



Hydrogeochemical Characterization of the Transboundary San Pedro and Santa Cruz Aquifers

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COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION
**WATER RESOURCES
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CONAGUA
Comisión Nacional del Agua

Transboundary Aquifer Assessment Program (TAAP)

- Joint effort between Mexico and the United States to evaluate shared aquifers.
- Had its beginnings in 2006 with the signing of the Transboundary Aquifer Assessment Act (U.S. Public Law 109-448, TAA-Act).
 - The TAA-Act authorized the United States Geological Survey (USGS) and the Water Resources Research Institutes (WRRIs) of Arizona, New Mexico, and Texas, to work with Mexican counterparts in the development of transboundary aquifer assessments.
- Mexican involvement took place only after the signing of the Cooperative Framework of 2009.



INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO

El Paso, Texas
August 19, 2009

**JOINT REPORT OF THE PRINCIPAL ENGINEERS
REGARDING THE JOINT COOPERATIVE PROCESS
UNITED STATES-MEXICO FOR THE TRANSBOUNDARY AQUIFER
ASSESSMENT PROGRAM**

To the Honorable Commissioners,
International Boundary and Water Commission,
United States and Mexico,
El Paso, Texas and Ciudad Juarez, Chihuahua.

Sirs:

We respectfully submit for your consideration this Joint Report recommending the joint cooperative process between the United States and Mexico to implement an assessment program for the transboundary aquifers shared by both countries.

I. Background

Since the decade of the 1970s, there exists within the framework of the International Boundary and Water Commission (IBWC), a process for the exchange of information on groundwater along the border between the United States and Mexico. Any issues of data or studies have been addressed on a case by case basis through mutual consultation as established in Resolution 6 of IBWC Minute No. 242.

By way of example, on December 2, 1997, the IBWC issued the "Joint Report of Principal Engineers Regarding Information Exchange and Mathematical Modeling in the El Paso, Texas and Ciudad Juarez, Chihuahua Area Aquifer." The IBWC arranged for the exchange of groundwater data between both countries and the development of a bilingual publication that was produced jointly under this effort.

On December 22, 2006, United States Public Law 109-448, the "United States-Mexico Transboundary Aquifer Assessment Act" was passed, establishing a program to evaluate transboundary aquifers between the United States and Mexico, which included the possibility of applying United States funds for assessment activities in Mexico.

II. International Boundary and Water Commission's Position and Process Framework

The IBWC, United States and Mexican Sections, are aware of the interest on both sides of the border to preserve and understand the aquifers used by both countries, whereby it is considered necessary to develop a team of binational experts to assess transboundary aquifers, exchange data, and if needed, develop new datasets.

Initiatives that include transboundary water resources are traditionally coordinated through the IBWC using the customary binational cooperation process used by both

COMISION INTERNACIONAL DE LIMITES Y AGUAS
ENTRE MEXICO Y LOS ESTADOS UNIDOS.

El Paso, Texas, 19 de agosto de 2009

**INFORME COMÚN DE LOS INGENIEROS PRINCIPALES
REFERENTE AL PROCESO DE COOPERACIÓN CONJUNTA
MÉXICO – ESTADOS UNIDOS PARA EL PROGRAMA DE EVALUACIÓN DE
ACUÍFEROS TRANSFRONTERIZOS**

A los Honorables Comisionados,
Comisión Internacional de Límites y Aguas entre
México y los Estados Unidos,
Ciudad Juárez, Chihuahua y El Paso, Texas.

Señores:

Respetuosamente sometemos a su consideración este Informe Común recomendando el proceso de cooperación conjunta entre México y Estados Unidos para la realización de un programa de evaluación de los acuíferos transfronterizos entre ambos países.

I. Antecedentes

Desde la década de los 1970's ha tenido lugar en el seno de la Comisión Internacional de Límites y Aguas (CILA) un proceso de intercambio de información sobre aguas subterráneas en diferentes zonas de la frontera entre México y Estados Unidos. Cualquier asunto de información o estudios sobre esta materia se ha atendido caso por caso sobre la base de la consulta recíproca establecida en la Resolución 6 del Acta 242 de la CILA.

Como ejemplo, el 2 de diciembre de 1997, la CILA emitió un "*Informe Común de los Ingenieros Principales relativo al Intercambio de Información y Modelo Matemático del acuífero en la zona de Ciudad Juárez, Chihuahua – El Paso, Texas*", en el marco del cual, la CILA coordinó el intercambio de información de datos de aguas subterráneas entre los dos países, así como la elaboración y publicación bilingüe del documento conjunto generado como resultado de dicho informe.

El 22 de diciembre de 2006, se aprobó la Ley Pública de Estados Unidos 109-448, relativa al "Acta sobre Evaluación de Acuíferos Transfronterizos México-Estados Unidos", estableciendo un Programa de Evaluación de Acuíferos Transfronterizos entre México y Estados Unidos, el cual incluye la posibilidad de aplicar recursos estadounidenses para actividades de evaluación en México.

II. Marco de la Posición y Proceso de la Comisión Internacional de Límites y Aguas

Las Secciones mexicana y estadounidense de la CILA, están conscientes del interés en ambos lados de la frontera en entender y preservar los acuíferos compartidos por ambos países, para lo cual se considera necesario establecer un grupo de expertos binacionales para evaluar los acuíferos transfronterizos, intercambiar información y según se requiera, desarrollar nuevas series de datos.

Las iniciativas que incluyen recursos de aguas transfronterizas, tradicionalmente son coordinadas a través de la CILA aplicando el proceso acostumbrado de cooperación

Data Exchange

Assessment

Coordinating Agency (IBWC)

Sovereignty

Binational Technical Advisory Committees

Binational Technical Groups

Bilingual studies

Activities Beneficial for the two countries

Obligation to Cooperate

Funding provisions

Communication and Information

Communication provisions

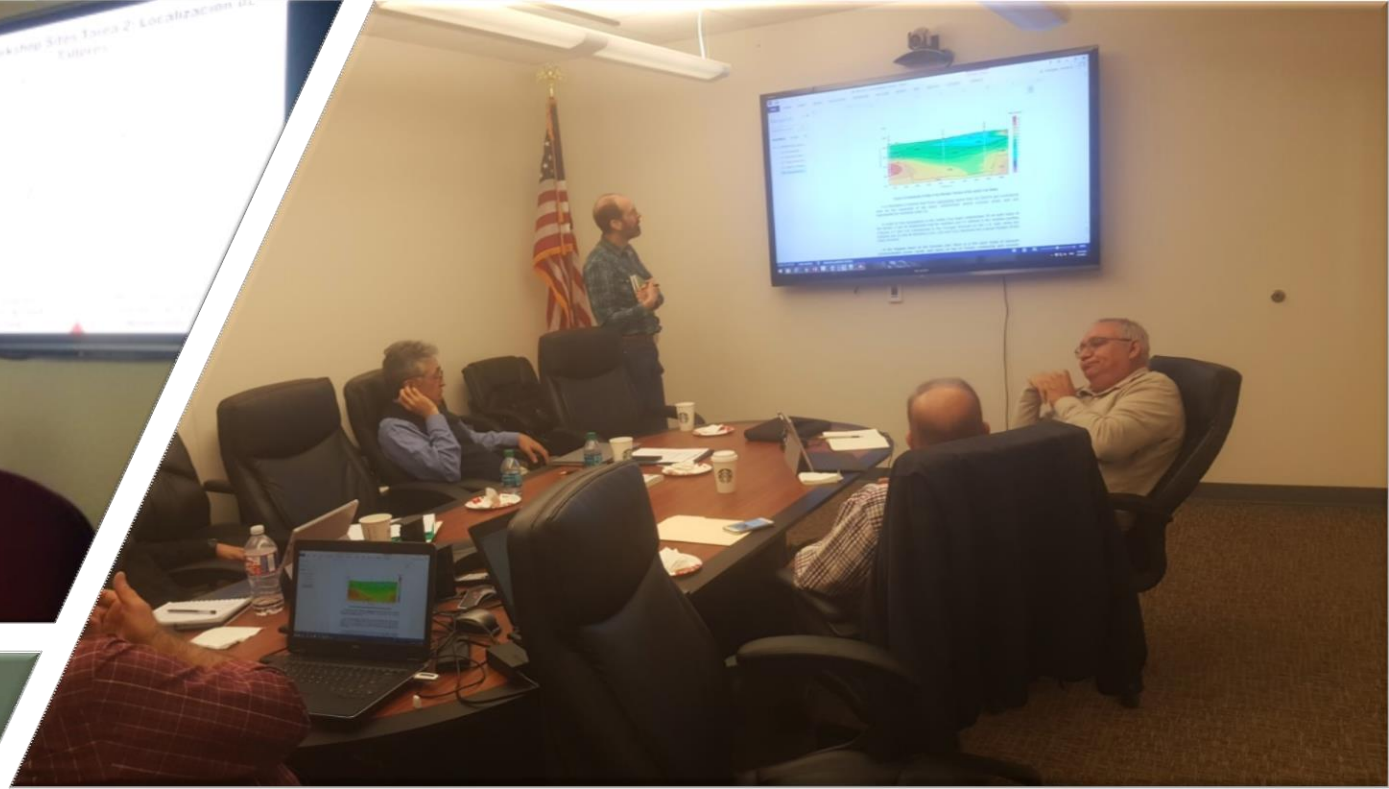
**The TAAP
Cooperative
Framework/
Joint Report
(IBWC, 2009)**



San Pedro, MX.



Santa Cruz, MX.



TAAP Technical Meetings

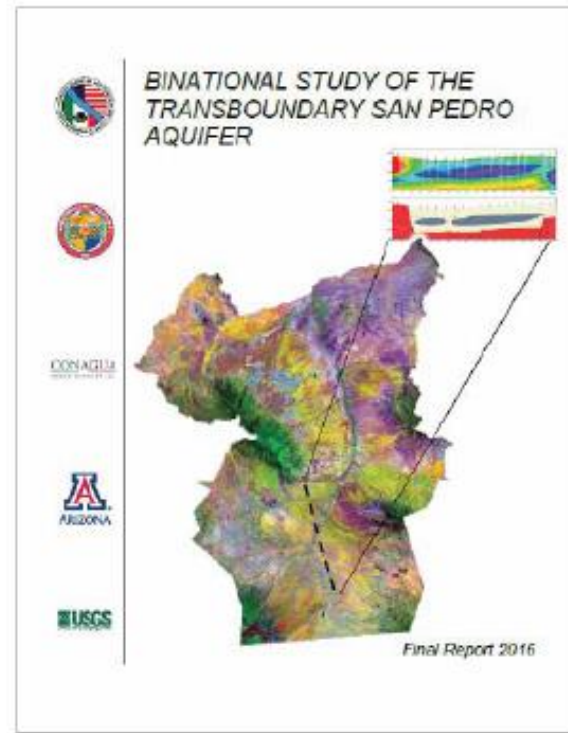
Collaboration

BINATIONAL COLLABORATION

COLABORACIÓN BINACIONAL

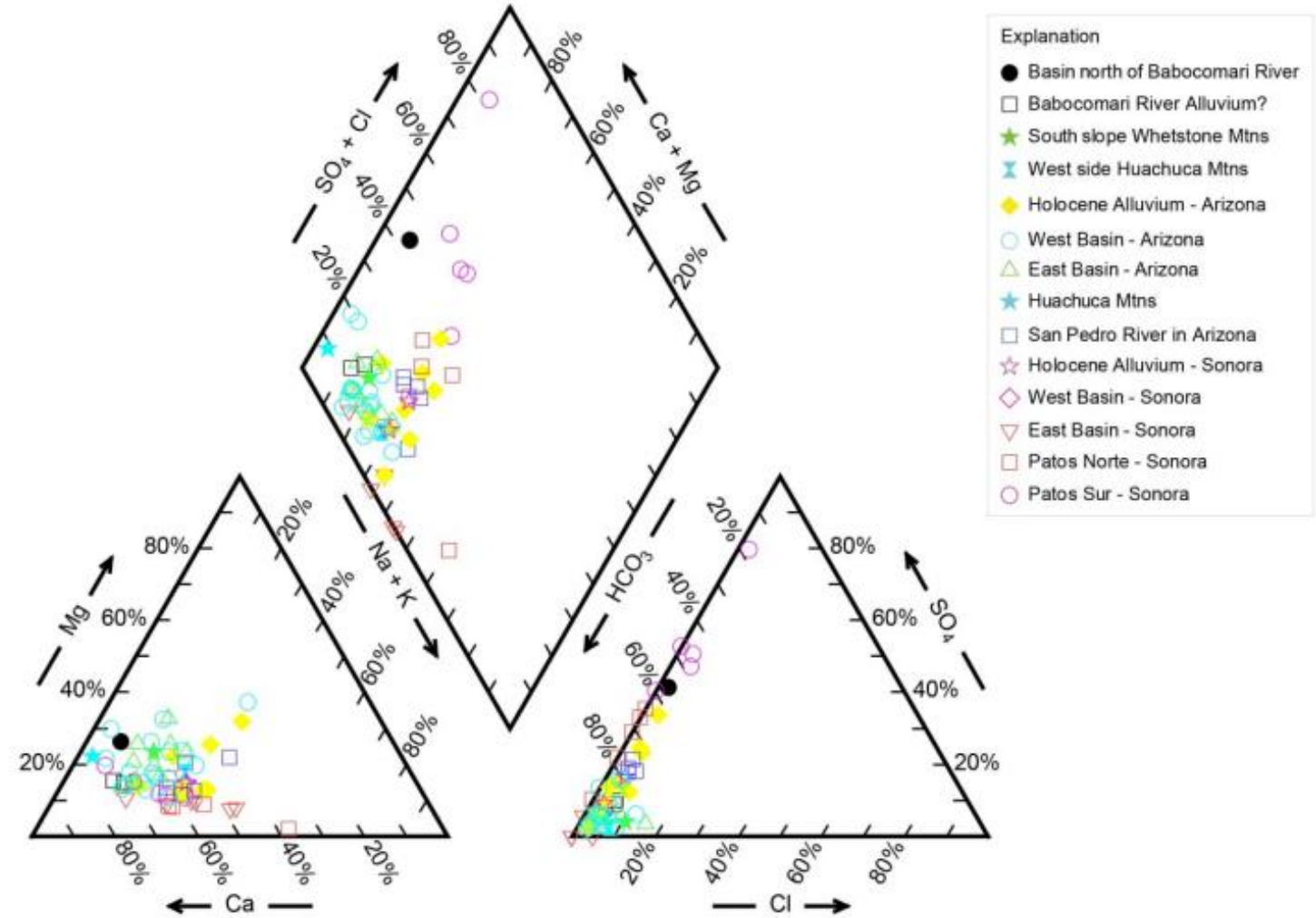
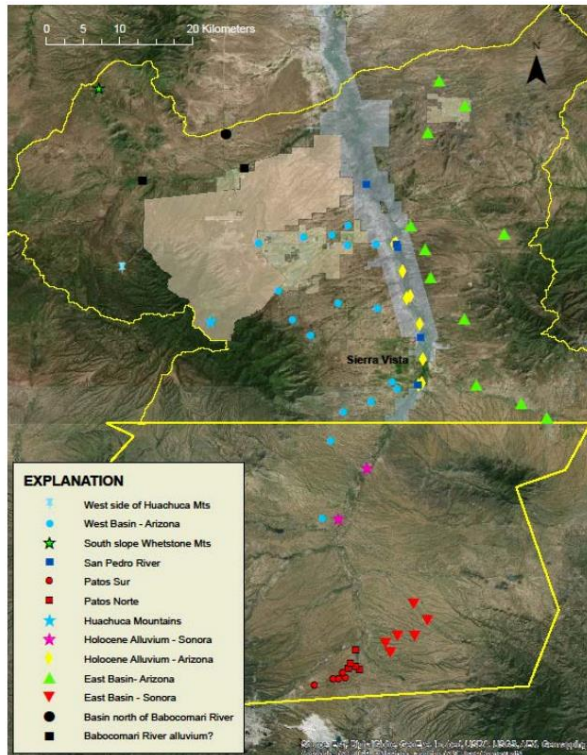
The San Pedro Report is the first-ever binational aquifer study prepared and released simultaneously in English and Spanish by the International Boundary Waters Commission.

El Reporte Binacional San Pedro es el primer estudio de acuífero binacional preparado y publicado simultáneamente en inglés y español por la Comisión Internacional de Límites y Aguas.

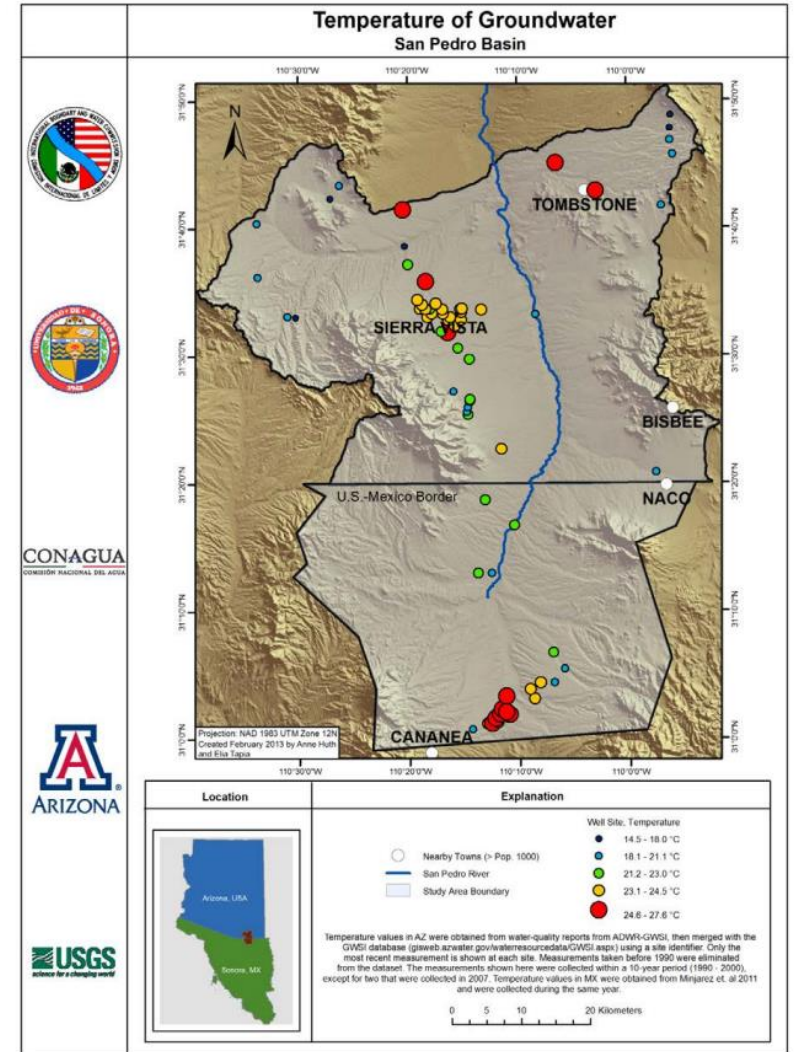
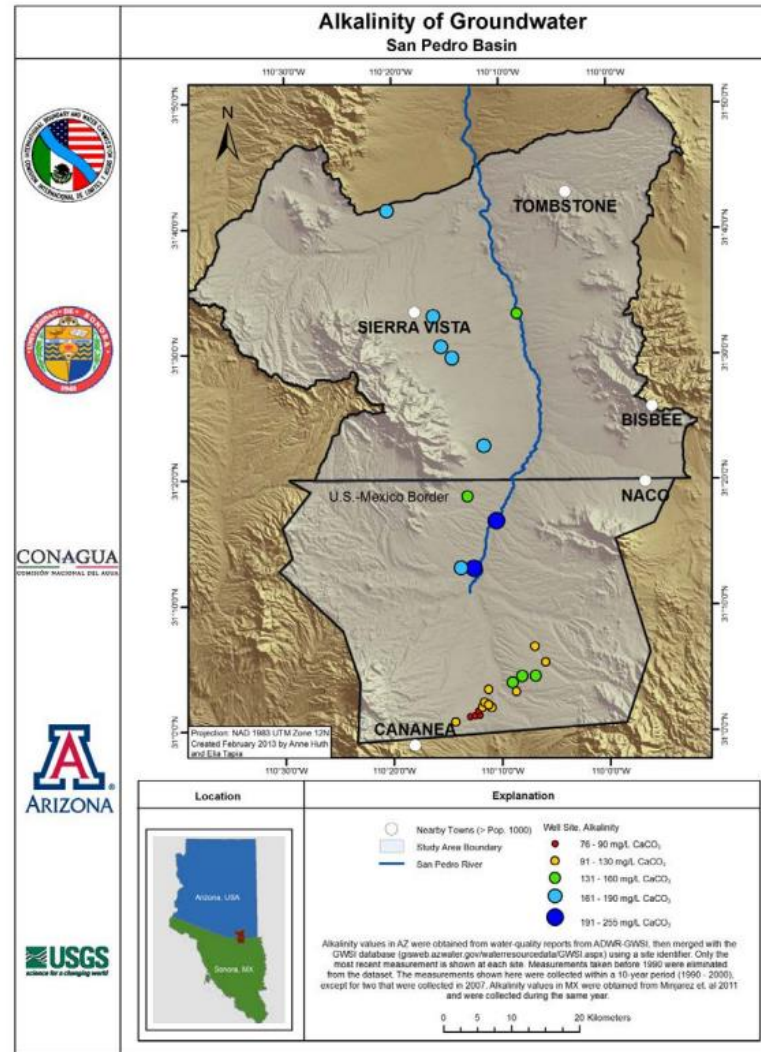
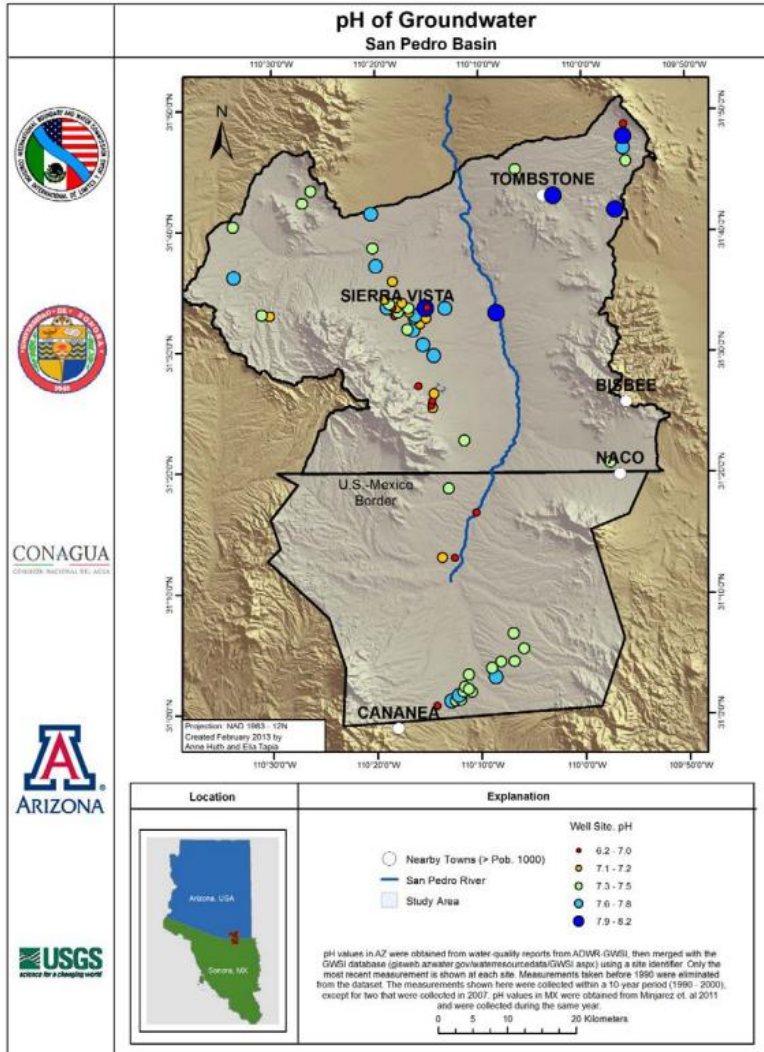


San Pedro Report Content:

The San Pedro report included the following chapters: Introduction, Physical geography, Hydrography and hydrometeorology, Conceptual geologic model, Piezometry and hydraulic parameters, Hydrogeology **Hydrogeochemistry**, Conceptual model of hydrodynamic behavior, Conclusions and recommendations.



pH, Alkalinity, Temperature

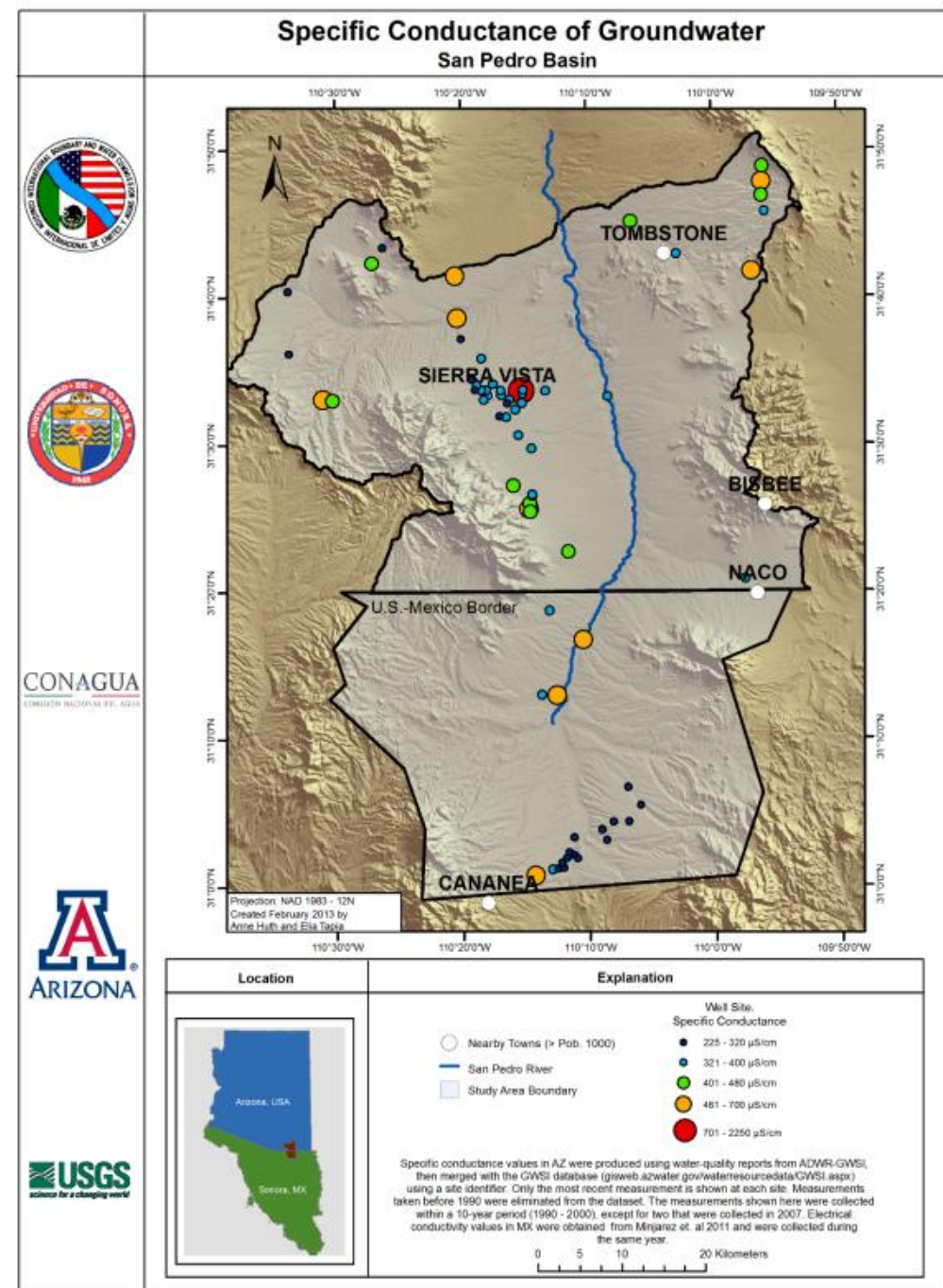


Specific Conductance

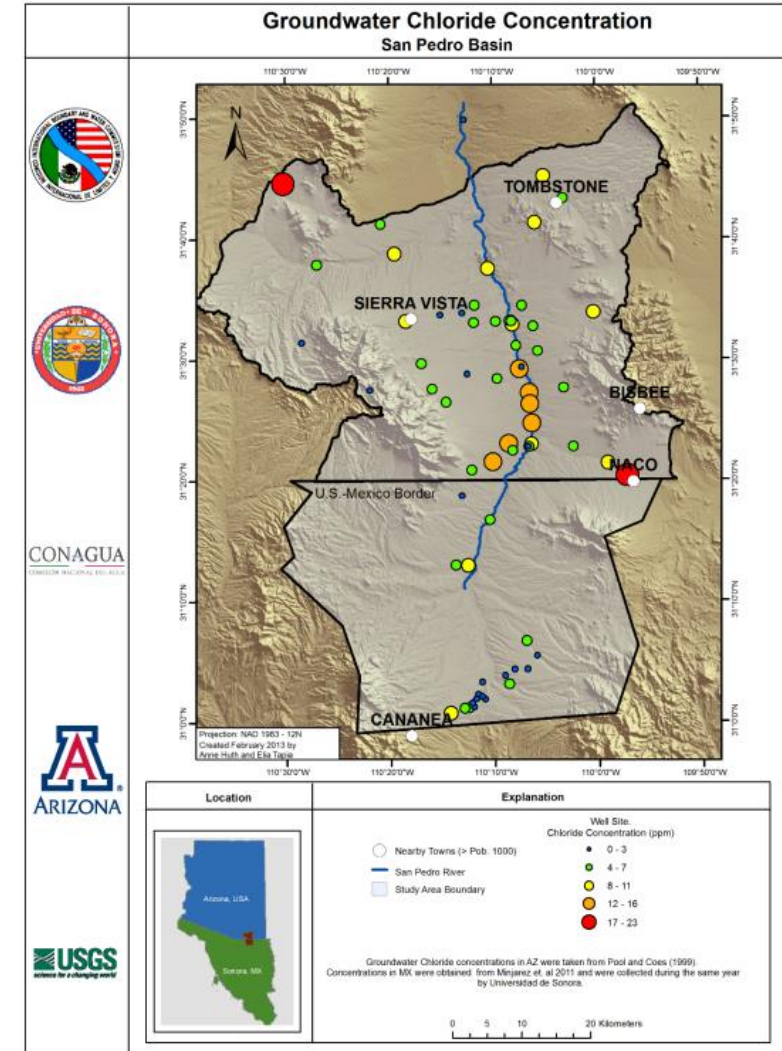
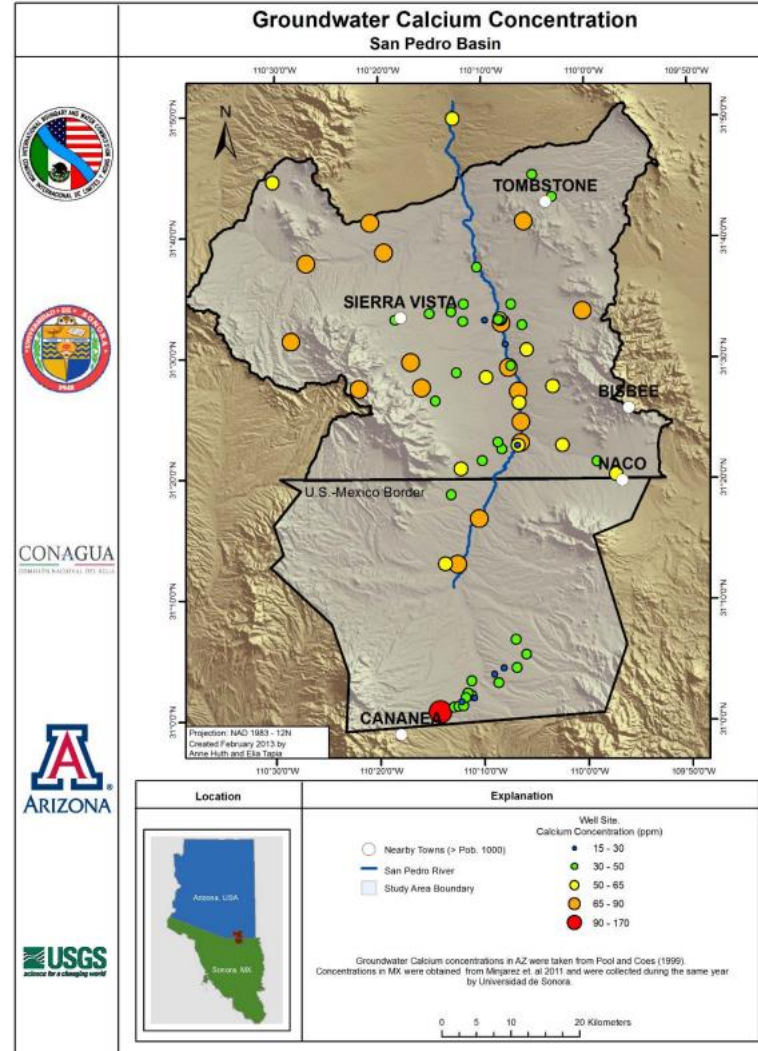
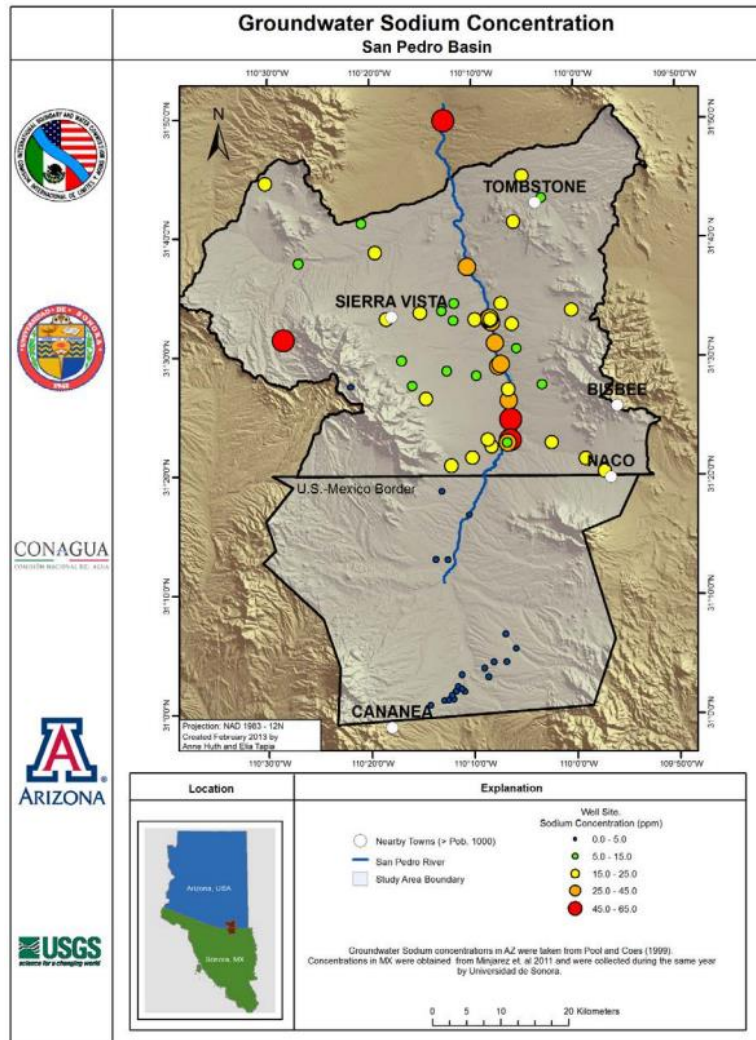
- Specific conductance, often used as a surrogate for TDS, is a measurement of the water's capacity to conduct electricity.
- It is an indicator of the concentration of ions present, and this is a good approximation of the concentration of dissolved salts in the water.
- The conversion of electrical conductance values to ppm of TDS and vice versa is complex and depends on concentration among other factors, but a frequent simplification is the following (Weiner, 2012):

1.0 ppm of TDS \approx 0.67 μ S/cm of Specific Conductance

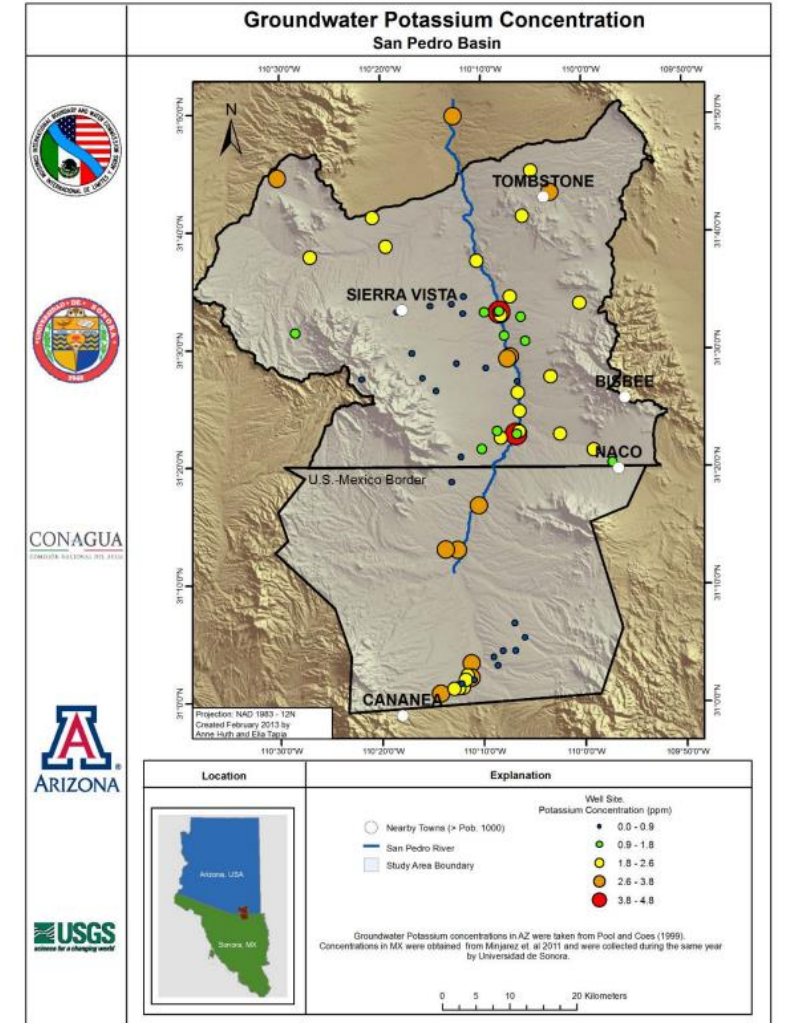
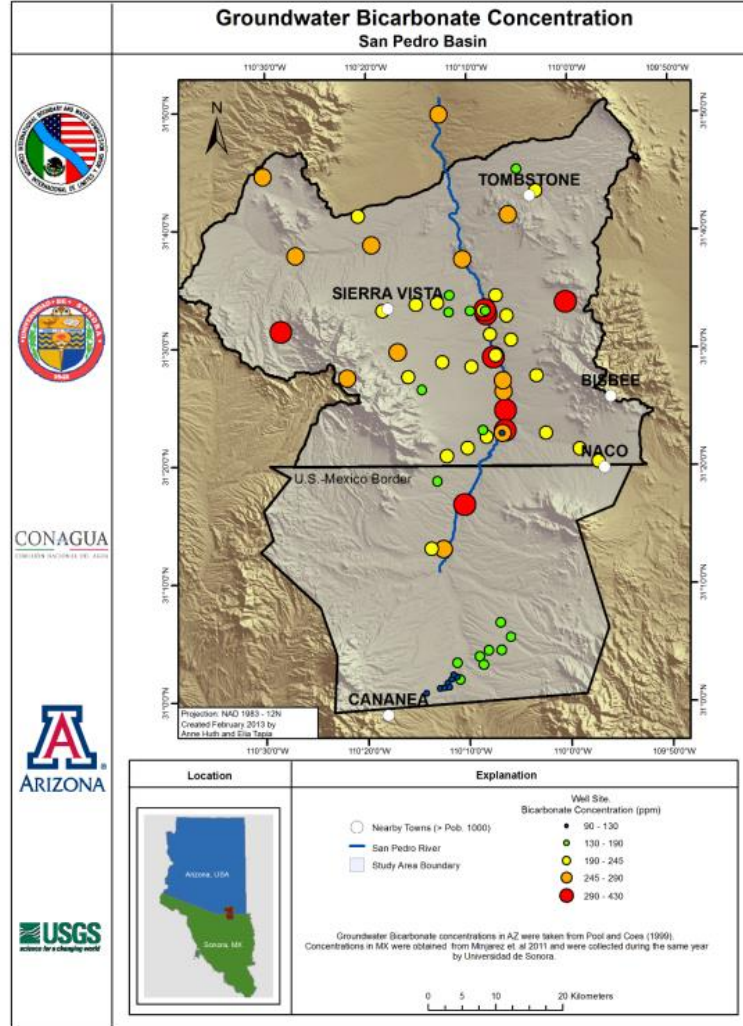
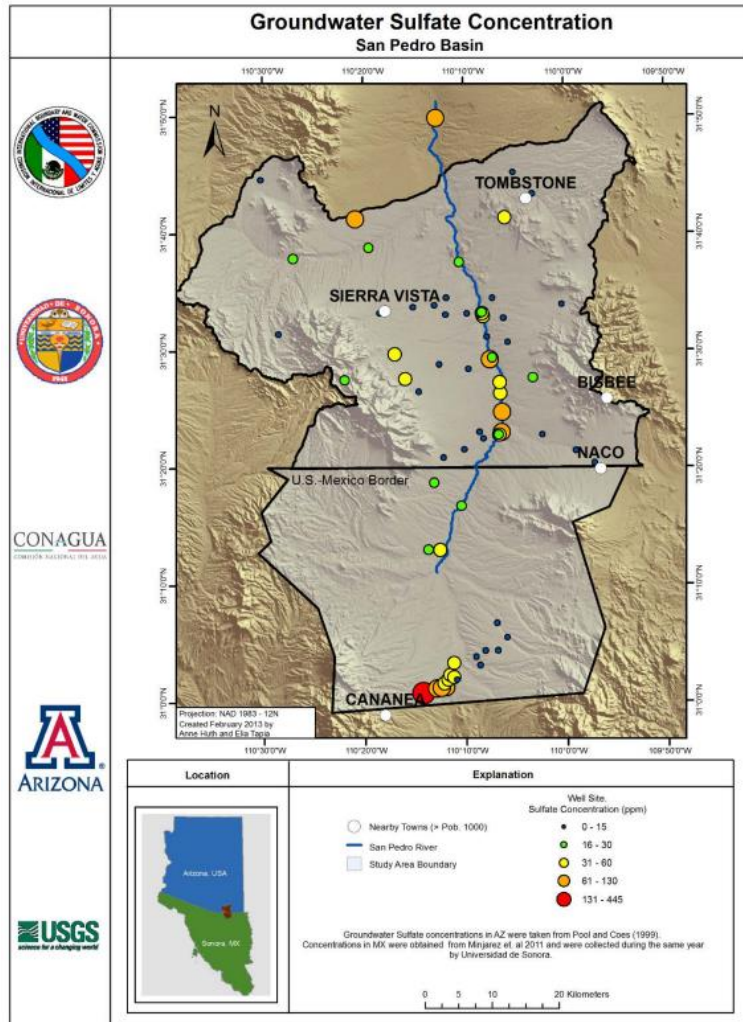
- Lower concentrations are found in the southcentral portion of the subbasin and values tend to increase slightly heading north along the regional flow path for groundwater.
- Decreasing values in the river in the direction of surface flow.
- High values in the alluvium possibly related to concentration of salts by evaporation prior to infiltration and/or the dissolution of gypsum or other evaporite minerals present in the regional aquifer close to or south of the international boundary line.



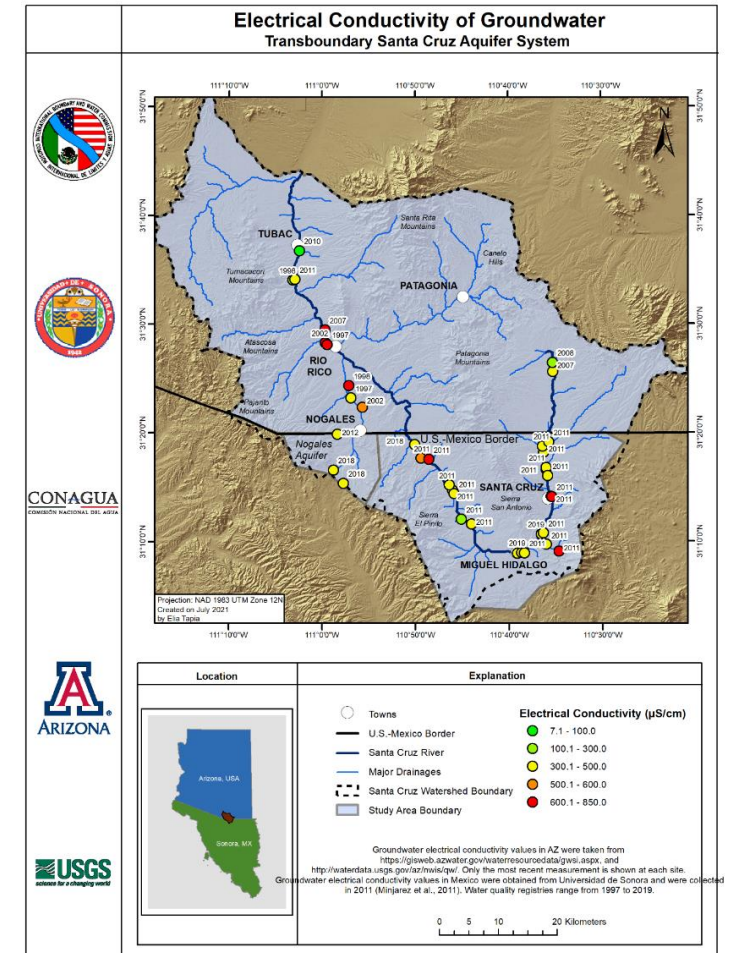
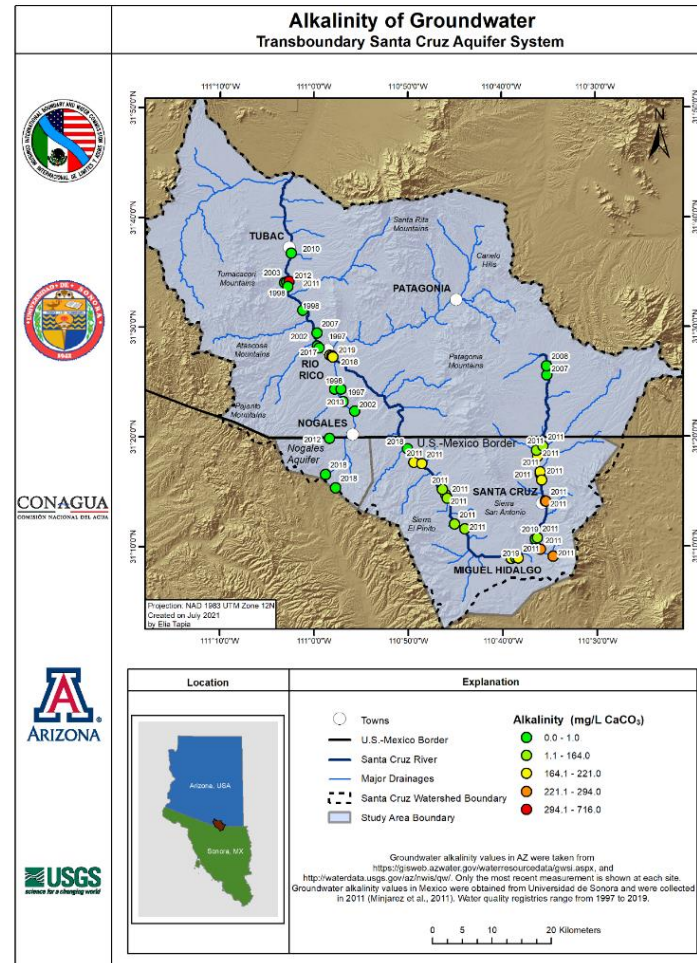
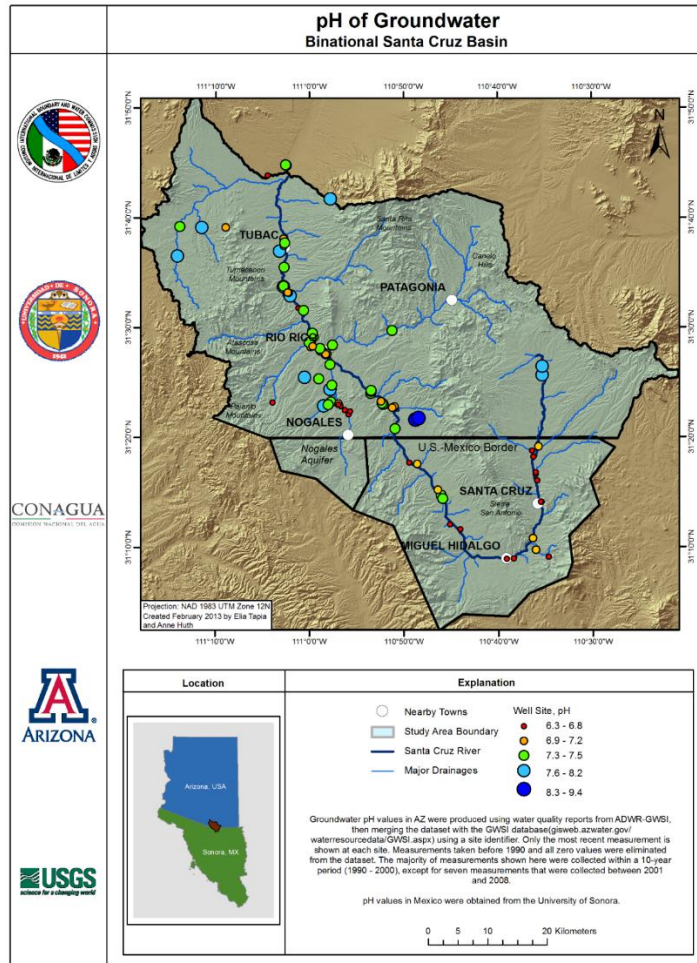
Sodium, Magnesium, Chloride



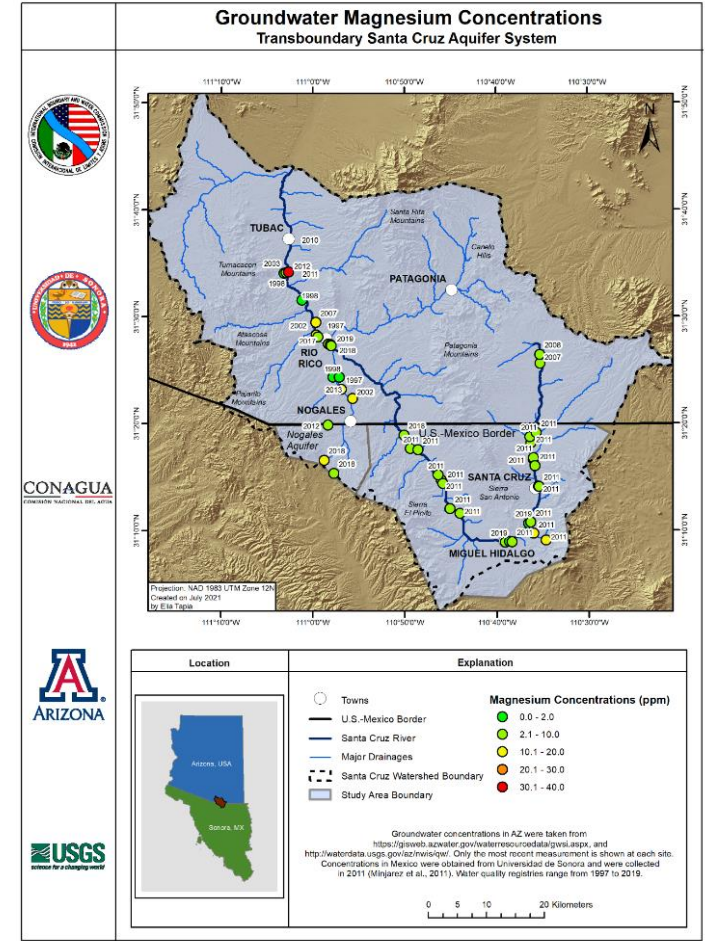
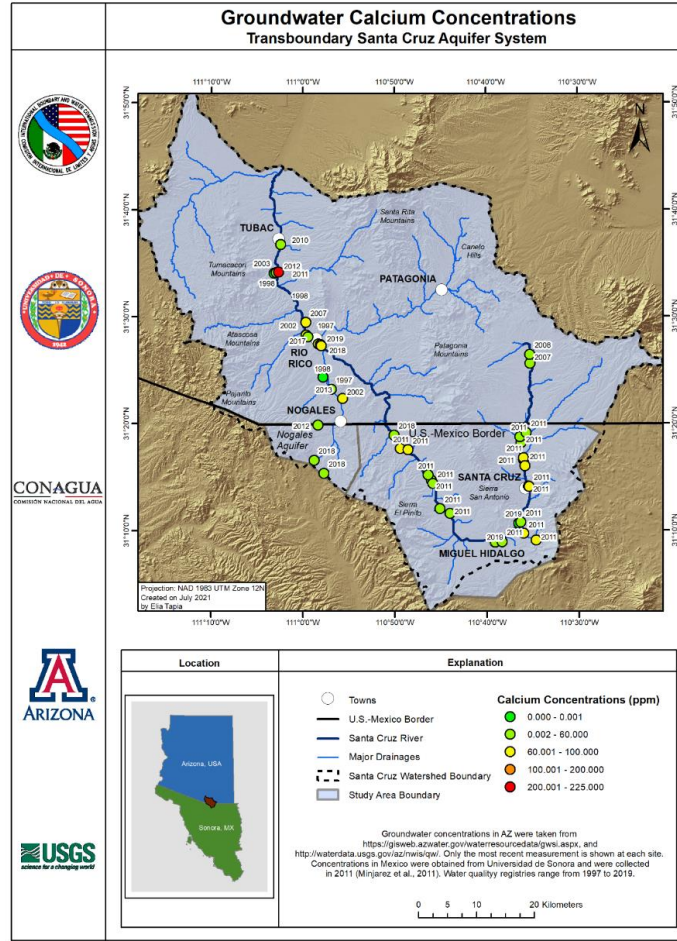
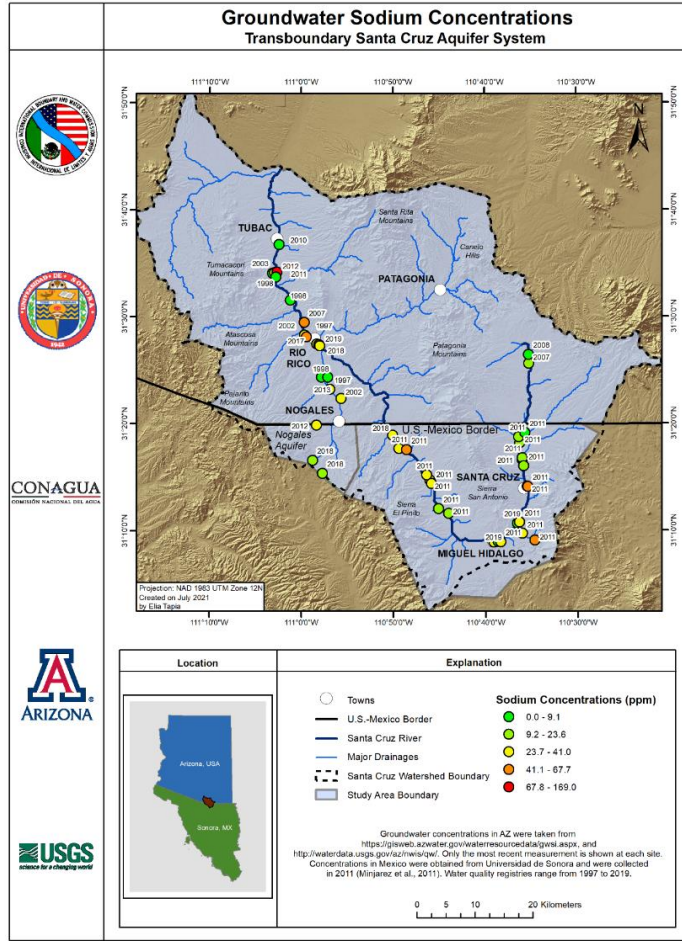
Sulfate, Bicarbonate, Potassium



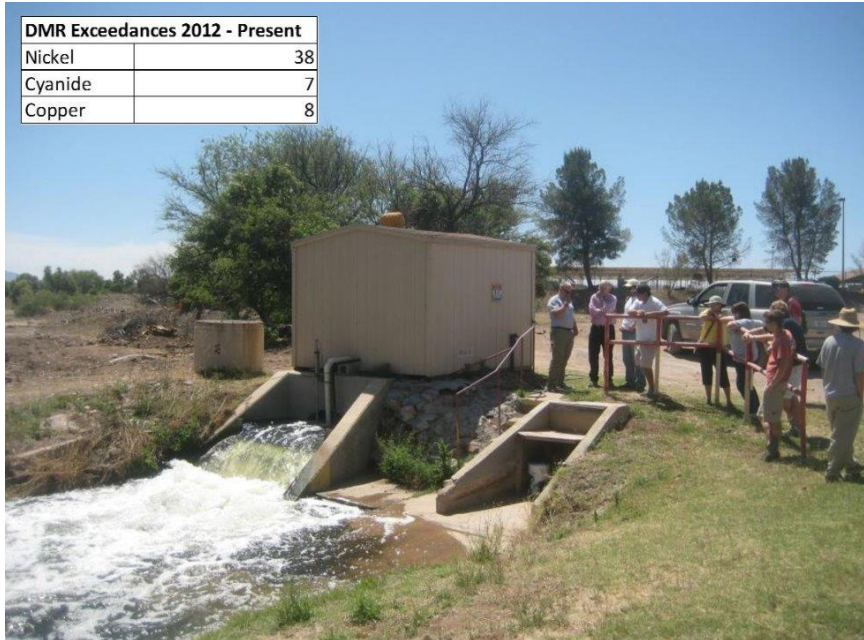
pH, Alkalinity, Specific Conductance in the Santa Cruz Aquifer



Sodium, Calcium, Magnesium

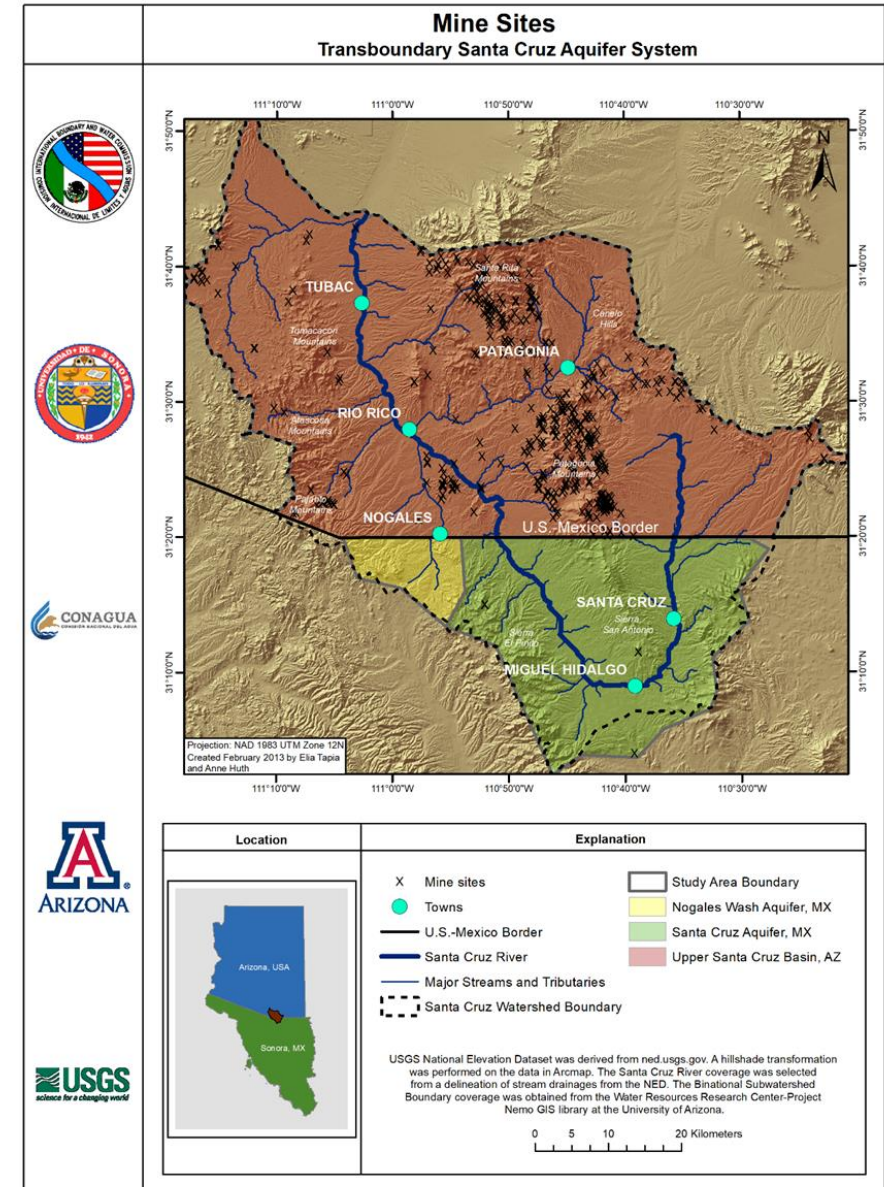


Work in Process



DMR Exceedances 2012 - Present	
Nickel	38
Cyanide	7
Copper	8

Nogales International Wastewater Treatment Plant at the International Outfall Interceptor (IOI).



Discussion

- Hydrogeochemistry is an important factor in understanding the hydrogeologic conditions of the San Pedro and Santa Cruz aquifers.
- Groundwater in the San Pedro and Santa Cruz aquifer are of a calcium-bicarbonate water chemistry, which is typical of recharge areas in Arizona (alkaline and low salinity).
- There is still a gap in binational information concerning Cu, PB, Zn and other pollutants, particular those produced through mining activities in the region.
- The analysis of current geochemical characteristics of the study area could provide information for land and water managers in the U.S.-Mexico border that could serve for the implementation of methods for improving water quality in these binational aquifers.



Thank you!

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For more information about the
TAAP please visit:

<https://wrrc.arizona.edu/TAAP>
