Appendix M

Modeling Assumptions: Lake Mead Storage and Delivery of Conserved System and Non-system Water

Three of the action alternatives assume some form of a Lake Mead storage and delivery mechanism for conserved system and non-system water (the Basin States, Conservation Before Shortage and Reservoir Storage alternatives). This appendix describes the modeling assumptions used in the CRSS regarding the activities assumed to generate storage credits and the conditions under which the storage credits are assumed to be generated and delivered.

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M.1 Introduction

At this time, it is unknown which entities might participate in a Lake Mead mechanism that allows the storage and delivery of conserved system and non-system water. Furthermore, the timing and magnitude of the storage and delivery of conserved water is unknown. However, modeling assumptions with respect to the entities that might participate and their respective level of participation were needed to enable the evaluation of the mechanism and its potential effects on environmental resources, particularly to reservoir storage and river flows below Lake Mead.

The proposed federal action is for the purpose of adopting additional operational strategies to improve the Department's annual management and operation of key Colorado River reservoirs. However, in order to assess the potential effects of the proposed federal action in this Draft EIS, certain modeling assumptions are used that display projected water deliveries to Mexico. Reclamation's modeling assumptions are not intended to constitute an interpretation or application of the 1944 Treaty or to represent current or future United States policy regarding deliveries to Mexico. The United States will conduct all necessary and appropriate discussions regarding the proposed federal action and implementation of the 1944 Treaty with Mexico through the IBWC in consultation with the Department of State. [1]

For two of the action alternatives (the Conservation Before Shortage Alternative and the Reservoir Storage Alternative), it was assumed that storage credits would be generated and used for environmental purposes. These modeling assumptions were utilized in this Draft EIS in order to analyze the potential impacts to environmental resources of the storage and delivery mechanism, particularly with regard to reservoir elevations and river flow impacts. The use of these modeling assumptions does not represent any determination by Reclamation as to whether, or how, these releases could be made under current administration of the river.

M.2 General Modeling Assumptions

Three alternatives assume some form of a Lake Mead storage and delivery mechanism for conserved system and non-system water (the Basin States, Conservation Before Shortage and Reservoir Storage alternatives). This section explains the general modeling assumptions

[1] Notwithstanding the lack of an existing mechanism to implement such modeling assumptions, Reclamation utilized these assumptions for a number of reasons, including the following: (1) a larger volume of potential storage in Lake Mead is identified, (2) the maximum potential impacts on river flows below Hoover Dam are identified, (3) the alternative proponent's recommendations as to participating entities and levels of participation are modeled, (4) the arbitrary assignment of water conservation amounts to entities in the Lower Basin states is avoided, and (5) a program of potential future cooperation between the United States and Mexico is identified.

regarding how storage credits are generated and delivered within the CRSS model. Examples of the accounting of storage credits within the model are also presented below.

M.2.1 Generation of Storage Credits

When storage credits are created, the model assumes either a delivery from Lake Mead is decreased or a new gain to the system is introduced, resulting in an increase to Lake Mead storage. If the reduced delivery is located downstream of Lake Mead, creation of the storage credit results in a reduction in the release from Lake Mead and river flow downstream.

At the beginning of each year, the model assumes that storage credits will be generated based on annual schedules and that the scheduled amount does not change throughout the year. The ability to store conservation credits in Lake Mead is assumed to be in effect from 2008 through 2026 (i.e., conserved water is assumed to not be stored in Lake Mead after 2026).

The activity resulting in the creation of credits is assumed to originate from a point on the river located furthest downstream in order to evaluate the maximum effects of the storage and delivery mechanism on river flows. In general, water conserved for use by a particular state is assumed to be generated by an entity within that state that had an annual depletion schedule sufficiently large enough to accommodate the reductions. In the case of the Conservation Before Shortage and Reservoir Storage alternatives, which assume storage and delivery activities for Mexico and the federal government, these activities were assumed to occur within Mexico because this is the last major user in the lower part of the river and again, this permitted evaluation of the potential effects on river flow reductions.

A one-time system assessment is assumed to be dedicated to the system upon the creation of a storage credit (i.e., when water is placed in storage). The system assessment is assumed to be five percent of the volume of water stored for the Basin States and Conservation Before Shortage alternatives. For the Reservoir Storage Alternative, the system assessment is assumed to be ten percent of the volume of water stored. For example, if an entity wishes to receive credit for 100 kaf, then the credits that must be generated become: 100 kaf / (1 – system assessment).

The model assumes that the accounting of storage credits occurs annually, at the end of the year. Storage credits in Lake Mead are assumed to be subject to the following rules:

- An annual 3 percent deduction for evaporation. The deduction occurs at the end of the year and is based on the available credits at the beginning of the year.
- No evaporation deductions occur during Shortage conditions.
- In the event of a flood control release, all storage credits are eliminated and stored water reverts to the system.
- The total volume of storage credits in Lake Mead at any given time is not included in the determination of a Quantified Surplus using the 70R Strategy.

- The amount of storage credits that may be generated in a single year is constrained by assumed maximum annual and maximum total limits. These assumed limits vary by alternative and are presented in Section M.3.

M.2.2 Delivery of Storage Credits

When storage credits are delivered from Lake Mead, the model assumed that a delivery from Lake Mead was increased for that year, resulting in a decrease in Lake Mead storage. If the increased delivery is located downstream of Lake Mead, delivery of the storage credit results in an increase in the release from Lake Mead and river flow downstream.

At the beginning of each year, the model assumes that storage credits will be delivered based on annual schedules and that the scheduled delivery amount does not change throughout the year. Although the ability to store conservation credits in Lake Mead is assumed to be in effect from 2008 through 2026 (i.e., conserved water may not be stored in Lake Mead after 2026), a 10-year period (from 2027 through 2036) was assumed for entities to take any storage credits remaining after the end of the interim period.

After 2026, some conservation activities assumed to be undertaken by Nevada are assumed to continue through 2060 (tributary conservation, groundwater return flows, and desalinization described further in Section M.3.1). The model assumes delivery of that water to Nevada in the year that the conservation occurs.

M.2.3 Examples of Storage Credit Accounting

Table M-1 provides an example of storage credit accounting in CRSS. A “put” refers to the creation of credits. A “take” is the delivery of credits. Although most calculations in CRSS occur on a monthly basis, the model calculates available storage credits annually, at the end of the year. At the end of year n, the balance of storage credits is determined as,

$$Balance_n = Balance_{n-1} + Put(1 - Assessment\%) - Take - Evap\%(Balance_{n-1})$$

Table M-1
Example of Storage Credit Accounting (af)

Year	Put	Assessment[1]	Put Adjusted for Assessment	Requested Take	Actual Take	Evaporation	Balance
1	0	0	0	0	0	0	0
2	200,000	10,000	190,000	0	0	0	190,000
3	100,000	5,000	95,000	50,000	50,000	5,700	229,300
4	0	0	0	200,000	200,000	6,879	22,421
5	0	0	0	50,000	21,748	673	0

1 Assuming a system assessment of five percent.

Year 1: The storage credit balance is zero and there is no activity for this year.

Year 2: A put of 200 kaf is scheduled for this year. There is a 200 kaf reduction in delivery for this year. Assuming a system assessment of 5 percent, 190 kaf of storage credits are generated for this year and 10 kaf (five percent of 200 kaf) is credited to the system. There are no takes scheduled. Evaporation is counted as 3 percent of the previous year's balance. Because the balance in Year 1 is 0, there is no evaporation loss deducted in Year 2.

Year 3: Applying the scheduled put and take values to the equation above a balance of 229,300 is created.

$$229{,}300 = 190{,}000 + 100{,}000(1 - 0.05) - 50{,}000 - 0.03(190{,}000)$$

Year 4: Applying the scheduled put and take values to the equation above a balance of 22,421 is created.

$$22{,}421 = 229{,}300 + 0(1 - 0.05) - 200{,}000 - 0.03(229{,}300)$$

Year 5: The requested take is higher than the available storage credits. Therefore the actual take is constrained by the available credits to be 21,748 af.

M.3 Modeling Assumptions Specific to Alternatives

Modeling assumptions with respect to the entities that might participate and their respective level of participation were needed to enable the evaluation of the potential effects of the mechanism for each alternative. These assumptions include the maximum amount of storage credits that may be created during any year, the maximum amount of storage credits that may be recovered during any year, and the maximum total amount of storage credits that may be available at any one time. In addition, assumptions with regard to the timing and magnitude of the storage and delivery of conserved water are needed. The assumptions made for each alternative are detailed in the following sections.

M.3.1 Basin States Alternative

As discussed in Section 2.3, the Basin States Alternative assumes the levels of participation as shown in Table M-2.

Table M-2
Basin States Alternative Volume Limitations of Storage and Delivery Mechanism

Entity	Maximum Annual Storage of Conserved System or Non-system Water (kaf)	Maximum Total Storage of Conserved System or Non-system Water (kaf)	Maximum Annual Delivery of Conserved System or Non-system Water (kaf)
Arizona	100	300	300
California	400	1,500	400
Nevada	125	300	300
Total	625	2,100	1,000

These volume limitations are recognized in CRSS as are other rules that specify under which water supply conditions conserved system or non-system water may be delivered or stored as summarized in Section M.3.4. The schedules for Arizona, California and Nevada were provided by the Arizona Department of Water Resources (ADWR), the Metropolitan Water District of Southern California (MWD) and the Southern Nevada Water Authority (SNWA), respectively, and are detailed below.

M.3.1.1 Arizona

In order to analyze the maximum effects on river flows, the model assumes that Arizona storage credits are generated through extraordinary conservation by the Yuma County Water Users Association and are delivered to CAP. According to the storage and delivery schedules provided by ADWR, the generation of storage credits begins in 2017, as shown in Table M-3. It was assumed that credits are stored and delivered only during Normal conditions.

M.3.1.2 California

In order to analyze the maximum effects on river flows, the model assumes that California storage credits are generated through extraordinary conservation by the Imperial Irrigation District and are delivered to MWD. Schedules for the generation and delivery of storage credits were provided by MWD. Ninety-nine (99) schedules were provided, corresponding to the 99 hydrologic traces used in the ISM simulations (Section 4.2). As an example, one of these schedules is presented in Table M-3. In 2008 California is assumed to begin with a storage credit balance of 100 kaf due to pilot programs in place in 2006 and 2007. It was assumed that credits are stored and delivered only during Normal conditions.

M.3.1.3 Nevada

As provided by SNWA, four different conservation activities are assumed to be undertaken by Nevada to generate storage credits. Each activity is subject to different assumptions as to when storage credits may be generated and used as described below. The schedules provided by SNWA are shown in Table M-3.

Tributary Conservation. It was assumed that water from extraordinary conservation on the Muddy and Virgin Rivers would generate storage credits. This activity is assumed to be in place during the period from 2009 through 2060. In the CRSS model, a gain to Lake Mead was introduced as the source of these storage credits and it is assumed that delivery is taken by SNWA from Lake Mead. In general, it was assumed that credits may be stored during all water supply conditions (except the Flood Control Surplus condition) and may be delivered during Normal and Shortage conditions. However, it was also assumed that SNWA would take storage credits during a Full Domestic Surplus condition if needed to avoid exceeding the maximum total amount of storage credits. After 2026, it is assumed that the tributary conservation water would continue to be created each year and would be used in the same year. The system assessment is assumed to be in effect through 2060.

Groundwater. SNWA return flows originating from Nevada groundwater development projects are assumed to be available during the period from 2009 through 2060. In the CRSS model, a gain to Lake Mead was introduced as the source of groundwater and it is assumed that delivery is taken by SNWA from Lake Mead. It was assumed that groundwater return flows are stored and delivered only during Normal and Shortage conditions. After 2026, it is assumed that the groundwater return flows would continue to be created each year and would be used in the same year. The system assessment for groundwater is assumed to be in effect through 2060.

Desalinization. SNWA is assumed to receive water generated from desalinization beginning in 2012 through 2060. To account for water created through desalinization, a gain was introduced to the system below Imperial Dam. Desalinization water is assumed to be generated and taken during all water supply conditions except during Flood Control Surplus conditions. After 2026, it is assumed that the desalinization water would continue to be created each year and would be used in the same year. The system assessment for desalinization is assumed to be in effect through 2060.

Drop 2 Reservoir. As discussed in Section 4.2.7, the proposed Drop 2 Reservoir is assumed to be in operation beginning in 2010 and to conserve an average of 69 kafy, reducing the average over-delivery to Mexico from 77 kafy to 8 kafy under all alternatives. Under the three action alternatives that assume a storage and delivery mechanism, SNWA is assumed to use water conserved by the Drop 2 Reservoir beginning in 2013 during Surplus (excluding the Flood Control Surplus condition) and Normal conditions. A system assessment is not applied to Drop 2 Reservoir water. Nevada takes Drop 2 Reservoir water at a maximum rate of 40 kaf each year until a total of 300 kaf has been taken. Thereafter, water conserved by the Drop 2 Reservoir is assumed to be system water.

Table M-3
Assumed Storage and Delivery Schedules for Conservation Activities Under the Basin States Alternative[1]

	Arizona		**California[2]**		**Nevada**					
	Extraordinary Conservation (af)		Extraordinary Conservation (af)		Tributary Conservation (af)		Groundwater (af)		Desalinization (af)	
YEAR	STORE	DELIVER	STORE	DELIVER	STORE	DELIVER	STORE	DELIVER	STORE	DELIVER
2008	0	0	400,000	0	0	0	0	0	0	0
2009	0	0	400,000	0	30,000	5,000	13,000	13,000	0	0
2010	0	0	400,000	0	30,000	5,000	13,000	13,000	0	0
2011	0	0	400,000	0	30,000	5,000	13,000	13,000	0	0
2012	0	0	400,000	0	30,000	5,000	13,000	13,000	0	0
2013	0	0	400,000	0	30,000	5,000	13,000	13,000	0	0
2014	0	0	100,000	0	30,000	5,000	13,000	13,000	0	0
2015	0	0	0	0	30,000	5,000	13,000	13,000	0	0
2016	0	0	300,000	0	30,000	5,000	13,000	13,000	0	0
2017	100,000	0	400,000	0	30,000	5,000	13,000	13,000	0	0
2018	100,000	0	300,000	0	30,000	5,000	13,000	13,000	0	0
2019	100,000	0	200,000	0	30,000	5,000	13,000	13,000	0	0
2020	0	300,000	0	100,000	30,000	5,000	80,000	80,000	75,000	75,000
2021	100,000	50,000	0	100,000	30,000	5,000	80,000	80,000	75,000	75,000
2022	100,000	0	0	200,000	30,000	5,000	80,000	80,000	75,000	75,000
2023	100,000	0	0	0	30,000	5,000	80,000	80,000	75,000	75,000
2024	50,000	0	100,000	0	30,000	5,000	80,000	80,000	75,000	75,000

Table M-3
Assumed Storage and Delivery Schedules for Conservation Activities Under the Basin States Alternative[1]

	Arizona		California[2]		Nevada					
	Extraordinary Conservation (af)		Extraordinary Conservation (af)		Tributary Conservation (af)		Groundwater (af)		Desalinization (af)	
YEAR	STORE	DELIVER	STORE	DELIVER	STORE	DELIVER	STORE	DELIVER	STORE	DELIVER
2025	0	50,000	0	100,000	30,000	30,000	80,000	80,000	75,000	75,000
2026	0	50,000	0	400,000	30,000	30,000	80,000	80,000	75,000	75,000
2027	0	50,000	0	300,000	30,000	30,000	80,000	80,000	75,000	75,000
2028	0	50,000	0	200,000	30,000	30,000	80,000	80,000	75,000	75,000
2029	0	50,000	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2030	0	50,000	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2031	0	50,000	0	400,000	30,000	30,000	80,000	80,000	75,000	75,000
2032	0	50,000	0	400,000	30,000	30,000	80,000	80,000	75,000	75,000
2033	0	50,000	0	400,000	30,000	30,000	80,000	80,000	75,000	75,000
2034	0	50,000	0	400,000	30,000	30,000	80,000	80,000	75,000	75,000
2035	0	50,000	0	400,000	30,000	30,000	80,000	80,000	75,000	75,000
2036	0	50,000	0	400,000	30,000	30,000	80,000	80,000	75,000	75,000
2037	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2038	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2039	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2040	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2041	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2042	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2043	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2044	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2045	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2046	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2047	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2048	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2049	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2050	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2051	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2052	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2053	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2054	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2055	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2056	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2057	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2058	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2059	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000
2060	0	0	0	0	30,000	30,000	80,000	80,000	75,000	75,000

1 Actual modeled delivery amounts may be less depending on availability, system assessment and evaporation losses.

2 Reclamation was provided 99 distinct storage and delivery schedules by MWD to be used with the Index Sequential Method. The schedule in this table is an example of one schedule corresponding to one hydrologic sequence.

M.3.2 Conservation Before Shortage

As discussed in Section 2.4, the Conservation Before Shortage Alternative assumes the levels of participation as shown in Table M-4.

Table M-4
Conservation Before Shortage Alternative Volume Limitations of Storage and Delivery Mechanism

Entity	Maximum Annual Storage of Conserved System or Non-system Water (kaf)	Maximum Total Storage of Conserved System or Non-system Water (kaf)	Maximum Annual Delivery of Conserved System or Non-system Water (kaf)
Arizona	100	300	300
California	400	1,500	400
Nevada	125	300	300
Unassigned	825	2100	600
Total	1,450	4,200	1,600

These volume limitations are recognized in CRSS as are other rules that specify under which water supply conditions conserved system or non-system water may be delivered or stored as summarized in Section M.3.4. The schedules for the Conservation Before Shortage Alternative for the participation of the Lower Division states were assumed to be identical to those used in the Basin States Alternative (Table M-3). The schedules for the expanded participation by other entities (Unassigned in Table M-4) were provided by the NGOs and are detailed below.

The Conservation Before Shortage proposal includes voluntary, compensated reductions in water use prior to the imposition of involuntary shortages (Section 2.4). To model this proposal, it was assumed that storage credits of 400, 500 and 600 kafy would be created when Lake Mead was at specific elevations within the range of 1,075 feet msl and 1,025 feet msl, as described in Section 2.4.3. For modeling purposes and to maximize river flow effects, these storage credits were assumed to be generated via extraordinary conservation within Mexico. The system assessment is applied when these storage credits are created and it was assumed that these storage credits would remain in Lake Mead and would be counted toward the replacement of the bypass flows to the Cienega de Santa Clara in Mexico.

The model maintains an accounting for the bypass flow replacement. In each year, the model releases 109 kaf (Section 4.2.6) for the bypass flows and deducts that amount from the bypass flow replacement account. Any deficit that accumulates in the account is tracked and offset at a later time when Lake Mead is below elevation 1,075 feet msl and storage credits are created. The maximum positive volume for the account is assumed to be 1.5 maf and any additional water that is conserved above that amount is assumed to convert to system water. Evaporation losses are applied to any positive balance in the account at the end of each year.

The NGOs also postulated that storage credits would be generated by Mexico and be used for the purpose of environmental flows in Mexico. These credits would be subject to the system assessment and evaporation losses and would be stored and delivered during Surplus or Normal conditions, but not during Flood Control Surplus or Shortage conditions. Two sets of environmental flows are assumed to occur. The first are pulse flows to the Colorado River Delta flowing into the Gulf of California, assumed to occur every five years after the last flood control release, with the first flow scheduled for 2012 (referred to as “Delta Pulse Flows” in Table M-5). Each year, storage credits of 50 kaf are assumed to be generated. Delta pulse flows are of magnitude 250 kaf; however, in the fifth year, the storage credit of 50 kaf is assumed to be stored and delivered in the same year and a system assessment is not applied. The model assumes that Delta pulse flows would flow past the NIB and are counted as part of Mexico’s delivery. The second set of environmental flows (termed “Other Environmental Flows Below NIB” in Table M-5) is assumed also to occur every five years, with the first scheduled for 2010 at a volume of 80 kaf. Each year 40 kaf of storage credits is scheduled to be created for these flows. After 2010, these flows increase to a volume of 200 kaf and similar to the Delta pulse flows, in the fifth year the 40 kaf is assumed to be stored and delivered in the same year. The model also assumes that this water would flow past the NIB and is counted as part of Mexico’s delivery.

The NGOs postulated an additional activity to create 100 kafy of storage credits to be used for environmental uses within the United States (termed “Additional Environmental Uses” in Table M-5). It was assumed that these credits would be created and delivered during Normal and Surplus conditions and would be subject to the system assessment and evaporation losses. For modeling purposes and to maximize river flow effects, this water was also assumed to be generated via extraordinary conservation within Mexico.

The assumed schedules for these activities are presented in Table M-5.

Table M-5
Assumed Storage and Delivery Schedules for
Other Conservation Activities Under the Conservation Before Shortage Alternative[1]

Year	Delta Pulse Flows		Other Environmental Flows Below NIB		Additional Environmental Uses	
	STORE	DELIVER	STORE	DELIVER	STORE	DELIVER
2008	52,632	0	42,105	0	105,263	100,000
2009	52,632	0	42,105	0	105,263	100,000
2010	52,632	0	0	80,000	105,263	100,000
2011	52,632	0	42,105	0	105,263	100,000
2012	50,000	250,000	42,105	0	105,263	100,000
2013	52,632	0	42,105	0	105,263	100,000
2014	52,632	0	42,105	0	105,263	100,000
2015	52,632	0	40,000	200,000	105,263	100,000
2016	52,632	0	42,105	0	105,263	100,000
2017	50,000	250,000	42,105	0	105,263	100,000
2018	52,632	0	42,105	0	105,263	100,000
2019	52,632	0	42,105	0	105,263	100,000
2020	52,632	0	40,000	200,000	105,263	100,000
2021	52,632	0	42,105	0	105,263	100,000
2022	50,000	250,000	42,105	0	105,263	100,000
2023	52,632	0	42,105	0	105,263	100,000
2024	52,632	0	42,105	0	105,263	100,000
2025	52,632	0	40,000	200,000	105,263	100,000
2026	52,632	0	42,105	0	105,263	100,000
2027	50,000	250,000	0	0	0	100,000
2028	0	0	0	0	0	100,000
2029	0	0	0	0	0	100,000

Table M-5
Assumed Storage and Delivery Schedules for
Other Conservation Activities Under the Conservation Before Shortage Alternative[1]

Year	Delta Pulse Flows		Other Environmental Flows Below NIB		Additional Environmental Uses	
	STORE	DELIVER	STORE	DELIVER	STORE	DELIVER
2030	0	0	0	200,000	0	100,000
2031	0	0	0	0	0	100,000
2032	0	250,000	0	0	0	100,000
2033	0	0	0	0	0	100,000
2034	0	0	0	0	0	100,000
2035	0	0	0	200,000	0	100,000
2036	0	0	0	0	0	100,000
2037	0	0	0	0	0	0
2038	0	0	0	0	0	0
2039	0	0	0	0	0	0
2040	0	0	0	0	0	0
2041	0	0	0	0	0	0
2042	0	0	0	0	0	0
2043	0	0	0	0	0	0
2044	0	0	0	0	0	0
2045	0	0	0	0	0	0
2046	0	0	0	0	0	0
2047	0	0	0	0	0	0
2048	0	0	0	0	0	0
2049	0	0	0	0	0	0
2050	0	0	0	0	0	0
2051	0	0	0	0	0	0
2052	0	0	0	0	0	0
2053	0	0	0	0	0	0
2054	0	0	0	0	0	0
2055	0	0	0	0	0	0
2056	0	0	0	0	0	0
2057	0	0	0	0	0	0
2058	0	0	0	0	0	0
2059	0	0	0	0	0	0
2060	0	0	0	0	0	0

[1] Storage amounts are adjusted for system assessment. Actual modeled delivery amounts may be less depending on availability and evaporation losses.

M.3.3 Reservoir Storage Alternative

As discussed in Section 2.6, the Reservoir Storage Alternative assumes the levels of participation as shown in Table M-6.

Table M-6
Reservoir Storage Alternative Volume Limitations of Storage and Delivery Mechanism

Entity	Maximum Annual Storage of Conserved System or Non-system Water (kaf)	Maximum Total Storage of Conserved System or Non-system Water (kaf)	Maximum Annual Delivery of Conserved System or Non-system Water (kaf)
Arizona	100	300	300
California	400	1,500	400
Nevada	125	300	300
Unassigned	475	950	950
Total	1,100	3,050	1,950

These volume limitations are recognized in CRSS as are other rules that specify under which water supply conditions conserved system or non-system water may be delivered or stored as summarized in Section M.3.4. The schedules for the Reservoir Storage Alternative for the participation of the Lower Division states were assumed to be identical to those used in the Basin States Alternative (Table M-3). The schedules for the expanded participation by other entities (Unassigned in Table M-6) are detailed below.

Some of the activities assumed in the Conservation Before Shortage Alternative were also assumed for the Reservoir Storage Alternative. In particular, the schedules for the “Delta Pulse Flows” and “Other Environmental Flows Below NIB” (Table M-5) were assumed to be identical. Other additional activities were assumed for the Reservoir Storage Alternative in order to assess the potential effects of a storage and delivery mechanism with limits different from either the Basin States or the Conservation Before Shortage alternatives.

During all water supply conditions except the Flood Control Surplus condition, storage credits are assumed to be created to replace bypass flows to the Cienega de Santa Clara in Mexico. As noted in Section 4.2.6, the model assumes that 109 kafy is released from Lake Mead for the bypass flows. Because the system assessment for the Reservoir Storage Alternative is assumed to be 10 percent, storage credits of 121 kafy are assumed to be created each year to replace the bypass flows (termed “Bypass Flow Replacement” in Table M-7). For modeling purposes and to maximize river flow effects this water was assumed to be generated via extraordinary conservation within Mexico.

It was also assumed that storage credits of 55 kafy would be created for environmental consumptive uses (in the amount of 50 kafy after the system assessment) in the United States (termed “Environmental Uses” in Table M-7). These credits are assumed to be created and delivered during all conditions (except the Flood Control Surplus condition). For modeling purposes and to maximize river flow effects this water was assumed to be generated via extraordinary conservation within Mexico.

During Normal and Surplus conditions only, an additional 150 kafy is assumed to be created each year with a delivery of 100 kafy (termed “Additional Conservation Activities” in Table M-7). For modeling purposes and to maximize river flow effects, this water was assumed to be generated via extraordinary conservation within Mexico and delivered to SNWA at Lake Mead.

The assumed schedules for these activities are shown in Table M-7.

M.3.4 Summary of Assumed Storage and Delivery Activities

A summary of the activities assumed to occur under the various water supply conditions (Surplus, Normal, and Shortage conditions) for each alternative is presented in Table M-8.

Table M-7
Assumed Storage and Delivery Schedules for Other Conservation Activities Under the Reservoir Storage Alternative[1]

	Environmental Uses		Bypass Flow Replacement		Additional Conservation Activities	
YEAR	STORE	DELIVER	STORE	DELIVER	STORE	DELIVER
2008	55,555	50,000	121,111	109,000	150,000	100,000
2009	55,555	50,000	121,111	109,000	150,000	100,000
2010	55,555	50,000	121,111	109,000	150,000	100,000
2011	55,555	50,000	121,111	109,000	150,000	100,000
2012	55,555	50,000	121,111	109,000	150,000	100,000
2013	55,555	50,000	121,111	109,000	150,000	100,000
2014	55,555	50,000	121,111	109,000	150,000	100,000
2015	55,555	50,000	121,111	109,000	150,000	100,000
2016	55,555	50,000	121,111	109,000	150,000	100,000
2017	55,555	50,000	121,111	109,000	150,000	100,000
2018	55,555	50,000	121,111	109,000	150,000	100,000
2019	55,555	50,000	121,111	109,000	150,000	100,000
2020	55,555	50,000	121,111	109,000	150,000	100,000
2021	55,555	50,000	121,111	109,000	150,000	100,000
2022	55,555	50,000	121,111	109,000	150,000	100,000
2023	55,555	50,000	121,111	109,000	150,000	100,000
2024	55,555	50,000	121,111	109,000	150,000	100,000
2025	55,555	50,000	121,111	109,000	150,000	100,000
2026	55,555	50,000	121,111	109,000	150,000	100,000
2027	0	50,000	0	109,000	0	100,000
2028	0	50,000	0	109,000	0	100,000
2029	0	50,000	0	109,000	0	100,000
2030	0	50,000	0	109,000	0	100,000
2031	0	50,000	0	109,000	0	100,000
2032	0	50,000	0	109,000	0	100,000
2033	0	50,000	0	109,000	0	100,000
2034	0	50,000	0	109,000	0	100,000
2035	0	50,000	0	109,000	0	100,000
2036	0	50,000	0	109,000	0	100,000
2037	0	0	0	0	0	0
2038	0	0	0	0	0	0
2039	0	0	0	0	0	0
2040	0	0	0	0	0	0
2041	0	0	0	0	0	0
2042	0	0	0	0	0	0
2043	0	0	0	0	0	0

Table M-7
Assumed Storage and Delivery Schedules for Other Conservation Activities Under the Reservoir Storage Alternative[1]

YEAR	Environmental Uses STORE	Environmental Uses DELIVER	Bypass Flow Replacement STORE	Bypass Flow Replacement DELIVER	Additional Conservation Activities STORE	Additional Conservation Activities DELIVER
2044	0	0	0	0	0	0
2045	0	0	0	0	0	0
2046	0	0	0	0	0	0
2047	0	0	0	0	0	0
2048	0	0	0	0	0	0
2049	0	0	0	0	0	0
2050	0	0	0	0	0	0
2051	0	0	0	0	0	0
2052	0	0	0	0	0	0
2053	0	0	0	0	0	0
2054	0	0	0	0	0	0
2055	0	0	0	0	0	0
2056	0	0	0	0	0	0
2057	0	0	0	0	0	0
2058	0	0	0	0	0	0
2059	0	0	0	0	0	0
2060	0	0	0	0	0	0

[1] Storage amounts are adjusted for system assessment. Actual modeled delivery amounts may be less depending on availability and evaporation losses.

Table M-8
Modeling Assumptions for Storage and Delivery of Conserved System and Non-System Water

Water Supply Condition		BS, CBS & RS [1]						CBS & RS	CBS	RS
		California	Arizona	Nevada				Mexico	Federal	Federal
		Extraordinary Conservation	Extraordinary Conservation	Tributary Conservation	Groundwater	Desalinization	Drop 2 Reservoir [4]	Extraordinary Conservation	Extraordinary Conservation	Extraordinary Conservation
Flood Control Surplus	Store	no	no	no	no	no	no	no	no	no
	Deliver	no	no	no	no	no	no	no	no	no
Quantified (70R) Surplus	Store	no	no	yes	no	yes	yes	yes	yes	yes
	Deliver	no	no	no	no	yes	yes	yes	yes	yes
Full Domestic Surplus	Store	no	no	yes	no	yes	yes	yes	yes	yes
	Deliver	no	no	yes	no	yes	yes	yes	yes	yes
Normal	Store	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Deliver	yes	yes	yes	yes	yes	yes	yes	yes	yes
Shortage (involuntary and voluntary)	Store	no	no	yes	yes	yes	no	no	no [5]	yes
	Deliver	no	no	yes	yes	yes	no	no	no	yes
System Assessment		yes	yes	yes	yes	yes	no	yes	yes	yes
Period of Activity		2006-2026	2017-2026	2009-2060	2009-2060	2020-2060	Temporary	2008-2026	2008-2026	2008-2026

Notes:

1. *BS = Basin States, CBS = Conservation Before Shortage, RS = Reservoir Storage*
2. *yes = Activity assumed to occur*
3. *no = Activity assumed to not occur*
4. *Beginning in 2012, Nevada is assumed to receive 40 kafy of the water conserved by the Drop 2 Reservoir during Normal and Surplus years until a total of 300 kaf has been credited to Nevada. Thereafter, water conserved by the Drop 2 Reservoir is assumed to be system water.*
5. *Under the Conservation Before Shortage Alternative, extraordinary conservation is assumed to be undertaken by the federal government during voluntary shortage conditions but not during involuntary shortage conditions.*

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