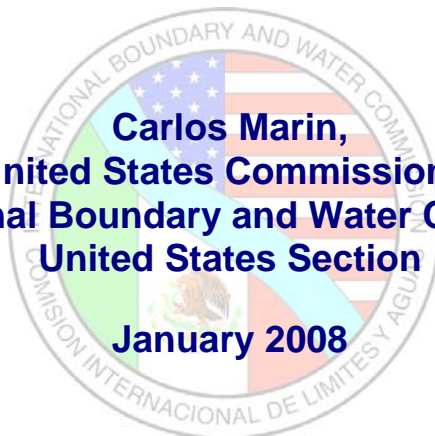


**A REPORT ON  
COLORADO RIVER SALINITY OPERATIONS,  
UNDER INTERNATIONAL BOUNDARY AND WATER  
COMMISSION MINUTE NO. 242  
JANUARY 1 to DECEMBER 31, 2006**



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United States Section  
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## Acronyms

Af - Acre-feet	IBWC – International Boundary and Water Commission
Ppm - Parts per million	USIBWC - United States Section of the IBWC
Tcm - Thousand cubic meters	NIB - Northerly International Boundary
TDS - Total dissolved solids	SIB - Southerly International Boundary

*Cover Photo: Wellton-Mohawk Bypass Channel between NIB and SIB, taken February 2005.*

## COLORADO RIVER SALINITY OPERATIONS, JANUARY 1, 2006 THROUGH DECEMBER 31, 2006, UNDER IBWC MINUTE NO. 242

This report presents the results of the operations from January 1 through December 31, 2006 under the agreement with the Republic of Mexico (Mexico) titled *Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River*. The agreement is incorporated into International Boundary and Water Commission, United States and Mexico (IBWC) Minute No. 242 dated August 30, 1973. Minute No. 242 replaced Minute No. 241 (which replaced Minute No. 218). Operations began on June 25, 1974, under Minute No. 242, immediately following approval of Public Law 93-320 *Colorado River Basin Salinity Control Act*.

This report is based on United States Section of the IBWC (USIBWC) records on water flows and salinity levels determined jointly by the United States and Mexican Sections of the IBWC, as well as the United States Geological Survey, which provided flow-monitoring data, and the Bureau of Reclamation, which provided volume and chemical investigations data. **Exhibit 1** shows the locations referred to in this report. The 2006 records show that the United States (U.S.) operations of the lower Colorado River resulted in compliance with the agreement in IBWC Minute No. 242.

### SALINITY DIFFERENTIAL

#### **IBWC Minute No. 242 and Water Deliveries**

Point 1 of IBWC Minute No. 242 provides that:

*“The United States shall adopt measures to assure that . . . the approximately 1,360,000 acre-feet (1,677,545,000 cubic meters) delivered to Mexico upstream of Morelos Dam, have an annual average salinity of no more than 115 p.p.m. ± 30 p.p.m. U.S. count (121 p.p.m. ± 30 p.p.m. Mexican count) over the annual average salinity of Colorado River waters which arrive at Imperial Dam . . .”*

A summary of the “scheduled deliveries” and “actual deliveries” made to Mexico follows in **Table 1**:

<b>Table 1: Summary, Total Deliveries of Colorado River Water to Mexico in 2006</b>		
	<b>Scheduled Deliveries</b>	<b>Actual Deliveries Made</b>
NIB (“at the riverbed above Morelos Dam”)	<b>1,678,234 tcm</b> (1,360,561 af) <sup>1</sup>	1,738,979 tcm <sup>2</sup> (1,409,807 af)
SIB (“across the land boundary near San Luis, Arizona,” includes the water flows through the limitrophe of the river below Morelos Dam)	<b>172,000 tcm</b> (139,442 af) <sup>1</sup>	155,992 tcm <sup>3</sup> (126,465 af)
Total	<b>1,850,234 tcm<sup>1</sup></b> (1,500,003 af)	<b>1,894,971 tcm</b> (1,536,271 af)
Other water delivered [arriving] to Mexico in the Limitrophe Section <sup>4</sup>		<b>44,737 tcm<sup>4</sup></b> (36,269 af)

<sup>1</sup> Source: 2006 Mexico schedule.

<sup>2</sup> Source: Northerly International Boundary tcm + Cooper Wasteway tcm + Tijuana tcm

<sup>3</sup> Sources: Southerly Land Boundary Combined Flow (East Main Canal WW, West Main Canal WW, Main Drain, 242-Lateral) + 11-Mile WW + 21-Mile WW

<sup>4</sup> Source: Yuma Field Office calculations

The accumulated volume of Colorado River water recorded at Imperial Dam in 2006 was 6,998,314 tcm (5,673,533 af)<sup>5</sup>. The quantities requested by Mexico to be made for 2006 were in accordance with Article 10 of the 1944 Water Treaty. The quantities requested are for deliveries to be made at the riverbed above Morelos Diversion Dam, and across the southern land boundary near San Luis, Arizona, also referred to as Southerly International Boundary (SIB). Deliveries across the SIB include the water flows through the limitrophe of the river below Morelos Dam.

The actual deliveries made to Mexico at Tijuana, Baja California in 2006 by diverting Colorado River water at Parker Dam were made under IBWC Minute No. 310, using an existing pipeline at Otay Mesa, in San Diego, California. This Minute, which was signed in 2003, was intended to address periods of shortages expected to occur over the subsequent five years.

**Salinity**

**Table 2** shows a summary of salinity levels and differentials in the lower Colorado River in 2006.

<b>Table 2: Annual Average Flow-Weighted Salinity at Imperial Dam and Morelos Diversion Dam in 2006</b>		
<b>Waters</b>	<b>U.S. count (ppm)</b>	<b>Mexican count (ppm)</b>
<b>Arriving Upstream of Morelos Diversion Dam</b>	844	981
<b>Arriving at Imperial Dam</b>	713	835
<b>Salinity Differential</b>	131	146

The difference in the U.S. count and the Mexican count is due to different methods of analysis and computing the total dissolved solids (TDS) results used by laboratories in each country. Both countries are currently working together to try and determine the exact reason for the large difference in the salinity values and differential between the U.S. and Mexican count. In 2006, both US and Mexican Sections continued discussions regarding salinity analysis.

**Table 3** shows all of the annual average flow-weighted salinity levels and salinity differentials of the water resulting from operations under IBWC Minute No. 242, which became effective on June 24, 1974.

**Exhibit 2**, which demonstrates the effect of operations under the Minute, graphs the annual average salinity levels in the water arriving [delivered] at Imperial Dam since 1951 (the first full year of deliveries to Mexico under the 1944 Water Treaty) and at NIB since 1958.

**Quantities of United States Bypass Drain Water**

The Yuma Desalting Plant, located four miles west of Yuma, was built to reduce the salinity of pumped drainage water from the Wellton-Mohawk Irrigation and Drainage District before the water is returned to the Colorado River. Pending completion and operation of desalting projects, the U.S. adopted an interim measure to achieve the agreed upon salinity differential. This measure consisted of discharging all Wellton-Mohawk pumped drainage water into the United States Bypass Drain, which would convey these waters to the Santa Clara Slough on the Gulf of California in Mexico. An equal volume of other water consisting of drainage return flows above Northerly International Boundary (NIB) and Colorado River water

<sup>5</sup> Source: Table No. 4 from USIBWC Joint Salinity Report.

from upstream storage would be substituted for the diverted waters.

**Table 4** shows quantities of United States Bypass Drain water delivered, including the 2006 delivery at SIB and substituted for by other water for the deliveries to Mexico under IBWC Minute No. 242, since the Act of 1974. There was no Bypass Drain water discharged into the Colorado River during 2006.

## **DELIVERIES AT THE SOUTHERLY INTERNATIONAL BOUNDARY**

Point 1 of Minute No. 242 further provides that:

*The United States will continue to deliver to Mexico on the land boundary at San Luis and in the limitrophe section of the Colorado River downstream from Morelos Dam approximately 140,000 acre-feet (172,689,000 cubic meters) annually with a salinity substantially the same as that of the waters customarily delivered there.*

The annual volumes of water delivered to Mexico on the land boundary at San Luis through the Sanchez Mejorada Canal and in the limitrophe section of the river below Morelos Dam since Minute No. 242 operations began on June 25, 1974 are shown in **Table 5**. These volumes exclude the Wellton-Mohawk drainage water, which was bypassed in accordance with Minute No. 242 (discussed above). Delivery volume made in 2006, which totaled 155,992 tcm (126,465 af)<sup>6</sup>, was less than the annual volume of 172,000 tcm (139,442 af) referred to in IBWC Minute No. 242. The quantity of water to make up the difference was delivered in the bed of the Colorado River above Morelos Dam, as stipulated in Point 1 c) of IBWC Minute No. 242.

### **Annual Average Flow-Weighted Salinity in the Water Delivered to Mexico in 2006 at SIB**

The annual average flow-weighted salinity levels of the water delivered to Mexico at SIB near San Luis under IBWC Minute No. 242 since the Act of 1974 are shown in **Table 6**. The 2006 average salinity, at 995 ppm, was lower than the 33-year average of 1,352 ppm, as well as the average of 1,540 ppm for the 10-year period of 1963-72. 2006 was also the first time the annual average flow-weighted salinity was less than 1,000 ppm.

The U.S. shall continue to meet its legal obligations as described in IBWC Minute No. 242 by continuing to make the land boundary deliveries with the salinity level in the water customarily delivered at that point.

### **Southerly International Boundary (SIB) Issues and Resolutions**

Beginning in late 1995, Mexico raised objections to peaks in salinity levels and variability of flows in water delivered at SIB. The IBWC addressed these SIB matters through an international task force involving the federal water agencies of each country.

Mexico utilizes the 1944 Water Treaty water diverted at Morelos Dam for irrigation and domestic uses in the Mexicali Valley and conveys some of the water via aqueduct to Tecate and Tijuana. Mexico also uses some of the NIB delivered water along with water from wells near San Luis, Sonora, for mixing with the

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<sup>6</sup> Source: East Main Canal Wasteway + West Main Canal Wasteway + Main Drain + Two-Forty-Two Lateral - Diversion at SIB + Eleven-Mile Wasteway + Twenty-One- Mile Wasteway.

drainage water that the U.S. continues to deliver at SIB, so that the salinity level of these waters would be suitable for farming. Mexico uses this combination of waters to irrigate 93,860 acres (38,013 hectares) in the area of the Mexicali Valley in Sonora, known as the Left Bank unit. Thus, Mexico was concerned about reduction of crop yields, deterioration of soil quality, and increased water salinity on the Mexican side of the river.

Mexico, in this respect, requested that all its 1944 Water Treaty deliveries be made at NIB. This proposal was not practical to the U.S. in that it is impossible to stop drainage flows arriving at SIB and the U.S. continues to have the right to make deliveries at SIB as part of the 1944 Water Treaty volume. Further, this request would require an additional release of stored Colorado River water in the U.S. that is fully appropriated. Finally, there was a need to better understand all the factors that influence increasing soil and groundwater salinity and lower crop yields along the West Bank.

The International Task Force met several times to exchange information on U.S. operations and Mexico's management of the delivered water. As a matter of International Comity, the Task Force narrowed the various alternatives for salinity control at SIB to a period of four months of the year during which up to 8,000 af (9,868 tcm) of drainage water from the Boundary Pumping Plant, which pumps Main Drain water into the Sanchez-Mejorada Canal into Mexico, would be diverted to the United States Bypass Drain. It would be replaced with better quality water from the Minute 242 Well Field, discussed in the next section.

The Task Force also recommended structural modifications to the water delivery system at the SIB to reduce salinity levels and lessen the variability of flows delivered to Mexico. After examining various alternatives to ameliorate salinity peaks and variations in flows at SIB, the alternative to use variable speed motor controllers on the pumps at the Boundary Pumping Plant was chosen. The variable speed motor controller allows a pump to gradually increase its discharge until it reaches its maximum rate of discharge. If the forebay water surface elevation at the Boundary Pumping Plant does not drop, then the variable speed pump will shut down and another pump will start up. If the forebay elevation still does not drop, then the variable speed pump will start up again. Then it gradually increases its discharge rate until the forebay elevation drops. This should reduce the size of variation in water deliveries and salinity peaks at SIB.

Additions to the facilities at SIB based on the Task Force recommendations included: the replacement of one pump with a variable speed pump; construction of a bifurcation structure with three sluice gates; construction of a 7,000-foot concrete-lined diversion channel from the Boundary Pumping Plant to the United States Bypass Drain; and a control panel for the operation of all pumps and sluice gates.

All facilities have been completed with the exception of a remotely operated salinity monitoring and control system. Installation of the original supervisory control and data acquisition (SCADA) system began in 2004; however, equipment problems persisted and the Bureau of Reclamation continues to evaluate the equipment to ensure it meets project specifications.

The Yuma Desalting Plant (YDP) has been off-line and maintained in ready reserve status since the first part of 1993, when the concrete lining of the United States Bypass Drain was damaged by floodwater from the Gila River, and the size and quality of flows arriving at NIB made operation of the YDP unnecessary. During 2006, the Bureau of Reclamation continued to review alternatives for complying with the salinity differential [U.S. count], and plan on conducting a test run of the plant in 2007.

## GROUNDWATER – MINUTE NO. 242 WELL FIELD

Point 5 of Minute No. 242 provides that:

*Pending the conclusion by the Governments of the United States and Mexico of a comprehensive agreement on groundwater in the border areas, each country shall limit pumping of groundwater in its territory within five miles (eight kilometers) of the Arizona-Sonora boundary near San Luis to 160,000 acre-feet (197,358,000 cubic meters) annually.*

In 2006, Mexico pumped 174,778 tcm (141,693 af) from its San Luis Mesa Well Field located within five miles (eight kilometers) of the boundary near San Luis. **Table 7** shows the annual quantities pumped by Mexico from its San Luis Mesa field.

The U.S. pumped a total of 56,710 tcm (45,975 af), including the Minute 242 Well Field. **Table 8** shows the annual quantities pumped by the U.S. from the Minute 242 Well Field from 1975 through 2006 and pumpage within five miles that includes the Minute 242 Well Field.

The Bureau of Reclamation has constructed 21 wells of the original plan to build up to 35 that would eventually be required on the U.S. side of the SIB. Construction of the remaining 14 wells has been deferred until additional water supply needs make it necessary. All of the existing wells are located on the mesa within 5 miles (8 kilometers) of the SIB near San Luis. Water captured from these wells is then delivered to Mexico at the SIB in partial satisfaction of the 1944 Water Treaty. In 2006, 18 wells were pumped.

## CONSULTATIONS AND REGIONAL DEVELOPMENTS

Point 6 of Minute No. 242 provides that:

*... the United States and Mexico shall consult with each other prior to undertaking any new development of either the surface or the groundwater resources, or undertaking substantial modifications of present developments, in its own territory in the border area that might adversely affect the other country.*

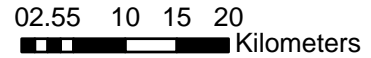
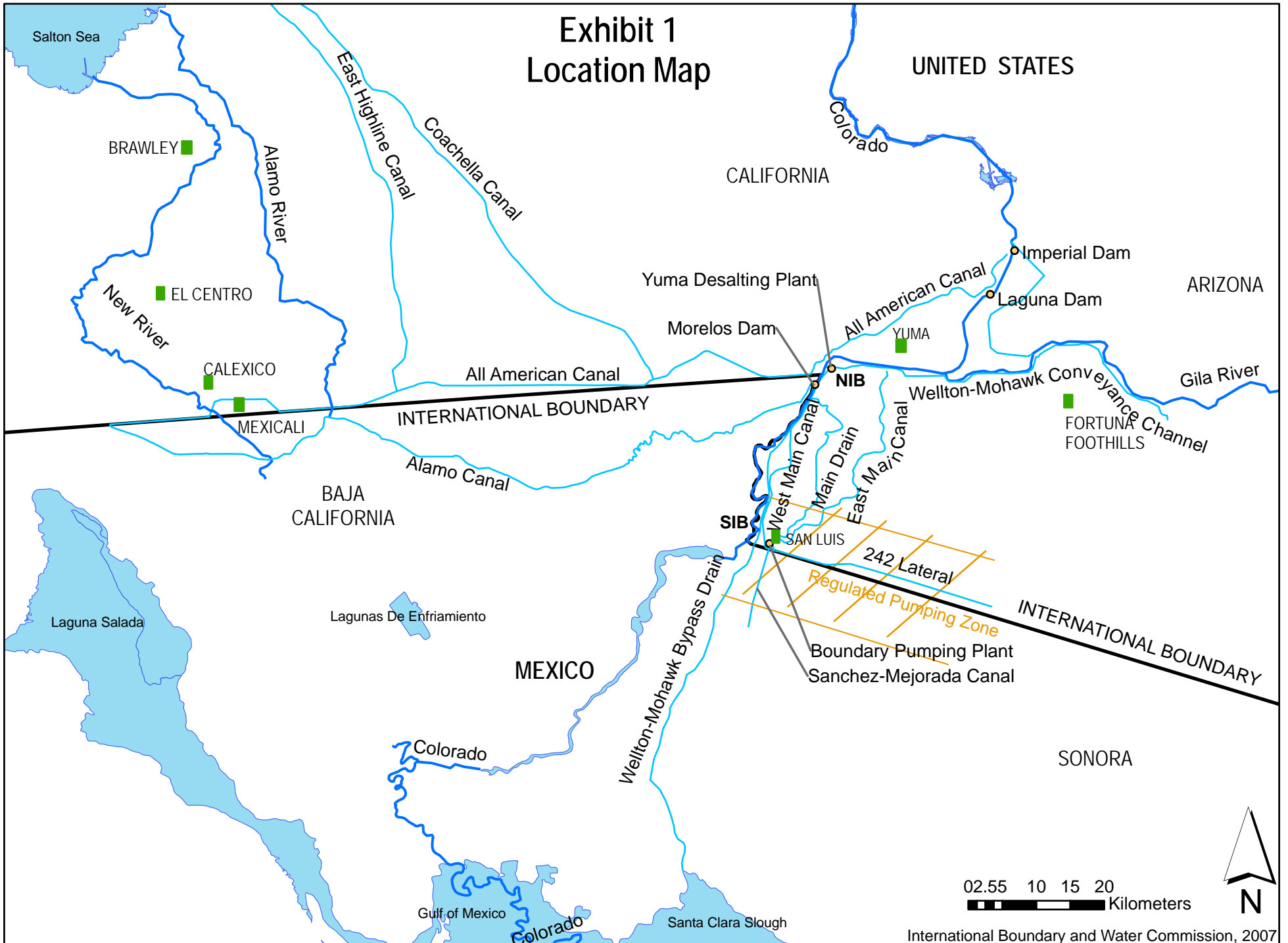
The U.S. and Mexico continued discussions related to cooperative measures to reduce potential impacts of the All American Canal lining on Mexico. IBWC also consulted with the Bureau of Reclamation in preparing the draft alternatives and draft Environmental Impact Statement, “Colorado River Interim Guidelines for Lower Basin Shortages for Lower Colorado River Shortage Criteria”. Similarly, IBWC binational technical work groups continued to develop joint cooperation positions concerning salinity peaks in the deliveries made at the SIB and removal of sediment in the international boundary reach of the Colorado River.

## ACKNOWLEDGMENT

The full cooperation of the United States Geological Survey and the Bureau of Reclamation, as reported herein, is acknowledged with appreciation. This cooperation enabled compliance with the 1944 Water Treaty and with the salinity agreement with Mexico.



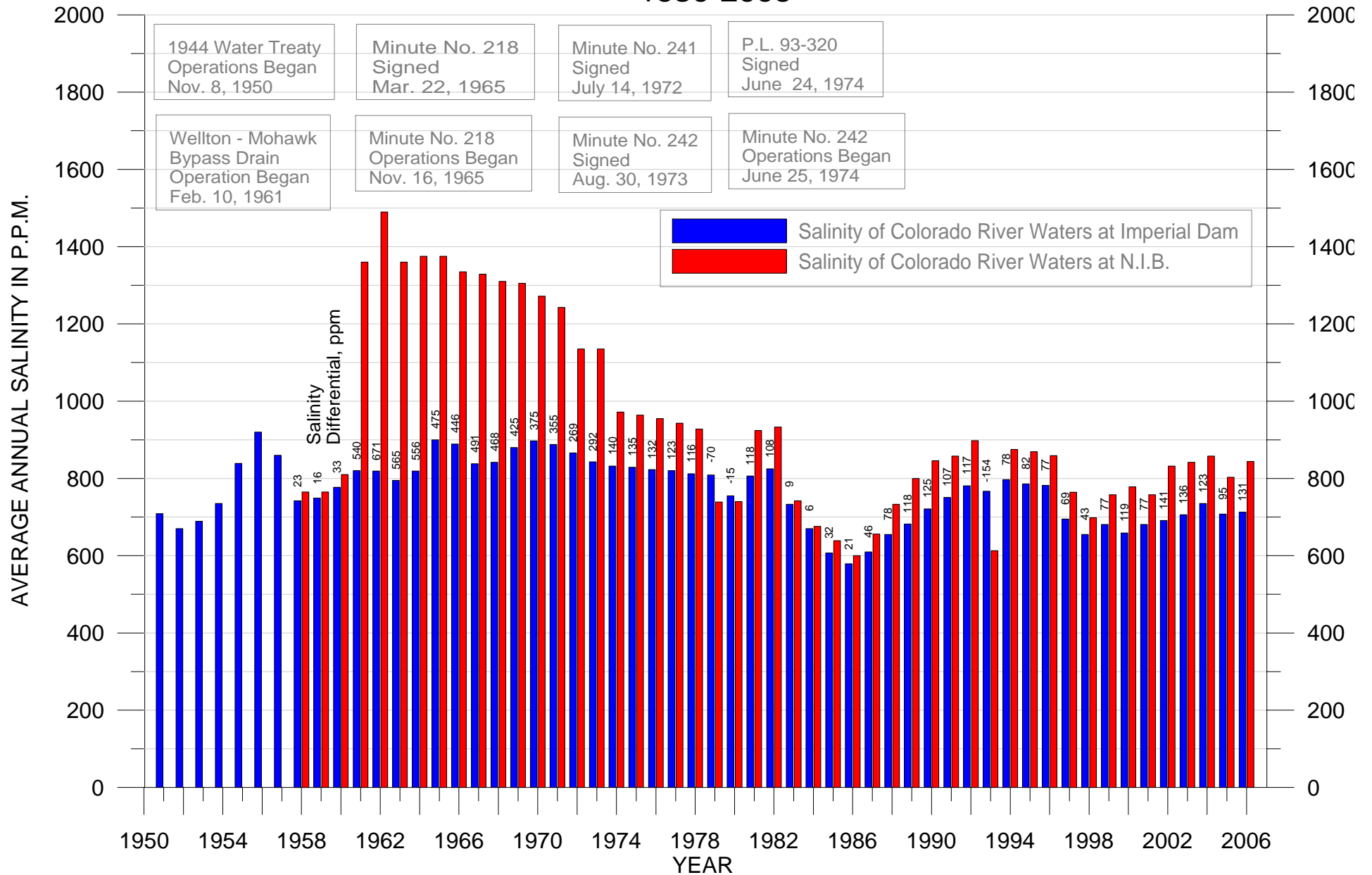
# Exhibit 1 Location Map





**Exhibit 2. Flow-Weighted Annual Average Salinity Levels in the Water Arriving at Imperial Dam Since 1951, and at the Northerly International Boundary (NIB) Since 1958.**

## SALINITY OF COLORADO RIVER TREATY WATERS AT IMPERIAL DAM AND THE NORTHERLY INTERNATIONAL BOUNDARY 1950-2006



**Table 3. Annual Average Flow-Weighted Salinities of the Water of the Colorado River Delivered Upstream of Morelos Diversion Dam [at Northerly International Boundary], and at Imperial Dam [Resulting from Operations under IBWC Minute No. 242, since the Colorado River Salinity Control Act, as amended, became effective on June 24, 1974]**

Year	Annual Average Salinity (U.S. Count) as TDS (ppm)		Differential (U.S. Count) (ppm)
	At Imperial Dam	Upstream of Morelos Dam	
1974 (6/25-12/31)	832	972	140
1975	829	964	135
1976	823	955	132
1977	820	943	123
1978	812	928	116
1979	809	739	-70
1980	755	740	-15
1981	806	924	118
1982	825	933	108
1983	733	742	9
1984	670	676	6
1985	607	639	32
1986	579	600	21
1987	610	656	46
1988	655	733	78
1989	682	800	118
1990	721	846	125
1991	751	858	107
1992	781	898	117
1993	767	613	-154
1994	797	875	78
1995	787	869	82
1996	782	859	77
1997	695	764	69
1998	655	698	43
1999	681	758	77
2000	659	778	119
2001	681	820	139
2002	691	832	141
2003	706	842	136
2004	735	858	123
2005	708	803	95
2006	713	844	131

**Table 4. United States Bypass Drain Water Delivered at Southerly International Boundary (SIB)**

Year	Annual Volume Discharged	
	(tcm)	(af)
1974 (6/25 – 12/31)	140,180	113,645
1975	264,866	214,729
1976	253,353	205,395
1977	255,113	206,822
1978	224,540	182,036
1979	219,472	177,928
1980	190,735	154,630
1981	183,082	148,426
1982	184,651	149,698
1983	220,988 <sup>1</sup>	179,157 <sup>1</sup>
1984	154,944 <sup>2</sup>	125,615 <sup>2</sup>
1985	159,987	129,704
1986	135,747	110,052
1987	120,562	97,741
1988	158,103	128,176
1989	170,990	138,624
1990	164,900	133,690
1991	173,583	140,726
1992	124,716	101,109
1993	75,784 <sup>3</sup>	61,439 <sup>3</sup>
1994	156,477	124,435
1995	154,772	125,475
1996	138,632	112,390
1997	109,971	89,155
1998	140,332	113,769
1999	97,044	78,675
2000	132,530	107,443
2001	127,969	103,746
2002	150,176	121,749
2003	141,523	114,734
2004	121,883	98,812
2005	132,519	107,433
2006	132,617	107,514

<sup>1</sup> Includes undetermined # floodwater from bypass canal levee breaks in U.S.

<sup>2</sup> Includes Gila R. water.

<sup>3</sup> Low flows due to damage on drainage canal by Gila R. floodwater. Drainage water entered the Gila R., Feb. 21, 93-Jan. 18, 94 and was diluted by high flows.

**Table 5. Annual Volumes of Water Scheduled [and/or Actually Delivered] to the Sanchez Mejorada Canal, at the Southerly International Boundary Near San Luis, Arizona, and in the Limitrophe Section of the Colorado River below Morelos Dam [Under IBWC Minute No. 242, since the Colorado River Salinity Control Act, as Amended, became effective on June 24, 1974]**

Year	Annual Volume Delivered	
	(tcm)	(af)
1974 (June 25 – Dec. 31)	70,377	57,055
1975	133,377	107,916
1976	133,328	108,090
1977	115,034	93,259
1978	99,409	80,592
1979	108,263	87,770
1980	126,058	102,196
1981	143,077	115,994
1982	134,843	107,697
1983	120,616	97,784
1984	138,007	111,884
1985	138,091	111,952
1986	153,974	124,829
1987	145,581	118,025
1988	138,832	112,553
1989	167,355	135,677
1990	165,169	133,905
1991	166,289	134,813
1992	157,069	127,338
1993	139,929	113,442
1994	155,091	125,734
1995	144,663	117,279
1996	144,331	117,010
1997	142,013	115,131
1998	159,782	129,537
1999	164,643	133,477
2000	169,577	137,478
2001	164,736	133,553
2002	151,919	123,162
2003	141,523	114,734
2004	160,957	130,488
2005	157,437	127,634
2006	155,992	126,465

**Table 6. Annual Average Flow-Weighted Salinities of the Water Delivered to Mexico at the Southerly International Boundary [Under IBWC Minute No. 242, since the Colorado River Basin Salinity Control Act, as Amended, became effective on June 24, 1974]**

<b>Year</b>	<b>Annual Average Flow-Weighted Salinity (U.S. Count) as TDS (ppm)</b>
1974 (6/25 – 12/31)	1,515
1975	1,500
1976	1,480
1977	1,510
1978	1,470
1979	1,538
1980	1,582
1981	1,572
1982	1,470
1983	1,434
1984	1,487
1985	1,513
1986	1,496
1987	1,431
1988	1,488
1989	1,300
1990	1,333
1991	1,223
1992	1,312
1993	1,306
1994	1,299
1995	1,313
1996	1,358
1997	1,341
1998	1,214
1999	1,242
2000	1,173
2001	1,192
2002	1,166
2003	1,094
2004	1,155
2005	1,103
2006	995

**Table 7. Mexico Pumping from its San Luis Mesa Well Field Located Within Five Miles (Eight Kilometers) of the Arizona-Sonora boundary near San Luis**

Year	Annual Volume Pumped	
	(tcm)	(af)
1975	131,030	106,227
1976	120,722	97,870
1977	159,905	129,636
1978	121,172	98,235
1979	29,063	23,562
1980	17,735	14,378
1981	148,742	120,586
1982	162,498	131,738
1983	22,437	18,190
1984	8,963	7,266
1985	37,373	30,299
1986	13,308	10,789
1987	64,453	52,253
1988	157,374	127,585
1989	173,551	140,700
1990	167,848	136,077
1991	153,227	124,223
1992	81,374	65,971
1993	7,237 <sup>1</sup>	5,867 <sup>1</sup>
1994	76,281	61,841
1995	48,830	39,587
1996	81,039	65,699
1997	36,576	29,653
1998	0 <sup>2</sup>	0 <sup>2</sup>
1998	0 <sup>2</sup>	0 <sup>2</sup>
1999	0 <sup>2</sup>	0 <sup>2</sup>
2000	0 <sup>2</sup>	0 <sup>2</sup>
2001	67,173	54,458
2002	135,687	110,003
2003	174,747	141,669
2004	182,994	148,355
2005	153,762	124,655
2006	174,778	141,693

<sup>1</sup> The reduced pumping was due to excess delivery from the Gila River flood flows.

<sup>2</sup> No Pumping required due to sufficient flows in the Colorado River.

<b>Table 8. Total Volume Pumped by the United States, and Volume Pumped At the Minute 242 Well Field</b>				
<b>Year</b>	<b>Total Volume Pumped</b>		<b>242 Well Field Volume Pumped <sup>1</sup></b>	
	<b>(tcm)</b>	<b>(af)</b>	<b>(tcm)</b>	<b>(af)</b>
1975	33,401	26,787		
1976	28,047	22,738		
1977	28,358	22,990		
1978 <sup>1</sup>	22,079	17,900		
1979	31,353	25,418	201	163
1980	35,188	28,527	2,244	1,819
1981	47,443	38,463	23,361	18,939
1982	50,516	40,954	29,036	23,540
1983	20,608	16,707	4,856	3,937
1984	19,078	15,467	3,721	3,017
1985	16,818	13,635	2,531	2,952
1986	32,497	26,346	3,358	2,723
1987	33,213	26,926	4,215	3,417
1988	29,512	23,096	3,073	2,491
1989	63,020	51,091	35,430	28,724
1990	71,721	58,145	38,050	30,848
1991	53,000	42,968	38,461	31,181
1992	38,696	31,371	28,319	22,958
1993	18,473	14,976	8,001	6,486
1994	40,478	32,816	23,738	19,245
1995	38,879	31,520	15,354	12,448
1996	21,546	17,468	8,055	6,530
1997	9,776	7,926	550	446
1998	20,592	16,694	6,337	5,138
1999	14,107	11,437	4,884	3,960
2000	14,311	11,602	5,240	4,248
2001	13,329	10,806	2,788	2,260
2002	17,576	14,249	4,402	3,569
2003	31,589	25,609	18,727	15,182
2004	37,605	30,487	27,797	22,536
2005	53,466	43,345	36,906	29,920
2006	56,710	45,975	40,548	32,872

<sup>1</sup>Minute No. 242 Well Field was constructed in 1978.