

Testimony before
U.S. House of Representatives
Committee on Natural Resources
Subcommittee on Water, Wildlife and Fisheries
With respect to H.R. 5874
To amend the United States-Mexico Transboundary Aquifer Assessment Act
to reauthorize the United States-Mexico transboundary aquifer assessment
program.

Written Testimony of Sharon B. Megdal, Ph.D.
Director, Water Resources Research Center, A Cooperative Extension Center
Faculty Member, Department of Environmental Science and Cooperative Extension
The University of Arizona, Tucson, Arizona

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Mr. Chairman, Members of the Subcommittee, and Representative Ciscomani, thank you for the opportunity to provide input on H.R. 5874, which would amend the United States-Mexico Transboundary Aquifer Assessment Act (Act). I thank Representative Ciscomani and co-sponsor Representative Stansbury for introducing this Bill to reauthorize the United States-Mexico transboundary aquifer assessment program and modify a restriction on the ability to study additional transboundary aquifers along the border shared by Arizona and the Mexican state of Sonora.

Background

Like elsewhere in the Southwest – and the Nation – water security and reliability are critical concerns along the border shared by the United States and Mexico. Along the border, groundwater is a particularly important source of water for many communities, and it is the only source for some. Due to its invisibility, assessment of groundwater quantity and quality are needed. Characterizing groundwater conditions and aquifer properties will enable communities along the border to understand their water supply conditions and the implications of their water utilization. Assessments enable more informed decision making by water users, water managers, and policy makers at multiple levels.

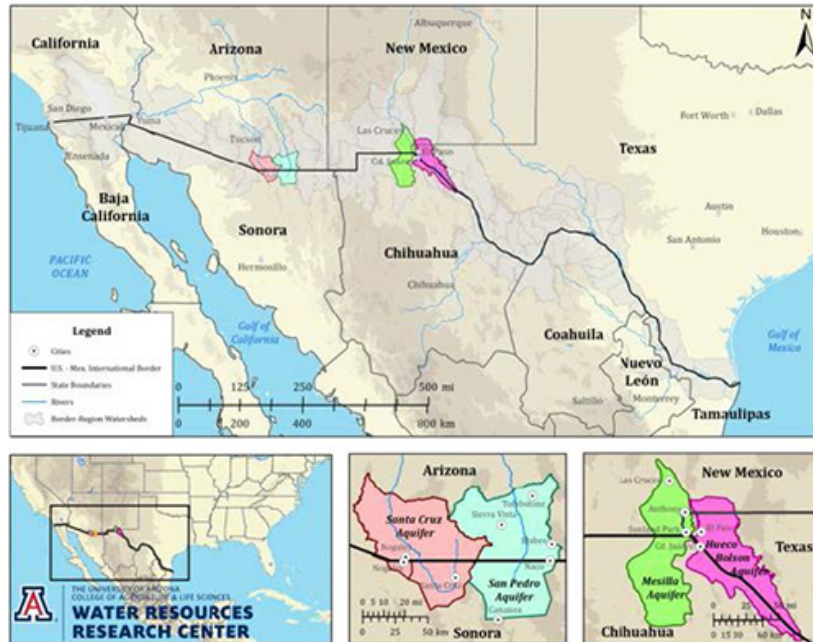
The original legislation authorizing the Transboundary Aquifer Assessment Program, codified as P.L. 109-448, became law in late 2006. It authorized the Secretary of the Interior, through the U.S. Geologic Survey (USGS), to collaborate with the states of Arizona, New Mexico and Texas,

the country of Mexico, and others to characterize priority transboundary aquifers. The Act established a partnership between the USGS and the federally authorized water resources research institutes per the Water Resources Research Act of 1964, as amended, for the participating states. The University of Arizona Water Resources Research Center, for which I serve as Director, is the federally authorized water institute for Arizona, with the New Mexico Water Resources Research Institute at New Mexico State University and the Texas Water Resources Institute at Texas A&M University being the other two participating university partners. I had the honor of providing testimony at the May 2006 House hearing on the original authorization, H.R. 469 at the time, and I have been involved in implementing the program ever since its approval. This testimony reflects this involvement, along with perspectives gained from my professional academic and non-academic work on groundwater policy and management that extends beyond 30 years.

Aquifers contain the groundwater on which many communities across the country depend. Because groundwater is not visible or accessible like river water, assessments are necessary to characterize the water quantity and quality of the resource, including the rate at which groundwater is being depleted and recharged. Many communities along our shared border with Mexico rely on groundwater. Current research has established that close to 30 aquifers along this border can be considered transboundary. The national frameworks of the United States and Mexico for managing groundwater are quite different. How states and communities within the United States manage groundwater varies considerably. The Transboundary Aquifer Assessment Program authorized by P.L. 109-448 has enabled collaborative research on groundwater and the aquifers that hold it, along with binational dialogue, which has contributed considerably to developing a common understanding of this critically important water resource. With sound, verifiable information in hand, water users, water managers, and policy makers are better equipped to make decisions to support the long-term viability of their economies and communities along the border.

An Overview of Transboundary Aquifer Assessment Program Efforts to Date

The Transboundary Aquifer Assessment Program has focused on the four priority aquifers specified in P.L. 109-448, which are shown on the map below. The map can be accessed at <https://webapps.usgs.gov/taap/index.html>.



Given the program’s focus on internationally shared aquifers, the International Boundary and Water Commission (IBWC) has played a key coordination role for efforts carried out binationally. The IBWC is the binational body responsible for implementing the 1944 Water Treaty for the "Utilization of waters of the Colorado and Tijuana Rivers and of the Rio Grande." It is the key diplomatic mechanism for working on water matters along the border. The IBWC’s 2009 three-page “Joint Report of the Principal Engineers Regarding the Joint Cooperative Process United States-Mexico for the Transboundary Aquifer Assessment Program” established the binational cooperative framework that has guided the collaborative binational efforts to date. The six Principles of Agreement are as follows. 1. Activities described under this agreement should be beneficial to both countries. 2. Aquifers to be jointly studied, as well as the scope of the studies or activities to be done on each aquifer, should be agreed upon within the framework of the IBWC. 3. The activities should respect the legal framework and jurisdictional requirements of each country. 4. No provisions set forth in this agreement will limit what either country can do independently in its own territory. 5. Nothing in this agreement may contravene what has been stipulated in the Boundary and Water Treaties between the two countries. 6. The information generated from these projects is solely for the purpose of expanding knowledge of the aquifers and should not be used by one country to require that the other country modify its water management and use.

The USGS website on the Transboundary Aquifer Assessment Program (TAAP) (<https://webapps.usgs.gov/taap/index.html>) provides information about TAAP studies and products, many of which have been carried out on the US side of the transboundary aquifers. The USGS site lists these key TAAP objectives:

- Develop binational information and shared databases on groundwater quantity and quality;
- Identify and delineate transboundary aquifers of importance;
- Develop binational criteria for determination of priority transboundary aquifers;
- Assess the extent, availability, and movement of water in transboundary aquifers and the interaction with surface water;
- Develop and improve groundwater-flow information for binational aquifers to facilitate water-resource assessment and planning;
- Analyze trends in groundwater quality, including salinity and nutrients;
- Apply new data, models, and information to evaluate strategies to protect water quality and enhance supplies; and
- Provide useful information to decision makers, including assessments of groundwater management institutions and policies.

Teams have been working on meeting these objectives through many investigations, reports, presentations, and dialogues. A noteworthy dialogue extending across the border region was the 2019 border groundwater summit convened by IBWC. Ongoing dialogue has been fostered by meetings of technical project teams and less formal dialogues, such as the Permanent Forum of Binational Waters (<https://www.binationalwaters.org/>), which includes significant coverage of groundwater.

One of the earlier binational reports is the 2011 report, Hydrogeological Activities in the Conejos-Medanos/Mesilla Basin Aquifer, Chihuahua, Phase I, which was facilitated by IBWC. The 2016 Binational Study of the Transboundary San Pedro Aquifer (“San Pedro report”) was co-produced by the International Boundary and Water Commission, USGS, the University of Arizona, the University of Sonora, and CONAGUA (Mexico’s National Water Agency). Along with the 2011 study, this first fully bilingual, binational study of a transboundary aquifer can be accessed online at the USGS TAAP website.

The San Pedro report includes compilation of much existing information and harmonization of maps to provide visual representation of the data and information. Instead of having maps that end on the respective national borders, which had been the case, this report includes binational maps that show the nature of the aquifer system that spans the border. All information, including maps, went through careful review by U.S. and Mexican experts and is published in both English and Spanish. While much of the content is highly technical, the importance of groundwater to supporting the economies of the border communities is underscored in the report’s concluding section. A six-page, bilingual bulletin on the San Pedro report (appended to this Testimony) demonstrates efforts to present the information to broad audiences. The report and bulletin can be accessed at <https://wrrc.arizona.edu/programs/taap-transboundary-aquifer-assessment-program/taap-official-binational-reports>.

The process of developing the binationally endorsed San Pedro study involved constant interactions of the binational technical team. The mutually respectful approach enabled seamless transition to the development of a similarly structured binational report for the transboundary Santa Cruz aquifer system, which is nearing completion. The Santa Cruz aquifer system provides the groundwater for the “Ambos Nogales” region, an important border region for transportation of produce from Mexico to the United States and other products. Nogales, Sonora, which is much larger in population than Nogales, Arizona, is home to many maquiladora factories. The Arizona TAAP team has developed a water balance modeling framework and performed a series of water balance analyses, which show decline in groundwater levels and over-drafting of the aquifers. The modeling approach can be used to study impact of various water management decisions.

These and additional studies of the aquifers that support population and economic centers along the border, such as the El Paso-Ciudad Juarez area, increase understanding of the uncertainties associated with changing precipitation patterns and increased pumping. They contribute to more informed water management decisions. However, additional transboundary assessment, particularly groundwater modeling, is needed. In some areas, no modeling has been done. In other regions, updated, binationally developed numerical models would provide more accurate representation of the implications of pumping and recharge on groundwater supplies.

Assessments are performed aquifer-by-aquifer or community-by-community because the hydrologic, geologic, recharge, and other conditions vary by aquifer. Groundwater is withdrawn to support municipal, industrial and agricultural uses, and groundwater supports natural riparian systems. Groundwater extraction is often occurring at rates that exceed naturally occurring recharge. Recharge rates are dependent on a host of factors, including the connected surface water flows, which themselves involve significant variability.

Many TAAP products can be found at <https://webapps.usgs.gov/taap/products.html>. Published in 2023, the book version of the special issue of the journal *Water* entitled “Advances in Transboundary Aquifer Assessment,” which was guest edited by USGS scientist Dr. Anne-Marie Matherne and me, includes several recent TAAP-funded analyses. The free PDF version of the book can be accessed at <https://www.mdpi.com/books/book/7794>. Most publications are freely accessed. The University of Arizona Water Resources Research Center maintains websites that catalog reports and publications in English (<https://wrrc.arizona.edu/programs/taap-transboundary-aquifer-assessment-program>) and Spanish (<https://wrrc.arizona.edu/programs/programa-de-evaluacion-de-acuiferos-transfronterizos-taap>). New Mexico State University’s TAAP activities and products can be accessed at <https://taap.nmwrr.nmsu.edu/>. Texas A&M has a transboundary water portal, from which

information about TAAP can be found. See <https://transboundary.tamu.edu/taap/>. Additional references can be provided on request.

Through Fiscal Year 2023, a total of \$10 million has been appropriated for the Transboundary Aquifer Assessment Program. The authorizing legislation specified that 50% of any appropriated funding remains with the USGS, with the other 50% distributed to the participating Water Resources Research Institutes, though the legislation does not specify how the funding is distributed across the states. According to my records, funding has occurred as shown in the table below. The University of Arizona Water Resources Research Center has received one-sixth of the amounts noted below.

Federal TAAP Appropriations through FY2023	
FY2008	\$ ~500,000
FY2009	\$ 500,000
FY2010	\$ 1,000,000
FY2016	\$ 1,000,000
FY2017	\$ 1,000,000
FY2018	\$ 1,000,000
FY2019	\$ 1,000,000
FY2020	\$ 1,000,000
FY2021	\$ 1,000,000
FY2022	\$ 1,000,000
FY2023	\$ 1,000,000
TOTAL	\$ 10,000,000

The collaborative work continues. The USGS and the Water Resources Research Institutes have prioritized five over-arching tasks for the five-year period beginning with Fiscal Year 2023:

1. Stakeholder Engagement and Capacity Building
2. Socio-Economic Context, Governance, and Policy [Note: Although USGS does not preform research related to water policy, personnel at the partner universities do engage in policy analyses.]
3. Binational Groundwater Atlas: Data Management, Mapping, and Visualization
4. Aquifer prioritization and vulnerability assessment
5. Hydrologic Studies to Understand Water Availability Challenges Facing Transboundary Aquifers – Stressors from Population, Industry, Agriculture, Drought, and Climate Variability

The extent to which each is accomplished will depend on funding availability. The U.S. team is actively engaged in discussions with Mexico regarding their participation, particularly with Atlas preparation and hydrologic modeling and data compilation. The five-year plan notes that substantial time and effort are required for binational reports. Fortunately, the international relationships are good and the framework for cooperation has been established. Some of the international work of TAAP team members has been to underscore the strong binational water cooperation we have at our country’s southern border. Although cross-border work requires

substantial time, the partners can build upon past experiences with carrying out multi-agency reviews and translation of reports to identify opportunities to streamline these processes going forward. There is commitment to work together across the USGS and the university-based water institutes and across the international border.

The Proposed Amendments included in H.R. 5874

Although the Transboundary Aquifer Assessment Program has accomplished a lot with the funding made available, there is still much work to be done. The partnerships established through TAAP have provided a very strong foundation for additional work. The processes and collaborations are in place for continuing and expanding these efforts.

In addition to the extension of the authorization period, H.R. 5874 includes a provision to enable the designation of additional priority aquifers along the Arizona-Sonora border. The original law envisioned the specification of additional priority aquifers along New Mexico's and Texas' border regions. However, in 2006, some water entities wanted to keep the very western, Colorado River portion of Arizona's border region outside of the Transboundary Aquifer Assessment Program. Between the time of the May 2006 hearing and the final passage of the legislation, language prohibiting designation of any additional priority aquifers along the Arizona-Sonora border was added. Section 2 (a) of H.R. 5874 would refine that prohibition by limiting it to the "Yuma groundwater basin designated by the order of the Director of the Arizona Department of Water Resources dated June 21, 1984". This change would enable other transboundary aquifers along the border, except the Yuma groundwater basin, to be eligible for study as part of the Transboundary Aquifer Assessment Program.

As someone who has worked on this program since its inception, I can attest to the productive collaboration of all involved to provide needed analyses and insights. Reauthorization will reinvigorate and reinforce the robust effort to bolster water security for our border communities and economies.

Thank you, Mr. Chairman, Members of the Committee, and Representative Ciscomani, for the opportunity to present this testimony.

Screenshots of the six-page bulletin on the Binational Study of the Transboundary San Pedro Aquifer.

BINATIONAL INFORMATION	INFORMACIÓN BINACIONAL	THE BINATIONAL EXPERIENCE	LA EXPERIENCIA BINACIONAL
<p>Basin Information</p> <p>Area = 3,000 km² (1,159 mi²) Length of basin = 100 km (62 mi) stream outlet = 4 - 7 terrain slope = 0 - 65°</p>	<p>Información de la Cuenca</p> <p>Área = 3,000 km² (1,159 mi²) Longitud del río = 100 km (62 mi) coeficiente de corriente = 4 - 7 pendiente de terreno = 0 - 65°</p>	<p>The study provides much more than a report, it opened doors to creating scientific co-operation between the U.S. and Mexico.</p> <p>—James Gillingham, Lead author of the study</p> <p>“This international study has provided us an understanding of the transboundary San Pedro aquifer and provides the solid basis for decision making related to water management in both countries.”</p> <p>—Bill Warr, Executive Director, Binational Boundary Waters</p>	<p>“Este estudio provee mucho más que un reporte, ha abierto las puertas a una cooperación científica transfronteriza entre los Estados Unidos y México.”</p> <p>—James Gillingham, autor principal del estudio</p> <p>“La información incluida en este estudio conjuga mejores conocimientos internacionales sobre el acuífero transfronterizo del San Pedro y proporciona la base más sólida para la toma de decisiones relacionadas con el manejo de agua en ambas países.”</p> <p>—Bill Warr, Director, Coordinación de la CUSA (Binational Boundary Waters)</p>
<p>Hydrostratigraphic Units</p> <p>units in gravel and sand (permeable basin fill) units in fine sediments with low hydraulic conductivity units in units that could be lumped together as fractured rock aquifers</p>	<p>Unidades Hidroestratigráficas</p> <p>unidad de gravas y arenas (filos permeables de cuenca) unidades de sedimentos finos con baja conductividad hidráulica unidades de unidades que pueden agruparse como acuíferos de roca fracturada</p>	<p>Additional collaborative efforts continue under this program, two aquifers are being studied along the Arizona-Sonora border: the San Pedro and the Santa Cruz. The San Pedro report is the first to be completed and already issued. Other cooperative efforts include groundwater monitoring and analysis in Chihuahua, New Mexico, and Texas for the Mexico-Boston and the Mexico-Aguila.</p> <p>Full report: http://www.itrc.gov/USM/Report/USMTRC_Report_2016</p> <p>Informe completo: http://www.itrc.gov/USM/Report/USMTRC_Report_2016</p>	<p>El estudio del acuífero transfronterizo de los Acuíferos Transfronterizos de América del Norte continúa bajo este programa, dos acuíferos están siendo estudiados a lo largo de la frontera Arizona-Sonora: el Acuífero San Pedro y el Acuífero Santa Cruz. El informe del Acuífero San Pedro es el primero en completarse y ya está publicado. Otros esfuerzos cooperativos incluyen monitoreo de agua subterránea y análisis en Chihuahua, Nuevo México, y Texas para los acuíferos del Boston y el Aguila.</p> <p>Informe completo: http://www.itrc.gov/USM/Report/USMTRC_Report_2016</p>
<p>Climatological Analysis</p> <p>Annual average temperature: 12 - 14°C (54 - 57°F) Annual average precipitation: 300 - 600 mm (11.8 - 23.6 in) Annual average potential evapotranspiration: 1.3 - 2.0 mm (0.05 - 0.08 in)</p>	<p>Análisis Climatológico</p> <p>temperatura anual promedio: 12 - 14°C (54 - 57°F) precipitación anual promedio: 300 - 600 mm (11.8 - 23.6 in) evapotranspiración potencial anual promedio: 1.3 - 2.0 mm (0.05 - 0.08 in)</p>	<p>Well Locations and Water Uses</p> <p>Localización de Pozos y Usos de Agua</p> <p>Por favor ver el Anexo 1 (Figura B1) en el Reporte en Español.</p> <p>For more information, please visit: www.itrc.gov/USM/Report/USMTRC_Report_2016</p>	<p>El Estudio Binacional sobre el Acuífero Transfronterizo de San Pedro es uno de los logros principales de este esfuerzo conjunto. Ambos países contribuyeron con conocimientos científicos y datos sobre el clima, geología, tipos de cobertura y uso de suelo e hidrología. El estudio cumple y crea una base de datos de información científica e hidrología que facilitará la información que necesita ser actualizada en futuros subsectores.</p> <p>Informe completo: www.itrc.gov/USM/Report/USMTRC_Report_2016</p>
<p>Piezometry and Hydraulic Parameters</p> <p>number of wells: 5 (2015) depth to static water level (2013): 0 - 170 ft (0 - 51.8 m) static water level elevation (2013): 1,230 ft - 1,250 ft (377 - 381 m) hydraulic conductivity (2013): 0.001 - 13.2 mD (0.0001 - 41.1 D) total transmissivity (2013): 0.00001 - 1.00001 specific storage (2013): 1.0e-07 - 1.0e-01 specific yield (2013): 0.001 - 0.3</p>	<p>Piezometría y Parámetros Hidráulicos</p> <p>número de pozos: 5 (2015) elevación de nivel estático (2013): 0 - 170 ft (0 - 51.8 m) elevación de nivel estático (2013): 1,230 ft - 1,250 ft (377 - 381 m) conductividad hidráulica (2013): 0.001 - 13.2 mD (0.0001 - 41.1 D) transmisividad total (2013): 0.00001 - 1.00001 almacenamiento específico (2013): 1.0e-07 - 1.0e-01 rendimiento específico (2013): 0.001 - 0.3</p>	<p>For more information, please visit: www.itrc.gov/USM/Report/USMTRC_Report_2016</p>	<p>For more information, please visit: www.itrc.gov/USM/Report/USMTRC_Report_2016</p>

BINATIONAL INFORMATION	INFORMACIÓN BINACIONAL	BINATIONAL COLLABORATION	COLABORACIÓN BINACIONAL	BINATIONAL COLLABORATION	COLABORACIÓN BINACIONAL
<p>Topics Covered in Report</p> <ul style="list-style-type: none"> physical geography hydrological modeling and hydrogeology conceptual geologic model hydrology hydrology and hydraulic parameters hydrogeology conceptual and numerical groundwater models 	<p>Temas Cubiertos en el Reporte</p> <ul style="list-style-type: none"> geografía física modelado hidrológico e hidrogeología modelo geológico conceptual hidrología hidrología y parámetros hidráulicos hidrogeología modelos de agua subterránea conceptual y numérico 	<p>The San Pedro Report is the first-ever binational aquifer study prepared and released simultaneously in English and Spanish by the International Boundary and Water Commission.</p>	<p>El Informe Binacional sobre el acuífero San Pedro es el primer estudio binacional sobre un acuífero preparado y publicado simultáneamente en inglés y español por la Comisión Internacional de Límites y Aguas.</p>	<p>Harmonization Efforts</p> <p>aligning different classification systems in cross studies and harmonizing data of the U.S. and Mexico for geology and hydrostratigraphic units</p>	<p>Esfuerzos de Armonización</p> <p>alineando diferentes sistemas de clasificación para cruzar mapas de datos armonizados para los estudios de geología y hidroestratigráficas</p>
<p>Recommendations from the Technical Team</p> <ul style="list-style-type: none"> monitor water use and groundwater extractions measure piezometric levels measure surface flows update climate classification report measure evapotranspiration and vegetation change monitor water quality and capacity for water supplies use of geophysical and remote sensing methods develop hydrologic evaluate a binational risk map create a standard for data update the existing binational groundwater flow model 	<p>Recomendaciones del Equipo Técnico</p> <ul style="list-style-type: none"> monitoreo de uso y extracción de agua subterránea medir niveles piezométricos medir flujo superficial actualizar el reporte climático medir evapotranspiración y cambios de vegetación monitoreo de calidad de agua y capacidad de los cuerpos de agua utilización de métodos geofísicos y de sensores remotos desarrollar hidrología evaluar un mapa binacional de riesgo crear un estándar de datos actualizar el modelo binacional de flujo de agua subterránea existente 	<p>Mapping Efforts</p> <ul style="list-style-type: none"> 20 binational maps about climate, hydrology, geology, land use, soil characteristics, vegetation, etc. 12 binational water quality maps 3 binational maps with information depth and surface groundwater level for the year 2011 	<p>Esfuerzos Cartográficos</p> <ul style="list-style-type: none"> 20 mapas binacionales acerca del clima, hidrología, geología, uso de suelo, vegetación, etc. 12 mapas binacionales de calidad de agua 3 mapas binacionales de información de profundidad y elevación de agua subterránea del año 2011 	<p>Binational Efforts</p> <p>18 binational meetings between 2010 and 2016</p>	<p>Esfuerzos Binacionales</p> <p>18 reuniones binacionales entre 2010 y 2016</p>
<p>Schematic interpretation of the Binational San Pedro Basin</p> <p>interpretación esquemática de la Cuenca Binacional San Pedro</p> <p>For more information on the schematic cross section please see section 4 in the report, para más información sobre la sección esquemática, vea la sección 4 en el informe.</p>	<p>Total Extraction water uses</p> <p>784,140,000 (31,842,242.70)</p> <p>Usos de Agua extracción total</p> <p>784,140,000 (31,842,242.70)</p>	<p>Binational Efforts</p> <p>18 binational meetings between 2010 and 2016</p>	<p>Esfuerzos Binacionales</p> <p>18 reuniones binacionales entre 2010 y 2016</p>	<p>Binational Efforts</p> <p>18 binational meetings between 2010 and 2016</p>	<p>Esfuerzos Binacionales</p> <p>18 reuniones binacionales entre 2010 y 2016</p>