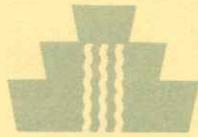


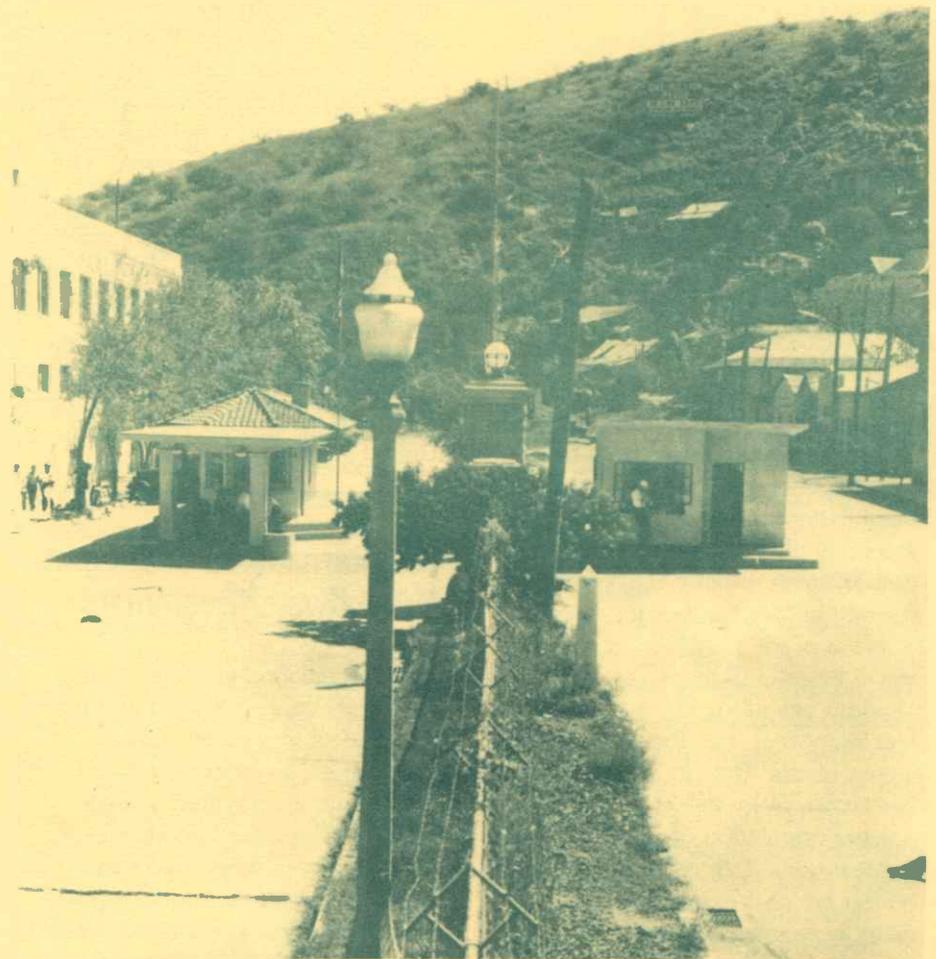
# ARROYO

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## U.S.-Mexico Transboundary Water Issues Challenge Policymakers



*Photo from the Arizona Historical Society, Tucson*

**T**he U.S.-Mexico boundary is a political division and, although surveyed, mapped and patrolled, cannot completely determine the two nations' rights to the water resources along their common border. The flow of rivers and streams and the occurrence of groundwater are largely determined by nonpolitical, natural forces. As a result, the United States and Mexico must often negotiate the allocation and use of border water resources.

This edition of *Arroyo* will discuss U.S.-Mexico transboundary water

issues, with a focus on events along the 358-mile Arizona-Sonora border. The newsletter was prepared with the belief that an interest in Arizona or domestic water issues includes a concern about U.S.-Mexico transboundary water affairs.

In fact, an understanding of Arizona water issues broadens with an awareness of the binational complexity of such familiar water concerns as groundwater use, water quality, floods, wastewater treatment, surface and instream flow, and the preservation of an endangered

species of fish. In a sense, to review transboundary water issues is to view domestic water concerns on the international stage.

Further, it could be argued that U.S. activities to address transboundary water affairs are motivated by the same attitudes and beliefs that ultimately determine the course of action taken to resolve domestic water issues. This again demonstrates that an expanded understanding of transboundary water affairs increases comprehension of state water issues.

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## Transboundary Water Issues Gain Importance

Generally located within a semiarid zone, the U.S.-Mexico border area was at one time considered an unlikely region for growth and development. Recent occurrences, however, have greatly modified this view, and populations from both countries are now rapidly settling near the border, although usually for very different reasons. The results, however, are the same: increased population. With a present annual growth rate in excess of three percent, the border population can be expected to double in less than 20 years.

Mexican border cities are growing rapidly as people arrive from the interior, often seeking employment at maquiladora industries. These assembly plants, which are set up by non-Mexican, usually U.S. companies, operate in Mexican border cities because of the available surplus labor. Nogales, Sonora, the largest Mexican city along the Arizona-Mexico border, has about 100 maquiladora plants. The city's population has grown from 30,000 in 1960 to a present population of about 200,000.

Meanwhile U.S. cities along the border are also expanding, with many newcomers drawn by the warmth and appeal of the Sunbelt. Nogales, Arizona, now has a population of 80,000 people. In 1960 Sierra Vista, another southern Arizona city, had a population of 3,100 people. By 1985 the population had increased to 29,000, with 55,000 people projected by the year 2000.

Before identifying specific transboundary water issues, an important matter needs to be raised, one that is not clearly understood can sow seeds of discontent and misunderstanding between the two countries. Although it should be obvious, it still must be emphasized that the neighboring

countries of Mexico and the United States are separated by social, economic, cultural, political and legal differences, and these differences strongly affect how and what international policies are worked out.

For example, each country's level of economic development is an important consideration when water quality, especially wastewater treatment, is an issue. With limited economic means and an expanding population, Mexico's water planning priority is to secure needed potable water supplies for its people. The United States, on the other hand, has the resources to expend for higher levels of water quality. More generally, the U.S. concern for the environment is a luxury denied to less developed countries which simply cannot afford the environmental standards often expected by the United States.

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## An International Sharing of Groundwater Resources

Underground and out-of-sight, with imprecise form and flows and undemarcated by surface boundaries, groundwater is not easy to regulate even within a single country. The issue becomes even more complex when two nations are involved. Of all the transboundary water issues confronting the United States and Mexico, the shared use of transboundary groundwater resources is the one with the most potential to spark future disputes.

Arizona and Sonora share groundwater resources in Ambos Nogales, an area that includes metropolitan Nogales, Arizona, and Nogales, Sonora. In appearance Ambos Nogales seems to consist of a single city divided by a border fence, an impression reinforced by the fact that both the U.S. and Mexican cities are called Nogales. The cities are located in a narrow valley and bordered by steep hills. Along with environmental,

economic and cultural ties, the two cities also share the Santa Cruz basin aquifer for their water supplies.

Fed by the Santa Cruz River, the Santa Cruz Basin aquifer is bisected by the U.S.-Mexico border. Nogales, Sonora, draws water from the aquifer with five wells and an infiltration system located along the Santa Cruz River east of the city, an area upstream of the Nogales, Arizona, wellfield. The wells, however, are not able to provide sufficient water, and water supply problems afflict Nogales, Sonora. Dry spells during the summer of 1987 severely taxed the city's water resources leaving an estimated 80 percent of its residences with insufficient water supplies, and 50 percent suffered periods of no water at all. Plans have been made to sink additional wells (*U.S.-Mexico*, 1988).

Nogales, Arizona, obtains water from a wellfield located downstream from the wells of its twin city. Heavy pumping by Nogales, Sonora, increases the depth of water in Arizona wells. With its wells becoming less reliable, Nogales, Arizona, is exploring options for additional water supplies. Its options include applying for its allocation of Central Arizona Project water; purchasing small private water companies; and locating sites for additional wells (*U.S.-Mexico*, 1988).

The Ambos Nogales area and its use of transboundary groundwater resources are of special interest to water managers because the Tucson Active Management Area (AMA) extends to the border and includes the U.S. portion of the Santa Cruz Basin aquifer. An AMA is an area that is intensely managed to assure an eventual safe yield—i.e., a balance between groundwater pumping and the amount naturally and incidentally recharged. Since Nogales, Arizona, is within the Tucson AMA its groundwater use is carefully documented to determine its effect on the aquifer. Arizona's management of the aquifer, however, becomes complicated since

the aquifer is also shared by Nogales, Sonora.

Another shared transboundary basin underlies Douglas, Arizona, and Agua Prieta, Sonora. Heavy groundwater pumping to support agriculture in southern Sulphur Springs Valley on the U.S. side resulted in a significant drop in the water tables in the area. As a result, the state of Arizona designated the location as an Irrigation Non-Expansion Area.

The areas of greatest water level declines are several miles north of the border, with relatively small declines reported along the border. Because groundwater use on the Arizona side is now regulated, excessive water table declines are not expected at the border from U.S. activities.

Another transboundary groundwater concern involves pumping in the Mexican Sonoita River valley south of Organ Pipe National Monument. The Mexican area is experiencing rapid growth and development, with extensive groundwater pumping occurring to support expanding activities. In Mexico and adjacent to the monument the groundwater table has dropped about 12 feet during the last six years.

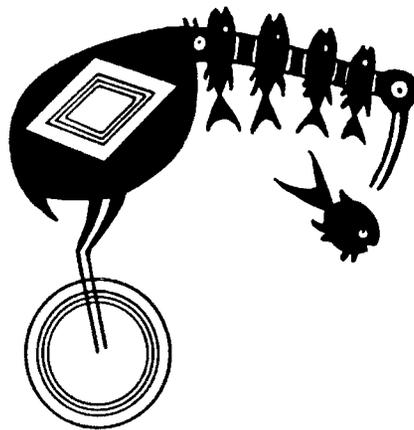
The U.S. National Park Service fears that this pumping will eventually affect the monument's natural habitat. For example, an endangered species of desert pupfish resides in a pond created by Quitobaquito Springs within the monument. The pond is located along the border, and a drop in the regional aquifer could affect the flow of Quitobaquito Springs. The pond's ecosystem would then be disturbed threatening the existence of the endangered pupfish. No effects to the springs and the pond have yet been reported.

Law and precedent is lacking to establish the means to regulate the two countries' use of shared groundwater resources. In the United States the individual states have authority over groundwater use. This means in

effect that four sets of laws regulate groundwater withdrawal along the U.S. side of the border, with Texas, New Mexico, Arizona, and California each having its own approach. Further, each state exerts different degrees of control over its groundwater.

In contrast to the U.S. situation, the Mexican federal government has the power to control groundwater use, even to the extent of establishing prohibited groundwater zones. Neither the U.S. states nor Mexico, however, has worked out procedures for joint international use of an aquifer. In fact, the existence of so many and varied laws inhibits the establishment of such international regulations.

Despite a lack of established procedures to resolve transboundary groundwater problems, a situation in the Yuma-San Luis area was successfully addressed. It stands as one of the few international settlements to address transboundary groundwater use directly. Its terms were included as part of Minute 242, a 1973 binational agreement to resolve the salinity controversy of Colorado River water flowing to Mexico. The terms stipulate that each country, when pumping groundwater within five miles of the border in the Yuma-San Luis area, is to limit its pumping to 160,000 acre feet annually.



*Mimbres pottery design of fish-eating water bird*

## Water Quality Concerns

The United States and Mexico share a history of water quality disputes. An early, major conflict was sparked when the United States seriously contaminated Mexico's Mexicali Valley, an important agricultural area, with highly saline water. This concern arose in 1961 when the Bureau of Reclamation began pumping salty drain water from Arizona's Wellton-Mohawk Valley into the Gila River, near its confluence with the Colorado. As a result, Colorado River water flowing to Mexico contained as much as 2,500 parts per million of salinity.

Mexico strenuously objected to the saline water that threatened vital agricultural production in its Mexicali Valley and claimed that the 1944 treaty that assured delivery of Colorado River water to Mexico was being violated. The U.S. responded that the treaty said nothing about water quality.

After prolonged negotiations an agreement was reached in 1973 that guaranteed the quality of Colorado River water delivered to Mexico. With regards to salinity, water flowing to Mexico is to be within 121 parts per million of that provided to the Imperial Valley, an agricultural area in southern California. Later Congress passed the Colorado River Basin Salinity Control Act that included provisions to build a desalination plant at Yuma to treat Colorado River water before it flows to Mexico.

Flooding is a cause of water quality problems in Ambos Nogales. Floodwaters periodically flow through the Santa Cruz and its tributaries causing increased sedimentation and bacterial contamination. Originating in Nogales, Sonora, the Nogales Wash, a tributary of the Santa Cruz River, drains the two cities. Because of rapid urbanization, Nogales, Sonora, experiences increased runoff with additional

pollutants.

After draining Nogales, Sonora, the wash carries floodwaters with pollution from landfills, sewage, and other sources of potentially hazardous materials to the Santa Cruz River. The contaminated floodwaters settle in areas where the cities' wellfields are recharged. The U.S. Army Corps of Engineers is considering a \$6-million flood control project for the area (*U.S.-Mexico*, 1988).

Segments of the Santa Cruz River were recently included in a pollution list drawn up by the U.S. Environmental Protection Agency. According to the EPA the stretch of river from the Mexican border to the Nogales sewer treatment plant is an area with high readings of copper, manganese, dissolved oxygen, and acidity-alkalinity. The agency noted that the source of pollution is unknown, but presumably is from Mexico.

Maquiladoras may also contribute to border water quality problems. Although most maquiladoras are established by U.S. firms, they are not bound by U.S. industrial pollution and safety standards. Further, acquiring basic information about their operations, including water use, is difficult. Evidence indicates, however, that solvents and other hazardous material used in their operations have entered water supplies. Water samples from the two cities of Nogales, as well as Douglas, Arizona, and Agua Prieta, Sonora, have contained levels of heavy metal and trichloroethylene (TCE) in excess of current U.S. drinking water standards.

The San Pedro River has also been the focus of a water quality controversy between Mexico and the United States. Beginning in 1977 pollution from a large copper works located in the Cananea area in Sonora entered the river and flowed into Arizona. At the time the mining operation was jointly owned by the Mexican government, private Mexican investors, and the U.S. Anaconda Copper Company. The immediate problem was basically resolved

when the mine established new tailing ponds outside the San Pedro watershed.

The water quality of the San Pedro River, however, is of continued concern. Water samples taken close to the border on the Arizona side show some heavy metals, ammonia and turbidity, presumably coming from mining activities at Cananea. A recently published pollution list from EPA included the San Pedro from the U.S.-Mexico border to the Gila River. Much of the pollution, however, comes from a U.S. industry located in the St. David area of Arizona.

Concern about water quality in the San Pedro River system also focuses on Greenbush Draw, one of the river's tributaries. At one time sewage from both Naco, Sonora, and Naco, Arizona, was entering Greenbush Draw because neither town had adequate sewage treatment facilities.

This situation was of special concern because Greenbush Draw flows directly north of the wells that provide water to the community of Bisbee.

Naco, Arizona, has since had suitable sewage treatment facilities designed and built. And since Naco, Sonora, rehabilitated its original lagoons, sewage flows from the area have largely ceased. The situation, however, is of continued concern to the Arizona Department of Environmental Quality which monitors it.

Water quality violations also have been reported at the border where the White River Draw flows south from Douglas, Arizona, to Agua Prieta, Sonora. Water samples have shown high turbidity, ammonia, dissolved oxygen, and mercury. Concern has been expressed that the abandoned mines in Douglas are the source of various pollutants.

## Transboundary Resources Information Available

The UA's Udall Center for Studies in Public Policy promotes interdisciplinary public policy studies in three areas: environment and natural resources; regional economic development; and health and welfare. Because the U.S.-Mexico border is a dominant factor in the region and poses policy challenges in all three areas, the Udall Center established a Border Policy Working Group. The group is made up of researchers and community leaders with significant border policy interests. The Udall Center has published a directory of the group that lists over 50 individuals and institutions conducting research and service activities in the border region.

To obtain a copy of the directory contact: Udall Center for Studies in Public Policy, University of Arizona, 1031 North Mountain,

Tucson, AZ 85721. (602) 621-7189.

The International Transboundary Resources Center (CIRT) at the University of New Mexico is concerned with issues relating to the occurrence of natural resources across political boundaries, with a special interest in U.S.-Mexico border issues. Along with water, the center is also interested in air, energy, and living resources, as well as the transboundary environmental impacts of human activities.

CIRT's newsletter, *Transboundary Resources Report*, is published three times per year. The publication was established to identify common transboundary concerns, with the hope that solutions adaptable to common problems will be found. To receive copies of the newsletter contact: The International Transboundary Resources Center, University of New Mexico, School of Law, 1117 Stanford NE, Albuquerque, NM 87131. (505) 277-4820.

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## U.S.-Mexico International Sewer Treatment Plants

**S**ewage disposal is the transboundary water issue most successfully addressed jointly by Mexico and the United States. Two projects have been developed, one to serve the cities of Douglas, Arizona, and Agua Prieta, Sonora, and the other to treat waste from Ambos Nogales. The Douglas-Agua Prieta plant operated jointly for 20 years, until 1969 when the Mexican city opened its own plant.

The plant established to serve the two border cities of Ambos Nogales is still in operation. To many this project stands as a symbol of productive international collaboration, as well as a model for solving border sewage disposal problems. First discussed in the 1930s, the plant was constructed in 1950-51 to treat sewage produced by the twin cities. The plant was constructed in Nogales, Arizona, since the land slopes northward.

Because of the area's rapid increase in population the system was inadequate by 1967. Negotiations had already begun between the two countries to work out details to expand the operation. At the same time, however, Mexico also wanted to consider the option of each city establishing its own waste disposal plant. Mexico was concerned that the proposed location of the enlarged plant and the rigorous federal and state water treatment standards to be enforced served U.S. interests better than Mexico's. Details, however, were worked out, and construction of a joint plant was completed in December 1971.

The arrangements negotiated by the two countries to accommodate different national concerns and levels of economic development are worth noting. For example, since Mexico did not require chlorination, the United States paid all chlorination

costs at the Ambos Nogales plant. Also, other costs, such as construction costs, were prorated. The U.S. share of construction cost was \$1.1 million compared to Mexico's contribution of \$0.9 million because higher costs are involved in constructing a plant in the United States than in Mexico. Operating costs were also prorated to reflect rates in the two countries.

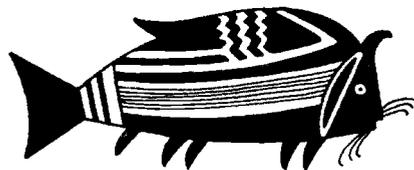
Despite the 1971 expansion, the plant was insufficient by the late 1970s. At present, its capacity is exceeded by about 700,000 gallons daily. Also, broken sewer lines, unmonitored industrial sources, outhouses and unconnected septic tanks in Nogales, Sonora, cause about one million gallons of untreated sewage flows to the United States daily via the Santa Cruz River and its tributaries (*U.S.-Mexico*, 1988).

An agreement to further expand the plant was signed July 21, 1988, with Mexico agreeing to pay \$1 million of the \$11 million expansion cost and another \$3 million to improve the Nogales, Sonora, sewage collection system.

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## Transboundary Surface Water Flow

**A**long with numerous ephemeral streams, which originate in the desert and flow only during or after rain, four basic watersheds or stream drainages are shared by Arizona and Sonora.



*Mimbres pottery design of a catfish*

The Colorado River is a resource for seven U.S. states before flowing to the U.S.-Mexico border. Concerned about U.S. development of the Colorado River, Mexico was anxious to secure an international agreement to assure its supply of water from the river.

Beginning in 1912 efforts were made to establish such an agreement with the United States, but it was not until 1944, after Colorado River water was divided among U.S. Basin states, that a treaty was worked out and signed. This document assured 1.5 million acre-feet a year of Colorado River water to Mexico. The Colorado River is the only transboundary Arizona-Sonora river flow that is apportioned.

Despite the above agreement, however, some observers believe that a major problem remains unresolved and may prove disruptive in the future. Mexico's assured water supply by the 1944 treaty can be reduced only in the event of "extraordinary drought or accident." An "extraordinary drought" can be treacherously difficult to define to justify cutting back water delivered to Mexico—especially if threatened climate changes develop. For example, would a long-term dry spell in the Southwest be an extraordinary drought, or could it be seen as part of a global climate change pattern, with Mexico still entitled to its full share of Colorado River water?

The White River Draw, which is located near Douglas, Arizona, is another transboundary surface flow. The White River watershed drains south from Arizona to Sonora. Not perennial and with little flow, the stream discharges less than 7,000 acre-feet annually, with little or no surface water use in the United States.

West of the Whitewater Draw is the San Pedro Basin. With its headwaters in Mexico, the San Pedro River, which is a major tributary to the Gila River, flows northward entering Arizona near the community

of Palominas. The San Pedro watershed covers 4,483 square miles with 696 square miles in Mexico, and is 155 miles long with 30 miles of its length flowing in Mexico.

The flow of the San Pedro gained special significance recently when the U.S. federal government established the San Pedro Riparian National Conservation Area. This 56,431-acre reserve includes a 31-mile stretch of the San Pedro River, and the Arizona Department of Water Resources granted instream flow rights to the area to protect its valuable riparian ecosystem. Obviously a secure river flow is needed to justify this status.

Some U.S. water managers have expressed concern about how Mexico might develop its water resources in the San Pedro River Basin and what effect this might have on the river flow. The Cananea mine is located at the head of the San Pedro valley in Mexico, and a remote possibility exists that, if the mine were to expand and develop and water consumption increase, surface flow at the international boundary could be affected.

Many hydrologists believe, however, that increased agricultural groundwater pumping in the Sierra Vista-Fort Huachuca area is a more immediate threat to the flow of the San Pedro—including flow within the established conservation area—than any potential Mexican activities.

West of the San Pedro River is the Santa Cruz River. The Santa Cruz originates in Arizona, then flows south into Mexico before returning to Arizona in the Nogales area and eventually flowing through Tucson. The river feeds the Santa Cruz Basin aquifer which supplies water to the twin cities of Nogales, Arizona, and Nogales, Sonora. The Santa Cruz River flow is too periodic or intermittent to support regular surface water uses in either country.

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## The Institutional Setting

A plethora of organizations and institutions are involved with U.S.-Mexico transboundary water issues. This impressively demonstrates that the topic has attracted many and varied resources and expertise. Also demonstrated, however, is the complexity of the situation since, according to a recent document, 13 U.S. organizations, 12 Mexican organizations and six binational organizations have substantial interest in water resources management along the Arizona-Sonora border. (*U.S.-Mexico*, 1988).

U.S. agencies include the Environmental Protection Agency, the Bureau of Reclamation, the Corps of Engineers, and the Bureau of Land Management. At the Arizona state level the Departments of Environmental Quality, Health Services, and Water Resources are involved. In Mexico the federal government maintains centralized control functioning through agencies such as the Secretaria de Agricultura y Recursos Hidraulicos and the Secretaria de Desarrollo Urbano y Ecologia.

The key international institution is the International Boundary and Water Commission (IBWC), which was created by the 1944 water treaty. The commission, which has considerable authority to manage border water issues, is made up of a U.S. section and a Mexican section, each headed by a commissioner with diplomatic status. The role of the IBWC and its effectiveness are debated and criticized, as well as lauded. Even its critics, however, generally acknowledge that the commission, through its continuous, ongoing efforts, has managed to defuse international conflicts resulting from transboundary water disputes.

Resolving U.S.-Mexico transboundary water issues involves developing foreign policy, usually a specialized federal activity. Some observers

believe, however, that when natural resource issues between Mexico and the United States are addressed, the border states have significant influence in the making of foreign policy, an unusual role for a U.S. state.

That border states have a vital interest in the outcome of transboundary water issues is readily apparent, for it is these states that directly suffer the ill consequences of activities that threaten the quality and quantity of shared natural resources. State officials as a result often have a stronger incentive to solve these problems than do federal officials. Furthermore, U.S.-Mexico transboundary water policy is an obvious area of state interest and involvement, since states are empowered to work out domestic water policies within the United States.

Helen Ingram, UA professor of political science and acting director of the UA Udall Center for the Studies in Public Policy, reviewed natural resource issues occurring along the U.S.-Mexico border to determine policy areas that are influenced by state actions (Ingram, 1988). She identified several areas.

She found that states have had considerable power to determine which natural resource issues would be included on the federal agenda. For example, the Colorado River Basin states, believing their interests threatened, succeeded in delaying until 1944 federal action to allocate Colorado River water to Mexico.

States also affect U.S. foreign policy development by influencing foreign policy implementation, especially when state action is needed to establish an international agreement. Further, states have influenced the substance of foreign policy. For example, the Colorado River Basin states in effect got the federal government to accept responsibility for building a desalination plant to purify water for delivery to Mexico.

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## Transboundary Policy Development

**W**ith populations expanding on both sides of the border, the United States and Mexico are becoming increasingly aware of their need to manage shared and limited water resources. To do this effectively initial informational needs will have to be met.

The two countries now maintain hydrologic information on different databases and, as a result, it is difficult to coordinate the information. A method needs to be worked out to transfer information from one nation's database to the other's to facilitate data use in the analysis of transboundary water issues. Further, Mexican agencies do not ordinarily gather the massive amount of hydrologic information that U.S. agencies are accustomed to collecting. As a result, more Mexican hydrologic information is needed.

Also hindering effective policymaking is the lack of research devoted to transboundary natural resource concerns. Valuable research is at times not undertaken because of the complexity involved with working in an international setting.

In sum, because of missing or inaccessible information and various institutional constraints, the two countries have been unable to develop a rational and comprehensive plan to manage border water resources. Many believe that such a plan—one that would also integrate water management with a consideration of other natural resources—is very much needed.

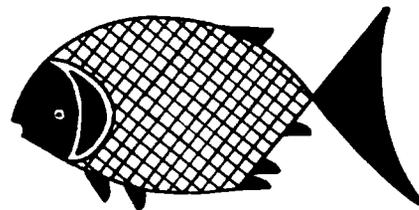
Addressing this matter, a UA project identifies specific areas of concern related to transboundary water use, including the need to develop effective policy. Funded by the Ford Foundation, the project is the result of the combined efforts of the UA Udall Center for Studies in Public Policy and the UA Office of

Arid Lands Studies, in collaboration with El Colegio de la Frontera Norte in Nogales, Sonora, and the Instituto Tecnológico de Sonora in Ciudad Obregon, Sonora.

Acknowledging the value of federal support and activities to resolve border problems, the project aims to broaden centralized efforts by developing locally based solutions to border water resource issues. By working with local people and organizations, project researchers expect to identify strategies and solutions that better reflect local needs and interests than do externally imposed actions.

The project, which is scheduled to operate for 18 months, will focus on Ambos Nogales. Researchers will gather information about the quantity and quality of water resources shared by the twin cities. Interdisciplinary in approach, the project will also identify and analyze the legal, social and political aspects of water resources decision-making on both sides of the border. International treaties and laws are to be reviewed, and relevant government agencies, public interest organizations, and private sector interests will be identified.

Data and information will be reviewed to define and prioritize water management problems in Ambos Nogales. Hydrologic information is to be made available to decision makers; and officials, laws and institutions will be identified with the potential to address water management concerns effectively. People and groups who, although not officially sanctioned, influence the resolution of water resource issues, will also be identified.



*Mimbres pottery design of sunfish*

In the final and crucial phase of the project research results are to be applied to help develop local and binational strategies to address transboundary water problems. Local individuals and groups will actively participate to help promote acceptance and implementation of the recommended strategies.

Information about the project can be obtained from its principal investigators at the UA: Simon Ince, Department of Hydrology and Water Resources; Helen Ingram, Udall Center; and Robert Varady, Office of Arid Lands Studies, and the Udall Center

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## Conclusion

**A**n international boundary defines or clarifies national territories. At the same time, however, an international border can create ambiguity when transboundary natural resource issues are to be decided. For example, groundwater pumping issues that can be readily settled in Phoenix or Flagstaff, Arizona, or water quality concerns that can be resolved in Ciudad Obregon or Hermosillo, Sonora, take on added complications when they occur along the U.S.-Mexico border. Instead of resolving internal problems with local or national resources, nations must confront social, cultural, and historical complexities when working out transboundary issues.

Therefore no easy solution exists to resolve U.S.-Mexico transboundary water problems. A systematic and coordinated effort is needed to develop policy, involving state, national and international agencies and including the participation of private citizens from both sides of the border. Such an effort would help establish the rational, long-term, comprehensive policies needed to address transboundary water issues between Mexico and the United States.

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*The ideas and opinions expressed in the newsletter do not necessarily reflect the views of any of the above people.*

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