University of California, Davis
Water Management Lab

Monthly Report – Cycle 35

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Background and Objectives

Water availability and water supply in the Rio Grande basin depend on numerous factors related to climate conditions, storage in reservoirs and aquifers, stochastic characteristics of rainfall, water allocation policies, and other climatic variables.

As a result, it is essential to determine the current conditions and estimate the most probable future conditions of water availability to define strategies to meet water demands in the basin in order to mitigate the risk of not complying with the commitments of the international agreement (See Appendix A, Article 4 of the 1944 Water Treaty).

The main objective this study is to present the current conditions of the allocation of water to the United States (US) for the fulfilling the agreements established in the 1944 Treaty, including probable future scenarios if no management actions are taken and also if some management actions are taken in order to fulfill international commitments.

This document presents two scenarios for allocating water to the US:

- Current Situation - The allocation of water to the US on the date of this monthly report.
- Probable Future:
    - Without any management action: This scenario depends exclusively on weather conditions with predictions based on the current conditions of the basin and the historical behavior of the streamflow from 1953 to 2019.

    - With management action(s): This scenario considers transfers from some Mexican rivers, reservoirs, and international dams.

In both probable future scenarios, the estimated allocation of water to the US in a medium-term (October 25, 2020 as the probable date of the end of the Cycle 35) is estimated.

Water allocation scenarios in the Rio Bravo designated to the United States

First scenario - Current situation: Allocation of water to the US up to the date of this report

Figure 1 shows the current conditions of the accumulated volume of the Rio Grande/Bravo water in thousands of acre-feet (TAF) designated to the US from one-third of the total volume of the six Mexican tributary rivers (Conchos, San Diego, San Rodrigo, Escondido, Salado, and Arroyo Las Vacas) until **September 30, 2020**, as stipulated in the 1944 Treaty.

As of the date of this report, **1,287.7 TAF has been delivered** of **1,727.45 TAF that is committed to this date**, which represents a **deficit of 439.8 TAF**.

Comparing the cumulative volume delivered up to the date of this report with the commitment established for the possible end of the cycle on October 25, 2020 (1,750 TAF), the current deliveries have a difference below the amount of **462.3 TAF.**

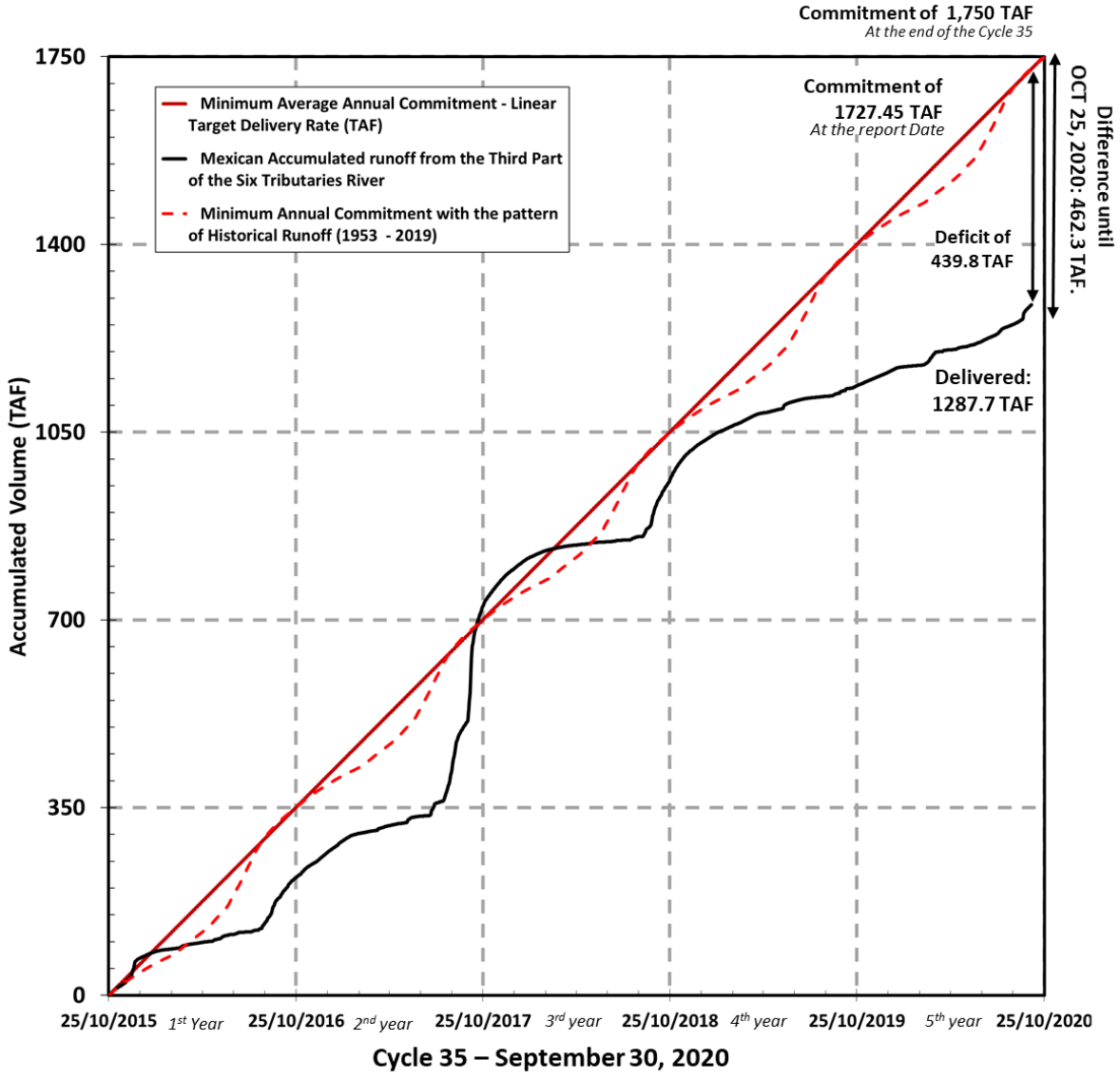

Figure 1. Accumulated volume assigned to the United States for Cycle 35 (from Oct. 25, 2015 to August 31, 2020) from the six Mexican tributary rivers in accordance with the Treaty of 1944.

Second scenario – Probable future: Without any management action

a) Medium term - Until October 25, 2020 (probable end of the cycle 35)

The procedure used to estimate runoff at the possible end date of cycle 35 (October 25, 2020) without any management action is as follows:

- The accumulated runoff for the previous year was calculated from October 26, 2018 to October 25, 2019, with a total volume of 497 TAF.
- The values of all the previous years from 1953 to 2019 were obtained to determine the years with equal to or less than 503 TAF (similar to 497 TAF) leading to 11 years with similar cumulative runoff: 1956, 1983, 1984, 1994, 1995, 1996, 1997, 1998, 2000, 2001, 2002 and 2012.
- Using the immediate next years of the series from the previous step (for example, for the year 1956 we use the upcoming year, 1957), we were able to determine the probable volume accumulated for the following year (from October 26, 2019, to October 25, 2020).

Figure 3 shows the result of the described analysis. The table in the figure shows the different probabilities (P (x)) associated with the volume delivered, showing that the higher the volume, the lower the probability that the water (or the required amount) will be delivered.

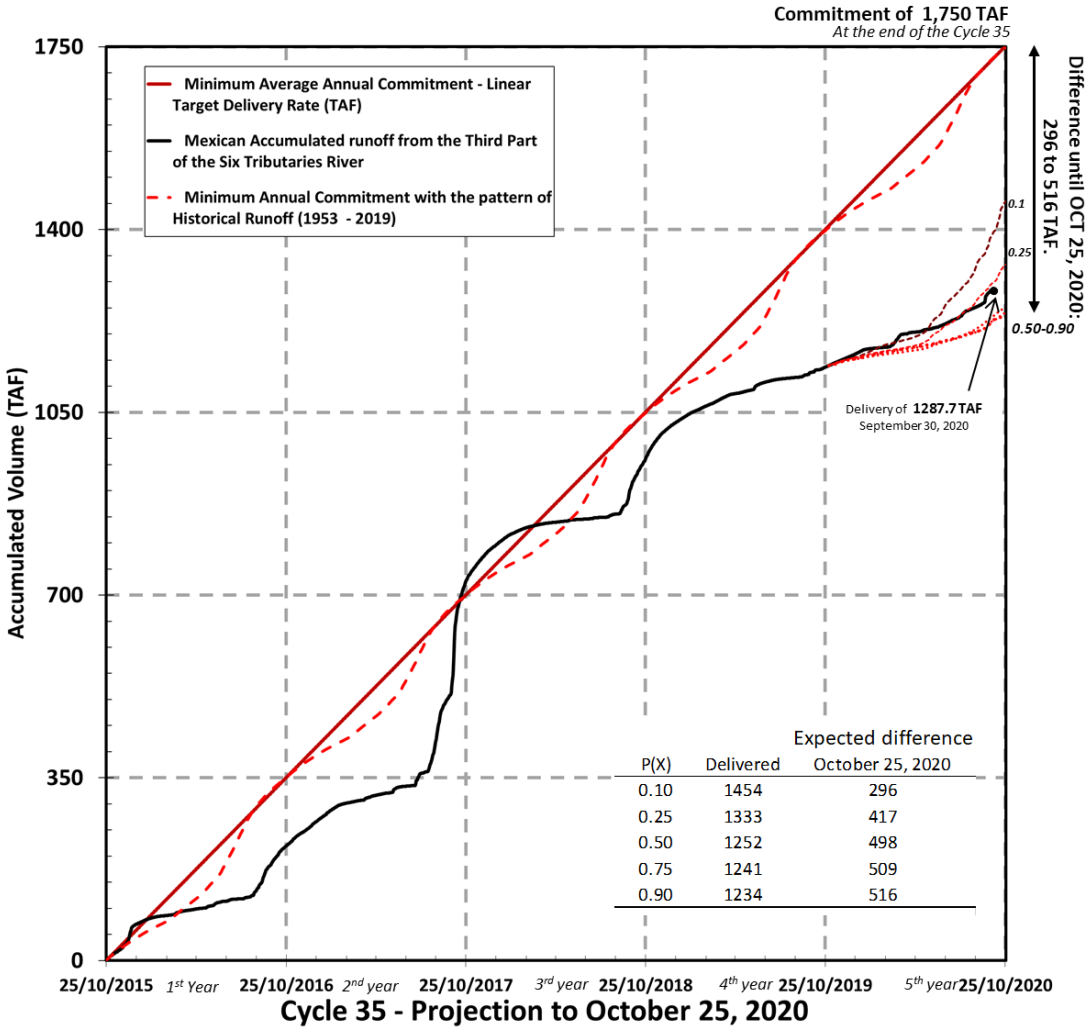

Figure 2. Estimated accumulated volume likely until October 25, 2020, to predict possible difference with treaty commitments at the end of cycle 35.

Third Scenario – Probable Future: Considering management action(s)

a) Water resources model: End of the cycle 35 with and without management action(s)

This section presents the water transfer and sharing from the six Mexican tributaries and reservoirs (stipulated in the Treaty) as shown in the schematic. Here, we present different strategies that vary from operating the system as business as usual (no water transfers to meet treaty commitments) to different levels of water transfers from reservoirs. The strategies are evaluated based on their hydrologic feasibility and do not represent any recommended action, here we only explore different scenarios.

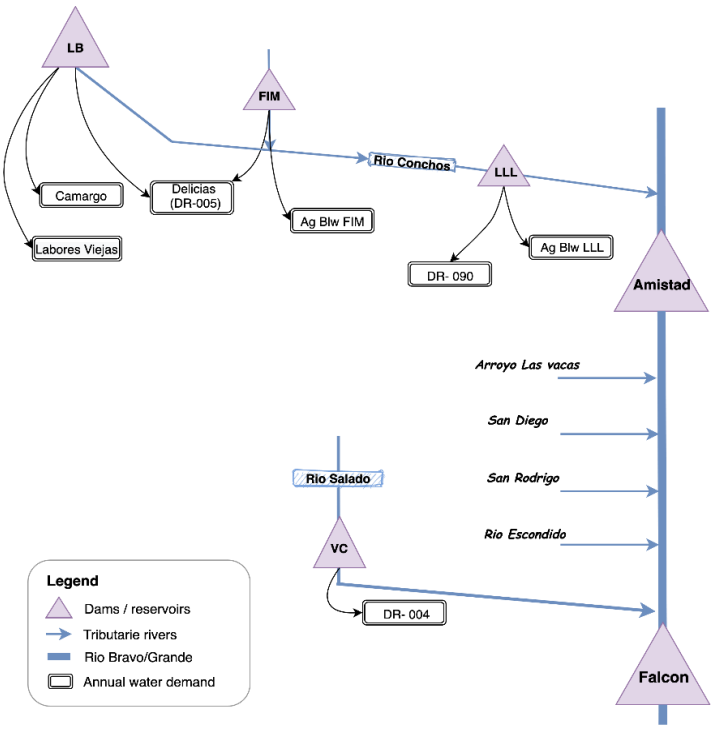

Figure 3. Water resources model schematic

This water resources model is based on a mass balance principle (Figure 3) that consider the initial storage for each reservoir on June 25th 2020 (beginning of the wet season) and evaluate different scenarios considering the following variables: (1) annual water demands for the districts, (2) hydrologic conditions (wet, semi-wet, moderate, dry and extremely dry), and (3) no water transfers or a certain amount of water transfers from reservoirs to the treaty.

There are three main results estimated in this analysis:

- Treaty deliveries from the six Mexican tributaries and the subsequent water deficit or surplus in meeting the treaty obligations (see Table 1); and
- End of cycle storage for each reservoir considering no water transfers or a given water transfer (Table 2). Results with blank spaces represent scenarios where the reservoir is empty.

This model, even with its simplicity, creates an excellent opportunity to explore different scenarios. Appendix B shows the discharges of water from October 25, 2019 up to date of this report. The discharges from the Rio Conchos could have been modified in a way to benefit the sediment transportation by changing the magnitude and timing of the release.

Hydrologic condition: 1 – wet, 2 – semi-wet, 3 – moderate, 4 – Dry, 5 – very dry

Treaty Transfers (MCM)	Minimum Deficit					Maximum Deficit				
	1	2	3	4	5	1	2	3	4	5
0	-123.0	-382.8	-460.5	-563.3	-631.5	-123.0	-382.8	-460.5	-563.3	-631.5
100	-93.7	-353.5	-431.1	-534.0	-602.2	-100.9	-360.7	-438.3	-541.2	-609.4
200	-5.7	-265.5	-343.1	-446.0	-514.2	-78.7	-338.5	-416.2	-519.1	-587.3
300	141.0	-118.8	-196.5	-299.3	-367.5	-56.6	-316.4	-394.1	-496.9	-565.1
500	610.3	350.5	272.9	170.0	101.8	-12.3	-272.1	-349.8	-452.7	-520.9
700	1314.3	1054.5	976.9	874.0	805.8	31.9	-227.9	-305.5	-408.4	-476.6
900	2253.0	1993.2	1915.5	1812.7	1744.5	76.2	-183.6	-261.3	-364.1	-432.3
1000	2810.3	2550.5	2472.9	2370.0	2301.8	98.3	-161.5	-239.1	-342.0	-410.2

Table 1. Water surplus or deficit to meet treaty obligations

Treaty Transfers (MCM)	Initial Storage																			
	Venustiano Carranza 255.44					La Boquilla 1290.74					Francisco I. Madero 242.70					Luis L. Leon 144.02				
	*Hydrologic Condition																			
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
0	713	597	344	277	253	2407	1940	1411	1215	1089	790	529	385	295	238	391	207	192	164	164
100	613	497	244	177	153	2307	1840	1311	1115	989	690	429	285	195	138	291	107	92	64	64
200	513	397	144	77	53	2207	1740	1211	1015	889	590	329	185	95	38	191	7			
300	413	297	44			2107	1640	1111	915	789	490	229	85			91				
500	213	97				1907	1440	911	715	589	290	29								
700	13					1707	1240	711	515	389	90									
900						1507	1040	511	315	189										
1000						1407	940	411	215	89										

- *1 - Wet, 2 - Semi-wet, 3 - Moderate, 4 - Dry, 5 - Extreme Dry*
- *Results in this table are the Storage at the end of Cycle 35, October 24th, 2020.*

Table 2.End of cycle storage for each reservoir considering (a) no water transfer or a given amount of water transfers, and (b) hydrologic condition (1 – wet, 2 – semi-wet, 3 – moderate, 4 – Dry, 5 – very dry)

Appendix A - Water distribution between Mexico and the United States in the Rio Grande

Article 4 of the 1944 Water Treaty (Treaty) establishes the distribution of Rio Bravo water between Mexico and the United States (EU) as follows:

For Mexico (MX):

- 100% from San Juan and Álamo rivers
- **Two-thirds of the six Mexican rivers: Conchos, San Diego, San Rodrigo, Escondido, Salado, and Arroyo Las Vacas**
- Half of any other runoff including ungraded rivers (not specified in the treaty)

For the United States (US):

- 100% Pecos, Devils rivers and Alamito, Terlingua, San Felipe, and Pinto streams.
- **One-third of the six Mexican rivers. This third must not be less than 350 Thousand Acre-Feet on an annual average, during cycles of 5 consecutive years.**
- Half of any other runoff and ungraded rivers

Treaty Cycles:

The cycles last **five years.** However, the cycles will be considered completed **(it may last less than five years)** if the useful capacity assigned to the US of both international dams (Amistad and Falcón) is filled with water assigned to the US.

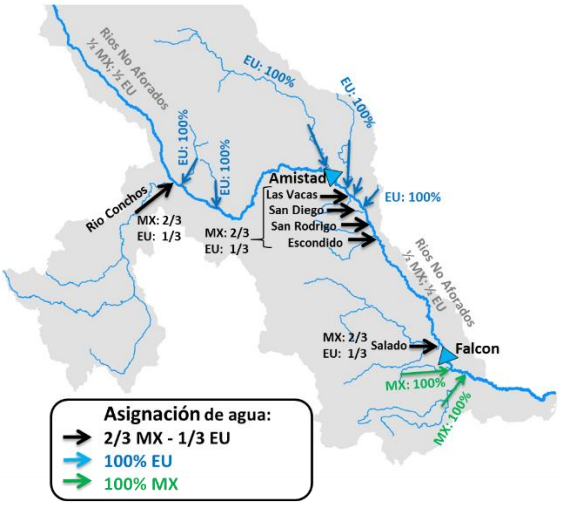

Figure A.1 – Global description of water distribution within the US and Mexico according to the 1944 Treaty.

The accumulated volume of the one-third of water assigned to the US from the six Mexican rivers is accounted for in cycles of the treaty. The treaty cycles last five years. However, the cycle will be considered concluded (it may last less than five years) if the useful capacity of water assigned to the US of both of the international dams (Amistad and Falcón) is filled with water assigned to the US from México. When this occurs, all debts will be considered entirely paid, beginning from this moment a new cycle.

Appendix B - Water releases from October 25, 2019.