



Border Water: Sovereignty, Scarcity, and Security in the U.S.-Mexican Binational Region

by **D. Rick Van Schoik, Erik Lee, and Thomas McGuckin**

Van Schoik is managing director of the Southwest Center for Environmental Research and Policy (SCERP), a binational consortium of universities in the United States and Mexico that focus research efforts on border environmental problems. He teaches environmental security in the International Security and Conflict Resolution Program at San Diego State University. Lee is assistant director of the Center for U.S.-Mexican Studies at the University of California at San Diego. McGuckin is a professor in the Economics and International Business Department at New Mexico State University. Van Schoik can be contacted at scerp@mail.sdsu.edu, www.scerp.org, or (619) 594-0568.

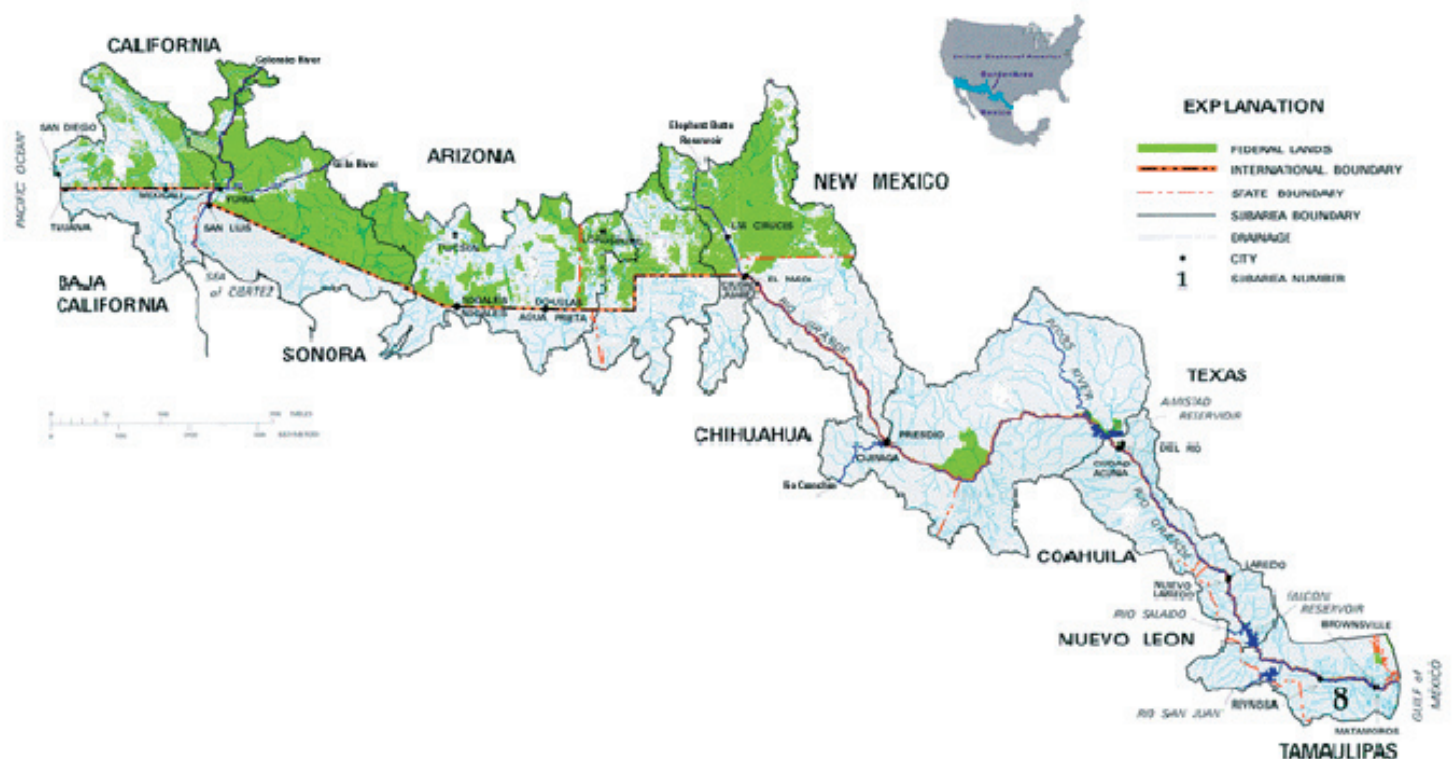
“If water does not cross borders, soldiers will.”

Cordell Hull, Franklin Delano Roosevelt’s Secretary of State

Abstract

Security and water are inextricably and increasingly linked. Water and its related issues have recently risen to make U.S.-Mexican relations as tense as they are over drugs, immigration, and violence. For example, last year a Congressional initiative urged President George W. Bush to withhold waters from the Colorado River until a deficit owed to the United States by Mexico was paid from the Río Conchos. Under today’s drought conditions and predictions, the United States may be unable to deliver current levels of Colorado River water to Mexico.

For decades, the treaties and institutions set up between the United States and Mexico to deal with transboundary and binational issues have served as models of cooperation around the world. The relations between the two “friends” culminated in a Joint Declaration by Presidents Vicente Fox and Bush, as it so happens, in early (pre-9/11) September 2001. However, extraordinary population growth in the border region¹, largely unaddressed environmental infrastructure deficit, rapid industrialization, and a rise in the middle class in Mexico has stressed water availability, energy fuels and electricity, air quality, biodiversity, and proper handling and disposal of hazardous waste streams, in turn stressing the relations between the two neighbors. Resolution of these tensions will preclude binational strife.



Some opportunities do exist. Insights revealed by comparing and contrasting successful and failed examples of cooperation show the need for innovation and reinvention.

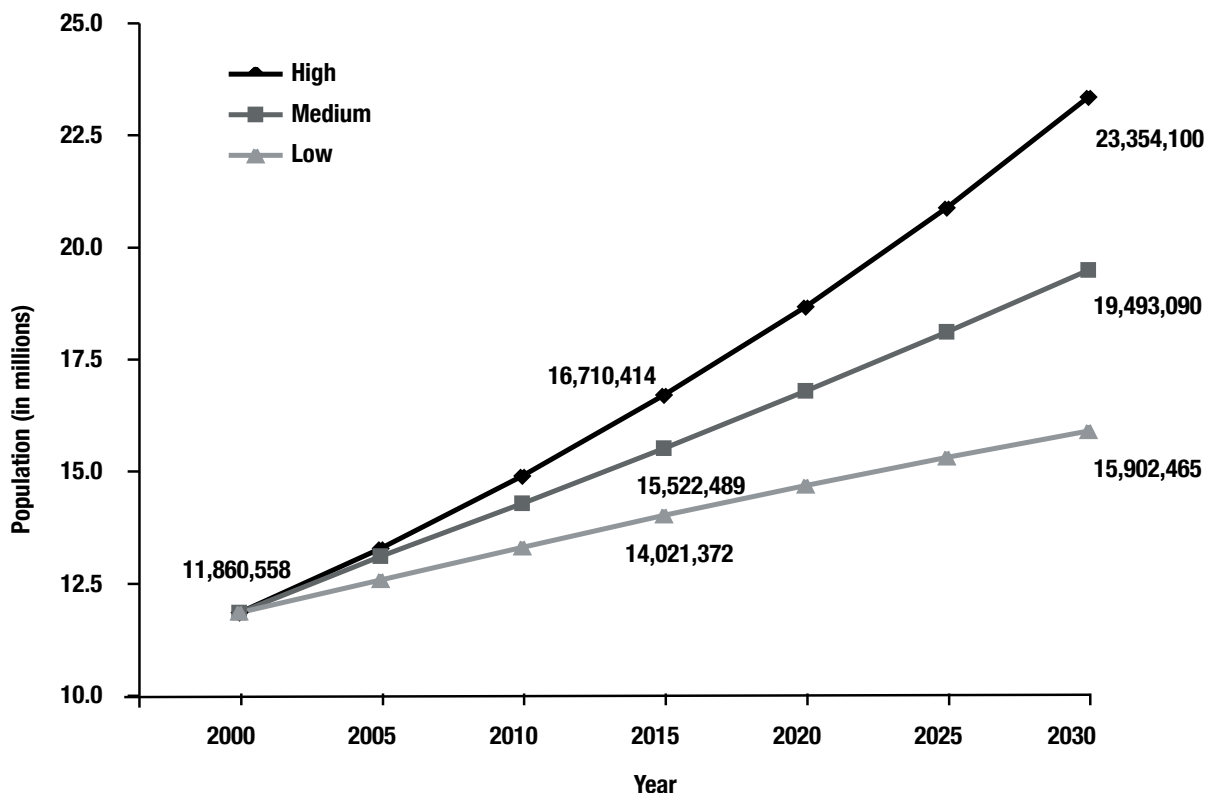
Introduction

The U.S.-Mexican border is a meandering line superimposed over an arid and resource-poor frontier between two countries with utterly different origins and social, economic, and political systems. Recently, however, this line has evolved, out of political and economic necessity, from a focal point of mistrust and neglect to a priority area for environmental and security issues for the two countries. These two issue areas come together in this region, creating a potent challenge for stakeholders wishing to derive full benefit and minimize the negative consequences of expanded U.S.-Mexican trade in the North American Free Trade Agreement (NAFTA) era. Despite a history of tension along the border, new institutions such as the U.S. Environmental Protection Agency's (EPA) and Secretaría de Ambiente y Recursos Naturales' (SEMARNAT) Border 2012 framework and program, the Border Environment Cooperation Commission (BECC), the North American Development Bank (NADBank), the Good Neighbor Environmental Board (GNEB)², and the Southwest Center for Environmental Research and Policy (SCERP) have emerged to refocus and shift attention on the area's problems, moving the public discourse from one of *competition* to one of *cooperation* and ultimately to *sustainability* in the fullest sense of the words.

1. The U.S.-Mexican Border Environment: The Results of Asymmetrical Development and the General Links Between Environment and Security

Aside from illegal immigration, drug trafficking, and high crime rates, environmental issues such as air and water pollution, public health issues, hazardous materials and waste, and a broad range of other environmental and security issues face the U.S.- Mexican border region. Further complicating matters is the fact that all of this is occurring in a region that is experiencing particularly rapid demographic growth: The current population of about 13 million along the 2,000-mile border is expected to grow by 10 million by 2030, bringing the total population to more than 23 million (Peach and Williams 2004).³ Despite its demographic importance, border regions on both sides have historically suffered from central government neglect. From the U.S. perspective, the area lags behind the rest of the country in economic terms. San Diego, the largest city in economic and demographic terms on the U.S. side of the border, only recently emerged as a focal point of the "new economy" after its slow recovery from defense industry downsizing in the early 1990s.⁴ From the Mexican lens, the region is viewed both with disdain and as one of economic opportunity precisely because of its proximity to the United States. The economic "pull" of the area has overwhelmed the former view for

Total Population Projection for the U.S.-Mexican Border Region



many Mexicans in search of economic betterment: The arrival of migrants from the country's interior accelerated rapidly beginning in the 1960s with the development of the in-bond *maquiladora* industry. This industry, in turn, has continually expanded over the last 30 years, even in the face of successive economic crises in Mexico. This has turned transboundary metroplexes such as Tijuana-San Diego and Ciudad Juárez-El Paso into major population centers.

However, this uneven and often explosive growth has high costs in terms of environmental security. Environmental problems that pose serious risks to the health, safety, and well being of border residents are a result of this expansion and growth. At a glance, it is easy to see a region at considerable environmental risk:

- The water supply is precarious and declining in quality
- Health-threatening levels of particulates, ozone, carbon monoxide, and in some locations sulfur dioxide, are polluting the region's air
- Expanding urbanization, ranching, grazing, and growing recreational use threaten areas with rare ecosystems and have resulted in a lowering of the water table and destruction of habitat (Ganster 2004)

Significant economic costs for human populations accrue every year because of this accelerated environmental degradation: More than \$1 billion in annual health costs is attributed to air pollution and nearly \$1 billion in productivity is lost directly due to water contamination; this in turn leads to a probable loss of approximately \$1 billion due to decreased recreational and leisure use of water bodies. Unknown billions of dollars are lost in biodiversity due to habitat destruction. Some 450 endemic species and 700 migratory species are found in the border area, 31% of the species listed as threatened or endangered by the U.S. Department of the Interior are found in the borderlands, and the rates of endangerment are the highest for those species found along the international boundary (Van Schoik, et al. 2004a).

The links between environmental degradation and a generalized insecurity in the region are both direct and indirect, but generally stem from the area's explosive demographic growth. To take the two largest Mexican border cities as case studies, Tijuana and Ciudad Juárez represent the "flip side" of rural depopulation in Mexico. The arrival of thousands of immigrants from the interior every month into cities with long traditions of informal economic activity based on smuggling (guns, alcohol, drugs, and so forth) and that have traditionally catered to various American vices (prostitution, drugs, etc.) has created urban areas with particularly high levels of crime. Homicide rates in the two cities are several times that of their sister cities, San Diego and El Paso. Tijuana is burdened by the violence and ancillary crime that comes with being the headquarters of the Arellano-Félix drug cartel, while Ciudad Juárez must contend with drug cartel infighting plus the disappearances of some 370 women (Amnesty International USA, no date) since the mid-1990s, the multiple causes of which are only beginning to be understood in their full, horrific sociological complexity. Skyrocketing homicide rates provide obvious evidence of profound security problems, while the highly contaminated water- and airsheds of the two cities are further environmental manifestations of this explosive economic growth. Both of these aspects combined with years of neglect from both countries' federal governments make for truly unpleasant and often dangerous urban contexts for human beings to function in, and therefore are excellent case studies for environmental security. Viewing the area's difficulties through the interdisciplinary lens of environmental security gives us new insights into the origins of the region's various challenges; specifically, it allows us to see the different economic, demographic, and natural "systems" at work in the region, each affecting the other in a complex, multi-dimensional manner.

2. A Brief History of Security Challenges on the Border

It is worth remembering past U.S. and Mexican competition for land and other resources. From a historical perspective, border security issues have emerged, receded, and emerged again as priority issues for both the U.S. and Mexican governments. It bears repeating that threats haven't emanated from Mexico alone. During the early 19th century, Mexican officials grew increasingly worried as they witnessed the relentless westward expansion and exploitation of the United States, spearheaded by such people as Texans Stephen Austin and Sam Houston. Covert arms sales by U.S. dealers to Apache Indians prolonged and intensified what would become a war of attrition between that tribe and settlers in northern Mexico (Vélez-Ibáñez 1996). On a continental scale, however, the advent of the U.S.-Mexican War (1846-1848) forever altered the geopolitical context of North America, as Mexico lost more than one-third of its national territory through three separate events: the secession of Texas from the Mexican Republic in 1836, the Treaty of Guadalupe Hidalgo in 1848, and the Gadsden Purchase in 1853. Troubles continued for decades as U.S. filibusterers continually mounted small-scale armed incursions into Mexico, often in the hopes of carving off strips of territory to be annexed by the United States.

The two nations negotiated a series of three treaties (the Conventions of 1882, 1884, and 1889), which led to the creation of the International Boundary Commission and a means to "equalize" the meanderings of border rivers. The Mexican

Revolution (1910-1920) witnessed the reawakening of a thriving North-South arms trade, with American suppliers exporting large quantities of weapons and ammunition through key border distribution points such as Nogales and El Paso. The consolidation of centralized government in Mexico calmed the border somewhat following Prohibition-era smuggling in the area. And during the Cold War, Mexico served a vital role to U.S. security interests as a stable buffer state between the United States and bloody revolutions and counterrevolutions in the rest of Latin America. The acceleration of northward migration from rural areas in Mexico, beginning with the Bracero program in the early 1940s and lasting to the present, eventually ran head-on into a conservative, anti-immigrant political current in the United States in the 1980s and 1990s. This was exemplified by people like former California Governor Pete Wilson and institutionalized by the federal government in border militarization programs such as Operation Gatekeeper in San Diego and Operation Hold The Line in El Paso. Both programs have caused the exposure deaths of hundreds of immigrants forced to avoid major urban areas and cross the border through extremely rugged terrain in treacherously hot, arid weather.

In addition, major drug cartels were consolidated in Mexico during the 1980s and 1990s and considerably raised the level of violence in cities such as Tijuana and Ciudad Juárez, which were already challenged by rising immigration and rapid industrialization. The Mexican drug trade witnessed a boom during the early years of NAFTA, part of a larger, though incipient, economic process of consolidation in the Americas. The forces of economic integration, however, must contend with worldwide geopolitical realities following the terrorist attacks of September 11, 2001, which caused the U.S. government to tighten overall frontier security activities and infrastructure, especially border port-of-entry procedures, causing northbound traffic jams of truly mammoth proportions all along the U.S.-Mexican border.

Paralleling the most recent and often unfortunate events along the border is a story of unprecedented attempts at cooperation between the two countries on the multiple environmental challenges facing the region. Over a century, both nations recognized the need to ameliorate the constantly shifting border created by the meandering rivers that determine the border. The International Boundary Commission, under another treaty (the 1944 Water Treaty), became the International Boundary and Water Commission (IBWC), charged with regulating river waters that flow between the two nations as well as across their borders. Today it serves as the forerunner and model for several organizations that have grown out of the 1983 La Paz Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area, such as the EPA/SEMARNAT Border 2012 Framework, Program, and its many working groups.

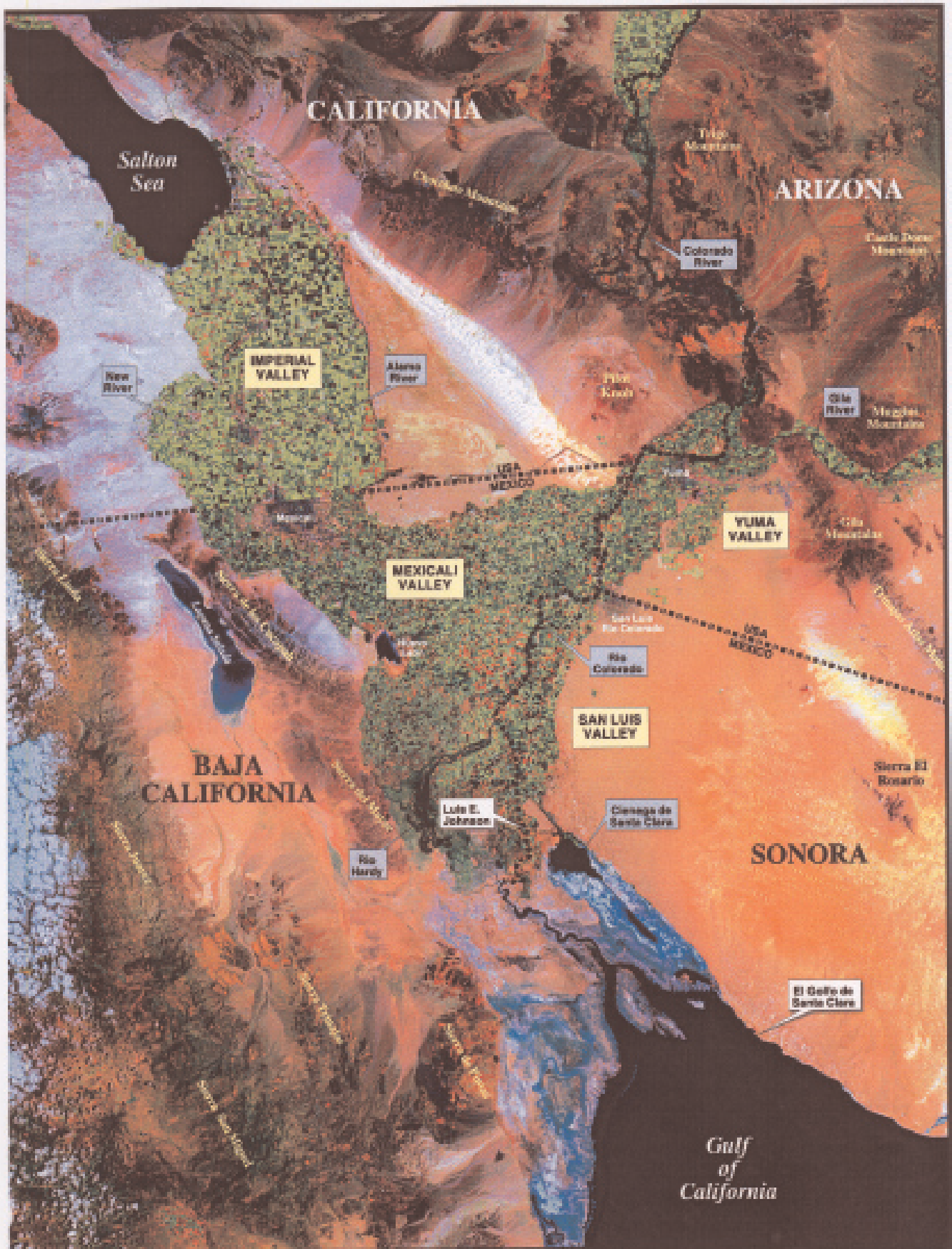
The myriad events add up to a particular challenge to meet the needs of an increasingly thirsty economy and populace. NAFTA commodifies, but doesn't facilitate, water trades. The move to bolster security activities and infrastructure make the border less permeable to almost everything, including even water. And the continuing, if not widening, economic asymmetry means one side can continue to afford plentiful and clean water while the other may not. Once again the long, meandering border has become a central cause for concern for policymakers on both sides of the border.

3. Specific U.S.-Mexican Water Issues and their Interdependencies

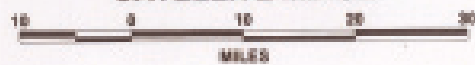
Water is a first-tier issue between the United States and Mexico, a situation that has potentially serious implications for the whole of the bilateral relationship. As population explodes in the border region, the demand for clean water increases. This increased demand intensifies competition among water users, including the economy, communities, and the environment itself. The challenge is to balance the needs of natural resources—which represent the future—with current demands from the two nations' economies and citizens.

Water capital on the border to the year 2020 is shaped by two fundamental factors: First, the variable supply of naturally occurring water, and second, the steadily rising water demand. The sources of conflict stem from competition among user groups. Users—including tribal nations, ecological resources, and rural communities—now compete for water of which they were once the sole user. Water is becoming such a major international issue that many foresee serious conflicts emerging from worsening tensions and disputes over this resource.

There is a kaleidoscope of jurisdictions on the border that further inhibits cooperation on water issues. These include hydrological, jurisdictional, and competing sector discontinuities as well as mismatches between the two governments, among the levels of governments, and even within governments. For example, the water supply, water treatment, wastewater treatment, and public health agencies are often separate organizations with different organizational cultures operating in different locations. While the region has been water-scarce for decades, extreme shortages and higher costs are looming. Historic and current usage patterns reflect the asymmetry in water availability and price.



**COLORADO RIVER DELTA OVERVIEW
SATELLITE IMAGE**



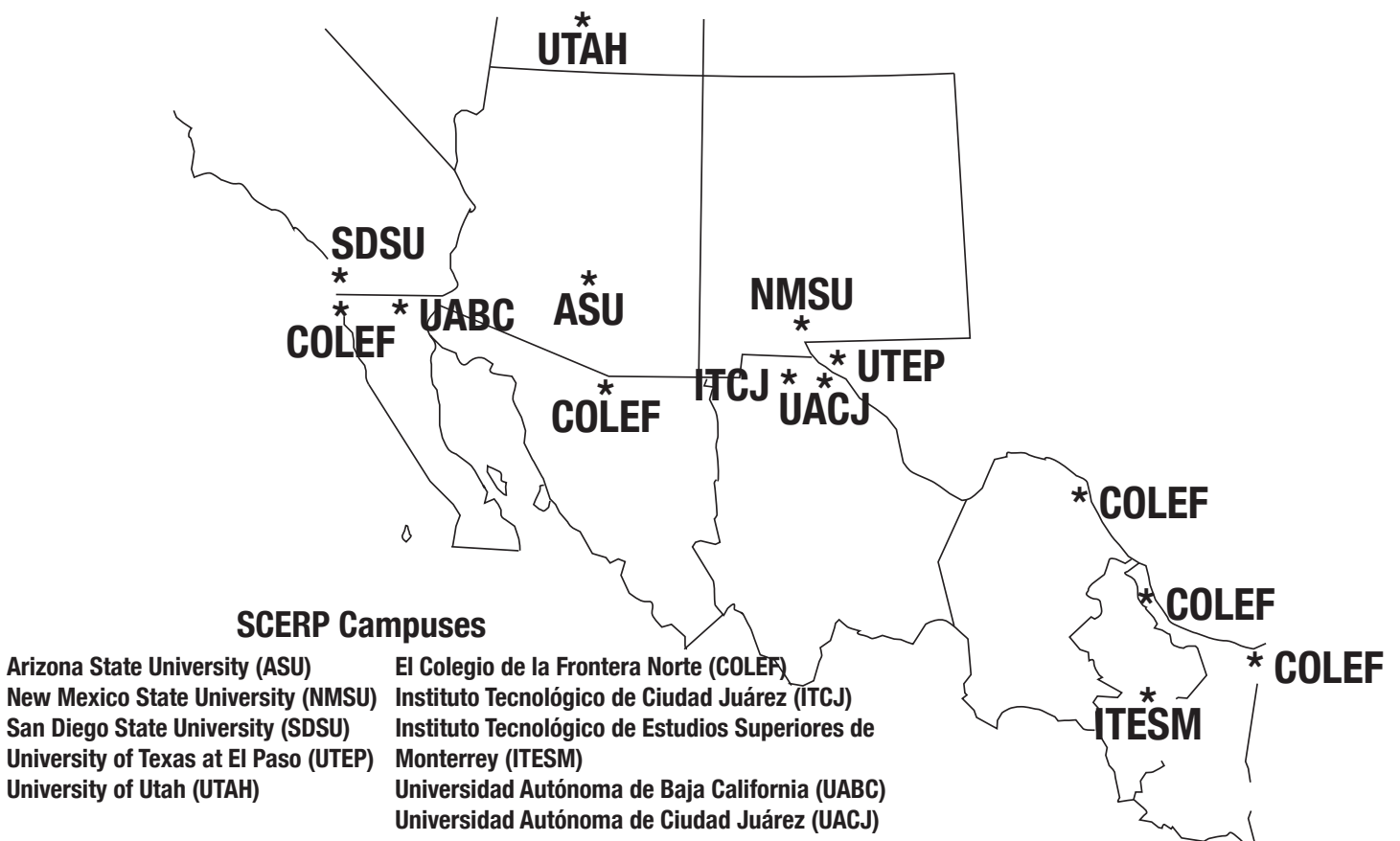
SWPCA, Resources Department
revised Satellite Image - June 1999
Fall 2000 - 04/11/0000

Projections for major sister-city pairs in the border region are not optimistic. For example, in a typical year, San Diego County imports 90% of its water while Tijuana imports about 95%; by 2010 San Diego will consume about 87% of the water in this area while Tijuana will consume 13%—that is, if infrastructure keeps up with demand (Bradley and de la Fuente 2003). El Paso and Ciudad Juárez are likely to exhaust fresh water from the Hueco Bolson, the major source of supply for these cities, by the mid 2020s (Boyle Engineering Corp. 1992). Agricultural use is relatively constant, using between 60% and more than 80% of surface waters while municipal withdrawals range from 10% to 30%, depending on location. Per capita use is higher in the U.S. border cities than Mexican border cities. Likewise, information quality, institutional capacity, and budget size is better on the U.S. side.

To claim that the border region is arid is not remarkable, but to realize that it lacks sufficient indigenous energy sources may be news to some. What remains startling is the tight connection between them—you can't have clean water without energy and most energy generation depends in one way or another on water. One of every seven watts of electricity used in California is dedicated to pumping or treating water and as water is mined deeper or farther away that component goes up in a region already electricity-starved.

Neither side knows enough about groundwater resources to justify the current pumping rates. The aquifers on the border region are nearly unknown in quantity, quality, dimension, and flows. Yet many locations that have exhausted their surface supplies are turning to their limited, and probably overdrawn, reserves. Few are replacing them. The binational claims are confounded by U.S. states' rights issues and decentralization of authority on the Mexican side without commensurate capacity building.

As ground- and surface waters are depleted, little, if any, water remains for nature. Ecosystems integrity is challenged by global climate change, over-grazing, invasive species, and sprawl without having to struggle under artificial drought conditions imposed by water markets. All the rivers of the region dry up at some location or time in their lives—in fact, the Río Bravo a three places, on occasion. To address these binational water issues there is only an outdated treaty. The ideal intent to attribute waters to nations cannot be executed wisely or fairly in today's world. Population pressure alone would make it archaic and almost irrelevant if it didn't have such high legal status and an entire plumbing system to accommodate it. While valiant and innovative attempts to address various emerging issues, such as biodiversity in the lower Colorado River Delta, have been advanced by the two sections of the treaty's commission, it is unable to address groundwater, drought, pollution, or even impacts from the lining of canals.



4. New Hope: Border Academic and Institutional Focus on the Environment

The focus on the border of academic and institutions has laid the groundwork for so much important environmental work in the region. The institutions with perhaps the most promise, though not without their share of critics, are BECC and NADBank. BECC, headquartered in Ciudad Juárez, is charged with assessing environmental impacts and benefits, thereby certifying border infrastructure projects that will later be funded by NADBank, located in San Antonio, Texas. Although the early story of the two sister institutions has been one of bureaucratic wrangling and badly needed money being tied up rather than reaching the communities that are so sorely in need of it, the institutions still serve as a model of binational cooperation, public participation, and transparency. Together they have avoided the missteps of the World Bank and others on their own path to sustainability.

Yet another evolution has been the Bush-Fox relationship. The two presidents, both elected in 2000, are each interested in what the other can provide. In the case of Fox, a new guest-worker program could provide increased remittances from Mexican migrants working in the United States, while Bush sees Mexico's petrochemical sector as potentially providing new life for U.S. oil and natural gas companies who want "in" to Mexico's state-run energy sector. Bush also sees Mexico giving the United States access to greatly expanded reserves in the Gulf of Mexico.

The Southwest Center for Environmental Research and Policy (SCERP) came to life in this context of new binational cooperation. SCERP is a consortium of five U.S. and five Mexican universities⁵ that serves U.S.-Mexican border residents by applying research information, insights, and innovations to border environmental challenges. SCERP was created in 1989 to initiate a comprehensive analysis of possible solutions to acute air, water, and hazardous waste problems that plague the U.S.-Mexican border region. The consortium works closely with EPA, SEMARNAT, and other environmental agencies in both countries at the local, state, and federal levels. In looking for solutions to the multiple environmental challenges in the region, SCERP casts a wide net by bringing together stakeholders from the public, private, and non-governmental sectors to attempt to achieve consensus on best practices for sustainable development along the U.S.-Mexican border. In doing so, SCERP emphasizes that the region is an integrated and dynamic system comprised of natural but also political, social, and economic components. This kind of binational cooperation based on serious and sustained scientific study is sorely needed in light of the environmental challenges facing the region, which include diminishing water quality and quantity, poor air quality (particularly because of particulate matter in the Paso del Norte region), hazardous waste generated by the *maquiladora* industry, and other troubling aspects of the border environment not specific to the region but certainly aggravated by the region's rapid and often uneven growth. SCERP fills a necessary gap in the mosaic of border environmental institutions and organizations by focusing its member institutions' scientific acumen and institutional prestige in order to formulate solid policy recommendations based on high-quality, binational applied research solutions.

One particularly effective policy-recommending forum is an annual think tank that identifies and examines a pressing issue from a regional and long-term perspective. The Border Institute series commissions papers from experts, convenes the top 100 decision-makers and resource managers from the border region, presents findings, and discusses optimal policy strategies. Border Institute IV in 2002 was dedicated to binational water (quality and quantity) management planning and the monograph⁶ of its findings contains several recommendations.

5. Predicting and Bettering the Future of the U.S.-Mexican Border Region

The border environment and quality of life for border residents are in danger of deteriorating significantly if "business as usual" trends continue for population and economic growth. By 2020, with no dramatic changes in regional development, the border region will be one of greater traffic congestion, poorer water quality and attendant human health effects, water shortages, increasing numbers of endangered and threatened habitats and species, hazardous and solid waste disposal crises, sewage infrastructure shortfalls, and contaminated beaches and oceans (Ganster, et al. 2000). It is clear that in order to make sense of the present and future stresses upon the region, some sort of forecasting and backcasting (proactive current planning based upon predictions to avoid worst scenarios) tool is sorely needed by stakeholders in order to understand the human, natural, and fiscal consequences of economic growth and development in the region. SCERP's Border Plus Twenty Years (B+20) Project works to this end. The purpose of the project is to create a systems modeling framework that provides an environment for exploring and visioning alternate futures for the border region and motivating prudent decision-making. This model will evaluate the interactions between human, environmental, and ecological systems. The prototype system will help stakeholders better understand changes in various environmental systems in response to population growth and industrial development. It will also account for the unique challenges associated with

implementing binational environmental policy in the U.S.-Mexican border region.⁷

Expanding industrialization and growing populations without the corresponding improvements in infrastructure have led, and will continue to lead, to ever-increasing stress on the region's communities, natural resources, and ecosystems. As environmental issues become more complex and severe each year and influence the economic, political, and social agendas of both countries, a concerted, interdisciplinary, and binational response to the border region's environmental problems must be undertaken. The border region must be viewed as an integrated and dynamic system, taking into account its political, social, economic, and natural components. If left unaddressed, these multiple environmental stresses will ultimately lead to adverse effects upon the economic health, quality of life, and the general security of the region.

6. The Need to Develop International Water Exchanges and Market

A simple comparison of recent successful and failed attempts at binational cooperation, collaboration, and commingling of funds reveals opportunities for a long-term true partnership for water management. After years of apparent cooperation and expensive planning on the construction of a binational aqueduct from the Imperial and Mexicali Valleys over the mountain to quench the thirst of the coastal cities of San Diego and Tijuana, San Diego backed out of the plan without much explanation and almost exactly at a time when they needed it the most. San Diego had finally reached an agreement to buy the water rights from agricultural water appropriations holders when it announced that it would continue to "wheel" water through the regional wholesalers.

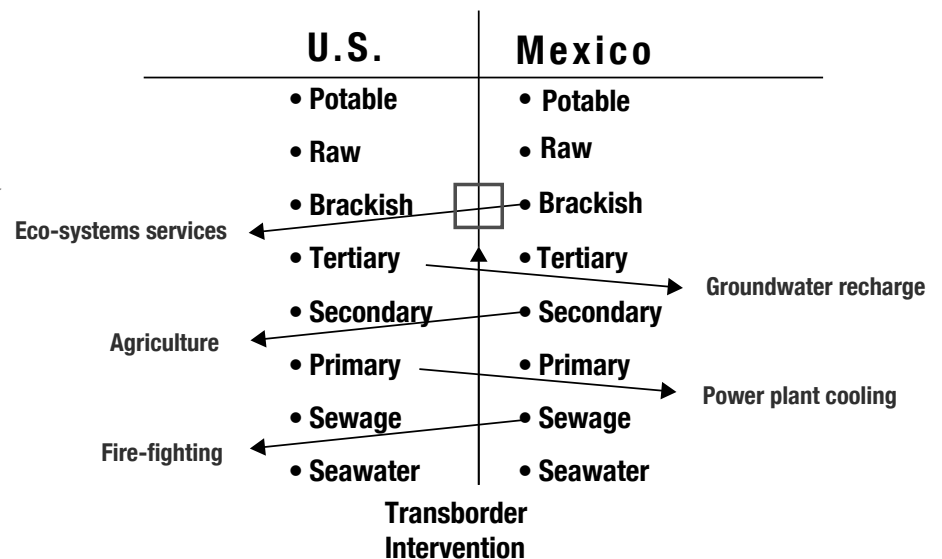
Water from Mexico that reaches the estuary on the U.S. side from the Tijuana watershed is treated at the International Wastewater Treatment Plant, a huge binational success, only to be pumped out to sea, even though it is located adjacent to a U.S. water reclamation plant that provides water to much of the southern half of San Diego. This truly golden opportunity has been allowed to wane through parochial concerns, unilateral thinking, and salutations to sovereignty.

Among the many remaining failures is the inability to deal with water lost to Mexico wells when the All-American Canal is lined to conserve water for San Diego. Currently, agriculture can flourish in the eastern Mexicali Valley because water from the unlined canal seeps underground south past wells on the Mexican side on its way to the Sea of Cortez. Besides a quantification of the amount of water that will be lost, little acknowledgement of the social, economic, and ecological impacts has been accomplished, let alone a calculation of compensation.

The above embarrassments lead one to envision an ideal of binational water planning and management. For example, water of various grades and quantities exists on both sides of the border that, because they are underutilized and undervalued, can be exchanged or sold on the other side. Wastewater can be used for agriculture, treated water can be recharged into the ground instead of dumped into the ocean, excess municipal flows can be diverted to nature's use in winter, at night, or other off-peak times. If agricultural waters can be conserved through various practices on one side, they could be made available to the other.

All that is needed, since most of the laws and plumbing is already in place is a "bank"—an agency tasked with monitoring, moving, pricing, and accounting for flows. The idea is not so far-fetched as some claim. Very recently, when the California and Arizona water managers met on the river with the Secretary of Interior's water official, they realized that innovation and breaking the rules was necessary to avoid extremism and disaster for all concerned. They agreed that takes and returns to the river at different locations and times could indeed solve some current and future demand woes.

SCERP recently completed a study that took a serious look at an international water market with a bank and exchange



philosophy and found that indeed there is the opportunity to match and trade across the border—a possible solution to water scarcity. The challenge is to motivate current users to make the different grades available for trade. For example, a Mexican farmer should be compensated for saving water (or perhaps temporarily fallowing) and “delivering” the saved water to a broker. The broker, in turn, could sell the water to a farmer in Texas or to a government agency that wants to restore a habitat. In 2000, for example, agencies paid \$61 million for just over 397 million cubic meters of water for habitat restoration. Clearly the possibilities of moving water across the border are many and varied, as reclaimed water can be engineered to serve either side without topographical hindrances and associated costs.

A recent SCERP study presents additional motivation for this proposed solution. The study reports the economic benefits and costs of an international water market along the reach of the Rio Grande from Elephant Butte in New Mexico to Fort Quitman in Texas by comparing a hypothetical market institution to current non-market allocations of water.

Urban and agricultural water conservation is often proposed as policies that can reconcile differences between the supply and demand of water. Another method to balance water demand and supply is an international water market that allocates water on an established priority in water claims, available supply, and with a price mechanism that reflects the value of water in all uses. A market for water within the Rio Grande Project would significantly reallocate water among users. The model results replicate the allocation that would occur if water rights were completely assigned to original beneficial users and if these owners were allowed to trade their rights based on their own financial advantage.

The model is subdivided into four types of components: (1) river, groundwater, and transport; (2) municipal diversions; (3) agricultural diversions; and (4) a priority system and exchange. Each component contains a number of alternative activities that are described in the full study. For the entire project, there are six municipalities and five agricultural subdistricts, each representing a point of diversion from the river.

The conclusions drawn from the modeling are that there is an overwhelming increase in net benefits to most parties from a market allocation, relative to the current allocation of surface water. In essence, surface water supplies from the Rio Grande Project would satisfy all demand until at least 2043. In particular, El Paso and Ciudad Juárez would have present value monetary benefits (avoided costs associated with discovery, acquisition, delivery, desalination, treatment, or delivery of water) of \$450 million. Contrary to popular suspicions, the water market would not kill off agriculture; by 2043, there would still be active production in the Mesilla Valley. Net income to farmers in both Elephant Butte Irrigation District and El Paso County Water Improvement District #1 would increase between 200% and 250%, respectively, from current levels when water sales are factored into net income. The impending drought could amplify benefits to all involved.

SCERP appreciates all the challenges and transaction costs to such a trading scheme but has worked on and seen a successful trade of air emission reduction credits across the international boundary. Such cooperative leanings could lead to trades of water, water pollution reduction credits, water-related habitat mitigation credits, and other water-associated assets, maybe even ending tensions between the national governments, among water managers and users, and ultimately leading to secure and sustainable water for all.

Endnotes

¹ Herein defined as the 100 kilometers on either side of the U.S.-Mexican border, as designated by the La Paz Agreement of 1983. However and obviously, natural water flows and human-engineered transfers into the region are considered.

² GNEB has recommended in a past annual report that watershed planning be effected in the border region and is dedicating its 2004 annual report to binational water management in the region.

³ This is a “high” estimate, though, simply based on continuing migration rates experienced during the 1990-1995 period.

⁴ Per capita income in U.S. border counties as a whole is approximately 78% of U.S. per capita income; if San Diego County is excluded from this calculation, the rest of the border region’s residents earn approximately 60% of what non-border county U.S. residents earn (Peach and Williams 2000).

⁵ The institutions representing the United States are Arizona State University, New Mexico State University, University of Texas at El Paso, University of Utah, and San Diego State University. The Mexican universities are Colegio de la Frontera Norte, Universidad Autónoma de Baja California, Universidad Autónoma de Ciudad Juárez, Instituto Tecnológico de Ciudad Juárez, and Instituto Tecnológico y de Estudios Superiores de Monterrey.

⁶ Suzanne Michel, ed. 2003. *Binational Water Management Planning*, SCERP Monograph No. 8. San Diego: San Diego State University Press. Available at www.scerp.org.

⁷ SCERP's "Border + 20" systems modeling framework is being developed by a team headed by Craig B. Forster, Research Associate Professor in Environmental Engineering at the University of Utah. A fuller description of the project can be found at <http://www.borderplus20.sdsu.edu>.

References

- Amnesty International USA. no date. "Intolerable Killings: Ten Years of Abductions and Murders in Ciudad Juárez and Chihuahua." <http://www.amnestyusa.org/women/juarez/>
- Boyle Engineering Corp. 1992. "El Paso Water Resource Management Plan Executive Summary ii." Unpublished.
- Bradley, Barbara, and Emilio de la Fuente. 2003. "Water Without Borders: A Look at Water Sharing in the San Diego-Tijuana Region." Pages 247–278 in *Binational Water Management Planning*, Suzanne Michel, ed. San Diego: San Diego State University Press.
- Forster, Craig. 2004. *B+20*. Forthcoming SCERP Monograph. San Diego: San Diego State University Press.
- Ganster, Paul, David Pijawka, Paul W. Rasmussen, and Rick Van Schoik. 2000. "Overview." Pages 37–72 in *The U.S.-Mexican Border Environment: A Road Map to a Sustainable 2020*, Paul Ganster, ed. San Diego: San Diego State University Press.
- Ganster, Paul. 2004. "State of the Border Environment Report." The State of the Border and the Health of its Citizens: Indicators of Progress 1993–2023. Forthcoming SCERP Monograph. San Diego: San Diego State University Press.
- Michel, Suzanne. 2003. *Binational Water Management Planning*, SCERP Monograph no 8. San Diego: San Diego State University Press.
- Peach, James, and James Williams. 2000. "Population and Economic Dynamics on the U.S.-Mexican Border: Past, Present, and Future." Pages 37-72 in *The U.S.-Mexican Border Environment: A Road Map to a Sustainable 2020*, Paul Ganster, ed. San Diego: San Diego State University Press.
- Peach, James, and James Williams. 2004. Population Dynamics of the U.S.-Mexican Border Region. Forthcoming SCERP Monograph. San Diego: San Diego State University Press.
- Pijawka, David. 2002. *Overcoming vulnerability: The Southwest Center for Environmental Research and Policy's research program (1990–2002) and future agenda*, SCERP Monograph no 5. San Diego: San Diego State University Press.
- Van Schoik, D. Rick, Elena Lelea, and John Cunningham. 2004a. Sovereignty, Borders, and Transboundary Biodiversity: Turning a Potential Tragedy into a True Partnership An Introduction to the Theory and Practice of Conservation Biology in the U.S.-Mexican Border Region." Forthcoming SCERP Monograph. San Diego: San Diego State University Press. Paper available at www.scerp.org.
- Van Schoik, D. Rick, Christopher Brown, Elena Lelea, and Amy Conner. 2004b. Barriers and Bridges, Managing Water in the U.S.-Mexican Border Region. *Environment* 46:1.
- Vélez-Ibáñez, Carlos G. 1996. *Border Visions: Mexican Cultures of the Southwest United States*. Tucson: University of Arizona Press.