



A history of the 2014 Minute 319 environmental pulse flow as documented by field measurements and satellite imagery



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ABSTRACT

As provided in Minute 319 of the U.S.-Mexico Water Treaty of 1944, a pulse flow of approximately 132 million cubic meters (mcm) was released to the riparian corridor of the Colorado River Delta over an eight-week period that began March 23, 2014 and ended May 18, 2014. Peak flows were released in the early part of the pulse to simulate a spring flood, with approximately 101.7 mcm released at Morelos Dam on the U.S.-Mexico border. The remainder of the pulse flow water was released to the riparian corridor via Mexicali Valley irrigation spillway canals, with 20.9 mcm released at Km 27 Spillway (41 km below Morelos Dam) and 9.3 mcm released at Km 18 Spillway (78 km below Morelos Dam). We used sequential satellite images, overflights, ground observations, water discharge measurements, and automated temperature, river stage and water quality loggers to document and describe the progression of pulse flow water through the study area. The rate of advance of the wetted front was slowed by infiltration and high channel roughness as the pulse flow crossed more than 40 km of dry channel which was disconnected from underlying groundwater and partially overgrown with salt cedar. High lag time and significant attenuation of flow resulted in a changing hydrograph as the pulse flow progressed to the downstream delivery points; two peak flows occurred in some lower reaches. The pulse flow advanced more than 120 km downstream from Morelos Dam to reach the Colorado River estuary at the northern end of the Gulf of California.

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1. Introduction

From Morelos Dam on the U.S.-Mexico International Boundary, the Colorado River Delta riparian corridor extends 120 km southwest to the river's estuary in the lower delta (Fig. 1). River flows to the delta between 1896 and 1921 averaged 20.7 billion cubic meters (bcm) annually (Fradkin, 1996). Although substantial river flows and even occasional floods continued to reach the delta after completion of Hoover Dam in 1932 (Ramirez, 1990), flow to the delta was significantly reduced after completion of Glen Canyon Dam in 1964 (Glenn et al., 2001; IBWC, 2012a). From 1984 through 1999,

when upstream reservoirs were full and excess water was released downstream, the annual average flow to the delta was 5.2 bcm (Glenn et al., 1999). Regional drought conditions have prevailed since 2000, with little or no water being released for in-channel flow into Mexico (IBWC, 2012a), though some of the water diverted for irrigation and domestic use in Mexico is eventually returned to the lower reaches of the river (Cohen, 2005).

To promote collaboration on water conservation and management and to address binational concerns about the environmental condition of the delta riparian corridor, the two sections of the International Boundary and Water Commission (IBWC) signed Minute No. 319 (Minute 319), Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja Cal-

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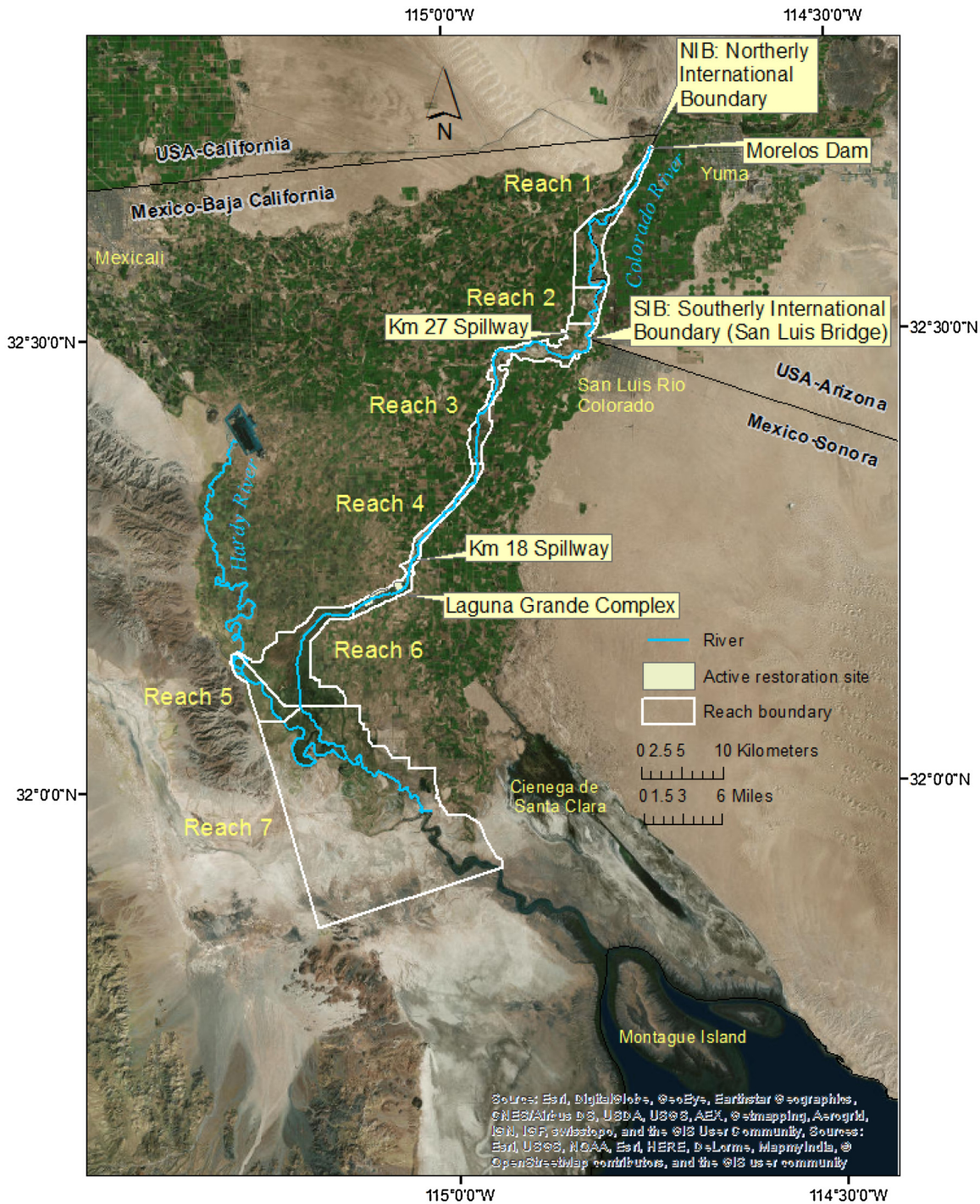


Fig. 1. The Colorado River Delta riparian corridor study area. Map prepared by Martha Gomez-Sapiens.

ifornia, on November 20, 2012 (IBWC, 2012b). Section III.6 of the minute authorized the Water for the Environment and ICMA/ICS Exchange Pilot Program (ICMA – Intentionally Created Mexican Allocation; ICS – Intentionally Created Surplus), stipulating that the pilot program “will arrange for the means to create 158,088 acre-feet (195 million cubic meters [mcm]) of water for base flow and pulse flow for the Colorado River Limitrophe and its delta by means of the participation of the United States, Mexico, and non-governmental organizations.”

Under provisions of the Minute, the IBWC Commissioners directed that a Delivery Plan be developed which would “include a schedule of monthly flows, delivery points and volumes in an

amount of approximately 105,392 acre-feet (130 mcm) for pulse flow and 52,696 acre-feet (65 mcm) for base flow.” The Delivery Plan for the pulse flow was prepared by a binational Environmental Flows Team and approved by the Commissioners in early March 2014 (Cothrun, 2014). In addition to preparing the Delivery Plan, the Environmental Flows Team worked with scientists and experts to develop plans for ecosystem monitoring in order to meet the Minute’s requirement for evaluation of “the ecosystem response, most importantly the hydrological response, and secondarily, the biological response” of the environmental flow (Flessa et al., 2014). Ecosystem monitoring was conducted before, during, and after the pulse flow event, and will continue through 2017. The observa-

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