. Yet, as a result of the changes wrought by humankind, these cradles of life often have been altered to the point where they now bear little resemblance to their original state, and the life forms that once thrived no longer survive.

The hydrological cycle—evaporation, atmospheric transport and precipitation—provides a means of renewing and replenishing the world's freshwater heritage, yet there are limits. Today people live in a world where every drop of rain or flake of snow contains traces of chemicals that can be attributed to human activities. Water—freshwater, marine and in the tissues of living things—is an integrator of the many stresses and demands that humankind has placed on the planetary life support systems.

Boundary lakes, rivers and streams, and the rivers and streams that cross political boundaries are typically important pressure points. Often they force decision makers to try and develop management regimes to accommodate the multiplicity of human and other uses of these shared ecosystems, and the benefits and resources they provide. The Boundary Waters Treaty of 1909, one such example, has for almost a century served as an evolving framework for cooperation between Canada and the United States. Similarly, comprehensive mechanisms for binational cooperation along the US-Mexico border have been in place since 1889.

In developing this report, the North American Commission for Environmental Cooperation relied heavily on specialists to draft various sections (see Acknowledgments, p. 23). It is our hope that readers will find this report to be a useful introduction to the rich—but not always consistent—legacy of water management experiences on which Canada,

Mexico and the United States have to build. We also hope that it will help stimulate a greater appreciation of this most precious of nature's many life-sustaining gifts. Finally, and perhaps most importantly, we hope that the report might help catalyze creative and lasting solutions to some of the challenges that the three countries will encounter as they seek to manage their current uses of their freshwater heritage to meet the needs of today without compromising the ability of future generations to meet their own needs.

Janine Ferretti
Executive Director
North American Commission for Environmental Cooperation

EXECUTIVE SUMMARY

In many regions along both international borders of North America, demands for water and pressures on aquatic ecosystems are on the rise, spurred by economic and demographic changes. These changes, combined with growing concerns about human health and environmental quality, are impelling citizens and governments at all levels to pay far greater attention to the management and protection of boundary and transboundary waters.

Freshwater resources situated along and across North America's international boundaries are managed through a variety of domestic and binational mechanisms that have evolved over more than a century to meet emerging issues and challenges. Traditionally, the framework for managing boundary and transboundary water on the US-Mexico border has focused on the apportionment of scarce surface water resources. In the 1960s, water quality issues also began to receive serious attention. Groundwater received little consideration until very recently, despite the growing reliance on groundwater resources in North America.

The framework for managing transboundary water issues on the US-Canada border is directed at surface water allocation arrangements, water level maintenance and water quality. Other shared interests, such as controlling floods and maximizing the production of hydroelectric power, have also played an important role in the evolution of the binational framework for water management.

Frameworks for Domestic Water Management

Mexico

In the past, Mexico's inland waters were managed almost exclusively by the national government, with very little involvement of state governments. In recent years, however, the government has shifted toward decentralization of federal water management, particularly in the area of sewage and water infrastructure.

The 1992 *National Waters Act*, administered by the National Water Commission (*Comisión Nacional del Agua*—CNA), is the main institutional framework for water management in Mexico. CNA, whose responsibilities are primarily operational, oversees the development and use of Mexico's water resources. Since its creation in 1989, CNA has sought to reduce the level of federal centralization in water resources management by conceding more operational functions to states, municipalities and private firms.

The Department of Environment, Natural Resources and Fisheries (*Secretaría de Medio Ambiente, Recursos Naturales y Pesca*—Semarnap) is directly charged with implementing federal environmental laws. By law, Semarnap is the leading agency responsible for protecting water quality, which it does by setting standards and enforcing compliance with regulatory requirements. Its authority in this area, however, is largely administrative rather than operational. Most operational functions (for example, ownership and management of waste treatment facilities), inspections and monitoring are carried out by CNA and other federal, state and municipal entities.

United States

In the United States, water allocation is mainly a matter of state law, with the western and southern states generally relying on prior appropriation systems for surface water allocation, and the northern and eastern states relying mainly on riparian rights systems. Groundwater allocation, which is also under state jurisdiction, is often managed separately from surface water—a perpetual problem in water resources management, given the pervasive interactions between groundwater and surface water.

The federal Environmental Protection Agency implements laws to protect the environment, including water quality and aquatic habitat, for which many states have assumed administrative responsibility. Through the US Bureau of Reclamation and the US Army Corps of Engineers, the federal government has participated in the development of large water projects.

Interstate commissions administer water compact agreements between state governments. Some of the important waterways affected are the Colorado River, the Río Grande and the Great Lakes. In addition, Native American groups have begun to play an increasingly significant role in water management, particularly in the western United States.

Canada

The domestic framework for transboundary water management in Canada is a product of constitutional provisions, federal and provincial statutes, federal water policy, and intergovernmental institutional arrangements. The provinces have primary responsibility for land and resource management—including water management—within their respective boundaries.

The provinces legislate in most areas of water use, including allocation of water rights for surface and groundwater. They also play an important role in managing water through their responsibility for environmental protection and through provincial hydroelectric utilities. The federal government's responsibilities for water management derive from its jurisdiction over such things as fisheries, navigation, interprovincial matters and relations with foreign governments. Through laws such as the *Fisheries Act* and the *Canadian Environmental Protection Act*, the federal government is also responsible for protecting water quality. The *Canada Water Act* (1970) permits the federal government to enter into cooperative agreements with provincial governments to manage water resources. The *International River Improvement Act* (1955) provides a statutory basis for federal regulation of dams, diversions and other developments that affect the flow of rivers crossing the US-Canada border. As in parts of the United States, aboriginal peoples in Canada have a growing influence on water management, particularly in western and northern Canada.

Managing Transboundary Waters in North America

The US-Mexico Framework

The 1944 Treaty Relating to the Utilization of Waters of the Colorado and Tijuana Rivers and of the Río Grande—also known as the 1944 Water Utilization Treaty—is considered the centerpiece of the US-Mexico legal framework for managing transboundary waters. It established the binational International Boundary and Water Commission (IBWC, formerly the International Boundary Commission), which has many responsibilities, including oversight of transboundary water allocation (as established in the 1944 treaty and subsequent agreements), management of reclamation works, and development of joint sewage and sanitation facilities.

The 1944 Water Utilization Treaty has permitted IBWC's administrative role to evolve in response to emerging needs and circumstances.

As populations have grown in the border area, IBWC has become increasingly active in dealing with sewage and industrial water pollution in transboundary rivers. The commission has also assumed responsibility for addressing the persistent problem of high salinity in waters flowing from the United States to Mexico, particularly the Colorado River.

Growing concerns about environmental quality in the border region have fostered the creation of several recent binational institutions with responsibilities for transboundary water management. The United States-Mexico Border Environmental Cooperation Agreement (the La Paz Agreement) of 1983 established a process to reduce and prevent various forms of pollution in the border area. Working groups under the La Paz process have collaborated with IBWC to address specific problems, such as sewage in the Tijuana basin and discharges of hazardous substances into transboundary waters.

The Border Environment Cooperation Commission (BECC) is a binational commission established in 1994 to address shortcomings in environmental infrastructure along the US-Mexico border. The commission was created at the same time as the North American Development Bank (NADBank), and both grew out of the North American Free Trade Agreement (NAFTA). BECC and NADBank have been particularly active in providing technical assistance to border communities for water and sanitation projects that meet strict environmental criteria. Another recent binational initiative, the Integrated Border Environmental Plan, or Border XXI, promotes intergovernmental cooperation and public involvement in sustainable development in the border area.

Over the past three decades, rapid urbanization and economic development along the US-Mexico border have exacerbated problems associated with water scarcity and have placed increasing demands on groundwater resources. At the same time, water quality and environmental protection have become very important concerns. Although it has improved considerably in the recent years, adequate sewage is a persistent issue affecting US-Mexico transboundary rivers. Rapid population growth on both sides of the border, coupled with Mexico's limited financial resources, continue to undermine efforts to treat raw sewage prior to its disposal in the Río Grande and other rivers.

Transboundary water management on the US-Mexico border takes place largely within the framework of four major basins:

- The *Tijuana River basin* is characterized by dense and growing populations and extremely scarce surface water resources. Despite various

attempts, the two governments have failed to reach agreement on the apportionment of what little surface water exists in the basin. Surface water pollution and concerns about groundwater depletion add to the issues facing this region.

- The *Colorado River basin* is one of the most heavily regulated and used water systems in the world. Apportionment of the Colorado River's water within the United States is governed by a series of agreements constituting the "Law of the River." The 1944 Water Utilization Treaty allocates a specific volume of the Colorado to Mexico—1,850 million cubic meters (Mm^3) per year or 1.5 million acre-feet per year (MAF/yr), equivalent to roughly 10 percent of the average annual flow—but was silent on the quality of water to be delivered. As a result, serious problems have arisen, the most important of which is the increased salinity caused by upstream irrigation. This problem was addressed in 1973 by Minute 242 to the 1944 treaty, but it continues to be a concern for Mexico.

- The waters of the *Santa Cruz and San Pedro River basins*, although part of the Colorado system, are managed separately. The United States and Mexico have no binational agreement on the apportionment of these rivers. The most significant feature of these basins, from a water management perspective, is their reliance on groundwater. Rapid population growth highlights the urgent need for a transboundary groundwater management strategy for the region.

- International apportionment of the waters of the *Río Grande and its tributaries* is stipulated in a 1906 binational convention and further clarified by the 1944 Water Utilization Treaty. IBWC is responsible for implementing these agreements and operating the binational structures that regulate flows in the basin. Also under IBWC, the two countries are monitoring and mitigating salinity levels in the Río Grande. This problem remains, however, as does the need for groundwater management in the basin. Mexico also is concerned about the potential for transboundary groundwater contamination from prospective hazardous and radioactive waste disposal sites in Texas. It is attempting to use the La Paz process to address its concerns.

The US-Canada Framework

Transboundary water management on the US-Canada border is conducted within the framework established of the 1909 Boundary Waters Treaty. Several other region-specific treaties, conventions and agreements have since been adopted, including the Columbia River

Treaty (1961) and the second Great Lakes Water Quality Agreement (1978).

The International Joint Commission (IJC) was established by the Boundary Waters Treaty of 1909 to oversee issues arising from the waters shared by the United States and Canada. Initially, the IJC was responsible for approving water uses, obstructions and diversions of boundary and transboundary waters between Canada and the United States, and for investigating and making recommendations on questions or disputes referred to it by the national governments. Since beginning its work in 1912, the commission has seen its jurisdiction and functions expanded by treaties, agreements and protocols. With the creation of several international pollution boards in the 1960s and the signing of the first Great Lakes Water Quality Agreement in 1972, water quality was added to the more traditional concerns of water level and flow regulation.

Several bilateral government-to-government mechanisms and province-state arrangements also have a long history in dealing with transboundary water-related issues independent of the IJC. Examples of such mechanisms are the Columbia River Permanent Engineering Board, the Garrison Consultative Group and its Joint Technical Committee, the Bilateral Monitoring Committees for the Poplar and Souris Rivers, the Great Lakes Charter, and the Saint John Water Quality Committee.

In this report, discussions of transboundary water management on the US-Canada border focus on five regions:

- The *upper St. Lawrence and Atlantic drainage basins* include several transboundary and boundary waters from the region east of the Great Lakes to the Bay of Fundy. Both surface and groundwater resources in these areas are abundant. The most pressing issues related to boundary and transboundary water management in these basins are water quality and the maintenance of water levels. Water levels are especially important to navigation and hydroelectric power production in the upper St. Lawrence. Concerns along the St. John River relate to the potential flooding of agricultural land upstream of dams, and springtime floods in the lower St. John River Valley. In the St. Croix River basin, fluctuating water levels affect the local bass fishery and other wildlife species.

- The *Great Lakes* system is the world's largest surface water system and an extremely important transboundary resource. The management of water levels in this basin is important for industrial, domestic, envi-

ronmental and navigational purposes, as well as for flooding, hydropower and recreation. Proposals for large-scale diversions and the potential effects of climate change are two of many concerns that make water level regulation and maintenance in the Great Lakes an ongoing issue. Problems with eutrophication in the lower lakes and contamination by persistent toxic substances have spurred much binational activity on improving water quality since the mid-1960s. The Great Lakes Water Quality Agreement (1972) established the "ecosystem approach" to restoring and maintaining "the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem." This approach has helped to promote the adoption of a long-term, basinwide perspective on both sides of the border.

- The *Great Plains* contains several transboundary rivers, the most significant of which are the St. Mary, Milk, Souris and Red. Despite a recent major flood on the Red River, water is considered a scarce resource, particularly in the western portion of this region, and the rivers have been apportioned accordingly. The apportionment agreement for the St. Mary and Milk Rivers was reached in 1921 and is administered by a permanent board overseen by the IJC. The Souris River is apportioned as per a 1992 agreement. The increased uses and evaporation from storage reservoirs, and the prospective effects of climate change add to concerns about increasing water scarcity in the plains region.

- The *Columbia River* flows from Canada to the United States across the British Columbia-Washington border. Management of the river is governed by the 1961 Columbia River Treaty, which is aimed at improving flood control and maximizing hydropower generation. The treaty is overseen by a Permanent Engineering Board, established to assist in reconciling differences that may arise under the treaty. The 1992 British Columbia-Washington Environmental Cooperation Agreement provides an additional forum for addressing transboundary water issues in the basin. A still unresolved dispute between the United States and Canada has arisen over how to accommodate concerns about fisheries conservation in managing one of the Columbia River Treaty facilities, the Libby Dam.

- The *Yukon River basin*, the fifth largest in North America, and several other contiguous boundary basins make up the *Northwestern International Drainage Area*. The most significant of these are the Alsek, Taku and Stikine Rivers, which flow from Canada into the Alaskan Panhandle. Some of the tributaries within the Yukon basin are themselves boundary waters. The most important are the White,

Porcupine and Fortymile Rivers. The bulk removal or transfer of freshwater, water quality degradation from mining activities, and the hydrological and ecological impacts of climate change are the issues most likely to emerge over the next several decades.

Common Issues and Challenges

Despite some obvious differences between water management on the two international boundaries, several common trends and issues emerge in this report:

- G*roundwater depletion and quality.* The availability and quality of groundwater are becoming a major concern in all three countries of North America. Until recently, water managers gave little thought to groundwater. But with increasing dependence on this resource and more frequent groundwater depletion and contamination, the need to develop specific groundwater management and protection regimes has become clearer. Groundwater is becoming a particularly important issue on the US-Mexico border, where growing populations and vulnerable groundwater supplies suggest an urgent need for coordinated binational strategies. The lack of operative mechanisms for the management of transboundary groundwater resources promises to become one of the most pressing challenges of the 21st century. Failure to address the need to better manage transboundary groundwater could heighten the potential for regional conflicts, raising serious environmental security issues.

- *Growing concern about the environment.* Until fairly recently, water management meant ensuring the availability of water for domestic, industrial, agricultural, navigational and power needs, with little regard for the impact of these activities on aquatic ecosystems. Today, all national and binational water agencies recognize the need to consider the wider ecological implications of water management. Maintaining instream flows to permit essential biological functions is just one environmental imperative that challenges water management regimes in different parts of the continent, particularly in arid regions. Elsewhere, the need to protect surface and groundwater quality so it supports healthy fish and wildlife populations as well as human health is emerging as an important issue.

- *Public participation.* Across North America, concern about the environment has been accompanied by greater public interest and involvement in water issues. Popular interest in water issues, combined with the growth of a more participatory political culture in all

three countries, has led to demands for greater public involvement in water-related decision making. These demands have resulted in a variety of institutional changes to open the process of transboundary water management to the public on both borders.

- *Decentralization of water management.* In Canada and the United States, freshwater allocation falls under provincial and state jurisdiction. A trend toward the devolution of water management also has emerged in Mexico. From a local perspective, the empowerment of local governments and citizen groups facilitates the development of policies designed to address pressing local issues. However, decentralized control over water management extends the process and complexity of national and binational decision making; binational agencies, which traditionally have operated within a federal diplomatic framework, have to deal with a wider range of governments and other stakeholders.

- *Concern about the adequacy of financial resources.* Lack of financial resources is an ongoing concern for water management agencies in all three countries, as well as for the binational agencies with responsibilities in transboundary water management. Rising demands and pressures on water resources throughout North America will call for improved water-related research, data collection, monitoring and other functions that are essential to effective water management, but that require additional resources.

- *Water conservation.* In many parts of North America, people used to think of water as a practically infinite resource that could be manipulated to a very high degree to suit their social and economic needs. Today, however, many realize that much of the water on the continent is overapportioned, and they better understand the economic and ecological costs of damming or diverting surface waters. In all three countries, people generally recognize that they must use the available water more efficiently rather than seek new supplies. Thus water conservation is being promoted by a variety of means, including through economic instruments, the application of modern and efficient technologies, and public education. These developments are gaining importance for transboundary water management, where the adoption of new and improved conservation measures can help alleviate several current and potential problems.

- *Water marketing and pricing.* Over the past two decades, international agencies, including the Organisation for Economic Co-operation and Development (OECD) and the World Bank, have linked the achievement of more efficient and ecologically sustainable water consump-

tion patterns to the use of economic instruments such as the pricing of water supplies and services. In addition to creating a disincentive for waste, market-based, pay-for-service funding of water supply and sanitation services promises to produce the much-needed resources for water infrastructure projects. However, any transition to full-cost pricing must include the assurance that the water requirements (for basic human needs) of low-income groups will be met, particularly in regions characterized by a substantial disparity of wealth.

- *Large-scale diversions and bulk exports.* The transfer of large quantities of water from one basin to another raises issues of environmental resource management in the context of long-term, sustainable development. Although large-scale diversion and transfer schemes have been around for centuries, increased concerns about water scarcity in arid regions have coincided with a resurgence of proposals for bulk transfers of water. For example, some recently proposed, but highly controversial, projects call for shipping water in tankers and even building continental canal systems from northern Canada to the southern United States. The emerging issue is how trade law and principles may or should relate to bulk water exports (defined as the withdrawal of water from surface waters or from groundwater for the purpose of selling it to a third party outside the country for profit).

A Note on Terminology

In this report the term *boundary waters* refers to surface waters located *along* an international boundary; waters that flow *across* the boundary are called *transboundary waters*. Binational surface water agreements between Canada and the United States differentiate between boundary waters and transboundary waters. However, similar agreements between the United States and Mexico use the term *transboundary waters* to encompass both boundary and transboundary waters. The authors of this report have attempted to use the proper terminology where appropriate.

Finally, it should be pointed out that the bulk of this report was prepared in November 1999 and some government bodies referred to may have subsequently changed names or reorganized.

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INTRODUCTION

Clean, abundant freshwater is an essential component of human health, economic development and environmental quality. As they continue to grow economically and in population, many regions of North America face the challenge of meeting growing demands for water without compromising its quality and availability.

Meeting this challenge is no easy task. The legal and institutional frameworks for managing water in Canada, Mexico and the United States are complex and often cumbersome, making it difficult for these countries to respond to emerging issues and circumstances. Economic development produces shifting demands for water and new use patterns that may not suit traditional management strategies. Concerns about social equity and about involving the public in decision making are causing significant changes in the way new strategies are developed. The growing appreciation of the need to integrate economic with environmental and social considerations in water management adds to the challenge.

Assessing water resources, sorting out the conflicting demands for water, protecting aquatic ecosystems, responding to emerging uses and demands for water, ensuring that fairness and equity prevail in providing access to water—these are some of the basic tasks that must be carried out by each country in managing its water resources. The challenge of managing water is compounded when the water is shared by more than one country. Indeed, the successful management of international transboundary waters, perhaps as much as any other shared resource, requires an extraordinary degree of cooperation and collaboration between countries.

In essence, a successful transboundary water management framework must ensure that the countries sharing a given water resource have fair and equitable—if not equal[1]—access to the water and that appropri-

1. The critical principle of the Boundary Waters Treaty between Canada and the United States is that, despite the disproportionate size of the United States, the two parties must have *equal* access to the water.

ate rules be established and followed to ensure its sustainability. The failure to develop adequate transboundary water management frameworks can lead, as the past has shown, to severely strained international relations. Yet examples of successful transboundary management regimes for water abound, including those governing the two international boundaries considered in this study.

This report describes transboundary water management in North America in the context of evolving environmental, economic and social conditions. It also outlines the legal and institutional frameworks for managing transboundary waters on the US-Mexico and US-Canada borders, as well as the relevant domestic laws and agencies in all three countries. And the report describes the history and evolution of water management in North America with specific reference to transboundary issues. Overall, it represents a first step in providing a continental perspective of the transboundary water management challenges facing the three countries.

The report is a collaborative effort of several researchers from all three countries working under the direction of the Secretariat of the North American Commission for Environmental Cooperation. CEC assembled a team of Canadian, Mexican and US researchers with broad experience in transboundary water management in different parts of the continent. Nine major transboundary basins were selected for careful analysis and draft reports on surface water were prepared for each basin. Separate sections were prepared on groundwater for the two international borders and incorporated into chapters four and five. Researchers also analyzed the domestic and transboundary legal regimes for water allocation and management.

The appendix to this report presents an overview of the nine major basins discussed in the report and includes maps of the basins. Each basin is described in terms of its physical and social characteristics, the overall balance of uses to which the basin's water is put, and important or emerging management issues, as well as relevant transboundary issues.

CHAPTER 1

Mexico's Domestic Framework for Transboundary Water Management

The domestic framework for water resources management in Mexico is established by the fifth paragraph of Article 27 of the Political Constitution of the United Mexican States, which provides that all transboundary water—superficial or groundwater—situated in or under Mexican territory is regarded as "national water.[2]" According to the sixth paragraph of that article, such national waters may be exploited only through federal concessions. The 1992 *National Waters Act (Ley de Aguas Nacionales)*, implemented by the federal National Water Commission (*Comisión Nacional del Agua*—CNA), governs these concessions. From a legal standpoint, the federal government is the principal actor managing transboundary waters; the Department of Foreign Affairs (*Secretaría de Relaciones Exteriores*) serves as the conduit for diplomatic intercourse. This situation greatly facilitates matters of binational cooperation in view of the many actors, federal and state, involved on the US side of the border.

To explore and use national waters, a party must obtain a "concession" (for private users) or an "assignation" (for government users), which can be in force for a period of between five and 50 years.[3] Both are subject to certain conditions meant to ensure water quality, hydraulic security, environmental protection, dam safety and control of flows. Federal law also provides authority for designating by decree special administrative and reserve zones in areas particularly affected by water scarcity, poor water quality or environmental degradation. These zones

2. C. Díaz and J. Ramón, "Constitutional Framework for Water Regulation in Mexico", (1995) 35 *Natural Resources Journal* 489-499.
3. According to Article 17 of the Act, the exploitation and use of national waters are free when done by manual means and for domestic and cattle use, but the water flow may not be changed or significantly diminished and the water quality may not be altered. The same applies, according to Article 18, to the use and exploitation of groundwater through infrastructure, except when, for the public interest, the federal government regulates it.

may be established during "emergency" or drought conditions, and in them water use may be restricted or curtailed completely.[4]

With financial support from the World Bank through its Northern Border Environmental Project, Mexico is making efforts to promote conservation, improve water management and foster better intersectorial allocation of rights. In addition, the loan will promote the strengthening of the water management capabilities of user associations in irrigation districts (management of these districts has devolved from the federal government to the users' associations). Like water management policy in the United States and Canada, Mexico's water policy is evolving to meet changing needs and demands. Because major new water storage projects or technological alternatives such as desalination are likely to be too expensive to consider in the near term, water conservation may often be the most desirable solution.

The institutional framework for transboundary inland water management in Mexico is centered in the agencies, institutions and administrative bodies described in the sections that follow.

1.1 National Water Commission (CNA)

Although a trend toward decentralization has been evident in recent years, the administration of water resources in Mexico is still dominated by the federal government and is highly centralized. The *National Waters Act* of 1992 designates the National Water Commission, a semiautonomous federal agency, as the lead agency for the administration of national water resources. CNA was established in 1989 in response to the perceived need for greater integration of national water policies. Since 1995, CNA has been located administratively within the Department of Environment, Natural Resources and Fisheries (*Secretaría de Medio Ambiente, Recursos Naturales y Pesca*—Semarnap). The commission is required to, among other things:

- develop and implement the national water plan;
- develop criteria and guidelines for coordinating and integrating federal activity related to water resources use and development;
- develop and support the development of potable water systems, sanitation systems, water treatment and wastewater recycling, irrigation and drainage, and flood control;

4. World Bank, *Staff Appraisal Report: Mexico Water Resources Management Project*, Report No. 15435-ME, Washington, DC: World Bank, 1966, 3.

- administer and protect the quantity and quality of national water resources;
- construct, operate, and maintain federal hydraulic works directly or by contracts and concessions with third parties;
- administer and oversee the allocation of water rights;
- referee water disputes and arbitrate them at the request of water users within the terms of the law;
- promote efficient water use and water conservation; and
- administer and enforce the terms of the present law and apply such sanctions as are specified for noncompliance that are not otherwise reserved to the federal executive.

Under the authority of the *National Waters Act*, the CNA discharges these various functions in coordination with other federal, state, and municipal agencies. Since its inception, the agency has sought to reduce the level of centralization in water resources administration by conceding more administrative functions to the states, municipalities (*municipios)* and private firms. Nevertheless, CNA remains the lead agency for national water resource administration in virtually all functional areas.[5]

CNA has a significant impact on the management of transboundary water resources along the US-Mexico border through its direct involvement in: (1) the administration of water supply and sanitation in border states and *municipios*; (2) the management of national irrigation districts; (3) the creation of river basin councils; (4) the maintenance of water supply and treatment infrastructure; and (5) the maintenance of a public registry of public water rights. Brief descriptions of these functional areas follow.

1.1.1 State and Municipal Water Administrations

Traditionally, state and municipal authorities have exercised little independent authority over water resources within their jurisdictions because of the constitutional and statutory dominance of federal institutions and their own limited financial capabilities. Under the 1992 *National Waters Act* and related administrative changes, however, CNA is now delegating the planning and budgeting of urban water supply and sewerage services to the states, which in turn provide technical

5. G. Newman, *Managing Mexico's Environmental Challenge,* London: Economist Intelligence Unit, 1995, 54.

assistance, support services, and budgetary support to water utilities and local organizations.[6] State plans are detailed, describing various classes of water users, listing applicable statutes and relevant federal and state agencies, and setting out priorities for water use. The largest part of state funding for municipal water management is derived from CNA, and CNA continues to monitor state plans and management activities, retaining an oversight role.

Just how far the decentralization of urban water management will proceed remains to be seen. Within the Federal District (Mexico City), a 1992 presidential decree created a new municipal water commission with the authority to contract with private utilities for water distribution, sewerage and wastewater treatment. This arrangement is intended to introduce market mechanisms and greater economic efficiency in municipal water management. Consistent with this approach, the government initiated a new program of municipal subcontracting in 1992.[7] The privatization of municipal water management has just begun in border states and *municipios*.

1.1.2 Irrigation Districts

As the lead agency for water management in Mexico, the CNA exercises considerable influence over rural and agricultural water management through its control of the nation's reclamation works and federal irrigation districts. Since its inception, the CNA has sought to introduce a greater degree of autonomy in irrigation district management, giving user groups greater influence. Under the 1992 *National Waters Act*, the voting power of federal agencies in district water committees (*comites hidraulicas)* has been reduced. These committees are headed by a chief engineer designated by CNA and comprise representatives of each of the user groups within the district. Other federal agencies, including the Department of Agriculture (*Secretaría de Agricultura*), federal credit agencies, and state and municipal agencies, may also be represented on a nonvoting basis.

Although CNA is now the only federal voting member on *comites hidraulicas*, the continued presence of federal authorities in irrigation

6. *Ibid*., 55; and H. Ingram, N. Laney and D. Gillilan, *Divided Waters,* Tucson: University of Arizona Press, 1995, 174-175.
7. This new program, known as the build-operate-transfer, or BOT, permits municipalities to establish *organismos operadores*, or operating entities, to contract out for wastewater treatment services. These bodies may enter into contracts with private enterprises to construct and operate the utility. State governments normally participate as financial guarantors for the operating entities. See Newman, *Managing Mexico's Environmental Challenge*, 57-60.

district management, coupled with their technical expertise and the financial resources they provide for agricultural development at the district level, lend considerable weight to the federal government in district-level water management.

Of Mexico's 101 irrigation districts over 1,000 hectares (ha) in size, 27 are located in border states, and 11 of these are located directly along the border.[8]

1.1.3 River Basin Councils (Consejos de Cuenca)

The CNA Technical Council is empowered to create the river basin councils *(consejos de cuenca)*. These bodies coordinate CNA activities with federal, state and municipal agencies, as well as the representatives of water users of each basin. More specifically, the councils propose, formulate and execute programs for water management, for the development of hydraulic infrastructure and services, and for the conservation of the basin's water resources.

The river basin councils are chaired by a representative of CNA, who has tie-breaking voting authority. Additional voting members include representatives of the Department of Budget and Public Credit (*Secretaría de Hacienda y Crédito)*, Department of Energy, Mining and State-owned Industries (*Secretaría de Energía, Minas e Industria Paraestatal)*, Department of Agriculture, and Semarnap, and up to six representatives of water user groups within the basin. Other representatives of federal agencies, states, municipalities and nongovernmental organizations may be invited to participate in matters relevant to their jurisdictions and interests.

The river basin councils propose to CNA changes in water management regulations that would better serve the needs of the basin; organize workshops and study groups to evaluate and improve water management conditions and practices within the basin; work with CNA to set priorities of use and address problems of water emergencies, drought, depletion and contamination of water resources within the basin; and assist CNA in setting user fees for the delivery and consumption of water resources within the basin.

Since the adoption of the *National Waters Act* in 1992, two river basin councils have been established: (1) the Lerma-Chapala Basin

8. A. Orive et al., *La Irrigación en México,* Mexico, DF: Editorial Grijalbo, 1970, 164-170.

Council, created on 8 December 1992 and covering the states of Guanajuato, Jalisco, México, Michoacán and Querétaro; and (2) the Río Bravo (Río Grande) Basin Council, created on 12 January 1994 and covering the states of Durango, Coahuila, Chihuahua, Nuevo León and Tamaulipas.[9]

A third river basin council, for the Valley of Mexico, was being established by CNA at the time of writing this report.

Adoption of this river basin approach is consistent with federal efforts to reduce the level of centralization in national water management. It also represents a significant departure from previous water management practices, and aims to provide a more integrated and cohesive intergovernmental response to the conservation of water resources at the river basin level throughout Mexico.

1.1.4 Water Quality

Semarnap, through its subsidiary agencies, has the lead role in setting water quality standards and enforcing compliance with water quality regulations. CNA also has a substantial water quality management role through its operational oversight of water conservation activities and through its participation in the development, operation and management of reclamation works, sewage and wastewater treatment facilities. Furthermore, CNA is responsible for monitoring and regulating the quality of water bodies, including groundwater aquifers.

Some of the water quality functions performed by these two agencies are: disseminating technical regulations for the discharge of pollutants and wastewater affecting water bodies; issuing licenses and permits to sewage and wastewater treatment facilities; promulgating technical norms for wastewater recycling; promulgating technical norms for the use of urban wastewater in agriculture; and developing policy recommendations affecting the location of industrial facilities whose effluent may affect the quality of water resources.

The role of states and municipalities in water quality management is largely focused on municipal water supply and sanitation. Under the 1992 *National Waters Act*, municipalities and other providers of water and sewer services are obligated to provide sufficient water treatment to comply with national sanitary standards for drinking water and

9. Several observers assert that little progress has been made toward the implementation of the Río Grande Council, however.

wastewater. Under the 1988 Ecology Law,[10] states and municipalities are required to regulate the discharge of sewage and wastewater, provide for adequate sewage treatment, and maintain a registry of pollutants discharged to sewage systems, among other requirements. Many state and municipal governments, however, lack the funds to finance such activities themselves and remain dependent on federal support.

State and local water management authorities are becoming increasingly involved in the ecological aspects of land-use management. Among other things, they designate and manage conservation zones, protected areas and other instruments of land-use management sensitive to environmental concerns. Such practices potentially affect water quality by regulating the scope and character of urban development. The relatively recent activities of the states and municipalities in this area derive from the 1988 Ecology Law and new state environmental laws.

Under the same statutory authority, states and localities also may require environmental impact assessments. The new state environmental laws also authorize the state environmental agencies actively to limit the discharge of pollutants from industrial and agricultural sources, including pesticides and fertilizers.

1.1.5 Public Registry of Water Rights

In accordance with the *National Waters Act*, CNA maintains a Public Registry of Water Rights, which includes all titles of concession and assignation, as well as all permits to construct drilling works for the extraction of groundwater. The registry also includes contracts for the partial or total transfer of water rights. As of March 1996, 43,400 water users had initiated the registration process, and 37,600 of these had formally registered, accounting for more than 80 percent of total water use in Mexico by volume. The registry also keeps a permanent national record, by zones and regions, of groundwater extraction and groundwater springs. This record keeping permits the monitoring of aquifers in order to regulate their use and exploitation.

Water rights, once registered, are transferable and can be bought and sold, as long as such a transaction is determined to be technically feasible and as long as the transfer does not adversely affect uncompen-

10. *Ley General de Equilibro Ecológico y la Protección al Ambiente*, Mexico, DF: Editorial Porrua, 1991.

sated third parties. Full implementation of a water rights market, however, is not likely to occur until the water rights registry is complete, CNA has fully implemented the appropriate fee schedules and CNA staff has received additional training in water rights management.

1.2 Department of Environment, Natural Resources and Fisheries (Semarnap)

Semarnap is directly charged with implementing the federal environmental laws. The mandate of this multipurpose agency includes environmental protection, natural resources management and the management of Mexico's marine resources. By law, it is the leading agency with responsibility for protecting water quality, a function it shares with CNA. Semarnap's authority in this area is largely administrative rather than operational. Most operational functions (such as ownership and management of waste treatment facilities), inspection and monitoring are carried out by CNA and other federal, state and municipal entities.

Semarnap has overall responsibility for setting standards and enforcing compliance with regulatory requirements. It also is the primary mechanism for the articulation of public complaints about water pollution throughout the country. Additional environmental functions of the department affecting the management of water resources include: developing standards for cross-media pollution; regulating solid and hazardous wastes, radioactive substances, and air pollution; administering the environmental impact review process; designating and enforcing natural protected areas and the conservation of wildlife; and identifying and promoting new technologies for environmental protection. All these functions contribute to Mexico's capacity to manage its water resources.

Semarnap's environmental functions are divided between two autonomous agencies, the National Institute of Ecology (*Instituto Nacional de Ecología*—INE) and the Office of the Federal Attorney for Environmental Protection (*Procuraduría Federal para la Protección al Ambiente*—Profepa). INE is responsible for the research, development and evaluation of Mexico's environmental policies; for the implementation of environmental programs; and for natural resources conservation. Profepa is charged with enforcing compliance with INE regulations, investigating noncompliance, providing public access, and responding to public complaints of environmental noncompliance and activities harmful to the environment.

1.3 State Environmental Agencies

Since 1988, as part of the overall trend toward decentralizing public administration, the federal government has encouraged Mexican states to adopt their own environmental laws and environmental agencies. By the end of 1994, all but two of the 31 states had adopted environmental laws and established state environmental agencies to facilitate environmental protection. As a rule, state environmental laws emulated the 1988 Ecology Law, allowing for variations in state administration and practice. Important aspects of national environmental management at the state and local levels include: operational control of municipal wastewater collection and treatment; application of the environmental impact and assessment process; norm setting within the parameters set by federal guidelines; conservation of natural resources and protected areas; land-use planning; and application of sanctions for violations of environmental laws.[11]

The establishment of state environmental agencies has not yet significantly altered the pattern of federal predominance in Mexican environmental management, particularly in water management. At present, many state-level environmental agencies are fledgling operations with limited resources. State agencies remain heavily dependent on federal financing for their operating budgets and remain underfunded in relation to their statutory assignments. Where conflicts between state and federal agencies have arisen, federal authorities have often prevailed on the basis of federal preemption and fiscal dominance. State agencies are less able to draw on technically qualified personnel and thus suffer from shortages of inspectors, analysts and other skilled personnel.[12] These weaknesses, and the related needs of state and municipal environmental agencies are a major focus of the World Bank's Northern Border Environmental Project for Mexico.

1.4 Municipal Environmental Management

Provisions for municipal participation in environmental management are based on Article 115 of the Mexican Constitution and the 1988

11. Environmental Law Institute, *Decentralization of Environmental Protection in Mexico: An Overview of State and Local Law Institutions*, Washington, DC: ELI, 1996.
12. World Bank, *Staff Appraisal Report, Mexico Northern Border Environment Project*, Report No. 12603-ME, Latin American and Caribbean Regional Office, International Bank for Reconstruction and Development, Washington, DC: World Bank, 16 May 1994, Annex I, 7-10.

Ecology Law. Municipalities, or *municipios,* are governed in greater detail by the state environmental laws. Under the new state environmental laws, *municipios* now have the authority to establish environmental agencies or assign the administration of environmental laws to existing divisions of municipal administration. *Municipios* also may establish public advisory boards, known in some states as municipal environmental commissions (*comisiónes municipales de ecología)*, or other mechanisms for providing public input in environmental administration and planning. At present, municipal governments have made only limited progress in elaborating systems of environmental administration and public participation, although various municipalities along Mexico's northern border have made some headway in this regard. The World Bank's Northern Border Environmental Project for Mexico is working toward, among other things, enhancement of the capacity of municipal governments to participate in environmental administration.

Insofar as state and municipal environmental legislation affects water management, the division of responsibilities between state and municipal governments is specified by state law. Border state environmental laws vary in the assignment of responsibilities to municipalities. The state of Nuevo León, for example, delegates to *municipios* the very general responsibility for preserving and restoring ecological equilibrium and protecting the environment in those areas deriving from its public service mandate, but without expressly mentioning water pollution. The state of Coahuila assigns to its *municipios* the responsibility for promoting the rational use, conservation and recycling of assigned municipal water, as well as the capture and efficient use of rainwater, and for preventing and controlling the contamination of federal water assigned for the discharge of municipal public services. In the state of Sonora, the *municipios* are responsible for preventing and controlling contamination of federal waters assigned to *municipios* or their concessionaires for the provision of public services, as well as those waters discharged in drainage and sewage systems in population centers or discharged to water bodies under state jurisdiction.

Other municipal responsibilities that have indirect impacts on water management are: regulation of solid and hazardous waste, air pollution, contingency planning, environmental impact assessment, creation and maintenance of ecological preserves, land-use planning, and human settlements management.

CHAPTER 2

United States' Domestic Framework for Transboundary Water Management

In the United States, the intrastate allocation of water rights is basically a matter of state law. Even water rights held by the federal government—federal reserved water rights associated with federal lands—and Native American water rights (see section 2.3) are often subject to state water rights adjudication procedures.[13] State constitutions, particularly in those states that follow the prior appropriation doctrine (see section 2.2.1.1), often have provisions stating that all waters belong to the state or are held by the state in trust for the public.

The federal government's powers under the US Constitution, however, impose some limits on state authority over water allocation. For example, the US Supreme Court has limited the ability of states to prohibit out-of-state water exports.[14] Federal powers over navigation and power generation and federal environmental laws can also constrain states' abilities to approve certain water allocations. Of particular importance to this report, the federal government's power to enter into treaties limits state authority over international (transboundary) waters. Nevertheless, in terms of water resource management the federal government's primary responsibilities relate to water quality.

The legal and institutional framework for transboundary inland water management in the United States comprises a wide range of federal, state, tribal, municipal and intergovernmental laws and agencies. The most relevant of these laws and institutions are described in the rest

13. C.J. Strong and S.W. Strack, "The McCarran Amendment Is Alive and Well", in *Water Law: Trends, Policies and Practice*, K.M. Carr and J.D. Crammond, ed., Chicago: American Bar Association, 1995, 43-57. Some adjudications in western US states deal with entire river basins to ensure that the adjudication encompasses federal rights.
14. *Sporhase* v. *Nebraska*, 458 US 941 (1982). This decision held that water is an article of commerce and thus strict state limits on exports are not permissible if they unreasonably burden commerce without federal authorization. States can, however, regulate exports on the basis of water conservation and public welfare.

of this chapter, starting at the federal level and proceeding to the state and subnational levels. An overview of management and jurisdictional issues pertaining to groundwater is presented in section 2.2.1.3.

2.1 Federal Legal and Institutional Framework

Federal environmental and natural resources legislation encompasses several different laws; they address water issues mostly in terms of water quality. Some of these laws are described below:

- The federal *Clean Water Act* prohibits any person from discharging a pollutant from a point source into navigable waters without a permit from the National Pollutant Discharge Elimination System (NPDES). It also requires each state to identify those waters that cannot meet water quality standards without control of non-point sources; the categories of non-point sources that significantly pollute those waters; the methods used to determine best management practices for those categories of non-point sources; and any existing programs aimed at curbing non-point pollution.

- The *National Environmental Policy Act* (NEPA) authorizes the federal government, in cooperation with state and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, to foster and promote the general welfare, to create and maintain conditions under which people and nature can exist in productive harmony, and to fulfill the social, economic and other requirements of present and future generations.

- The *Safe Drinking Water Act* requires all public water systems to meet certain national primary drinking-water regulations.

- The *Federal Endangered Species Act* declares that federal agencies shall cooperate with state and local agencies to resolve water resource issues in concert with the conservation of endangered species.

- The *Fish and Wildlife Coordination Act* requires federal agencies to consult with the US Fish and Wildlife Service to identify potential mitigation steps before permitting or licensing certain water development projects.

- The *Wild and Scenic Rivers Act* prohibits any activities, including logging, water diversions or development projects, that could conflict with the purposes of the "Wild and Scenic" designation allowed for specified rivers.

- Various other statutes govern construction and operation of federal reclamation projects. The *Pacific Northwest Power Planning and Conservation Act* applies to the Northwest.

It is beyond the scope of this report to provide full descriptions of these detailed and complex federal laws.[15] It is of significance to the management of transboundary waters, however, that each of these acts may affect both the development of new water supply sources and the management of existing water rights and supply reservoirs. For example, development of a new reservoir would have to comply, at a minimum, with restrictions imposed under the federal *Clean Water Act*, NEPA and the *Endangered Species Act*. In other cases, the *Endangered Species Act* may require changes in the management of existing hydropower developments.[16]

The following sections briefly describe the main federal institutions responsible for managing US freshwater resources and the legislative context in which these institutions function.[17]

2.1.1 Environmental Protection Agency (EPA)

Established in December 1970 by an executive order submitted to Congress, EPA is the independent agency in the executive branch that has primary responsibility for implementing, monitoring and enforcing the nation's environmental protection laws. EPA's mission is to protect human health and to safeguard the natural environment—air, water and land—on which life depends. It also is a key research agency, conducting analysis on toxic substances, pesticides, air and water quality, hazardous wastes, radiation, and the causes and effects of acid rain.

EPA has 10 regional offices: Boston, New York, Philadelphia, Atlanta, Chicago, Dallas, Kansas City, Denver, San Francisco and Seattle. The regional offices are responsible for carrying out, within their region, the national program objectives established by EPA. They work with federal, state, interstate, local, tribal and nongovernmental organizations to ensure that regional needs and circumstances are considered and federal environmental laws are implemented. Six of the EPA

15. Summaries may be found at http://www.cec.org.
16. For a thorough discussion of these issues from a legal perspective in the context of the northwest, see "Symposium: Northwest Water Law", (1996) 26(1) *Environmental Law*.
17. This section is drawn primarily from: *The US Government Manual 1995/96*, Washington, DC: Government Printing Office, 1995; and C. Kerwin, *Guide to US Federal Regulatory Agencies*, Washington, DC: CQ Press, 1995.

regional offices are involved in and provide leadership for regional domestic and binational efforts to protect many US-Canada waters. In addition, EPA's regional office in Kansas City carries out a key role in certain domestic and US-Canada cooperation aimed at protecting prairie waters ecosystems, which include many waters critical for the survival of migratory birds.

EPA does not have a direct role in water allocation, nor does it have a separate program for the protection of groundwater quality. It does, however, have significant responsibilities as part of US-Canada relations under the Boundary Waters Treaty to help ensure that allocations of certain US-Canada waters are planned and carried out in an environmentally sound manner consistent with up-to-date interpretations of compliance with Article IV on water quality protection of the 1909 Boundary Waters Treaty. EPA has the following major responsibilities for surface water quality:

- Issue permits for the discharge of any pollutant into navigable waters.
- In cooperation with the US Coast Guard, coordinate cleanup of oil and chemical spills into waterways.
- Develop effluent guidelines to control discharge of specific water pollutants.
- Develop criteria that serve as guidance when states and tribes set surface-water quality standards.
- Administer federal grants programs to subsidize the cost of building sewage treatment facilities.
- Regulate disposal of waste materials into the oceans.
- In cooperation with the US Army Corps of Engineers, issue permits for the dredging and filling of wetlands.
- Set national drinking water standards.
- Regulate underground injection of waste materials.
- Authorize states and tribes to issue permits and set standards for surface-water quality standards.

2.1.2 Council on Environmental Quality (CEQ)

CEQ was established within the Executive Office of the President by the *National Environmental Policy Act* to formulate and recommend

national policies that would promote improvements in the quality of the environment. The council develops and recommends national policies that further environmental quality; analyzes changes or trends in national environmental matters; reviews and appraises federal government programs to determine their contributions to sound environmental policy; conducts research related to ecological systems and environmental quality; assists the president in preparing the annual environmental quality report to Congress; and oversees implementation of NEPA. CEQ also resolves interagency disputes on NEPA-related matters, including preparation of environmental impact statements (EIS).[18] Since 1979, the provisions of NEPA have been extended to federal agency actions that have significant environmental impacts beyond the territorial boundaries of the United States. Thus CEQ's EIS functions are potentially significant for transboundary water management.

2.1.3 Department of Agriculture (USDA)

Although not directly involved with water management issues, two branches of the USDA: the US Forestry Service and the Natural Resources Conservation Service—have general mandates that give them some authority over certain water-related issues.

2.1.3.1 US Forest Service (USFS)

A federal agency created in 1905, USFS is responsible for national leadership in forestry. It manages forests and grasslands on over 77 million ha (191 million acres) of public lands under the principle of multiple use. In doing so, USFS strives to meet the nation's need for wood products while assuring the availability of other forest system benefits for the public, including wildlife habitat and water supplies.

2.1.3.2 Natural Resources Conservation Service (NRCS)

Formerly the Soil Conservation Service, the NRCS helps farmers, ranchers and other private landowners develop voluntary programs to conserve and protect natural resources, including water. NRCS is the technical delivery arm for conservation of the US Department of Agriculture.

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18. US Environmental Protection Agency, *Facts about the National Environmental Policy Act*, Washington, DC: EPA, 1989; and Council on Environmental Quality, *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*, Washington, DC: CEQ, Executive Office of the President, 1986.

Key water-related NRCS programs include: Conservation Technical Assistance, Snow Survey and Water Supply Forecasting Program, River Basin Surveys and Investigations, Resource Conservation and Development Program, Wetlands Reserve Program, and the Colorado River Basin Salinity Control Program.

2.1.4 National Oceanic and Atmospheric Administration (NOAA)

An agency within the Department of Commerce, NOAA is primarily concerned with developing scientific understanding of oceanic and atmospheric natural resources. NOAA disseminates information about the short- and long-term consequences of environmental modification and provides services to a variety of governmental and nongovernmental organizations in support of air quality, agricultural, forestry and marine activities. Marine activities are supported by the National Marine Fisheries Service, which assists in administering the *Endangered Species Act* and the new Essential Fish Habitat Program. Finally, NOAA conducts research and implements services related to inland waterways, including the St. Lawrence Seaway and the Great Lakes.

2.1.5 US Army Corps of Engineers

The Corps of Engineers is a division of the US Army and is administered by the Defense Department. Its major role is to regulate all construction projects in the navigable waterways of the United States. In cooperation with the Environmental Protection Agency, the Corps promulgates regulations governing the transportation and dumping of dredged materials in navigable waters under Section 404 of the *Clean Water Act*.

The majority of the Corps's activities involve water resource development projects, including the planning, construction, and often operation of dams, reservoirs, levees, harbors, waterways and locks. These projects are designed to provide protection from floods, reduce transportation costs, supply water for municipal and industrial use, generate hydroelectric power, create recreation opportunities, improve wildlife and water quality, and protect the shorelines of lakes and oceans. The Corps also provides assistance to state, local and nonfederal water resource management groups, as well as to foreign countries, for the purpose of improving water management activities.

2.1.6 Department of Energy (DOE)

Created in 1977, the DOE is responsible for research and development on energy technology and overseeing energy conservation and

energy regulatory programs, as well as the nation's nuclear weapons program. The department also is responsible for marketing power produced at federal hydroelectric projects and reservoirs. The marketing and transmission of power is carried out by five power administrations including two that are relevant to this study:

- *Bonneville Power Administration.* Established in 1937, the Bonneville Power Administration markets electric power and sells surplus power generated by federal hydroelectric projects in the Pacific Northwest. These projects are constructed and operated by the Army Corps of Engineers and the Bureau of Reclamation. The Bonneville Power Administration is also responsible for energy conservation, renewable resource development and fish and wildlife enhancement under the provisions of the *Pacific Northwest Electric Power Planning and Conservation Act* of 1980. In cooperation with the Army Corps of Engineers, the administration represents the United States in implementing the provisions of the Columbia River Treaty with Canada.

- *Western Area Power Administration*. The Western Area Power Administration, established in 1977, is responsible for marketing and transmitting federal electric power in the western United States, where it operates 47 hydropower facilities. The Western Area Power Administration is also responsible for planning, constructing and maintaining any additional federal facilities that may be authorized in the future.

2.1.7 Department of the Interior

The Department of the Interior is the federal agency with primary responsibilities for the management of natural resources. These resources include public lands, national parks and monuments, recreation areas, wildlife refuges, fish and wildlife (including endangered species), and minerals. Within the Department of the Interior, several bureaus have specific responsibilities for various natural resources, as described in the sections that follow,

2.1.7.1 Bureau of Land Management (BLM)

The Bureau of Land Management, created in 1946, is responsible for administering more than 109 million ha (270 million acres) of public lands, located mainly in the western United States and Alaska. The bureau is also responsible for developing the mineral resources found on an additional 236 million ha (582 million acres) of public lands, including lands administered by other federal agencies.

BLM regulates federal grazing lands, protects and preserves timberland for permanent forest production, manages watersheds to protect soil and water quality, and issues permits for mineral exploration.

2.1.7.2 US Fish and Wildlife Service (USFWS)

The US Fish and Wildlife Service, created in 1940, manages more than 500 National Wildlife Refuges and 166 waterfowl production area, totaling over 37 million ha (92 million acres). The service is responsible for the conservation and management of fish and wildlife, including migratory birds, endangered species, certain marine mammals, and freshwater fish. As the lead federal agency for the protection and improvement of habitat for fish and wildlife, USFWS regulates and preserves wetlands for waterfowl and other species within the National Wildlife Refuge system. USFWS also plays a key role in administering the *Endangered Species Act*.

Major water quality-related activities of the FWS include: monitoring pesticides and other contaminants in the environment; studying ecology and fish and wildlife populations; performing environmental impact assessments of hydroelectric projects and stream channelization; and assessing requests for dredge and fill permits under the *Clean Water Act*.

2.1.7.3 US Geological Survey (USGS)

Established in 1879, USGS surveys and identifies the mineral, water and energy resources of the United States. In the area of water, USGS maintains a water resources office in every state, and conducts nationwide assessments of the supply, quality and use of water resources.

2.1.7.4 National Park Service (NPS)

Established in 1916, the fundamental objective of the NPS is to conserve the scenery, natural and historic objects, and wildlife in the nation's park system. The service manages an extensive system of national parks, monuments, historic sites, riverways, seashores, lakeshores and recreation areas, more than 365 areas in all.

2.1.7.5 Bureau of Reclamation

Established by the *Reclamation Act* of 1902 and created as a separate agency in 1907, the bureau is responsible for water and power develop-

ment in the 17 contiguous western states. Its activities include municipal and industrial water services, irrigation systems, hydropower generation, flood control, river regulation, fish and wildlife enhancement, recreational opportunities, and water quality improvement. Bureau reclamation projects currently in operation include 348 storage reservoirs, thousands of miles of canals and other distribution facilities, and 58 hydroelectric projects. These projects are funded in part by taxes levied on the direct beneficiaries. With its infrastructure largely in place, the bureau now focuses more on promoting the efficient management and conservation of water resources than on developing new supplies of water.

The primary activities of the bureau include:

- working in concert with other governmental and nongovernmental organizations to develop water conservation plans and working to improve the management of existing water resources;
- designing and constructing water resources projects;
- assisting other federal and state agencies in protecting surface and groundwater resources from hazardous waste contamination and restoring affected resources;
- providing engineering and technical support to federal and state agencies and Native American governments; and
- preparing and reviewing, in cooperation with other federal agencies, environmental impact statements for proposed federal water resource projects.

2.1.8 US Coast Guard

Established in 1915, the US Coast Guard became part of the Department of Transportation in 1967. Although the Coast Guard is a branch of the armed services, it acts as a service within the Department of Transportation, except in times of war or as specified by presidential directive.

The Coast Guard is responsible for enforcing elements of the federal *Water Pollution Control Act* and various other statutes relating to the protection of the marine environment from oil and other material spills. In addition, through its Port Safety and Security Program, the Coast Guard enforces rules and regulations governing the safety and security of ports, the movement of vessels and the prevention of pollution in US waterways.

2.2 State-Level Legislation and Institutions

State law generally governs allocation of water resources.[19] In addition, states have begun to play a central role in protecting water quality. Because Congress designed most major environmental legislation so it could be administered by state and local governments, the states are the key implementers of most major environmental programs. As of the late 1970s and early 1980s, state and local governments began to shoulder a greater share of environmental program responsibilities. Under the "new federalism" of recent presidential administrations, public policy responsibilities were shifted from the federal to the state and local levels of government. In general, state responsibilities in pollution control have increased significantly during the past two decades.

The early national environmental laws were enacted with a strong federal focus that provided for consistency across states—many states did not have the capacity needed to carry out major environmental programs themselves. Nevertheless, while these laws gave EPA the main role in the delivery of environmental programs, they also allowed states to assume these responsibilities as they developed the capacity to do so. As a result, the states have now become key players in the implementation of a full range of environmental program responsibilities. Essentially, operational responsibilities for many of EPA's major environmental programs, including water pollution control and abatement, lie with the states.

In part in response to their increased program responsibilities, states have undergone transformations in their fiscal, managerial and political capacities for implementing federal environmental programs. Yet these transformations are not uniform across the 50 states. Comparative analyses of state environmental policy indicate that the states diverge widely in their capacity for environmental protection, including freshwater resources.

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19. For more on state-level legislation and institutions, see E.J. Ringquis, *Environmental Protection at the State Level,* Armonk, NY: M.E. Sharpe, 1993; W. Lowry, *The Dimensions of Federalism*, Durham, NC: Duke University Press, 1993; U.S. General Accounting Office, *EPA and the States: Environmental Challenges Require a Better Working Relationship,* GAO/RCED-95-64, 1995; and J.P. Lester, "Federalism and State Environmental Policy", in *Environmental Politics and Policy: Theories and Evidence*, 2nd ed., J.P. Lester, ed., Durham, NC: Duke University Press, 1995.

2.2.1 Water Rights Allocation Systems

The northern US states employ a variety of water rights allocation systems.[20] The states along the western portion of the US-Canada border (Alaska, Washington, Idaho, Montana and North Dakota) rely on prior appropriation systems for surface water allocation. Two of these states (Washington and North Dakota) have what are sometimes called "hybrid" systems, because existing riparian rights were preserved when the prior appropriation statutory scheme was enacted. The US states in the Great Lakes area and the eastern portion of the US-Canada border rely on the riparian doctrine, overlaid by a modern permit system which allows the states to better track and control water use.

A relative lack of abundance characterizes freshwater resources along the US-Mexico border. Thus, in this region, instream flow, federal reserved rights, Native American reserved rights and public trust issues generally receive more attention than in the northern border states. As they have along the northern US border, water allocations and the legal regimes governing those allocations are evolving in response to growing urban populations, changing economic and social conditions, and increased recognition of environmental values.

The southern boundary states use prior appropriation systems for allocating surface water. The Texas system also protects existing riparian rights, as long as those rights were asserted during stream adjudication proceedings. And, although California generally relies on a prior appropriation system, it also recognizes riparian rights. Key features of the prior appropriation and riparian doctrines of water rights are described in the sections that follow.

In addition to state law systems, surface water allocation along the northern and southern US border areas is affected by several interstate compacts applicable to rivers that flow through one or more states (Colorado, Río Grande and the Great Lakes). The relevant provisions of these compacts are discussed in section 2.2.2.

2.2.1.1. Prior Appropriation

The doctrine of prior appropriation gives secure title to those who undertook to develop water resources for beneficial use by awarding

20. D. Getches, *Water Law in a Nutshell,* St. Paul, MN: West Publishing, 1990; and C.J. Meyers et al., *Water Resource Management,* Mineola, NY: Foundation Press, 1988.

water rights on a "first in time, first in right" basis. Thus, in times of shortages, which can be frequent in some areas of the arid west, the rights of senior appropriators take precedence over those of junior appropriators—that is, the senior's rights must be fully satisfied before the junior appropriator receives any water. Permits under prior appropriation systems generally specify the amount of water that may be diverted, for what purpose it may be used and where it may be used. Diversions outside of the basin of origin are generally not permitted or are only permitted under certain conditions.

Rights under prior appropriation are generally secured through a permit process. New permits are granted only if there is unappropriated water in the watercourse. Most states have an administrative or judicial adjudication process whereby existing rights are quantified on a basin-by-basin basis.[21] These adjudications are necessary to establish certainty of title, facilitate water allocation decisions, allow for water resource planning to meet future needs and to quantify federal and Native American reserved rights. Many rivers in western US states are already fully appropriated or overappropriated (the rights on paper to water withdrawals exceed the actual supply).[22]

Beneficial uses, which are usually defined by state statute, originally included uses tied to economic development or basic needs: domestic, municipal, industrial, irrigation, mining and the like. In recent decades, however, use of water to preserve fish and wildlife habitat, sustain recreational activities or otherwise maintain instream flows are often—but not universally—recognized as beneficial uses.[23] Earlier interpretation of the prior appropriation doctrine did not recognize such uses as beneficial because they did not involve diversions of water.

Wasting water is not considered a beneficial use. Most states and courts, however, have been reluctant to deny rights to water on the grounds of waste. Nevertheless, as water conservation gains higher priority and judicial interpretation of state statutes defining beneficial use

21. An excellent survey of adjudication systems in western US states can be found in A.L. Krogh, "Water Right Adjudications in the Western States: Procedures, Constitutionality, Problems and Solutions", (1995) 30 *Land and Water Law Review* 35.
22. R.D. Benson, "A Watershed Issue: The Role of Stream Flow Protection in Northwest River Basin Management", (1996) 26(1) *Environmental Law* 175.
23. The literature on recognition of instream flows and other environmental uses of water in western US states is extensive. See L.J. MacDonnell and T. Rice, ed., *Instream Flow Protection in the West,* Boulder: University of Colorado, Natural Resources Law Center, 1993.

responds to changing conditions, it is likely that waste will be less tolerated.[24]

To preserve a water right under the prior appropriation doctrine, the water right holder must actually use the water. Many analysts have concluded that this "use it or lose it" aspect of the prior appropriation doctrine can hinder water conservation efforts. A water right holder may refrain from implementing conservation measures if he believes he may lose the right to the unused water. Some states have begun to adjust their statutory schemes to remove this potential barrier to conservation.

Another key feature of the prior appropriation doctrine is the "no injury" rule. This principle prevents transfers of water rights that would adversely affect any downstream appropriator, whether junior or senior. Thus, a transfer from one use to another that would increase water consumption, thereby reducing return flows to the watershed, may be prohibited if it would adversely affect downstream users. Minimum instream flow requirements in some states may also limit the possibility of transfers. Most state statutes provide for notice and opportunity for hearing for potentially affected persons before a transfer can be approved. Some states, like Alaska, require that any proposed water-rights transfer be reviewed to determine if it is in the public interest. In some western states, special laws have been enacted to facilitate water transfers and water-rights "banking," especially during times of drought.

A final feature of some prior appropriation systems is that municipal water use may, in times of shortages, take precedence over other uses, particularly irrigation, even if the irrigation rights are senior. In most cases, however, compensation must be paid to those whose rights cannot be satisfied.

As this discussion has suggested, in the western US states the prior appropriation doctrine has undergone significant changes over last two to three decades in response to growing urban populations and changing economic and social conditions.[25] It is likely that this evolution will continue as (1) more watercourses become fully appropriated; (2) conservation and water marketing take central stage as mechanisms for

24. D. Getches, "Changing the River's Course: Western Water Policy Reform", (1996) 26(1) *Environmental Law* 157.
25. C.F. Wilkinson, "Western Water Law in Transition", (1985) 59 *University of Colorado Law Review* 551; and N. Johnson and C.T. DuMars, "A Survey of the Evolution of Western Water Law in Response to Changing Economic and Public Interest Demands", (1989) 29 *Natural Resources Journal* 347.

meeting new water demands; and (3) economic values of instream uses are recognized and quantified.

Another factor that may influence the regulation of water rights is the development of case law and statutory principles regarding constitutional and "regulatory" takings. Some water rights holders in western states are increasingly objecting to regulation of their water rights on the grounds that such actions can constitute a taking of private property for which they are entitled to compensation.[26] Most of the constitutional takings claims have failed, but interest groups continue to pressure western states to enact legislation requiring compensation for regulatory takings that do not meet the constitutional standard.

2.2.1.2 Riparian Rights

The riparian system forms the basis for surface water rights management and allocation in those states where water resources are relatively more abundant than in the more arid western states. Riparian-based systems are based on the common law and are generally less rigorous than those based on the prior appropriation doctrine.

Riparian water rights pertain to land located alongside a watercourse (so-called riparian land). Under the common law riparian doctrine, water use was limited to the riparian land itself. Under most permit systems, however, riparian rights can be exercised on nonriparian land and nonriparians can obtain water rights. The riparian doctrine is based on a principle of reasonable use: the amount of water used must be reasonable in relation to other riparian uses of the watercourse. It is also based on the principle that water must not be spoiled for downstream use. Under common law, riparians have a right to clean water, with a tort remedy against upstream pollution.

Riparian rights under common law are not lost because of nonuse. Most permit systems, however, provide for cancellation of unused rights. In times of shortage, allocation priorities under a riparian system are based on the reasonable use principle rather than on seniority of rights. Some permit systems also provide for preferences to be given to certain uses, both in issuing new permits and in allocations during shortages. The issuance of permits in most riparian states is based on statutory schemes that require the permitting agency to consider the type of

26. B.H. Thompson Jr., "Takings and Water Rights", in *Water Law: Trends, Policies and Practice*, K.M. Carr and J.D. Crammond, ed., Chicago: American Bar Association, 1995.

use, the condition of the watercourse and the effect of the proposed use on other water users and the public.

2.2.1.3 Groundwater

The northern US border states vary in the way they manage groundwater rights, which is a matter of state jurisdiction. Most of the states manage groundwater separately from surface water—a perpetual problem in water resources management given pervasive groundwater/surface water interactions. The US states along the western portion of the US-Canada border (Alaska, Washington, Idaho, Montana and North Dakota) use a prior appropriation/permit system for groundwater management.[27] These systems are similar to those for surface water rights, with permits specifying the rate of withdrawal, well location, and place and purpose of use. Allocations in times of shortage are based on seniority of rights.

The rest of the states generally rely on a "reasonable use" doctrine, whether adopted through statute or developed through court decisions. This doctrine entitles overlying landowners to make reasonable use of groundwater pumped from beneath their property, with some limited liability to adversely affected neighboring landowners for unreasonable use. Michigan, Ohio and Wisconsin (which depends very heavily on groundwater) have adopted this doctrine through court decisions.[28] Minnesota, which also depends heavily on groundwater, has adopted the doctrine through a statute and has implemented a groundwater permitting program. Pumping of groundwater by the city of Chicago and its suburbs is so extensive that the water being drawn out through wells actually comes from Lake Michigan and is thus included in Chicago's surface water allocation. As noted, efforts to manage groundwater quantity and quality are inadequate, constituting a significant gap in the legal framework for managing transboundary water in the Great Lakes and eastern US-Canada border region.[29]

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27. J.D. Aiken, "Well Interference and Groundwater Mining: The Legal Framework", in *Proceedings of Conference on Groundwater Law, Hydrology and Policy in the 1990s,* Boulder: University of Colorado School of Law, 1992.
28. A.D. Tarbock and S.L. Deutsch, "Foreword to Symposium on Prevention of Groundwater Contamination in the Great Lakes Region", (1989) 65 *Chicago-Kent Law Review* 345.
29. Tarlock and Deutsch (*ibid*.) observe that groundwater resources in the Great Lakes region were historically treated as inexhaustible and consumption has not been limited through regulatory measures. They also note that many crucial hydrological connections between surface and groundwater are poorly understood. They advocate better definition of groundwater property rights to foster conservation of the resource.

Legal regimes for allocating groundwater also vary substantially among southern US border states. Texas has no statutory regulation of groundwater pumping, relying instead on the common law "rule of capture" or absolute ownership.[30] Recent drought conditions and a major conflict over use of the Edwards Aquifer in the central Texas region, however, may force the state to adopt some sort of statewide groundwater regulatory system over the next few years. New Mexico has a prior appropriation permit system for groundwater management. Arizona has a groundwater withdrawal permitting process for designated active management areas (AMAs). California has a combination of correlative rights[31] for overlying landowners and an appropriation system for nonoverlying landowners.

2.2.2 Interstate River Basin Compacts Commissions

Interstate and river basin commissions administer water compact agreements between state governments. Compacts, an outgrowth of the recognition that water resource planning and development is central to the interests of state and federal governments, are formal agreements between state governments to address water resource issues relevant to the particular circumstances of river basins. Under the US Constitution, interstate agreements must receive the approval of the federal government. Interstate commissions are established by interstate compact to administer the terms of the agreements.

In general, interstate and river basin commissions:

- coordinate the water management activities of the signatory parties;
- serve as a mechanism for resolving disputes between interested parties;
- provide a forum for observation and communication among states, federal agencies, tribal governments and other parties interested in water resource management;
- recommend priorities for data collection and for the investigation, planning and construction of water projects; and

30. Under this rule, an overlying landowner can pump as much groundwater as he cares to, virtually without any liability for damage to adjacent landowners who might be adversely affected.
31. Under a correlative rights system, *pro rata* sharing goes into effect among pumpers during times of shortage.

- undertake the development of comprehensive plans for water resource management.

The three interstate river basin commissions with transboundary water management implications are described in the sections that follow.

2.2.2.1 Colorado River Commission

The Colorado River has been described as the most closely regulated and controlled stream in the United States.[32] The "Law of the River" as applied to the Colorado River is a complex mosaic of federal and state statutes, interstate compacts, court decisions and water delivery contracts that have been established over time (see section 4.6.2.1 for a detailed discussion of the Law of the River). The Colorado River Commission is responsible for administering the Law of the River. It is composed of two representatives of each of the signatory states to the Colorado River Compact.

The Colorado River Compact, signed by each of the seven Colorado River basin states in 1922, serves as the cornerstone of the Law of the River.[33] The compact divides the Colorado River basin into "upper" (Colorado, Wyoming, Utah, New Mexico) and "lower" (Arizona, Nevada, California) basins, with the dividing line drawn at Lee's Ferry, Arizona. The water of the river is apportioned roughly in half (1922 flow) at 9,250 Mm^3 (7.5 MAF) per year per basin. Apportionment among lower basin states was determined by the *Boulder Canyon Project Act* of 1928 and affirmed by the US Supreme Court in *Arizona* v. *California* (1963). The Court decree also confirmed the apportionment of water (known as present perfect rights) to Indian reservations, national recreation areas and wildlife refuges. The upper basin is apportioned in accordance with the 1948 Upper Colorado River Basin Compact.

A provision of the Colorado River Compact recognizes the right of Mexico to Colorado River waters. This right was elaborated in a bilateral treaty signed in 1944 (see chapter 4). Other bilateral agreements have been signed since to deal with increasing salinity problems in Mexico's portion of Colorado River water.

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32. M. Nathanson, *Updating the Hoover Dam Documents,* Denver: US Department of the Interior, Bureau of Reclamation, 1978.
33. The compact was ratified by all the Colorado River basin states in 1923, except Arizona which did not ratify until 1944. Congress gave its consent to the compact in 1928 with the passage of the *Boulder Canyon Project Act*, authorizing the construction of the Hoover Dam near Las Vegas, NV.

2.2.2.2 Río Grande Commission

The Río Grande Compact, among Colorado, New Mexico and Texas, was ratified in 1939.[34] The compact was designed to stabilize the water allocation pattern in the upper Río Grande and establish the various annual water delivery obligations of the signatory parties. The Río Grande Commission is composed of a federal chairperson appointed by the president and three voting members from the states.

The commission meets annually to review compliance with the compact over the previous year, to hear reports from federal water management agencies, and to consider water management decisions that have interstate implications. It issues a report to the governors of Colorado, New Mexico and Texas on the streamflow of the Río Grande at various gauging stations, and water storage in the system of reservoirs that make up the Río Grande Project. The data contained in the annual reports of the Río Grande Commission are provided by the relevant state agencies, the Bureau of Reclamation, the US Army Corps of Engineers, the US Geologic Survey and the Bureau of Indian Affairs.

The Bureau of Reclamation and the Corps of Engineers are bound by federal statute to ensure that their actions are consistent with the provisions of the compact. The Bureau of Indian Affairs is involved primarily to ensure that Pueblo Indian reservations receive their allotted share of Río Grande waters.

2.2.2.3 Great Lakes Commission

Established in 1955 by the Great Lakes Basin Compact, the Great Lakes Commission comprises appointed officials from Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin.[35] The commission was granted congressional consent in 1968. The commission's history includes informal yet long-standing relationships with Canada's federal and provincial governments. Under the Great Lakes Compact, the Great Lakes Commission is responsible for:

- promoting the orderly, integrated and comprehensive use and conservation of water resources;

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34. This section is based on the *Report of the Río Grande Compact Commission*, 1994.
35. This section is based on the *Great Lakes Commission 1995 Annual Report*, 9(1) January/February 1996, Great Lakes Commission, Ann Arbor, MI.

- planning for the welfare and development of water resources as a whole as well as the particular needs of specific areas within the Great Lakes basin; and

- advising in securing and maintaining a proper balance among the various uses of water resources in the basin.

Other activities of the Great Lakes Commission include advising federal, state and binational agencies; providing testimony before the US Congress and Canadian Parliament on Great Lakes issues; fostering cooperation and consensus among Great Lakes states on policy and research priorities; and promoting linkages among researchers, policy makers and resource managers.

Many groups have observer status at the Great Lakes Commission. Federal observers include representatives of the US Geological Survey, US Army Corps of Engineers, National Oceanic and Atmospheric Administration, US Fish and Wildlife Service, US National Park Service, Environmental Protection Agency, Natural Resources Conservation Service, US Coast Guard, and the St. Lawrence Seaway Development Corporation. Canadian observers include representatives of the federal government as well as the provinces of Ontario and Quebec. Regional observers include representatives of the Council of Great Lakes Governors and of the Great Lakes Sea Grant Network. Other observers represent the International Joint Commission and the Chippewa/Ottawa Treaty Fishery Management Authority. According to the commission's work plan, regional coordination is a major program goal for strengthening Great Lakes management.

2.3 Native American Governments

Of the more than 500 federally recognized Native American tribes in the United States, more than 300 are in the lower 48 states. In the Colorado River basin alone, nearly 300,000 Native Americans are living on 29 reservations covering more than 11.3 million ha (28 million acres).[36] Many of the tribal governments are playing an increasingly significant role in water management issues. Their growing role is based on federal reserved water rights and the federal *Clean Water Act*.

Native American water rights have been established by law, beginning with a US Supreme Court decision in 1908 that protected the water

36. G. Weatherford, M. Wallace and L.H. Storey, *Leasing Indian Water: Choices in the Colorado River Basin,* Washington, DC: Conservation Foundation, 1988.

rights of Indian reservations. This decision is the basis for the Winters Doctrine, which quantifies tribal rights in terms of the amount of water necessary to irrigate the "practicably irrigable acreage" on the various reservations. The right to this amount of water is prior to nearly all state appropriated rights, meaning that reservations in the southwestern United States, for example, would have prior rights to most of the available supply if the doctrine were applied uniformly.[37]

Given the extent of these rights, it is not surprising that, in the 1980s alone, more than four dozen major Native American water rights disputes were winding their way through state and federal courtrooms and administrative hearings throughout the United States.[38] Even if the existing water rights claims are settled, the utilization of allocated waters is likely to come under scrutiny. In some instances, off-reservation water marketing, allowable in principle under a recent Bureau of Reclamation ruling, may encourage water utilization in less-efficient, low-value applications, with possibly adverse environmental effects.[39]

The authority of tribal governments to regulate the environment is based on the retained sovereignty of Native American peoples. Recent amendments to the *Clean Water Act* state explicitly that Indian reservations are to be treated as states for certain purposes related to water quality. Thus, at least 77 of the tribes in the lower 48 states issue water quality standards, undertake point source management and develop instream flow programs.[40] Tribal governments have the potential to become important players in transboundary water management. Generally, the result of their involvement has been a heightening of standards applicable to many transboundary waterways. Reservations vary widely, however, in regulatory capacity in terms of both funding and staffing.[41]

37. P. Sly, *Reserved Water Rights Settlement Manual,* Washington, DC: Island Press, 1988, 5. The Supreme Court opinion is that of *Winters* v. *US*, 207 US 564 (1908).
38. L. Burton, *American Indian Water Rights and the Limits of the Law,* Lawrence: University of Kansas Press, 1991, 2.
39. J. Morrison, *The Sustainable Use of Water in the Lower Colorado River Basin,* Oakland: Pacific Institute, 1996, 58-59.
40. Gover, Stetson, and Williams, "Survey of Tribal Actions to Protect Water Quality and the Implementation of Tribal Amendments to the Clean Water Act", in *Report to the National Indian Policy Center*, Albuquerque: National Indian Policy Center, 1994, 82-83.
41. L. Jones, "Reservation Environmental Issues: Problems in Federal and Tribal Governmental Responses: 1989-1991", unpublished manuscript, Department of Political Science, Colorado State University, Fort Collins, 1993, 21.

CHAPTER 3

Canada's Domestic Framework for Transboundary Water Management

3.1 Introduction: The Constitutional Basis for Transboundary Water Management in Canada

The framework for transboundary water management in Canada is a product of constitutional provisions, federal and provincial statutes, federal water policy, and intergovernmental institutional arrangements. The legal foundation for this framework is the *Constitution Act* of 1867, which establishes the division of powers between the federal government and the provinces.[42] Since no single authority is in charge of water management, control devolves to a variety of specific and general powers of each order of government.

The provinces have primary responsibility for land and resource management—including water management—within their respective boundaries.[43] This authority is based on provincial ownership of most public land and resources[44] and on the provinces' legislative authority over "property and civil rights," "local works and undertakings," "all matters of a merely local and private nature" and "municipal institutions" (*Constitution Act*, Section 92). Provincial legislative authority over the "development, conservation and management of sites and facilities in the province for the generation and production of electrical energy" was explicitly established through constitutional amendment in 1982 (Section 92A).

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42. The authoritative text on Canadian constitutional law is P.W. Hogg, *Constitutional Law of Canada*, 4th ed., Scarborough, ON: Carswell, 1997. Constitutional issues relating to transboundary water management are discussed in more detail in S.A. Kennett, *Managing Interjurisdictional Waters in Canada: A Constitutional Analysis*, Calgary: Canadian Institute of Resources Law, 1991; and J.O. Saunders, *Interjurisdictional Issues in Canadian Water Management*, Calgary: Canadian Institute of Resources Law, 1988.
43. In the northern territories, the federal government exercises province-like resource management authority. Northern water management is discussed in section 2.2.8.
44. *Constitution Act*, 1867, Section 109; and Natural Resources Transfer Agreements, *Constitution Act*, 1930.

The provinces thus have considerable authority, as owners and legislators, to manage their water resources and regulate the principal land-based activities, ranging from forestry operations to industrial and municipal facilities, that affect water quality and consumption. Where watersheds cross provincial, territorial or international boundaries, the provinces' water management regimes and their regulation of individual projects (such as dams and diversions, pulp and paper mills, and municipal discharges) have important direct effects on transboundary waters. The provincial role in transboundary water management is, however, subject to two important legal limitations. First, the territorial limitation on provincial powers means that provinces cannot regulate water uses occurring beyond their boundaries. Second, provincial water management is subject to the legislative authority of the federal government, described below, which is accorded constitutional primacy by the principle of federal paramountcy.

Despite the provinces' position as the primary resource managers, the federal government occupies a very strong constitutional position on transboundary waters by virtue of specific oversight exercised by several ministries and its general authority to pass laws for the "peace, order, and good government of Canada" (*Constitution Act*, Section 91). In addition, the federal government has a proprietary basis for its role as water resource manager on federal lands (for example, national parks) and in the northern territories.

Specific ministries exercise federal authority over "sea coast and inland fisheries" and "navigation and shipping." Federal legislation under the former protects fish and fish habitat, while the latter supports regulation of projects and activities, such as dams and dumping, that may affect navigable waters. It should be noted, however, that neither the navigation power nor the more broadly worded federal power over "trade and commerce" have been interpreted by the courts as permitting expansive legislative authority along the lines exercised by the US government under the interstate commerce clause. Federal jurisdiction in relation to "Indians and lands reserved for Indians," taxation, federal public property, and interprovincial works and undertakings could also support a role in transboundary water management under certain circumstances. Moreover, the federal government's "spending power"—which enables it to establish and fund programs in areas of provincial jurisdiction—could serve as a basis for federal leverage in water management through joint funding arrangements and conditional grants to the provinces.

The federal government's power to implement treaties (*Constitution Act*, Section 132) is of particular importance for transboundary waters, because it gives the federal government authority to implement the Boundary Waters Treaty (1909) between Canada and the United States. This power is, however, applicable only to "Empire" treaties, signed before Canada attained full independence in international relations. It is thus doubtful whether the federal government could unilaterally implement more recent treaties affecting areas of provincial jurisdiction.

On the other hand, the provinces themselves may not extend management beyond their borders, nor may they unilaterally regulate shared-jurisdiction waters. The area beyond provincial jurisdiction falls precisely into the federal domain. For example, in the spring of 1998 the province of Ontario issued a water extraction permit for the bulk export by tanker of water from Lake Superior (the Nova project). The Canadian federal government and the US state and federal governments all expressed strong opposition. In response, not only did Ontario respond by revoking the permit, but it also appealed to the federal government to act within its jurisdiction to prevent bulk water exports. Thus, in 1999, the federal government launched a strategy to prohibit the bulk removal of water, including for export, from Canadian watersheds.

The federal government's criminal law power has emerged as an important general basis for federal environmental regulation. The Supreme Court of Canada recently upheld federal legislation prohibiting the dumping of PCBs into waterways as a valid exercise of this power.[45] The case went beyond earlier decisions upholding federal environmental regulations designed to protect public health under the criminal law power and relied instead on a very broad definition of criminal law (requiring only a prohibition enforced by a penal sanction) to support the legislation at issue. The resulting scope for federal environmental regulation, including water management, is untested but potentially significant.

Finally, the federal authority to enact laws for "peace, order, and good government" (POGG) is directly relevant to transboundary water management. In 1997, the "national concern" facet of POGG was applied by the Supreme Court of Canada in *R.* v. *Crown Zellerbach* to uphold federal legislation prohibiting ocean dumping in intraprovincial waters.[46]

45. *R.* v. *Hydro Quebec* (1997), 151 D.L.R. (4th) 32 (S.C.C.).
46. *R.* v. *Crown Zellerbach,* [1988] 1 S.C.R. 401.

This case set out a three-element test for the "national concern" branch of POGG, specifying that it applies (1) to matters that did not exist at the time of Confederation or have since attained national significance; (2) to matters that have a singleness, distinctiveness and indivisibility that distinguish them from matters of provincial concern and ensure an impact on provincial jurisdiction consistent with the division of powers; and (3) in cases where a provincial failure to deal with intraprovincial aspects of an issue have effects on extraprovincial issues. The third element, called the "provincial inability test," underlines the particular relevance of POGG to federal regulation of transboundary waters.[47]

The Supreme Court of Canada, unlike the US Supreme Court, does not have original jurisdiction under the Constitution in relation to interprovincial disputes. Thus the Canadian Court has not played a significant role in transboundary apportionment issues or in other aspects of transboundary water management. Canadian governments have generally avoided resorting to the courts to resolve disputes over transboundary waters.

In summary, the Constitution confers on the provinces a predominant role in water management generally, while giving the federal government significant water-related powers, some of which are particularly suited to managing interprovincial and international transboundary waters. As the rest of this chapter will show, however, the Constitution reveals relatively little about transboundary water management in practice. The operational framework for transboundary water management, where one exists, is established through statutes and, more important, through informal administrative arrangements and formal—but generally nonstatutory—intergovernmental agreements. From a constitutional perspective, the story is one of unexercised federal powers.

3.2 The Legal Framework at the Federal Level

All federal water law is concerned with transboundary water management in the sense that federal legislation is, in principle, applicable throughout the country without regard to provincial or territorial boundaries.[48] Yet only a few elements of federal water law deal

47. See, Kennett, *Managing Interjurisdictional Waters in Canada,* 191-227, n. 42.
48. As discussed in section 3.3.2, the applicability of federal legislation in practice may differ among provinces as a result of formal delegation of powers, equivalency agreements, informal administrative arrangements and discretionary enforcement policy.

expressly with transboundary water management. The rest of this section begins by reviewing these transboundary provisions and then turns to other legislation relevant to federal water management.

3.2.1 Canada Water Act

The *Canada Water Act*,[49] passed in 1970, was the federal government's first statutory attempt to adopt a comprehensive and focused approach to freshwater management and to promote federal- provincial cooperation on related initiatives. With its emphasis on water resource management broadly defined, the act has a *de facto* transboundary orientation, because most of Canada's major river basins cross provincial, territorial or international boundaries. Furthermore, the act sets out a basic framework for transboundary water management in that it provides both for intergovernmental management arrangements and for unilateral federal action on certain transboundary issues. In practice, however, the *Canada Water Act* has never been fully implemented and has had a relatively limited impact on transboundary water management in Canada.

Parts I and II of the act are relevant to transboundary water management. Part I, "Comprehensive Water Resource Management," authorizes the federal government to enter into consultative arrangements with the provinces and to conclude federal-provincial agreements for programs relating to any waters where there is a significant national interest in water resource management. Specified subjects for agreement include establishing water inventories, collecting data, conducting research, formulating comprehensive management plans, and designing water management projects. Joint commissions or boards may be established to oversee these programs. The federal government may undertake such programs unilaterally for those waters over which it has full jurisdiction. For interjurisdictional, international and boundary waters, unilateral federal action is limited to planning and project design where "there is a significant national interest in the water resource management" of the waters in question and where "all reasonable efforts" have been made to reach agreement with the provincial governments whose interests are affected (Section 6). Part I of the act has resulted in formal agreements and informal work-sharing arrangements for intergovernmental cooperation—but not necessarily transboundary water management—in the form of water resource surveys, studies and other programs.

49. R.S.C. 1985, c. C-11.

Part II of the act, "Water Quality Management," provides for federal-provincial agreements to designate water quality management areas where water quality management has become a matter of urgent national concern. The federal government is authorized to take unilateral action in relation to the water quality management of interjurisdictional waters if, despite "all reasonable efforts," no agreement can be reached with the affected province(s) (Section 13). Although unilateral federal action is restricted to interjurisdictional waters where water quality management has become a matter of "urgent national concern," the definition of interjurisdictional waters is broad enough to include water bodies wholly within a province.[50] While this portion of the act could enable significant federal-provincial cooperation on transboundary water quality problems and could also support unilateral federal measures in the transboundary context, it has not been implemented to date.

Should the federal government seek a stronger, even unilateral, role in transboundary water management, the *Canada Water Act* provides some of the necessary legal tools. At present, however, there is no indication that the act will be used in this way.

3.2.2 International River Improvements Act

The *International River Improvements Act*[51] is directly related to transboundary water management, because it provides an explicit statutory basis for federal regulation of dams, diversions and other developments that affect the flow of rivers crossing the US-Canada border. The act was originally passed in 1955 to allow the federal government to prevent the construction of a major dam on the Columbia River by the province of British Columbia. The objective was to permit a larger scale, coordinated effort to develop the water resources of the basin. More recently, the act received attention when it served as a trigger for the federal environmental assessment process.[52]

The act requires a license for the construction, operation or maintenance of certain international river improvements. An "international

50. The term *interjurisdictional waters* is defined in Section 2(1) of the act as "any waters, whether international, boundary, or otherwise, that, whether wholly situated in a province or not, significantly affect the quantity or quality of waters outside the province."
51. R.S.C. 1985, c. I-20.
52. The act provided the basis for litigation over federal environmental assessment obligations in relation to the Rafferty-Alameda Dam project in Saskatchewan. See *Canadian Wildlife Federation* v. *Canada (Minister of the Environment)* (1989), 4 C.E.L.R. (N.S.) 1 (F.C.A.).

river improvement" is defined as "a dam, obstruction, canal, reservoir or other work the purpose or effect of which is (a) to increase, decrease or alter the natural flow of an international river, and (b) to interfere with, alter or affect the actual or potential use of the international river outside Canada" (Section 2). The act applies to any waters in Canada that flow across the international boundary into the United States, but it does not apply to projects authorized by an act of Parliament, situated within boundary waters as defined in the Boundary Waters Treaty, or constructed or operated solely for domestic, sanitary or irrigation purposes or other similar consumptive uses.

3.2.3 Fisheries Act

The *Fisheries Act*[53] is a powerful legal tool for the management of fish stocks and the protection of fish habitat. Although it does not focus expressly on transboundary waters, it provides the basis for a federal role in the management of Canadian fisheries waters. Section 35(1) of the act makes it an offense to "carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat" and Section 36(3) prohibits the deposit of deleterious substances into Canadian fisheries waters or at any other location where these substances may enter such waters. The activities specified in these sections are not offences, however, if carried on pursuant to federal regulatory approvals. The Supreme Court of Canada has interpreted these provisions as authorizing a broad range of measures to protect water quality, provided that these measures have a clear nexus with fish and fish habitat.[54] However, despite its broad applicability and clear prohibitions, the *Fisheries Act* is not meant to provide legislative authority for a full-fledged water management scheme.

Effluent regulations passed under the act have been criticized as weak, and the federal government's enforcement policy has been characterized as "inconsistent and sporadic.[55]" Furthermore, as discussed in section 3.3.2, enforcement of the fish habitat protection and pollution prevention provisions of the act has generally been assumed by the inland provinces, which have often preferred to use their own environmental legislation instead of the *Fisheries Act* when prosecuting environmental offenses.

53. R.S.C. 1985, c. F-14.
54. *Fowle*r v. *R.*, [1980] 2 S.C.R. 213; and *Northwest Falling Contractors Ltd*. v. *R.*, [1980] 2 S.C.R. 292.
55. D. Estrin and J. Swaigen, *Environment on Trial: A Guide to Ontario Environmental Law and Policy*, 3rd ed., Toronto: Emond Montgomery, 1993, 523.

3.2.4 Navigable Waters Protection Act

Under the *Navigable Waters Protection Act*,[56] the minister of Transport must approve the construction of any structure such as a bridge or dam that might affect navigable waters. The term *navigable* has been broadly defined to include relatively small streams and bodies of water capable of floating a canoe or logs. The act also prohibits the dumping of specified substances into water in a way that might interfere with navigation. These provisions create some scope for federal control over dumping, provided a nexus exists between the prohibition and navigation. Although this act is not concerned explicitly with transboundary waters, it does authorize federal involvement in aspects of the management of a broad range of Canada's waters, transboundary and other. Like the *International River Improvements Act*, it is a trigger for the federal environmental assessment process.

3.2.5 Canada Shipping Act

The *Canada Shipping Act*[57] applies generally to Canadian ships everywhere and to foreign ships in Canadian waters and in Canada's Exclusive Economic Zone within the limits imposed by international law. Part XV of the act and the regulations pursuant to this part make it an offence to discharge prescribed pollutants, which are broadly defined.[58] The act also specifies various preventive, control and remediation measures. Because much of the shipping regulated by the *Canada Shipping Act* occurs in the Great Lakes and in coastal waters close to boundaries with the United States and international waters, this act provides a federal instrument for addressing certain water pollution issues in the transboundary context.

3.2.6 Canadian Environmental Protection Act

The *Canadian Environmental Protection Act*[59] (CEPA) is intended to protect the environment and human health by regulating the use of toxic and dangerous substances. CEPA is not directed specifically at water resource management, but it does apply to discharges of prescribed substances into bodies of water. In laying the groundwork for a constitutional defense of this legislation under the "peace, order, and good

56. R.S.C. 1985, c. N-22.
57. R.S.C. 1985, c. S-9.
58. The pollution control regime established under this act is described in Estrin and Swaigen, *Environment on Trial*, 525-526, n. 14.
59. R.S.C. 1985, c. 16 (4th Supp.), first enacted as S.C. 1988, c. 22.

government" clause,[60] the preamble to CEPA notes that "the presence of toxic substances in the environment is a matter of national concern" and that "toxic substances, once introduced into the environment, cannot always be contained within geographic boundaries." The preamble also speaks of federal leadership through the establishment of national environmental quality objectives and notes that "Canada must be able to fulfil its international obligations in respect of the environment." These provisions reveal a clear connection between the federal role under CEPA and transboundary environmental issues.

CEPA adopts an ecosystem approach to regulating toxic substances, focusing on controlling releases throughout the environment and promoting life cycle management. The act creates a complex regulatory process for the designation of toxic substances. National standards may be established, but the act also states that federal regulations will not apply in provinces that develop equivalent standards and sign "equivalency agreements" with the federal government.[61] Provisions regulating "cleaning agents" and "nutrients," formerly in the *Canada Water Act*, are now included in Part III of CEPA. Ocean dumping, the subject of the landmark *R.* v. *Crown Zellerbach* decision on federal environmental powers, is regulated under Part VI. Principles for applying CEPA are set out in the Enforcement and Compliance Policy.[62]

Although CEPA deals explicitly with "International Air Pollution" in Part V, it does not provide equivalent treatment of transboundary or international water pollution. This deficiency was discussed in a 1995 review of CEPA by the House of Commons Standing Committee on Environment and Sustainable Development. The committee recommended amendments to CEPA "authorizing the federal government to prevent transboundary water pollution and to ensure that Canada complies with international agreements relating to transboundary water pollution.[63]" In its response to the committee's report, the federal government stated that it "proposes to include, in a renewed CEPA, provisions to prevent transboundary water pollution, to mirror and respect the reciprocity provisions of the US *Clean Water Act*, and to enable Canada to continue to comply with international agreements, to which it is a

60. Interestingly, as noted in section 3.1, the Supreme Court of Canada in *R.* v. *Hydro Quebec* recently upheld key provisions of CEPA under the criminal law power.
61. CEPA, Section 34(5), (6). See, for example, *An Agreement on the Equivalency of Federal and Alberta Regulations for the Control of Toxic Substances in Alberta* (1st June 1994).
62. Environment Canada, *Enforcement and Compliance Policy,* 1992.
63. House of Commons Standing Committee on Environment and Sustainable Development, *It's About Our Health! Towards Pollution Prevention,* June 1995, 118.

party or may become a party, relating to transboundary water pollution.[64]"

As of the fall of 1998, CEPA had not been amended to include these measures.[65] Nonetheless, CEPA remains an important federal instrument for addressing specific pollution issues in transboundary and other contexts.[66]

3.2.7 Canadian Environmental Assessment Act

The *Canadian Environmental Assessment Act*[67] (CEAA) requires the federal government to consider environmental consequences when making decisions regarding specified projects. The process is, however, entirely advisory in that the federal "responsible authorities" retain authority to make final decisions about whether or not to authorize the projects in question.

Although CEAA does not establish a resource management regime, it is relevant to the federal role in transboundary water management for two reasons. First, CEAA has an explicit transboundary focus.[68] One purpose of the act is "to ensure that projects that are to be carried out in Canada or on federal lands do not cause significant adverse environmental effects outside the jurisdictions in which the projects are carried out" (Section 4(c)). Sections 46-53 contain specific provisions dealing with projects that have interprovincial and international effects and effects on federal lands.[69] Although these sections focus on the procedure for transboundary environmental assessment, they also authorize the federal minister of the environment to order a proponent not to proceed with a project having potential transboundary effects until the environmental assessment is completed and the minister is satisfied that these effects have been appropriately dealt with (Sections 50, 51).

64. Environment Canada, *CEPA Review: The Government Response*, Ottawa: Minister of Supply and Services Canada, 1995, 57.
65. Provisions addressing international water pollution are, however, contained in Division 7 of the proposed *Canadian Environmental Protection Act*, 1998 (Bill C-32), Second Reading and referred to the Standing Committee on Environment and Sustainable Development, 28 April 1998.
66. For a more extensive discussion of CEPA and transboundary issues, see Steven A. Kennett, "Boundary Issues and Canadian Environmental Legislation", in *Environmental Policy: Transnational Issues and National Trends*, L.K. Caldwell and R.V. Bartlett, ed., Westport, CT: Quorum Books, 1997, 138-143.
67. S.C. 1992, c. 37.
68. CEAA's relevance to transboundary issues is discussed in Kennett, *Managing Interjurisdictional Waters in Canada*, 144-147, cf. n. 42, *supra.*
69. These provisions are discussed in Steven A. Kennett, "The *Canadian Environmental Assessment Act's* Transboundary Provisions: Trojan Horse or Paper Tiger?", (1995) 5 *Journal of Environmental Law and Practice* 263.

The second way that CEAA affects transboundary water management is by permitting the federal government to review a broad range of water projects falling primarily under provincial jurisdiction. Federal regulatory powers under statutes such as the *Fisheries Act*, the *International River Improvements Act* and the *Navigable Waters Protection Act* constitute triggers for the CEAA process.[70] Once triggered for a project, the assessment process applies to a broad range of environmental and other effects, not simply those associated with the particular trigger mechanism, such as effects on fisheries or navigable waters.[71] Transboundary effects may thus be considered in any CEAA environmental assessment, not simply where the specific transboundary processes are used.

3.2.8 Northern Water Management

The legal framework for transboundary water management in the northern territories is complex and currently in flux. The federal government is the principal owner of land and resources in the north and has primary responsibility for water management. These responsibilities are carried out through the *Northwest Territories Waters Act*[72] and the *Yukon Waters Act*.[73] Although important instruments of federal water management, these acts do not address transboundary water management directly.[74] Transboundary water issues are addressed, however, in constitutionally entrenched northern land claims agreements.[75]

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70. Law List Regulations, SOR/94-636.
71. See S.A. Kennett, "Federal Environmental Jurisdiction after *Oldman*", (1993) 38 *McGill Law Journal* 180.
72. S.C. 1992, c. 40.
73. S.C. 1992, c. 39. A separate water management statute for the new territory of Nunavut is currently being prepared.
74. The conditions specified for issuing water licenses do, however, require attention to significant adverse effects on "the use of waters, whether in or outside the water management area to which the application relates." See *Northwest Territories Waters Act*, Section 14(4)(a)(I).
75. See, for example, Article 20 of the Nunavut Agreement. This article states that projects outside the Nunavut Settlement Area that affect Inuit water rights should not be approved until arrangements are made for compensation. The settlement of land claims in the Mackenzie River basin adds a new set of transboundary issues, because, for water management purposes, the boundaries between land claims regimes are increasingly important. Transboundary provisions are found in the Mackenzie Valley claims (see, for example, Sections 20.1.18 and 20.1.19 of the Sahtu Dene and Metís Comprehensive Land Claim Agreement) and in the *Mackenzie Valley Resource Management Act* (S.C. 1998, c. 25; see Sections 55, 60(3), 107, 141-144), which will implement these claims by establishing new institutions for managing resources, including water.

3.2.9 Summary

The legal framework for transboundary water management at the federal level is a patchwork quilt of specific provisions. These provisions, taken together, could support a strong federal role in this area, but they have yet to be integrated into a coherent whole. Furthermore, a history of selective enforcement, limited resources for monitoring and investigating offenses, delegation to the provinces and deference to provincial sensitivities in relation to resource management has meant that the federal role in transboundary water management is significantly less important in practice than a reading of the relevant statutes might suggest.

3.3 The Policy and Institutional Framework at the Federal Level

3.3.1 Federal Water Policy

In January 1984, an advisory committee was established by the minister of the environment pursuant to the *Canada Water Act* with a broad mandate to review and advise on Canada's water policy. The committee's final report, issued in September 1985, dealt with the federal responsibility for interjurisdictional waters by recommending the repeal of Part II of the *Canada Water Act* and its replacement with "provisions to authorize the federal government to assist in resolving disputes between provinces and territories about the use of interjurisdictional waters.[76]" The recommended provisions would have included authorization for the federal government to intervene and impose a solution to an intergovernmental dispute where the provincial or territorial governments had failed to agree after reasonable efforts and where one of the jurisdictions had submitted a complaint to the federal government. The report also made recommendations on water exports, including those calling for the federal government to require permits for any water exports and the cabinet to determine whether large-scale diversions of water to the United States would be open to consideration.

The federal government responded to the report two years later by issuing the Federal Water Policy.[77] For interjurisdictional water conflicts generally within Canada, the government committed itself to developing, in consultation with the provinces, a mechanism for resolving interjurisdictional disputes where other avenues had failed.[78] On the

76. Canada, *Currents of Change,* Inquiry on Federal Water Policy, Final Report, Ottawa, 1985.
77. Environment Canada, *Federal Water Policy*, Ottawa, November 1987.
78. *Ibid*., 33.

issue of interbasin transfers, the government agreed to three key efforts: to "draft guidelines and criteria for assessing interbasin transfers within Canada in cooperation with the provinces/territories; to take measures to prohibit interbasin diversions aimed at exporting water from Canada; and to develop with the provinces a system to regulate small-scale transfers of water.[79]" A specific provision also committed the government to establishing "mechanisms with the provinces regarding (trans)boundary water to ensure that the [northern territories'] interests are protected.[80]" None of these commitments (with the arguable exception of the last one) was implemented in the first 10 years following adoption of the policy.

Although the 1987 policy focused on interbasin water transfers, the federal government did offer a commitment to take all steps within its jurisdiction to prohibit the export of Canadian waters by interbasin diversions and to strengthen legislation to the extent needed to implement this policy. Smaller-scale transfers, including containerized ones, were viewed as a matter better handled by the provinces. Interestingly, however, this 1987 policy notes the need for the provinces to take into account federal interests in making decisions on these transfers, with trade considerations being expressly included.[81] One effort to pass such legislation, Bill C-156, the *Canada Water Preservation Act*, died in Parliament in 1988.

In February 1999, the federal government announced its strategy to prevent the bulk removal of water from Canadian watersheds. The strategy had three prongs:[82]

1. Amendments to the *International Boundary Waters Treaty Act*, which implements the 1909 Boundary Waters Treaty, to give the federal government the power to regulate to prohibit bulk water exports from boundary waters (waters with a boundary running through them). These amendments were not tabled, but were expected to be tabled in the spring of 1999, before the session of Parliament was adjourned. The development of a regulation would then be subject to further consultations with the provinces and a review of the state of provincial laws affecting potential water exports.

79. *Ibid*., 24.
80. *Ibid*., 30.
81. Environment Canada, *Federal Water Policy*, Section 8, "Interbasin Transfers."
82. The following is taken from the press release "Strategy Launched to Prohibit the Bulk Removal of Canadian Water, Including Water for Export," Foreign Minister Lloyd Axworthy and Environment Minister Christine Stewart, 10 February 1999. Numbered paragraphs note the strategy elements.

2. The Canadian government, with the United States government, issued a joint reference under the Boundary Waters Treaty to the International Joint Commission to study the effects of water consumption, diversion and removal, including for export, from boundary waters. Recommendations are to be made on the "management and protection" of these shared waters. The IJC is to conduct public consultations and to submit interim recommendations six months from the reference date. Final recommendations are to follow in a further six months.

3. The federal government proposes to pursue a Canada-wide accord on bulk water removals from watersheds, by which all governments will act through legislation or policy to prohibit them. The strategy urged the provinces and territories without existing prohibitions to adopt a moratorium on any bulk transfers while such an accord is developed.

At the time of this writing, the federal government had initiated discussions with the provinces and territories on these and other elements of its Federal Freshwater Strategy. Thus policies and other measures were in a state of evolution, with further developments anticipated over the course of 1999-2000.

The federal strategy is anchored in the view that water in its natural state is not a good and should not be treated as such. Accordingly, it seeks to promote a consistent approach to all interbasin transfers or bulk removals, whether for domestic or export purposes, as part of a broader sound environmental management strategy for freshwater resources.

The strategy also reflects a jurisdictional dilemma at the federal level. Provincial jurisdiction over water resources in their natural state includes the ownership and overall management of the resource. Federal jurisdiction is limited to international and interprovincial issues, but it also could be invoked at the border through the use of the trade and commerce power.[83] Exercising this constitutional jurisdiction, however, requires the use of trade tools. It has been feared that this requirement could be turned around to argue that water, even in its natural state, is being treated as a good and thus should be subject to the full panoply of trade laws applying to goods. This is not to imply that the use of such tools would be inconsistent with the North American Free Trade Agreement (NAFTA) or World Trade Organization agreement. Rather, it implies that the use of other tools, which would not raise these issues nor

83. This power is set out in Section 91(2) of the *Canada Act*, 1867.

reflect the proposition that water in its natural state is not a good, is the preferable route to follow.

3.3.2 Institutional and Administrative Arrangements

Federal water management is implemented by a number of government departments and by the water boards in the northern territories. The administrative arrangements are sometimes complex, with the departments of Environment, Fisheries and Oceans, Transport, Indian Affairs and Northern Development and Health all taking some measure of responsibility for water-related legislation and policy. In some cases, authority for enforcing a single piece of legislation is shared by two departments. The Department of Foreign Affairs and International Trade is Canada's lead federal agency for dealing with the International Boundary Waters Treaty, the IJC, and the US State Department.

Federal institutional arrangements are further complicated by formal and informal arrangements that delegate powers to the provinces. For example, some of the federal government's enforcement powers under the *Fisheries Act* related to fish habitat protection and pollution prevention in inland waters have been assumed by the provinces. Equivalency agreements under CEPA also limit the applicability of this act and thereby reduce the direct federal role in pollution control. Moreover, deference to provincial sensitivities has produced an often passive and sometimes uneven federal enforcement policy.

Finally, federal participation in intergovernmental water management agreements is particularly important in relation to transboundary waters. These agreements are discussed in section 3.5.

3.4 The Legal Framework at the Provincial Level

As the principal water resource managers in Canada, the provinces have detailed legislation dealing with water quality and allocation. In general, these statutes do not address transboundary water management, but statutory authorization for intergovernmental agreements is usually provided, whether in water management legislation or elsewhere.[84]

In some provinces, transboundary water issues are addressed through environmental assessment legislation. For example, Manito-

84. See Saunders, *Interjurisdictional Issues in Canadian Water Management*, 105-106, see n. 42 above.

ba's *Environment Act* provides for a joint assessment process where a project "may have an environmental impact of concern to a jurisdiction other than Manitoba.[85]" British Columbia's *Environmental Assessment Act* allows neighboring jurisdictions to participate in project reviews.[86] Although these provisions are the exception rather than the rule in provincial legislation, they provide a model for incorporating transboundary concerns into the review and regulation of projects affecting transboundary waters.[87]

One transboundary issue that has been addressed in several provinces is water exports. Three provinces have taken specific measures on water exports: British Columbia, Alberta and Ontario. The province of Quebec is currently undergoing a public consultation process on water, and in Newfoundland proposed water exports became subject to the province's permitting and assessment processes as this report was being written. It is likely that the policies in other provinces will develop over the near future.

3.5 Interjurisdictional Water Management Agreements

As with many other shared federal/provincial areas of interest under Canadian federalism, cooperation between the two levels of government is facilitated in important respects through a range of intergovernmental agreements. Generally, these agreements fall into two categories: those that set out cost-sharing arrangements in areas of water research and development (for example, hydrometric agreements and flood damage reduction agreements), and those that are directed at water management in specific basins. The latter are more relevant to transboundary issues.

The federal government sits on several interjurisdictional water boards, including the Prairie Provinces Water Board (PPWB), the Ottawa River Regulation Planning Board (ORRPB), the Mackenzie River Basin Board (MRBP) and the Lake of the Woods Control Board (LWCB) —all established by intergovernmental agreements. These boards, which have been created to deal with basin-specific concerns, have no consistent structure or mandate. PPWB (comprising Canada, Alberta, Saskatchewan and Manitoba) was set up to administer an apportionment agreement for prairie waters and later took on responsibility for

85. C.C.S.M., c. E125; and Joint Environmental Assessment Regulation, *Manitoba Register* 126/91.
86. S.B.C. 1994, c. 35, Section 2(e).
87. See, Kennett, *Managing Interjurisdictional Water in Canada*, see n. 42 above.

water quality. ORRPB (comprising Canada, Ontario and Quebec) coordinates use of the Ottawa River and concentrates primarily on balancing hydroelectricity interests with flood reduction. MRBP (comprising Canada, three western provinces and the two northern territories) facilitates "cooperative management of the Aquatic Ecosystem of the . . . Basin" and reflects a balancing of upstream development interests (hydroelectricity and resource industry use) with a downstream interest in instream uses, especially by aboriginal peoples. Finally, LWCB (comprising Canada, Manitoba and Ontario), which mirrors the International Lake of the Woods Control Board, manages the lake flows within certain high and low water marks, beyond which the international board assumes responsibility (which occurs only about five percent of the time).

The federal role in these boards varies somewhat, but the emphasis in all the arrangements is on resolving disputes by consultation and agreement. The precise legal status of the agreements establishing the boards is at best ambiguous, but none of the agreements has ever been litigated, and water managers involved in the boards stress the lengths to which they will go in order to avoid litigation. They consistently refer to the need to avoid the litigious approach to interjurisdictional water management that they perceive as existing in the United States.

CHAPTER 4

Mexico and the United States: The Binational Water Management Framework

4.1 Overview of the Legal Framework

Historically, the economic disparities between the United States and Mexico have posed a significant challenge to the binational management of water resources. Yet despite their differences, the two countries have established a high standard of cooperation on transboundary waters.

The history of US-Mexico legal relations over water can be divided into three stages. In the first stage, beginning in the late 19th century, transboundary surface water resources, their use and, above all, their apportionment, distribution and allocation, prevailed. The connection between surface water and groundwater was not addressed at this stage, nor was water quality considered a major issue. Several binational agreements marked this first stage:

The 1889 Convention to Avoid the Difficulties Occasioned by Reason of the Changes which Take Place in the Beds of the Río Grande and Colorado River created the first bilateral mechanism to deal with boundary water problems: the International Boundary Commission (now the International Boundary and Water Commission, or IBWC). This was followed by the 1906 Convention Providing for the Equitable Distribution of the Waters of the Río Grande for Irrigation Purposes. This agreement guaranteed 74 Mm^3 (60,000 AF) per year in deliveries to Mexico at a point above Ciudad Juárez, in accordance with a monthly schedule. In turn, Mexico waived any claims to Río Grande waters between the point of delivery and Fort Quitman, located roughly 115 kilometers (km, 70 miles) downstream.

In November 1944, Mexico and the United States signed the Treaty Relating to the Utilization of Waters of the Colorado and Tijuana Rivers and of the Río Grande, which has been in force ever since and which

established the modern International Boundary and Water Commission. Better known as the 1944 Water Utilization Treaty, it is considered the centerpiece of the US-Mexico legal framework for transboundary water allocation.

The 1944 treaty sets forth a hierarchy of preferential water uses that guide IBWC in its duties. According to Article 3 of the treaty:

> In matters in which the Commission may be called upon to make provision for joint use of international waters, the following order of preferences shall serve as a guide:
>
> 1. Domestic and Municipal Uses.
> 2. Agriculture and stock raising.
> 3. Electric power.
> 4. Other industrial uses.
> 5. Navigation.
> 6. Fishing and hunting.
> 7. Any other beneficial uses which may be determined by the Commission.
>
> All of the foregoing uses shall be subject to any sanitary measures or works which may be mutually agreed upon by the two Governments, which hereby agree to give preferential attention to the solution of all border sanitation problems.

This comprehensive treaty applies to surface water allocation in the three transboundary basins but does not cover the allocation of groundwater resources.[88] The 1944 treaty's apportionment of water in the Río Grande and Colorado basins is described in the sections below. Apportionment of the water of the Tijuana River has not yet been agreed upon under the terms of the treaty.

The second stage of US-Mexico relations on transboundary water resources began in the 1960s, propelled by the first major water quality difference between the two countries: high-salinity water was being delivered to the Mexicali Valley through the Colorado River. High concentrations of salts were entering the river upstream, particularly as a result of extensive irrigation. The Colorado salinity controversy temporarily disrupted US-Mexico relations. As described in section 4.6.2.2, this problem was largely resolved in 1973 by Minute 242 to the 1944 treaty. The salinity of Colorado River water, however, remains a concern.

88. IBWC Minute No. 242, adopted in 1973, does provide for regulation of groundwater withdrawals on the Yuma Mesa on the western Arizona-Sonora border. This minute order encourages binational efforts to achieve a groundwater agreement, but no substantive progress has been made toward such an agreement.

At the end of its first eight decades of work, the IBWC had led the two neighbors to settle all major surface water allocation and distribution problems. Moreover, the institution had served as the platform for jointly constructed, financed and operated engineering projects, such as the Amistad and Falcon International Reservoirs on the main channel of the Río Grande.

Mexico and the United States are now entering a third stage in the history of their management of transboundary waters. Issues likely to dominate in the coming years are surface water quality and transboundary groundwater issues, including allocation, quality and groundwater/surface water interconnections.

The following sections describe in detail the prominent binational institutions and the relevant legislation involved in the management of freshwater resources along the US-Mexico border.

4.2 International Boundary and Water Commission (IBWC)

IBWC is a binational commission made up of two national sections. Each section is headed by a single commissioner who holds the rank of ambassador in his or her respective foreign service. The commissioners are mandated by treaty to be licensed engineers. Each section also includes up to two principal engineers, a legal adviser and a secretary. National sections remain under the policy authority of the national governments operating through their respective foreign ministries—the Department of Foreign Affairs (*Secretaría de Relaciones Exteriores)* in Mexico and the Department of State in the United States.

As an international body, IBWC is first and foremost an operational agency charged with boundary maintenance and reclamation duties for the two governments. Under the 1944 Water Utilization Treaty and earlier conventions and agreements, IBWC is responsible for six functions: (1) maintaining the boundary; (2) constructing and operating reclamation works located on the boundary; (3) allocating transboundary water resources in accordance with treaty specifications; (4) interpreting, investigating and resolving differences between the Parties with respect to the meaning of the 1944 treaty and earlier agreements in its charge; (5) ensuring the enforcement of rules and procedures within its jurisdiction; and (6) constructing and maintaining joint sewage and sanitation works, and resolving differences related to the quality of transboundary water.

The sections that follow describe the specific roles of IBWC in relation to different transboundary water management issues.

4.2.1 Reclamation

Through IBWC, the two countries have constructed and operated a series of major reclamation works on the Río Grande and Colorado Rivers for purposes of flood prevention and water storage. These projects, including channelization of the Río Grande, diversion and flood control projects (the Anzalduas Dam on the Río Grande and the Morelos Dam on the Colorado), and water impoundment for irrigation (the Falcon and Amistad Dams on the Río Grande) have played an important role in the development of agriculture and human settlements in the arid border region. The commission also operates several hydropower projects associated with the Río Grande dams.

In compliance with the provisions of the 1906 Río Grande Water Treaty and the 1944 Water Utilization Treaty, the IBWC has important functions in the area of water allocation. It is the only institution to operate stream gaging stations, audit water flows and balances, and certify compliance with treaty provisions. And it is the lead agency for investigating and mediating any disputes over treaty-based water deliveries and water allocation issues (see next section).

4.2.2 Investigations and Dispute Settlement

The investigative, dispute settlement and other diplomatic functions of IBWC are found in Articles 2 and 24 of the 1944 Water Utilization Treaty. IBWC is mandated to "settle all disputes" related to the "observance and execution" of the treaty; to "settle all differences that may arise between the two Governments with respect to the interpretation or application of this Treaty, subject to the approval of the two Governments"; and to "initiate and carry on investigations and develop plans for the works which are to be constructed or established in accordance with this or other treaties or agreements in force." Under such authority, IBWC has addressed a wide range of water-related environmental problems in the border area, including sanitation and sewage issues, salinity and other water quality issues.

4.2.3 Quasi-judicial Function

IBWC's quasi-judicial functions are confined to the actions necessary to carry out its other duties. The commission is required by the 1944

treaty "to carry into execution and prevent the violation of the provisions of those treaties and agreements" applicable to it. The treaty further stipulates that "the authorities of each country shall aid and support the exercise and discharge of these powers and duties, and each Commissioner shall invoke when necessary the jurisdiction of the courts or other appropriate agencies of his country to aid in the execution and enforcement of these powers and duties."

4.2.4 Water Quality, Water Pollution

IBWC has a range of functions in the area of water quality management. Until the mid-1980s, the commission was the sole agency dealing with transboundary water quality issues along the US-Mexico border. Under the authority of the 1983 United States-Mexico Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area (the La Paz Agreement) and more recent initiatives, it now shares this responsibility with other agencies, particularly the environmental ministries of each country. IBWC's authority in this area derives from Article 3 of the treaty, which, as noted earlier, stipulates priority of uses for international waters under the commission's jurisdiction and subjects those uses "to any sanitary measure or works which may be mutually agreed upon by the two Governments, which hereby agree to give preferential treatment to the solution of all border sanitation problems."

Under the provisions of Article 3, IBWC became the lead agency for the development of transboundary sewage and sanitation projects along the US-Mexico border. From 1946 through 1990, IBWC developed and operated sanitation projects at Douglas, Arizona, and Agua Prieta, Sonora; San Diego, California, and Tijuana, Baja California; Nogales, Arizona, and Nogales, Mexicali; and Laredo, Texas, and Nuevo Laredo, Tamaulipas. The rapid urbanization in the border area since the 1960s has generated steady pressure for the expansion and further development of these and other projects in the border area, making sewage and sanitation the most vigorous area of functional growth for the commission.[89]

The need to better define IBWC's responsibilities in sewage treatment and water quality led to Minute 261 (in 1979), Minute 288 (1992), and Minute 294 (1995). In response to numerous demands that the commission move more aggressively to deal with a wide range of

89. S.P. Mumme, "Innovation and Reform in Transboundary Resource Management: A Critical Look at the International Boundary and Water Commission, United States and Mexico", (1993) 33 *Natural Resources Journal* 113-114.

transboundary water quality issues, Minute 261 broadens interpretation of the 1944 water treaty's Article 3 to allow the commission to deal with problems of persistent water pollution. Minute 261 also provides the basis for intensified binational efforts through IBWC to deal with sewage and sanitation, and related water pollution that is transboundary in nature.[90] Building on Minute 261, Minute 288 provides for a coordinated water quality planning through partnerships with US and Mexican governmental agencies.

Minute 294 consolidates agreements on sewage treatment plant works. Perhaps more important, Minute 294 represents an effort by IBWC to provide assistance to border communities in bringing their water quality and sanitation planning up to levels that would help them achieve certification by the Border Environment Cooperation Commission (BECC) and, potentially, financing by the North American Development Bank (see section 4.4). In essence, this minute created a foundation for increased cooperation between IBWC and BECC. In December 1998, IBWC issued Minute 299 which called for a "Coordinated Memorandum of Understanding" that would formalize cooperation between the two commissions.

Under Minutes 261, 288 and 294, IBWC has addressed sewage contamination issues on a case-by-case basis, negotiating binational plans for the construction of sewage collection works in San Diego-Tijuana, the New River, Ambos Nogales and Nuevo Laredo. Progress in the New River and San Diego-Tijuana areas has been slower than hoped for because of a variety of complicating factors at the local and binational levels. Rapid industrial development, population growth and the unequal economic conditions on different sides of the border have undermined efforts to treat all raw sewage prior to disposal in the Río Grande and other areas of the border. The quality of transboundary surface waters thus often violates the basic water quality standards of both countries.[91]

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90. S.P. Mumme, "The Background and Significance of Minute 261 of the International Boundary and Water Commission", (1981) 11 *California Western International Law Journal* 223-235.

91. D.J. Eaton and D. Hurlbut, *Challenges in the Binational Management of Water Resources in the Río Grande/Río Bravo*, US-Mexican Policy Report No. 2, Lyndon B. Johnson School of Public Affairs, University of Texas at Austin, 1992, 2; R.A. Sánchez, *El Drenaje de Tijuana como Fuente de Conflicto entre México y Estados Unidos*, El Colegio de la Frontera Norte, Tijuana, Mayo de 1988; R. Morales and C. Romero, "Evaluación de la contaminación en playas de Tijuana, B.C. Reporte Preliminar", *Ecología y Frontera,* Universidad Autónoma de Baja California, 1986; R. Sánchez, "Las relaciones binacionales como un marco conceptual en el análisis de los problemas ambientales transfronterizos entre México y Estados Unidos", in *Una Frontera Dos Países*, A. Utton and E. Marroquín, ed., Mexico: ANUIES, 1988;

Managing salinity in transboundary waters continues to be of great importance on the US-Mexico border, particularly for the Colorado River. This issue, which is one of IBWC's most active, is discussed in further detail in section 4.6.2.2.

4.3 La Paz Framework Agreement

In response to the new and more complex environmental situation on the US-Mexico border, the United States and Mexico signed a framework agreement for binational environmental cooperation in 1983. The United States-Mexico Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area (the La Paz Agreement) establishes a process for regular binational consultation on border area environmental problems, the assignment of priorities, and the development of binational solutions to identified problems.[92] Under La Paz, Mexico and the United States agreed to work together in preventing, reducing and eliminating pollution that may affect the border area. The agreement defines the border area as a zone extending 100 km (62 miles) on either side of the international boundary.

The heads of the two national environmental agencies (Semarnap and EPA) are national coordinators for the La Paz Agreement. The national coordinators' principal functions are to coordinate and monitor the implementation of the agreement and its annexes, make recommendations to the parties, and organize annual meetings.[93] While official participation is mostly federal, the national coordinators may invite state, municipal and non-governmental representatives to take part in the meetings.

The La Paz Agreement has been implemented primarily by means of the binational working groups. These working groups bring together

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and C. Metzner, "Transboundary Sewage Problems: Tijuana/San Diego/New River/Imperial Valley", (1988) 2 *Transboundary Resources Report* 5-6.

92. A. Székely, "Establishing a Region for Ecological Cooperation in North America", (1992) 32 *Natural Resources Journal* 563; S.P. Mumme, "La Paz Agreement: Progress and Problems in Managing the Border Environment", (1988) 2 *Transboundary Resources Report* 1-3; M.A. Sinclair, "The Environmental Protection Agreement between Mexico and the United States: A Response to Pollution Problems of the Borderlands", (1986) 19 *Cornell International Law Journal* 87; H.M. Ingram, "State Role in US-Mexico Resource Issues", (1987) 1 *Transboundary Resources Report* 4; and A. Székely, "How to Accommodate an Uncertain Future into Institutional Responsiveness and Planning: The Case of Mexico and the United States", (1993) 33 *Natural Resources Journal* 9.

93. At least one meeting of the national coordinators must be held annually, and meetings may be held more frequently as necessary.

federal agencies from both countries in various areas to work toward common solutions to identified problems. Within the Border XXI framework (see section 4.5.1), working groups deal with water, air, hazardous and solid wastes, contingency planning and emergency response, cooperative enforcement, and pollution prevention.

The La Paz Agreement provides a means of concluding special or *ad hoc* arrangements, in the form of annexes, to deal with specific common environmental problems at the border. The agreement is applicable to all environmental issues, including land and water pollution, so long as it does not "prejudice or otherwise affect the functions entrusted" to IBWC in accordance with the 1944 treaty. This recognition of IBWC as the lead agency for resolving binational water disputes means that IBWC frequently works on water quality issues in cooperation with the working groups established under the La Paz Agreement.[94]

During the first six years of the La Paz process, the two countries were able to agree on five annexes, two of which were water-related. Annex I for the "Solution of the Border Sanitation Problem at San Diego, California/Tijuana, Baja California" was concluded in 1985 to deal with a serious water sanitation problem that had arisen when sewage from Tijuana entered San Diego and its adjoining bay. Annex II, "Regarding Pollution of the Environment along the Inland International Boundary by Discharges of Hazardous Substances," also concluded in 1985, dealt with water pollution in border rivers. Other annexes address issues such as hazardous waste, air quality and emergency response.

As a result of this early work under the La Paz Agreement and its annexes, sewage treatment plants and collection facilities have been and are being built; copper smelters have been either closed down, frozen at their current capacity or modified; more water quality monitoring devices and programs have been put in place for transboundary waters; the two countries have adopted more stringent environmental regulations for the area; and the exchange of data and training of personnel has become commonplace.

In keeping with its mandate, the La Paz process has not addressed certain transboundary water-related issues. These issues include drought and groundwater management, which have yet to be addressed

94. Scott A. Hajost, "US-Mexico Environmental Cooperation: Agreement between the United States of America and the United Mexican States for the Protection and Improvement of the Environment in the Border Area", (1984) *Environmental Law* 1-3.

by IBWC.[95] Concerns about groundwater quality have led to suggestions that the La Paz process be extended. The controversy of a few years ago surrounding the siting of a low-level radioactive waste disposal site in Hudspeth County of southern Texas underscores the need for enhanced mechanisms. Current discussions on transboundary environmental impact assessments under way in CEC may lead to the development of suitable mechanisms.

4.4 Border Environment Cooperation Commission

Inaugurated along with the NAFTA on 1st January 1994, the Border Environment Cooperation Commission (BECC) is the most recent institutional player with a mandate affecting binational water management. The Commission is a direct result of the NAFTA process and is intended to address historic shortcomings in environmental infrastructure along the US-Mexico border. The BECC's functions are to provide technical assistance for developing environmental infrastructure projects in the border area, and to certify those projects for financing consideration by the North American Development Bank (NADBank) and other sources. As such, it is limited to the official border region of 100 kilometers on each side of the border and to three types of environmental infrastructure development: water supply and treatment, waste water treatment and disposal, and solid municipal waste (and related matters).

BECC is required to certify that projects meet basic environmental criteria before they are eligible for any financing. Project financing is arranged through the NADBank and other public and private lenders. The BECC/NADBank structure is unique. First, the structure ensures that only environmentally sound projects ever make it to final consideration, rather than doing a cursory environmental impact review of otherwise financiable development projects. Second, that such certification is not in the same hands as those making the decisions on the financiability of the projects eliminates a potential conflict of interest.

A binational commission, BECC relies on its board of directors, general manager, deputy general manager, advisory council and staff to carry out its functions. The board of directors oversees "operational and structural policies." It is made up of 10 members, including the US and Mexican commissioners of IBWC, and the chief administrative officers of the national environmental agencies or their deputies. The six addi-

95. A.E. Utton, "Water and the Arid Southwest: An International Region under Stress", (1994) 34 *Natural Resources Journal* 957-961.

tional directors, chosen on the basis of needed expertise, represent US and Mexican border states, municipalities and the general public. The chair of the board of directors is selected annually, named by each of the parties on a rotating basis. The positions of general manager and deputy general manager are divided between the two countries. The board of directors appoints each manager for a three-year term, after which the positions rotate between the two countries. The advisory council may consist of up to 18 members. Up to six members represent US border states and municipalities; another six represent Mexican border states and municipalities; three members represent the US public; and three members represent the Mexican public.

Through a special grant fund, BECC helps small communities field project proposals. This up-front, before certification, technical assistance helps ensure technically sound and feasible projects, master plans, project design, environmental assessment and local institutional capacity-building. BECC works with states, municipalities and private parties to deliver such projects. Under its charter, the BECC works closely with the IBWC and domestic environmental agencies in considering the need for infrastructure projects. Operationally, however, it remains dependent on project submissions from border communities.

4.4.1 BECC Project Certification

Water-related projects are expected to continue to make up a significant component of BECC projects, particularly in the area of sewage, sanitation and municipal water supply. Of the 49 projects (29 American and 20 Mexican), with a total investment value of US $ 1 billion, that obtained BECC certification through June 2001, 44 were water-related. Although urban projects are likely to be favored, rural water supply, groundwater protection, restoration and preservation of wetlands, and other biodiversity issues may qualify for BECC certification and technical assistance.

The detailed certification itself is based on a set of environmental, health, technical, financial, community participation and sustainable development criteria, through a process that ensures extensive public and local input.

4.4.2 North American Development Bank

The North American Development Bank (NADBank) was established under the auspices of NAFTA to facilitate financing for the development, execution and operation environmental infrastructure projects

that have been certified by BECC, its sister institution. NADBank has a binational, six-person board of directors—three from the United States and three from Mexico. All six members are federal cabinet level presidential appointees. There is no state, local or public representation on the board. The chairmanship of the board alternates each year between Mexican and US representatives.

NADBank's capital is committed in equal amounts by the two governments. Fifteen percent of this capital, $ 450 million, is in the form of paid-in capital and the remainder is subscribed as callable capital. Through June 2001, NADBank had approved $ 295 million in loans, guarantees and grants to help finance 36 environmental infrastructure projects along the US-Mexico border, of which 30 were directly related to water, wastewater or both.

Overall, NADBank funds are expected to augment and strengthen existing financial support for border water-based infrastructure, and to leverage financing for unrated (by traditional finance sources) and underserved communities. However, the provision of adequate financing remains a serious limitation. The BECC-NADBank structure does not officially preclude more traditional approaches to infrastructure financing, but it does shift the emphasis from government grants and subsidies to market-driven, pay-for-service instruments. This approach favors urban areas in the competition for funded projects. Some have raised concerns about the capacity of poorer people to pay for local water services, particularly in Mexico.

The BECC/NADBank institutional structures as implemented allow for innovative initiatives to resolve border environmental problems. In particular, the BECC's project certification criteria are to be highly applauded. As such, the BECC and the NADBank have had a limited but generally positive effect on binational environmental cooperation in the region. For example, the nearly 50 BECC/NADBank projects certified to date exceed the number of projects and people served in all preceding efforts in the border region. The BECC and the NADBank have adopted real measurements for qualitative outcomes rather than simply quantitative outcomes; they are institutions with sustainable development criteria to implement solutions.[96] Over time, the mechanism of the BECC criteria for certification and the NADBank financial evaluations should ensure the efficient spending of funds to improve the quality of life of those who live in the border region.

96. For a more full discussion of this see: M. Spalding, "The NAFTA Environmental Institutions and Sustainable Development on the US-Mexico Border", chapter for *Shared Space: Rethinking the US Mexico Border Environment*, Herzog, ed., Regents of the University of California, 2000.

4.4.3 Expansion of the Mandate of the BECC/NADBank Institutions

Despite the many urgent infrastructure and environmental needs in the region, less than four percent of the NADBank's paid-in capital has been expended on loans for border environmental infrastructure projects in its more than seven years of existence. As a result of a growing concern that the majority portion of the NADBank's resources were going unused, the board of the NADBank directed the NADBank staff to prepare a white paper to explore options to address this issue. This white paper was issued in June 2000. The white paper primarily proposed a mandate expansion to allow the bank to lend in sectors more easily financed. As examples of the proposed areas for mandate expansion, the NADBank listed:

- agriculture to municipal water transfers;
- individual water and wastewater home installations;
- industrial and hazardous waste treatment and disposal projects;
- air quality projects: general;
- air quality projects: street paving;
- municipal urban roads and public transportation systems;
- housing improvements.

NADBank describes the outcome for this process as follows:

> In November 2000, the [NADBank] Board approved a resolution allowing the Bank to finance new types of BECC-certified environmental infrastructure projects within the current charter. While water, wastewater and solid waste will continue to be priorities, this new flexibility to consider additional sectors and financing mechanisms will greatly enhance the Bank's positive impact along the border. The Bank and the Border Environment Cooperation Commission (BECC) are working together to identify which new environmental infrastructure sectors to pursue in the near term.[97]

In early 2001, the BECC and the NADBank agreed to open additional types of projects for certification and financing. This mandate expansion has just begun and is not yet fulfilled. A recent joint letter from the BECC and the NADBank indicated their agreement to expand

97. From the NADBank's web site discussion of mandate expansion: <http://www.nadbank.org/Reports/mandate/eng/mandate_frame.htm>.

their scope beyond the original mandate for water, wastewater, and solid waste projects. The BECC will certify industrial and hazardous waste projects (to the extent they will prevent a pollution threat to water or soil); water conservation projects; water and wastewater hookups for housing; and recycling and waste reduction projects. BECC will also certify, on a pilot basis, projects related to air quality, public transportation, and clean and efficient energy, as well as projects that improve municipal planning and development, and water management.

In addition, new finance mechanisms have just been developed to address the lack of affordability of NADBank lending. For example, the NADBank has recently set up a limited-purpose financial mechanism that channels NADBank financing to Mexican public sector environmental infrastructure projects to avoid Mexican constitutional prohibitions on sub-federal entities borrowing in foreign currencies and from foreign entities. Even more promising is NADBank's new Value Lending Program to lend $ 50 million of its paid-in capital through low interest rate loans for water, wastewater, and solid waste projects.

To complement the agreement between the sister institutions, the mandate expansion discussion has been continued through proposals of environmental groups and politicians. Leading policy advocates for the border region, the Texas Center for Policy Studies, together with the North American Integration and Development Center, and the William C. Velasquez Institute, have now fielded their own proposal for reform of the institutions:

- Dedicate a majority of the bank's paid-in capital—between $ 150 and $ 200 million—to low interest loans for border environmental projects certified by BECC.
- Improve the certification process itself.
- Allow other NADBank capital to be used for non-environmental infrastructure projects in and outside the border zone, with guarantees for transparency and accountability in the use of these public funds.
- Establish a program within NADBank to leverage transnational remittances for community development projects in those regions of Mexico where economic opportunity is so scarce that people are forced to migrate in search of work.[98]

98. *Finding Common Ground: A Public Interest Proposal for BECC/NADBANK Reform*, Austin/Los Angeles: William C. Velasquez Institute, Texas Center for Policy Studies, and the North American Integration and Development Center, 9 August 2001.

In February 2001, President Fox in his first official meeting with President Bush suggested that we convert the existing NADBank and redirect its capital to be used for North America-wide economic promotion loans, including micro-enterprise loans to stimulate small and medium businesses, especially those in Mexico. Fox suggested that Canada, Mexico and the US contribute to such a redesigned NADBank. His proposals included expanding the geographical focus of the NADBank from US/Mexican border to all of North America, and would expand the scope of development projects from environmental infrastructure (sanitation and solid waste projects, air quality, water quality and conservation) to non-environmental infrastructure projects such as airports, bridges and transportation corridors.

According to a Joint Statement between the United States of America and the United Mexican States issued on 6 September 2001:

> To serve urgent environmental priorities in the border area, the Presidents agreed that immediate measures were needed to strengthen the performance of the North American Development Bank (NADBank), and its sister Border Environmental Cooperation Commission (BECC), to identify and fund environmental infrastructure projects on the border. Presidents Bush and Fox agreed that a binational working group —which will consult with national legislatures, border states, communities, and other stakeholders— will develop joint recommendations and report back to the Presidents by 31 October 2001.

4.5 Other Binational Initiatives

Since 1992, Mexico and the United States have sought to further improve binational cooperation in environmental management, including water resources. Many of these initiatives can be traced to perceived deficiencies in the La Paz process and to public demands for the two countries to work together more aggressively to deal with environmental problems on the border.

4.5.1 Border XXI (Integrated Border Environmental Plan)

The Border XXI initiative, adopted in October 1996, builds on the Integrated Border Environmental Plan (IBEP) of 1992, in response to concerns about the possible adverse environmental consequences of activities flowing from the NAFTA agreements. Border XXI is a regional sustainable development program that complies with Agenda 21 at the

global level.[99] Its core objective is to improve binational, intergovernmental, and social cooperation for environmental protection and sustainable development in the border area. The Border XXI operational approach emphasizes public involvement, decentralization of environmental management through state and local capacity building, and improved communication and cooperation among federal, state and local government agencies.

Building on the La Paz process and other existing binational institutions, Border XXI sets five-year targets for environmental improvement in the California-Baja California, Arizona-Sonora, New Mexico-Texas-Chihuahua, Texas-Coahuila/Nuevo León, and Texas-Tamaulipas regions of the border. Nine new binational working groups, incorporating the La Paz process working groups, are coordinating binational environmental/sustainable development policy for the border area. These groups meet at least annually to coordinate activities in their respective areas of concern.

At this juncture, it is difficult to point to concrete advances in transboundary water management associated with the Border XXI initiative. Compared with the La Paz process and the earlier IBEP, Border XXI adopts the language of sustainable development, construes the border area in more flexible and more ecological terms and establishes five-year objectives for the realization of new and ongoing projects. Biennial implementation plans and progress reports will track and assess the Border XXI process. Financial commitments beyond current authorizations remain nebulous, however, and are tied, in the Mexican case, to implementation of the World Bank's Northern Border Environmental Program, a program heavily oriented to urban water and environmental infrastructure development.[100] The initiative should reinforce institutional commitments and strengthen the case for further coordination and cooperation in binational water management. Perhaps most important, Border XXI provides an additional means of accommodating public participation and public input on environmental management in the border region. In other respects, Border XXI may well be viewed as a repackaging of existing binational agreements and practices as these influence water management in the border region.

99. Agenda 21, the Rio Declaration on Environment and Development, and the Statement of Principles for the Sustainable Management of Forests is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations system, governments, and major groups in every area in which humans affect on the environment (see <http://www.un.org/esa/sustdev/agenda21.htm>).

100. World Bank, *Staff Appraisal Report: Northern Border Environment Project*, Report No. 12603-ME, Latin American and Caribbean Regional Office, International Bank for Reconstruction and Development, Washington, DC, 16 May 1994.

4.5.2 Good Neighbor Environmental Board and Regional Advisory Council for Sustainable Development

The Good Neighbor Environmental Board (GNEB) was established by the US Congress in 1992. It advises the president and Congress concerning environmental and infrastructure issues and needs within the states contiguous to Mexico. As such, it directly assists federal authorities involved in environmental protection in the border area. Its Mexican counterpart, the Regional Advisory Council for Sustainable Development *(Consejo Regional para Desarollo Sustenable)* was created in 1995 to advise Semarnap on regional matters of concern. The advisory council covers four national regions; Region 1 is the northern border area. Although some intergroup consultation occurs, the groups function independently. Through these institutions, the federal governments are formalizing and supporting mechanisms for the border area, which are formally incorporated in Border XXI's public participation processes.

The GNEB is attempting to take a long-term view including the use of long-term indicators of human and ecosystem health. It is effective at calling for and reporting on the transparency and accountability from the various other border institutions and government agencies working on border issues. While the GNEB's deliberate, but important development of consensus results in a more diplomatic message, it represents an important integrative approach to border issues. The 25-member board is composed of representatives from federal, tribal, state, and local government, non-governmental organizations (NGOs), academia, private organizations, and the community.

The GNEB's most important contribution to date regarding water in the border region is its September 2000 Fourth Report to the President and Congress.[101] The five recommendations it contains all reflect the basic premise that the US/Mexico border region faces critical water issues, and takes a "watershed" approach to strategically addressing priorities for our growing populations. According to the report, "[w]atersheds are natural boundaries that can be thought of as dividing the land into water-resource management units that are often more useful than more traditional designations such as political boundaries." The report's five recommendations are:

101. The full text of the Good Neighbor Environmental Board's Fourth Report to the President and Congress of the United States is available on line at <www.epa.gov/ocem/gneb-page.htm>.

- *Institutionalize a border-wide watershed approach.* Enable institution of a watershed approach as the underlying standard operating procedure for all projects that deal with water-resources management along the US border with Mexico. Concentrate initially on key priority watersheds and then expand the effort.

- *Support data-gathering and analysis that generates a clear picture of border watersheds.* Using, initially, a subset of priority watersheds, strengthen current efforts to collect, integrate, and analyze the data needed to flesh out watershed-based planning frameworks and fully understand both existing conditions and potential future scenarios in them. Expand this effort until, eventually, sufficient data is gathered and available for all border-region watersheds so that a watershed approach can be fully implemented.

- *Highlight and support water resource management practices along the border that are based on a watershed approach.* Develop a border-region strategic water plan that becomes a useful operational tool for day-to-day management decisions about individual watersheds made by US federal, state, county, municipal and tribal decision makers, and also is available to other interested groups. The plan should identify key transboundary water quality and quantity issues, present core components of a transboundary watershed analysis, include preliminary options for addressing these issues, and complement existing state, local and tribal government watershed-based plans and programs.

- *Encourage the full participation of tribal governments, along with binational organizations, federal, state and local governments and other border groups, in developing and implementing a watershed approach.* Ensure that the training, funding and physical infrastructure needs of all tribal governments, along with other border governmental agencies and population groups, are fully addressed when developing and implementing a watershed management approach.

- *Provide continued federal budgetary support for actions and programs consistent with the themes and purposes of a watershed approach for the border region.* Good Neighbor especially wishes to emphasize the importance and urgency of continued and full budgetary support for binational commitments to address border environmental issues within the context of a watershed approach.

4.6 Basin-Specific Frameworks

Many aspects of freshwater resource management along the US-Mexico border fall under state or other regional jurisdictions. The

following sections profile the existing legal and institutional transboundary water management frameworks at the individual basin level.

4.6.1 Tijuana River Basin

The relevant legal regimes for this basin include California state law, Mexican federal law and the 1944 Water Utilization Treaty. California state law and the 1944 treaty, as they relate to the Tijuana basin, are described below. Mexican federal law is described in Chapter 1.

California has a hybrid system of water rights, recognizing both riparian and prior appropriation rights.[102] For the most part, allocations in times of shortage are based on seniority of appropriative rights, and some existing riparian rights have seniority. California is unique in that its permitting system is based on beneficial and reasonable use of water. Reasonableness is determined on the facts of each case and may change over time. This provision implies that water rights holders under California's appropriative system are more susceptible to having their rights modified than are water rights holders in some other prior appropriation states.

California law provides for public interest review of water right applications and transfers. The state also has a strong public interest doctrine that has been enforced by the courts. Instream use is defined as beneficial use, but it is not clear that a private person could secure an appropriative right to instream flows under California law.

Article 16 of the 1944 treaty provides that in order to "improve existing uses and to assure any feasible further development, the IBWC shall study and investigate, and shall submit to the two governments for approval, recommendations for the equitable distribution between the two countries of the waters of [the Tijuana] River system." But despite various attempts, the two governments, through IBWC, have failed to reach any apportionment agreement for the Tijuana basin waters. As a result, each country has tried unilaterally to capture what little surface water the basin offers.

4.6.2 Colorado River Basin

The relevant legal regimes for this basin include California, Colorado and Arizona state laws, various interstate compacts, Mexican

102. For a thorough analysis of current California water management policy and implications, see P. Gleick et al., *California Water Management 2020: A Sustainable Vision*, Oakland, CA: Pacific Institute, 1995.

federal law (Chapter 1) and the 1944 Treaty. Colorado and Arizona rely on prior appropriation permitting systems, and the California system is described in the previous section.

4.6.2.1 US "Law of the River"

Water management in the Colorado River has a history of conflict and mistrust. Throughout the first part of the 20th century, conflicts arose over rights to use the river's water. Since then, ways to develop and deliver the water to support economic growth within the basin states have been the subject of debate. The conflict-ridden process of "dividing" and then "developing" the waters of the Colorado has preoccupied water planners throughout most of the century. The resultant combination of federal legislation, compacts, mandates, and court decisions makes up what is now called the "Law of the River." The most relevant elements of the Law of the River are summarized in the discussion that follows.

The Colorado River Compact of 1922 (see section 2.2.2.1) was the first attempt by political leaders and water officials to divide the waters of the Colorado River. The compact came about because of concerns by the upper-basin states (Colorado, Wyoming, New Mexico and Utah) that the proposed Hoover Dam and other lower-basin water projects might deprive them of water in the future. Lower-basin states (California, Arizona and Nevada), especially California, were growing faster than the upper-basin states. Because of the western water law doctrine of prior appropriation, it was feared that rights to the river's water would be established before the upper basin had a chance to develop its fair share.

The compact splits the Colorado River basin into two geopolitical regions—the upper and lower basins—with Lee's Ferry, Arizona, specified as the dividing mark. The 1922 compact stipulated that any amount allocated to Mexico by future treaty would come equally from the upper and lower basins. Finally, it was agreed the lower basin retained the right to use any water that the upper basin did not use.

Six years later, the US Congress passed the *Boulder Canyon Project Act* of 1928, which granted congressional approval of the 1922 compact. The act also authorized the construction of Boulder (later called Hoover) Dam for water supply, flood control and hydropower generation in the lower basin, as well as the All American Canal for delivery of water to California. In addition, the secretary of the interior, through the Bureau of Reclamation, was authorized to enter into contracts for the storage of

water in Lake Mead and the delivery of water for irrigation and urban use in the lower basin.

In the late 1940s, the upper-basin states signed the Upper Basin Compact of 1948, allocating Colorado River water among the states as percentage shares of the annual volume available and based the distribution on each state's contribution to the river's flow.[103]

The *Colorado River Storage Project Act* of 1956 authorized the construction of several dams, including Glen Canyon Dam, which, when completed in 1963, formed Lake Powell on the Arizona-Utah border. The reservoir is able to hold the equivalent of two years of the Colorado's annual average flow. This dam was supposed to be the engineering solution to a problem that became evident during the decades that followed the signing of the 1922 compact: the average flow of the river was considerably less than the compact negotiators had assumed.[104]

A 1963 US Supreme Court decision, *Arizona* v. *California*, settled 11 years of litigation stemming from Arizona's desire to build the Central Arizona Project so it could use its full Colorado River apportionment. The Supreme Court ruled that the *Boulder Canyon Project Act* of 1928 had determined that Arizona's apportionment (3,454 Mm^3) did not include tributary waters of the state. The court's 1964 decree also prohibited the secretary of the interior from delivering water outside the framework of entitlements defined by law. Moreover, the court granted five Native American tribes along the Colorado River reserved rights to river water dating back to the establishment of their reservations, with the total amount of these rights to be quantified according to each reservation's "practicably irrigable acreage.[105]" These Native American entitlements were to be drawn from the water apportionment of the state in which the tribe was located.

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103. Colorado (51.75 percent), Utah (23 percent), Wyoming (14 percent) and New Mexico (11.25 percent). Arizona (a northern portion of which is in the upper basin) received a fixed allocation of 61.7 Mm^3 (50,000 AF) per year.

104. Emerging hydrologic evidence suggested that if the upper basin were to consume its full 9,251 Mm^3 (7.5 MAF) annual allotment, it would fail to meet its obligation to provide at least 92,511 Mm^3 (75 MAF) to the lower basin during any consecutive 10 years. By building a large reservoir near Lee's Ferry, the upper basin could store water during wet periods and release it during dry periods, helping to meet its compact obligations while maximizing its own supply. In addition to regulating the flow into the lower basin, Glen Canyon Dam, like Hoover Dam downstream, became a major generator of hydroelectric power and a "cash register" (through power sales) for constructing other water supply projects.

105. H. Ingram, A.D. Tarlock and C.R. Oggins, "The Law and Politics of the Operation of Glen Canyon Dam", in Committee to Review the Glen Canyon Environmental Studies, Water Science and Technology Board, *Colorado River Ecology and Dam Management*, Washington, DC: National Academy Press, 1991.

The *Colorado River Basin Project Act* of 1968 authorized construction of the Central Arizona Project (CAP) and other water development projects in the upper basin. However, in order to mollify California's concerns about reliability of supply in dry years, Arizona agreed to subordinate CAP's entitlement to that of California's full basic apportionment of 5,427 Mm^3 (4.4 MAF). As a result, in times of shortage, deliveries to CAP are eliminated before California's entitlements are affected.

The *Grand Canyon Protection Act* of 1992 requires the secretary of interior to operate Glen Canyon Dam in such a way as to protect and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established. This marked the first time that protection of downstream river resources was identified as a primary purpose of a Colorado River dam. The act ensures that water releases from Glen Canyon Dam will stay within a range that protects the safety of Grand Canyon river rafters and boaters. This strategy helps maintain the sand beaches along the river that are used by these boaters and that constitute important habitat for aquatic and terrestrial species. The act thus raised the priority of recreational values and lowered the priority of hydropower values in the operation of the dam.

It is important to note that because of the way the Law of the River was created, amended and modified, each of the river's stakeholders now holds a different hand of cards. Because of negotiations that took place in the early-1920s and the mid-1930s, respectively, the urban areas of Nevada and California receive limited supplies from the Colorado River. These areas are currently seeking more water to meet their growing demands. Arizona, by contrast, has an abundance of Colorado River water rights, but more than half of them are extremely junior priority rights due to concessions made in the early 1960s. Because in times of drought Arizona's supply will be the first to be cut back, reliability of water supply remains a concern for Arizona.

In general, most farming communities of the lower basin are well endowed when it comes to water rights. Their rights are senior and their entitlements are more than sufficient to meet their needs. However, as water laws are now structured there is little incentive for them to conserve because of a system that permanently removes cancel rights for water that is not being put to beneficial use.

Though not formally part of the Law of the River, some federal statutes have a bearing on how the Colorado River is managed. The three most important are the *Clean Water Act*, the *Endangered Species Act* (ESA), and the *National Environmental Policy Act*, each of which may

impose habitat maintenance or environmental protection mandates on existing water rights allocations, dam operations and river management procedures.

When the waters of the Colorado River were divided over 70 years ago, no water was explicitly dedicated to maintain healthy aquatic ecosystems. One could argue that instream flows were accounted for by the 1922 compact signatories when they apportioned only 18,500 Mm^3 (15 MAF) of a river they believed to have an annual average flow of 22,200 Mm^3 (18 MAF). Unfortunately, that 3,700 Mm^3 (3 MAF) cushion instantly disappeared when scientists learned that annual average flows were closer to 18,500 Mm^3 per year (measured at Lee's Ferry) and possibly lower. Even though the river's flows were grossly overestimated, subsequent laws and decrees have been based on the original apportionments agreed to in the compact.

In the United States, federal legislation such as the *Endangered Species Act*, the *National Environmental Policy Act* and the *Grand Canyon Protection Act* have made environmental issues a factor in the river's management. No river management plan, however, comprehensively accounts for ecosystems. Laws such as ESA and NEPA restrict and influence river operations, but only in a fragmented way. As a result, piecemeal attempts have been made to rescue imperiled species, but only recently have agencies begun looking into comprehensive strategies for ecosystem recovery.

In essence, the environment does not have any explicit rights to the waters of the Colorado River. The water needed to meet local ecosystem requirements has thus far been fulfilled with unused entitlements. In this sense, the environment, which has not yet been fully integrated into Law of the River and given explicit water rights, is living off of "borrowed" water. Because all the legally apportioned water for human uses is eventually used by basin states, there is great uncertainty as to what will happen to the ecosystems. Unless a mechanism can be established that provides water for the environment, water will surely be taken from the most junior water rights holders in order to meet existing ESA and NEPA requirements. If so, several stakeholders on the lower basin stand to be adversely affected.

4.6.2.2 1944 Water Utilization Treaty

In 1944, to resolve Mexico's long-standing concerns that it have secure rights to transnational rivers along the border, the US and Mexican governments entered into the 1944 Water Utilization Treaty. Among

other things, the treaty committed 1,850 Mm^3 per year (1.5 MAF/yr, roughly equivalent to 10 percent of the average annual flow) of Colorado River water to Mexico. In times of surplus, Mexico would receive an additional 246.7 Mm^3 (200,000 AF) per year from the Colorado. In accordance with the 1922 compact, the upper and lower basins were each to supply half of the total amount obligated by treaty to Mexico.

The US-Mexico treaty of 1944 said nothing about the quality of water to be delivered to Mexico under the agreement. Salinity is the major water quality issue facing the river basin. As with many rivers of the western United States, the Colorado is naturally salty. Half of the average annual salt load of 8.2 million tonnes (9 million tons) carried past Hoover Dam is attributed to natural occurrences.[106] Human-caused increases in salinity concentration account for the remainder, and include saline irrigation return flows, reservoir evaporation, out-of-basin transfers, and municipal/industrial uses.

In the early 1900s, the salinity of the river's water increased from under 50 parts per million (ppm) at its source high in the Rocky Mountains to 400 ppm when it crossed the border into Mexico. Development and human uses have now more than doubled the salinity of water entering Mexico at the border. As water is repeatedly diverted, used and returned to the main stream on its journey from the Rocky Mountains to the Sea of Cortez, the quality of the water decreases. As a result, high salt loadings have been a long-standing problem for stakeholders in the lower Colorado and especially Mexico. As early as 1961, Mexico began to worry publicly that high salinity levels were affecting crop yields in the country's Mexicali Valley.

After 12 years of negotiations and various interim agreements, a solution was reached in 1973. Minute 242 of the 1944 Water Utilization Treaty was signed to resolve the dispute over the deterioration in the quality of water crossing the border. This minute stipulated that the water received by Mexico should have salinity levels of 115 (±30) ppm not higher than the water arriving at Imperial Dam just north of the border. In 1974, the US Congress passed the *Colorado River Basin Salinity Control Act* to help meet the Minute 242 obligations. Among the measures authorized by the act were construction of a desalting plant at Yuma, Arizona, as well as a 4,047-ha (10,000-acre) reduction in irrigable land in the Wellton-Mohawk Irrigation District.

106. Colorado River Basin Salinity Control Forum, *Water Quality Standards for Salinity: Colorado River System,* Final Report, October 1993.

Although Minute 242 resolved most of the problem, the issue of salinity has not yet been completely resolved. The current dispute centers on the fact that water quality standards are based on annual averages and do not take into account the significant fluctuations in salt concentrations that occur on a monthly basis. Extremely high salinity levels can have negative effects on crop yields, soil conditions and aquatic ecosystem health.

4.6.3 Santa Cruz and San Pedro Basins

The Santa Cruz and San Pedro Rivers are part of the Colorado River system whose basins overlap the US-Mexico border. Their streamflow is negligible, however, and for purposes of transboundary water management no agreement applies specifically to these rivers. The legal regimes most relevant to water allocation in these two basins include Arizona state law, US interstate compacts and Mexican federal law (described in chapter 1). Transboundary agreements applicable to water allocation have not been concluded for these two basins.

Arizona relies on the prior appropriation doctrine. Those who developed or diverted surface water in Arizona prior to 1919 have senior rights to that water so long as it is put to beneficial use. After 1919, water rights could be obtained by applying for a permit for offstream beneficial use. Arizona law provides that "the waters of all sources, flowing in streams, canyons, ravines or other natural channels, or in definite underground channels . . . belong to the public and are subject to appropriation and beneficial use." Beneficial uses under Arizona law include domestic, municipal, irrigation, stock watering, hydropower, recreation, wildlife (including fish), artificial groundwater recharge and mining.[107]

For many years it was not clear whether this language applied just to surface water or also included groundwater.[108] In 1953, the Arizona Supreme Court (*Bristor* v. *Cheatam*) decided that the prior appropriation doctrine did not apply to groundwater. Thus senior surface water rights could be negatively affected by more recent groundwater pumping, with no legal recourse for the holder of the surface water rights. This legal separation of surface and subsurface water rights has had significant implications in the Santa Cruz and San Pedro watersheds.[109]

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107. Arizona Department of Water Resources, *Arizona Water Resources Assessment*, Vol. 1, *Inventory and Analysis*, State of Arizona, 1994, 22.
108. J.D. Leshy and J. Belanger, "Arizona Law Where Ground and Surface Water Meet", (1988) 20 *Arizona State Law Journal* 657.
109. R.J. Glennon and T. Maddock III, "In Search of Subflow: Arizona's Futile Effort to Separate Groundwater from Surface Water", (1994) 36 *Arizona Law Review* 567.

In 1988, a court decision granted surface water right holders protection from surface flow depletion due to groundwater extraction. By acknowledging a link between surface and goundwater, the 1988 decision made groundwater users responsible for any significant surface water depletion they may cause. A later court ruling (1993), however, narrowed the responsibility of detrimental (or "negatively consequential") groundwater extraction to include only those extractors located in the riparian zone. The 1993 case linked surface water to "subflow"—a term defined as groundwater flowing adjacent to or directly below a surface water body. As the court itself acknowledged, this ruling ignores hydrological science, which has shown that groundwater pumping some distance away from a river can interrupt or redirect flow that would eventually reach the river.

Other legal issues in Arizona water management are associated with the use of the Colorado River and litigation over various compacts and congressional acts. In order to use its share of Colorado River water, Arizona persuaded Congress to approve funding for the Central Arizona Project under the 1968 *Colorado River Basin Project Act*. CAP involved the construction of a canal to bring water to southern Arizona and was completed as far as Tucson in 1991. The water was originally targeted for municipal and industrial use and to replace groundwater in existing irrigation districts. CAP water is not supposed to be used for new irrigation development, except on Native American lands.[110]

In addition to the legal restrictions, barriers to the actual use of CAP water include cost and quality. In Tucson, the public perception of poor water quality led to the passage of Proposition 200 in 1995. This proposition forces CAP water to be used only for aquifer recharge or other nonpotable uses. The costs of the project are to be repaid through charges levied by the Central Arizona Water Conservation District, which covers Pima, Pinal and Maricopa Counties. As discussed earlier, in years when there is less than 9,250 Mm^3 (7.5 MAF) of water in the lower Colorado, the CAP rights are junior to the pre-1968 rights of Mexico, California and Arizona. Thus CAP water allocations are vulnerable to low flows on the Colorado and to the overallocation of water under the Colorado River Compact.

In 1988, Congress passed the *San Pedro Riparian National Conservation Act*, establishing the San Pedro Riparian National Conservation Area (SPRNCA). SPRNCA consists of 22,663 ha (56,000 acres) of public

110. R.J. Glennon, "Coattails of the Past: Using and Financing the Central Arizona Project", (1995) 27 *Arizona State Law Journal* 677.

lands managed by the federal Bureau of the Land Management to protect the riparian area and associated aquatic, wildlife, archeological, paleontological, scientific, cultural, educational and recreational resources. The act explicitly reserved federal water rights for SPRNCA, putting it in possible contention with all other water rights claimants in the basin, including Native Americans, the US Department of Defense and the burgeoning municipality of Sierra Vista.

Native American water rights are another major issue in southern Arizona. A 1935 court case involving the Gila River (into which the Santa Cruz and San Pedro Rivers flow) recognized that Native American lands might hold prior appropriation rights. The US Supreme Court decision *Arizona* v. *Colorado* held that the reserved rights of five Native American reservations should be calculated on the basis of an amount of water necessary to irrigate "all practicably irrigable acreage" on each reservation. In 1974, the Salt River Valley Waters Users Association requested the adjudication of water rights on the Gila, and in 1981 this adjudication was consolidated into a general adjudication of water rights for the entire Gila basin. Among other issues being adjudicated are over-appropriation of surface water in the Gila River, groundwater overdraft and growing municipal water use.

This adjudication process continues, involving some 60,000 claimants and 12 Native American reservations. If the Native American water rights are found to have seniority (dating from the date of the treaty, executive order or act of Congress that established the reservation), water allocations in southern Arizona could shift dramatically. Some have suggested that CAP water could fill some of the demand. The first region of the Gila for full adjudication will be the San Pedro.

As problems emerged with groundwater overdraft, and because subsurface water was not subject to prior appropriation, it became clear that Arizona needed to manage the groundwater upon which much of the state depends. The *Arizona Groundwater Management Act*, often cited as a relatively forward-looking groundwater management scheme among western US states, was enacted in 1980. The Arizona Department of Water Resources (ADWR), which also was created by the 1980 legislation, is charged with managing and developing the state's water resources.

The Groundwater Code, as implemented under the 1980 act, sets out to control the severe overdraft and allocate limited resources effectively. It includes general provisions on well registration and has led to the establishment of four "active management areas" (AMAs) in which

groundwater was being seriously depleted. Three of these AMAs—the Pinal, Tucson and Santa Cruz-—lie in the Santa Cruz watershed. The ADWR was directed to prepare a series of decade management plans for each AMA, with progressively stricter regulations and conservation objectives. One major goal of these AMAs is "safe yield" of the aquifers by 2025 (balancing annual groundwater extraction against natural and artificial aquifer recharge). For new subdivisions, the AMAs are required to produce an "assured water supply" for 100 years.

There is no AMA for the San Pedro River basin. Groundwater is regulated through a mix of pre-1980 statutes and common law.[111] In the San Pedro basin, groundwater users can pump an unlimited amount of groundwater for "reasonable and beneficial" use. If one user's pumping affects the well of another user, the offending user may be required to cease and pay damages through private tort actions. ADWR does require that the construction, deepening and abandonment of wells be reported to the agency, but it does not regulate the quantity or quality of the water coming from the wells in the San Pedro basin. State law also requires that a subdivision developer demonstrate to ADWR that it has an adequate water supply.

4.6.4 Río Grande Basin

The legal framework governing the management of surface water in the Texas/Mexico portion of the Río Grande basin is quite complex. This complexity derives from several factors, including: the transboundary and interstate nature of many of the basin's water resources, the legacy of different regimes that have governed the region, and the role of various sectors with substantial political influence and often competing interests.

Groundwater, by contrast, lacks a substantial legal management framework, especially in Texas where landowners are free to pump as much groundwater from under their land as they can use under the long-standing "rule of capture." Moreover, there is no agreement between the United States and Mexico for management of transboundary groundwater resources.

The two US-Mexico treaties governing water resource management in the Texas/Mexico portion of the Río Grande are the 1906 Río Grande Convention and the 1944 Water Utilization Treaty. Both treaties

111. Arizona Department of Water Resources, *Hydrographic Survey Report for the San Pedro River Watershed,* Vol. 1, *General Assessment,* State of Arizona, 1991.

apply to management of surface water only and generally do not address surface water/groundwater connections.

The 1906 convention applies to distribution of Río Grande waters above Fort Quitman, Texas. Its major features are guaranteed deliveries of a total of 74 Mm^3 (60,000 AF) per year at a point above Juárez according to a monthly schedule, and waiver by Mexico of any claims to the waters of the Río Grande between the point of delivery and Fort Quitman.

As described later in this section, the water allotted to the United States is divided among Colorado, Texas and New Mexico pursuant to the 1938 Río Grande Compact.

The 1944 treaty is more comprehensive, applying to other transboundary waters in addition to the Río Grande and also governing matters such as the maintenance of the boundary between the two countries. The pertinent legal features of the 1944 treaty regarding allocation of the waters of the Río Grande watershed from Fort Quitman to the Gulf of Mexico are described in the following table.

1944 Treaty Allocations for the Río Grande

Mexico	United States
All waters reaching the main channel of the Río Grande from the Río San Juan and the Río Alamo, including the return flow from the lands irrigated from these two rivers.	All waters reaching the main channel of the Río Grande from the Pecos and Devils Rivers, Goodenough Springs and the Alamito, Terlingua, San Felipe and Pinto Creeks.
Two-thirds of the flow reaching the main channel of the Río Grande from the Ríos Conchos, San Diego, San Rodrigo, Escondido and Salado, and the Las Vacas Arroyo, subject to the US right to an average of at least 432 Mm^3 (350,000 AF) per year in cycles of five consecutive years.	One-third of the flow reaching the main channel of the Río Grande from the Ríos Conchos, San Diego, San Rodrigo, Escondido, and Salado, and the Las Vacas Arroyo, provided that this third shall not be less, as an average amount in cycles of five consecutive years, than 432 Mm^3 (350,000 AF) per year. The United States does not acquire rights in the Mexican tributaries in excess of 432 Mm^3 per year except the right to use one-third of the flow reaching the Río Grande from these tributaries, although the one-third may be in excess of 432 Mm^3 per year.

One-half all other flows of the main channel of the Río Grande not otherwise allotted, including contributions from all unmeasured tributaries between Fort Quitman and the lowest major international storage dam (Falcon).	One-half of all the flows of the main channel of the Río Grande not otherwise allotted by the treaty, including contributions from all unmeasured tributaries between Fort Quitman and the lowest major international storage dam (Falcon).
One-half the flow in the main channel of the Río Grande below the lowest major international storage dam (Falcon), unless it is specifically allocated under the treaty to either of the two countries.	One half of the flow in the main channel of the Río Grande below the lowest international storage dam (Falcon) unless it is specifically allocated under the treaty to either of the countries.

The 1944 treaty contains few provisions for water management and allocation during times of drought. The treaty, which includes, but does not define the term *extraordinary drought*, provides that if there is abundant water in one country while the other one is experiencing an "extraordinary drought," "water stored in the international storage reservoirs and belonging to the country enjoying such abundant water supply may be withdrawn, with the consent of the International Boundary and Water Commission (IBWC) for use of the country undergoing the drought." It also provides that if an "extraordinary drought" prevents Mexico from being able to deliver the 432 Mm^3 per year average from its tributaries, "any deficiencies existing at the end of the aforesaid five-year cycle shall be made up in the following five-year cycle with water from the measured tributaries in which the US has the right to a 1/3 share."

In 1995, during a prolonged drought that was threatening Mexico's water supply, IBWC concluded Minute 293, which provided for an emergency water loan from the United States. Although Minute 293 was never brought into force, it established a coordinated drought planning process for Texas and Mexico that could be used in the future.

IBWC is responsible for implementing the 1906 convention and the 1944 treaty. It also operates the Amistad and Falcon International Reservoirs on the main channel of the Río Grande. The US share of the water from the Río Grande basin is managed by the Texas Natural Resource Conservation Commission (TNRCC) through the Río Grande Watermaster program.

Two US interstate compacts also are relevant to the Río Grande basin. The Río Grande Compact of 1938 provides for distribution of the US share of the waters of the Río Grande among Colorado, New Mexico

and Texas, above Fort Quitman, Texas. The compact includes schedules for carrying out Colorado's obligation to deliver water at the Colorado-New Mexico state line and the obligation of New Mexico to deliver water to Elephant Butte Reservoir, from where it is transferred to downstream users in New Mexico and Texas. The provisions of the compact allow for certain accrued credits and debits between states, but these provisions have produced a long-standing controversy and lengthy litigation.[112]

Like the 1944 Treaty, the Río Grande Compact deals only with surface water allocation. It thus is ill-suited to deal with groundwater/surface water interactions in the Texas/New Mexico border region.

The 1948 Pecos River Compact between Texas and New Mexico governs the allocation of the Pecos River basin above its confluence with the Río Grande. The compact provides that New Mexico must deliver to Texas, subject to streamflow and other conditions, the same amount of flow that Texas received from the Pecos in 1947. It provides for a cooperative program designed to salvage water from consumption by phreatophytes (water-consuming vegetation) and to alleviate high salinity in certain areas of the basin.

Management and allocation of the US share of Río Grande waters in Texas are governed largely by Texas state law.[113] Texas law also governs use of groundwater resources. Federal law is relevant to at least two aspects of surface water management in the basin, however: federal conservation requirements govern irrigators using water from the Río Grande Project (Elephant Butte/Caballo system), and instream flow rights apply to the federally designated Wild and Scenic River section of the Río Grande below Big Bend National Park.

With few exceptions, surface water in Texas is the property of the state. Water rights, which are granted and administered by the Texas Natural Resource Conservation Commission, specify the amount of water that can be used, where it can be used, and for what purpose. In general, Texas uses a system of prior appropriation, but through a process of water rights adjudication[114] it also recognizes riparian and other rights.

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112. For a brief description on this litigation, see F. Skillern, *Texas Water Law,* Vol. 2, San Antonio: Sterling Press, 1991, 285-86.
113. It is beyond the scope of this report to provide a detailed description of Texas surface water law. For a comprehensive discussion see *ibid*., Vol. 1 and 2.
114. *Texas Water Code*, Sections 11.301-11.341. In this process, all water rights claimants are required to file their claims with the state water rights agency (TNRCC). The

In Texas, a water right is a real property right and therefore cannot be removed by the state without compensation to the water rights holder.[115] Because they are property rights, water rights can be sold, leased or transferred. For such sales and transfers, the conditions included in the permit (point, amount and purpose of use) still apply unless a change in these conditions is sought from and granted by TNRCC.

A large share of irrigation water rights in the Texas portion of the Río Grande are held and managed by special districts. These government entities include irrigation districts and water improvement districts. Over 30 such districts can be found in the lower Río Grande. Some also supply water to municipal and industrial users.

Texas state law provides that surface water rights are subject to a "beneficial use" requirement. Beneficial use is broadly defined and the courts have never ruled any use to be nonbeneficial.[116] There is some controversy in Texas over whether a water right can be held solely to preserve instream flow, with some arguing that such a purpose is not a "beneficial use." Others argue that instream flow is a beneficial use, because it preserves important aquatic and/or riparian habitats.

In the 1985, the Texas Water Code was amended to take into account conservation and environmental needs. Before the 1985 amendments, the term *conservation* in Texas water law generally referred only to the development of water resources. Now, however, the concept includes notions of efficiency of use, as well as preservation of water quality. Applicants for new or amended water rights permits are now required to submit water conservation plans as part of their application to TNRCC. These plans are to "demonstrate that reasonable diligence will be used to avoid waste and achieve water conservation."

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agency evaluates the claims and then holds an administrative hearing to determine which are valid and which are not. The amount and place of use are also adjudicated. The final results are filed with the courts for approval, and parties can appeal agency decisions through this judicial validation process.

115. *Texas Water Code*, Section 11.033. There is substantial confusion about whether the 1931 Texas statute known as the *Wagstaff Act* might allow municipalities to acquire agricultural or other rights without compensation, but this act does not apply to the Río Grande. See "Texas Municipalities' Thirst for Water: Acquisition Methods for Water Planning", (1993) 45 *Baylor Law Review* 685.

116. *Texas Water Code*, Section 11.002(14). Beneficial use is defined as "the amount of water which is economically necessary for a purpose authorized by this chapter, when reasonable intelligence and reasonable diligence are used in applying the water to that purpose."

These conservation rules allow TNRCC to require irrigators who transfer part of their water rights to municipal users to submit water conservation plans for the rest of their irrigation water. This is expected to be particularly important in the lower Río Grande, where conservation practices have not yet been widely adopted by irrigators.

In 1997, the Texas legislature passed a major water resources management bill. This act, which was motivated largely by the problems caused by a recent drought, strengthens conservation and drought planning requirements, and provides for the development of regional water management plans. For purposes of conservation, those holding municipal, industrial or other surface water rights in excess of 1.23 Mm^3 (1,000 AF) per year, and those holding irrigation rights in excess of 12.3 Mm^3 (10,000 AF) per year are required to develop and implement water conservation plans. Wholesale and retail public water suppliers and irrigation districts also are required to prepare drought contingency plans. Finally, the 1997 legislation makes cancellation of unused water rights somewhat easier, establishes more specific guidelines for water reuse projects and expands provisions for surface water rights marketing.

For groundwater, Texas relies on the English common law doctrine of absolute ownership. Under this doctrine, the surface estate owner has ownership rights to all the groundwater he can pump for use at any location; he bears no responsibility to neighboring landowners. Texas is the only state that still adheres to this approach.[117]

The Texas Water Code does provide, however, that the state may act (through TNRCC) to "make and enforce rules and regulations for conserving, protecting and preserving, and distributing underground, subterranean, and percolating water" and to "do all things necessary for these purposes." Despite this broad language, TNRCC and its predecessor agencies have done little to restrict pumping from overexploited aquifers.

Groundwater management has been confined to those areas where groundwater management districts have been formed by the legislature, through local petition or through TNRCC initiation of a "critical area" designation.[118] These districts are authorized to regulate pumping from

117. *Houston & T.C. Railway* v. *East*, 81 SW 279 (Tex. 1904). For an overview of the problems caused by this doctrine, see D. Todd, "Common Resources, Private Rights and Liabilities: A Case Study on Texas Groundwater Law", (1992) 32 *Natural Resources Journal* 233.

118. In the latter process, TNRCC and the Texas Water Development Board carry out a study, with the involvement of local interests, to determine whether the ground-

wells to protect aquifer levels, but most created to date have not exercised this authority. In spite of the recognition that some areas are facing critical problems, there are no groundwater conservation districts in the Texas portion of the Río Grande basin.

water problems in an area are critical. If they are, TNRCC may propose creation of an underground water conservation district to manage the groundwater resource, but local landowners can still vote on whether to create the district. If the proposed district is voted down, the state can withhold funds for water development or wastewater treatment projects.

CHAPTER 5

The United States and Canada: The Binational Water Management Framework

Several binational agreements between the United States and Canada govern boundary and transboundary surface water management (see table below). Among the most important of these are the 1909 Boundary Waters Treaty, the Columbia River Treaty (1961), and the Great Lakes Water Quality Agreement (1978). These agreements and the institutions that have been established to administer them are described in the following sections.

US-Canada Boundary Water Arrangements

Treaties

- Boundary Waters Treaty, 1909
- Niagara River Treaty, 1950
- Columbia River Treaty and Protocol, 1961 and 1964
- Skagit River Treaty, 1984

Conventions

- Lake of the Woods Convention and Protocol, 1925
- Rainy Lake Convention, 1938
- Convention on Great Lakes Fisheries, 1955 (Great Lakes Fisheries Commission)

Agreements

- St. Lawrence Seaway Agreement, 1959
- Great Lakes Water Quality Agreements, 1972 and 1978
- Water Supply and Flood Control in the Souris River Basin, 1989

Although this chapter focuses primarily on the International Joint Commission and its related mechanisms, several bilateral government-to-government mechanisms and province-state arrangements also have a long history of dealing with boundary and transboundary water-related issues. According to Environment Canada, bilateral and

province-state mechanisms appear to be taking on greater importance. Examples of such mechanisms include the Garrison Consultative Group and its Joint Technical Committee and the bilateral monitoring committees for the Poplar River, Souris River, Great Lakes Commission and St. Croix Waterway.

5.1 The Boundary Waters Treaty and the International Joint Commission

By the beginning of the 20th century, concerns had begun to emerge about the waters flowing along the US-Canada border. These included controlling water levels at Lake of the Woods, power developments on the St. Marys and Niagara Rivers, and conflicting plans for diverting irrigation water from the St. Mary and Milk Rivers of Alberta and Montana.[119] Discussions in Washington and in London, which made all foreign affairs decisions on behalf of Canada at the time, were not able to resolve these issues. In response, the countries began to develop a new institutional mechanism to deal with binational water issues.

The International Waterways Commission was established in 1905 to provide advice on the Great Lakes-St. Lawrence system. Commissioners from both countries recommended general principles to be followed in resolving binational disputes. The resulting Boundary Waters Treaty, signed by Great Britain and the United States in 1909, was a far-reaching document that, among other things, created the International Joint Commission (IJC).

The 1909 treaty provided the principals and mechanisms to help resolve disputes over boundary and transboundary waters and prevent future ones. It dealt with a variety of issues involving boundary and transboundary surface waters, providing for joint studies and establishing requirements for the approval of certain uses, obstructions and diversions in waters that affected levels or flows in the other country. The treaty also contained a provision against any pollution that would result in "injury of health or property" on the other side of the boundary.

In establishing "rules of principles" to govern decisions on uses, obstructions and diversions, the 1909 treaty:

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119. J.L. Huffman, "A Brief History of North American Water Diplomacy", in *Continental Water Marketing*, Terry L. Anderson, ed., San Francisco: Pacific Institute for Public Policy, 1994, 12-13.

- instituted a hierarchy of uses, giving primacy to domestic and sanitary needs, followed by navigation and then irrigation and power production;
- protected the freedom of navigation for the purpose of commerce of all navigable boundary waters, Lake Michigan and all canals connecting boundary waters;
- directed that each country shall have equal and similar rights in the use of waters that flow along the boundary; and
- allowed the upstream country the exclusive jurisdiction and control over the use and diversion of all waters, on its own side of the boundary, which in their natural channels would flow across the boundary or into boundary waters. However, in the case of any interference with or diversion from the natural channels of such waters, and if such interference or diversion resulted in injury on the other side of the boundary, it gave the injured parties the same rights and legal remedies due them as if such injury had taken place in the country where such diversion or interference occurred.

The IJC's six commissioners, three from each country, are obligated to pursue the joint or common interest of both nations rather than adopt a nationalist perspective on each question. The IJC attempts to seek consensus in making decisions in an effort to forge common solutions.

The IJC has two basic functions. First, it approves remedial or protective works, dams or other obstructions that raise the natural level of waters in the upstream country, except in cases in which the parties have a special agreement. The commission also sets terms and conditions for the operation of projects as well as any obligations for compensation. Second, The IJC investigates and makes recommendations on questions or disputes referred to it by either or both governments. In practice, this has meant that the commission investigates matters that are agreed to by both governments.

In addition, the commission was given an arbitral function which to date it has not been asked to exercise. Although not a direct responsibility, the IJC also alerts the public about transboundary water and air issues, and monitors water quality and quantity under certain specific references and agreements, most notably the Great Lakes Water Quality Agreement.

Since it began its work in 1912, the IJC has built an enviable reputation as an institutional mechanism for cooperative problem solving on a wide range of water- and boundary-related issues. The commission has seen its role enhanced or further defined through several additional treaties, agreements and protocols, including the Lake of the Woods Treaty of 1925, the Niagara River Treaty (1950), the Columbia River Treaty of 1961 (see section 5.2), and the Great Lakes Water Quality Agreements of 1972 and 1978 and their supplementary protocols. Moreover, numerous decisions on applications related to the use of boundary waters have been handled by the commission, which has 116 dockets for references and orders.

Most observers agree that the IJC's reputation as an effective instrument of binational water management stems from: (1) the principle of legal equality in the representation of the two countries on the commission and its practice of arriving at decisions by consensus or near consensus reflecting binational rather than strictly national concerns; (2) a high level of practical autonomy from government interference that enhances its authority and investigative independence; and (3) its comprehensive operational procedures for conducting investigations in response to government references, or in the issuance, implementation and amendment of orders. Since the outset, the IJC has sought to achieve a high level of consensus and to avoid national partisanship. Indeed, its decisions have rarely split along national lines, contributing to its image as an objective and impartial arbiter.

The IJC's operational procedures deserve special mention. Possessing a small secretariat and professional staff, the commission is authorized to "call upon the best qualified technical experts and officials" from various levels of government and the private sector in both countries. This expertise is accessed by the commission through several investigative boards, some temporary and some permanent, normally made up of equal numbers of Canadian and US representatives and chaired by representatives of both countries (see table). The procedural practices of the commission and its boards have contributed to the IJC's reputation for fairness and effectiveness in decision making.[120] Among other things, they conduct local hearings and encourage public participation to help clarify issues and resolve problems.

Over the years the IJC has had a significant impact on binational water management practices in three functional areas: (1) oversight of water apportionment, (2) management of water levels, and (3) oversight of quality of transboundary waters. The IJC also assists the United States

and Canada in carrying out certain binational projects on the protection of transboundary air quality. Although this is an important IJC role, it is smaller than the IJC's many diverse responsibilities in the area of boundary waters. The commission's role in each of the three functional areas of binational water management practices is reviewed briefly in the sections that follow.

5.1.1 Water Apportionment Oversight

Important in the commission's early years, overseeing apportionment of boundary and transboundary water resources is now only one of several elements of the IJC's agenda. The commission's most specific water apportionment functions derive from Article VI of the 1909 treaty, which specifies the division of the waters of the St. Mary and Milk Rivers. After conflicting interpretations of Article VI emerged in the early 1920s, the two governments agreed to establish the St. Mary and Milk Rivers Board at the suggestion of the IJC. The board, comprising an engineer from each country, operates under IJC oversight, advising national water management authorities on the placement of gauging stations and assigning seasonal water deliveries. The IJC's instrumental role in resolving this binational water dispute helped to galvanize public and government confidence in the commission at an early date.

Almost all of the orders issued by the IJC are related to apportionment arrangements. For example, the IJC currently oversees the apportionment stipulated in an agreement among Saskatchewan, Manitoba and North Dakota (Agreement for Water Supply and Flood Control in the Souris River). The commission also has issued orders about the apportionment of water in the St. Marys River at Sault Sainte Marie, Michigan, and assisted governments in apportioning the Poplar River.

120. W.R. Willoughby, *The Joint Organizations of Canada and the United States,* Toronto: University of Toronto Press, 1979, 56-57.

US-Canada Boundary Water Institutions (Water Boards)

The following boards report to the International Joint Commission:

Water Quantity Boards

- Accredited Officers for the St. Mary and Milk Rivers, 1914
- International Lake Superior Board of Control, 1914
- International St. Croix River Board of Control, 1915
- International Lake of the Woods Board of Control, 1925
- International Lake Champlain Board of Control, 1937 [inactive]
- International Kootenai Lake Board of Control, 1938
- International Columbia River Board of Control, 1941
- International Rainy Lake Board of Control, 1941
- International Osoyoos Lake Board of Control, 1946
- International Niagara Board of Control, 1950
- International St. Lawrence River Board of Control, 1952
- International Souris River Board of Control, 1959

Pollution Boards

- International Advisory Board on Pollution Control–St. Croix River, 1962
- International Rainy River Water Pollution Board, 1966
- International Red River Pollution Board, 1969
- Great Lakes Water Quality Board, 1972

Advisory Boards

- Great Lakes Science Advisory Board, 1978
- International Air Quality Advisory Board, 1978

Investigative Boards

- International Souris-Red River Engineering Board, 1948
- International Technical Information (Network) Board, 1979 [inactive]
- Flathead River International Study Board, 1985 [inactive]
- Red River Flood Study Board (to be established under 1997 IJC reference)

The following bilateral boards report to the Canadian and US governments:

Control Boards

- International Lake Memphremagog Levels Board, 1920

Pollution Boards

- Canada-United States Committee on Quality in the St. John River, 1972
- Poplar River Bilateral Monitoring Committee, 1980
- Souris Basin Bilateral Water Quality Monitoring Group, 1991

Treaty Boards

- International Niagara Committee, 1955
- Columbia River Permanent Engineering Board, 1964

Study Boards

- Canada-United States Garrison Consultative and Technical Committee, 1981
- Niagara River Toxics Committee, 1981

5.1.2 Water Levels

Since its inception, the IJC has played a central role in advising on management of competing water uses, because they affect water levels in boundary waters. Under Article III of the 1909 treaty, the commission must authorize any "uses or obstructions or diversions . . . affecting the natural level or flow of boundary waters." Article VIII gives water uses for domestic and sanitary purposes priority over uses for navigation. Uses for power and irrigation receive lowest priority.

Operating in its quasi-judicial capacity under Articles III, IV and VIII of the 1909 treaty,[121] the IJC has over the years addressed a range of issues involving water levels and flows. In the Great Lakes-St. Lawrence River basin alone, these include:

- Detroit River and St. Marys River flow questions (1912 and 1913, respectively);
- St. Clair River flows (1916);
- Great Lakes-St. Lawrence hydroelectric power questions (1918) and navigation (1920);
- Niagara River navigation (1925);
- Niagara Falls preservation of natural beauty (1950);
- Lake Ontario levels and St. Lawrence power (1952);
- Niagara Falls remedial work (1961) and shoal removal (1963);
- Lake Erie and Niagara River ice booms (1964);
- general Great Lakes levels (1964);
- American Falls on the Niagara River (1967);
- Raisin River power diversions from the St. Lawrence (1968); and
- Lake Erie regulation, Great Lakes diversions and consumptive uses studies, and Great Lakes Advisory Board activities (1977).

Many issues involving water levels have arisen in the Great Lakes, where a wide range of competing uses are present. Shipping is a major concern; 150 billion tonne-kilometers of freight pass through the Great

121. Article IX allows the IJC to act in an investigative and advisory capacity when responding to references, but this article is not usually interpreted as conferring a quasi-judicial power on the IJC.

Lakes system annually. The Great Lakes also provide significant hydroelectric power resources for both countries, and the shoreline property is dotted with ports and marinas, industrial facilities, residential dwellings and recreational areas, all of which are affected by changing water levels. Finally, the fish and other wildlife that depend on streams and wetlands within the Great Lakes system also are affected by water levels.

Natural fluctuations in water level occur on a seasonal basis, but the two countries are limited in their capacity to influence lake levels through existing works and diversions. Numerous diversions and other works have been constructed for irrigation, flood control, hydropower and navigation improvements. The growing urbanization of the lakeshore is an important trend contributing to the increasing demands on Great Lakes water to satisfy domestic requirements within the basin. Withdrawals for domestic uses, permissible under the 1909 treaty, may collectively affect lake levels over the long term.[122] Other larger diversions have been proposed to export water from the Great Lakes basin. Such threats prompted the US Great Lakes states, together with Ontario and Quebec, to initiate in 1985 a process of protecting lake levels through the Great Lakes Charter.

The IJC has established various permanent boards to oversee implementation of the requirements of its orders of approval. Among other things, these boards monitor and make recommendations for managing lake levels. In general, these IJC boards have recommended against additional diversions that would modify lake levels. The International Great Lakes Diversions and Consumptive Uses Study Board, established by reference in 1977, concluded in its 1981 report that:

a. No further consideration be given to the concept of managing Great Lakes levels and outflows through the manipulation of the existing diversions; and,

b. The IJC...recommends to Governments that a mechanism be established for institutional consultation so that monitoring can be undertaken and appropriate public policies can be formulated to address the potential future impacts of new or increased diversions and consumptive uses.

In 1986, a high-water crisis prompted the governments to ask the IJC to examine the effects of fluctuating water levels. The final report,

122. A.E. Utton, "Canadian International Waters", in *Waters and Water Rights,* Vol. 5, Robert E. Beck, ed., Charlottesville, VA: Michie,1991, 66-67.

issued in 1993, recommended that governments continue to use, and promote the use of, the ecosystem approach in managing water levels and flows in the Great Lakes-St. Lawrence River basin; encouraged continued public involvement; and recommended continued shoreline monitoring, including a wetlands inventory.

Although proposed new diversions have not been authorized, the development of a more formal consultative mechanism has been slow in coming. Some critics, concerned about the lack of consensus on the long-term management of water levels, point to the increasing consumptive uses of Great Lakes water and potential systemic influences like climate change to argue for the development of a better institutional mechanism for dealing with diversions and levels questions into the 21st century.[123]

The IJC has been very active in regulating water levels in several areas along the US-Canada border outside of the Great Lakes system. The commission has issued orders and reports under reference that address water level and flow issues in the St. Croix River, upper Rainy River (Sucker Lake), Shoal Lake, the Souris River, the Poplar River, the Okanogan River and Osoyoos Lake, Kootenai Lake and the Kootenai River, the Pend Oreille River and the Columbia River.

In order to administer flows and levels along these various boundary waters, the IJC has established a system of permanent boards (see table) that oversee implementation of commission orders. However, the IJC retained jurisdiction over these orders so that it could review and, if necessary, amend them.

One fairly recent and notable example can be found in the Rainy Lake watershed on the Ontario-Minnesota border. Here, the commission operates under authority of the 1938 Rainy Lake Convention, which provides for the regulation of water levels to prevent unnecessary flooding of contiguous land surface areas. The IJC, through its International Rainy Lake Board of Control, recently reviewed its order for emergency regulation of boundary waters in the Rainy Lake watershed in response to various concerns raised over the years about navigation, aquatic vegetation, fish and wildlife, tourism and shoreline property.[124]

123. R.D. Kreutzwiser, "Water Resources Management: Canadian Perspectives and the Great Lakes Water Levels Issue", in *Resource and Environmental Management in Canada,* Toronto: Oxford University Press, 1995, 259-285.
124. J. Chandler and R. Koop, "International Joint Commission to Review Water Levels Regulation in Rainy Lake Watershed", (1995) *Focus* 21-22.

5.1.3 Water Quality

During the last two decades, the commission's most important area of functional expansion has been water quality. The basis for the IJC's water quality functions is found in Article IV of the 1909 Treaty which provides that "the waters defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other." Although Article IV does not mention the IJC directly, the commission has been given several references, pursuant to Article IX of the treaty, which have required it to advise the governments on the application of the obligation in Article IV. Pursuant to Article VIII, the commission, when issuing orders of approval, must consider interests that may be injured, which are now recognized to include environmental interests.

With the exception of a 1912 reference to study pollution in boundary waters, the IJC's forays into water quality management were relatively minor until the early 1960s. Since then, the commission has surveyed pollution trends pursuant to references provided under Article VIII of the 1909 treaty in various boundary waters, including the St. Croix and St. John Rivers, the Rainy Lake system and the Red River.

However, most of the attention to water quality issues has centered on the Great Lakes and its tributaries. In 1964, the two countries, motivated by deteriorating conditions in the lower Great Lakes, referred the question to the IJC. The commission's report led directly to the Great Lakes Water Quality Agreement (GLWQA) of 1972. The primary goal of the 1972 accord was to control the process of eutrophication in the lower Great Lakes by concentrating on the management of phosphorous. It set water quality objectives and regulations for the control of toxic substances discharged to lake waters. The agreement specified action in four areas: (1) regulations to control mercury and heavy metals; (2) regulations aimed at eliminating toxic organic contamination; (3) pesticide regulations; and (4) regulations aimed at controlling oil pollution and other toxic substances.

The 1972 GLWQA amplified the IJC's functional responsibilities in several ways. Under the agreement, the commission was made responsible for surveillance of water quality, monitoring compliance with US-Canada agreements, recommending improvements to the governments, coordinating joint activities, reporting on water quality problems, submitting annual progress reports, and independently verifying data submitted by the governments. The agreement also established two permanent boards to assist the IJC in implementing the agreement: the

Great Lakes Water Quality Board and the Research Advisory Board. Additional references related to the 1972 agreement established the Upper Great Lakes Reference Group and the Pollution from Land-Use Activities Reference Group. A Great Lakes Regional Office was authorized and established in 1973 at Windsor, Ontario, to provide permanent administrative and technical support to the boards and groups implementing the IJC's references.

In 1978, the two countries developed the second Great Lakes Water Quality Agreement, in part with the help of the IJC. The 1978 agreement widened the regime's focus on boundary waters to embrace a precedent-setting "ecosystem approach" to water quality management within the basin. In this context, an ecosystem approach is understood to mean "adopting a basin wide, long term perspective which includes taking account of the impacts of all man's activities on the natural and socio-economic systems of the Great Lakes basin.[125]"

The 1978 GLWQA further enhanced the IJC's jurisdiction and functions, focusing more explicitly on the discharge of persistent toxic substances and aiming at zero discharge. The IJC's 1972 data collation, analysis and dissemination mandate was expanded from boundary and tributary waters to include "tributary waters and other sources" related to assistance and advice on "research in the Great Lake basin ecosystem." The Water Quality Board was upgraded to principal adviser to the IJC with the support of the Science Advisory Board. The role of the Great Lakes Regional Office was defined as serving as "a secretariat to the boards" and carrying out "the commission's public information programs for the Great Lakes.[126]"

An additional protocol in 1987 broadened the scope of the agreements to address three additional concerns: the airborne deposition of toxic pollutants in lakes, groundwater, and contaminated sediments.[127] The 1987 protocol also incorporated the IJC's proposed approaches to ameliorating critical water quality problems through the Remedial Action Plan (RAP) and Lakewide Management Plan (LAMP) processes, and gave the commission the authority to oversee and review such projects. However, the implementation and operational responsibilities for these projects were left to the governments.

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125. International Joint Commission, *Pollution in the Great Lakes Basin from Land Use Activities: An IJC Report to the Governments of the United States and Canada*, Windsor, ON, March 1980.
126. D.G. LeMarquand, "Preconditions to Cooperation in Canada-United States Boundary Waters", (1986) 26 *Natural Resources Journal* 237.
127. R.A. Liroff, "The Great Lakes Basin: A Great Resource at Risk", (1989) 5 *Conservation Foundation Newsletter* 1-12.

Under IJC guidance, researchers and policy makers have addressed water quality issues in the Great Lakes ecosystem principally by identifying "areas of concern," establishing LAMPs, and developing local RAPs to address the problems identified. Some 43 areas of concern have been identified, virtually all in urbanized areas. To date, Collingwood Harbour, located on the southeastern end of Georgian Bay (Lake Huron), is the only de-listed area of concern.

The RAP and LAMP processes were built into the 1987 GLWQA, which provided for the preparation of Remedial Action Plans through procedures appropriate to each country. LAMPs have been developed for each of the Great Lakes, except for Lake Michigan. These plans are designed to reduce loadings of critical pollutants in order to restore beneficial uses. The RAP procedures involve public meetings of interested parties within each area of concern and a rigorous IJC review at each of three stages: (1) problem definition and specification of long-term objectives; (2) identification of measures required for implementation; and (3) achievement of specified objectives. Throughout the process of developing the different RAPs and LAMPs, the IJC has emphasized the "ecosystem approach," including health issues. In the late 1990s, most of the RAPs were still working on stages 1 and 2.

In keeping with the objective of the GLWQA to restore and protect the Great Lakes, Environment Canada and the US Environmental Protection Agency adopted the Binational Toxics Strategy in 1997. This strategy sets forth a collaborative process by which Environment Canada and EPA, in consultation with other federal departments and agencies, the Great Lakes states, the province of Ontario, tribes, and First Nations, will work with their public and private partners toward the goal of virtually eliminating persistent toxic substances resulting from human activity, particularly those that bioaccumulate, from the Great Lakes basin in order to protect and ensure the health and integrity of the Great Lakes ecosystem.

The IJC's biennial meetings, which provide opportunities for people to express their views to the commission on Great Lakes quality issues, and reports on Great Lakes water quality have been effective tools for drawing public attention to Great Lakes water quality problems and garnering public support for IJC recommendations. The IJC's *Sixth Biennial Report* (1992), for example, recommended that the two governments develop timetables to "sunset the use of chlorine and chlorine-containing compounds as industrial feedstocks." The recommendation was not accepted, but the initiative received widespread public attention and served as a means of educating the public. The *Seventh Biennial*

Report (1994) called for a "major shift in the way decision-making takes place for the Great Lakes ecosystem" and for the adoption of "a clear and comprehensive action plan to virtually eliminate toxic substances that are threatening the human health and the future of the Great Lakes ecosystems."

5.1.4 Air Quality

The IJC's role in assisting the governments to manage air quality stems from a 1966 reference on air pollution, which was issued pursuant to Article IX of the 1909 Boundary Waters Treaty. Article IX states: "The Commission is also requested to take note of air pollution problems in boundary areas. . . . If at any time the Commission considers it appropriate to do so, the Commission is invited to draw such problems to the attention of both Governments."

This part of the 1966 reference is, in effect, a variant of the commission's more general "alerting" mandate under which the IJC draws to the attention of governments matters of potential interest (to governments) that it encounters in the course of its normal activities. This development eventually led to the establishment of the IJC's International Air Quality Advisory Board.

In 1988, the governments asked the commission to commence work under a 1975 reference on air quality in the Detroit-Windsor and Port Huron-Sarnia areas. The 1978 Great Lakes Water Quality Agreement, as amended, authorized the IJC to examine, report and advise on the governments' commitments under Annex 15 of the agreement with respect to airborne toxics.

A very important air pollution issue in US-Canada relations is acid deposition, or acid rain. In spite of its importance, the IJC's role in this area has been very limited. Regional SO_2 and NO_X emissions are a source of acid deposition in eastern Canada. Beginning in the early 1970s, the IJC, acting on the authority of its standing reference and its mandate to monitor and improve water quality in the Great Lakes, warned of the dangers of acid deposition arising from the long-range transport of air pollutants. In 1979, the IJC's Science Advisory Board recommended the commission establish "an integrated acid precipitation program for the Great Lakes" stressing the systematic collection of scientific data and an emphasis on public education about the causes and effects of acid rain. The IJC Air Pollution Advisory Board also argued for an IJC role in managing acid rain. In the end, however, the regulatory and economic implications, including the possibility that coal-fired

power plants in the United States would have to be closed or modified, led the two governments to opt instead for conventional diplomatic approaches to settling the controversy.[128]

In 1991, the United States and Canada signed the Air Quality Agreement (AQA), which serves as an instrument for responding to problems and working toward solutions on acid deposition in northeastern North America and other priority air quality protection issues. In addition to establishing in 1991 a new role for the IJC to assist with certain AQA work, the United States and Canada continue to rely on the IJC's assistance under the Great Lakes Water Quality Agreement on air toxics and on contributory work by the IJC International Air Quality Advisory Board. This US-Canada-IJC careful division of labor on air pollution and air quality protection is an important element of the larger US-Canada relationship for the protection of human health, water quality and shared ecosystems along the extensive border.

5.2 Columbia River Treaty

The Treaty between Canada and the United States of America Relating to Cooperative Development of the Water Resources of the Columbia River basin, better known as the Columbia River Treaty, was signed in Washington on 17 January 1961 (also see section 5.3.2). The treaty was not ratified and did not enter into force, however, until 16 September 1964, after the parties had agreed on a protocol to the treaty and negotiated a 30-year sale to the United States of Canada's entitlement to downstream power benefits.

The Columbia River Treaty is intended to improve flood control and maximize hydropower generation in both countries. Implementation of the treaty involved the construction of three dams on the Canadian side of the border in British Columbia: Duncan, Keenleyside and Mica. As compensation for building the dams, Canada was entitled to one-half of the additional power that could be produced by American hydroelectric plants downstream.

In a Canadian concession, the United States acquired the option to build a dam on the Kootenai River near Libby, Montana, for hydroelectric generation and flood control. When full, the Libby Dam reservoir

128. R. Leslie, "The Long Road Towards Influence: Canada as an American Interest Group", (1993) 2 *Journal of Borderlands Studies* 12-32; and V.L. Golich and T.F. Young, "Resolution of the United States-Canadian Conflict over Acid Rain Controls", (1993) 2 *Environment and Development* 63-109.

backs up water 70 km (42 miles) into Canada. Completed in 1973, the dam provides hydroelectric power and flood control benefits to both countries.

Canada and the province of British Columbia entered into agreements in 1963 and 1964 whereby they agreed that all proprietary rights, title and interests arising under the treaty (including downstream power benefits accruing to Canada under the treaty) would belong to British Columbia. The province undertook to perform Canada's obligations under the treaty, including the construction, operation and maintenance of the Canadian treaty dams and reservoirs. Canada and British Columbia agreed that British Columbia Hydro and Power Authority (BC Hydro) would be the entity designated to carry out the operating arrangements necessary to implement the treaty. The position of US entity is held jointly by Bonneville Power Administration (BPA) and the US Army Corps of Engineers. BPA is responsible for marketing the power from treaty projects, and the Corps of Engineers handles flood control and operation of the Libby Dam and other works in the Columbia River basin.

In January 1964, Canada and the United States agreed on the terms of sale for Canada's share of the downstream benefits. Under these terms, Canada sold its full entitlement to the downstream power benefits from the three Canadian treaty projects to the United States for a period of 30 years after each project went into operation. In exchange, a group of US utilities paid Canada US $ 254 million for the first 30 years of the Canadian entitlement. The money was to be applied toward the cost of constructing the three Canadian treaty dams. The agreements governing these sales expire in 1998, 1999 and 2003, coinciding with the 30th anniversaries of the completion of the three Canadian storage dams. British Columbia and BPA are negotiating the terms of disposal of the Canadian entitlement for the remainder of the term of the treaty.

A hierarchy of dispute resolution mechanisms has been established to resolve any conflicts that may arise under the Columbia River Treaty. First, the matter is referred to the Permanent Engineering Board (PEB), which is empowered under the treaty to "assist in reconciling differences concerning technical or operational matters that may arise between the entities," and to "investigate and report with respect to any other matter coming within the scope of the treaty at the request of either Canada or the United States of America." Should Canada and the United States be unable to resolve their differences, either of them can refer the matter to the IJC for a decision. Should the IJC not render a decision

within three months of the referral or any other period agreed on by the parties, either may submit the matter to arbitration. Alternatively, Canada and the United States may agree on other procedures for settling differences, including a reference to the International Court of Justice.

5.3 Basin-specific Frameworks

This section describes the existing legal and institutional water management frameworks for each of the major transboundary basins.

5.3.1 Yukon River and Northwest International Drainage Area

The relevant legal regimes for managing water rights in this basin include Alaska state law, Yukon Territory law, and the provincial water rights laws of British Columbia. Transboundary water issues in the basin are limited. They have generally been resolved through informal discussions among state and local authorities, and representatives of the two federal governments, using the principles established under the 1909 Boundary Waters Treaty.

Water rights management in the Yukon is governed by a framework largely determined by federal law.[129] The *Yukon Waters Act*, enacted in 1992, builds on a previous framework established by the *Northern Inland Waters Act* of 1970. The federal government has enacted an "authority management scheme" for water rights in both the Yukon and the Northwest Territories and has devolved certain powers to territorial water boards. The Yukon Territory Water Board is made up of four to nine members appointed by the government of the Yukon and the federal government. The water board provides for the conservation, development and use of Yukon waters. The federal minister of Indian and northern affairs is authorized to give written policy directions to the board in certain situations.

Prior to the 1992 *Yukon Waters Act*, the permit system in the Yukon Territory was based on priority of use, unlike many other permit systems which are based on priority in time. But the new system, while preserving existing rights, bases priority of new permits on the permit application date. The governor in council, on the recommendation of the water board, has authority to delineate water management areas and classify different uses within those areas.

129. D.R. Percy, *The Framework of Water Rights Legislation in Canada,* Calgary: Canadian Institute of Resources Law, University of Calgary, 1988.

To obtain a permit under the *Yukon Waters Act*, an applicant must show that the proposed use would not affect other users (including instream uses and holders of outfitting concessions) or that compensation will be paid to any permittee with a lower statutory priority of use who will be adversely affected by the proposed use. The board has broad authority to determine appropriate compensation and to set conditions on permits, which cannot be issued for a period of greater than 25 years. Permits can also be amended or canceled. The law allows the transfer of water rights only when there is no change in use and other conditions are met.

Although the federal government appropriated most riparian lands under the *Territorial Lands Act*, certain older riparian rights, mostly related to domestic uses, exist in the Yukon. Aboriginal water rights could become an important issue in this region as part of land claims settlements. As for instream uses, they receive little express statutory protection in the water rights management schemes for the Yukon. However, instream uses were considered in some allocation decisions under the prior *Northern Inland Waters Act*, which suggests that they may be considered valid by the current board.

Alaska administers surface water rights under the prior appropriation doctrine. Some early riparian rights for mining were converted in 1966 to the prior appropriation system. One interesting facet of the Alaska system is its detailed list of statutory factors to be considered in determining whether issuing or transferring a water right would be in the public interest. Although most prior appropriation states now have some type of public interest review for water rights decisions, Alaska has the most specific statutory criteria. The factors used to evaluate the public interest are:

1. benefit of the proposed appropriation to the applicant;
2. effect of the proposed appropriation on fish and game habitat and on public recreation;
3. effect of the proposed appropriation on public health;
4. effect of the loss of alternate uses of water that might be made within a reasonable time if not precluded or hindered by the proposed appropriation;
5. harm to others from the proposed appropriation;
6. intent and ability of applicant to complete appropriation; and

7. effect of prior appropriation on access to navigation and public waters.

These concerns grow out of the strong public trust aspect of Alaska's state constitution.[130] Until 1980, Alaska relied on these statutory public interest factors to protect instream flows. That year, however, the law was changed to allow any local, state or federal agency or any private person or organization to apply for a "reservation" of water for recognized instream uses. These recognized uses include protecting fish and wildlife habitat, recreation, navigation, transportation and maintaining water quality. The reservations are not as secure as appropriative rights, however, in that they must be reviewed every 10 years. If the review finds the reservation is no longer necessary, it can be canceled in whole or in part.

5.3.2 Columbia River Basin

The relevant legal regimes for water rights management in this basin include the Columbia River Treaty and the 1909 Boundary Waters Treaty. Overviews of the two treaties are provided in sections 5.1 and 5.2. Also of relevance are the state water rights laws of Washington, Idaho and Montana, and the provincial water rights laws of British Columbia. The IJC has three international boards of control in the basin: the Columbia River, Osoyoos Lake and Kootenai Lake.

The state of Washington relies on a prior appropriation water rights permitting system adopted in 1917. Riparian rights existing at the time this system was adopted are preserved if they were exercised by 1932. Because of its extensive development and the difficulties encountered in managing it for a broad range of purposes, the Columbia River has been described as a monument to the modern-day problems engendered by the prior appropriation doctrine.[131]

The Columbia basin also is a good example of how the powers of the federal government overlie state allocation of water rights. Federal regulation of power production and the federal *Endangered Species Act*

130. M.L. Harte and C. Estes, "Assessment of Instream Flow Protection in Alaska", in *Instream Flow Protection in the West*, L.J. MacDonnell and T. Rice, ed., Boulder: Natural Resources Law Center, University of Colorado, 1993. On the public trust doctrine generally, see *National Audubon Society* v. *Superior Court of Alpine County*, 658 P.2d 709 (Cal. 1983), *cert. denied* 464 US 977 (1983); and J.L. Sax, "The Public Trust Doctrine in Natural Resources Law: Effective Judicial Intervention", (1970) 68 *Michigan Law Review* 471.

131. Getches, *Water Law in a Nutshell*.

have greatly influenced the institutions that relate to water resources management in the basin.

Instream flows have been intensely controversial in Washington, both within the state and in a transboundary context.[132] Washington State law gives the Department of Ecology exclusive authority to establish minimum instream flows to protect the public interest. This authority, however, is of little value in restoring streamflows, because most rivers in the state, including the Columbia, are already fully appropriated. Thus the department was given authority to acquire and convert existing private rights to instream use. The department also can lease rights for this purpose. This program applies to the Yakima basin and to pilot programs in the Dungeness/Quilcene and Methow basin.

By the end of the 1970s, it was clear that the traditional system of river governance led by federal agencies was in need of reform. In response, Congress created an interstate compact in 1980 in an effort to deal with three emerging problems. Made up of representatives of Idaho, Montana, Oregon and Washington, the council was entrusted, under the *Northwest Power Act* of 1980, to develop a 20-year regional electric power and conservation plan to ensure an adequate, efficient, economical and reliable power supply for the Pacific Northwest; to prepare a fish and wildlife program to protect and enhance the stocks; and to involve the public in these activities. Although the council initiated ambitious programs in all of these areas, anadromous fish populations continued to decline over the next 16 years for a variety of reasons. Many of these were beyond the mandate of the council to control.

During the late 1980s and early 1990s, Washington policy makers reached a consensus on instream flow issues and the need for increased protection of instream flows by the Department of Ecology. Washington State law now includes a watershed planning process that reflects that consensus.

British Columbia also relies on a prior appropriation system, administered through permits granted by provincial authorities. The province has a system of regional water bailiffs who enforce priorities

132. K.O. Slattery and R.F. Barwin, "Protecting Instream Resources in Washington State", in *Instream Flow Protection in the West*, L.J. MacDonnell and T. Rice, ed., Boulder: University of Colorado, Natural Resources Law Center, 1993. Also see M. McGinnis, "On the Verge of Collapse: The Columbia River System, Wild Salmon and the Northwest Power Planning Council", (1995) 35 *Natural Resources Journal* 63; and "Symposium on Northwest Water Law", (1996) 26(1) *Environmental Law* 141.

and water rights. Water rights in British Columbia are more readily transferable than they are in the Canadian prairie provinces, with transfers from one purpose to another allowed if approved by the controller.

The government of British Columbia has the authority to reserve unappropriated water to ensure its availability for future use. Permits to this water may be granted, subject to the reservation, but they can be canceled at any time. Water rights in British Columbia can also be canceled if they have not been used for three years. The province recognizes conservation as a beneficial purpose, but it is almost last in the hierarchy of purposes. The importance of the hierarchy relates to determining priority of use if the licenses for different uses of the water carry the same priority date.

The *Columbia Basin Trust Act*, passed by the provincial legislature in May 1995, led to the establishment of a British Columbia corporation called the Columbia Basin Trust. The purpose of the trust is to invest, spend and manage assets deriving from the Columbia River Treaty. These assets are managed for the ongoing economic, environmental and social benefit of the region in recognition of regional losses that the Columbia River Treaty entailed.

The Columbia River Treaty solved the two main challenges of the day: providing greater flood control and increasing energy resources. Over the last three decades, however, environmental issues not addressed by the treaty have arisen. For example, nowhere in the treaty are there formal provisions for the integration of fisheries and other environmental concerns with existing power and flood control priorities. Adjustments can be made in systems operations to accommodate multiple-use concerns, but if the adjustments reduce power production on the other side of the border compensation is required. Unfortunately, this approach creates a climate in which management decisions are often viewed as "non-power vs. power" tradeoffs. On the Canadian side in particular, BC Hydro has had to deal with conflicts that have arisen as a result of its obligations under domestic environmental protection legislation, such as the *Fisheries Act*, and its obligations under the Columbia River Treaty. There is a similar conflict between "power" and "non-power" tradeoffs in the United States, because increasingly the *Endangered Species Act* drives water management (Bonneville Power, US Army Corps of Engineers) in the Columbia basin.

Among those who have been vocal in their dissatisfaction with the current management regime for the Columbia River are groups who are interested in protecting aquatic and terrestrial habitats, fisheries and

water quality. Of special note are First Nations on both sides of the border. Aboriginal groups in Canada and the United States have formed regional commissions to address the loss of their fisheries.[133] In the United States, the Columbia River Inter-Tribal Fish Commission is becoming increasingly involved in fisheries management in the basin and wields significant influence in this process. The Canadian Columbia River Inter-Tribal Fish Commission is working toward achieving a similar level of involvement for First Nations in Canada. Spokespeople for the recreation and tourism industries in both countries have also expressed concern over the limited mandate of the Columbia River Treaty. All interest groups, including First Nations, have played an important role in bringing non-power issues to the attention of governments and the general public.

Recent years, however, have seen a move toward exploring alternatives to the institutional framework for managing the Columbia River basin. The 1992 British Columbia-Washington Environmental Cooperation Agreement, for example, introduced a means of fostering regional cooperation in environmental protection. The agreement established the British Columbia/Washington Environmental Council, with a mandate "to promote and coordinate mutual efforts to ensure the protection, preservation, and enhancement of our shared environment for the benefit of current and future generations." Members of the Council include representatives of the BC Ministry of Environment and the Washington State Department of Ecology. In addition, representatives of Environment Canada and the US Environmental Protection Agency have informal observer status. A similar agreement between BC and Montana is under development.

The British Columbia/Washington Environmental Council meets biannually and reports annually to provincial and state officials. It can establish subcommittees to deal with specific matters or, by formal agreement, establish international task forces to address issues of special or major significance. The council recently signed a memorandum of understanding to supplement the original agreement on management of

133. Canadian Columbia River Inter-Tribal Fish Commission (CCRIFC), "CCRIFC Compensation Workshop Discussion Paper: Toward the Restoration of the Columbia River Basin", unpublished draft, Cranbrook, BC, 1993; CCRIFC, "Towards a Columbia Basin Restoration Strategy", third unpublished draft, Cranbrook, BC, 1993; and CCRIFC, "January-February 1996 Report", *Newsletter*, Cranbrook, BC, 1996. Columbia River Inter-Tribal Fish Commission (CRITFC), *Restoring Salmon to the Columbia River Watershed: A Tribal Perspective*, Portland, OR, 1994; and CRITFC, *Wy-Kan-Ush-Mi Wa-Kish-Wit–Spirit of the Salmon: The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs and Yakama Tribes*, Portland, OR, 1995.

the Columbia basin. This memorandum is intended to improve communications on environmental management in the transboundary area of the Columbia basin. It provides for:

- notification of proposed discharges to land and water that may have transboundary impacts;
- notification of proposed large consumptive water diversions;
- notification of planning activities that may have transboundary impact;
- sharing of air and water quality information;
- notification of spills;
- opportunity for public comment (in both the United States and Canada) on proposals; and
- joint facilitation of public information meetings upon mutual agreement of need.

5.3.3 Great Plains Region

In addition to the 1909 Boundary Waters Treaty, the relevant legal regimes for the Great Plains region of the US-Canada border include state water rights laws in Montana and North Dakota, and the provincial laws of Alberta, Saskatchewan and Manitoba.

Montana uses a prior appropriation system for surface water rights and it is still in the process of adjudicating water rights in various basins. North Dakota also has a prior appropriation system, but it protects riparian rights that existed when the system was adopted.

In addition to a 1995 statute that allows a temporary (up to 10-year) conversion of water rights to instream flow use if it will benefit a fishery resource, Montana has a somewhat unique system that attempts to provide for protection of instream flows while protecting the state from being at a disadvantage relative to downstream states. Montana's "reservation" system essentially allows public entities to reserve water rights for existing or future beneficial uses, including maintaining instream flows. This system applies to six Montana rivers, including the Kootenai and the St. Mary. Under this system, water rights can be reserved without the usual prior appropriation requirement that water be diverted or impounded.

To secure a reservation, which is available only to state or political subdivisions or an agency of the state or federal government, the applicant must show the water is "needed." Need is "established by showing a reasonable likelihood that future in-state or out-of-state competing water uses would consume, degrade or otherwise affect available water." Reserved rights, especially for future use, can also be granted to those eligible entities that can show they must have additional time to develop the proposed water use project. The reservation process, which was initiated first on the Yellowstone and upper Missouri Rivers, brought the instream issue to the forefront. The process highlighted competing economic values in a state that depends heavily on tourism oriented to water-based recreation. It has been speculated that, if the reservation process is eventually used on the Kootenai or St. Mary Rivers, it may raise a host of issues related to cross-border flows.

Alberta, Saskatchewan and Manitoba all have surface water rights regimes based largely on the prior appropriation doctrine, with some protection for existing riparian rights (at least for domestic and small-scale agricultural purposes).[134] Water rights management is largely under the control of the provincial governments. The Prairie provinces have developed appropriate legal regimes for water rights management in times of periodic water shortages caused by drought. In times of drought, there is generally not a legal cutoff of junior rights, but rather a negotiated sharing of available supplies. In Saskatchewan, the Saskatchewan Water Corporation, a crown corporation described in more detail later in this section, has broad discretion to allocate supplies.

Water rights are generally not readily transferable in the Prairie provinces. However, Alberta's 1996 water law allows transfers of water rights if an approved water management plan for the region authorizes transfers. In addition to clarifying the legal status of riparian rights and groundwater rights for household and traditional agricultural use, the 1996 law specifically prohibits interbasin transfers, including the transfer of water outside of Canada, unless authorized by a special act of the Alberta legislature.

In 1984, Saskatchewan transferred all authority over water resource issues to the province-run Saskatchewan Water Corporation. The corporation has a mandate to: regulate and control the flow of water in Saskatchewan; administer all interjurisdictional water matters; provide comprehensive basin planning; approve the use of water for water-

134. D.R. Percy, "75 Years of Alberta Water Law: Maturity, Demise and Rebirth", (1966) *Alberta Law Review.* The authors are indebted to Professor Percy who readily provided his comprehensive analysis of Alberta's August 1996 water law.

works, sewage works and drainage works; and construct, acquire, manage and operate any facility incidental to the use of water.

The legislation establishing the corporation gives it broad and discretionary powers over water rights management. The corporation also has broad powers to cancel water rights, either when the permittee agrees or when the "corporation considers that the water user no longer needs the water."

In spite of being part of separate continental drainage systems, the St. Mary and Milk Rivers are jointly administered for international purposes. Substantial quantities of water are diverted from the St. Mary River to the Milk River in the mountain headwaters to augment the water supply for irrigation downstream in the arid prairie region of Montana. The waters of these rivers are heavily used for irrigation purposes on both sides of the border.

A 1921 order by the IJC detailed the apportionment of the St. Mary and Milk Rivers. During the irrigation season, Canada is assured of receiving 75 percent of the water of the St. Mary River up to a natural flow of 596 Mm^3 (666 cubic feet per second, cfs) per year and half of flows in excess of 596 Mm^3 per year. In winter, Canada is assured half the natural flow. On the Milk River, at its eastern crossing, the United States is assured the same share. The eastern tributaries of the Milk River are to be shared equally at their boundary crossing. The interjurisdictional sharing of several of these tributaries is also complicated by the fact that they cross the Alberta-Saskatchewan border, where they are apportioned under the Prairie Provinces Water Board Agreement.

The three largest tributaries of the Milk River—Lodge Creek, Battle Creek and Frenchman River—are monitored. On these tributaries, irrigation, reservoir storage for future irrigation and reservoir evaporation use most of Canada's share in low flow years. Significant excess delivery to the United States occurs only in wet years.

Although no formal international apportionment agreement has been established under the IJC, the Poplar River is managed under a 1976 bilateral agreement sanctioned by an exchange of notes by governments and administered by a bilateral committee. The agreement was, however, based on an IJC recommendation. The apportionment provides for equal sharing, with flexibility for Saskatchewan to use more than half on individual streams. Montana is assured of a certain base flow to meet the needs of existing users.

Water apportionment of the Souris River along the Saskatchewan-North Dakota border and at the North Dakota-Manitoba border is prescribed in the Agreement for Water Supply and Flood Control in the Souris River (1992). The agreement, prompted by proposals for relatively large storage reservoirs at Rafferty and Alameda in Saskatchewan, provides that "the Province of Saskatchewan shall have the right to divert, store, and use waters which originate in the Saskatchewan portion of the Souris River basin, provided that such diversion, storage, and use shall not diminish the annual flow of the River at Sherwood Crossing more than fifty percent of that which would have occurred in the state of nature, as calculated by the Board."

With the large storage capacity in Saskatchewan relative to the natural flows, the apportionment formula is a dominant factor in operating the Rafferty and Alameda Reservoirs. As these new reservoirs fill, increased uses and evaporation will make apportionment of the Souris River a much more important issue than it was prior to 1992. In 1994, the governments entered bilateral negotiations to revise apportionment measures for river between Saskatchewan and North Dakota. According to Environment Canada, the revised apportionment was expected to be finalized through an exchange of notes between governments.[135]

Water sharing at the Manitoba crossing of the Souris River has not generated major difficulties in the past, but as upstream developments in North Dakota and Saskatchewan have increased, policy makers have begun to worry about the possibility of more frequent lower deliveries. The current drought criteria, which allow reduced deliveries, were established before much of the upstream development. The Souris River Board of Control has been reviewing this issue.

One well-known transboundary issue in the Souris River and Red River region was the proposed Garrison Diversion. It was originally proposed by US interests in the 1940s as a method of providing irrigation water for 101,200 ha (250,000 acres) in North Dakota from the Missouri River. These flows would have been diverted into the Hudson Bay drainage basin and would have gone into Lakes Winnipeg and Manitoba. The project was opposed by Canada. Of special concern was the chemical and biological quality of the return flows from the proposed project. Another specific concern was the potential for interbasin transfers of (exotic) aquatic species.

135. J. Cooper, Environmental Conservation Service, Environment Canada, personal communication.

The matter was referred to the IJC in the 1970s, which established a study board to investigate these concerns. In its 1977 study, the IJC recommended against construction of that part of the project that would affect Canadian waters. Under pressure from Canada and from environmentalists in the United States, the US Congress scaled back the project with the 1986 *Garrison Diversion Reformulation Act* to reduce irrigated acreage to 56,660 ha (140,000 acres), and include as payments to North Dakota money for rural development and municipal water supplies.

In November 1997, a bill was introduced in the US Congress to complete the Garrison Diversion, including features that would transfer water from the Missouri basin to the Hudson Bay basin (*Dakota Water Resources Act*). Canada, the IJC, and the Great Lakes Commission, among many others, however, continue to oppose the parts of this initiative involving interbasin transfers of water.

5.3.4 Great Lakes Basin (Including Lake of the Woods)

The prospects of extrabasin diversions and climate change have raised concerns about water levels in the Great Lakes basin, but much of the most recent attention has centered on water quality. In addition to federal laws, the relevant legal regimes for this region include state laws in Minnesota, Michigan, Illinois, New York, Pennsylvania, Indiana, Wisconsin and Ohio; the provincial laws of Ontario; and various boundary and transboundary agreements, including IJC orders that govern outflows from Lake Superior and Lake Ontario.

The region's US states and the province of Ontario all have permit systems based on the riparian doctrine. Until 1961, when the permit system was adopted, the province relied on common law. While uses of water away from riparian land were common, there was little conflict over these uses because of the abundance of water. Today, Ontario's permit system applies to uses greater than 50,000 liters (13,208 gallons) per day, unless the use was established before March 1961 or unless the water is used solely for domestic, fire fighting or small farm purposes. In 1998, the controversy surrounding Ontario's issuance of a permit for tanker export from Lake Superior resulted in changes to Ontario's permit system to prevent the bulk withdrawal of water.

Under the Ontario system, applications for permits are evaluated according to the effect of the proposed use on others, on the availability of water and on the environment. The Ontario Ministry of the Environment, which administers the permit system, has wide discretion in

resolving conflicts, in imposing any conditions needed to address water shortages, and in altering terms or canceling permits.

Much of the transboundary effort in this region has centered on water quality under the Great Lakes Agreement and related instruments (see section 5.1.3). This work has been thoroughly analyzed by others and is not discussed in detail here.[136]

The IJC has received references from the two governments on lake levels, diversions and consumptive uses in the Great Lakes-St. Lawrence system. Flood and shoreline management figured prominently in many of these references. Notably, the IJC has concluded that the enormously expensive structural measures required to reduce erosion and flood damage, while technically feasible, are not justified in view of the benefits expected.

As noted elsewhere in this report, the Canadian provinces of Ontario and Quebec have joined with the eight US states in the Great Lakes region in endorsing the Great Lakes Charter. This charter joins the states and provinces together to protect the water resources of the Great Lakes, particularly from the anticipated pressures for interbasin diversions to meet needs in western US states. The charter also provides a means by which the major consumptive uses of water in the Great Lakes are recorded in a joint database.

5.3.5 Upper St. Lawrence and Atlantic Drainage Basins

The primary legal regimes for water rights management in this transboundary region include the state laws of New York, Vermont and Maine, the provincial laws of Quebec and New Brunswick, and the 1909 Boundary Waters Treaty.

New York, Vermont and Maine rely on riparian-based permit systems. The generally abundant water resources of this region, relative to demand, result in fairly straightforward water rights administration. Both Quebec and New Brunswick also rely on riparian-based systems. Quebec's civil law distinguishes such a system from common law-based systems.

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136. See, for example, B. Sadler, "Shared Resources, Common Future: Sustainable Management of Canada-United States Border Waters", (1993) 33 *Natural Resources Journal* 376; and P. Muldoon, "Public Participation in Bilateral Institutions", in *Proceedings of First North American Conference on Environmental Law: Phase II*, Washington, DC: Environmental Law Institute, 1993.

Major binational issues include maintenance of the St. Lawrence Seaway, cross-border hydropower development and water quality in the St. Croix and St. John Rivers. In addition to the three IJC control boards, more direct relationships between provincial/state and federal governments are responsible for managing several aspects of the region's boundary and transboundary surface waters. For example, the conservation, development and use of the St. Croix River is overseen by the New Brunswick-Maine International St. Croix Waterway Commission, established by the premier and governor.

CHAPTER 6

Issues and Challenges

This report has revealed that the legal and institutional frameworks for managing North America's boundary and transboundary fresh waters are in a constant state of change stemming from evolving political, social and economic structures, and changes in the physical environment and in public opinion. This chapter identifies the trends and challenges that are affecting domestic and transboundary water management in North America. It begins by describing the domestic situations in Mexico, the United States and Canada and then discusses the issues and challenges particular to each of the two international boundaries.

6.1 Mexico

Despite Mexico's long-standing reputation for centralized administration and federal control of water resources, the significant intergovernmental transformations under way are certain to affect the management of water resources across national boundaries. These domestic changes unavoidably affect the established institutions for binational water management, both old and new.

The principal domestic trend influencing Mexico's formal involvement in transboundary water management is the devolution of federal administrative responsibilities to the states and municipalities. The process of devolution in national water management has been under way since 1992 under authority of the *National Waters Act (Ley de Aguas Nacionales)*. One difficulty associated with this devolution is that the transfer of rulemaking and implementation responsibilities to states and municipalities has often exceeded the capacity of these local agencies to act on their new responsibilities. Yet the devolution of administrative responsibilities has opened the door to greater public-private sector cooperation in water management and the incorporation of market elements into national water administration. These developments may

make additional financial resources available and create new opportunities for managing transboundary waters.

Devolution affects Mexico's transboundary water management in several ways. First, state and municipal participation extends the process and complexity of national decision making in water policy development and implementation. Second, with devolution, states and municipalities become increasingly important at the level of implementing water policy. Improving the fiscal, technical and human resources of local institutions is thus vital to transboundary inland water management. Third, devolution raises new challenges in coordinating public policies across agencies and sectors relevant to Mexican domestic and international water resource management. And, fourth, devolution amplifies the importance of local public participation as an element of transboundary water management.

In addition to policy decentralization, two other intergovernmental trends are evident at the national level in Mexico. One of these trends is the incorporation of more integrative, basinwide approaches to managing national water resources. The new river basin councils (*consejos de cuenca)* incorporate ecological and social concerns in planning processes. The impact of these new planning mechanisms is not yet evident, but they have promise for the design of approaches to river basin management that are more effective and ecologically-sensitive than past ones. Another important trend is the evolution of a body of environmental legislation and technical norms at the national, state and local levels to regulate water pollution and water quality.

The recent restructuring of federal environmental agencies, coupled with policy devolution to states and municipalities, and the incorporation of market-based mechanisms adds to the challenge of integrating water management practices. The process of refining national legislation to better define responsibilities for implementing water-related legislation is now under way in Mexico.

Another area that requires special effort is the collection, coordination and publication of the relevant data on water. At present, the inadequacy of information on water quantity and quality is a major obstacle to effective water management in Mexico. The task of collecting more data on both surface and groundwater is made somewhat more challenging in the context of the decentralization of authority for water management.

Decentralization of policy responsibility for water management in Mexico affects binational institutions, including the International

Boundary and Water Commission (IBWC) and the Border Environment Cooperation Commission (BECC). The IBWC's Mexican Section, for example, has traditionally operated within a federal diplomatic framework. It must now deal with a wider range of Mexican jurisdictions as it attempts to resolve water-related treaty differences, and participate in binational sewage and sanitation projects. BECC must now deal more directly with local *municipios*, state agencies and private sector entities in certifying environmental infrastructure projects and developing financial arrangements for their completion.

The mobilization of new social forces in Mexican politics has important implications for the administration of Mexican water resources. The emergence of a wide range of nongovernmental environmental organizations (ENGOs), one of the most distinctive developments of the past decade, accelerated with the signing of the NAFTA accords.[137] ENGOs now play an important role in monitoring enforcement of environmental laws, organizing local communities and neighborhoods for the articulation of environmental concerns, contributing technical skills on which governments at all levels may draw, and linking local communities with national and international organizations engaged in environmental management.[138]

There is little doubt that the emergence of popular concern about the environment is contributing to the strengthening and vitalization of Mexican civil society in ways that affect transboundary water management. As in other countries, environmental organizations in Mexico are pushing for greater procedural openness and accountability to the public in environmental management. They call for greater access to government records and proceedings, and more public participation in policy making and implementation. These demands are consistent with international trends and are reflected in agreements affecting transboundary waters. Recent US-Mexico binational agreements, especially the Border XXI program, incorporate provisions for public participation, consultation and greater public access to formal decision making.

With the mobilization of public, nongovernmental participation in environmental management, all levels of government are now subjected to greater public scrutiny, compelling officials to be more accountable

137. Newman, *Managing Mexico's Environmental Challenge*, 15; and E. Kurzinger et al., *Política Ambiental en México: El Papel de las Organizaciones no Gubernamentales*, México, DF: Instituto Alemán de Desarrollo, Friedrich Ebert Stiftung, 1991.

138. For an excellent account of how environmental organizations have recently contributed to local water management in a Mexican border city, see the case of Nogales, Sonora, in H. Ingram, N. Laney and D. Gillilan, *Divided Waters: Bridging the US-Mexico Border*, Tucson: University of Arizona Press, 1995.

and responsive to public demands and perspectives. Public demands generate pressure for changing formal administrative protocols and political practices to incorporate public participation in water management. Once involved, citizens then have an opportunity to perform functions formerly left to the governments. The expanding role of the public augments institutional capacity for effective environmental management and water management at all levels. Finding ways to support and strengthen this trend is one of the fundamental challenges for improved management of transboundary water resources on the US-Mexico border.

6.2 United States

Transboundary water management could be improved by more coordinated water policy and administration in the United States. Differences in laws, capacities and political will characterize US water management among federal agencies and individual states. Numerous studies have documented the different approaches to water management, varying administrative capacities and uneven implementation and enforcement of water management policies across the United States.[139] Moreover, the trend of the past 15 years has been away from a coordinated federal approach to water policy, and this trend seems likely to continue, given the general political and fiscal constraints on federal programs.[140]

Although a great wealth of data is available on water in the United States, a failure to coordinate federal and interstate data gathering and publication has at times lessened the effectiveness of water management. Little coordination exists among the federal agencies involved in assessing water quantity and water quality throughout the country and between states that share watersheds.[141] One exception, however, is

139. Responsibility for water management is fragmented among federal agencies and between federal and subnational agencies. Thirty-four different federal agencies make decisions directly related to water management, and they maintain at least 25 separate water programs. This fragmentation at the federal level reflects the fragmentation of water matters within Congress, where 14 House committees and 13 Senate committees deal with some aspect of water management. As a result, legal authority and technical assignments are spread diffusely and unevenly at the federal level.

140. L.B. Dworsky, D. Allee and R. North, "Water Resources Planning and Management in the United States Federal System: Long Term Assessment and Intergovernmental Issues for the Nineties", (1991) 31 *Natural Resources Journal* 475-548; and P. Rogers, *America's Water: Federal Roles and Responsibilities*, Cambridge: MIT Press, 1993, 285.

141. At the federal level, three agencies collect data on water quantity or water quality: USGS, NOAA and EPA. There are no direct linkages between the EPA and NOAA

EPA's new electronic watershed database, which brings together and makes public a good deal of data relevant to US watersheds. Nevertheless, comprehensive information on groundwater, in particular, is still lacking.

The variability of flows in certain watersheds has resulted in considerable ambiguity about the actual amount of water available. As a result of this ambiguity and the lack of coordinated water management in both the southwest and the northwest, it is not unusual for water to be overallocated on paper.[142] For groundwater, even less is known about the quantities available, withdrawal and recharge rates, and contamination by pollutants.[143] Because most groundwater management programs remain under state control, the national data collection and assessment capacities are relatively poor in this area.

Currently, there is no institutional mechanism for coordinating the disparate national, state and local interests in matters involving domestic transboundary waters. In Congress, however, the political process plays this coordinating role in an indirect way. Competing interests are played out during the budget process and in the interagency competition for authority. In addition, upper- and lower-basin states compete in Congress for access to water. However, this competitive process only exacerbates the uncoordinated and fragmented approach to water management.

Litigation is another uncoordinated mechanism for reconciling competing interests in domestic transboundary water. This is especially true in areas involving Native American reserved water rights. Nevertheless, the lack of consistency inherent in litigated resolutions presents serious problems of fairness, with some tribes achieving markedly better terms than others. These competitive and inconsistent processes provide little basis for a coordinated approach to transboundary water resource issues such as groundwater depletion and contamination in the southwest, overallocation within a river basin, or toxic pollution in the Great Lakes.

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data systems, nor between the USGS and NOAA data systems, making use of these data sets for assessment purposes difficult. EPA's recently launched "Index of Watershed Indicators" Web site (htttp://www.epa.gov/iwi) is, however, an important step toward providing integrated, comprehensive information on many water-related variables.

142. J. Haggard, "Institutional Considerations", in *Are We Prepared for the Next Drought? Managing Low Water Year Emergencies,* proceedings of a workshop, 6 May 1983, University of Washington, Seattle, C. Borches, M. Spranger and B. Williamson, ed., Portland, OR, n.d., 29-35

143. Z. Smith, *The Environmental Policy Paradox*, 2nd ed., Englewood Cliffs, NJ: Prentice Hall, 1995, 108-109.

These shortcomings in domestic water management can create problems for the management of water resources across international boundaries, especially for Mexico where data remain scarce and difficult to obtain. For example, more coordination is needed to mitigate the downstream impacts of agriculture, the variation between jurisdictions in instream flow needs, and the health effects of different water contaminants on downstream users. In recent years, however, the United States has been more explicit in acknowledging the ecological and recreational value of water resources.

In the past, there has been no consistent mechanism for ensuring public participation in transboundary water management from a federal standpoint. The IJC's approach to dealing with issues on the US-Canada border has been an exception, and IBWC also has been developing mechanisms designed to include the public. Recent developments, however, in the Great Lakes, Columbia River, Colorado River and Río Grande regions suggest a growing institutional commitment to public participation in transboundary water management at the state and interstate levels.[144]

6.3 Canada

As a result of financial and political developments, the management of freshwater in Canada is changing. Reductions in funding for federal and other government programs and the growing role of provincial authorities in water management are contributing to significant challenges for the future. Yet at the same time, public interest and involvement in both transboundary and domestic water management are growing in Canada.

In the 1970s and 1980s, the recognized need for a clear federal role in water management in Canada led to initiatives such as the *Canada Water Act* (1970) and the Federal Water Policy (1987). But efforts to clarify and strengthen the role of the federal government in water management then lost momentum until the mid-1990s.[145] In early 1999, the Canadian government launched a strategy to prohibit the bulk removal of Canadian water, including water for export. Under this strategy, the *International Boundary Waters Treaty Act* has been amended to give the

144. J. Hartig and M. Zarull, "Keystones for Success", in *Under RAPs: Towards Grassroots Ecological Democracy in the Great Lakes Basin*, Ann Arbor: University of Michigan Press, 1992, 263-279.

145. In an attempt to help clarify the federal role in water management, the Canadian federal government commissioned the report, *Broadening Water Perspectives* by B. Mitchell and J. Bruce, Incidental Report No. IR95-1, Ottawa: The Royal Society of Canada, August 1995.

federal government the regulatory power it needs to prohibit bulk removals from boundary waters, principally the Great Lakes. Also included in the strategy is a proposal to develop, in consultation with the provinces and territories, a Canada-wide accord on bulk water removals to protect Canadian watersheds. The strategy has prompted discussions across the country at both the provincial and federal levels, and has resulted in growing public awareness about water management issues.

For nearly three decades, the *Canada Water Act* has authorized several useful programs, particularly in the mapping of flood-prone regions and the construction of flood control structures. Recent budget cuts to these programs, however, make it unclear what influence the act will have in the years to come. The Federal Water Policy, which was intended to clarify the federal government's role in managing water, remains a potentially useful guideline, but it has been largely ignored, leaving no overall, coordinated water management strategy at the federal level. In July 1998, the federal government circulated to all provinces a comprehensive draft of the Federal Freshwater Strategy, as a major policy update to the 1987 Federal Water Policy. Consultations with the provinces took place over the summer and autumn of 1998, but no concrete developments have emerged from this process and the strategy itself has yet, as of this writing, to be made public.

Because the provincial governments are assuming greater responsibilities for water management, capacity building at the provincial level is of central importance. The provinces are key players in water monitoring, regulation, planning, impact assessment and research, and they are taking on greater responsibility for gathering data on water quantity and quality within their boundaries. Nevertheless, administrative restructuring and reduced budgets for provincial environmental agencies challenge the provinces' abilities to maintain their current level of services and make it particularly difficult for them to assume their new responsibilities.

Fiscal austerity and the intergovernmental restructuring of water management in Canada have mixed implications for binational bodies like the IJC. A shift toward the new, integrated "ecosystem approach" to environmental and water management at the federal level is consistent with the IJC's approach. But, faced with reductions in the resources available, federal agencies find it difficult to put the ecosystem approach into effect.[146] Moreover, as Great Lakes pollution standards

146. If successful, the IJC's proposed international watershed boards could be of considerable help in addressing the institutional challenges associated with adopting an "ecosystem approach."

are tightened in response to recommendations of the IJC and others, the governments are increasingly strapped for resources to implement these standards. The federal government has shown a willingness to link water management programs to IJC recommendations. However, before committing resources to these programs, it has sought cost-sharing agreements with the affected provinces.

Administrative changes and budget reductions at the federal level are affecting the agencies involved in water management, particularly Environment Canada. One report even warned that these developments "will lead to insufficient capability in the federal system to understand and deal with pressing water issues.[147]" Among the activities that will face major challenges in the years ahead are the development of national guidelines for water quality and use, the nationwide monitoring of water quality and water use, the promotion of aquatic science, and programs such as the protection of heritage rivers.

As in Mexico and the United States, public interest in water issues and water management has grown significantly in Canada in recent decades. Canadians associate themselves with water, because lakes, rivers and wetlands, along with the wildlife they sustain, are an important element of Canada's national identity. Issues such as acid rain, the effects of large dams, interbasin water exports, and water quality in the Great Lakes and elsewhere have generated much popular concern over the years, thereby helping to gain public support for national legislation such as the *Canadian Environmental Protection Act* and sparking demands for public involvement in water management.

6.4 Common Themes on the Two Borders

Transboundary water management in North America is vested in institutions that reflect the different environmental, political, economic and historical conditions of the border regions. These institutions do possess some commonalities, however, in the management of transboundary waters.

Among the more important features common to the binational transboundary water management institutions on the US-Canada and US-Mexico borders are: a dependence on national governments for initiative and action; the predominance of government agencies in insti-

147. J. Bruce and B. Mitchell, *Broadening Perspectives on Water Issues,* report prepared for the Canadian Global Change Program and the Canadian Water Resources Association, Ottawa: Royal Society of Canada, 1995, vi.

tutional structure; problems with coordinating the roles and responsibilities of governments and agencies in binational programs; and the growing importance of public participation, including access to information and influence in institutional decision making.[148]

The binational institutions that have been established to manage transboundary waters on the two borders were created by and derive their authority from the three national governments. The work of these institutions and their success in resolving issues depend on the confidence and the resources that the national governments place in them. Effective management of transboundary waters also depends on coordination between national and subnational governments in the affected regions. Therefore, the role of national governments, their attention to the needs of the binational institutions and their ability to coordinate bilateral policies are critical to the effectiveness of these institutions.

The dependence of binational institutions on the national governments and the presence of domestic political constraints can pose a challenge for transboundary water management. The IJC may identify and draw the governments' attention to various problems in the US-Canada border region, but it cannot act without a reference from at least one of the two national governments. The IBWC has in principle some latitude for investigation and policy initiative on the US-Mexico border, but it has seldom exercised such powers without carefully soliciting the support of its member governments in advance. Furthermore, both commissions can become subject to *de facto* state and provincial vetoes when their activities affect these subnational jurisdictions. Domestic political constraints may thus restrict the commissions' capacity to play a proactive role in binational water management.

An important consequence of institutional dependence on national governments is that government bureaucracies dominate policy on both borders. Despite the impartiality displayed by the commissioners of the main binational institutions, the composition of the IJC's advisory boards and the IBWC's consultative patterns favor the expertise and views of established government agencies with water-related experience. Although these patterns of influence may be

148. The IJC brought these same issues to the attention of governments of Canada and the United States in the 1997 report *The IJC and the 21st century*. The governments have now approved, in principle, the commission's proposal that it establish permanent IJC international watershed boards for the major watersheds along the US-Canada boundary, and the commission has been given a reference to begin implementing it.

technically efficient and politically expedient, they contribute to the commonly held view that transboundary water management can be unresponsive to the concerns of affected citizens.

On both borders, difficulties have arisen in coordinating government responses to suggestions and programs put forward by the binational institutions. A 1989 report by the US General Accounting Office cited the failure of federal agencies to respond to recommendations of the IJC.[149] Thus the lack of protocol for coordinating government responses to the IJC may have delayed the formulation of US government positions on important issues affecting transboundary waters. Similar gaps in communication appear to have existed among federal agencies and between federal and provincial governments in Canada. On the US-Mexico border, IBWC has experienced similar problems at the policy and operational levels. By contrast, the interagency linkages established by the Border Environment Cooperation Commission have facilitated communications and created incentives for US domestic interagency cooperation in water management.

Accommodating the growing demands for public participation is a common challenge for transboundary water management on both borders. As public awareness of environmental conditions has increased, so too have the demands for greater public involvement in the affairs of institutions traditionally oriented toward more exclusive, diplomatic *modus operandi*. Historically, the IJC has been relatively well equipped to accommodate these demands. Involvement of the public has grown, particularly within the framework of the Great Lakes Water Quality Agreement and its protocols. The Remedial Action Plan process (see Chapter 5) has been praised as a model of public participation in remediating pollution problems in the Great Lakes. These procedures, however, are in place only in the Great Lakes region and apply only to water quality issues.

On the US-Mexico border, IBWC has not traditionally invited public participation in its decisions, nor has it sought to be broadly representative of the border public in setting its agenda. IBWC procedures are changing, however, partly in response to increased demands for public

149. The US General Accounting Office report of 1989 cited the failure of federal agencies to respond to the IJC's suggestions. It recommended that "the Secretary of State, in conjunction with officials from the EPA, the Army Corps of Engineers, and other involved technical agencies, establish a formal mechanism to provide prompt US responses to IJC's recommendations. Such responses should include either a confirmation that the US agencies plan to implement a recommendation or an explanation of their rationale for rejecting the IJC's recommended course of action."

involvement. In addition, the advent of the Border Environment Cooperation Commission has indirectly exposed IBWC to greater public participation in transboundary water infrastructure projects. On both the US-Canada and US-Mexico borders, bilateral institutions are expected to face continuing demands for greater public participation, transparency and accountability to the public.

6.5 Issues and Challenges Particular to the US-Canada Border

During the past 30 years, the management of transboundary waters between Canada and the United States has become increasingly complex and challenging. New issues have arisen within the context of the economic and population growth affecting various parts of the US-Canada border region. The emerging concerns about water quality and environmental health have placed new demands on the management of transboundary waters.

US-Canada transboundary water management is conducted mainly through the International Joint Commission. Since beginning its work in 1912, the IJC has proven effective in handling the shared water resources issues that have come before it. The commission, however, has been constrained in its ability to respond to emerging issues by several factors.

Although the IJC enjoys considerable independence to investigate and report on the matters referred to it, many observers have noted the governments' reluctance to utilize the commission to its full capacity. For example, some critics have argued that the IJC's current mandate is overly focused on the Great Lakes to the neglect of other transboundary waters. Some also have suggested that the IJC be given more independence, that its quasi-judicial, investigative and fact-finding functions be strengthened, and that its capacity to anticipate, study and advise the governments on emerging transboundary problems be improved.[150]

150. B. Sadler, "The Management of Canada-US Boundary Waters: Retrospect and Prospect", (1986) 26 *Natural Resources Journal* 274; International Joint Commission, "Summary of the International Joint Commission Seminar on the IJC, Its Achievement, Needs, and Potential", unpublished manuscript, Montreal, 1974, 26; Senate Committee on Foreign Affairs, *Canada-United States Relations,* Vol. 1, *The Institutional Framework for the Relationship*, Ottawa: Senate of Canada, December 1975, 43; L.B. Dworsky and D. Allee, "An Agenda for the Management of the Great Lakes on a Long Term Ecosystem Basis", in *Great Lakes, Living with North America's Inland Waters. Symposium Proceedings*, Herndon, VA: American Water Resources Association, 1988; and D.J. Allee, "Subnational Governance and the International Joint Commission: Local Management of United States and Canadian Boundary Waters", (1993) 33 *Natural Resources Journal* 148.

The IJC itself addressed several emerging trends in its forward-looking 1997 report.[151] Prepared in response to a specific request by the United States and Canada, the report provided advice on how the IJC might best assist governments to face the environmental challenges of the 21st century. One of the report's most significant recommendations was the establishment of international watershed boards along the border.

Although the IJC enjoys a broad mandate to deal with boundary water management issues along the US-Canada border, its highest-profile work has been carried out on water quality issues in the Great Lakes region. The IJC's success in implementing the Great Lakes Water Quality Agreements has prompted recommendations that similar efforts be made in other transboundary waters and that the ecosystem approach—which involves all sectors of society in the protection and management of ecosystems—be applied more broadly. The IJC's recent reference on the establishment of international watershed boards will in all likelihood apply the ecosystem approach all along the US-Canada border.

Another factor that appears to prevent the IJC from responding to transboundary water issues as effectively as it might is a paucity of resources. Most observers agree that the commission's operating budget and staff resources are inadequate to meet even the tasks it is currently mandated to perform. The IJC's staff in the United States, for example, has not increased since 1982, in spite of an increase in responsibilities.

Implementation of plans to improve water quality and environmental health on the border are sometimes hampered by institutional and financial obstacles that could be overcome by strengthening the role of the IJC. For example, the Great Lakes Water Quality Agreements set specific targets for remediating specific "areas of concern" through a series of Remedial Action Plans (RAPs). At the same time, the Lakewide Management Plan establishes a means for dealing with specific contaminants in the open waters of the Great Lakes. The RAP process, however, has proceeded slowly because of the rigorous criteria that have to be met in remediation, as well as the difficulty encountered in trying to reach a consensus among all the affected stakeholders. Implementation of the Lakewide Management Plans has been delayed for similar reasons. For such remediation processes, the International Joint Commission acts as referee rather than implementor. The responsibility for implementation rests with domestic governments and their environmental agencies.

151. International Joint Commission, *The IJC and the 21st Century*, Ottawa, 1997.

Funding for remedial activities also has been a chronic problem, exacerbated by the many layers of government involved and the limited financial support from the federal governments.

Most observers of US-Canada transboundary water issues regard the IJC as an excellent means of settling water disputes and overseeing the management of common water issues. Not surprisingly, then, the governments are often encouraged to strengthen and to make fuller use of the commission. At the same time, some observers have suggested that, once provided with sufficient funding and support from the parties, the commission itself could improve its operating procedures in order to improve its performance. Critics have expressed concerns about the commission's oversight of the boards and study groups that report to it, its shortcomings in coordinating its activities with government agencies, its need to better specify desired objectives and standards, and its need to develop a better database.[152]

Like other institutions involved in water management throughout North America, the IJC faces growing demands to involve the public in its decisions, programs and activities. Although the 1909 Boundary Waters Treaty authorizes the commission to determine its own rules of procedure, the treaty does require that all parties interested in a matter be given "convenient opportunity to be heard." These rules have permitted public participation at the level of IJC hearings, advisory board hearings and other proceedings as determined by the commission. The annual meetings of the commission's individual boards include a role for public, as do its biennial meetings under the Great Lakes Water Quality Agreements.

The IJC's orientation toward inclusiveness and public participation is also evident in the representation of water professionals and state and provincial authorities on IJC boards. The commission has been particularly sensitive to the need for public involvement in refining and implementing its mandate on the Great Lakes. For example, the IJC solicited extensive public comment in 1986 on proposed amendments to the 1978 Great Lakes Water Quality Agreement. The resulting 1987 protocol, annex II, requires that the "Parties, in cooperation with State and Provincial Governments, shall ensure that the public is consulted on all actions undertaken pursuant to this Annex." The 1987 protocol also

152. L.B. Dworsky, "The Great Lakes: 1955-1985", (1986) 26 *Natural Resources Journal* 326-327; US General Accounting Office, *Need to Reassess Participation in the International Joint Commission*, Washington, DC, 8 June 1989; and B. Sadler, "Commentary", (1993) 33 *National Resources Journal* 389-396.

provides for a "complex, decentralized, and highly participatory RAP process and lakewide management planning process.[153]" Public consultation and involvement also figure prominently in other regions where the IJC is active, including the St. Croix River, Rainy River, Red River and Okanogan River.

Nevertheless, the IJC's efforts to include the public in its deliberations have not been above criticism. In its 1989 report, the US General Accounting Office noted. "The public's access to, and involvement in, the activities of the IJC has increased somewhat in recent years but is still minor. The IJC co-chairmen have generally opposed increasing public participation or representation because they believe that the level of public participation is sufficient already." In response to these concerns, the IJC has tried to improve its public participation process—for example, the extensive public consultation process conducted in conjunction with the 1999 reference on the use, diversion and removal of water along the border.

6.6 Issues and Challenges Particular to the US-Mexico Border

Water management on the US-Mexico border occurs in a context of generally scarce water resources and economic asymmetry between the two countries. These conditions shaped the design of the treaties governing US-Mexico transboundary waters and the institutions created to put them into effect. Historically, these treaties and institutions have reflected a preoccupation with water scarcity and with the apportionment of surface water resources.

During the past three decades, rapid urbanization and economic development in most parts of the border region have exacerbated the problems associated with water scarcity. At the same time, water quality and environmental protection have become important concerns. The problems related to water scarcity have highlighted the need for improvements in the management of transboundary water and in the coordination of national and binational agencies in the border area. The growing demands for public participation in water management have added to the challenge of developing a more effective and responsive binational framework. These demands are being met by several recent initiatives.

153. M.L. Becker, "The International Joint Commission and Public Participation: Past Experiences, Present Challenges, Future Tasks", (1993) 33 *National Resources Journal* 267.

The 1906 and 1944 treaties for managing transboundary water resources on the US-Mexico border deal mainly with surface water allocation; they devote scant attention to water quality, and even less to groundwater and broader environmental concerns. Treaty authority for managing water quality is limited to sewage and sanitation, and provides little scope for taking account of environmental factors in project design and implementation. Most important, the treaties do not specify national responsibilities related to the quality of transboundary waters. This shortcoming was revealed by the problem of the high-saline waters flowing from the United States into Mexico, particularly in the Colorado River basin (see Chapter 4).

The 1983 La Paz Agreement provides a more comprehensive institutional basis for addressing water quality problems in the border area. This agreement addresses water quality specifically, treating it as a high priority. It also establishes an intergovernmental water working group to consider water quality issues. The creation of the Border Environment Cooperation Commission in 1994 was another step forward in handling water quality problems on the US-Mexico border. The commission applies strict environmental criteria to the sewage and sanitation projects it oversees, and its operating procedures may be applied in other areas in the future.

A concern about the treaties that has yet to be addressed by subsequent agreements is their reluctance to include specific provisions for the apportionment, management or protection of transboundary groundwater resources. As the demands for water grow in the arid boundary regions such as the Tijuana, San Pedro and Santa Cruz basins, groundwater exploitation occurs at rates that often exceed the capacity of the aquifers to recharge. The increasing demands for water and the perception of growing scarcity in the border region are highlighting other aspects of the treaties as well. These include their failure to apportion the surface water of certain rivers and streams, including the Tijuana River, and the ambiguity with which they prescribe the management of sustained drought on the Colorado River and the Río Grande.[154]

In 1973, the United States and Mexico, through Minute 242, agreed on the need to apportion and manage transboundary groundwater resources. However, since then little progress has been made in establishing a groundwater management regime. Because of US plans to build a new, lined All-American canal along California's southern bor-

154. A.E. Utton, "Overview", in *The US-Mexico Border Region: Anticipating Resource Needs and Issues to the Year 2000,* C. Sepulveda and A.E. Utton, ed., El Paso: Texas Western Press, 1982, 7-20.

der with Baja California Norte, the issue of transboundary groundwater resources has now taken on some urgency.[155] The overappropriation of water on the Colorado River and the recent sustained drought in the Río Grande basin have highlighted the need to improve transboundary water management in these areas. Furthermore, regimes for apportioning rivers and streams not covered by the 1906 or 1944 treaties have not yet been established. The prospect of climate change, with its projected disruption of local hydrology, adds to these concerns.

In addition to the limitations of the treaties just described, binational cooperation in addressing emerging transboundary water issues is constrained by historical attitudes toward the apportionment of water. Several important interests, both public and private, have become established within the context of an apportionment regime that they are now reluctant to change. This is particularly true of certain federal and state water agencies, irrigation districts and municipalities on the US side of the border. Apparently, these groups are sometimes unwilling to consider alternatives to the status quo such as water markets and transfers, new regulations, and water conservation initiatives, because such initiatives could have a significant influence on patterns of allocation.

The institutional framework established to manage transboundary water issues on the US-Mexico border is evolving in response to changes in circumstances. IBWC has functioned traditionally as a technical and diplomatic agency, conducting its activities with little public participation. Lacking any treaty provision to consult the public, the commission has tended to rely on a core of experts to guide its deliberations and has refrained from making most of its communications available to the public.[156] Its reputation appears to be changing, however, in the face of demands that the commission become more responsive to public concerns. These concerns include the need to address the growing number of water issues on the border, as well as the need to heighten the public's involvement in water management. Recent management reforms and changes in procedure at IBWC have addressed these concerns.

The past 15 years have seen a clear trend toward greater transparency and public participation in water management on the US-Mexico border. In 1983, the La Paz Agreement officially gave the environmental

155. US Department of Interior, Bureau of Reclamation, *Final Environmental Impact Statement/Final Environmental Impact Report: All American Canal Lining Project, Imperial County, California*, Boulder City, NV: Bureau of Reclamation, 1994.

156. S.P. Mumme and S.T. Moore, "Agency Autonomy in Transboundary Resource Management: The United States Section of the International Boundary and Water Commission, United States and Mexico", (1990) 30 *Natural Resources Journal*.

ministries of the two countries the lead in addressing a wide range of water issues in a systematic and publicly responsive fashion. The La Paz Agreement acknowledges IBWC's leading role in the area of treaty-specific water management functions, but provides a regular process for involving the public in the environmental aspects of managing transboundary waters.

Since La Paz, IBWC has been drawn into more intensive cooperation with the domestic environmental agencies of the two governments in discharging its functions.[157] The result has been improved interagency cooperation and sharing of information. Historically, federal agencies on both sides of the border have shown little inclination to share functional control of water management. At the binational level, competition for scarce water supplies has occasionally made Mexican and US water management agencies reluctant to share information. Such practices have worked against cooperative approaches to managing water in the border area. Beginning in 1991, however, EPA (and IBWC) was given the budget authority to fund sewage projects—a change that stemmed from the La Paz process and greater intergovernmental cooperation in the United States. And since 1983, the La Paz binational water working group has helped to bridge some of the institutional barriers to data sharing and identifying common priorities, and is now folded into the Border XXI process. BECC, with its intergovernmental and binational board of directors and its orientation toward institutional openness should deepen and accelerate this trend.

The Integrated Border Environmental Plan, 1992-1994 (now Border XXI), and the Border Environment Cooperation Commission further institutionalize public participation in the management of transboundary water resources. The Border XXI process provides an opportunity for the public to articulate concerns and to help shape priorities at the level of the environmental ministries of the two countries.

Although it is too early to draw final conclusions about the significance of BECC, several aspects of its mission and structure suggest that it has already begun to change water management practices in the border area. First, BECC's certification provisions require that proposed projects meet strict environmental criteria to qualify for support. These provisions are strengthened by EPA's internal decision to make approval of its domestic water infrastructure grants for border projects conditional on BECC certification. Second, BECC's inclusion of all stakeholders in border constituencies, its procedural transparency and its orientation

157. J. Knox, "Figuring Out the Relationship between the BECC and the IBWC", (1996) 1 *BECC Perspectives* 1.

toward public participation in decision making are unprecedented for a binational body on the US-Mexico border.

Some observers affirm that IBWC is growing more responsive to border constituencies, partly as a result of BECC's influence.[158] Recent initiatives by IBWC also suggest that the agency has responded to changes in political and economic circumstances. These initiatives include adopting BECC's sustainable development criteria for project development; including public participation in IBWC's decision-making process; and making the work of IBWC more transparent to the public.

158. *Ambiente Fronterizo,* "Agency Developments: BECC/NADBank", March 1996, 18. See also, <http://www.riogrande.org/proyecto/inventry/00563.htm>.

CHAPTER 7

Conclusion: Emerging Policy Considerations

Despite more than a century of research, cooperation and policy, North America's boundary and transboundary waters remain a source of potential dispute in several regions. Nevertheless, Canada, Mexico and the United States have shown a commitment toward developing strategies that would protect the natural integrity of their boundary and transboundary waters without compromising their legitimate rights to social and economic growth, and well-being. As observed throughout this report, significant obstacles must be overcome if all three countries are to continue moving toward achieving sustainable development practices in the management of boundary and transboundary water resources.

This chapter presents the policy considerations that emerged from this study. Although broad, they are meant to provide general guidelines to assist policy makers in generating long-term sustainable development strategies that are socially equitable and achievable. It is hoped that these considerations will provide a basis for further discussion and eventually serve in the elaboration and implementation of fully sustainable water management policies across North America's border regions.

7.1. The Nature of Water Resources

The scale, diversity and complexity of management issues vary from one transboundary basin to another. The majority of basins along the US-Canada border are characterized by relatively high freshwater availability relative to demand, improving quality and low rates of population growth (with the exception of the Great Lakes), which suggest only modest increases in future demand. Conversely, basins along the US-Mexico border are characterized by water scarcity —low availability coupled with overallocation, increasing demand fed by rapid population growth, and declining water quality. In fact, scarcity is the most important issue facing decision makers along the US-Mexico border.

Most other issues, such as resource vulnerability, are directly related to scarcity and must therefore be addressed in that context.

Several issues are also common to both border regions. All areas need a greater emphasis on valuing instream and environmental uses. Although such needs will vary considerably from one basin to another, the adoption of initiatives that place a greater value on ecological health and ecosystem maintenance should be an essential and integral part of any water management plan. These regions also need to recognize the potential effects of airborne toxics/contaminants and atmospheric change on freshwater resources and to assess how these may affect the future balance between availability and demand.

7.2 The Availability and Adequacy of Information

Researchers and policy makers in water management need to better coordinate the collection, interpretation and dissemination of data on water supplies, demand, quality and projections. Data on groundwater/surface water interactions is significantly lacking. Other examples of unavailable or incomplete data sets are groundwater availability, quality and use (particularly in Canada and Mexico), and the amount of water used for irrigation. More complete data sets are needed more quickly in those areas where conflicts could emerge such as the Columbia River basin, the Great Plains region, and all US-Mexico basins.

The relevant policy makers and institutions also need to improve access to data and present data in forms useful for public participation and overall decision making. Generally, consumptive use data from the US side of the boundary basins are more accessible and detailed than data from the Canadian and Mexican sides. Moreover, efforts to obtain water-related data have been declining in several jurisdictions. In the North American context, it is imperative that the data from neighboring countries become standardized and harmonized into a coherent format.

It would also be useful to initiate, develop and eventually maintain an inventory of indicators that have significant implications for water management. It could include indicators relevant to climate change and climate variability, ecosystems, health, pollution, economic growth and restructuring, and social vulnerability.[159]

159. Such efforts are already under way along the US-Canada border.

7.3 The Allocation of Surface Water and Groundwater Resources

Officials dealing with regions of actual or potential scarcity need to improve estimates of regional water availability in terms of the average minimal flow of surface waters and the aquifer recharge rates. In some of these regions, such as the Colorado River basin, the current allocation frameworks and streamflow regulation practices are not entirely consistent with physical realities.

In the 21st century, the allocation of groundwater resources is likely to be the subject of increasing debate for Canada, Mexico and the United States. The council of the Organization for Economic Cooperation and Development recommends that OECD member countries develop and implement comprehensive policies for the efficient, sustainable development of groundwater resources and for their long-term protection from pollution and overuse.

In border regions where groundwater represents a significant supply source, officials will eventually have to negotiate transboundary groundwater management agreements. Although many areas have already adopted this policy, they have yet to take specific actions. It is in the best interest of all border regions to adopt safe yield groundwater use policies that would serve to protect vulnerable or overexploited aquifers.

As the perceptions and requirements of various groups of citizens evolve, so do their values on water management. An understanding of this evolution can help guide decision making and policy through the adoption of new forms of environmental and social impact assessment, and public participation. Given the changing profile of regional water demands as a result of economic transition and restructuring, coupled with the recent growth in environmental awareness, there is a need to rethink supply allocations and facility commitments (such as dam storage). Finally, actions to anticipate and meet basic human needs must be taken into account and included in any revision of the current allocation frameworks.

7.4 Demand Management and the Use of Economic Instruments

In view of the present lack of incentives for conservation in certain regions, water managers should review the present water management frameworks—particularly those facing growing water scarcity. His-

torically, water management in North America has been characterized by an overreliance on structural solutions. Recently, however, water management has been shifting policies and actions away from supply management and toward demand management. Essentially, demand management establishes economic and social incentives for the sustainable use, conservation and protection of freshwater resources. One of the most often-cited proposals for demand management is the concept of water pricing.

Several international agencies, including the OECD and the World Bank, have suggested that water pricing is the principal economic instrument through which sustainable use patterns may be achieved in areas of growing water scarcity. When the full cost of water is passed on to the end-user, user awareness increases and wasteful consumption decreases. Such an approach facilitates more rational and environmentally desirable management and use of water resources, and can lead to a more cost-effective distribution of water resource within a regional context.

In the context of transboundary water resources, the introduction of economic instruments must be balanced with measures geared toward avoiding unfair competition and international trade distortion. Anyone contemplating the international harmonization of economic instruments must consider the different environmental and economic situations and fiscal structures in the countries involved.

Any pricing-based management strategies adopted must ensure that social concerns are met, environmental resources are protected, and monopoly pricing is prevented. Policies on water pricing should take into account differences in per capita consumption by different social groups. However, in areas with a substantial disparity of wealth, regulatory pricing frameworks must include provisions that ensure adequate water and sanitation services for the poor. Where underprivileged users are unable to meet the costs associated with water pricing regimes, targeted support mechanisms such as water credits could help to achieve and maintain equity.

One of the main obstacles to developing and implementing full-cost pricing is the definition of "full cost." Ideally, market-based pricing mechanisms should add the cost of mitigating ecosystem and other environmental impacts to the price of supply, storage and delivery. However, placing a value on the ecosystem can be difficult and contentious.

7.5 A Sustainable Future: Large-scale Freshwater Exports and Water Management Decisions

Water exports can be defined as the withdrawal of water from surface waters or from groundwater for the purpose of selling it to a third party outside the country for profit. Such a third party may be in a neighboring jurisdiction or may, in fact, be in a different part of the world. The emerging issue is water exports in bulk, and how trade law and principles may or should relate to such exports.

Bulk water exports are diversions or withdrawals from a source that are in addition to or potentially in competition with the normal apportionment of water for uses within that watershed. This can be the apportionment of water sources that are wholly domestic, such as an individual lake or a river beginning and ending in one country. It may also be a withdrawal or diversion from boundary or transboundary waters. In this case, the water export apportionment would be in addition to the traditional boundary/transboundary water management regimes that have developed on each North American border.[160] Whether the proposed source for water exports is a domestic one or a boundary/transboundary one is most likely to be based on economic and availability factors. Potential examples of both are now known.

In the North American context, policy considerations about water exports tend to be strongly influenced by the relative scarcity of water in many parts of Mexico and the southern United States and the relative abundance of water in Canada and the state of Alaska. Water shortages present immediate management challenges related to both human and ecosystem health. The longer-term potential for permanent shortages entails risks of political conflicts or of environmental refugees, even in a North American context. Water imports may help alleviate short-term problems and improve longer-term management potentials. But at the same time, some people assert that importing water is a potential disincentive to taking strong pricing and conservation measures.

Until the past decade, the rules underlying water apportionment within and between countries reflected principles of equity (including

160. In its interim report under the Water Uses Reference, released 18 August 1999, the IJC recommended that "for the next six months while the IJC completes its investigation, US and Canadian federal, state and provincial governments should not authorize or permit any new bulk sales or removals of surface water or groundwater of the Great Lakes basin." The commission also advanced an interim recommendation that "no removals of surface water or groundwater be allowed that would endanger the integrity of the waters of the ecosystem of the Great Lakes basin."

equality in appropriate cases), not trade rules or principles. Applying principles such as national treatment or most-favored-nation treatment from the trade law domain to water use, rights or apportionment poses a variety of management challenges. If commercial trade in water resources does become a reality, policy arguments against the application of trade principles are likely to be diminished.

Any shift from traditional apportionment approaches toward the application of trade principles should recognize the nature of this shift—that is, such a shift would move beyond the traditional needs for water management of a national or international water basin to what in effect would be the internationalization of previously unrecognized commercial rights to the water in potentially any watercourse. The significance of such a step in the management of a vital, perhaps the most vital, natural resource cannot be underestimated. The emerging challenge for policy makers is one of specifically addressing this issue before challenges materialize,[161] rather than relying on arbitration panels to determine the application of trade agreements to water issues.

Better decision making requires a more comprehensive and detailed level of knowledge. Long-term water management, specifically of allocation, must take into account the potential impacts of climate change and variability, which are likely to affect water availability. Long-term management policies also must consider the effects of economic restructuring on water use.

A broader range of actors could be incorporated into decision-making processes. In many cases, local governments possess useful and sometimes vital knowledge and are therefore best suited to deal with local problems. The capacity for local actors (governments and other local organizations) to pursue local solutions should be encouraged and strengthened, along with policies allowing for greater public participation generally.

161. In the same interim report, the IJC concluded that "international trade law obligations, including the provisions of the Canada-United States Free Trade Agreement, the North American Free Trade Agreement and World Trade Organization agreements, including the General Agreement on Tariffs and Trade (GATT), do not appear to prevent Canada and the United States from protecting their water resources and preserving the integrity of the Great Lakes basin ecosystem. Canada and the United States cannot be compelled by trade laws to endanger the waters of the Great Lakes ecosystem."

APPENDIX:
Transboundary Basin Fact Sheets

Transboundary Basin Fact Sheets

These fact sheets summarize the nature and current status of freshwater resources in North America's transboundary basins. For this summary, the US-Canada border regions were divided into five basins and the US-Mexico border into four basins. The basins were selected and defined primarily on the basis of geographic size and distribution, and therefore do not necessarily reflect actual hydrogeographic boundaries, particularly in the cases of the Great Lakes–Lake of the Woods and Atlantic–St. Lawrence regions.

The basin fact sheets focus mainly on water supply, demand and management. In addition, they identify issues that may figure importantly in future allocation and water management decisions.

Basin characteristics describe the overall physical, social and economic context in which water use and management are taking place. Physical factors determine overall water availability and often have an influence on the complexity of water management decision making. Social and economic factors frequently influence how water is allocated among competing demands.

Balance of uses not only identifies the principal water consumers and main supply sources, but also includes information on the adequacy of available data. Moreover, this section reveals where missing or inaccurate water use data pose barriers to productive decision making on controversial water management issues related to both current and future use. The current and projected allocation of water use is, of course, at the heart of water management decisions in the domestic and transboundary contexts. Use patterns vary substantially among the basins examined in this report, although patterns are similar along the US-Mexico border and along the US-Canada border.

Management issues include broad topics such as equity, water use efficiency, environmental concerns, and recreational issues. Equity/equality and efficiency issues reflect the increasingly important economic, social and, in some cases, political aspects of water manage-

ment decision making. Environmental and recreational needs are emerging in some basins as major, if not controlling, issues, even in the transboundary context. Finally, several of the basins present issues that are somewhat unique to that basin, at least relative to the others examined for this report. These special issues range from severe drought to recurrent mega-diversion proposals to serious water quality problems.

Each basin fact sheet also includes a brief discussion highlighting the most important issues affecting (or likely to affect) transboundary management. These may include, among others, areas and issues of potential conflict, gaps in the current management framework, and evolving environmental concerns.

Yukon River Basin and Northwestern International Drainage Area

BASIN CHARACTERISTICS

Geographic Extent/ Hydrologic Complexity	Yukon is the fifth largest basin in North America (895,000 km^2). Extensive snow fields and glaciers; sub-permafrost aquifers.
Water Availability	Linked to snow melt; abundant water, relatively low consumption.
Population	Very sparse; fewer than 60,000 over entire basin.
Economic Trends	Major industries: mining and tourism.

BALANCE OF USES

Data on Current/ Recent Use	Based on 1990-1991 water use surveys; use levels mostly estimated. Fewer data available for Canada, especially for nonconsumptive uses in mining industry.
Data on Projected Use	No projections available; historical and current data suggest no significant increases in use.
Dominant Uses	Industrial (mining), followed by municipal.
Supply Sources	Primarily surface water (mostly snow melt).
Future Demand/Shortages	No projections available, but large growth in use not expected and entire region has a great abundance of water.

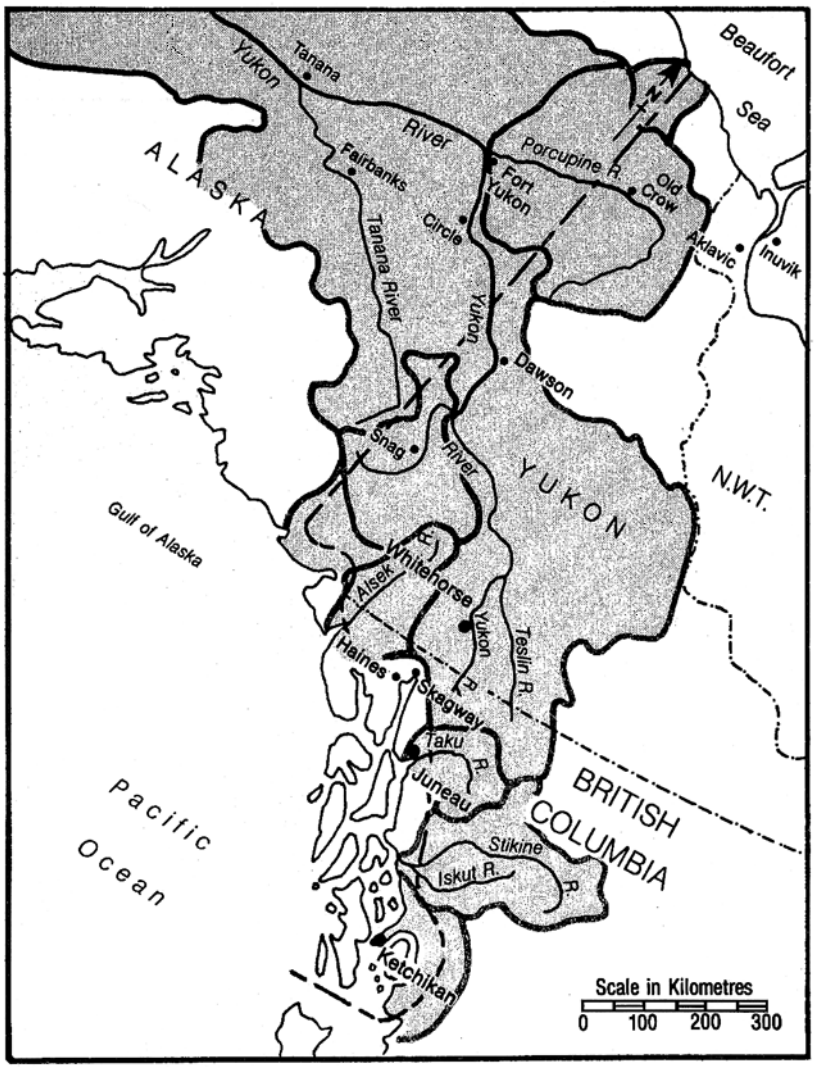
MANAGEMENT ISSUES

Equality Issues	No significant equity issues.
Water Use Efficiency Issues	No significant efficiency issues.
Environmental Needs/ Issues	Yukon supports salmon fishery; important spawning grounds. Basin is also important to a huge variety of migratory birds and wildlife.
Recreational Needs/ Issues	Basin's rivers provide wildlife viewing, canoeing and other recreational opportunities.

Special Issues	Recurrent proposals for mega diversion projects to supply out-of-basin needs. Localized water impacts from mineral mining.

In addition to the Yukon River basin, which is the fifth largest in North America, several other contiguous boundary basins lie in the Northwestern International Drainage Area. The most significant of these are the Alsek, Taku and Stikine Rivers, which flow from Canada into the Alaskan Panhandle. Some of the tributaries within the Yukon basin are themselves boundary waters, the most important of which are the White, Porcupine and Fortymile Rivers.

Figure 1: Northwestern International Drainage Area



Source: Adapted from a map titled "Current Activities of the International Joint Commission 1995," Gregory Geoscience Limited, 1995.

Mining and tourism, the major industries, form the economic base of the region. Smaller industries include forestry, hunting, fishing and trapping. Population migration patterns in the area respond strongly to economic opportunity. Basin residents are relatively younger than those

in North America generally. A large number tend to be young people who come to take advantage of high-paying jobs and then leave as employment opportunities decline. Aboriginal residents are highly dependent on the Yukon River and its tributaries for transportation and subsistence fishing.

Freshwater consumption on the Alaskan side of the border is dominated by the industrial sector, which accounts for roughly 70 percent of the uses in the Yukon and other boundary basins. On the Canadian side, municipal water systems are the most important water consumers. The Yukon Territory's mineral extraction industry, which consists of metal mining, nonmetal mining and coal mining, requires as much water as the municipal sector, but its consumptive use is very close to nil.

Water quality conditions throughout the area are suitable to support most uses. Most public sewage receives some treatment, and industrial discharges are subject to environmental regulation. Some localized problems exist, however. For example, placer mining requires large volumes of water, resulting in changes to the landscape and some water quality degradation. Nevertheless, general water quality conditions in the Yukon River itself are not, and are unlikely to become, an international issue in the foreseeable future. Of more immediate concern are specific developments on smaller tributaries in the vicinity of the boundary. Some current examples include increased placer mining on the Fortymile River (US-Canada) and Moose Creek (Canada-US).

Some contentious issues also have emerged in contiguous basins flowing from Canada to the Alaska Panhandle. For example, establishment of a World Heritage Site Park linked to two national parks in the United States precluded development of the Windy Craggy Mine on Tats Creek in the upstream part of the Alsek River basin. The developer sought compensation. Other potential developments with transboundary implications include several additional mine proposals in the Stikine-Iskut and Unuk basins. The Eskay Creek mine in the Unuk basin was granted a mine certificate in 1994 and is operational. Another proposal in the Tulsequa basin in British Columbia is currently under review, with Alaska officials participating.

With the exception of localized problems due to seepage from septic systems, landfills and abandoned fuel tanks in the Fairbanks area, the basin's groundwater has been virtually unaffected by human activity. No issues related to groundwater quality along the Yukon-Alaska border have been documented. Nor is there any evidence of large-scale

groundwater degradation caused by industrial or mining activity on either side of the boundary.

At least 20 species of fish inhabit the Yukon basin, including 17 freshwater and three anadromous species. The most prevalent species are Chinook salmon, chum salmon, lake trout and arctic grayling. A commercial fishery for Chinook and chum salmon has existed in the basin since 1903. Sport fishing is a major component of water-based recreation, and the fishery is a significant food source for aboriginal people. As elsewhere in North America, rising demands could threaten the long-term sustainability of this resource.

Some water-related phenomena are important for wildlife. Spring floods renew the nutrients critical to river valley productivity. Fall drawdown results in exposure of feed at waterfowl staging areas and winter drawdown creates air spaces below river ice, providing foraging areas for muskrat. The areas that remain ice-free during winter are important to both resident and migrating waterfowl. And the erosion and deposition of sediment maintain deltas and river valleys in a state of dynamic equilibrium, providing a more or less constant set of habitats for plants and animals. Clearly, any changes in the hydrologic or quality regimes that would significantly affect seasonal rhythms in nature would affect biological diversity in and well beyond the basin.

Over the next several decades, it is not anticipated that events within the Yukon River basin will lead to significant boundary waters issues. Population and industrial activity in the Canadian portion of the basin are not expected to create significant changes in the streamflow, water balance or water quality regimes at the international boundary.

However, it is almost certain that the number of very localized issues will continue to arise. Most of these are likely to involve mining developments on streams flowing to the Alaska Panhandle, or on smaller boundary streams within the Yukon River basin. Localized issues also are likely to be associated with wilderness designations which may limit either access or development in the upstream jurisdiction. Finally, there is a moderate possibility that smaller-scale diversions may be created from the headwater lakes for hydroelectric development, or that significant hydroelectric development may take place on the main stem of the Yukon itself. If so, it is likely that such developments will be undertaken to meet demands outside the basin and that the transboundary implications will be significant. Those implications will relate to changes in the flow regime and in turn to a number of ecological variables.

Columbia River Basin

BASIN CHARACTERISTICS

Geographic Extent/ Hydrologic Complexity	Basin covers 646,000 km^2. Columbia River is one of the most extensively dammed rivers in North America.
Water Availability	Primary source is snow melt, with peak flows in summer. Rainfall contributes to flows in winter.
Population	Some areas sparsely populated; others (including the British Columbia portion of the basin) growing rapidly.
Economic Trends	Irrigated agriculture remains important. Tourism and recreation are increasing. Forestry is significant in British Columbia.

BALANCE OF USES

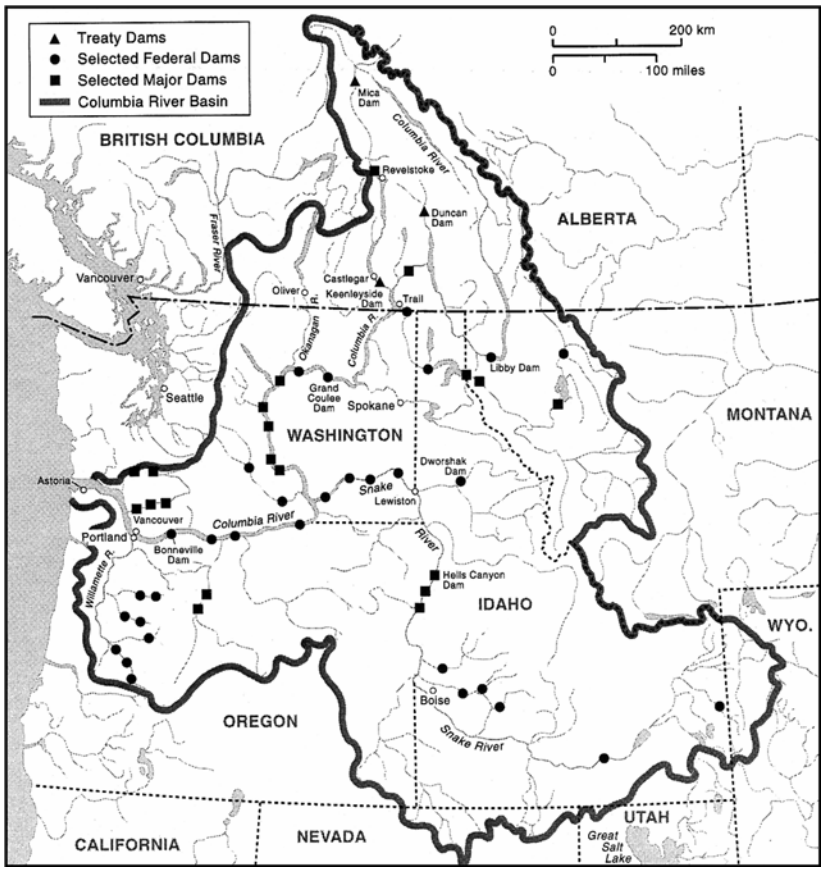
Data on Current/ Recent Use	Generally inadequate. Some analysis done in US portion of basin for review of dam operations and new water rights database in British Columbia.
Data on Projected Use	Projections available for US side only (USGS).
Other Information	New efforts by agencies to better characterize water use under way in both countries.
Dominant Uses	Hydroelectricity (nonconsumptive), forestry (BC), irrigation (US portion). Municipal use is less than four percent on average.
Supply Sources	Surface water is the primary source.
Future Demand/Shortages	Abundant water. Conflicts around flow management, however, may affect availability for certain uses.

MANAGEMENT ISSUES

Equality Issues	Conflicts between irrigation uses and municipal needs (BC portion) and instream flow needs (US portion) and conflicts between hydroelectric and other uses (particularly instream needs). Cross-border equity issues regarding hydropower generation and irrigation allocations.
Water Use Efficiency Issues	Subsidization of irrigation water; little progress in conservation by irrigation users.
Environmental Needs/ Issues	Major conflicts between flow needs for endangered salmon and other fish and hydropower and irrigation uses—one of the most important issues in the basin.
Recreational Needs/ Issues	Reservoir water levels can affect recreational opportunities, creating conflicts with hydropower use. Maintaining flows in river for recreation is also an important issue.
Special Issues	Fisheries restoration efforts under the *Endangered Species Act* in the US portion of the basin; cross-border hydropower generation disputes.

The Columbia River has been described not only as a scenic treasure and ecological gem, but also as the economic backbone of the entire Pacific Northwest in the United States and central interior of British Columbia. Although the high-technology fields of aerospace engineering, scientific instruments and computer programming now contribute 42 percent of all employment in the Pacific Northwest, the Columbia basin remains a supplier of many raw materials and semifinished manufactured goods.

Figure 2: Columbia River Basin

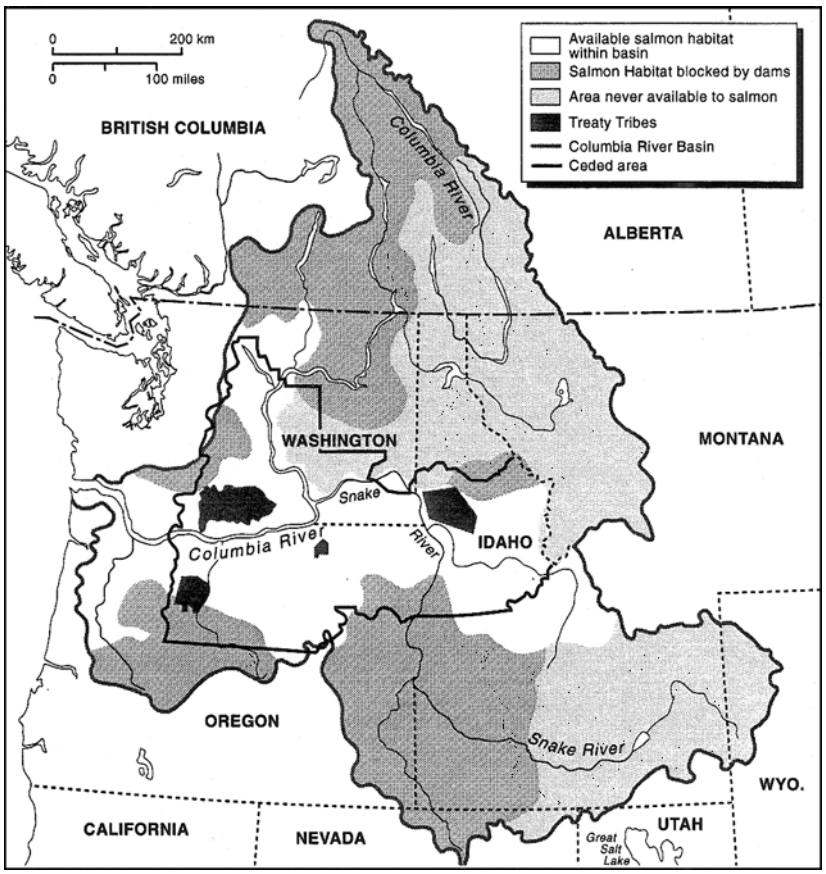


The Columbia is one of the most extensively dammed rivers in North America. Federal dams built on the Columbia and its tributaries beginning in the 1930s, as well as many nonfederal projects, support the numerous uses of the basin by diverting, regulating and storing water for consumptive and instream uses. Investment in these dams and related infrastructure has enabled many uses to coexist and, thus far, share the water resources within the Columbia River system. Nevertheless, hydroelectricity, flood control and navigation have been favored over all other uses.

Little has been written on water uses in the Columbia basin, reflecting perhaps that, until recent years, water has been plentiful in the basin. This situation changed rapidly over the past decade with the identifica-

tion of endangered anadromous salmon and other species in the US section of the river, and the need for massive water releases in an effort to flush fry through the large reservoirs and past the dams. As shown in Figure 3, dams have blocked off nearly 50 percent of available salmon habitat in the Columbia basin.

Figure 3: Changes in Available Salmon Habitat in the Columbia River Basin



The 1961 Treaty between Canada and the United States of America Relating to Cooperative Development of the Water Resources of the Columbia River Basin, better known as the Columbia River Treaty, and subsequent agreements legitimized hydroelectricity as the dominant water use on both sides of the border. However, beginning in the 1970s this agreement also led to conflicts with the needs of fisheries and recre-

ation for special flow conditions. Later, new patterns of reservoir releases were adopted in an effort to promote the sustainability of anadromous fish. These changes significantly reduced streamflow for energy use in the United States and, to a comparatively minor level, in Canada. Recently emerging water conflicts in the basin relate to the special levels and flows required to maximize recreation benefits in both countries. The Columbia River Treaty, however, does not recognize recreation as a legitimate water use and hydroelectric agencies in each country, augmented by federal flood control interests in the United States, decide how much, and when, water will be allocated for recreational purposes. To date, hydroelectricity needs have been paramount in this conflict.

Consumptive water uses have been growing in both portions of the basin. Irrigation is currently the largest consumer of water in the basin (90 percent), with six percent of the flow in the United States allocated to this use. By comparison, only two percent of the Canadian consumption of a much smaller volume of flow is used in irrigation. On the Canadian side of the border, the largest industrial water user is the forestry industry, with a smaller volume allocated to mining. The only large city on the river, Portland, Oregon, uses other watersheds to supply its domestic needs, so municipal use of water from the Columbia is modest. Commercial and industrial water demand is also comparatively small compared with the volume of flow.

In general, water quality problems in the Columbia basin are less significant than in some other basins in North America. Point source pollution has been drastically reduced through regulation in recent decades, and the remaining concerns largely revolve around the effects of non-point source pollution and the effects of dams on water quality. On a basinwide scale, the water problems that remain at the forefront include: temperature, sedimentation, dissolved gas levels, dioxin concentrations, PCB contamination, and interactions between surface and groundwater.

Over the next decades, sustainable management of the Columbia River basin's water resources will require combined efforts between Canadian and US institutions. As the basin population grows and industrial water uses increasingly compete for the finite resources within the basin, it would be useful to assign planning and monitoring functions to a regulatory body. Given current fiscal constraints in both countries, it seems prudent to assign this task to existing institutions. Doing so would heighten the prospect that mutually agreeable resource and environmental policies will be adopted in each country, increasing the probability of continued harmonious international relations.

Great Plains Region

BASIN CHARACTERISTICS

Geographic Extent/	Five main basins crisscross the border: St. Mary, Milk, Poplar, Souris and Red
Hydrologic Complexity	Rivers. Several storage reservoirs are located in the basin.
Water Availability	Arid to subhumid continental; spring flooding from snow melt; seasonal periods of heavy rainfall (highly variable), near-surface aquifers.
Population	Generally sparse; concentrated in urban areas of Red River Valley and Winnipeg, Manitoba.
Economic Trends	Still largely agricultural (farming and ranching); tourism increasing.

BALANCE OF USES

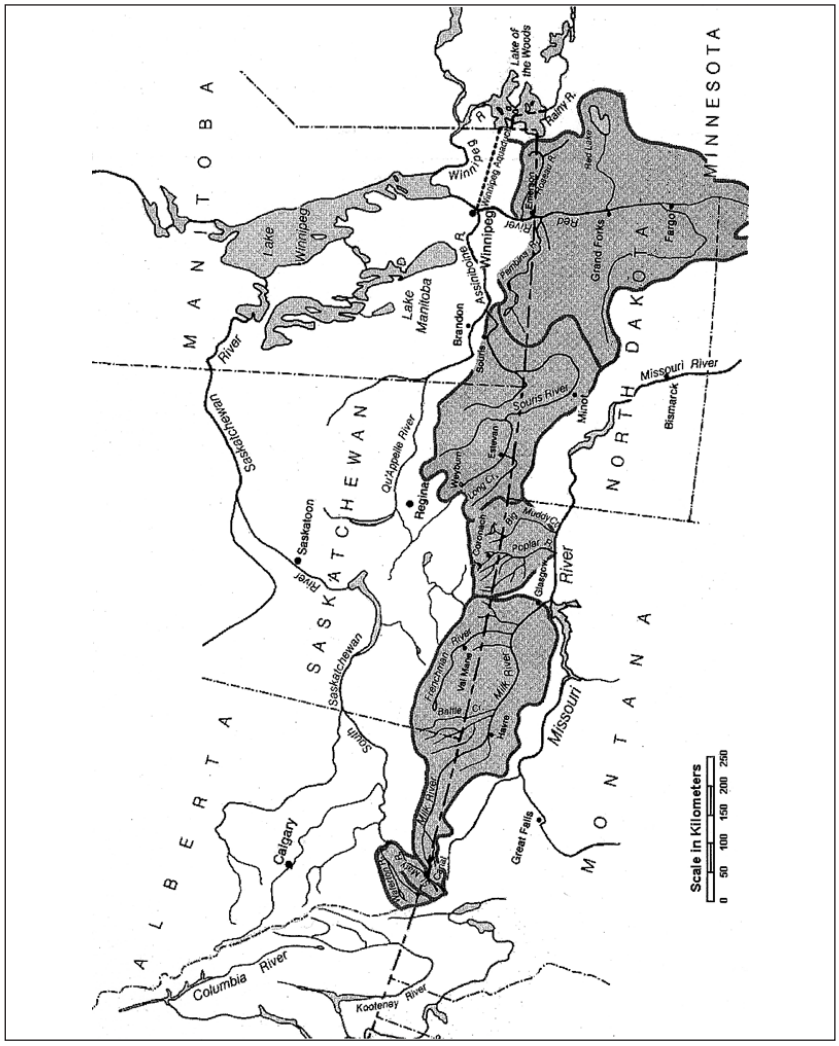
Data on Current/ Recent Use	Relatively good data on existing uses in both countries due to boards of control activities; lack of data on agricultural use in Canada.
Data on Projected Use	Projections available for US side only (USGS).
Other Information	Groundwater vulnerability mapping is being developed in the Prairie provinces.
Dominant Uses	Irrigated agriculture is the dominant use in all four basins. Thermoelectric power production is a large user in the Canadian portion of Souris River basin.
Supply Sources	Surface water is the primary source in the Milk and Poplar Rivers. Groundwater is important in the Souris basin and constitutes about half of supply in Red River basin.
Future Demand/Shortages	Potential shortages for irrigators in Montana portion of Milk River during prolonged drought; potential shortages in Souris River basin during drought.

MANAGEMENT ISSUES

Equality Issues	Cross-border allocations governed by various bilateral accords, but Canada not yet using full allocation in some basins.
Water Use Efficiency Issues	Relatively little information available on water use efficiency for irrigation or municipal needs.
Environmental Needs/ Issues	Maintaining adequate streamflow for wildlife refuges; loss of habitat due to reservoir construction in Saskatchewan portion of Souris River basin.
Recreational Needs/ Issues	Sport fishing in free flowing rivers is an important source of tourism revenue in some areas, mostly in the United States.
Special Issues	Garrison Diversion Project raised concern about effects of transbasin diversions on aquatic biota in Souris River in Manitoba. Major flooding along the Red River in 1997 led to a reexamination of flood control infrastructure.

The Great Plains region occupies some two million km^2 in southern Canada and the northern United States. The climate throughout most of the area is subhumid continental, except for the region that lies in Montana, southwestern Saskatchewan and southeastern Alberta, where it is generally classified as arid to semiarid. For international water management purposes, the transboundary waters are administered on the basis of hydrologic units, the most important being the St. Mary, Milk, Poplar, Souris and Red River basins.

Figure 4: Great Plains Boundary Basins



Source: Adapted from a map titled "Current Activities of the International Joint Commission 1995," Gregory Geoscience Limited, 1995.

The population in the boundary water basins is generally sparse, numbering about 1.6 million. Over 75 percent is concentrated in urban areas of the Red River Valley. The region's economy is largely based on agriculture. Livestock raising and irrigated agriculture is greatest in the western part of the region (Montana, Alberta), shifting to a mixture of

grains and specialty crops toward the east (Saskatchewan, North Dakota). In the eastern extremity of the region, the economic base becomes more diversified with the presence of urban centers such as Winnipeg, Grand Forks and Fargo, which have significant manufacturing and industrial activities. Water consumption is dominated by irrigation throughout most of the basin. Livestock watering and domestic, industrial and power generation uses are also important in certain regions. Because this area is generally short on water, the issues of water use and interjurisdictional water sharing are both extremely important and closely interrelated.

In spite of being part of separate continental drainage systems, the St. Mary and Milk Rivers are jointly administered for international purposes. Substantial quantities of water are diverted from the St. Mary River to the Milk River in the mountain headwaters to augment the water supply for irrigation downstream in the arid prairie region of Montana. The waters of these rivers are heavily used for irrigation, which accounts for more than 90 percent of all consumptive uses on both sides of the border. In general, the waters of the St. Mary and Milk Rivers are shared equally between the two countries, with the upstream country responsible for ensuring the delivery of at least 50 percent of the natural flow. Significant excess deliveries occur only in wet years. Water quality has not yet been raised as an international issue in the area, but Alberta irrigation return flows could potentially create undesirable salinity at the boundary. Alberta has imposed a unilateral limit on irrigation return flow to the Milk River of 10 percent of river flow in an attempt to prevent this problem from arising.

In the Poplar basin, several small streams drain south across the border to the Missouri River east of the Milk River basin. These streams drain a semiarid prairie region with low and highly variable runoff characteristics. No formal international apportionment agreement has been established for the Poplar River, but since 1976 an informal arrangement based on an IJC recommendation has been used. The recommended apportionment provides for equal sharing, with flexibility for Saskatchewan to use more than half of the water from individual streams. Provision is also made to assure Montana a certain base flow to meet the needs of existing users. No problems with meeting this informal understanding have been documented. The International Poplar River Quality Board has shown that quality objectives set in 1979 have been met, and that the boron and total dissolved solids (TDS) concentrations were very close to the objectives during drought years in the late 1980s and early 1990s. Wetter conditions in recent years are diluting these minerals and the overall quality has been improving.

The Souris River drains from southeastern Saskatchewan into North Dakota, then crosses back into Manitoba. Water quality in the Souris River is relatively poor, especially during low flow periods. Agricultural runoff, municipal and industrial effluent, and intensive livestock operations contribute high levels of total dissolved solids, nutrients and bacterial contamination and result in depressed concentrations of dissolved oxygen. In Manitoba, pollution has restricted recreational uses such as fishing, swimming and hunting in some areas. Prompted by proposals for relatively large storage reservoirs at Rafferty and Alameda in Saskatchewan, the United States and Canada signed the Agreement for Water Supply and Flood Control in the Souris River (1989). Under this agreement, Saskatchewan has the right to divert, store and use waters that originate in the Saskatchewan portion of the Souris River basin, provided that the annual flow of the river at Sherwood Crossing is not diminished by more than 50 percent. In recent years, Saskatchewan has regularly released water from storage in order to meet apportionment requirements.

The Red River forms the border between the states of North and South Dakota and Minnesota and flows north into Lake Winnipeg. Flow apportionment has not yet become an issue in the Red River basin, where groundwater supplies roughly 50 percent of all the freshwater used. The high levels of pollution of the 1960s have been largely overcome by upgrading sewage treatment. However, monitoring indicates that the objectives are still exceeded for certain parameters (mineral quality indicators, chloride, TDS) during low flow periods.

The most important ecological issues in the Great Plains region are the effects of diversion and storage infrastructures (the proposed Garrison Diversion Unit in the Dakotas and the Rafferty and Alameda Dams in Saskatchewan) on wildlife habitat.

The waters from the Rocky Mountains to the Saskatchewan-Manitoba border are already heavily used, mainly by existing irrigation and thermal power developments. There will be little opportunity for meeting new demands unless some existing uses are discontinued. Groundwater, which is relatively abundant but highly vulnerable, may represent an untapped source, but it has yet to be incorporated into the present transboundary management framework.

Great Lakes Basin (Including Lake of the Woods)

BASIN CHARACTERISTICS

Geographic Extent/ Hydrologic Complexity	Great Lakes-St. Lawrence basin is largest body of freshwater in the world. The Lake of the Woods basin covers less than 75,000 km^2.
Water Availability	Snowfall, rainfall and runoff into lakes. Groundwater is relatively abundant.
Population	Great Lakes environs have a highly urbanized population of over 33 million; Lake of the Woods is only sparsely populated. Toronto (Canada) is only area showing significant growth.
Economic Trends	Manufacturing, services, trade and tourism. Agriculture important in some areas.

BALANCE OF USES

Data on Current/ Recent Use	Use data generally adequate.
Data on Projected Use	Some projections available from the International Joint Commission.
Other Information	Extensive information available on water quality, including toxics and nutrient loadings.
Dominant Uses	Industrial, municipal and electric power production (hydro, coal and nuclear). Recreation and navigation are the most important instream uses.
Supply Sources	Surface water is the primary source, although groundwater use is important in Wisconsin and some other areas.
Future Demand/Shortages	No predicted shortages. Groundwater availability could be compromised by localized contamination.

MANAGEMENT ISSUES

Equality Issues	Projects involving major diversions and bulk water exports continue to arise.

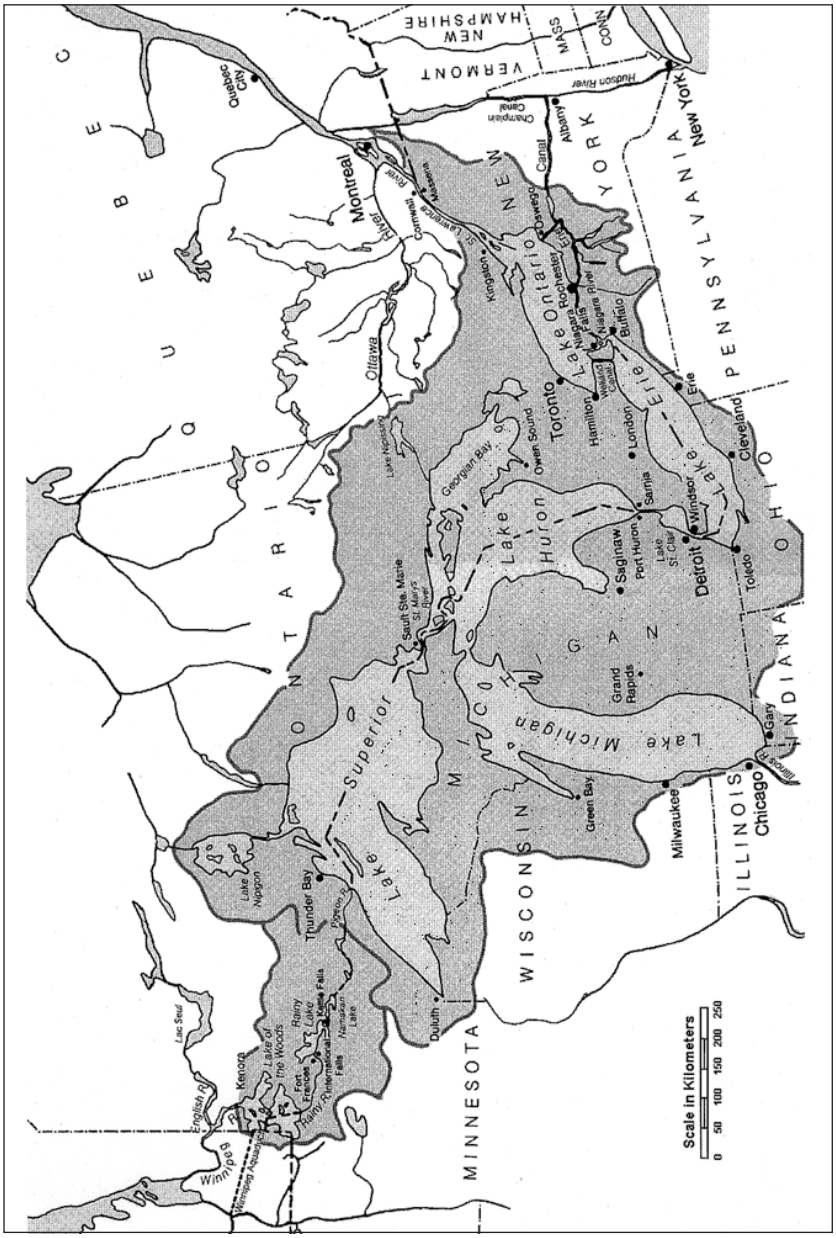
Water Use Efficiency Issues	Not an issue given availability.
Environmental Needs/ Issues	Major focus is on improving Great Lakes water quality, restoring fisheries and protecting other aquatic life, including habitat.
Recreational Needs/ Issues	Some conflicts over lake level management. Recreational use of lakes is economically important.
Special Issues	Challenges of water quality improvement and protection in a binational, multijurisdictional context.

When considered as a single hydrological unit, the Great Lakes basin is the largest freshwater reservoir in the world. Extending over 1,500 km east to west and three-quarters of that north to south, the size of the Great Lakes alone warrants a comparison with oceans. The number of studies and reports on the status and management of Great Lakes freshwater resources is enormous when compared to those conducted on and written about other transboundary basins.

As they have done for centuries, the Great Lakes and their connecting channels provide a major transportation and trade pathway into North America. The basin supplies freshwater to a large, mostly urbanized population, meeting the demands of industrial, commercial, domestic and agricultural sectors alike. Of the 34 million people living in the Great Lakes basin, nearly 75 percent are in the United States. The American population is concentrated along Lakes Erie and Michigan, whereas the majority of Canadians live along Lake Ontario. The Great Lakes also constitute a vital aquatic ecosystem, supporting commercial and sport fisheries as well as other recreational activities. The main international management issues of the Great Lakes are quality maintenance, navigation and lake level and flow regulation through diversions, and hydroelectric power generation.

In contrast to the Great Lakes, the Lake of the Woods basin remains a wilderness area, serving a special clientele devoted to conserving its environmental and ecological integrity. In fact, recreation and tourism are one of the region's major revenue-producing sectors. The entire basin is populated by fewer than 150,000 inhabitants, the large majority of whom live in municipalities such as Kenora and Fort Francis in Ontario and International Falls and Beaudette in Minnesota.

Figure 5: Great Lakes-Lake of the Woods Basins



Source: Adapted from a map titled "Current Activities of the International Joint Commission 1995," Gregory Geoscience Limited, 1995.

The predominant management issues in the Lake of the Woods basin are flow regulation and lake level maintenance in light of the recent increased frequency of spring flood events. Water quality in the Lake of the Woods basin has improved over the past several decades because of an increase in the number of local municipal treatment plants and remedial measures at the two major pulp and paper plants in Minnesota and Ontario.

Size and capacity are the fundamental characteristics governing the balance of water in the Great Lakes. For all practical purposes, Great Lakes water is sufficient to meet future regional demands. However, although the Great Lakes hold 20 percent of the world's freshwater, only a very small portion is renewed annually and only the top few centimeters are usable given the infrastructure in place. Thus consumptive uses, diversions into and out of the basin, and water allocation for hydropower generation combine to exert a significant influence on the system's hydrological and ecological balance.

Water quality continues to be the primary water management issue in the Great Lakes. Despite some improvements throughout the 70s and 80s, the overall water quality of the Great Lakes remains quite variable. With open lake pollutant concentrations such as phosphorus still exceeding targeted guidelines in several areas, it has become obvious that new approaches are required to ensure the sustainable management of the basin's water resources.

Over the past decade, water quality assessment has shifted from a quantitative to a more qualitative analysis in order to improve public understanding about quality conditions under the Great Lakes Water Quality Agreement. Other tools, such as the 1994 State of the Lakes Ecosystem Conference (SOLEC), have proven to be valuable in defining current quality issues. Because loadings of toxins and nutrients within the basin have decreased significantly, investigators are now turning toward other possible pollutant sources, such as the long-range transport of airborne contaminants, to explain the recent lack of progress in water quality remediation. Given the vastness of the lakes and their high level of spatial variability, it is essential that extensive data-gathering initiatives continue and that the public be kept informed. The use of indicators represents a new and promising direction in identifying needed information.

The IJC should continue to strive for an improved information-gathering and analysis process that will allow it or some other appropriate entity to provide objective advice to the two governments on the

management of the broad Great Lakes basin ecosystem. While such a goal may seem a small matter, it has great significance in placing the long-term management of the Great Lakes on a firm basis and in reducing the opportunity for the governments to be surprised by unforeseen events or by events that require a long lead time to be met in an effective way.

Upper St. Lawrence and Atlantic Drainage Basins

BASIN CHARACTERISTICS

Geographic Extent/ Hydrologic Complexity	Basin extends 1,000 km and includes many transboundary rivers, streams and lakes. Extensive network of near-surface and deep bedrock aquifers.
Water Availability	Outflow from Great Lakes; abundant precipitation year-round; high-yield aquifers.
Population	Mostly rural communities on US side; several small to medium-size municipalities on Canadian side; population growth nil over past decades over the entire region.
Economic Trends	Wide-ranging: agriculture (Vermont and Quebec), forestry and lumber (Maine and New Brunswick), tourism, pulp and paper, textile, manufacturing.

BALANCE OF USES

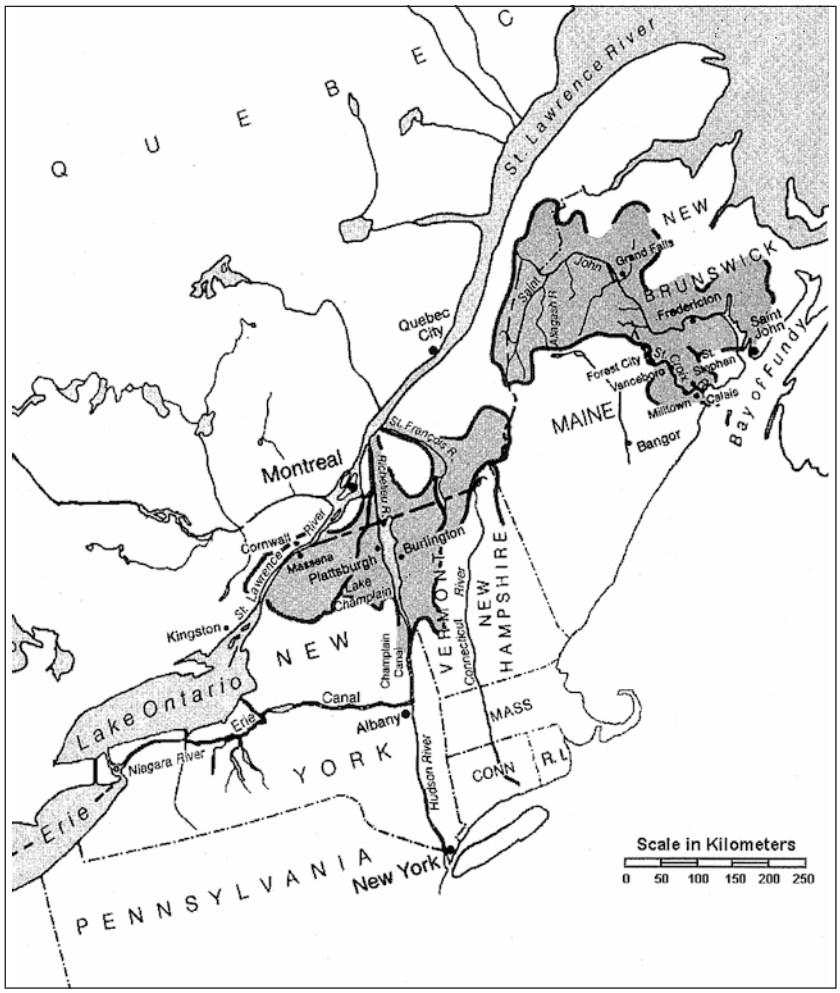
Data on Current/ Recent Use	Based on 1990-1991 water use surveys. Data on agricultural use are lacking; groundwater withdrawals for Canada are not fully quantified.
Data on Projected Use	No projections available (current population and economic growth patterns suggest only minimal increases in demand/use).
Other Information	Quality data available for St. Lawrence and St. Croix Rivers. Water use data from Quebec difficult to access.
Dominant Uses	Thermoelectric power, manufacturing and municipal uses. Agricultural use of groundwater (Quebec) mostly undocumented.
Supply Sources	Surface water is the primary source in the west; importance of groundwater generally increases from west to east.
Future Demand/Shortages	No predicted shortages.

MANAGEMENT ISSUES

Equality Issues	No significant equality issues.
Water Use Efficiency Issues	No significant efficiency issues.
Environmental Needs/ Issues	St. Lawrence wetlands are not included in present US-Canada environmental agreements. Proposed flood control infrastructures could affect wildlife. Eutrophication is problem in several lakes.
Recreational Needs/ Issues	Tourism (hunting, fishing, camping, boating etc.) remains very important to the regional economy. Local water quality problems have occurred along several lake beaches.
Special Issues	Area continues to be subject to pollutants from outside the basin, such as contaminants flowing out of the Great Lakes and the long-range transport of airborne pollutants. Spring floods along the Richelieu basin are a recurring issue.

The St. Lawrence-Atlantic drainage region includes several transboundary and boundary waters from the Great Lakes to the Bay of Fundy. The international reach of the St. Lawrence, a portion of the St. John River and most of the St. Croix River lie along the international boundary. Two other major transboundary streams—the Richelieu River crossing the New York-Quebec border, and the St. François River crossing the Vermont-Quebec border—flow north from the United States into the St. Lawrence.

Figure 6: Upper St. Lawrence-Atlantic Drainage Basins



Source: Adapted from a map titled "Current Activities of the International Joint Commission 1995," Gregory Geoscience Limited, 1995.

This boundary region is home to roughly 2 million people, just over half of whom live on the Canadian side. Population density generally decreases from west to east on both sides of the border. In the United States, the larger centers such as Massena, Plattsburgh and Burlington give way to smaller, mostly rural communities in Vermont and Maine. The pattern is similar in Canada, with the exception of a few larger municipalities such as Fredericton and Saint John in New Brunswick.

The St. Lawrence River and the Great Lakes basin which forms its headwaters make up one of the most economically significant water systems in North America. A large variety of manufacturing and transformation industries, located on or near the upper St. Lawrence shoreline, benefit from one of the world's most vital commercial transportation routes. The economic base of the southern tributaries to the St. Lawrence are perhaps best typified by conditions in the largest tributary basin, the Richelieu. Areas of New York and Vermont have a high level of agricultural employment; the resorts and recreation industry, as well as the textile, paper and wood products industries also are significant employers. In Quebec, textile and clothing manufacturing, dairy farming and commercial recreation are among the most important economic activities. Finally, in the St. John and St. Croix River basins the primary industries (agriculture, forestry, fisheries and mining) have traditionally been the dominant economic sectors.

With the outflow from the Great Lakes and precipitation averaging about 1,000 mm per year, water is plentiful throughout the region. Given such abundance, the region's transboundary water management focuses on the environmental, social and economic consequences of regional water quality and flow regulation. Levels and flows are important and sometimes controversial issues in the Great Lakes and St. Lawrence River.

In the upper St. Lawrence River, both hydroelectricity and navigation require reasonably high and stable water levels. To date, outflow rates from the Great Lakes have been sufficient to meet downstream requirements, but any significant reduction in the outflow could upset the balance. Water quality in the upper St. Lawrence remains relatively poor. The quality of the mainstream water generally reflects that of the eastern portion of Lake Ontario, which is its source. Water quality in the nearshore areas tends to be affected more by local municipal and industrial discharges, particularly in the Massena-Cornwall region. Many of the beneficial uses in the area have been impaired to some degree by contaminants such as zinc, lead, chromium and a wide variety of hydrocarbons. As a result, fish advisories are in effect along several reaches. PCBs have been repeatedly observed in bottom sediments, particularly in the south channel downstream of ongoing PCB sources, as well as in fish and wildlife tissues. The mercury found in fish and sediments is believed to have it origins in the low-level discharges of mercury from Cornwall sources.

With the exception of occasional spring flooding along the Canadian stretch of the Richelieu River, the major management issue along

the transboundary tributaries of the St. Lawrence are nutrient loadings and the resulting eutrophication of the two boundary lakes: Lake Champlain in the Richelieu basin, and Lake Memphremagog in the St. François basin. However, water quality is generally good in the lower-order rivers and streams within the vicinity of the border.

The St. John and St. Croix basins continue to support an important fisheries sector, despite having experienced serious environmental stresses from pesticide use, chemical wastes and acid deposition. Fortunately, water quality has improved in recent years. Of more immediate importance from a boundary and transboundary water management perspective is the issue of water level and streamflow regulation in the two basins. Three major hydroelectric dams are located along the St. John and several smaller dams within the St. Croix basin. Of concern along the St. John are the potential flooding of agricultural land upstream of the dams and the recurring springtime floods in the lower St. John Valley. In the St. Croix basin, concerns center on fluctuating water levels in the upstream section and the effects of this fluctuation on the local bass fishery and other wildlife species. The IJC has been reviewing its orders on the St. Croix with respect to these and other issues. Another growing problem is the effect of pollution in the St. Croix estuary on shellfish.

Tijuana River Basin

BASIN CHARACTERISTICS

Geographic Extent/ Hydrologic Complexity	Relatively small basin of 4,500 km^2; 75 percent of basin in Mexico. Strong groundwater/ surface water interconnections; series of reservoirs in upper part of basin.
Water Availability	Arid area; flow derived primarily from rainfall runoff. Streamflows extremely variable. Roughly 80 percent of water used in basin is imported from the lower Colorado River basin.
Population	Dense urban population in San Diego/Tijuana and Tecate. US population is about 2.5 million. Population exceeds one million in Mexican portion of basin.
Economic Trends	San Diego: technology, tourism, military, services. Tijuana and Tecate: manufacturing, trade. Some localized dependence on agriculture.

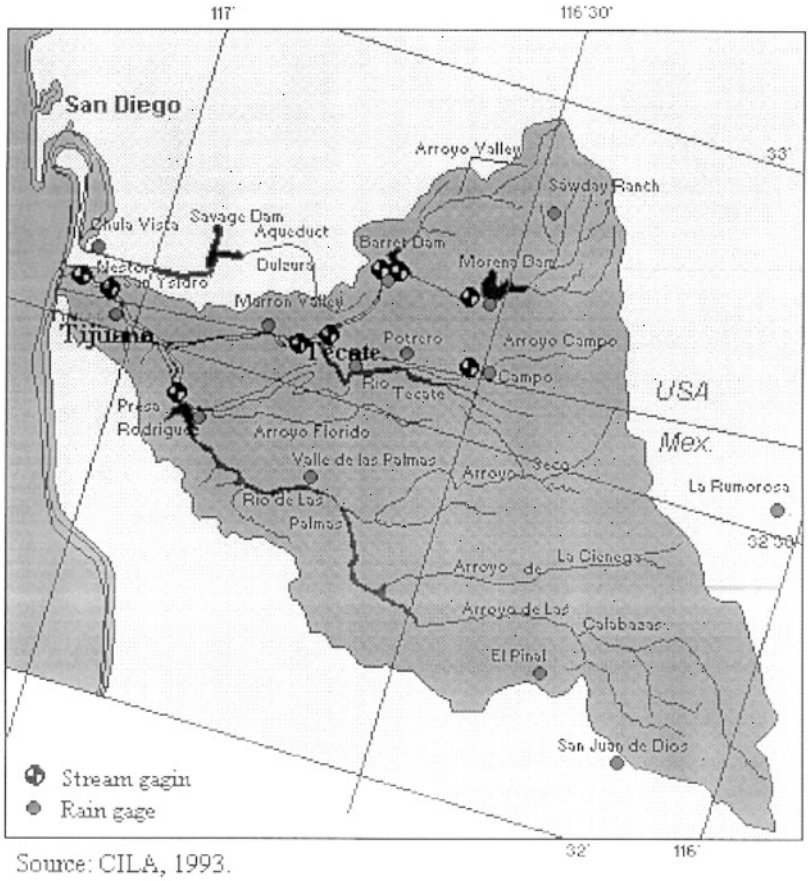
BALANCE OF USES

Data on Current/ Recent Use	Use data generally available, though use from basin fluctuates with available flow. Incomplete data on groundwater use. Estimates only available on agricultural uses.
Data on Projected Use	Aggregate projections available, but primarily based on population trends.
Other Information	Regional planning efforts on both sides of border are developing more extensive database.
Dominant Uses	Municipal use dominates on both sides. One major industrial user (brewery) in Tecate. High-technology manufacturing in Tijuana *maquiladoras* is also significant water user.
Supply Sources	Irrigation supplied primarily by groundwater in Mexico portion. Surface water applied to other uses, though availability of in-basin supply varies greatly. San Diego, Tijuana and Tecate depend heavily on out-of-basin supplies, particularly in drier years.

Future Demand/Shortages	Urban growth will increase demand, but Tijuana basin already fully appropriated. Reduced agricultural use may free up some water.
MANAGEMENT ISSUES	
Equality Issues	Need for increased access to centralized potable water in Tijuana and Tecate; cost of water for low-income populations; conflicts between environmental needs and other uses.
Water Use Efficiency Issues	High reliance on inefficient flood irrigation in Mexican portion of basin continues. Per capita municipal use much lower in Mexican portion of basin. Better metering of water use required; improvements needed in municipal water distribution system, particularly in Tijuana.
Environmental Needs/ Issues	Need to maintain appropriate balance of clean freshwater flows to Tijuana River estuary; riparian habitat restoration issues.
Recreational Needs/ Issues	Water quality problems affecting beaches near Tijuana River discharge.
Special Issues	Protection of Tijuana River Estuary Reserve with appropriate balance of freshwater inflows. Pollution of beaches due to raw or partially treated sewage flows. Construction of international wastewater treatment plant for Tijuana sewage.

The freshwater resources of the Tijuana River basin are shared by the Mexican municipalities of Tijuana and Tecate and San Diego County, California. Although relatively small (4,500 km^2), the basin is populated by more than 3.5 million inhabitants, of whom roughly one million reside on the Mexican side. The basin's population has grown rapidly over the past several decades and is expected to increase steadily well into the 21st century.

Figure 7: Tijuana River Basin



Source: CILA, 1993.

Physically, the basin is characterized by extremely variable streamflows, with extended periods of drought interrupted by heavy floods during wet years. Impoundment infrastructures such as the Rodrigez Dam south of Tijuana and the Morena and Barret Dams in San Diego County are incapable of stabilizing streamflow over extent periods. In light of such variability, and given the relatively small catchment area of the basin, the surface water resources of the Tijuana River are insufficient to meet the freshwater needs of the basin's growing population. As a result, the basin must import water to meet its overall demand.

Tijuana and Tecate import roughly 50 Mm^3 of water annually from *La Mesa Aresona*, an aquifer located in the lower Colorado River. On the other side of the border, the southern California aqueducts convey nearly 600 Mm^3 of water annually to San Diego County. These annual imports represent 70 percent of the total water used in the San Diego/Tijuana-Tecate region.

Table 1: Estimated Water Use in the Tijuana River Basin, by Source
(in million cubic meters per year)

	Tijuana Basin			
	Surface	Aquifer	Imported	Total
Tijuana-Tecate	0	30	50	80
San Diego	110	10	600	720
Total	110	40	650	800

Sources: Estimated from data by USGS 1993; COSAE 1994; CNA 1995.

* Given the high annual variability of supply within the basin, these estimates should be considered very rough.

Both Tijuana and Tecate rely almost entirely on groundwater for their freshwater supply (see Table 1). As for surface water, groundwater availability is narrowly tied to the dominant weather pattern and is therefore highly variable over seasonal and annual time frames. Incomplete, and sometimes incompatible, information is available on the state of water resources and water use in the basin, particularly for groundwater. This lack of data hampers efforts to control groundwater overdraft and impedes basinwide planning.

Municipal and industrial water consumption, already the predominant uses on both sides of the border, continue to increase as the urban population grows. Conversely, the agricultural sector's demand for water, which at present accounts for roughly 25 percent of all freshwater uses, has been declining since the 1960s.

Water quality and water supply problems on both sides of the basin stem primarily from inadequately controlled urban growth. During certain periods of intense precipitation, the cities of Tijuana and

Tecate have been unable to manage their production of wastewater, resulting in uncontrolled runoff of domestic and municipal wastewater through the natural channels crossing the international boundary. This problem in turn has raised public and environmental health issues on both sides of the border.

Urban planning and economic development programs have failed to adequately recognize the importance of the link between land use and water in the Tijuana basin. The cumulative effects of the lack of integration of these two factors are disastrous during times of extraordinary rainfall or drought on both sides of the border.

Water management in the Tijuana River basin is undergoing substantial changes, including the implementation of a more thorough planning process on both sides of the border. Planning has tended to regionalize water management, involving local agencies and users, and to conceptualize the basin as a complex single entity. In Mexico, the creation of the State Water Services Commission (*Comisión de Servicios de Agua del Estado*—COSAE) in 1992 set the stage for increased participation by local agencies in the formulation of long-term water management programs. The focus of the local agencies, however, remains supply oriented. State agencies retain a broader approach, stressing the need for demand management strategies and emphasizing the maintenance of natural flows for environmental uses.

Environmental uses and quality issues have had low priority in the management of the Tijuana River, at least until recently. The development of restoration initiatives for the estuarine area of the river, the joint construction of water-related facilities and renewed interest in transboundary cooperation could change this trend.

Colorado River Basin

BASIN CHARACTERISTICS

Geographic Extent/ Hydrologic Complexity	Sixth largest US river; watershed covering 632,000 km²; headwaters in Colorado mountains; flow controlled by 20 dams.
Water Availability	Flow depends primarily on snow melt in headwaters; extreme flow variability; drains arid region; groundwater important source, especially in lower basin.
Population	Waters serve more than 30 million people; partial supply for almost 17 million in southern California; population growing rapidly in lower-basin service areas.
Economic Trends	Manufacturing, high technology, services, trade and tourism important throughout the basin. Agricultural economy still strong in upper basin, southern California, Arizona and Mexicali Valley.

BALANCE OF USES

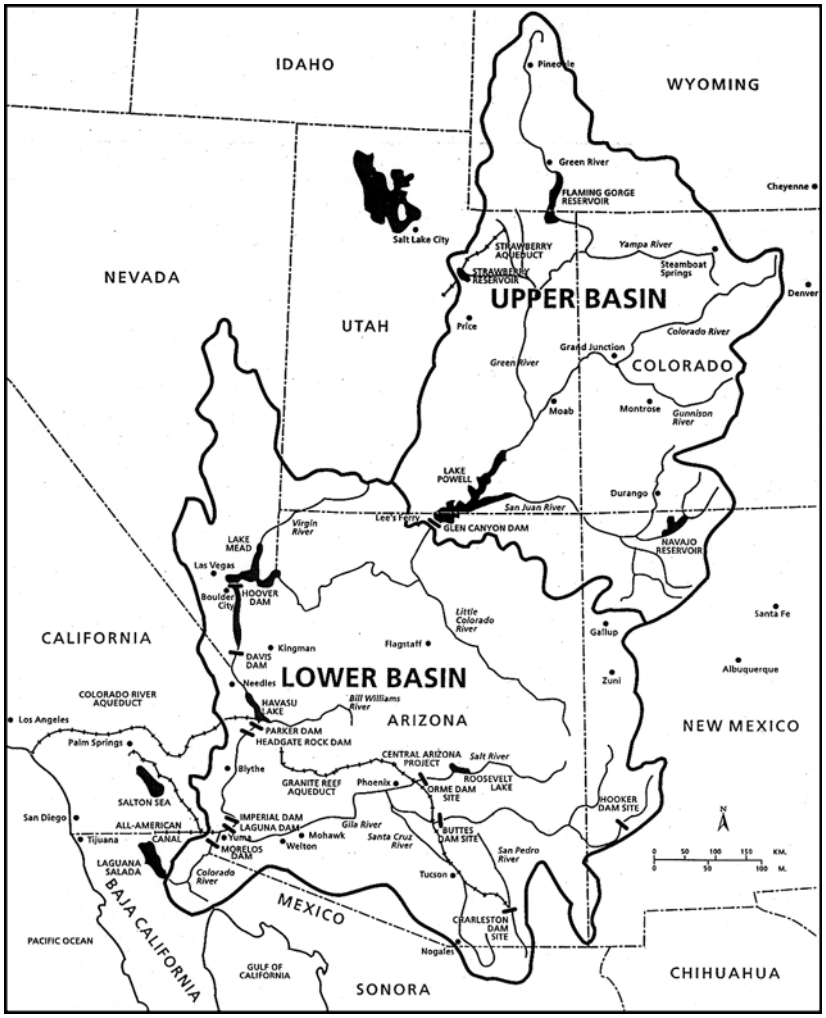
Data on Current/ Recent Use	Use data generally available for municipal uses, less accurate data for agricultural uses.
Data on Projected Use	Aggregate projections based primarily on population trends.
Other Information	Use measured against entitlements under various compacts, laws and treaties.
Dominant Uses	Dominant uses: irrigation in the upper and lower basins, followed by growing municipal use. Primary industrial uses: thermoelectric power production and mining.
Supply Sources	Groundwater is important source for irrigation in Arizona and Mexicali Valley, and exported out-of-basin water for municipal use in Tijuana. Surface water is primary source for municipal needs and irrigation in southern California.
Future Demand/Shortages	Long-term use projections substantially exceed available supply. Reallocation of irrigation use to municipal use likely. Potential conflicts with environmental needs.

MANAGEMENT ISSUES

Equality Issues	Subsidization of irrigation use in some portions of basin. Quality of water delivered to Mexico is poor. Long history of ecosystem modifications due to reservoir development.
Water Use Efficiency Issues	Low-efficiency irrigation practices for low-value crops (hay, alfalfa) in some portions of basin. Extremely high per capita municipal use in Las Vegas, Phoenix and other desert cities.
Environmental Needs/ Issues	Alteration of riparian habitat by reservoir construction; reduced freshwater flows to Colorado River Delta Estuary and Gulf of California; maintaining partially restored Cienega Santa Clara marsh with agricultural return flows.
Recreational Needs/ Issues	Call to operate dams to help protect endangered fish species. Recreational use of reservoirs and parts of river is economically important. Local ecotourism developing around Cienga Santa Clara marsh.
Special Issues	Efforts to control natural and manmade sources of salinity in order to protect quality of water delivered to Mexico will require bilateral negotiations. All American Canal lining poses prospect of reduced groundwater availability in Mexicali Valley. Groundwater overdraft in several areas of lower basin.

Ranking sixth in size among major US rivers, the Colorado River supplies water to almost 30 million people in seven western US states and Mexico. Colorado River water irrigates roughly 1.5 million hectares of farmland in Wyoming, Colorado, Utah, New Mexico, Arizona, California and Mexico. Draining a 632,000 km^2 watershed, the 2,300-km long river system eventually empties into the Sea of Cortez (known north of the border as the Gulf of California). While carrying less water on an annual basis than California's Sacramento River, the Colorado River has been the "lifeblood" for the western United States and Mexico's Mexicali Valley.

Figure 8: Colorado River Basin



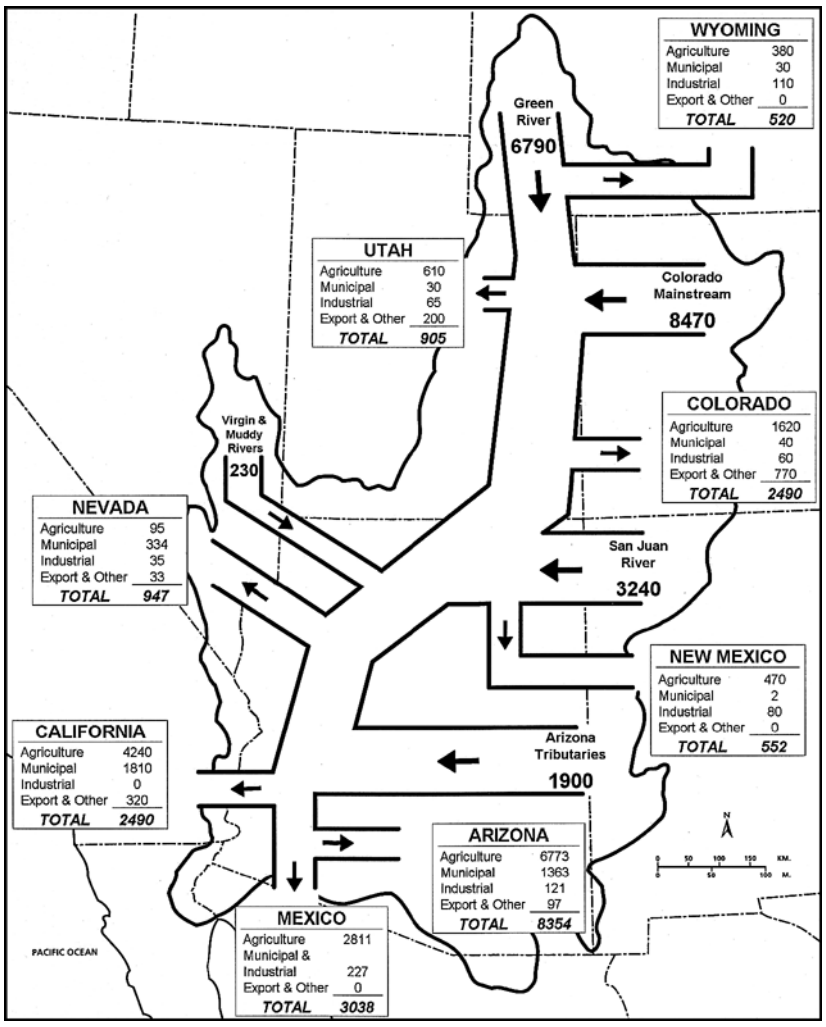
The Colorado River system has been stressed and transformed by seven decades of development. Now controlled by 20 dams, it ranks among the world's most heavily plumbed water systems. Dams that turn the river on and off like a faucet, and large-scale diversions that deplete the river's flow have dramatically modified the river's water environment from its predevelopment conditions. Changes in the river's sediment balance, water temperature and flow pattern, and the

introduction of exotic plant and fish species have all significantly altered riverine aquatic ecosystems. Throughout the basin, numerous efforts are under way to restore and maintain particularly stressed areas.

Historically, the average annual natural flow of the Colorado River has been, and still is, a subject of great debate, mainly because of the extreme flow variability both on an annual basis and over extended periods. Another reason is that data have been recorded over only a relatively short period. Based on historic flows over the last hundred years, the Bureau of Reclamation estimates the Colorado River's average annual natural flow at 18,500 Mm^3 (15 MAF), as measured at Lee's Ferry. The Colorado's high variability is, to a large degree, now offset by the water storage infrastructure along the river and its tributaries. The total capacity of the 14 major storage facilities of the upper basin and lower Colorado mainstem exceeds 75,200 Mm^3 (61 MAF)–roughly four times the river's annual average flow.

The most fundamental problem of the entire Colorado River basin is that the long-term planned use of the river's water exceeds the available supply. Because total legal entitlements to water are greater that the river's average annual flow, the river has been deemed "overapportioned." This predicament can be traced back to the first negotiations affecting the river. Based on river flow measurements for the 15 years leading up to the 1922 Colorado River Compact, compact signatories apportioned 18,500 Mm^3 (15 MAF) of a river they incorrectly believed to have an average annual flow of slightly more than 22,200 Mm^3 (18 MAF). Unfortunately, that projected 3,700 Mm^3 surplus disappeared as scientists later learned that average annual flows were closer to 18,500 Mm^3, or possibly lower. Even though the river's flows were considerably overestimated, subsequent laws and decrees have been based on the original apportionments agreed to in the 1922 Compact. Fortunately, human demands have not yet reached legal entitlements, and overapportionment has not yet posed a serious problem. As shown in Figure 9, however, practically all available surface water from the Colorado River basin is being used.

Figure 9: Surface Water Flows and Uses by State in the Colorado River Basin (in million cubic meters per year)



Notes: Upper basin figures are for depletion; lower basin figures are for total water use. Nevada uses include groundwater, local surface water and Colorado River water. Arizona uses correspond to total groundwater and surface water use.

One major challenge facing water managers of the Colorado basin is long-term groundwater overdraft. In some regions of the lower basin, groundwater overdraft has led to irreversible losses of storage capacity. Groundwater overdraft currently occurs on an annual basis in all three of the lower-basin states. Because of a paucity of data on groundwater use and the geohydrology of the Mexicali Valley region, it is difficult to determine with certainty whether, or to what degree, water is overdrafted. Groundwater in the upper Colorado River basin, unlike the lower basin, represents a small fraction (roughly two percent) of total water use and is therefore less likely to be overdrafted.

Salinity is the major water quality issue facing the river basin. Like many rivers in the western United States, the Colorado is naturally salty. Half of the average annual salt load of nine million tons carried past Hoover Dam is attributed to natural sources. Human-caused increases in salinity concentration account for the remainder and include saline irrigation return flows, reservoir evaporation, out-of-basin transfers and municipal/industrial uses.

Because none of the basin states except California, Baja California and Sonora have ever used their full basic entitlements, current average annual consumptive use of water in the basin plus deliveries to Mexico still lies within the limits of the river system. However, in 1990, for the first time, the lower portion of the basin used its full legal entitlement. Reaching this threshold has served as an impetus for rethinking management strategies for the river. Water managers are beginning to focus on conservation, improved management and voluntary transfers as strategies for redistributing water toward its highest-valued use.

Although it is widely agreed that there is enough water in the "system" to meet the needs of the basin for the next 50 years, the onerous task at hand is developing the mechanisms that will move water to where it is needed most, while continuing to satisfy the needs of its current users. Compounding the problem is the additional need to reallocate water to aquatic ecosystems in the Colorado River basin that are in serious decline due either to an overall lack of water or to untimely use of the resource. This transition period in the river's history is an ideal opportunity for water planners to make a commitment to sustainable water management.

San Pedro and Santa Cruz River Basins

BASIN CHARACTERISTICS

Geographic Extent/ Hydrologic Complexity	San Pedro headwaters in Sonora cover 11,620-km^2 basin; Santa Cruz headwaters in Arizona cross into Mexico and back into Arizona–about 14,000 km^2.
Water Availability	Arid to semiarid region. Surface flows generally intermittent and extremely variable. Groundwater in alluvium and deeper aquifers is main source of supply.
Population	San Pedro basin relatively sparsely populated; slightly less than one million in Santa Cruz basin, concentrated in Tucson and Nogales, Sonora.
Economic Trends	Mainstays of economy: agriculture, tourism, trade and mining. Assembly plants concentrated in Nogales, Sonora.

BALANCE OF USES

Data on Current/ Recent Use	Limited data on uses in Mexican portion of basins; more extensive data for active management areas (AMAs) in Arizona portion of basins.
Data on Projected Use	Detailed projections available for Arizona AMAs; less data available for Mexican portions of basins, but municipal use projections available for Nogales, Sonora.
Other Information	Data broken out by AMA for Arizona portion of basins, including projected sources of supply.
Dominant Uses	Irrigation, followed by municipal and mining. Municipal use dominates in Tucson AMA.
Supply Sources	Groundwater is the primary source of supply; Central Arizona Project water (from Colorado River) and recycled effluent (primarily for turf irrigation) supplement groundwater use.
Future Demand/Shortages	Ground water overdraft could be continuing problem if AMA management goals not met.

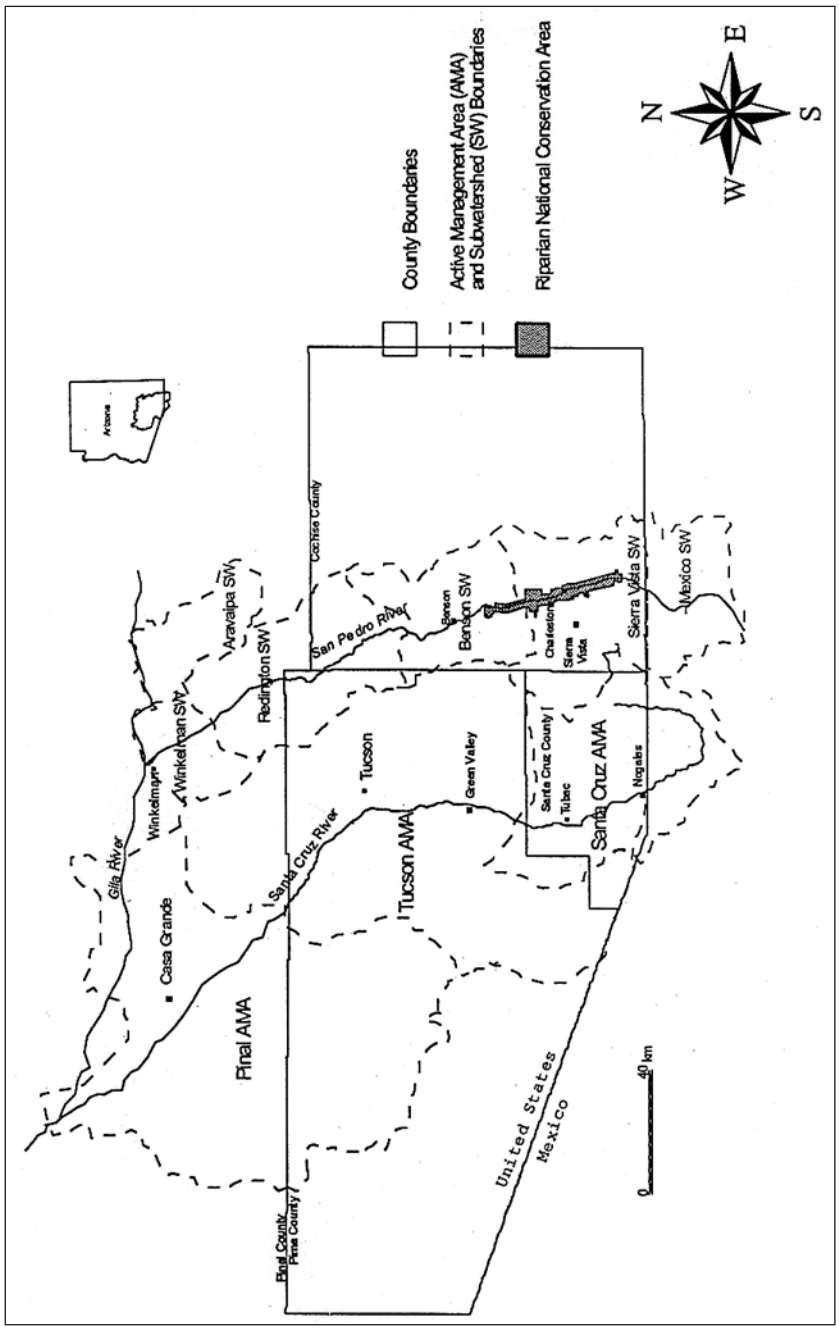
	Insufficient data to draw conclusions about sufficiency of binational groundwater resources. Reallocation of irrigation use to municipal use likely.

MANAGEMENT ISSUES

Equality Issues	Access to affordable, centralized potable water in Nogales, Sonora, and low-income areas of Tucson and other cities in basins.
Water Use Efficiency Issues	Conservation programs being implemented in municipal sector (pricing, effluent reuse); less progress in improving irrigation efficiencies.
Environmental Needs/ Issues	Need to protect flows for significant riparian habitat in both basins; creation of permanent flows and associated riparian habitat from discharge of Nogales International Wastewater Treatment Plant.
Recreational Needs/ Issues	Riparian areas generate tourism revenue in Arizona.
Special Issues	Problems with planned municipal use of Colorado River water from Central Arizona Project being rejected by Tucson voters; lack of understanding of groundwater/surface water interconnections, especially in immediate border area; "consumption" of water by phreatophytes; increasing use of tribal water rights for irrigation in Arizona.

The San Pedro and Santa Cruz Rivers and most of their tributaries are either ephemeral, flowing only during periods of rainfall or snow melt, or intermittent, with certain reaches having water most of the year while other reaches remain mostly dry. Both rivers have stretches of perennial flow, a situation that can result from one of three situations: (1) where water losses are less than the supply; (2) where the underlying bedrock forces the groundwater to the surface; or (3) where effluent is discharged from municipal wastewater treatment plants. In the case of the latter, such sources of continuous streamflow are largely or solely responsible for the existence of the few remaining and relatively lush riparian stretches on the Santa Cruz River.

Figure 10: Santa Cruz and San Pedro River Basins



Despite the arid climate, the region's ecology is remarkably diverse. Riparian zones along the stream channels give way to desert scrub, and at higher altitudes semidesert grasslands along mountain flanks yield to subalpine and alpine woodlands. Much of the riparian vegetation has been cleared and converted into what has become the most productive agricultural lands in the basins. However, along portions of the San Pedro River, significant areas of native vegetation persist, providing habitat for many different kinds of animal species. These zones also serve as a pathway for millions of birds migrating from their winter habitat in Mexico and Central America to their breeding habitat in the northern United States and Canada.

Although some localized quality problems have appeared, such as episodes of heavy metals leaching from the Cananea Mine in Sonora in the late 1970s and mid-1980s, the San Pedro River basin has no major regional threats. However, wastewater from livestock effluent continues to pose a threat in both basins, particularly the Santa Cruz.

Groundwater is the primary source—and in the Santa Cruz River basin the only reliable source—of water in the basins. In areas of both basins, overdrafting of the regional aquifers is causing the water table to fall significantly. In the Santa Cruz River basin, overpumping of groundwater is believed to have resulted in the elimination of several reaches of perennial flow in the streambed. In the San Pedro, the general consensus among scientific experts is that continued groundwater extractions at the current or an increased rate will significantly affect the base flow of the stream.

The Santa Cruz basin's population of about one million inhabitants, of which 900,000 live in the urban areas of Tucson (Arizona) and Nogales (Sonora), is growing rapidly. Although irrigation remains the largest consumer of freshwater, accounting for 70 percent of all freshwater withdrawals in 1990, the agricultural sector is declining, giving way to municipal development.

The basic hydrology and water balance of both river basins are not fully understood. Demand forecasts, based on various scenarios of consumption patterns, show that without conscientious management of the basins' water resources, serious consequences (shortages) could befall certain locations, certain groups of individuals, or certain sectors. More information is needed, for example, on the contribution of snowpack in the mountains that enclose the basins to recharge of groundwater in the regional aquifers and to streamflows. More data also are needed to better understand the contributions of surface and groundwater flows

from Mexico into the US portions of the watersheds. A better understanding of evapotranspiration rates, especially from riparian vegetation, is required as well.

In addition, more precise estimates of environmental water needs should be developed to allow better planning for instream uses and for management of highly valued ecosystems during dry periods. Better information might also help resolve some politicized debates about the relative importance of human and ecosystem effects on river flows.

The legal status of groundwater is a major issue in the sustainable management of the basins on the US side of the border. The failure of the law to recognize groundwater/surface water interconnections and the less regulated state of groundwater withdrawals have left gaps in the countries' ability to manage water resources. Recent Arizona court decisions indicate some increased recognition of the scientific realities, however.

Institutional structures in Mexico and the United States lack parity. For example, the state of Sonora does not place much water management authority at the local level. In effect, then, the counterpart of the Arizona Department of Water Resources (ADWR) must often be the federal National Water Commission (*Comisión Nacional del Agua*—CNA). Both CNA and ADWR want to manage their water resources in a sustainable fashion, but CNA is a large agency with many other responsibilities, and the Santa Cruz and San Pedro River basins are small compared with other basins for which CNA has responsibility. Finally, despite the various transboundary agreements and institutions that exist between the United States and Mexico, there has been no formal allocation of either the surface waters or the groundwater of the transboundary Santa Cruz and San Pedro basins. Thus for these basins, there is no existing framework within which potential future allocation disputes can be easily resolved.

Río Bravo Basin

BASIN CHARACTERISTICS

Geographic Extent/ Hydrologic Complexity	Headwaters in San Juan Mountains of Colorado; total basin covers about 920,000 km^2. Seventy-five percent of flow below El Paso is from Río Conchos, with headwaters in Chihuahua. Two major reservoirs on main-stream; several reservoirs on Mexican tributaries.
Water Availability	Highly variable flows; only intermittent flow on most tributaries, except for Río Conchos. Groundwater important in El Paso/Juárez area and Texas/ Coahuila border region.
Population	One million in Texas portion and eight million in Mexico. Rapidly growing population in urban areas; stable or declining population in rural areas.
Economic Trends	Increasing dependence on manufacturing, trade, services and tourism; decreasing dependence on agriculture, though still localized dependence in some areas.

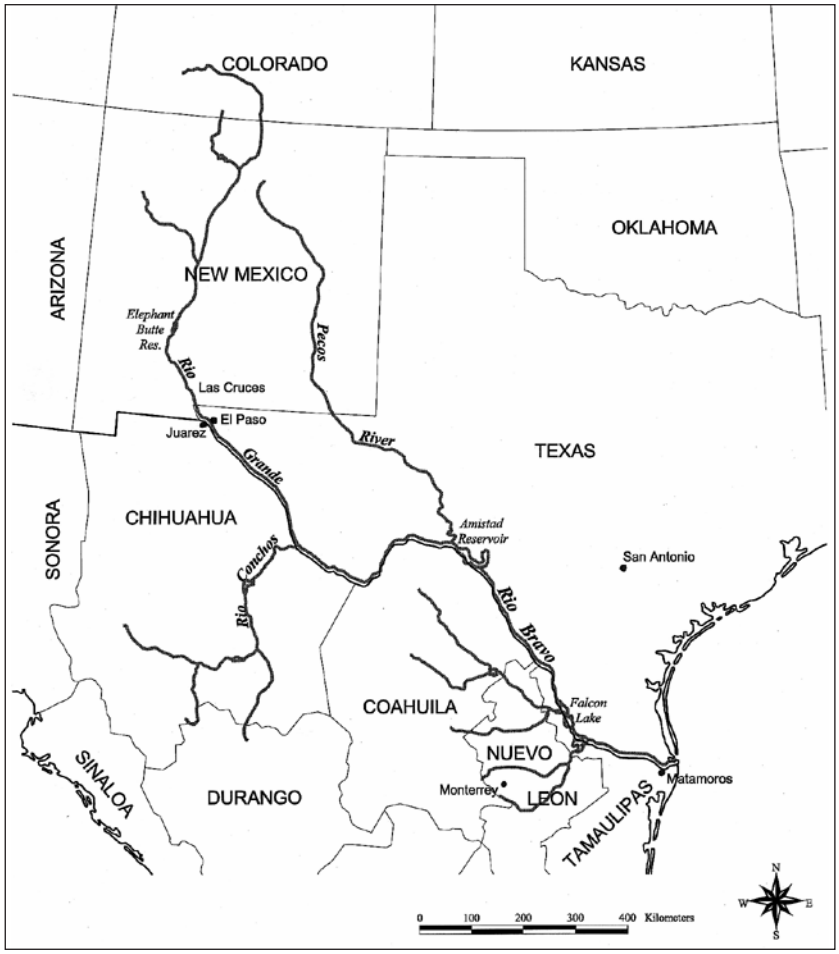
BALANCE OF USES

Data on Current/ Recent Use	Detailed data on uses in Texas, though agricultural use data are generally only estimates. Scattered aggregate data on uses in Mexico.
Data on Projected Use	Projections available for Texas, though some potential problems with assumptions. Projections generally not available for Mexico.
Other Information	Water rights registry being implemented in Mexican portion. Texas administration of water rights has been underfunded. Watermaster for lower portion of Texas basin and IBWC also are sources of data.
Dominant Uses	Irrigation (up to 90 percent of use in lower Río Bravo Valley of Texas), followed by municipal uses. Few significant industrial users, except thermoelectric power production (coal) in Coahuila portion of river.

Supply Sources	Primarily surface water from mainstream and Río Conchos; groundwater is sole source for Juárez and significant percentage of El Paso use. Groundwater also an important source of supply in Texas/Coahuila border region.
Future Demand/Shortages	El Paso/Juárez, unless El Paso able to shift to year-round surface water supply; possible shortages in Coahuila portion of border. Significant reallocation from irrigation to municipal use likely.
MANAGEMENT ISSUES	
Equality Issues	River managed almost solely for irrigation use upstream of El Paso/Juárez; heavily subsidized water for irrigation in both Texas and Mexico portions of basin; access to affordable, centralized potable water for low-income residents in urban areas of basin. Low per capita use in Mexico.
Water Use Efficiency Issues	Increasing attention to municipal water conservation in some cities; little progress in agricultural conservation, except for improvements highlighted by recent drought.
Environmental Needs/ Issues	Loss of springs, creek flows in northern Mexico because of overexploitation of water resources; increasing salinity of lower Río Bravo because of reduced freshwater flows and irrigation return flows. Riparian habitat maintenance and restoration are issues in some parts of basin.
Recreational Needs/ Issues	Need to maintain adequate flows for river-based recreation in Big Bend National Park and Wild and Scenic River. Wildlife viewing in riparian habitat in Lower Río Bravo Valley of Texas and sport fishing on Mexican reservoirs generate significant tourism revenue.
Special Issues	Need for better understanding of groundwater/surface water interconnections, especially in middle border region; Mexico; management of reservoirs in New Mexico to better accommodate downstream needs. The potential for significantly increased demand in Río Conchos and other Mexican tributaries does not appear to be considered in most projections.

The Río Grande/Río Bravo basin, which throughout this report is referred to as the Río Bravo basin, extends 3,140 km from its headwaters in the San Juan Mountains of Colorado to the Gulf of Mexico. The basin covers a total land area of 920,874 km² and is home to about nine million people, almost eight million of whom live in the Mexican portion of the basin.

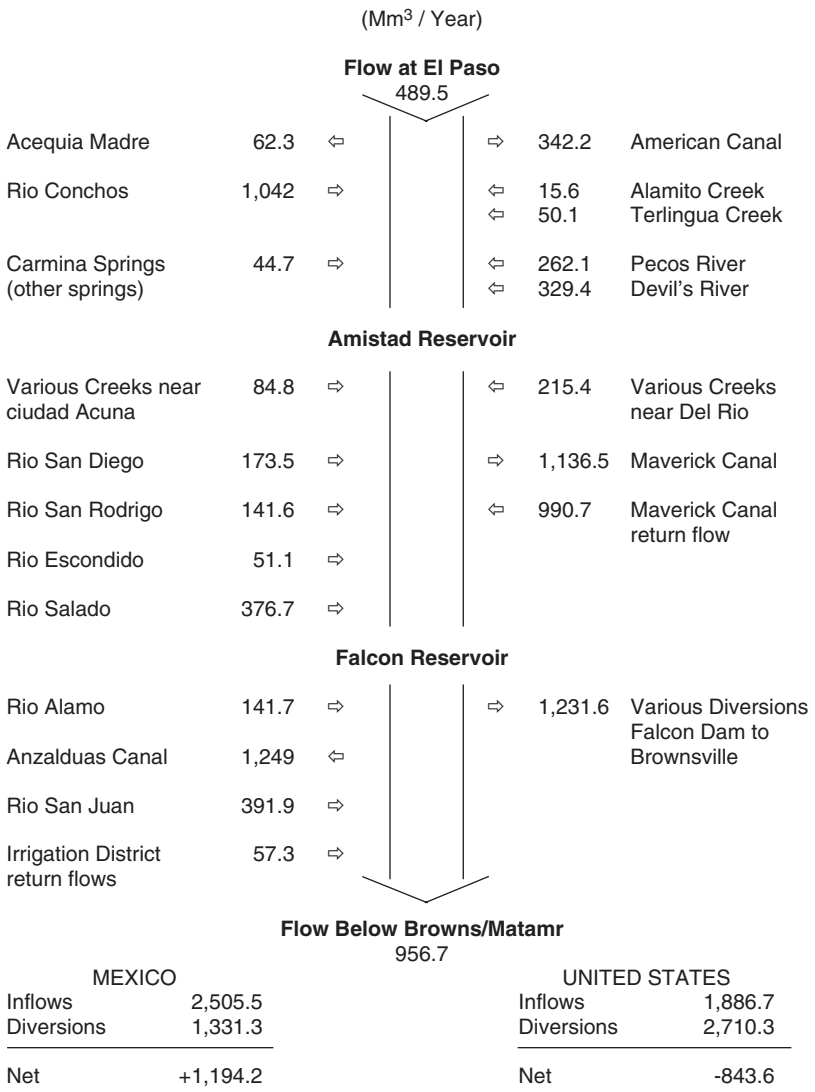
Figure 11: Río Bravo River System



The Texas/Mexico portion of the basin flows through relatively arid regions. Major base flow is provided by the headwaters located in southern Colorado and by the Río Conchos in Chihuahua. Several large

manmade reservoirs provide water storage and flood control. Figure 12 shows the major surface water inflows to and withdrawals from the Río Bravo from the Texas-New Mexico state line to the Gulf of Mexico.

Figure 12: Río Grande/Río Bravo Diversions and Tributary Inflows



MEXICO		UNITED STATES	
Inflows	2,505.5	Inflows	1,886.7
Diversions	1,331.3	Diversions	2,710.3
Net	+1,194.2	Net	-843.6

Source: International Boundary and Water Commision, "FLow of the Rio Grande and Related Data," Water Bulletin No. 63, 1993.

The amount of water present in the river basin at any given time is dependent on both surface water runoff and groundwater inputs via seeps, springs and infiltration. Little is known about the nature of surface/groundwater interactions in the Río Bravo basin, particularly in the middle reach of the river. The binational extent of the Edwards-Trinity Plateau aquifer and the contribution of springs from this aquifer to surface water flows have been little analyzed.

Historically, irrigated agriculture has played an extremely important economic role in many parts of the Texas border. Beginning in the 1940s, the creation of several reservoirs (Elephant Butte, Caballo, Amistad and Falcon) encouraged the expansion of irrigated agriculture by providing a reliable and, for the users, a relatively inexpensive supply of water from the Río Bravo. By the late 1960s and the 1970s, however, the character of the Texas/Mexico border region had begun to change significantly, due in large part to rapid population growth. Efforts by local governments to recruit industry to the area, coupled with the increasing size of local municipalities, have reduced the regional economy's dependence on agriculture. By the 1990s, 71 percent of the jobs in the lower Río Bravo Valley were in wholesale and retail trade, government and services. Unfortunately, the water supply infrastructure networks, originally set up to meet the needs of irrigated agriculture, were, and in several cases remain, ill-suited to efficiently supply and treat water for municipal purposes. As a result, many border municipalities need major expansions in their water supply, sewage and treatment systems.

Similar trends have characterized changes in the Mexican portion of the Río Bravo basin. The development of the Amistad and Falcon reservoirs as well as others on the Mexican tributaries facilitated the expansion of irrigated agriculture along the northeastern Mexico border. As in the Texas portion of the basin, federal funds paid for development of these reservoirs and federal subsidies helped support many agricultural operations. The *bracero* and *maquiladora* programs fueled population growth and industrialization in the border cities along the Río Bravo, thereby placing severe strains on these areas. With the exception of Nuevo Laredo, all of the major Mexican municipalities along the Río Bravo lack modern, functioning sewage treatment systems. In 1992, IBWC estimated it would need about US $ 1.4 billion to bring the collection and treatment systems in these Mexican border cities up to standard. Unfortunately, the ability of residents to pay for the necessary improvements in water (and sewer) services in northeastern Mexico is even more limited than at the Texas border. Affordability of water—in

addition to access to water—remains an important economic, social and, ultimately, political issue in the basin's Mexican municipalities.

Just as water allocation and management issues are likely to assume greater importance on each side of the Texas-Mexico border, transboundary water allocation and management issues will also take center stage. The 1944 treaty between the United States and Mexico makes provision for allocation of the Río Bravo and its tributaries, but no similar treaty exists for groundwater, which is an increasingly important source of freshwater along both sides of the border.

As the demand for water increases, the adequacy of instream flows to sustain natural aquatic assemblages will remain an important issue in several parts of the basin. Scientists have documented significant changes in the aquatic assemblages in the lower Río Bravo as a consequence of reduced freshwater flows and the increasing salinization in this lower part of the river. Mexican scientists also have documented extensive losses of rare and endangered aquatic species in northeastern Mexico due to overexploitation of groundwater and surface water, causing springs, seeps and entire creek beds to dry up. In the lower Río Bravo, maintaining adequate instream flows is important to several riverside wildlife refuges–including the Santa Ana National Wildlife Refuge, the National Audubon's Sabal Palm Grove and about 35 miles of river frontage on other riverine habitat tracts that are part of the Lower Río Grande Valley Wildlife Corridor (a public/private partnership designed to conserve some of the last remaining parcels of native habitat in the valley). Much of this habitat is in the river's flood plain and traditionally was periodically inundated by floodwaters. Like river rafting and reservoir-based recreation in other parts of the basin, these wildlife refuges also provide significant economic benefit to the local economy.

Also essential to the region's ecology and social well-being is the maintenance of surface water quality. The principal water quality concerns in the Río Bravo basin include high fecal coliform concentrations in certain areas of the mainstem, particularly downstream from major municipal discharges from Mexican border cities; elevated levels of total dissolved solids and chlorides (salinity concerns) throughout the basin; and elevated levels of nutrients, particularly in the upper Río Bravo.