OVERVIEW OF THE PRINCIPAL ISSUES AND THEMES

More than 10 million people live in 14 sister cities in the border region. Unreliable potable water supplies and the discharge of untreated wastewater are persistent environmental and public health problems. When the U.S.-Mexico Border XXI Program began in 1996, only 88 percent of border households in Mexico had potable water service; 69 percent were connected to sewers; and 34 percent were on sewer systems that were connected to wastewater treatment facilities. In most of those cities, the sewer systems were beyond their operating design capacity and projected life spans. Although more border cities in the United States had infrastructure in place, many of those systems were in need of rehabilitation and upgrading to meet more stringent water quality requirements. In addition, in Texas and New Mexico, unincorporated settlements not served by public utilities, known as *colonias*, were without potable water, sewers, and wastewater treatment systems.

Water

The signing of the *1944 International Boundary and Water Treaty* by the United States and Mexico underscored the need to work binationally to improve border environmental and public health conditions. The *La Paz Agreement* confirmed that binational commitment.[1] Since that time, many binational projects have been undertaken. Some projects addressed the allocation of river resources between the two nations and border states. Other projects addressed water quality in relation to such indicators as pesticides, salinity, and transportation of sediments. Bilateral agreements have also promoted the construction of wastewater treatment facilities.

Many federal, state, and local institutions and agencies have participated in and continue to work on these border area efforts. Specifically, the Mexican and U.S. sections of the International Boundary and Water Commission (IBWC), Mexico's *Comisión Nacional del Agua* (CNA, or National Water Commission), and the U.S. Environmental Protection Agency (EPA) have provided funding and technical assistance for project planning and construction of infrastructure. A side agreement to the *North American Free Trade Agreement* (NAFTA) created two binational institutions, the Border Environment Cooperation Commission (BECC) and the North American Development Bank (NADB). Those institutions focus specifically on assisting communities in developing environmental infrastructure projects, making the process by which projects are planned and implemented more transparent and responsive to local concerns. The BECC supports efforts to evaluate, plan, and implement water, wastewater, and solid waste projects; the NADB helps project sponsors develop the appropriate financial package. (Chapter 1 provides further details about the binational water and wastewater agreements and institutions.)

Under the structure of the Border XXI Water Workgroup, representatives of both governments review and approve policies that define criteria for environmental projects in the border region. The workgroup's goal is to put in place adequate infrastructure, or replace inadequate infrastructure, to improve public health and environmental conditions. To demonstrate the effectiveness of such projects, the workgroup recognizes the need to develop an understanding of the current condition of the water resources in the region. Therefore, from the outset, the objectives of the Border XXI Water Workgroup have included watershed evaluation and monitoring, as well as infrastructure planning and other infrastructure-related processes.

It is not yet possible to directly relate the effects of projects to improvements in water quality, since most projects are in the planning or construction stage. In anticipation of the need to establish that relationship, studies to characterize the quality of water bodies are already in place in the border

[1] The *Agreement Between the United States of America and the United Mexican States on Cooperation for the Protection and Improvement of the Environment in the Border Area* was signed in La Paz, Baja California Sur, Mexico on August 14, 1983, and entered into force on February 16, 1984.

region. The effort to monitor water quality will help to determine whether the projects achieve the water quality objectives.

Work in the border region is complicated by two factors: the many agencies and institutions participating in the efforts have overlapping functions, and the differences in relevant national, state, and local legislation and legislative processes may be difficult to reconcile. Increased binational communication, cooperation, and coordination have been critical to the success of the workgroup.

OBJECTIVES OF THE WATER WORKGROUP AND PROGRESS TOWARD GOALS

The Water Workgroup objectives set forth in Table 12-1 were identified in the *1996 U.S.-Mexico Border XXI Program: Framework Document (Framework Document)*:

Objectives
• Develop, rehabilitate, or expand drinking water, wastewater collection, and wastewater treatment infrastructure.
• Establish binational guidelines for developing pretreatment programs related to pollution prevention.
• Establish binational priorities related to watershed planning and management, and develop a long-term joint program, through the EPA, U.S. Department of the Interior (DOI), IBWC, CNA, and *Secretaría de Medio Ambiente Recursos Naturales, y Pesca* (SEMARNAP, or Secretariat of Environment, Natural Resources, and Fisheries), in cooperation with state and local authorities, to systematically map and characterize key transboundary surface and groundwater basins.
• Continue programs to monitor the quality of surface and groundwaters, including salinity and sediment transport, to characterize and determine the quality of water resources.
• Develop personnel training programs related to water management issues.
• Educate the public about water and related public health issues, promoting its efficient and rational use, along with conservation and recycling.
• Provide opportunities for public participation in decision making related to water infrastructure, disclosing all aspects of the projects, including the financial implications. Encour-age cross-border communication and exchange of informa-tion at the federal, state, and local government levels.
The objectives listed above may have been paraphrased from the *Framework Document*. For a more detailed description of the objectives, please refer to that report.
The objectives described in this section may be referred to by number. The numbers are intended for ease of reference only and do not imply order of importance.

Table 12-1

Develop, Rehabilitate, or Expand Drinking Water, Wastewater Collection, and Wastewater Treatment Infrastructure

Since 1996, considerable progress has been made in the planning, design, construction, and funding of wastewater and water treatment plants in the border region under the Border XXI Program. Binational federal and state governments in the border region have coordinated their efforts and funding authorities to construct, rehabilitate, or expand existing water and wastewater treatment and collection systems. The *Secretaría de Medio Ambiente, Recursos Naturales, y Pesca* (SEMARNAP, or Secretariat of Environment, Natural Resources, and Fisheries) CNA, EPA, IBWC, the BECC, and the NADB coordinate their activities through the Mexico-United States Border Infrastructure Coordination Committee. The committee has proposed, reviewed, and approved policies for the development of water and sanitation infrastructure projects in the region. Those efforts have helped federal, state, and local managers make decisions to optimize the use and management of the region's scarce resources.

- **Project Planning –** Border XXI Water Workgroup projects have been developed through one of two mechanisms. Under the authority of the 1944 water treaty and the *La Paz Agreement*, funds have been appropriated for certain binational projects. Studies of water-related infrastructure needs were coordinated with and supported by CNA, EPA, and IBWC. The studies focused on fundamental activities within the framework of Border XXI, including strengthening the operating entities to improve their planning base, developing specific projects, and monitoring the quality of the surface and groundwater within the border watersheds.

  In 1994, after NAFTA was signed, both countries provided funding and support for the establishment and operation of the BECC and the NADB; that effort included defining project criteria, developing operational procedures, and hiring technically experienced staff. The institutions are now operational and have begun to play an important role in developing projects.

  In Mexico, sewer and sanitation planning studies have been developed for the cities of Mexicali, Baja California; Nogales, Sonora; Ciudad Acuña and Piedras Negras, Coahuila; and Reynosa, Tamaulipas, through treaty con-

ditions defined in IBWC Minute 294, funded through CNA and EPA. For each of those communities, short- and long-term priority actions leading to the overall integration of sewer and sanitation systems have been identified and developed in project plans. Grant funding for the projects (Mexicali, Nogales, Ciudad Acuña, Piedras Negras, and Reynosa) through this mechanism totaled $57 million.

Other projects completed under these conditions are described below.

- The wastewater treatment plant in Nuevo Laredo, Tamaulipas began operation in March 1996.
- Construction of the first stage of the Tijuana, Baja California-San Diego, California International Wastewater Treatment Plant (IWTP) was completed in April 1997. The South Bay Ocean Outfall (SBOO), which carries the treated wastewater to an underwater outfall, was completed in January 1998. Plant operation, including discharge through the outfall, began in June 1998 and has reduced the number of dry-weather public health alerts along the border beaches. The cost of the IWTP and the SBOO was approximately $300 million.
- A "Quick Fix" program was completed in Mexicali and Nogales, Sonora. Managed by the IBWC, the program included the repair of some of the most degraded areas of the sewer system. Collection system failures, and subsequent treatment system bypasses, are a chronic cause of water pollution. The program has reduced system intrusions and raw sewage bypasses. In Mexicali, changes in water quality in the Río Nuevo, which consists of agricultural drainage and municipal and industrial wastewater, were evaluated before and after construction as part of the ongoing monitoring program at the international boundary.
- Surveys and geographic information system (GIS) mapping studies of wastewater collection systems have been completed for the cities of Mexicali and Nogales, Sonora. These studies provide the data by which infrastructure needs are identified and project specifications may be defined.
- Similar studies have been performed by CNA in other border locations and are in progress in Matamoros and Nuevo Laredo, Tamaulipas. Appendix 13 provides details about these activities.

• **Border Environment Cooperation Commission Project Development Assistance Program –** The BECC Project Development Assistance Program (PDAP) was established to provide technical assistance to border communities for the development of potable water, sewer, and sanitation projects. To date, EPA has contributed $20 million for water and wastewater technical assistance to PDAP. Technical assistance for solid waste is funded through BECC's operating budget, to which Mexico and the United States contribute equally. In Mexico, plans have already been developed for several cities, and studies are currently underway in several others. Table 12-2 lists cities and communities in both countries that have received PDAP funds. Mexicali, Ciudad Acuña, Piedras Negras, and Reynosa project plans have received BECC certification. Once a project has been certified, project sponsors may apply for funding from a variety of sources, including Mexican federal, state, and local governments; matching grants through the Border Environment Infrastructure Fund (BEIF) (see the following section); and loans from the NADB.

Project Development Assistance Program Activities in the United States
Brawley, Calexico, Heber, Vado/Del Cerro, Doña Ana County, San Pablo, Salem/Ogaz, La Union, Chaparral, Berino, Chamberino, San Miguel, Donna, El Paso, Terrell County, Presidio, Brownsville, Horizon City, Descanso, Palo Verde, San Luis, Patagonia, Tombstone, Somerton, Bisbee, Wilcox, Yuma, Douglas, Salton City, Presidio, Sweetwater, Fabens, Los Fresnos, Seeley, Nogales, Blythe
Project Development Assistance Program Activities in Mexico
Palomas, Carboníferos Region, Cinco Manantiales Region, Camargo, Nuevo Progreso, Díaz Ordáz, Valle Hermoso, Ensenada, Tijuana, Tecate, Mexicali, San Luis Río Colorado, Agua Prieta, Cananea, Magdalena de Kino, Santa Ana, Imuris, Ojinaga, China, General Bravo, Miguel Alemán, Nueva Ciudad Guerrero, Mier, Ahumada, Ascención, Ciudad Juárez, Valle de Juárez, Janos, Manuel, Benavides, Coyame, Nuevas Casas Grandes, Ciudad Acuña, Piedras Negras, El Sasabe, Magdalena, Altar, Reynosa, Los Ramones, Los Aldama, Cerralvo, Agualegas, Matamoros, Nogales, Puerto Peñasco, Vallecillo, Sabinas, Anáhuac

Table 12-2

• **Border Environment Infrastructure Fund –** EPA has provided funding to the NADB to administer the BEIF. The BEIF provides grant funding to com-

munities for the design and construction of water and wastewater infrastructure. The BEIF is used to support projects in two ways: design assistance and construction assistance. The funds are targeted to ease a community's adjustment to higher user fees over time and to complete a financial package, respectively. To receive consideration for BEIF funds, projects must be certified by the BECC. Through fiscal year 1999, EPA had provided $211 million for the BEIF.

• **North American Development Bank Institutional Development Program –** The NADB allocated $2.5 million from its operating budget for the Institutional Development Program (IDP) to help water and sanitation agencies achieve effective and efficient operation of services. The goal is to create a solid financial base for long-term operation and maintenance of existing and projected infrastructure. Financial analyses have helped to pinpoint deficiencies and have provided suggestions about ways to achieve self-supporting budgets. These efforts will extend the life of the infrastructure projects by ensuring support for critical operation and maintenance needs.

• **Projects Certified by the Border Environment Cooperation Commission –** Since September 1995, the BECC has certified 36 projects in the border region, including three solid waste-related projects (Table 12-3 on the following page). The total estimated cost of the 36 projects is almost $900 million. As of May 2000, 6 projects has been completed and are operating, and 16 more are under construction. The 22 projects will serve more than 5 million people.

- **Mexicali:** The integrated sanitation project for the city of Mexicali was certified in 1997. The project includes expansion and rehabilitation of the sewer system and existing wastewater treatment plant (Mexicali I) and construction of a pumping plant, pressure emitter (force main), and wastewater treatment plant (Mexicali II). Those facilities are expected to meet the city's wastewater treatment needs to the year 2010. Once it is fully operational, the project will significantly increase the amount of treated domestic and industrial wastewater, from 67 percent to 100 percent.
- **Ciudad Juárez:** The Ciudad Juárez Sanitation Project was certified in September 1997. The north and south wastewater treatment plants, now under construction, will provide advanced primary treatment, the process by which sewage solids are separated from the wastewater. Both plants are designed to be upgraded to secondary treatment in the future, thereby further improving the quality of the treated water. Once the two plants have become operational, wastewater treatment for the city will increase from 0 to 100 percent. Another component of the project will increase the number of households connected to the sewer system from 80 percent to 93 percent. The project will benefit 1.2 million inhabitants at an estimated cost of $30 million.
- **Tijuana:** In June 1997, the BECC certified the system of parallel works and the rehabilitation and expansion of the *Planta de Tratamiento* (Treatment Plant) San Antonio de Los Buenos in Tijuana. This project, now under construction, is expected to cost $19 million. When complete, the project will reduce the amount of untreated discharges that drain toward San Diego and decrease contaminant load to the region's coastal and marine resources.
- **Reynosa:** The Integrated Sanitation Project for Reynosa was certified in March 1998. The project, expected to cost $83 million, will bring sewer and sanitation service to 100 percent of the population. The principal components of the project are (1) rehabilitation of the existing wastewater treatment plant, (2) construction of two new wastewater treatment plants, (3) rehabilitation and expansion of the primary and secondary sanitary sewer network, and (4) construction and rehabilitation of the wastewater pump stations. Plans for future reuse of treated wastewater for irrigation should bring the added benefit of increased agricultural productivity to the arid region.

For details about other projects, consult the BECC web site at *www.cocef.org* and the NADB web site at *www.nadb.org*.

• **Indian Tribes Environmental Infrastructure Program (United States) –** Approximately 27 tribes have sovereignty over lands within the border zone, and several binational rivers or groundwater basins lie within, near, or under tribal lands. Degradation of water quality affects the public health and environment of trib-

BECC Certified Projects				
State	City	Type	Year Certified	Total US$M
Arizona	Douglas	PW-WWTP	1996	2.0
	Patagonia	WWTP	2000	1.3
	Somerton	WWTP	1996	2.7
Baja California	Ensenada	WW Reuse	1995	8.2
	Mexicali	WWTP	1997	57.3
	Tijuana	WWTP	1997	19.5
	Tijuana	WWTP	1997	0.2
California	Brawley	PWTP	1995	24.8
	Brawley	WWTP/Sewer	1999	13.6
	Calexico	PWTP	1998	11.3
	Heber	WWTP	1999	3.4
	Heber	WWW	1999	4.3
	San Diego	WWTP	1997	99.6
	Westmorland	WWTP	1999	4.4
Chihuahua	Ciudad Juárez	WWTP	1997	31.2
Coahuila	Ciudad Acuña	WW Line	2000	80.4
	Piedras Negras	WWTP/Line	2000	57.5
New Mexico	Berino	WW Line	1998	2.0
Sonora	Agua Prieta	SWLF	1996	2.0
	Naco	PW-WWTP	1996	1.1
	Nogales	PW	1996	39.0
	Puerto Peñasco	SWLF	1996	2.3
Tamaulipas	Matamoros	SWM	1998	13.0
	Matamoros	WWTP	1996	1.1
	Ciudad Reynosa	WW System	1998	83.4
Texas	Alton	WWTP	1997	14.5
	Colonias (7)	W/WW hook ups	1999	55.8
	Del Rio	PWTP	1998	36.5
	Donna	PWTP	1998	21.6
	El Paso - Jonathan Rogers	PWTP	1997	37.8
	El Paso - Lower Valley	PW-WWTP	1998	98.4
	El Paso	WW Reuse	1995	11.7
	El Paso	Septic Tanks	1996	0.2
	Mercedes	PW-WWTP	1996	11.0
	Roma (Colonias)	WWTP	1999	34.2
	Sanderson	WW Line	2000	3.6
Total through March 2000 (estimate in US$)				$891

PW = Potable water; PWTP = Potable water treatment plant; SW = Solid waste; SWLF = Solid waste landfill; SWM = Solid waste management; WW = Wastewater; WWTP = Wastewater treatment plant;

WW Line = Wastewater collection system

Sources: NADB (2000): NADB News. Volume IV, Number 4 (*www.nadb.org*); BECC: Project certification as of March 2000 (www.cocef.org).

Table 12-3

al communities. Examples of tribes affected by transboundary water issues include: Quechan and Cocopah (Colorado River water rights); Campo (on the Tecate River within the Tijuana River watershed); Tohono O'odham (drawing from a binational aquifer); and Torres-Martinez, Morongo, Twenty-nine Palms, Augustine, and Agua Caliente (affected by uses and treatment of Colorado River water carried to the area by the Coachella Canal and ultimately discharged to the Salton Sea).

Through the Border Tribal Grant Program, $17 million was allocated in fiscal year (FY) 1997, and $5 million in FY 1998 for wastewater and drinking water infrastructure projects. Of the 14 tribes that submitted proposals, all were awarded funds, for a total of $11.8 million (Table 12-4). Funds have been distributed through direct grants to tribes and through interagency agreements (IAG) with the Indian Health Service (IHS). Following are examples of typical projects:

Tribal Infrastructure Projects

Tribe	Project Type	Year(s) Awarded	Amount (US$M)
Cocopah	WWTP	1997, 1999	1.9
Tohono O'odham	PW-WW	1997, 1998, 1999	4.1
Manzanita	PW	1998	0.2
La Jolla	PW-WW	1998	0.2
Pauma	PW-WW	1998, 1999	0.6
San Pasqual	PW-WW	1998	0.2
Pala	PW-WW	1998, 1999	0.4
Quechan	PW, Sewer	1997	1.5
Rincon	PW	1998	0.1
Santa Ysabel	PW	998, 1999	1.0
Sycuan	PW	1997	0.6
Torres-Martinez	PW-WW	1998	0.2
Pechanga	PW-WW	1998, 1999	0.2
Mesa Grande	PW	1998, 1999	0.6
Total awarded through December 1999			$11.8

WWTP = Wastewater treatment plant; PW = Potable water; WW = Wastewater
Source: EPA Region 9 Tribal Water Program

Table 12-4

- **The Quechan Tribe** was awarded approximately $1.4 million. The tribe will construct a water treatment plant to improve the quality of the surface water supply. Construction of the plant began in spring 2000. The plant will serve more than 500 homes on the tribal water system. A second project, begun in fall 1999, will connect 70 homes, now on failing individual septic systems, to the existing wastewater collection and treatment system.
- **The Cocopah Tribe** was awarded $1.9 million to construct two new community sewer systems. The systems will provide better treatment than individual septic systems, which often fail because of high water-table levels in the area. The project will provide first-time community wastewater service to 139 homes in two separate communities. Construction began in spring 1998, and completion was expected in 2000.
- **The Tohono O'odham Nation** was awarded $4.1 million. Several projects begun in 1997 will benefit six communities. Three new wells will address high nitrate and fluoride levels in drinking water. Four community sewage systems will be installed. Existing sewer infrastructure in the nation's capital, Sells, will be repaired. In addition, drinking-water infrastructure, including a water tank and water lines, will be installed in two communities.

• **Total Funding for Border Infrastructure Projects –** Tables 12-5 and 12-6 (on the following page) list the total grants awarded by both nations for border infrastructure projects from 1995 to 1999.

Total Funding for Border Infrastructure Projects (1995–1999)

	Mexico		
Type of Project	CNA Pesos[2] (x1000)	State and Local (x1000)	Total Pesos Agencies (x1000)
Drinking water	239,000	142,000	381,000
Collection systems	221,000	192,000	413,000
Wastewater treatment	199,000	63,000	262,000
Studies	58,000	14,000	72,000
Totals (1995–1999)	717,000	411,000	1,128,000

Table 12-5

[2] When this report was prepared, one Mexican peso was equivalent to approximately US$0.11.

Total Funding for Border Infrastructure Projects (1995–1999) United States		
Place/Program	Agency	Amount US$M
Mexicali-Nogales-Rio Grande	IBWC/EPA	61
IDP	NADB/EPA	211
San Diego IWTP	IBWC/EPA	107
Border Tribal Infrastructure	EPA	23
PDAP	BECC/EPA	20
Border-wide studies	FUMEC	3.5
Total (1995-1999)		$425.5

Table 12-6

Pretreatment Programs Related to Pollution Prevention

All wastewater infrastructure construction projects certified by the BECC must develop pretreatment program plans. Implementation of those plans will be of critical importance as infrastructure facilities begin operation, if they are to function as designed over the lifetime of the project.

Supported by a Cooperative Enforcement and Compliance Workgroup grant in 1998, the California Regional Water Quality Control Board, Colorado River Region has been testing a continuous water quality monitoring station in the New River at the international boundary in Calexico, California. The objective is to detect unusual inputs into the river, using changes in basic water quality parameters (pH, temperature, electrical conductivity, and dissolved oxygen). Detection of a change triggers automatic sampling, collection, and analysis. It is expected that the information will help pinpoint the time of the event and the type and concentration of the contaminant. Sharing that information with authorities in Mexicali will help in the development of the industrial pretreatment program.

The *Comisión Estatal de Servicios Públicos de Tijuana* (State Public Service Commission of Tijuana), the City of San Diego, and the State of California have collaborated on several workshops on pretreatment programs. The training sessions have been attended by management and staff of wastewater treatment systems throughout Baja California.

Establish Binational Priorities Related to Watershed Planning and Management, and Develop a Long-term Joint Program, through EPA, DOI, IBWC, CNA and SEMARNAP, in Cooperation with State and Local Authorities, to Systematically Map and Characterize Key Transboundary Surface and Groundwater Basins

- **Colorado River Basin –** Allocation of Colorado River water has been the subject of many treaties and agreements. The Colorado River flowing into Mexico carries water that has been taken, used, and returned by agriculture and municipalities throughout the seven U.S. Colorado River basin states. Mexico is entitled to a certain quantity, but water quality is also of concern, as the water becomes more saline with each diversion and return. A binational technical committee convened by the IBWC meets regularly to discuss such issues as: (1) delivery of surplus water to Mexico; (2) options for improving water quality; (3) impact of the Yuma, Arizona desalination plant on the *Ciénaga de Santa Clara*, (Santa Clara Wetlands) one of the few remaining wetlands in the Colorado River delta; and (4) details of such projects as the excavation of a sediment-settling channel in the riverbed between the northern international boundary and the Morelos Dam.
- **Rio Grande Watershed –** A binational technical committee holds periodic meetings to define the best and most efficient use of the shared Rio Grande watershed resources. To further attainment of that objective, the committee has sponsored information exchanges, a training course in the use of models, and workshops on drought mitigation.

Continue Programs to Monitor the Quality of Surface and Groundwaters, including Salinity and Sediment Transport, to Characterize and Determine the Quality of Water Resources

- **Surface Water and Groundwater Quality Monitoring Projects –** The following surface water and groundwater quality monitoring projects have been completed or are in progress:
  - Investigation of toxic substances in the Rio Grande
  - Characterization of the transboundary aquifers from Ciudad Acuña, Coahila-Del Rio, Texas to Piedras Negras, Coahila-Eagle Pass, Texas

- Study of groundwater quality in the area of Ciudad Juárez Chihuahua-El Paso, Texas
- Study of water quality in Naco, Sonora
- Study of groundwater quality in Nogales-Nogales (the Nogales Wash)
- Investigation of toxic substances in the Lower Colorado River and the New River
- Modeling of toxic substances in the New River
- Synthesis of data from the lower Colorado River basin, including the New River, the Alamo River, and the Salton Sea

• **Rio Grande Studies –** On November 13, 1992, the IBWC approved Minute No. 289, Observation of the Quality of the Waters Along the United States-Mexico Border, authorizing the first phase of the *Rio Grande Toxics Substance Study* (RGTSS). The study is a binational, multi-phase and multi-agency effort to characterize the extent of toxic contamination of the Rio Grande system, including the tributaries.

A full suite of environmental chemical analyses was performed to determine the presence of contaminants and evaluate their impact on fish and other aquatic organisms. The study was designed to test the hypothesis that industrial and agricultural sources were adding contaminants to the river system. Concern has intensified in recent years, as the number of industrial facilities being built in the border region continues to grow.

• **Lower Colorado River Basin –** On two occasions in 1995 and 1996, water bodies that make up the lower Colorado River basin, including the New River, were sampled and analyzed to determine concentrations of chemical pollutants and effects on aquatic organisms. A final report summarizing the results is expected this year.

• **Other Water Quality Studies**

- **Agua Prieta and Naco:** In 1994, water quality concerns were identified by the binational Northeast Sonora-Cochise County, Arizona Health Council (NSCCHC). In 1996, the U.S. Agency for International Development (USAID) provided funding through the International City/County Management Association (ICMA) to *Enlace Ecológico A.C.*, a Mexican nongovernmental organization, to conduct a water quality project in the municipalities of Agua Prieta; Cananea; and Naco, Sonora. Both sections of the IBWC reviewed the project plan. *Enlace Ecológico,* the *Universidad de Sonora–Departamento de Investigaciones Científicas y Tecnológicas* (DICTUS, or the University of Sonora–Department of Scientfic Studies and Technology), and the three Sonoran municipalities developed the study. EPA funded the Arizona Department of Environmental Quality (ADEQ) to provide laboratory support for sample analysis. The Arizona Department of Health Services (ADHS) provided training for DICTUS investigators. The Border Ecology Project, a U.S. nongovernmental organization, provided technical support. Results of the study are being reviewed. Binational public meetings to discuss the findings will take place in 2000.

- **Nogales-Nogales:** In 1996, the IBWC *Joint Report of Principal Engineers Relative to the Joint Monitoring of the Quality of the Groundwater in the Ambos Nogales Area* was signed. The objective of the binational study was to determine groundwater quality along the alluvial aquifer of the Nogales Wash. The Nogales Wash originates 8.6 kilometers south of the international boundary and flows north through Nogales, Sonora and Nogales, Arizona. Monitoring wells were dug on both sides of the border. Soil and groundwater samples were collected quarterly for one year and analyzed by laboratories in both countries for heavy metals, organic compounds, and general water quality characteristics. Data were compared with Mexican water quality guidelines, the *critérios ecológicos de calidad de agua* (CECA, or ecological water quality criteria) and Arizona Aquifer Water Quality Standards (AWQS).

According to the data, groundwater quality exceeded both AWQS and CECA guidelines for nitrates and coliform bacteria in the aquifer. An organic solvent, tetrachloroethylene (PCE), was also detected in concentrations exceeding the CECA criterion in Mexico, but below the AWQS criterion in Arizona. The distribution suggests the existence of a PCE plume. Project data also indicated the presence in Sonora of iron and manganese at levels above the CECA criteria. Arsenic levels in Arizona exceeded AWQS. As a result of this study, EPA, IBWC, ADEQ, and CNA are exploring possible alternatives for further binational

activities to locate and remove the sources of PCE.

In 1998, the Arizona Department of Water Resources (ADWR) and CNA held joint meetings to exchange data on groundwater flow models to assist both nations in regional planning and operational efforts. The models will enable the water management agencies to plan for resource allocation during drought conditions, evaluate the effects of recharge projects, and determine how future development adjacent to the Santa Cruz River will affect base flow and seasonal variation in groundwater levels. The models can also be used to predict the fate of contaminants discharged into the surface water systems and into the flood-plain aquifer. The two agencies, each working with a different model, will coordinate efforts to ensure model compatibility.

- **New River:** The California Regional Water Quality Control Board, Colorado River Region, monitors water quality in the New River at the international boundary in Calexico. Monthly 8-hour and quarterly 24-hour samples are analyzed for a variety of substances and conditions (Table 12-7). This program provides baseline information that will be compared with water quality in the New River after the infrastructure projects in Mexicali have been built and become operational.

New River Water Quality Parameters
Flow, temperature, pH, conductivity, dissolved oxygen and settleable solids, methylene-blue-active substances (MBAS), total phosphate, phenol, cyanide, nitrogen (ammonia, nitrate, nitrite), organic nitrogen, hardness, alkalinity, total dissolved solids, total suspended solids, turbidity, biochemical oxygen demand and chemical oxygen demand, total and fecal coliform, heavy metals, and volatile organic compounds

Table 12-7

- **Santa Cruz River:** Two studies have been performed to evaluate water quality in the Santa Cruz River. The U.S. Fish and Wildlife Service (FWS) has completed a toxicity study of ambient water. Volunteers from Friends of the Santa Cruz River, a local nongovernmental organization, have completed a water quality study. Publication of the report is pending.
- **San Pedro River:** The San Pedro River is the one of the last free-flowing rivers in the United States. The willow flycatcher, an endangered species, inhabits its San Pedro riparian corridors. A coalition of government and private agencies has formed to purchase in-stream acreage within the San Pedro River (Arizona) watershed and channel to protect willow flycatcher habitat. The project will include the development of a flow regime management plan that will help to recharge groundwater to prevent land subsidence and protect well-water supplies, as well as maintain riparian habitat and stream flow.

Develop Personnel Training Programs Related to Water Management Issues

- **Operation and Maintenance –** The Water Workgroup is strongly committed to providing operators of water and wastewater systems on the border with the information and education they will need to keep facilities running as designed.

EPA has delivered to wastewater plant operators in the eastern border region binational training courses on wastewater treatment techniques, the importance of surface and groundwater protection, testing, and quality control, as well as methods of maintaining treatment plants and collection systems. In addition, water supply operators along the border were trained in a binational forum on the requirements of the Safe Drinking Water Act (SDWA). The EPA manuals and training materials for both programs were translated into Spanish.

With the support of the EPA, the State of California, and the City of San Diego have developed training workshops for operation and maintenance of water and wastewater treatment plants and distribution and collection systems. The workshops are intended specifically for binational projects. Training materials have been translated into Spanish and customized for specific facilities in Mexicali and Tijuana.

The sister cities of Calexico and Mexicali have developed a local binational certification program. Staff of the *Comisión Estatal de Servicios Públicos de Mexicali* (CESPM, or State Public Service Commission of Mexicali) received on-site training in water and wastewater treatment in Calexico. As a result, they were able to complete California requirements for operator certification. The train-

ing program will continue and is expected to lead to a Mexicali-based program.

The *Fundación de México-Estados Unidos para la Ciencia* (FUMEC, or Mexico-United States Foundation for Science) established in 1992 to support binational research projects in science and technology, has provided assistance for the customized translation of training manuals and programs for public agencies in Ciudad Juárez and other border communities.

- **Environmental and Water Quality Education** – EPA has also provided grants to several border communities to conduct training courses in environmental education. In 1997, the San Diego Natural History Museum received a grant to train teachers in the Tijuana and Ensenada, Baja California areas on general principles of ecology and water quality testing. In 1998, a total of 100 teachers received training. Mexican state and federal education agency staff in Mexico also attended the training courses. Appendix 7 provides additional information about the Border Community Grants.

Educate the Public about Water and Public Health Issues, Promoting Its Efficient and Rational Use, along with Conservation and Recycling

- Agua para Beber – In 1997, Project Concern International was awarded a grant to increase understanding of environmental sanitation in communities along the Baja California border through their *Agua para Beber* program. The program demonstrates techniques for storage and disinfection of water. Ten volunteers were trained in community health issues. They visited 400 homes, distributing drinking water containers, teaching people how to test water and purify it using chlorine, and demonstrating methods of safe water storage for both drinking and domestic use. It is estimated that 2,085 people benefitted from the program.

The Center for Environmental Resource Management at the University of Texas at El Paso also received funding through EPA and the Southwest Center for Environmental Research and Policy, a consortium of four U.S. universities, to develop and implement *Agua para Beber* in El Paso and Ciudad Juárez. Working with 51 volunteer health promoters, the initial pilot effort educated more than 500 families in water purification and hygiene. The program was subsequently transferred to community-based organizations to enhance program sustainability. More than 10,000 individuals and 175 health promoters have been educated and trained since the establishment of the program in 1994.

- Agua Limpia en Casa – The Water Workgroup and the Environmental Health Workgroup, in collaboration with CNA, have developed the *Agua Limpia en Casa* (Clean Water in Homes) program, an outreach effort to educate small communities about the relationship between basic sanitation and water borne illnesses. Mexico's *Secretaría de Salud* (SSA, or Secretariat of Health), FUMEC, the NADB, and state health agencies are participating in the program, which began during the third quarter of 1998 with a project in Ojinaga, Chihuahua. The results of the project were mixed, indicating the need for further work to inform people about the relationship between clean water and public health.

Other projects, planned for border communities in Sonora, will focus on such topics as the importance of water quality improvement, protection of water sources, efficient use of water, promotion of disinfection techniques, implementation of wastewater systems, promotion of appropriate handling of foodstuffs, and development of environmental sanitation certification programs. Appendix 12 provides more information about the *Agua Limpia en Casa* program.

Provide Opportunities for Public Participation in Decision Making Related to Water Infrastructure; Present All Aspects of the Projects, including the Financial Implications; Encourage Cross-border Communication and Exchange of Information at the Federal, State, and Local Government Levels

A well designed and implemented public participation program is one of the BECC's certification requirements for every environmental infrastructure project. Project sponsors must document effective efforts to inform the public about the project, to provide opportunities for public input, and to include that input in project development. Once the basic planning has been completed, the project must be presented in a series of public meetings. All aspects of the project are to be presented in sufficient detail, including the design, location, and cost. It must be made clear that realization of the project will require that the community commit some level of its resources to pay for the long-term sustainability of the project.

Communication about the progress of infrastructure projects has increased through binational technical committees, as well as public meetings held in border communities on both sides of the border. Collaboration on water quality studies has increased opportunities for binational sampling efforts, data comparison, and information exchange.

ENVIRONMENTAL INDICATORS

Types of Environmental Indicators

P	PRESSURE: ACTIONS OR ACTIVITIES THAT INDUCE PRESSURE ON THE ENVIRONMENT
S	STATE: ENVIRONMENTAL AND NATURAL RESOURCE QUALITY AND QUANTITY
R	RESPONSE: ACTIONS TAKEN TO RESPOND TO ENVIRONMENTAL AND NATURAL RESOURCE PRESSURES

As described in previous sections of this chapter, the binational priorities for the Water Workgroup are environmental infrastructure development, pollution prevention and watershed planning, water quality monitoring, environmental training, and public education and involvement. The indicators discussed below have been developed to relate the benefits of a project to the population being served (Mexico) or to present narrative or numeric water quality standards (United States). The workgorup expects to be able to measure the effectiveness of the Border Infrastructure Program when more of the water and wastewater projects are fully operational.

ENVIRONMENTAL INFRASTRUCTURE PROJECT DEVELOPMENT INDICATORS (MEXICO)

It is expected that infrastructure projects currently under construction or pending construction will produce significant changes in environmental indicators in the near future.

S **PERCENTAGE OF MEXICAN BORDER POPULATION WITH POTABLE DRINKING WATER**

Access to a reliable source of drinking water is critical for public health since many disease-causing organisms live in contaminated water. The Water Workgroup is actively engaged in the planning and construction of drinking-water infrastructure in the border area to allow the safe, reliable delivery of drinking water.

This indicator identifies the percentage of the population in Mexico's border region that is served drinking water from a central system and is intended to help assess the effectiveness of current and planned infrastructure projects (Table 12-8).

Year	Percentage Served
1995	88
2000	93

Table 12-8

S **PERCENTAGE OF TOTAL VOLUME OF DRINKING WATER BEING DISINFECTED PRIOR TO DELIVERY**

Data collected since 1996 indicate that 100 percent of all water that is consumed for drinking is disinfected. Unless the data change in the future, this indicator will be deleted from future indicator reports.

R **PERCENTAGE OF MEXICAN BORDER POPULATION SERVED BY WASTEWATER COLLECTION**

Wastewater contains chemicals and disease-causing organisms that can threaten public health. Sewers are needed to collect and convey wastewater and minimize public exposure to untreated wastewater.

This indicator is expressed as a percentage of the population served by a wastewater treatment system (Table 12-9). The workgroup will endeavor to obtain data for this indicator in the near future.

Year	Percentage Served
1995	34
2000	75

Table 12-9

R **PERCENTAGE OF MEXICAN BORDER POPULATION CONNECTED TO WASTEWATER TREATMENT**

Treatment of wastewater is necessary to remove pollutants and disease-causing organisms. Exposure to untreated wastewater can jeopardize public health.

This indicator is intended to help assess the effectiveness of current and planned wastewater treatment infrastructure projects in Mexico's border region. Because data are limited, only estimated wastewater treatment is presented (Table 12-10). The workgroup will endeavor to obtain the data necessary to fulfill this indicator in the near future.

Year	Percentage Connected
1995	60
2000	75

Table 12-10

SURFACE AND SUBSURFACE WATER QUALITY INDICATORS (UNITED STATES)

Local, state, and federal agencies conduct water quality monitoring programs in the border region. The programs are not coordinated with one another. Different agencies measure different sets of water quality characteristics; they have independent sampling schedules and different data quality objectives. The U.S. participants in the Border XXI Water Workgroup have mapped existing information from current or recently completed monitoring programs of the U.S. Geological Survey (USGS) and CNA. Table 12-11 lists the constituents according to whether they are monitored in surface or groundwater programs. Appendix 14 contains the maps.

S **QUALITY OF TRANSBOUNDARY SURFACE WATERS**

The U.S. participants in the Water Workgroup have mapped existing information from the USGS and Mexican agencies about levels of constituents in surface water bodies obtained through current or recently completed monitoring efforts. Maps were constructed to illustrate trends in water quality data for constituents analyzed over a 10-year period, from 1987 to 1997. The maps included watersheds of the Colorado River, the New River, the Rio Grande, the San Pedro River, and the Santa Cruz River. Information about certain surface-water constituents is summarized below. Appendix 14 contains the maps.

U.S.-Mexico Border Region Water Quality Data Base		
Parameter	Surface Water Body	Groundwater Basin
Longitude	San Luis Río Colorado	Edwards Aquifer (Del Río-Ciudad Acuña)
Latitude	Morelos Reservoir	
Chloride	Wellton-Mohawk Canal	Hueco Bolsón (El Paso-Ciudad Juárez)
Specific Conductance	Mexicali	
Hardness	Calexico	Mimbres Basin
Phosphate	Westmorland	San Pedro River
Oil and grease	Matamoros-Brownsville	Mexicali-Imperial Valleys
Nitrate	Reynosa-McAllen	
Ammonia	Falcon Reservoir	
Turbidity	Nuevo Laredo-Laredo	
Fecal coliform	Piedras Negras-Eagle Pass	
Dissolved oxygen	Ciudad Juárez-El Paso	
Total dissolved solids	Elephant Butte Reservoir	
MBAS (detergents)	San Pedro River	
	Santa Cruz River	

MBAS = Methylene-blue-active substances

Table 12-11

- **Nutrients –** The presence of nitrogen in water, measured in milligrams per liter, is an indicator of human impact. Nitrates are found in agricultural runoff; ammonia is a characteristic of effluent from municipal wastewater treatment plants (Table 12-12).

  Data were collected at nine sites in California, Texas, Baja California, Chihuahua, Coahuila, Nuevo León, and Tamaulipas. Appendix 14 provides additional details about site locations.

Constituent	Number of Sites		
	Increasing Concentrations	Decreasing Concentrations	No Change
Nitrogen - Nitrates	2	1	6
Nitrogen - Ammonia	2	4	3

Table 12-12

- **Salts –** Specific conductance and total dissolved solids indicate the level of salts present in a water sample, expressed as a measure of electrical charge (conductivity) or weight (milligrams per liter) for total dissolved solids. Total chloride is a measurement of a

specific chemical and, in fresh water samples, usually indicates the impact of human activities, both agricultural and municipal (Table 12-13).

Data on specific conductivity and total chloride were collected at locations in all states (except New Mexico and Coahuila) along the border. Data on total dissolved solids were collected in the same states. Appendix 3 contains additional details about site locations.

Parameter	Number of Sites		
	Increasing Concentrations	Decreasing Concentrations	No Change
Specific Conductivity	6	3	13
Total Dissolved Solids	2	4	18
Total Chloride	4	4	13

Table 12-13

• **Turbidity and Bacteria –** Turbidity is an indirect measurement of the amount of particles in a water sample. The turbidity of river water and other water bodies may vary, depending on the type of rock, sediment, or habitat through which they flow. Before the Colorado River was dammed, for example, it carried a large sediment load and was, therefore, naturally very turbid. Decaying organic matter and microscopic organisms, such as plankton and bacteria, will also increase turbidity.

Fecal coliform is a measurement of a type of bacteria found in vertebrate gut. It is an indirect measurement of the potential that human pathogenic bacteria are present (Table 12-14).

Data on turbidity were collected at 13 locations in all states along the border except New Mexico. Data on fecal coliform were collected at 14 locations in the same states.

Parameter	Number of Sites		
	Increasing Concentrations	Decreasing Concentrations	No Change
Turbidity	1	3	9
Fecal Coliform	1	2	11

Table 12-14

S QUALITY OF TRANSBOUNDARY SUBSURFACE WATERS

The workgroup continues to develop subsurface water quality indicators for the following basins in the United States and Mexico and will present the results in future reports:

- Edwards Aquifer at Del Rio-Ciudad Acuña
- Hueco Bolsón at El Paso-Ciudad Juárez
- Mimbres Basin
- San Pedro River groundwater basins
- Imperial-Mexicali valleys groundwater basins

FUTURE PERSPECTIVES

Infrastructure Projects

Mexico

- The integrated sanitation project for Mexicali, currently under construction, will increase the amount of of domestic and industrial wastewater treated from 67 percent to 100 percent.
- The north and south wastewater treatment plants of the sanitation project for Ciudad Juárez are currently under construction. Once completed, treatment of wastewater will increase from 0 percent to 100 percent.
- The start-up of the parallel works system and the rehabilitation and expansion of the *Planta de Tratamiento* (Treatment Plant) San Antonio de los Buenos in Tijuana are scheduled for the second half of 2000.
- The rehabilitation of the Reynosa Wastewater Treatment Plant Number 1 and pumping stations will be completed this year, at which time construction of two new wastewater treatment plants will begin. Rehabilitation and expansion of the primary and secondary sanitary sewer networks is also planned. The projects will increase the number of households that have sewer service and are connected to treatment facilities from 57 percent to 90 percent.

United States

- Improvement of the water treatment facilities and distribution system in Calexico will raise drinking water quality to the new California Department of Health Services standards. Construction began in March 1999.
- In Del Rio, construction of a potable water treatment plant, replacement of existing raw water pumping

facilities and potable water storage tanks, and expansion of the distribution system will increase water clarity by removing a higher percentage of particulates. This project will bring water quality into compliance with the SDWA standard, and will reduce water losses through distribution system leaks.

- Construction of a water treatment plant and expansion and rehabilitation of the water distribution system will improve the water quality in Donna, Texas. The plant will serve colonias in the vicinity of the city. Upgrades and replacements of the existing wastewater system will provide colonia residents with sewer service.
- Expansion of the Jonathan Rogers Water Treatment Plant in El Paso will bring potable water to colonias in the city and neighboring areas. Completion of the three-phase water and wastewater projects for the Lower Valley Water District in El Paso County will improve the delivery and quality of the potable water supply and will provide wastewater treatment to households in the Socorro and San Elizario colonias.
- In Heber, Arizona, expansion and rehabilitation of the existing wastewater treatment plant will reduce public and environmental health risks associated with a system that is being used beyond its capacity.
- Construction of the South Bay Water Reclamation Plant for water reuse in San Diego will provide additional treatment capacity within the South Bay area, reducing the potential for sewer spills, in addition to providing another source of reusable water for the community.

Binational, federal, state, and local agencies and institutions, working with the Border XXI Water Workgroup, have overseen the planning of improvements in drinking water treatment and delivery systems, wastewater collection and treatment systems, and solid waste handling and disposal. Projects certified in the BECC process have been completed, are in progress, or are planned for the largest cities along the border, including Matamoros, Reynosa, Ciudad Juárez, El Paso, Nogales (Arizona), Nogales (Sonora), Mexicali, Tijuana, and San Diego. Numerous smaller projects are planned, including a specific program to bring services to *colonias*.

In the workgroup's estimation, local sponsorhip of projects, with assistance and support from BECC and NADB, has proven to be an excellent method of promoting infrastructure development. However, the partnership has reached the point at which demand for grant support exceeds the funding agencies' – particularly EPA's – ability to meet it. Although many projects have been initiated, it is clear that the need to support environmental infrastructure projects is still strong.

Pretreatment and Pollution Prevention

Pretreatment and pollution prevention programs are in the initial stages of development along the border. As planned projects are completed and begin operations, the need to put such programs in place increases. Binational and federal agencies are discussing ways to integrate monitoring and enforcement programs with public education campaigns, industrial source reduction, pollution prevention, training in pretreatment methods, and economic incentives. An environmental management systems pilot grant program to assist municipalities on the border in evaluating their current practices and processes for long-term sustainability and in adopting comprehensive environmental management systems through training and technical assistance is in the planning stage.

Watershed Planning and Management

Watershed planning and management will continue throughout the border region, with special attention to binational issues related to Colorado River and Rio Grande water quality and quantity required to maintain or improve public and environmental health.

Research in the Rio Grande will continue to support the effort to reduce sources of pollution. Continued work to characterize transboundary aquifers will increase under-standing about how surface water and groundwater resources are interconnected. That understanding, in turn will aid management in making decisions that will protect all resources.

Water Quality and Environmental Indicators

Continuation and expansion of the effort to characterize water quality in transboundary water bodies, especially the Colorado River and the Rio Grande and their tributaries, are of critical importance. The activities will document whether the construction and maintenance of environmen-tal infrastructure have achieved the expected improvements in water quality of public water bodies.

Training

Workshops to provide training for operators of potable water, wastewater treatment, and wastewater collection systems will continue to be offered. It is expected that, by the end of 2000, a majority of the operators of principal infrastructure systems in Mexican border cities will have received initial training and that all instructional material will have been customized to reflect the actual conditions on site at each specific facility. Additional and expanded training programs will be integrated into all future project planning and implementation.

Water Use, Conservation, and Public Health

The pilot phase of the *Agua Limpia en Casa* program will continue in border cities in Chihuahua and Sonora. After review and evaluation, the program will be expanded to other Mexican border communities within the next two years.