



Arizona-Sonora Environmental Strategic Plan

2017 - 2021

Closeout Report



Cover and Inside Photo by Nicholas Matthews

**“Coming together is a beginning,
staying together is progress,
and working together is success.”**

- Henry Ford

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Executive Summary

This report is a compilation of the accomplishments obtained from the implementation of the Arizona-Sonora Environmental Strategic Plan (ASESP) 2017 – 2021, with the leadership of the state environmental governmental agencies from Sonora and Arizona: Comisión de Ecología y Desarrollo Sustentable del Estado de Sonora (CEDES) and the Arizona Department of Environmental Quality (ADEQ). The report was developed in collaboration with the Comisión Estatal del Agua (CEA) from Sonora, Arizona Department of Water Resources (ADWR) and the Arizona Game & Fish Department (AZGFD).

Since the signing of the Memorandum of Understanding between Sonora and Arizona Governors in December 2016, within the collaborative framework of the Arizona-Mexico Commission/Comisión Sonora Arizona, both governments began the coordination and implementation of the 15 prioritized projects identified and established in the ASESP under water, air, waste and wildlife.

After five years of collaboration, the ASESP reaches its final phase in 2021 with the completion of 17 projects that represent an investment of more than \$1.15 million dollars. In addition, the ASESP promoted the direct collaboration of more than 50 stakeholders, the development of more than 28 training events that reached almost 1,000 border residents in topics related to green infrastructure, wastewater post treatment from industrial discharges, electronic waste management, illegal dumping and air quality among others. With the implementation of the ASESP, authorities from both sides of the Sonora-Arizona border can better inform the population about air and water quality issues, as well as develop public policies and strategies to address these transboundary issues in a collaborative manner, reduce environmental impacts, and improve the public health of the region.

With this report, the states of Sonora and Arizona intend to show the results of developing a unified guiding planning tool to address the main concerns identified by Sonora and Arizona for the protection of the environment and health of the residents on both sides of the border.

Background

The development of the Arizona-Sonora Environmental Strategic Plan (ASESP) emerged from a long history of cross-border collaboration involving bilateral, federal, state and local agencies as well as the private sector and non-governmental organizations in Arizona and Sonora. In June 2016, the Environment and Water Committee of the Arizona-Mexico Commission/Comisión Sonora Arizona agreed to produce the Arizona-Sonora Environmental Strategic Plan for 2017 – 2021. The Arizona Department of Environmental Quality (ADEQ) and the Commission for Ecology and Sustainable Development for the State of Sonora (CEDES) were named as the lead agencies, and the Border Environmental Cooperation Commission (merged with the North American Development Bank in November 2018), supported the coordination of the project. Additional state agencies collaborated on specific topics, including Sonora’s State Water Commission, the Arizona Game and Fish Department and the Arizona Department of Water Resources. Federal agencies such as Mexico’s Secretariat for the Environment and Natural Resources (SEMARNAT) and the U.S. Environmental Protection Agency (USEPA) were also consulted during the process. The North American Research Partnership (NARP), an independent, non-profit research organization, was asked to organize, edit and produce the plan.



The plan established fifteen strategic projects addressing a range of issues within the areas of water, air, waste management and wildlife. Fourteen additional projects were selected by the agencies as meriting consideration as time and resources allowed and were also included as part of the plan itself. A Memorandum of Understanding was developed and subsequently presented at the Comisión Sonora-Arizona/Arizona-Mexico Commission meeting in Hermosillo on Dec. 1 – 2, 2016. The memorandum served as the formal framework for collaboration between the two state governments and for the implementation of the strategic plan.

With both leading agencies seeking funding opportunities and partners to leverage resources, the prioritized project implementation phase started as early as the year 2017 began, with the launching of the USEPA Border 2020 Program "Request for Proposals" by the North American Development Bank (NADB). Partners on both sides of the border sought collaboration and support from CEDES and ADEQ, which accompanied the proposals submitted to the NADB for evaluation. During the 2017

RFP, three ASEP projects were selected and developed (two under Water and one under Waste). The same process of proposal evaluation and selection was carried out by the NADB and USEPA during the 2019 RFP, where three projects from the ASEP were selected (two under Waste and one under Water). In addition, the leading agencies from both sides of the border, assigned funds from other sources to the development of the projects listed in the ASEP.

Project Priority List	
Water	Stormwater Control in Nogales, Sonora, for the Protection of Binational Infrastructure and Public Health
	Infrastructure for Metals and <i>E.coli</i> Attenuation in the San Pedro River
	Implementation of Green Infrastructure in Nogales, Sonora, for the Protection of Binational Stormwater Quality
	Industrial Pretreatment Support in Nogales, Sonora, for the Protection of Binational Water Quality
Air	Installation and Operation of Air Quality Equipment in Sonora Border Communities
	Phase 1. Rehabilitation of Current Equipment. Phase 2. Acquisition of New Equipment.
	Ozone Monitoring Pilot Project in San Luis Río Colorado
	Expansion of Air Quality Smartphone Application to Yuma
Waste	Identification and Cleanup Prioritization of Waste-impacted Sites in Combination with a Solid Waste Management Education Campaign
	Comprehensive Electronic Waste and Discarded Domestic Appliances Management Program
	Development of a Comprehensive Master Plan for the Management of Solid Waste
Wildlife	Population Study of the Sonoran Pronghorn in Arizona and Sonora
	Monitoring of the Black-tailed Prairie Dog Population in Arizona and Sonora
	Improvements to the Mexican Grey Wolf Captive Breeding Program
	Identification of Priority Areas for Jaguar Conservation in Southern Sonora
	Bighorn Population Study in Sonora

Fig. 1. ASEP Priority Projects

As of May 2021, 11 of the 15 priority projects identified in the ASEP were implemented and completed, while the remaining four projects are being developed and are expected to conclude by the end of the year 2021. Also, two projects from the additional list of priorities were developed: a junkyard inventory for the city of Nogales, Sonora, and the update of the emissions inventories for the cities of Nogales, Somerton, and Yuma in Arizona.

As part of the major accomplishments achieved with the implementation of the ASEP (see Fig. 2), there was a total investment of more than \$1.15 million dollars from the year 2017 to the year 2021, as a result of the development of the prioritized projects. In addition, their implementation involved the collaboration of more than 50 entities from academia, non-governmental organizations, local and state public officials and other community organizations. It is also important to note that as an integral part of some of the projects' outputs, there were about 28 training workshops and informational events carried out with more than 1000 attendees to these events on the topics of green infrastructure, industrial post-treatment for wastewater, electronic waste management and illegal waste dumping among others.



Fig. 2. General ASEP outputs

On the following pages of this report, each of the prioritized projects is described in detail, highlighting the outputs and outcomes accomplished from the implementation of those projects that were concluded at the time of the elaboration of this report. This report also contains information on the costs and collaborating entities that provided support to accomplish their objectives. Finally, each project concludes with the next steps that are recommended to continue the efforts in the future.



	Stormwater Control in Nogales, Sonora for the Protection of Binational Infrastructure and Public Health		
Background:			
<p>Flooding associated with extreme rainfall events, particularly during summer monsoons, poses a threat to both private property and crucial binational infrastructure in Ambos Nogales. A combination of green infrastructure with formal flood control mechanisms and other sustainable solutions aids in stormwater control, protecting municipalities from flooding. Structures such as stormwater gabions can direct stormwater flows of high volume and/or intense duration away from critical infrastructure and into areas where they can diffuse naturally, posing no threat to life or property. Stormwater gabions have previously been constructed in Nogales as per U.S. Army Corps of Engineers and the U.S. International Boundary and Water Commission recommendations, in conjunction with CONAGUA and supported by USEPA's Border 2020. Functionality and sustainability of the gabions remains challenged by continued maintenance and operation. This project addressed the issue of flooding in Nogales through supporting maintenance of existing gabions, as well as promotion of new stormwater gabions. Additionally, this project evaluated other formal flood-control alternatives. The goal of this project was to protect the residents of Ambos Nogales, securing its municipal assets by strengthening the region's stormwater management infrastructure, while reducing the risk of stormwater-induced sanitary sewer overflows (SSOs).</p>			
Sponsor	Cost Breakdown	Starting – Ending Dates	Location
Instituto Municipal de Planeación de Nogales, Sonora.	Total – \$52,659.88	2/18 – 6/19	Nogales, Sonora
	EPA's B2020 – \$32,500		
	IMIP – \$20,159.88		
Description:			
<p>The goal of this project was to improve surface water quality that flows into major water bodies, as well as to carry out demonstrative actions such as the installation of biofilters, stream waste removal and the development of a water planter. These actions were reinforced with outreach campaigns to promote clean-up activities in these sites.</p>			
Project Outputs:			

<ul style="list-style-type: none"> • Removal of more than 10 tons of trash from the Cañada de el Muerto stream. • Retention of 19.8 m³ of sediment in biofilters. • Processing of 36,887 liters of rain water by the demonstrative plant in three months of commissioning. • Creation of a demonstrative site for the “Rain Garden” green infrastructure on a central median strip in Nogales with the capacity to capture upwards of 10,300 liters of rain higher than 10 mm of precipitation in a day. • Attendance of 244 participants to the informational and training courses. • Development of 120 m of demonstrative biofilters installed in the Cañada de el Muerto stream. • A demonstrative water planter with the capacity to process up to 8,000 liters of rain water per 32mm of precipitation in one day. 	
Project Outcomes:	
<p>This project not only achieved the creation of demonstration sites that contribute in a palpable manner to the improvement of stream drainage water quality, but additionally created a favorable atmosphere for raising participation and awareness in a portion of Nogales residents on the impact that some smaller actions, such as picking up trash from the street, had over time.</p>	
Collaborating Entities:	
<p>Instituto de la Juventud de Nogales, Sonora; the Mexican Section of CILA; Nogales, Sonora City Government</p>	
Next Steps	<ul style="list-style-type: none"> • Search and prioritize sites for future intervention, utilizing urban bioretention designs, with the goal of forming an interconnected green infrastructure network that will improve the quality of water that arrives at receiving facilities. • Continue outreach programs, raising awareness on green infrastructure and its relation to stream preservation and site cleaning. • Investigate alternative techniques and models of bioretention for urban application, in order to better define its efficiency threshold.

Photos



Green Infrastructure Installations and Demonstrations in Nogales, Sonora;IMIP

	<p>Infrastructure for Metals and <i>E.coli</i> Attenuation in the San Pedro River.</p>
<p>Background:</p> <p>The Upper San Pedro watershed spans the eastern portion of the Sonora-Arizona border, including the community of Cananea, Sonora (25 miles from the US border) at its southernmost limits. Water quality monitoring of the San Pedro River in Charleston, Arizona, has revealed high levels of <i>E. coli</i> and dissolved copper relative to U.S. surface water quality standards, resulting in the river’s classification as “High” priority. Historical mining activities in Cananea, Sonora, have been linked by the University of Sonora to contaminated sediments along the river’s length in Sonora. Additionally, raw sewage discharges may contribute to the downstream exceedance of</p>	

bacterial standards for both countries. Contaminants from municipal and industrial discharges may be mobilized along the river’s length during high-flow events. This project sought to protect the San Pedro River from metal and *E. coli* contamination through the implementation of stormwater detention features, mitigating contaminated sediment remobilization and lessening the effects of cross-border sewage flows. Features such as those installed on the San Bernardino Ranch east of Agua Prieta, Sonora, can help control the migration of contaminated sediments. As part of this project, strategies for mitigation of contaminated sediment dispersal were investigated and implemented as appropriate through coordination with CONAGUA and CEA, and through technical support provided by ADEQ.

Sponsors	Cost Breakdown	Starting – Ending Dates	Location
Watershed Management Group & ProFauna	Total – \$524,000	12/18 – 12/21	San Pedro Watershed: Northern Sonora/Southern Arizona
	ADEQ (319h) – \$300,000		
	WMG/ProFauna – \$224,000		

Description:

The goal of this project was to address industrial metal and *E. coli* contamination in the San Pedro River. The river's watershed covers portions of Southern Arizona and Northern Sonora, carrying high levels of *E. coli* contamination from local agriculture, industry and municipal sewage, posing a threat to the health of local inhabitants and wildlife. Restoration of local sites sought to reduce stormwater erosion and dispersal of contaminated sediments. Additionally, community outreach and educational sessions sought to encourage better practices along the watershed to mitigate and prevent further contamination.

- Project Outputs:**
- Site visits to numerous ranches in Ejido Emiliano Zapata and Ejido Zaragoza by Profauna to identify potential sites for restoration.
 - 12 workshops were conducted in Cananea, Ejido Zaragoza, Ejido Zapata, with an attendance of more than 50 participants to discuss and educate on appropriate restorative range management.
 - Delivery of a report highlighting the rancher workshops and restoration practices to the Local Cattle Union of Cananea.
 - Development of a series of GIS maps and Google Earth locations identifying ejido land tenure and future restoration sites.

<ul style="list-style-type: none"> • Identification of three to five sites for cattle exclusion and infrastructure establishment along the riparian corridor in collaboration with ranchers. 	
Project Outcomes:	
Successful demonstration of green infrastructure in rural areas regulating control of sediments, rock structures, sustainable ranching/herding, and erosion of river banks through the development of demonstration sites, as well as successful collaboration amongst ranchers groups, civil society and non-governmental organizations.	
Collaborating Entities:	
Ranchers in the San Pedro Watershed, Municipality of Cananea, CONAGUA, Colegio de Sonora, CBTIS Cananea, Local Cattle Union of Cananea, Ajos-Bavispe Protected Area	
Next Steps	<ul style="list-style-type: none"> • Identify incentivizing mechanisms to develop sustainable ranching activities and restoration of the San Pedro River Watershed in collaboration with ranchers and non governmental organizations. • Recent studies suggesting the presence of beavers along the river highlights the possibility of using local biodiversity for watershed management.

Photos



Site Restoration and Ranching Management Outreach in the San Pedro Watershed; WMG

	Implementation of Green infrastructure in Nogales, Sonora for the Protection of Binational Stormwater Quality		
Background:			
<p>The impacts of flooding in Ambos Nogales can be severe, especially during the summer monsoons. The flow of stormwater causes damage to business, private property, the local environment and municipal structures when uncontrolled. Additionally, this can negatively impact public health and threaten important binational infrastructure. Urban development diminishes the infiltration of rainwater, raising the risk of downstream flooding through its contribution to the creation of exposed, impermeable terrain. Green infrastructure addresses these issues through improving the infiltration and beneficial deviation of rainwater, being utilized to sustain urban green spaces. The report “<i>City of Green Creeks: Sustainable Flood Management Alternatives for Nogales, Sonora,</i>” produced by Arizona State University, examined and proposed numerous green infrastructure projects to manage the control of stormwater at certain sites in Nogales, Sonora. This project sought to implement the green infrastructure strategies outlined in the previously mentioned report.</p>			
Sponsor	Cost Breakdown	Starting - Ending Dates	Location
Arizona State University - Board of Regents	Total – \$128,880	3/20 – 6/21	Nogales, Sonora & Nogales, Arizona
	EPA’s B2020 – \$100,000		
	Arizona Board of Regents (ASU) – \$28,880		
Description:			
<p>Project identified alternative sites for the placement of green infrastructure hubs and corridors, using a spatial capability analysis based on a binational geographic information system (GIS). Additionally the project evaluated the network’s hydrological efficiency, with its components utilizing the KINEROS platform to simulate water runoffs, erosion and sediment dragging at the watershed level. Numerous regulatory, institutional and perceptual barriers have been identified for the strategies implementation, with the support of local actors on both sides of the border. Workshops, demonstrations and art competitions relating to rain and green</p>			

<p>infrastructure have been conducted in Ambos Nogales to promote the project’s strategy with teachers, students and local families.</p>	
<p>Project Outputs:</p> <ul style="list-style-type: none"> • Creation of a binational GIS system for the development of a spatial capabilities analysis that permitted the identification of 82 potential sites for the placement of the infrastructure network in Ambos Nogales. • On site validation and a multifunctional, multiscalar prioritization of approximately 40 hubs of the binational network. • Elaboration of conceptual green infrastructure model planning for two sites in Nogales, Sonora, and two in Nogales, Arizona. Demonstrative and educational green infrastructure practices will be implemented in these sites. • Preliminary simulation of water runoff, erosion, and sediment dragging, based on the Ambos Nogales watershed urban hydraulic/hydrologic model (conceptual renderings were produced for three sites in Nogales, Sonora and three in Nogales, Arizona). • Implementation of educational and awareness activities in Ambos Nogales with a total of 124 participants: 35 attended the promotion of GI concepts through an art contest in Nogales, Arizona; 67 attended a workshop at Secundaria #3 in Nogales, Sonora; and 22 attended the rain garden presentation. 	
<p>Project Outcomes:</p> <p>Project is under development, with the design and planning phase planned to conclude on June 30, 2021.</p>	
<p>Collaborating Entities: Arizona State University, University of Arkansas, University of Arizona, Secundaria Gral. #3 Humberto Campos Varela, El Colegio de la Frontera Norte, U.S. Geological Survey, SEEDS Garden Crew, Instituto Municipal de Investigación y Planeación de Nogales, Sonora, H.Ayuntamiento de Nogales, Sonora, Wade Carpenter Middle School and the Santa Cruz County School District.</p>	
<p>Next Steps</p>	<ul style="list-style-type: none"> • Construction of micro projects at two sites in Nogales, Sonora. • Final design and plan presentation for the project. • Acquirement of funds for the implementation of the Green Infrastructure plan. • Continuation of training and development of experimental activities with community participants. • Project impact evaluation.

Photos



Green Infrastructure Implementation and Community Activities, Dr. Francisco Lara

	<p>Industrial Pretreatment Support in Nogales, Sonora for the Protection of Binational Water Quality</p>
<p>Background:</p> <p>The Nogales International Wastewater Treatment Plant (NIWTP), located in Rio Rico, Arizona, treats wastewater from both Arizona and Sonora, with Nogales, Sonora, contributing the majority of wastewater to the plant. Heavy metals in wastewater from Nogales, linked to industrial discharge from metal plating operations in</p>	

Nogales, Sonora, has consistently exceeded the allowable headwork loadings for the NIWTP. At times, metals pass through the NIWTP to the Santa Cruz River, where treated wastewater from the NIWTP is discharged. Wildlife and water quality monitoring has suggested environmental impact resulting from contaminated discharge. The Nogales, Sonora Potable Water and Wastewater Utility (OOMAPAS-NS) has reported itself to be in compliance with Mexican Federal requirements for industrial discharge monitoring and enforcement. OOMAPAS recognizes that differences in Mexican and U.S. requirements exist, and as such respective activities may be insufficient for addressing the NIWTP's efforts to protect the Santa Cruz River. The Nogales community and OOMAPAS have committed to collaborating on a solution, with the necessity of federal support given the binational nature of receiving infrastructure. This project leveraged these federal resources to strengthen the institutional pretreatment processes in Nogales, Sonora, allowing for source mitigation of contaminant loadings. This includes wastewater monitoring in the binational conveyance for source characterization, information exchange with the regulated community, and support of Mexico's Industrial Wastewater Discharge Limits (NOM-002) where necessary.

Sponsors	Cost Breakdown	Starting – Ending Dates	Location
OOMAPAS Nogales	Total – \$19,677	5/18 – 5/19	Nogales, Sonora
	EPA's B2020 – \$11,418		
	OOMAPAS Nogales – \$8,259		

Description:

The objective of this project was to develop a simultaneous monitoring of sites established by IBWC in strategic points of the municipal sewage system with industrial and commercial zones characteristics. The project then characterized wastewater from sectors with industrial and commercial discharges, with the intent of identifying the presence of metals found in MH #1 in analysis performed by IBWC (copper, chromium, nickel and zinc).

Project Outputs:

- Acquisition of three sets of autosamplers and materials for installation in six identified sites.
- Training for OOMAPAS Nogales employees.
- Characterization of wastewater in sub collectors with industrial discharge through identification of heavy metals. A total of 102 samples were taken, 90 of which were used for comparison against MH#1 samples and 12 for sample

- quality control. These results outline the presence of chromium, copper and nickel in the Nuevo Nogales industrial site, chromium and zinc in the Yaqui site, and finally chromium in the California site
- Simultaneous sample monitoring (MH#1) during the second trimester of 2018 of industrial areas across Nogales over the course of 30 days.

Project Outcomes:

Strengthened the organization's capacity, with new sampling equipment and employee training to continue monitoring in the next stage of the project. The presence of point metal discharges in sub collectors in the city of Nogales, Sonora, was verified. In the Nuevo Nogales industrial park these were metals such as copper, chromium and nickel; in the Colinas del Yaqui sub collector they were chromium and zinc, and in the California subcollector chromium. The contributions of metals in the inflow of the plant decreased, as evidenced by the results presented in the Binational Technical Committee meetings by the International Boundary and Water Commission.

Collaborating Entities:
IBWC both sections (US and Mexico)

- Next Steps:**
- Promote alternative post-treatment methods for industrial wastewater with heavy metal presence, through the development of technologies that improve water quality and ensure the appropriate function of existing water treatment plants in the region.

Photos



Water Sampling and CILA Community Forum in Nogales, Sonora (11/28/2020); OOMAPAS Nogales



	<p style="text-align: center;">Installation and Operation of Air Quality Equipment in Sonora Border Communities Phase 1 – Rehabilitation of Current Equipment Phase 2 – Acquisition of new equipment</p>		
Background:			
<p>Air pollutant emissions originating in the Sonoran cities of Nogales, Agua Prieta and San Luis Rio Colorado adversely impact the Arizona sister cities of Nogales, Douglas and Yuma, contributing to their designation as nonattainment areas for PM₁₀ (all three communities) and PM_{2.5} (in Nogales, Arizona). ADEQ operates PM monitoring stations on the Arizona side of the border, in addition to a few stations on the Sonoran side until 2011. CEDES briefly operated and maintained monitoring stations in various Sonora border communities, however, a lack of resources has forced the discontinuation of its monitoring efforts. With technical assistance from ADEQ, CEDES has been able to consistently operate a PM monitoring station in Nogales, Sonora, additionally demonstrating interest in re-deploying existing equipment to other border communities. The extent of necessary repairs for existing equipment is currently unknown, however, CEDES planned to acquire additional equipment for expansion of its border air monitoring network to additional border communities. Air monitoring in border communities is critical to providing data that justifies and secures funding for air quality improvement projects in the Arizona-Sonora region, giving rise to improved social and economic conditions. This project sought to assist in these monitoring programs, providing necessary resources for the acquisition of new equipment, and rehabilitation of previous equipment.</p>			
Sponsors	Cost Breakdown	Starting – Ending Dates	Location
ADEQ	Total – \$160,000	6/20 – 6/21	Nogales, Sonora
	ADEQ (EPA’s PPG Grant) – \$160,000		
Description:			
<p>This project consists of purchasing, transporting and installing PM₁₀, PM_{2.5} and ozone air monitoring instruments as well as meteorology equipment in Nogales, Sonora. These instruments were FRM or FEM to allow for best compatibility with air monitors currently operated by ADEQ in the U.S. Some funds went toward funding the ongoing operation and maintenance of the site and equipment.</p>			
Project Outputs:			

<ul style="list-style-type: none"> • Installation of ozone, PM₁₀, PM_{2.5}, and meteorological parameter equipment at Instituto Tecnológico (ITN) de Nogales, Sonora, on April 9, 2021. • Equipment testing and calibration. 	
Project Outcomes:	
<p>Project is under development. Equipment installation phase is set to be completed on April 29, 2021.</p>	
Collaborating Entities:	
<p>Comisión de Ecología y Desarrollo Sustentable del Estado de Sonora, Instituto Tecnológico de Nogales, RECIKLAN, S.A. de C.V.</p>	
Next Steps:	<ul style="list-style-type: none"> • Continue monitoring for ozone, PM₁₀, PM_{2.5} and meteorological parameters, sharing information with the states of Sonora and Arizona.

Photos



Installation of Monitoring Equipment in Nogales, Sonora; Sonoma Technology Inc.

	<h2>Ozone Monitoring Pilot Project in San Luis Rio Colorado</h2>		
Background:			
<p>Changes to the federal maximum standard for ozone pollution from 75 parts per billion (ppb) to 70 ppb increase the likelihood that part of Yuma County will be re-designated as a nonattainment area for ozone, based on the average ozone concentrations recorded over several years at ADEQ’s ozone monitoring location in Yuma County. As per the Clean Air Act, stricter regulations are prescribed on ozone nonattainment areas, such as the requirement for new or expanding factories above a certain size to buy ozone “offset” credits from current sources. Redesignation of part of Yuma County as a nonattainment area for ozone could damage the region’s economy, already grappling with high unemployment. In addition, much of Yuma County’s ozone problem likely originates outside of the county’s boundaries (i.e., in southern California and northwestern Mexico), however previous data is unable to accurately pinpoint sources. A lack of ozone monitors in northwestern Mexico, in addition to the expansion of the San Luis, Arizona-San Luis Rio Colorado, Sonora Port of Entry necessitates greater air monitoring in these border communities, as addressed in this project.</p>			
Sponsors	Cost Breakdown	Starting – Ending Dates	Location
ADEQ	Already existing ADEQ equipment was rehabilitated.	12/16 – 5/17* <small>*(Site Selection and Equipment Installation)</small>	San Luis Rio Colorado, Sonora
Description:			
<p>This project sought to install and operate a temporary air quality monitoring system in the municipality of San Luis Rio Colorado, Sonora, for the purposes of monitoring O₃, NO_y, and CO concentrations. Data obtained will be provided to the USEPA and collaborating organizations, and available to the general public. Maintenance and service of the equipment will be conducted by ADEQ personnel every two weeks.</p>			
Project Outputs:			
<ul style="list-style-type: none"> • Equipment installed May 2017. • Ozone monitoring started May 2017. 			
Project Outcomes:			

<p>ADEQ has more accurate information regarding the concentrations of ozone in the border region in the northwest of Sonora.</p>	
<p>Collaborating Entities: OOMAPAS San Luis Rio Colorado, San Luis Río Colorado Mayor’s Office</p>	
<p>Next Steps:</p>	<ul style="list-style-type: none"> • This project is currently paused due to COVID-19 travel restrictions. As soon as the project resumes, ADEQ will continue monitoring for ozone and meteorological parameters, and will make arrangements for the installation of CO and NO_y monitoring equipment. There is no set date at this time for resuming operations.

Photos



Interior and Exterior View of Monitoring site in SLRC; ADEQ (Gerardo Monroy)

	<h2>Expansion of Air Quality Smartphone Application to Yuma</h2>		
Background:			
<p>Designation of Yuma by the EPA as a PM₁₀ nonattainment area stipulates the necessity of informing local populations on current and forecasted air quality conditions, and providing a timely warning to sensitive populations regarding outdoor activities. In Nogales, Arizona (similarly designated as a PM₁₀ nonattainment area), ADEQ released a smartphone app to provide residents of Ambos Nogales with information regarding particulate matter pollution levels and air quality conditions. This app was modelled after a similar Maricopa County application, and can be found on both the Apple Store and Google Play. Creation of a similar application for the Yuma area aids in informing and warning area residents about air quality conditions.</p>			

Sponsors	Cost Breakdown	Starting – Ending Dates	Location
ADEQ	Total – \$20,000	2/17 – 9/17	Yuma, Arizona
	ADEQ – \$20,000		
Description:			
This project sought to create a mobile phone application to inform the public on the quality of air in Yuma. Expansion of a previously utilized application in Nogales.			
Project Outputs:			
<ul style="list-style-type: none"> • Development and implementation of a phone application. • A total of 890 informational rack cards distributed in the Yuma region. • The app had about 800 users around 2018 (3 years). 			
Project Outcomes:			
Achieved informing a greater number of Yuma residents on air quality conditions.			
Collaborating Entities:			
Local Yuma schools, libraries, government offices and other public places supported the distribution (rack cards/flyers) of the application and informational sessions.			
Next Steps:	<ul style="list-style-type: none"> • Bundle all individual Air Quality apps, including Yuma and Nogales, into a single app called Air Arizona. (Completed June 2019). • Keep updating all apps contained in the Air Arizona app. • Promote the app every time there is an opportunity. 		



Photos



Yuma Air Quality App Rack Card, ADEQ

	Identification and Cleanup Prioritization of Waste-Impacted Sites in Combination with a Solid Waste Management Education Campaign		
Background:			
<p>In the Arizona-Sonora border region, the location of waste-impacted sites, such as open dumps and other solid waste disposal areas, is largely unknown or unreferenced. This project addressed problems associated with uncharacterized waste-impacted sites through identification of these sites, and prioritization of their cleanup. With use of a geo-referencing program, these sites were identified and appropriate determinations as to site cleanup priority were determined based on established risk criteria. A solid waste management education campaign with components such as source separation training and community outreach complemented project efforts.</p>			
Sponsors	Cost Breakdown	Starting – Ending Dates	Location
Secretaria de Desarrollo Urbano y Ecología de Nogales Sonora	Total – \$61,645	8/19 – 1/21	Nogales, Sonora
	EPA's B2020 – \$40,000		
	Secretaria de Desarrollo Urbano y Ecología de Nogales, Sonora – \$21,645		
Description:			
<p>The project consisted of cleaning the 33 clandestine dumps to avoid the dragging of waste in the city of Nogales, Sonora, and Nogales, Arizona. In addition, the use of the mobile application for the detection of clandestine trash was promoted with the community.</p>			
Project Outputs:			
<ul style="list-style-type: none"> ● Cleaning of 33 illegal dumping sites. ● Creation of an inventory of abandoned building sites utilized as illegal waste dumps. ● 30% rise in complaints presented relating to illegal waste sites. ● Establishment and permanent operation of a temporary collection center for urban solid wastes that facilitates the final disposition of waste. ● Adoption of the “NO MORE ILLEGAL WASTE DUMPS” campaign as a public 			

<ul style="list-style-type: none"> ● policy and as a permanent action by the municipal government. ● Database of illegal dumping sites mentioned in this project and of abandoned properties or fields used for illegal waste dumps. ● Creation of registries of large urban solid waste generators and housing subdivisions, and their compliance in the management of solid waste. 	
Project Outcomes:	
<p>Establishment of the project objectives as part of the municipal government’s public policy was achieved, which will allow these actions to be taken permanently and not only during the current government term.</p>	
Collaborating Entities:	
<p>Secretaria de Desarrollo Urbano y Ecología Nogales, Sonora, Dirección de Servicios Públicos Municipales, Dirección de Imagen Urbana</p>	
Next Steps:	<ul style="list-style-type: none"> ● Address the lack of waste containers, to avoid increased presence of illegal dumping sites. ● Collaboration with the state government (CEDES, PROAES) for the regulation of big waste solid waste generators (special waste management), through informational campaigns and the establishment of an official process. ● Development of a permanent outreach campaign to engage other sectors into the special waste category. ● Continue with the identification and registration of abandoned sites used as illegal dumpsites.

Photos



Waste Management Information Promotion and Illegal Waste Disposal; SDUE

	<h2>Comprehensive Electronic Waste and Discarded Domestic Appliances Management Program</h2>		
<p>Background:</p> <p>Previous Border 2020 projects created informational materials and guides to assist in effective electronic waste collection and management programs. This project stipulated the actualization of these materials to include management of household appliances, addressing improper disposal of electronic materials and extending the life cycle of landfills in border communities.</p>			
Sponsors	Cost Breakdown	Starting – Ending Dates	Location
IAMM - Acciones para un Mundo Mejor	Total – \$49,325	4/20 – 4/21	Sonora Border Communities (Nogales, Agua Prieta, San Luis Río Colorado)
	EPA's B2020 – \$34,170		
	IAMM – \$15,155		
<p>Description:</p>			

Project adapted ADEQ's guidance for e-waste best management practices for use in cities along the US-Mexico border. The project worked with three municipalities in Sonora, Mex., to train staff and implement collection events. The project also includes a thorough tool for final reuse and proper disposal of electronic waste.

Project Outputs:

- Virtual training workshop held Dec. 7, 2020, to highlight appropriate disposal strategies.
- 709 participants attended six virtual training workshops that were held to highlight the e-waste recollection event manual and appropriate e-waste disposal (three were conducted at universities in Nogales, Agua Prieta and San Luis Rio Colorado; two were conducted with local Nogales staff, community organizations, and the general public; and one was conducted with high school students in Nogales).
- Three interviews with local news and media outlets were conducted to raise awareness and raise workshop participation.
- Development of a manual to assist in e-waste recollection events in Sonora.
- Informational material created for CEDES website: "Appropriate Disposal of Electronic Waste in Sonora," "Recycling Electronic Waste," and "Circular Economy and Comprehensive Management of E-Waste."
- Creation of six infographics to be distributed online across social media in order to raise awareness on the importance of e-waste management.

Project Outcomes:

Established a clear and organized mechanism to allow border cities to host e-waste recollection events, and to become more well informed on the importance of adequate electronic waste management. The support manual for e-waste recollection events will be available on the CEDES website, allowing any individual or community in Sonora to utilize it for e-waste reduction. These actions improve the environmental conditions in the Sonora - Arizona border region.

Collaborating Entities:

Regional Universities, Municipal Governments, CEDES, RECICLAN, IAMM A.C., SEMARNAT, SOLIMAR, numerous individuals (Armando Barajas, Lourdes Pando, America Katia Cid Bouchan)

Next Steps:

- Continue increasing the appropriate recollection, management, and final disposition of e-waste in the state.
- Incentivize the development of value chains for the use of sustainable materials.

	<p style="text-align: center;">Development of a Comprehensive Master Plan for the Management of Solid Waste, Including:</p> <ul style="list-style-type: none"> (a) Research of urban solid waste infrastructure lag and landfill locations (b) Provision of municipal solid waste collection, transport and disposal equipment (c) Establishment of at least one solid waste recycling plant project 	
Background:		
<p>Proliferation of open dump sites in border communities concerns both municipal authorities and citizens, exacerbated by a lack of adequate waste management practices in the region, and with previous investments, such as purchase of trash collection vehicles and landfill construction, insufficient to address the issue. As such, the State of Sonora conducted studies to identify optimal sites for new landfills. This project sought to update and communicate the results of these studies to relevant municipalities, ensuring the closure of clandestine sites and construction of priority landfills. Proper equipment was additionally required in many areas of the region to facilitate the collection, transport and disposal of non-recyclable solid wastes. Establishment of markets to support the operation of recyclable sorting facilities in communities with a large enough population and industry supported efforts in management of recyclable wastes, extending the life cycle of relevant landfills.</p>		
Project Developed	<p><i>Proposal of the “Law that regulates the production, management and final disposal of urban solid waste and special waste as well as single used plastic products in the State of Sonora”</i></p>	
Sponsors	Dates	Location
CEDES	April 11, 2021 – Submitted to Congress for approval	State of Sonora
Description:		
<p>The State of Sonora Ecology and Sustainable Development Commission collaborated with the proposal of the Sonora State Solid Waste Management Law.</p>		



As part of the Arizona-Sonora Environmental Strategic Plan for 2017 to 2021, five projects relating to wildlife were included to highlight the enduring collaboration between both states to protect the health of ecosystems in our shared borderlands region. As such, the Arizona Game and Fish Department (AZGFD) collaborated with various stakeholders such as Sonora’s Commission for Ecology and Sustainable Development (CEDES) in the scope of these projects to better protect key species of fauna in Arizona and Sonora. As the sponsors and key stakeholders for the projects included under wildlife in the Strategic Plan, AZGFD and CEDES should be contacted for further information regarding project specifics.

priority 1	Sonoran Pronghorn Population Monitoring in Arizona and Sonora	
Description:		
The Sonoran pronghorn is a subspecies endemic to the Sonoran Desert, listed as endangered in both the U.S. and Mexico. The first Sonoran pronghorn range wide survey in Arizona took place in 1992, and the first binational range wide survey in Sonora took place in 1993. Since the year 2000, binational range wide surveys have been conducted on a biennial basis in each country across the species’ historic range.		
Sponsors	Starting – Ending Dates	Location
AZGFD	2000 – Ongoing	Southwestern Arizona (Habitat south of Interstate-8) and Northwestern Sonora (El Pinacate Biosphere Reserve, Quitovac Subunit)
Project Outcomes and Outputs:		
<ul style="list-style-type: none"> • This is an ongoing project, however among its main outcomes is the successful long-term monitoring of the Sonoran pronghorn population. • SOPH Technical Reports. • Population survey conducted Feb. 18 – 21, 2020, in Pinacate and Quitovac subunits of Sonora established a total population estimate of 862 in Sonora. • Population survey conducted Nov. 21 – 29, 2020, south of I-8 in Arizona established a total population estimate of 257. 		
Collaborating Entities:		

USFWS, AZGFD, NPS, CEDES, CONANP - El Pinacate Biosphere Reserve	
Next Steps:	<ul style="list-style-type: none"> • Continue the long-term monitoring of the Sonoran pronghorn population across its binational range.

Photos:



Sonoran Pronghorn Population Surveys;CEDES

priority 2	Monitoring of the Black-tailed Prairie Dog Population in Arizona and Sonora		
Description:			
The black-tailed prairie dog is a priority subspecies for both the U.S. and Mexico. Black-tailed prairie dogs were reintroduced to Arizona in 2008, and since then, the population has gradually increased. Colonies are monitored every year and the habitat is managed to allow for colony expansion. Population monitoring was conducted in Arizona utilizing methods such as visual count, trapping and perimeter mapping. Currently, Sonora has one active black-tailed prairie dog colony; thus, future collaborations will focus on opportunities to implement conservation actions that will benefit the species in the long-term.			
Sponsors	Cost Breakdown	Starting – Ending Dates	Location
AZGFD	<p>Total* – \$3000</p> <p>*Estimated Supply Cost</p> <p>Federal Aid in Wildlife Restoration Act</p>	2008 – Ongoing	Northern Sonora (Cananea) and Southern Arizona (Las Cienegas National Conservation Area)

	(Pittman-Robertson Act) — \$3000		
Project Outcomes and Outputs:			
<ul style="list-style-type: none"> • The project is still ongoing, but some successes in Arizona include: the three satellite colonies that have been sustaining themselves on private land, and the four re-established colonies that seem to be following a slow upward trend as far as numbers of individuals and occupied acreage. • Black-tailed prairie dog technical reports and 2019 <i>Arizona Wildlife News Magazine</i> article. • Creation of black-tailed prairie dog habitat suitability layer in GIS. • Collaboration between CEDES and AZGFD to draft a work plan for conservation and binational population corridor establishment. • Visual counts were conducted annually in the spring and fall. • Trapping at reestablished colonies takes place semi-annually (i.e., spring and fall) to evaluate over-winter survival and juvenile survival, determine individual health, and, in the spring, assess the number of females reproductively active. • Perimeter mapping determined the growth of the colony by mapping the occupied acreage; in 2020, the total occupied acreage was 36.7 acres. • The minimum population size in 2020 was 364, and in 2019 it was 247. 			
Collaborating Entities:			
Las Cienegas National Conservation Area - Bureau of Land Management (BLM), Empire Ranch, Pima County, State Lands, private landowners, and CEDES.			
Next Steps:	<ul style="list-style-type: none"> • Continue monitoring the colonies in Arizona and reinitiate planning and coordination for future conservation actions in Sonora. 		

Photo:



Black-tailed Prairie Dog; AZGFD

	Improvements to the Mexican Grey Wolf Captive Breeding Program	
Project Description:		
<p>The Mexican grey wolf is a priority sub-species for Mexico and the U.S., which was previously considered extinct in the wild. The Mexican wolf captive breeding program started before 1980 with seven wolves, including five wild-caught individuals from Durango, Mexico. Captive-reared Mexican wolves were first released into the wild in 1998 within the Blue Range Recovery Area in Arizona and New Mexico. Binational collaboration has been key in terms of binational institutions participating in the captive breeding program, which has led to successful reintroductions in Chihuahua, Mexico, and in the Blue Range Recovery Area in the U.S., which has led to the establishment of a small yet healthy binational population. Improvements in breeding management protocols at the Centro Ecologico de Sonora further strengthened the species genetic diversity.</p>		
Sponsors	Starting – Ending Dates	Location
CEDES	2015 – Ongoing	Hermosillo, Sonora (Centro Ecologico de Sonora)
Project Outcomes and Outputs:		
<ul style="list-style-type: none"> • The project was successful for the species’ reproduction, with planned continuity to favor increased genetic diversity. • Establishment of multiple breeding pairs at the Centro Ecologico de Sonora, resulting in a 2017 population of 11 Mexican wolves at the center. • Transfer and exchange of male wolves to separate facilities in Mexico to ensure high genetic diversity among breeding pairs. 		
Collaborating Entities:		
USFWS		
Next Steps:	<ul style="list-style-type: none"> • Continue captive breeding efforts with a focus on increasing genetic diversity of offspring produced at facilities. 	

	Identification of Priority Areas for Jaguar Conservation in Southern Sonora	
Project Description:		
<p>Jaguars are a priority sub-species for Mexico and the U.S., with the northernmost component of their natural range extending into southern Arizona. Rehabilitation through livestock management measures reduces jaguar mortality relating to their interaction with cattle ranchers. Through collaboration between Arizona Game and Fish and CEDES, the project placed numerous camera traps to establish consistent jaguar monitoring in the Sierra de Sonora. Collaboration was previously conducted to increase the monitoring area with the organization PANTERA A.C. and CONANP in the Álamos, Sonora, region.</p>		
Sponsors	Starting – Ending Dates	Location
CEDES	2017 – Ongoing	Central Sonora (Sahuaripa, Sierra Bacatete, Alamos)
Project Outcomes and Outputs :		
<ul style="list-style-type: none"> • The phototraps placed across the Sierra de Sonora did not detect any local jaguar populations, thus requiring the continuance of continued monitoring for populations. • Obtainment of numerous photos and data via established photo traps in the Sierra de Sonora. 		
Collaborating Entities: CEDES, CONANP, AZGFD		
Next Steps:	<ul style="list-style-type: none"> • Continued monitoring efforts in the region to better understand local Jaguar populations. 	

	Bighorn Population Study in Sonora		
Project Description:			
<p>The bighorn sheep is a unique species in both Arizona and Sonora. Management and conservation of this species requires efficient and effective strategies such as controlled hunting. These strategies require monitoring and reproductive management by Mexico’s Wildlife Conservation Management Units (UMAs). In 2005, Sonora’s State Government Agency, Secretaria de Agricultura, Ganaderia, Recursos Hidraulicos, Pesca y Acuacultura (SAGARHPA) was delegated oversight of game species wildlife management from the federal government. The same year, the Desert Bighorn Sheep Conservation, Repopulation, and Sustainable Hunting State Program was established in Sonora. This project sought to survey the population health and management success of this species.</p>			
Sponsors	Cost Breakdown	Starting – Ending Dates	Location
SAGARHPA	Total – \$96,330	2005 – Ongoing	Northern Sonora (El Pinacate, Isla Tiburón, Sierra Pinta)
	Sonora State Government – \$96,330		
Project Outcomes and Outputs:			
<ul style="list-style-type: none"> • Monitoring efforts were successful in building a base of knowledge to establish the species' permanence in the region, in addition to the program's continuity in Sonora. • Surveys conducted in Sonora resulted in a population of 4,551 bighorn sheep in the wild and 3,762 in private areas, with a total population estimate of 8,313 individuals in 2019. • Deployment of 45 satellite GPS collars on wild bighorn sheep in 2019 to contribute to a better understanding of management and more detailed population data in Sonora. 			
Collaborating Entities:			

Secretaria de Medio Ambiente y Recursos Naturales / Direccion General de Vida Silvestre, Unión Ganadera del Estado de Sonora, Consejo Consultivo de la Vida Silvestre, PRODUCERS, SAGARHPA, PATROCIPES	
Next Steps:	<ul style="list-style-type: none"> • Continue monitoring species population and habitat.

In addition to the 15 prioritized projects described above, the ASESP included 14 projects that, as stated in the ASESP, in the case of time and resources, would be developed. In this context, the following projects under Waste and Air were developed during the timeframe of the ASESP:

Junkyard Management Plan

Within the Border 2020 request for proposals in 2019, a project promoted by the municipality of Nogales, Sonora, through the Directorate of Ecology was selected. The project began in February 2020 and will conclude in August 2021. Total project costs are \$ 32,550 (\$ 21,197 from Border 2020, and \$ 11,353 leveraged by the City of Nogales).

The objective of the project is to implement the published end-of-life vehicle guide, created by USEPA and SEMARNAT, in the city of Nogales, Sonora. The project created an inventory of disposal sites and trained junkyard workers on good junkyard management practices. The municipality will work with local stakeholders to identify future actions to improve the conditions in the existing industry in the Ambos Nogales region. The project managed to achieve several outputs:

- The development of an inventory of 121 junkyard sites in Nogales, Sonora.
- The creation of an advisory tool to assess and measure compliance at relevant sites.
- The creation and dissemination of a junkyard best practices manual.
- The evaluation and recommendation of practices in 28 identified sites.
- Development of four training workshops in Nogales, Sonora.

The end result of the project will be to establish collaboration with several private entities to manage hazardous waste, in addition to creating a database of such information.

Photos



November Junkyard Training Workshops & Junkyard Site Assessment Visit; SDUE Nogales

Emissions Inventory for Nogales, Somerton and Yuma, Arizona

Within the 2017 – 2021 period of the ASESP, multiple emissions inventories (EIs) were created in the Arizona-Sonora border region, particularly in the Nogales and Yuma/Somerton regions. Inventories for the Nogales region focused on the Nogales PM_{2.5} nonattainment area, additionally containing emissions inventories for NO_x, SO_x, VOCs and NH₃. The years inventoried for the Nogales PM_{2.5} SIP include 2017, 2026 and 2032. In the Yuma PM₁₀ nonattainment region, which includes Somerton, Arizona, numerous emissions inventories have been conducted during the 2017 – 2021 ASESP period.



Ambos Nogales; ADEQ

Closing

In spite of the challenges the world has been facing in recent times, the ties between Arizona and Sonora remain strong and resilient. Beyond the outputs and outcomes obtained through the five-year implementation period of the Arizona-Sonora Environmental Strategic Plan, this Plan achieved to reinforce the existing solid binational collaboration between both states, through a joint planning mechanism. On one side the Plan identified environmental priorities, and on the other, it facilitated the development of solutions to those priorities. This effort is another step toward the road to continuous collaboration, which seeks to improve the environmental conditions and public health of the residents on both sides of the Arizona-Sonora mega-region.

