Center for COLORADO RIVER Studies

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The State of the Colorado River Delta: Effects of Environmental Water Deliveries, 2014-2025

Karl W. Flessa[1], Martha Gómez-Sapiens[1], Eduardo González-Sargas[2] and Roberto Real Rangel[3]

[1]Department of Geosciences, University of Arizona, Tucson, AZ 85721 USA
[2]Department of Biology, Colorado State University, Fort Collins, CO 80523 USA
[3]The Nature Conservancy, Mexicali, México

Abstract

Ever since the pulse flow of 2014, a binational team of scientists have been monitoring the hydrological, biological and social effects of environmental water deliveries to the Colorado River Delta mandated by Minutes 319 and 323 of the U.S.-Mexico Water Treaty of 1944.

The pulse flow demonstrated the political, logistical, and hydrological feasibility of delivering environmental water. The river briefly reached the sea, groundwater levels rose, the river corridor became greener, and local communities celebrated the return of the river. These effects, however, were short-term.

Four smaller flows delivered from 2021 to 2025 directly to the main channel downstream of the dry reaches resulted in a flowing portion of the river, higher groundwater levels, revitalization of marshlands and invasive

Resumen

Desde el flujo pulso de 2014, un equipo binacional de científicos ha estado monitoreando los efectos hidrológicos, biológicos y sociales de las entregas de agua ambiental al Delta del Río Colorado, establecidas en las Actas 319 y 323 del Tratado de Aguas de 1944 entre México y Estados Unidos.

El flujo pulso demostró la viabilidad política, logística e hidrológica de entregar agua para fines ambientales. El río llegó brevemente al mar, los niveles de agua subterránea aumentaron, el corredor ripario se volvió más verde y las comunidades locales celebraron el regreso del río. Sin embargo, estos efectos fueron de corta duración.

Cuatro flujos más pequeños, entregados entre 2021 y 2025 directamente al cauce principal aguas abajo de los tramos secos, generaron una porción del río con flujo continuo, incrementaron los niveles de agua subterránea,

Minute 319 Pulse flow release from Morelos Dam, March 23, 2014
Credit: Karl Flessa

Abstract (continued)

vegetation, and provided local recreation opportunities. These effects were also short-lived.

Native vegetation was planted and thrived when flows irrigated three prepared restoration sites. Bird abundance and diversity increased in these restored areas. To date, 559 hectares (1,381 acres) of riparian habitat have been restored. These sites require regular irrigation and maintenance. Visitor programs connect the sites to the local communities.

Restoration sites are not self-sustaining. They require continuing irrigation, maintenance and monitoring. We estimate that annual irrigation deliveries of 8.5 million cubic meters (6,890 acre-feet) are needed to preserve existing sites. Additional water for the environment should be directed first to new or expanded restoration sites, then to additional in-channel flows.

Sustaining binational success requires a commitment of water and funding. In the Delta, restoration sites are not self-sustaining.

Resumen (continuado)

revitalizaron zonas de humedales y vegetación —incluida vegetación invasiva— y ofrecieron oportunidades recreativas para las comunidades locales. Estos efectos también fueron temporales.

Se plantó vegetación nativa que creció cuando los flujos irrigaron tres sitios de restauración previamente preparados. La abundancia y diversidad de aves aumentaron en estas áreas restauradas. Hasta la fecha, se han restaurado 559 hectáreas (1,381 acres) de hábitat ripario. Estos sitios requieren riego y mantenimiento regulares. Programas de visitantes vinculan estos espacios con las comunidades locales.

Los sitios de restauración no son autosostenibles. Requieren riego continuo, mantenimiento y monitoreo. Estimamos que se necesitan entregas anuales de riego de 8.5 millones de metros cúbicos (6,890 acres-pie) para conservar los sitios existentes. El agua adicional destinada al medio ambiente debería dirigirse primero a sitios nuevos o mantenimiento a la restauración y posteriormente a flujos adicionales dentro del cauce del río.

Introduction

No matter how the Basin States resolve their differences over post-2026 management of the Colorado River, the U.S. has a treaty obligation to provide Mexico with a share of the River's water. The current Minute 323 agreement prescribes how Mexico shares in shortages, how Mexico can store a portion of its allocation in Lake Mead and how the U.S., Mexico and a coalition of non-governmental organization provide water to benefit the Colorado River Delta's environment. Minute 323 expires at the end of 2026.

We are four scientists who have been engaged in monitoring the effects of environmental flows delivered to the Colorado River Delta as stipulated by Minute 323 of the U.S.-Mexico Water Treaty of 1944. Continuing this binational commitment to environmental flows after 2026 depends, at least in part, on the success of the Minute 323 environmental flows.

We judge that Minute 323's provision of water for the Delta environment—and funding for riparian restoration—has been a success.

The Pulse Flow of 2014 demonstrated the feasibility of the restoration effort. Subsequent creation, irrigation and maintenance of 559 hectares (1,381 acres) of riparian vegetation attracted birds and other wildlife. Deliveries to the river channel raised water tables, supported existing vegetation and increased the length of the flowing river. Local communities have benefitted from recreational, educational and job opportunities.

Sustaining this binational success will require a renewed commitment of water and funding by the United States, Mexico and non-governmental organizations. In the Delta, restoration sites are not self-sustaining.

Here, we review the effects of the environmental water deliveries mandated by Minutes 319 (2013-2017) and 323 (2018-2026) of the U.S.-Mexico Water Treaty of 1944. We make recommendations for future support of water deliveries for restoration activities in designated sites and in the river channel, based on the lessons learned during this 12-year period.

Our priorities for a future agreement are:

- 8.5 million cubic meters (6,890 acre-feet) per year to maintain existing restoration sites.
- A common pool of federal and NGO water for the environment, allocated according to restoration goals.
- Funding for restoration and scientific monitoring.
- Assessment and prioritization of future restoration opportunities.

Background

Figure 1 shows the places named in this report. Information used in this review is from two sources:

1. Biennial monitoring reports for Minutes 319 and 323 posted to, or in preparation for, the International Boundary and Water Commission (IBWC), and
2. Peer-reviewed scientific articles published, in press or in preparation. See Appendix.

Biennial monitoring reports to the IBWC are based on observations or measurements made by members of the Binational Science Team (BST) since 2014. The BST consists of more than 40 scientists from agencies, universities and non-governmental groups in both the U.S. and Mexico, including authors of this paper. Team members follow established and agreed-upon protocols for the assessment of hydrological, biological and social responses in the Delta. A list of the indicators measured is in Table 1. The teams compare conditions “before restoration” and “after restoration” and compare conditions within restoration sites (“treatment”) to those in unrestored “control” sites adjacent to restoration sites. Wherever possible, analyses assess the statistical significance of differences found in before-after or treatment-control comparisons.

Much has been learned and published about the Colorado Delta since the Glenn, et al. review in 2001. The 60 publications listed in the bibliography appended here focus on contributions since 2013 and scientific efforts surrounding Minutes 319 and 323. Most of the authors of the publications listed are or have been members of the BST.

Environmental Water Deliveries

Environmental water deliveries to the Colorado River Delta river corridor occurred as (1) in-channel flows, those delivered directly to the main channel, or (2) as direct deliveries to irrigate restoration sites. In-channel deliveries, sometimes referred to as “federal flows”, were delivered to meet the obligations of the federal governments of the U.S. and Mexico. Flows delivered to restoration sites, referred to as “base flows” in Minutes 319 and 323, were provided by non-government organizations.

In-channel flows included the pulse flow of 2014 and deliveries in 2021, 2022, 2024 and 2025. Because the pulse flow differed greatly in its delivery points, magnitude and duration from the in-channel flows delivered later, we review the pulse flow separately here.

The 2014 Pulse Flow

The pulse flow began on March 23, 2014 (title page photo). Approximately 130 million cubic meters (mcm) (105,000 acre-feet, af) were delivered to the main channel at Morelos Dam and at two downstream gates. Most of the pulse flow volume was delivered at Morelos Dam. An initial peak flow was delivered in an attempt to mimic a spring flood, followed by slowly diminishing flows until the pulse flow ended on May 18, 2014 for a total of 57 days.

Hydrologic effects

The pulse flow inundated approximately 1,600 ha (4,000 ac) of the main channel and adjacent terraces of the Colorado River Delta, achieving lateral and longitudinal connectivity along the entire river from Morelos Dam to the Gulf of California for the first time since 2001.

The pulse flow’s discharge and volume decreased downstream because of infiltration into the groundwater. Ninety-one percent of the pulse flow infiltrated within the first 61 river-km (38 river-mi) of the channel below Morelos Dam. Within two months of the pulse flow’s end, approximately 122 mcm (99,000 af), or about 94% of the pulse flow, infiltrated into the groundwater. About 1.6 mcm (1,300 af), or about 1% of the pulse flow, reached the upper estuary as surface flow. The remaining 5% evaporated, persisted for a short time as standing water or was taken up by plants.

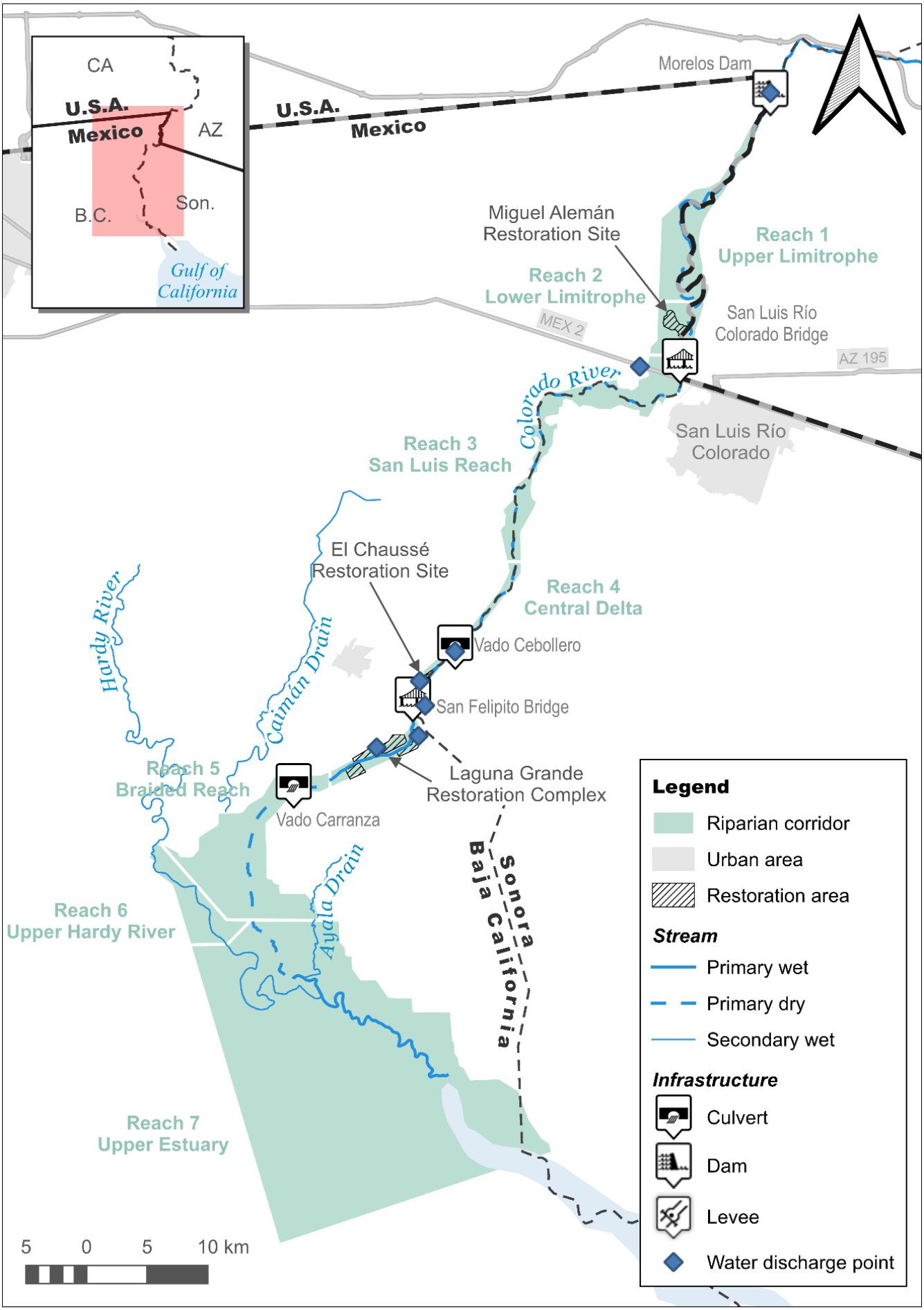

Figure 1. Map of delta showing places named in this report.

Table 1. *Environmental indicators monitored.*

Feature Monitored	Method
Hydrologic indicators	
Water delivered to channel	Daily measurement of discharge at gate
Water delivered to restoration sites	Daily measurement of discharge at gate
Flow rate in channel	8 measurement stations along channel
Length of flowing river	Satellite imagery, flow rate & salinity at 8 discharge measurement stations
Area flooded	Satellite imagery; hydrologic model
Water quality (salinity, temperature, pH oxygen, total dissolved solids)	20 measuring stations along the main channel, lagoons in restoration sites & Hardy River.
Soil salinity	Lab analysis of soil samples from three sampling points in Reach 4.
Depth to groundwater	122 measuring wells in the restoration sites & unrestored floodplain.
Biological indicators	
Area restored by habitat type	Annual reports from restoration teams
Vegetation composition & structure (cover by species, density of trees, vertical structure & herbaceous presence)	Annual field surveys (2018-2021) and every four years (since 2022), 212 plots in restoration sites & 33 in control sites.
Vegetation health	Monthly satellite and annual drone "greenness" (EVI2 & NDVI)
Vegetation germination & recruitment	Annual field surveys during environmental flows in 10 sites
Vegetation & physical change	Ground & aerial repeat photography, 14 sites
Riparian birds (species & abundance)	Surveys three times per year, 272 sites
Marsh birds (species & abundance)	Surveys twice per year, 169 sites
Waterbirds (species & abundance)	Surveys 4 times per year, 77 sites
Waterbird colonies (number of adults, active nests, eggs & juveniles)	Surveys twice during the breeding season 22 sites.
Other wildlife (species & behavior)	17 camera traps in three restoration sites
Fish (species & catch per unit effort)	Surveys 4 x per year in 6 sites in Reach 7.
Social indicators	
Social engagement (number of visitors)	Records in restoration sites.
Community events (number of events)	Records in restoration sites & local communities.
Recreation (number of visitors)	Surveys in flooded sites
Job creation (number of jobs)	Local FTE jobs created in restoration sites.
Economic impact	Payroll

Groundwater elevations rose as much as 9 m (30 ft) locally, decreasing away from the river channel. Groundwater levels returned to pre-pulse levels within 6 months, as the mound in groundwater elevation created by the pulse flow dissipated into the regional aquifer.

Biological effects

The pulse flow resulted in a 17% increase in vegetation health and 14% in cover throughout the riparian corridor in 2014. The increase in cover was largely due to the growth of annual and marsh plants, not trees. After the pulse flow, vegetation health and cover decreased steadily, with areas outside restoration sites falling below 2013 levels of health and cover by 2017.

Flooding of restoration sites that had been cleared, graded, seeded and planted resulted in successful establishment of native riparian shrubs and trees mixed with non-native salt cedar. Salt cedar was able to establish under any conditions. Sites were maintained with subsequent water deliveries (see below).

Social effects

Celebrations atop Morelos Dam on March 30, 2014, brought together federal officials, representatives of states, agencies, non-governmental organizations and residents of both Mexico and the United States. The event commemorated the broad partnership dedicated to the environmental health of the Colorado River Delta and its communities. Media coverage was extensive and overwhelmingly positive. Some coverage and on-site comments questioned the diversion of the water away from agricultural uses in both countries.

Flooding beneath the Highway 2 bridge near San Luis Río Colorado, Sonora, brought residents to an impromptu celebration of swimming, splashing, picnicking and music that marked the river's return.

Comments

The pulse flow of 2014 demonstrated that riparian restoration of the Colorado River Delta was politically, logistically and hydrologically possible, but also that it had some limitations.

Bypassing the high infiltration area of the first 60 river-km (38 river-mi) is necessary for the most effective use of environmental flows.

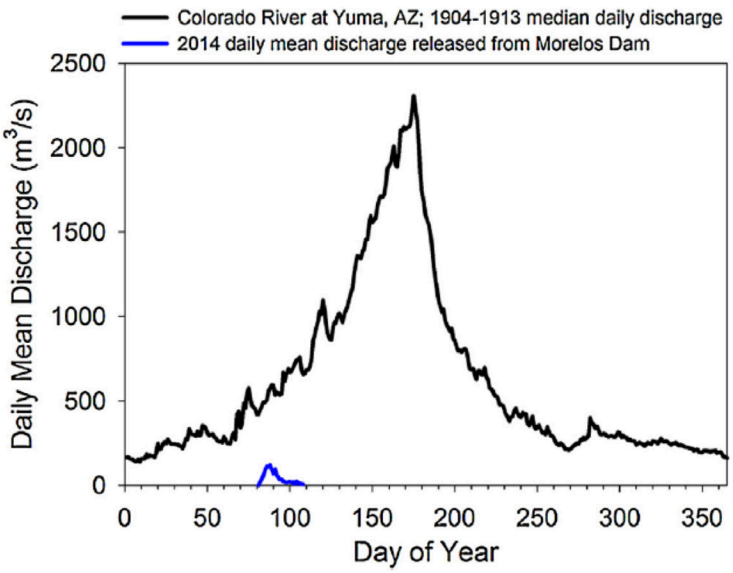

Figure 2. Comparison of the hydrograph of the 2014 Minute 319 Pulse Flow (blue line) with median daily discharge of the Colorado River at Yuma, AZ from 1904-1913 (black line). Figure credit: Mueller et al. (2017).

The natural spring flow of the Colorado River was more than 20 times the discharge of the 2014 pulse flow (Fig. 2) and also delivered large volumes of sediment to the delta plain and estuary. The pulse flow mimicked the shape, though not the timing or magnitude of the natural spring flood.

The 2014 pulse flow proved insufficient for the scouring, channel migration and sedimentation needed to prompt natural restoration of native vegetation. Mechanical clearing, topographic contouring and active planting in restoration sites are necessary for successful restoration. Continuous connection of the river to the Gulf of California would require periodic dredging of the channel as well as continuing flows.

In-Channel Flows, 2021, 2022, 2024, 2025

The total allocation for in-channel flows is 171 mcm (140,000 af). Slightly less was delivered because of drought conditions.

In-channel flows were released in 2021, 2022, 2024, 2025 and are underway in 2026 (Fig. 3). Water was routed through irrigation canals to Reach 4, bypassing dry segments in Reaches 2 and 3. Although volumes, start dates, and durations varied slightly, all deliveries

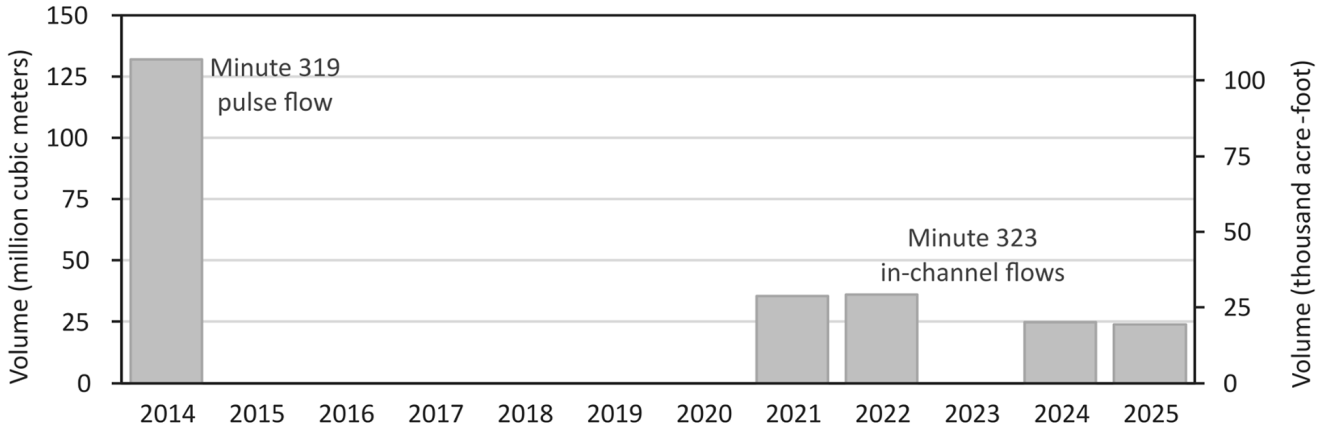

Figure 3. Water released to the channel of the Colorado River in its delta: 2014-2025. A major pulse flow in 2014 and smaller releases in 2021, 2022, 2024 and 2025 - a similar small flow is underway in 2026.

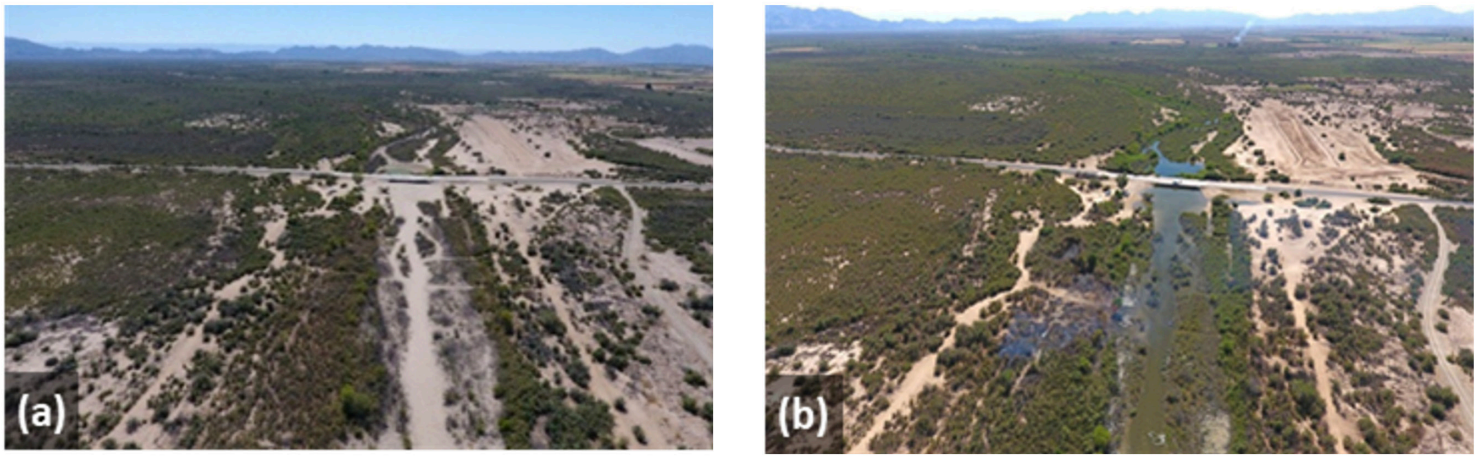

Figure 4. River channel at Vado Carranza, viewed downstream. (a) Dry channel, June 2023, (b) Flooded channel, June 2025. Vegetation is dominated by salt cedar. Photo credits: Martha Gómez-Sapiens.

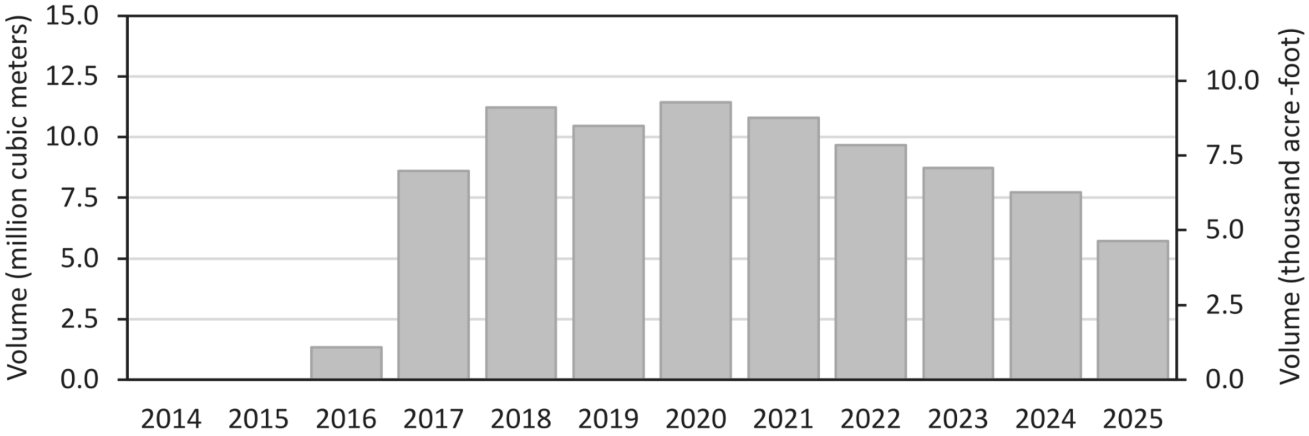

Figure 5. Water volumes delivered to restoration sites, 2016-2025.

were designed to replicate, in miniature, the natural spring hydrograph pattern—rising limb, peak flow, and falling limb.

Hydrological Effects

In-channel deliveries raised surface water levels in Reach 4 by approximately 50 cm (20 in). This increase reconnected the main channel with lagoons in the Laguna Grande complex and flowed over the Esquivias levee at the end of the reach. The flows extended the wetted river by 24 river-km (15 river-mi). A brief reduction in salinity was recorded in the upper estuary during peak flow days.

Flows were not sufficient to inundate adjacent floodplains in Reaches 4 and 5. However, shallow, recurrent flooding covered approximately 165 ha (407 ac), including 43 ha (105 ac) at the transition between riparian and estuarine zones in Reach 7. Roughly 54% of the in-channel deliveries infiltrated or evaporated before reaching the upper estuary, averaging 1 mcm of loss per river kilometer.

Groundwater elevations in Reach 4 rose up to 1 m (3.3 ft) near restoration sites but returned to pre-flow levels within one month. In Reach 5, groundwater showed a sustained increase, with cumulative gains of 1.5 m (5 ft) between 2021 and 2025. A similar but smaller trend was observed in upper Reach 7.

Biological Effects

In-channel deliveries triggered a temporary green-up of salt cedar along channel margins (Fig. 4) and by marsh species such as cattail and bulrush at the transition between riparian and estuarine zones in Reach 7. Vegetation greenness declined once surface water receded. Low survival of manually dispersed cottonwood seeds documented limited success in establishing riparian trees. No measurable benefits for riparian bird communities were observed.

Social Effects

During summer releases, residents of nearby communities engaged in swimming, fishing, and picnicking—primarily at Vado Carranza, where visitors also received information on restoration efforts. Increased water levels enabled guided boat trips within the Laguna Grande restoration complex.

Comments

Maintaining benefits requires continuing in-channel flows. Implementing in-channel deliveries required complex binational coordination for planning, operations, and monitoring. Constraints on the timing and volume of the federal commitments, irrigation canal capacities and flow limits on delivery gates restricted the range and character of the in-channel deliveries.

Future in-channel deliveries should focus on areas where benefits would be apparent. Deliveries to Reach 4 would focus flows where restored riparian habitat and groundwater recharge are achievable. Deliveries to Reach 5 would maintain channel wetness to support marsh vegetation.

Water Deliveries to Restoration Sites

Water deliveries to restoration sites during Minute 319 totaled 71 mcm (57,621 af). Water deliveries to restoration sites allocated under Minute 323 totaled 86.3 mcm (70,000 af). Deliveries have been reduced slightly due to drought conditions. Deliveries from 2016 through 2025 are shown in Figure 5.

Water deliveries to restoration sites were allocated by the Raise the River/Revive el Rio coalition of non-governmental organizations that committed water per Minutes 319 and 323. Restoration sites were established in Reach 2 at the Miguel Alemán site by Pronatura Noroeste. (Fig. 6)

Figure 6. Miguel Aleman restoration site in May 2021. Photo credit: Martha Gómez-Sapiens.

Figure 7. El Chaussé restoration site in June 2023 (left), compared to unrestored vegetation (right), mostly salt cedar, at a nearby control site in October 2017. Photo credits: Martha Gómez-Sapiens.

Restauremos el Colorado established the El Chaussé site in Reach 4. (Fig. 7). The Sonoran Institute established a complex of restoration sites at Laguna Grande. (Fig. 8).

Water was delivered directly to restoration sites managed by Pronatura Noroeste, Restauremos el Colorado and the Sonoran Institute. Water deliveries to restoration sites were conveyed via the Mexicali Valley irrigation system and facilitated by the irrigation district and modules.

Water deliveries peaked between 2018 and 2020 at approximately 11 mcm (8,900 af) per year, followed by a gradual decline through 2025 (Fig. 5).

Hydrologic effects

Monthly water deliveries often deviated from the requests made by the site managers. Groundwater levels increased by as much as 1.5 m (5 ft) in the immediate vicinity of the restoration sites. Groundwater levels in the El Chaussé and Laguna Grande sites increased during irrigation of the surrounding agricultural areas.

Part of the volume delivered monthly to El Chaussé site is used to increase the water level in the former river meander within the restoration site, after which it is released to the river's main channel. This resulted in 22 river-km (14 river-mi) of free-flowing river in Reach 4.

Biological Effects

As of December 31, 2025, a total of 559 hectares (1,381 acres) of riparian vegetation have been restored, including cottonwood-willow, mesquite bosque, open water/marsh and upland. Restoration crews planted

Figure 8. CILA site within the Laguna Grande complex of restoration sites in April 2017. Photo credit: Martha Gómez-Sapiens.

more than 250,000 trees sourced from on-site nurseries. Assisted restoration (clearing, contouring, planting, irrigation and weeding) is most effective where groundwater levels are high and where non-native and invasive native vegetation is removed and landscapes are graded. Irrigation needs in restoration sites decreased as vegetation matured (Fig. 5).

Vegetation health and cover are consistently higher in restoration sites than in surrounding, unrestored areas. Vegetation health and cover decreased steadily in unrestored areas from 2014 through 2025.

Mortality from fires and interruptions of irrigation flows caused patches of dead trees or bare ground, and recolonization of invasive species in some sites. These

disturbed areas required re-planting and additional water. Such recovery-planting typically requires 115% of normal irrigation deliveries.

Riparian forest birds were more abundant and diverse in restoration sites than in surrounding unrestored areas. Wetland birds became more abundant over time in the restoration sites of Reach 4 where marshes and vegetation were present.

Beavers are present in several sites within the restored areas of Reach 4. Their dam-building created aquatic habitat and increased groundwater infiltration.

Multiple videos confirm the presence of bobcats, coyotes and ten species of birds and mammals listed under the U.S. Endangered Species Act and Mexico's NOM-059 SEMARNAT 2010.

No consistent trends in fish population abundance or diversity in the upper estuary (Reach 7) were observed from 2014-2025. No studies of aquatic life were conducted in other reaches.

Social effects

The establishment, expansion and maintenance of restoration sites provided jobs for nearby residents.

All three sites established visitor activities for the local communities. The Laguna Grande site has a visitor center (Fig. 9). The Raise the River/Revive el Rio coalition, and its member organizations, used the sites for fundraising activities and for annual community-focused festivals.

Comments

Although irrigation needs in restoration sites decreased as vegetation matured, irrigation and maintenance are still needed to sustain restoration. Fire, disease, interruptions in irrigation and other disturbances require re-planting. Restoration sites are not self-sustaining.

Discussion

The 2014 pulse flow was important for binational environmental policy and its implementation in the Colorado River Delta. The pulse flow proved that water could be delivered to the Delta and that its delivery would have environmental benefits. It was a singular event – it should not be repeated. We have since learned better ways to use the available water to maximize environmental benefits.

Deliveries to the main channel of the Colorado River made up two-thirds of the commitment under Minutes 319 and 323. The 2014 pulse flow was Minute 319's commitment to in-channel flows while the two-thirds obligation in Minute 323 are being delivered in five events. In-channel deliveries restore flow in the river, at least for a brief period and in a limited stretch of the river. In-channel flows and elevated groundwater support both the dominant, invasive salt cedar as well as remnant stands of native vegetation. Channel flooding provides local communities with opportunities for recreation. In-channel deliveries require little preparation, are relatively inexpensive to deliver and can vary in duration. Their potential for substantial environmental benefit has yet to be fully explored.

Deliveries to restoration sites were one-third of the total allocation of environmental water under Minutes 319 and 323. Restoration of riparian and associated habitats works best when sites are cleared, graded, planted, irrigated and maintained. Water can now be delivered directly to such restoration sites, including those down-

Table 2. Summary comparison of deliveries to restoration sites and in-channel deliveries, 2014-2025.

Deliveries to restoration sites	In-channel deliveries
High site preparation costs	Low preparation costs
High maintenance costs	No maintenance costs
Relatively small amount of water	Relatively large amount of water
Long-term commitment of water	Short or long-term commitment of water
Major environmental benefits observed	Few environmental benefits observed

stream of the dry reaches. 559 hectares (1,381 acres) of cottonwood-willow, mesquite bosque, open water/ marsh and upland habitat attract birds and other wildlife and provide jobs and opportunities for community engagement. Sites are costly to prepare and maintain and require a long-term commitment of water. Restoration sites are now attractive features of the landscape.

Conclusions

The 2014 pulse flow demonstrated the commitment of Mexico, the U.S. and non-governmental organizations to provide water for environmental benefits in the Colorado River Delta. Hydrological, biological and social results on-the-ground proved that restoration was possible.

In-channel deliveries have resulted in 63 river-km (39 river-mi) of flowing Colorado River, community recreation and higher groundwater levels downstream of the restoration sites. Efforts are continuing to re-design and monitor in-channel flows so that they yield maximum benefits.

Restoration of parts of the riparian corridor of the Colorado River Delta has been successful. Restoration teams have learned effective techniques for land-clearing, planting, irrigation and maintenance of restoration sites. Birds and other wildlife have been attracted to the restored riparian habitats. Restoration sites require continuing irrigation and maintenance: they are not self-sustaining. Community engagement has been successful and is ongoing.

Recommendations

Based on this science-based review and analysis of the effects of the Minute 319 and Minute 323 deliveries of environmental water, we make the following recommendations for a future agreement:

- Continue financial support for the maintenance of existing restoration sites and for monitoring the effects of water deliveries. Restoration requires more than water.
- Assess the availability, suitability, preparation cost, water needs and management cost of potential new restoration sites. Such an assessment is needed before committing funds or water to expanded restoration activities.
- Provide a common pool of environmental water. Designating a common pool of available water from both federal partners and NGOs will greatly increase the efficacy of allocating water to the environment.

Priorities for water allocations

1. Preservation water deliveries are deliveries sufficient to maintain the existing restoration sites, thus preserving the accomplishments made under Minutes 319 and 323. Restoration sites are not self-sustaining- they require continuing irrigation and maintenance.

Preservation deliveries also include water needed to irrigate re-planting after disturbances within sites. Disturbances such as fire, pests, plant diseases and accidental interruption of irrigation flows may cause extensive mortality. Like initial plantings, recovery plantings require more water than established vegetation.

We propose Preservation Deliveries equal to the average of past three years of flows to restoration sites plus an additional 15% to support any needed re-restoration following disturbances. Total annual preservation deliveries should equal approximately 8.5 mcm (6,890 af).

2. Development water. Development water would support additional restoration sites that have been vetted for their suitability, availability, water needs, and have secured funding for their preparation and maintenance. Assigning development water to new restoration sites would be a commitment of water to preserving the site into the future.

3. In-Channel flows. In-channel flows would support such beneficial goals as new aquatic habitats, recreation sites, increased flooding, flows in the limitrophe (Reaches 1 and 2) or other activities. In-channel flows could be short term or long-term commitments of environmental water. In-channel flows should be designed to test hypotheses about how to deliver specific, measurable benefits. Proposals for in-channel flows should be solicited and evaluated by the Environment Working Group.

Authors' note

This paper is based on a report submitted to Centro Luken in January 2026. Its use here is with Centro Luken's permission. The observations, analyses and opinions expressed here are those of the authors and do not necessarily reflect those of Centro Luken. The authors are members of the Binational Science Team that works under the auspices of the Environmental Working Group of the International Boundary and Water Commission (IBWC). The Binational Science Team has been monitoring the effects of water deliveries to the Colorado River Delta since 2014. The observations, analyses and opinions expressed here are those of the authors and do not necessarily reflect those of the other members of the Binational Science Team, the Environmental Working Group or the IBWC.

Appendix

Recently published and papers in preparation produced by members of the Minutes 319 and 323 Binational Science Team.

Bark, E., Frisvold, G., and Flessa, K.W. (2014) The role of economics in transboundary restoration water management in the Colorado River Delta. Water Resources and Economics 8: 43-56. https://doi.org/10.1016/j.wre.2014.10.006

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Figure 9. Gabriella González Olimón explains Colorado River Delta restoration efforts at Sonoran Institute's Laguna Grande Interpretive Center. Photo credit: Bill Hatcher/Sonoran Institute.