



WORLD METEOROLOGICAL ORGANIZATION



# Transboundary water cooperation: Colorado River Basin, and the National Program Against Drought in Mexico (PRONACOSE)

International Workshop on Water Scarcity:  
Taking action in transboundary basins and reducing health impacts

Genève, Switzerland, December 2017

# OUTLINE

## **1. Transboundary water cooperation: Colorado River**

- 1.1. Overview of the Basin.
- 1.2. Water Allocation.
- 1.3. Natural Flow Records.
- 1.4. Water Treaty between Mexico and USA
- 1.5. Minute 319 & USBR Colorado River Study Report
- 1.6. Binational Group of Hydrology (BGH/CRB)
- 1.7. Colorado River Minute 323
- Appendix A. Colorado River Minute 323 (Savings & Reductions)

## **2. National Program Against Drought (PRONACOSE)**

- 2.1. Background
- 2.2. Application of the program under a condition of drought
- 2.3. Program achievements
- 2.4. Present work
- 2.5. Future work
- Appendix B. Case of drought in Mexico: Tehuantepec, Oaxaca

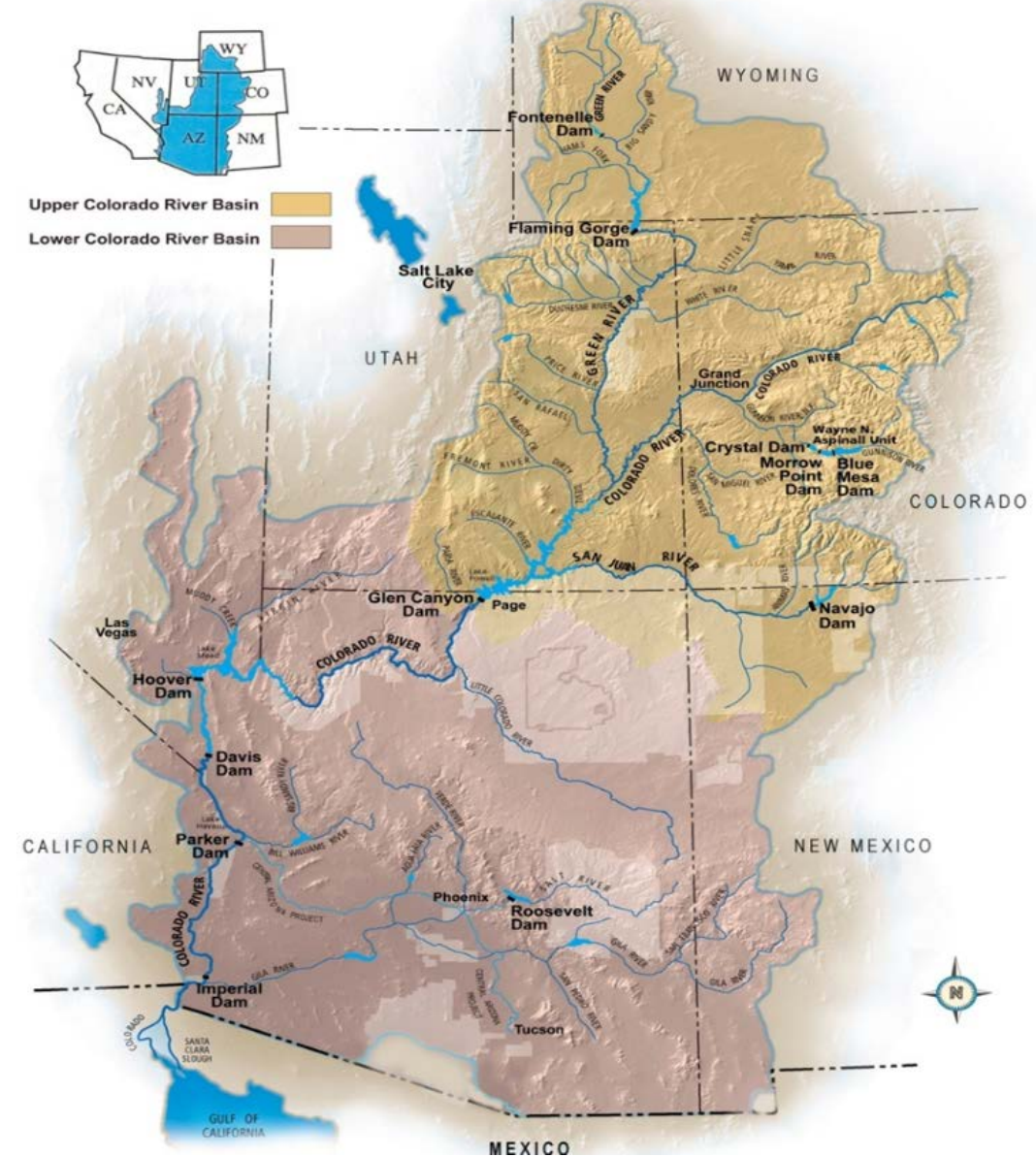


# **TRANSBOUNDARY WATER COOPERATION: COLORADO RIVER BASIN**

# OVERVIEW OF THE BASIN

- The Colorado River Basin (CRC) begins in the Rocky Mountains and flows towards the Sea of Cortez (Gulf of California).
- It has a total length of 2,300 km and its basin covers 634,840 km<sup>2</sup>.
  - Mexico has less than 1% of the area of the Colorado River basin.
- The annual natural flow volume is around 16,964 hm<sup>3</sup>.
  - Approximately, 92% of the runoff occurs in the upper Colorado River Basin.
- The main storage reservoirs are Lake Powell and Lake Mead:
  - a) Lake Powell 27,000,000 acre-ft (33,304 hm<sup>3</sup>).
  - b) Lake Mead 28,945,000 acre-ft (35,703 hm<sup>3</sup>).
  - c) Combined storage 55,945,000 acre-ft (69,007 hm<sup>3</sup>).

## Colorado River Basin





# WATER ALLOCATION

ZONE	WATER ALLOCATION Million acre-ft (hm <sup>3</sup> )	CONSUMPTIVE USE Million acre-ft (hm <sup>3</sup> )
UPPER BASIN*	7.5 (9,251)	3.8 (4,687)
LOWER BASIN*	7.5 (9,251)	7.5 (9,251)
MEXICO**	1.5 (1,850)	1.5 (1,850)
<b>TOTAL</b>	<b>16.5 (20,352)</b>	<b>12.8 (15,788)</b>

\*Colorado River Compact of 1922

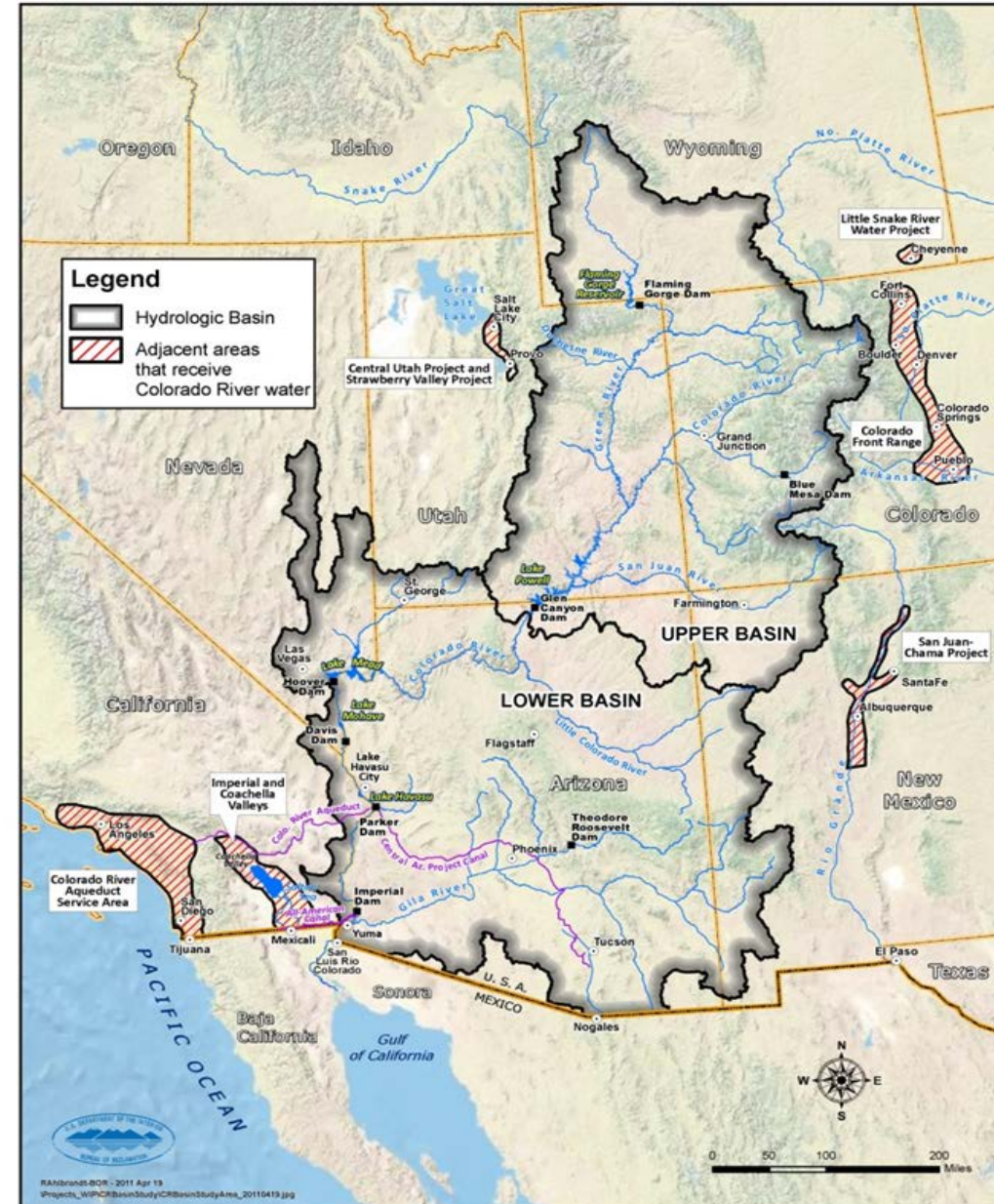
\*\*Water Treaty of 1944

Annual Natural Flow Regime of the upper basin (2000-2012):

**13.753 Million acre-ft**

**16,964 hm<sup>3</sup>**

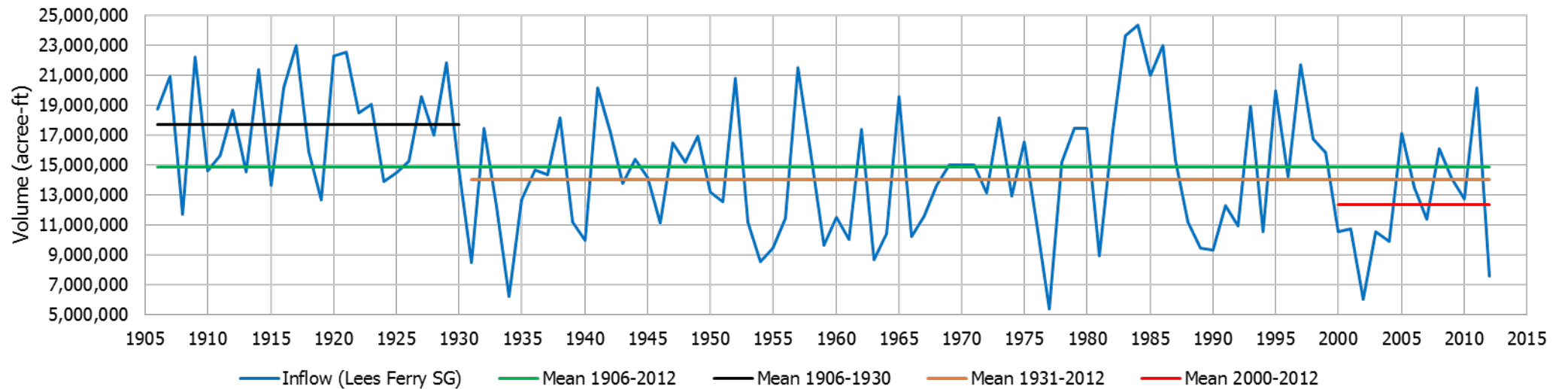
For this period, the water of the system is over allocated.



# NATURAL FLOWS RECORD

ZONE	ANNUAL NATURAL FLOW REGIME acre-ft (hm <sup>3</sup> )					
	1906-2012	%	1931-2012	%	2000-2012	%
UPPER BASIN	14,868,282 (18,339.76)	91.99	14,007,818 (17,278.39)	91.86	12,636,581 (15,586.99)	91.88
LOWER BASIN	1,295,384 (1,597.83)	8.01	1,240,569 (1,530.22)	8.14	1,116,512 (1,377.20)	8.12
<b>TOTAL CRC</b>	<b>16,163,666 (19,937.59)</b>	<b>100.00</b>	<b>15,248,387 (18,808.61)</b>	<b>100.00</b>	<b>13,753,093 (16,964.19)</b>	<b>100.00</b>

## UPPER BASIN NATURAL FLOW REGIME



The Colorado River Basin has reached low reservoir levels in its history nevertheless it has not failed because the users of the upper basin have not used their total allocation volume.

# 1944 Water Treaty between Mexico and USA

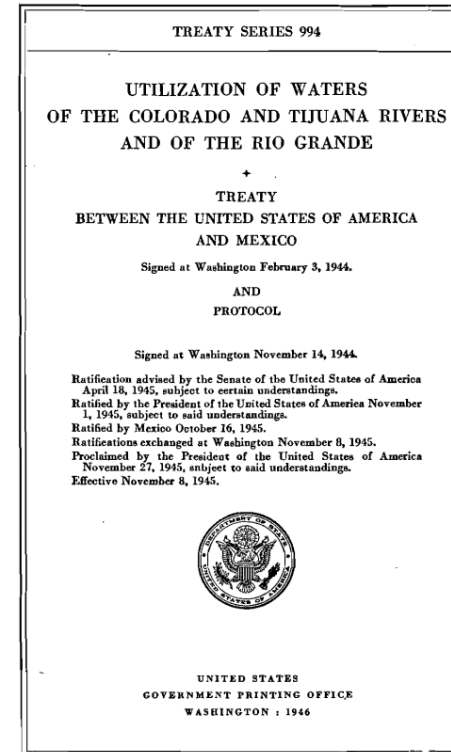
## According to the International Boundary and Water Commission (IBWC):

- The 1944 Water Treaty between Mexico and United States is the legal instrument that regulates the relationship between both countries to manage jointly the water of the international rivers (Colorado, Grande and Tijuana).
- It creates the IBWC as an international organization technical-diplomatic to ensure its application.
- Minutes mechanism of the IBWC.

## For Colorado River, 1944 Water Treaty establishes the following:

"Of the waters of the Colorado River, from any and all sources there are allotted to Mexico: (a) A guaranteed annual quantity of 1,500,000 acre-feet (1,850,234,000 cubic meters) to be delivered..."

"In the event of extraordinary drought or serious accident to the irrigation system in the United States, thereby making it difficult for the United States to deliver the guaranteed quantity... the water allotted to Mexico... will be reduced in the same proportion as consumptive uses in the United States are reduced". **Minute 319**



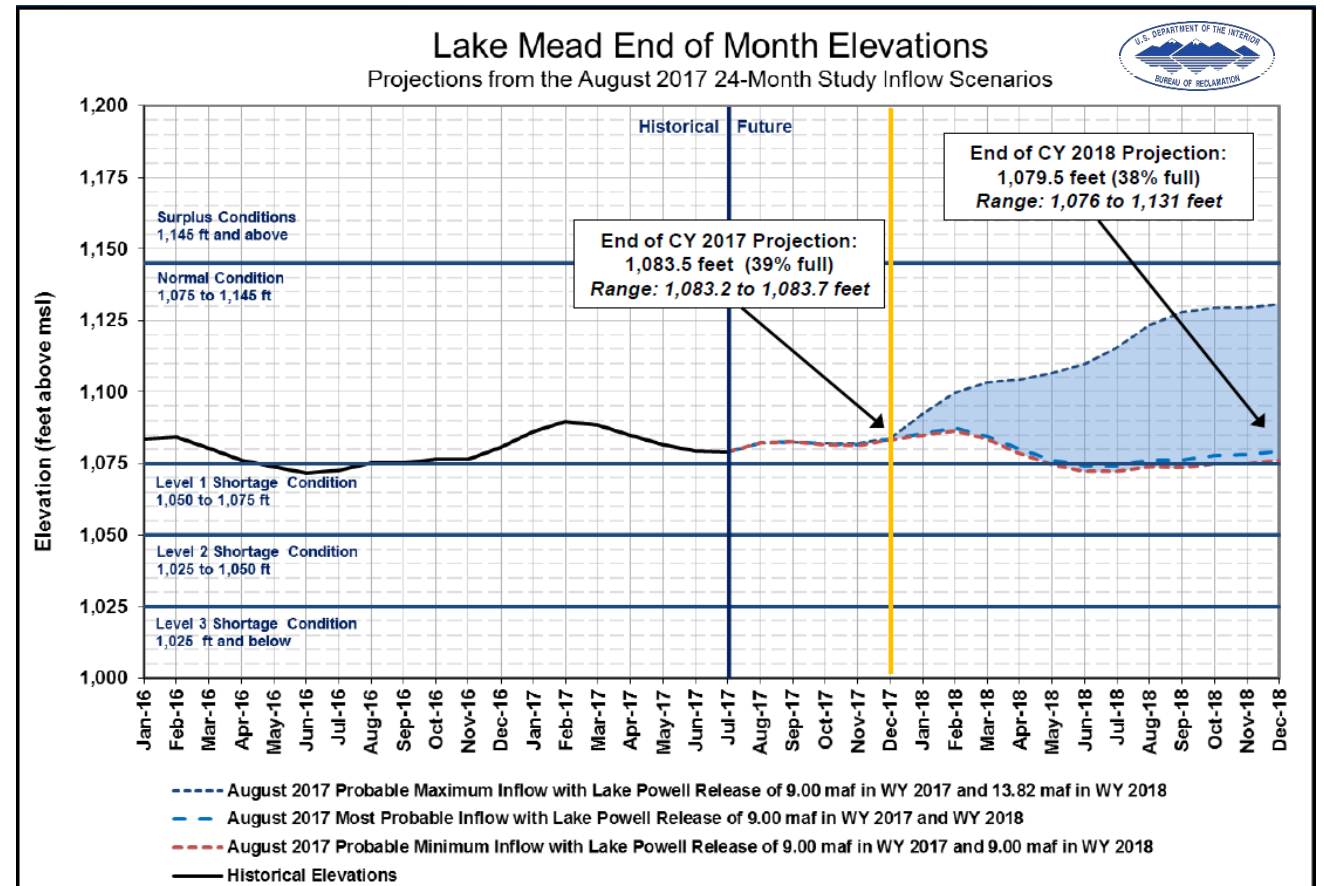
Signing of 1944 Treaty

# Minute 319 & USBR Colorado River Study Report

The U.S. Bureau of Reclamation performs a 24-Month Study Report each month, that presents the results of the hydrologic conditions and projected operations for the Colorado River system reservoirs for the next two years.

With the August 24-Month Study results, the operation of the system for the following year is determined:

- If the projected level at January 1<sup>st</sup> for Lake Mead will be at or below 1,075 feet above mean sea level, then **there is a shortage**.
- If the projected level at January 1<sup>st</sup> for Lake Mead will be at or over 1,145 feet above mean sea level, then **there is abundance**.





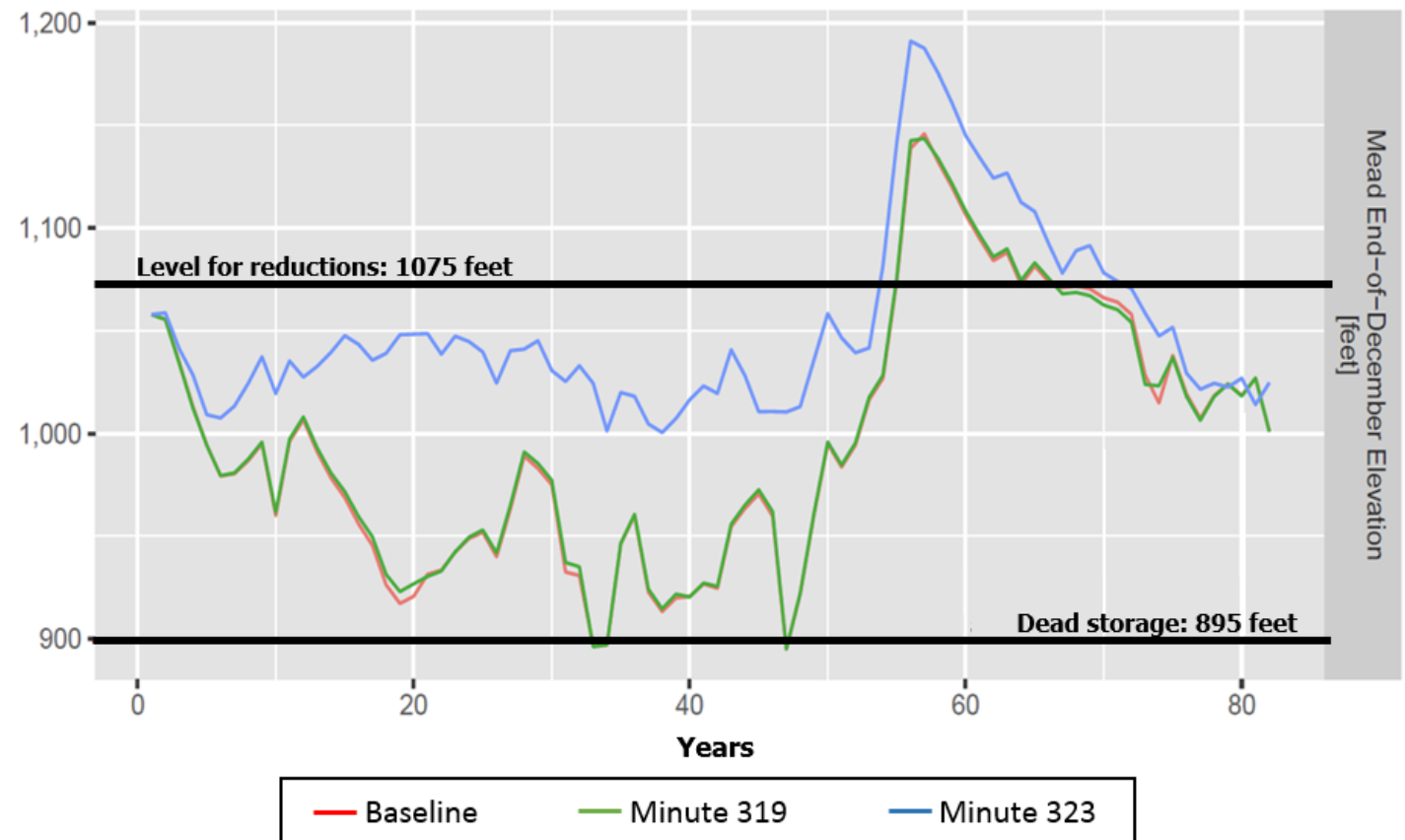
# Binational Group of Hydrology (BGH/CRB)

A Binational Working Group between Mexico and United States was formed to study and evaluate different management scenarios for the Colorado River Basin and propose future actions to the governments of both countries.

The results of the models carried out by the BGH showed that the reductions considered in Minute 319 would be insufficient to avoid the decrease of the level in Lake Mead, causing the collapse of the system and affecting both countries.

Therefore a Binational Water Scarcity Contingency Plan was developed.

Long Term simulation of the reservoir level (Hoover Dam)



# Colorado River Minute 323

Since 2015 in Mexico, the International Boundary and Water Commission and the National Water Commission coordinated the Project for Minute 323

The Commissioners of both countries met in Ciudad Juarez, Chihuahua on September 21, 2017 to replace the international joint cooperative measures agreed to in Minute 319 and adopting a Binational Water Scarcity Contingency Plan in the Colorado River Basin.

**This guidelines of the binational instrument is included in the Minute 323.**

Minute 323 indicates both recoverable savings and reductions for the US. and Mexico, defined by the level of Lake Mead (Hoover Dam).



# Colorado River Minute 323 (Savings and Reductions)

RECOVERABLE SAVINGS VOLUMES								
Lake Mead Elevation at January 1 <sup>st</sup> <i>(ft)</i>	US R. Savings <i>(acre-ft)</i>	US R. Savings <i>(Mm<sup>3</sup>)</i>	US Percentage of assignment <i>(7.5 M acre-ft)</i>	MX R. Savings <i>(acre-ft)</i>	MX R. Savings <i>(Mm<sup>3</sup>)</i>	MX Percentage of assignment <i>(1.5 M acre-ft)</i>	Total (US+MX) Reductions	Total (US+MX) Percentage of assignment
1090-1075	200,000	247	2.67%	41,000	51	2.73%	240,000	2.67%
1075-1050	200,000	247	2.67%	30,000	37	2.00%	230,030	2.56%
<1050-1045	200,000	247	2.67%	34,000	42	2.27%	233,573	2.60%
<1045-1040	450,000	555	6.00%	76,000	94	5.07%	525,540	5.84%
<1040-1035	500,000	617	6.67%	84,000	104	5.60%	583,933	6.49%
<1035-1030	550,000	679	7.33%	92,000	113	6.13%	642,326	7.14%
<1030-1025	600,000	740	8.00%	101,000	125	6.73%	700,719	7.79%
<1025	600,000	740	8.00%	150,000	185	10.00%	750,000	8.33%

REDUCTION VOLUMES								
Lake Mead Elevation at January 1 <sup>st</sup> <i>(ft)</i>	US Reductions <i>(acre-ft)</i>	US Reductions <i>(Mm<sup>3</sup>)</i>	US Percentage of assignment <i>(7.5 M acre-ft)</i>	MX Reductions <i>(acre-ft)</i>	MX Reductions <i>(Mm<sup>3</sup>)</i>	MX Percentage of assignment <i>(1.5 M acre-ft)</i>	Total (US+MX) Reductions	Total (US+MX) Percentage of assignment
1090-1075								
1075-1050	333,000	411	4.44%	50,000	62	3.33%	383,000	4.26%
<1050-1045	417,000	514	5.56%	70,000	86	4.67%	487,000	5.41%
<1045-1040	417,000	514	5.56%	70,000	86	4.67%	487,000	5.41%
<1040-1035	417,000	514	5.56%	70,000	86	4.67%	487,000	5.41%
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<1030-1025	417,000	514	5.56%	70,000	86	4.67%	487,000	5.41%
<1025	500,000	617	6.67%	125,000	154	8.33%	625,000	6.94%

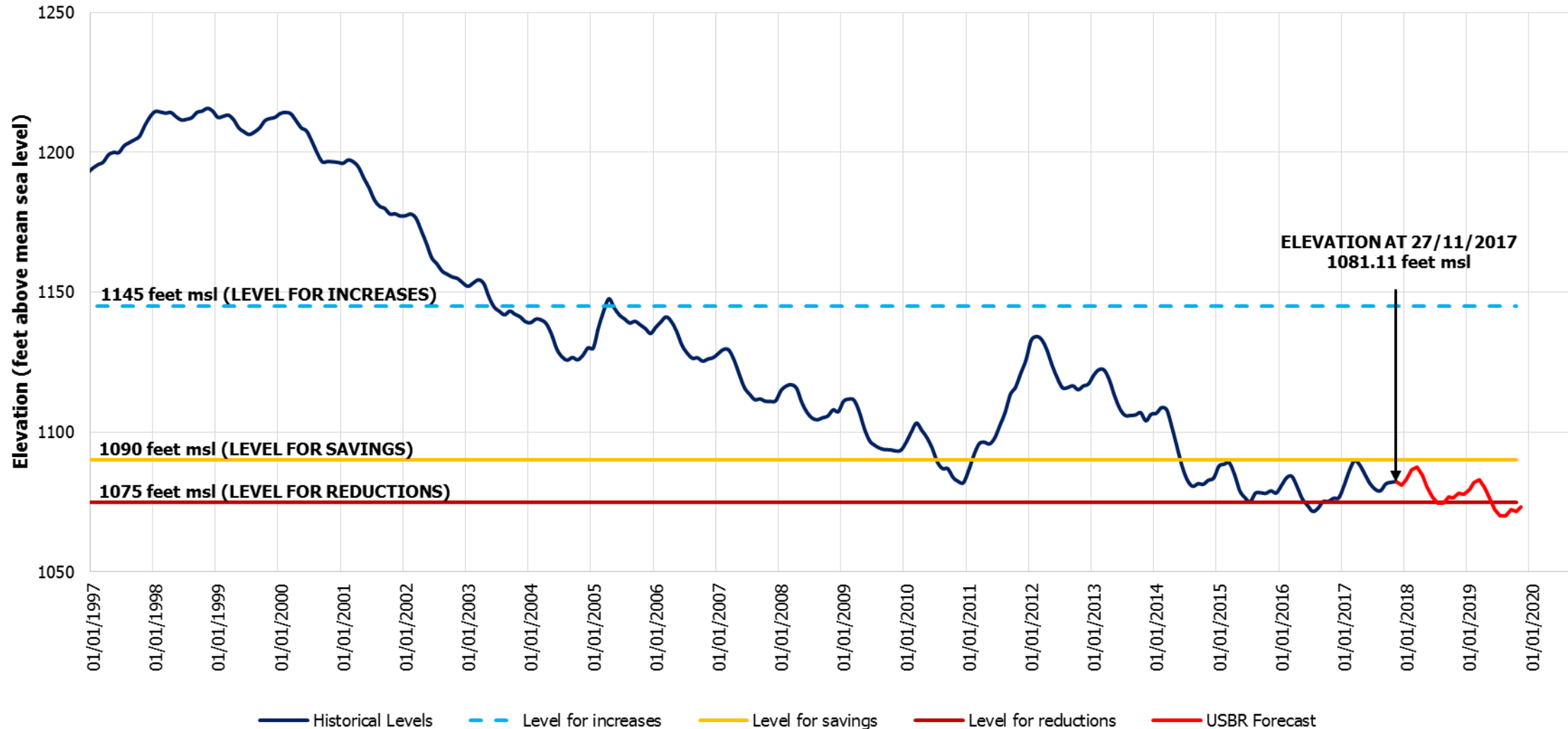




# Colorado River Minute 323 (Savings and Reductions)

## COLORADO RIVER BASIN LAKE MEAD (HOOVER DAM)

Data of the 24-Month Study: November, 2017 Report  
Results provided by Bureau of Reclamation

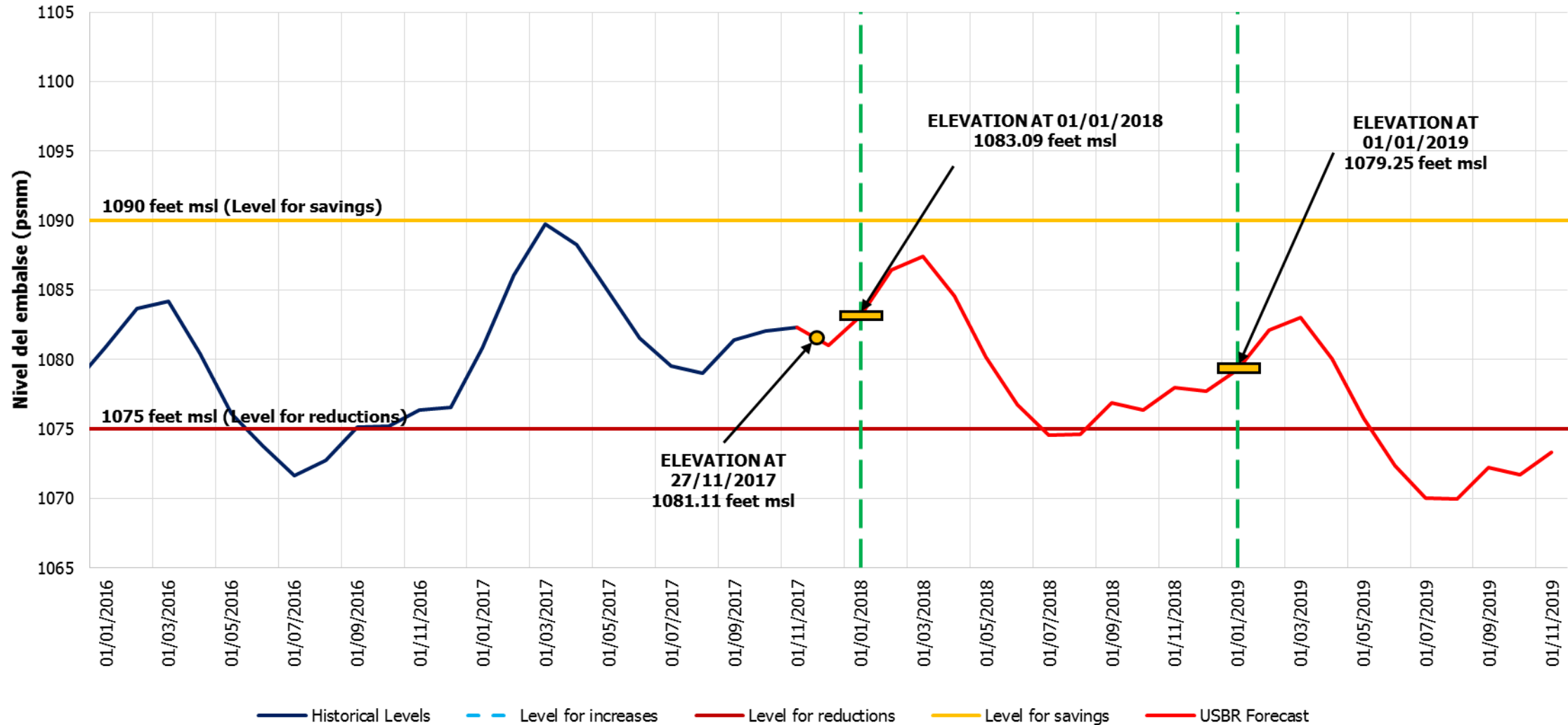




# Colorado River Minute 323 (Savings and Reductions)

## COLORADO RIVER BASIN LAKE MEAD (HOOVER)

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**PRONACOSE**  
PROGRAMA NACIONAL CONTRA LA SEQUÍA

# **NATIONAL PROGRAM AGAINST DROUGHT IN MEXICO (PRONACOSE)**

# Background

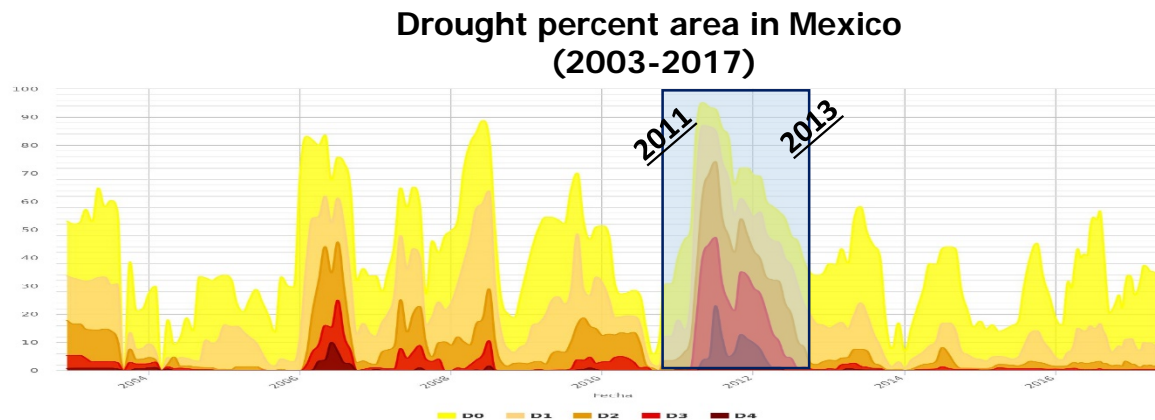
From 2011 to 2013, the worst drought since 1941 was presented in Mexico: It affected about 90% of the country, causing losses of 11.6 billion of USD according to an estimation of the Mexican Agriculture Commission.

Because of this drought event, it was necessary to take measurements of social, economic and fiscal policies:

- In 2011: "The Strategy for attention of the states affected by drought" was implemented
- In 2012: "The Agreement of actions to mitigate drought effects through federal entities" was established.
- In 2013: "The National Program Against Drought (PRONACOSE)" was designed and implemented.

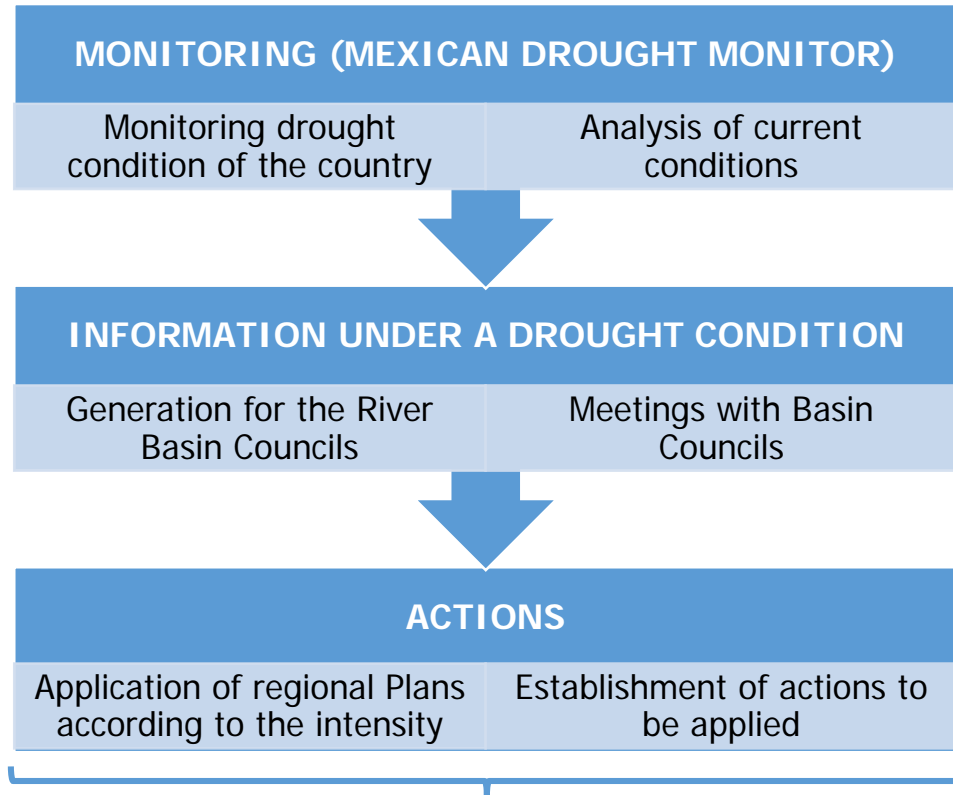
Its main objective is to identify actions that would allow making opportune decisions to prevent and mitigate drought affectations.

The **PRONACOSE** was implemented by the President of Mexico, and it is managed by the Federal Government trough the **National Water Commission**.



The National Water Law establishes that the authority and management of the national water and its public goods corresponds to the Federal Executive, which will exercise directly or trough the **National Water Commission (CONAGUA)**.

# Application of the Program under a drought condition



- At the beginning of the year the General Agreement for Drought Onset is published for river basins in that condition.
- The actions are reported to the Intersecretarial Commission for the Assistance of Droughts and Floods (CIASI).
- If it is necessary the Commission coordinates inter-institutional plans and actions.

## COMPONENTS



**Implementation of guidelines (PRONACOSE)**

**PREVENTION**

- Drought monitoring** - To develop the indicators of drought condition
- Programs (PMPMS)** - Measures to prevent and mitigate droughts at basin level

**MITIGATION**

**Drought attention**

- Inter - Institutional Committee** - To monitor the actions of the government agencies to deal with droughts
- Committee of experts** - To evaluate PRONACOSE and to make recommendations



(National Policy of Drought, 2014)



# Main achievements

2013

- Monitoring of drought intensity and early warning.
- Guidelines and Plans development: Preventive Measures and Drought Mitigation Programs (PMPMS).
- Creation of the Intersecretarial Commission for the Assistance of Droughts and Floods (CIASI).

2014

- Optimization of drought monitoring tools.
- Development of a methodology to evaluate vulnerability against drought.

2015

- Implementation of 48 PMPMS at two levels: Basin Council and Major Cities.
- Optimization of the methodology to evaluate vulnerability against drought applying 24 indicators.
- Risk drought evaluation.

2016

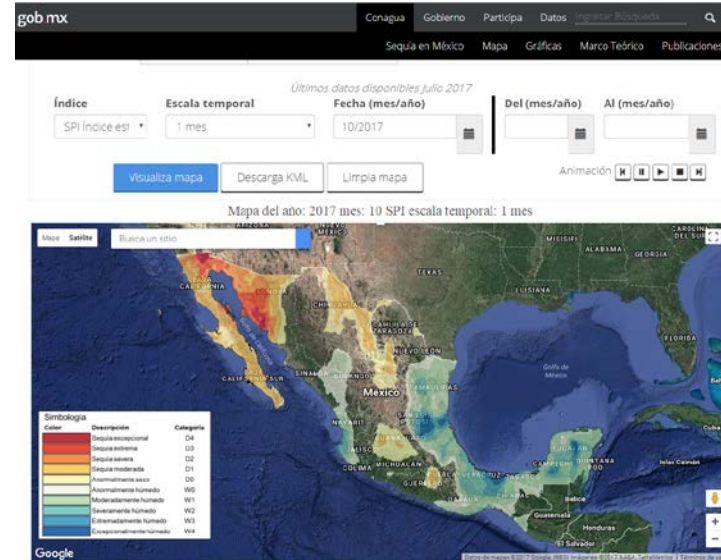
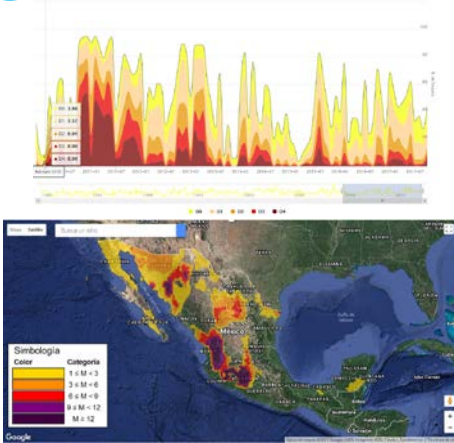
- Development of The Multivariate Drought Monitor in Mexico (MoSeMM).
- Upgrade of vulnerability maps against drought.
- Application of preventive actions in Basin Councils.

2017

- Intersecretarial attention for drought in Oaxaca State.
- MoSeMM publication on CONAGUA´s website.
- Development of studies to elaborate an Integrated Drought Management Programme in Mexico.

# Present Work: Integrated Drought Management Programme in Mexico

## MONITORING & EARLY WARNING



## MITIGATION & PREPARATION



## VULNERABILITY & IMPACT EVALUATION

Set multiple goals and objectives that promote positive long-term outcomes for society.

Encourage stakeholders from a variety of different sectors and realms to participate.

Implement measures to prepare, respond, and recover from drought and transform society's resilience to drought.

Utilize limited resources efficiently and fairly to reduce risk and maximize opportunities

Assess whole system behaviour and associated risks and uncertainties over the short and long term

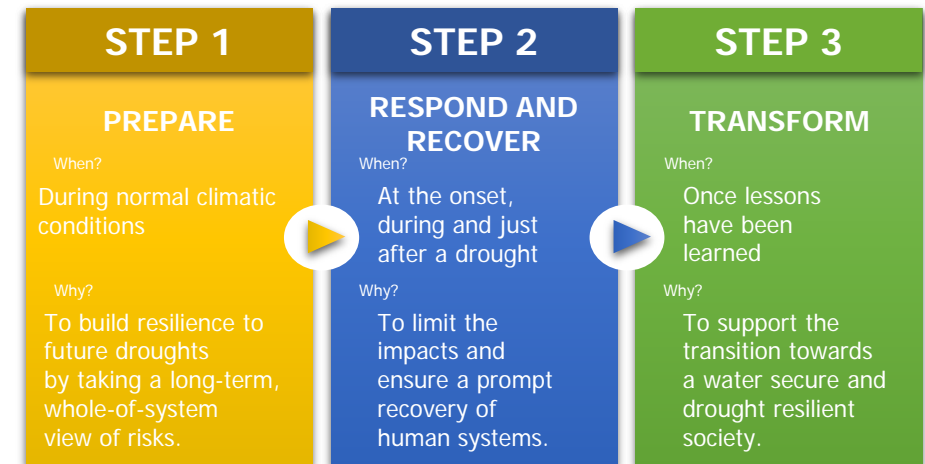
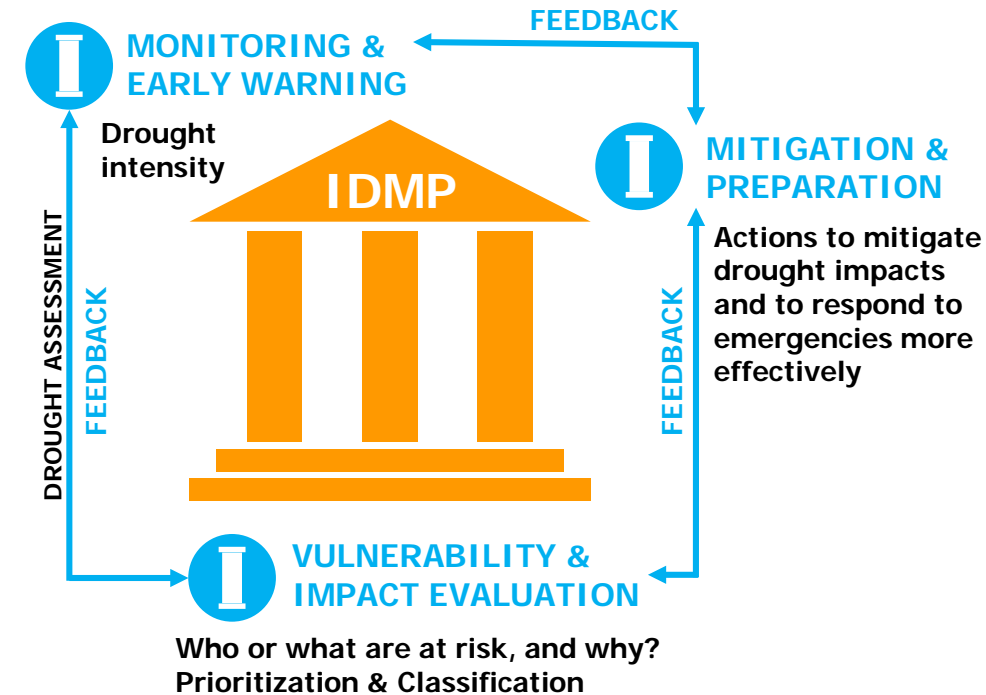
Communicate risks (and associated uncertainty) effectively and widely

Understand inherent controversies and trade-offs

Embed a continuous process of review and adaptation

## 8 Golden Rules of SDRM

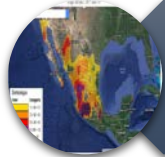
Sayers et al. (2016)



## Strategic Drought Risk Management (SDRM)

# Future Work

We are focused on strengthening the corresponding actions to the three pillars of the Integrated Drought Management Programme (IDMP) and Strategic Drought Risk Management (SDMP):



Efficiently application of The Multivariate Drought Monitor in Mexico, as a complementary tool of drought monitoring.



Development of an Early Warning Program.



Development of a Methodology for Impacts Evaluation.



Evaluation and restructuring of Preventive Measures and Drought Mitigation Programs (PMPMS) in terms of application and effectiveness.

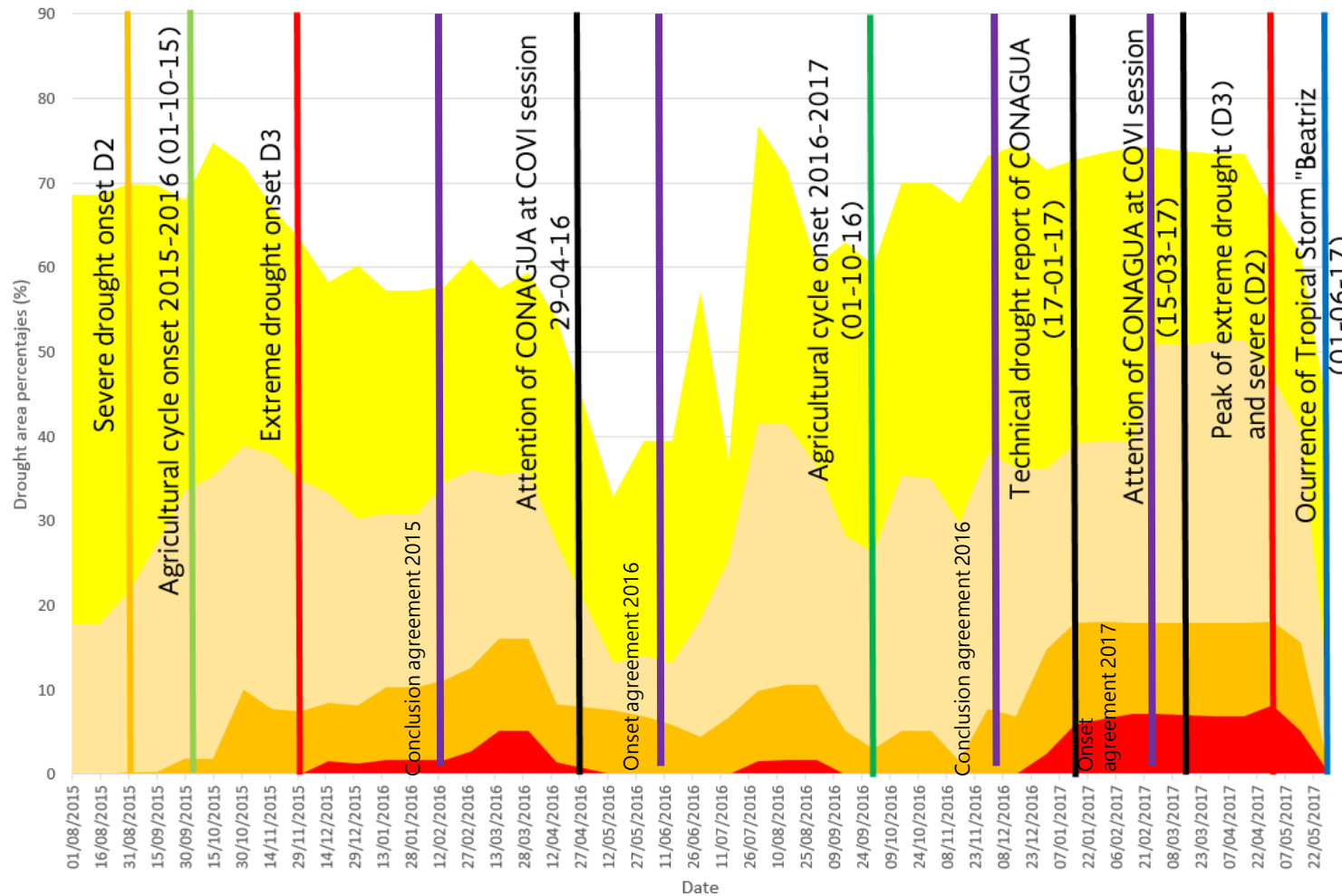


Establishment of a Integrated Drought Management Programme for the entire Mexican territory.

# Case of drought in Mexico: Tehuantepec, Oaxaca

## Monitoring and preventive actions (Operation and Vigilance Commission sessions)

Evolution of drought area percentages in the state of Oaxaca



## Impacts assessment

The consequence of this drought event was manifested in the Benito Juárez Dam **reservoir storage** located at El Istmo de Tehuantepec: the dam reached the **14%** of its capacity. This reservoir supplies water for **agricultural and domestic use**.

NADM (2017)



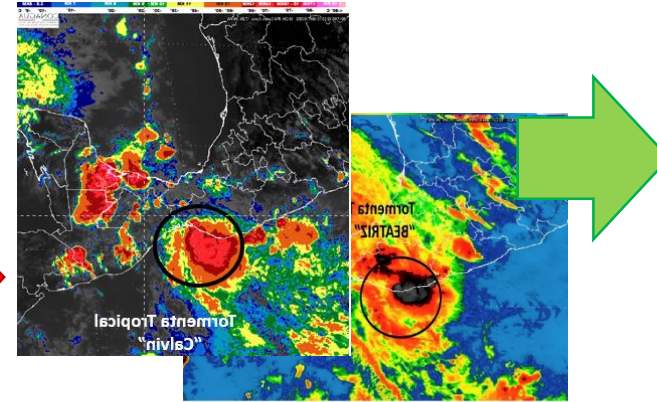
# Case of drought in Mexico: Tehuantepec, Oaxaca

## Mitigation actions

Because of the **extreme situation**, it was necessary to take **mitigation actions** in order to reduce the affectations.

CONAGUA proposed to **build and rehabilitate wells**.

Projected area for wells:



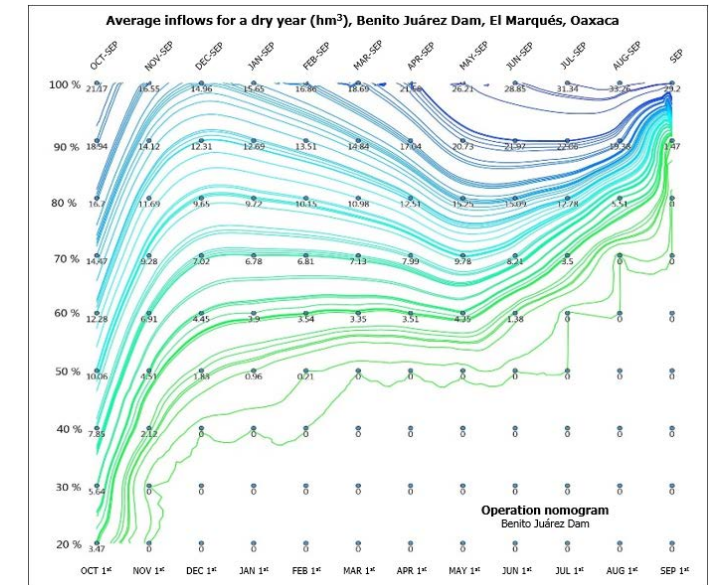
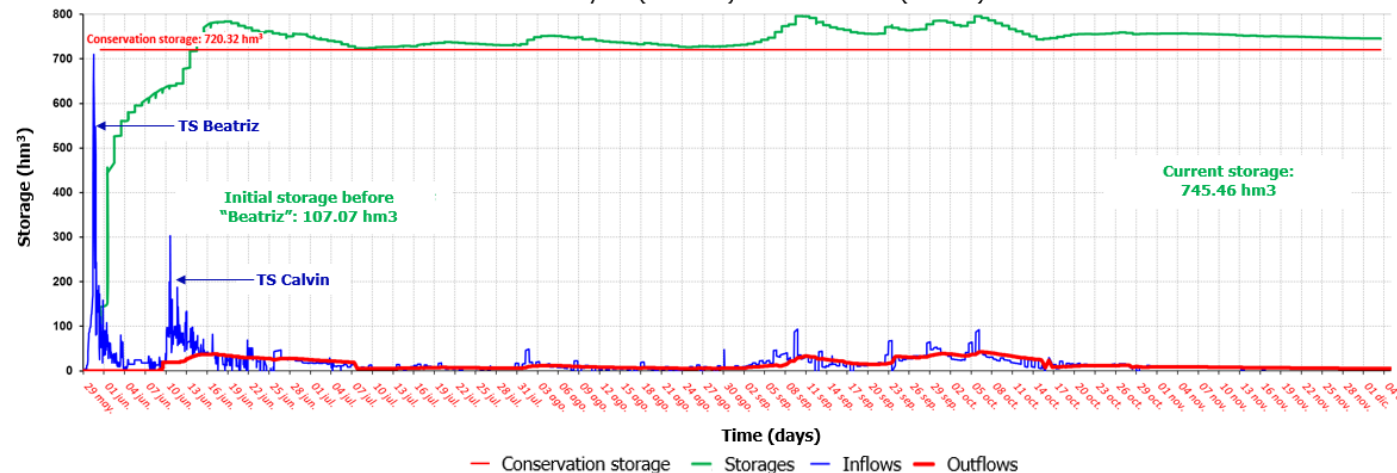
Occurrence of Tropical Storms: *Beatriz* and *Calvin*  
June 1<sup>st</sup> and June 10<sup>th</sup>

Benito Juárez dam reach reservoir levels over 100% of its capacity



## Monitoring actions after drought event

**Benito Juárez Dam, El Marqués, Oaxaca**  
From May 31 (17:00 h.) to December 4 (8:00 h.)



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For more information, please visit the following links:

Minute 323: <https://www.ibwc.gov/Files/Minutes/Min323.pdf> (English version)  
<http://www.cila.gob.mx/actas/323.pdf> (Spanish version)

PRONACOSE: <http://www.gob.mx/conagua/acciones-y-programas/programa-nacional-contra-la-sequia-pronacose-programas-de-medidas-preventivas-y-de-mitigacion-a-la-sequia-pmpms-para-ciudades>