Setting the Table: Where Are We in Colorado River Hydrology and Law of the River?

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INTRODUCTION

The interstate compact is a sacred instrument in Western water law. It is an agreement between sovereigns, but also a statute approved by Congress, a contract with intent and remedies, and an equitable apportionment of a vital resource.[1] Two states, sometimes more, commit to who gets how much and where, in perpetuity. The Colorado River Compact, then, is not just a sacred instrument, but more like the holy grail of interstate compacts. It is a commitment among *seven* states on how to use the river that allows these Western states to prosper and live in an otherwise arid landscape.[2]

So today, why does this seminal agreement feel more like a shrug? It is widespread knowledge that the negotiators of the Colorado River Compact based their fateful deal on hydrology that is no longer representative of what we see from the Colorado River today.[3] But there is still an obligation—a Compact obligation. At one point in time, the Upper Division States[4] described the Lee Ferry delivery as a "duty"[5] and an "obligation,"[6] so much so that they lobbied Congress for funding and authorization to build an entire system of reservoirs to ensure that they would also have enough stored water in the bank to meet the Compact obligation.[7] Now, Upper Basin representatives have changed their message from a sacred obligation to one of "equity" and Compact deliveries as "punish[ment]."[8]

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1. *See* Tarrant Reg'l Water Dist. v. Herrmann, 569 U.S. 614, 628 (2013); New Jersey v. New York, 523 U.S. 767, 810–11 (1998).

2. Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, 324 (1928).

3. *See, e.g.*, NORRIS HUNDLEY, JR., WATER AND THE WEST: THE COLORADO RIVER COMPACT AND THE POLITICS OF WATER IN THE AMERICAN WEST 352 (2d ed. 2009); MARC REISNER, CADILLAC DESERT: THE AMERICAN WEST AND ITS DISAPPEARING WATER 271 (1993); ERIC KUHN & JOHN FLECK, SCIENCE BE DAMMED: HOW IGNORING INCONVENIENT SCIENCE DRAINED THE COLORADO RIVER 3–5, 222–25 (2019).

4. The "States of the Upper Division" are the States of Colorado, New Mexico, Utah, and Wyoming, and the "States of the Lower Division" are the States of Arizona, Nevada, and California. Colorado River Compact, *supra* note 2, art. II(c), (e) (1928).

5. *Upper Colorado River Basin Compact Commission: Official Record of Meeting No. 5*, 111 (Colo. 1947) (statement of Utah attorney Mr. Howell).

6. *Upper Colorado River Basin Compact Commission: Official Record of Governor's Meeting*, 8 (Wyo. 1946) (statement of Director of the Colorado Water Conservation Board, Mr. Stone).

7. *See Making It Work: Monument Development, 1910-1955*, NAT'L PARK SERV., https://www.nps.gov/parkhistory/online_books/rabr/adhi/adhi4b.htm [https://perma.cc/7LMY-YTRS] (Feb. 7, 2003) ("The Upper Basin states proposed a series of dams, funded in part by the Bureau of Reclamation, to help secure water from the Colorado River for the benefit of the Upper Basin.").

8. Allen Best, *Shared Risk at the Heart of Dispute Over Colorado River*, COLO. NEWSLINE (June 4, 2025), https://coloradonewsline.com/2025/06/04/shared-risk-dispute-over-colorado-river/ [https://perma.cc/G48P-VUJE].

In this Article, a lawyer and a hydrologist set the table on what it actually means to comply with Article III(c) and III(d) of the Colorado River Compact. We trade off between the legal framework, meaning the language of the Compact and how it could be interpreted, and the physical framework, meaning how you might actually measure and estimate the number that is considered "compliance." There are many legal components to what must be delivered at Lee Ferry, but each physical component also has its own set of nuances and methodologies.

There is no consensus, of course, on this important question of Compact compliance, or the inverse, Compact noncompliance.[9] Perhaps at the conclusion of this Article, we can hope for consensus on the idea that it is not as simple as "8.25 MAF times 10."

I. DELIVERY AT LEE FERRY

A. The Legal Framework: What Is the Obligation at Lee Ferry?

Article III(a) of the Colorado River Compact provides: "There is hereby apportioned from the Colorado River System in perpetuity to the Upper Basin and to the Lower Basin, respectively, the exclusive beneficial consumptive use of 7,500,000 acre-feet of water per annum, which shall include all water necessary for the supply of any rights which may now exist."[10] Further, Article III(b) apportions an additional one million acre-feet per annum to the Lower Basin, and Article III(c) limits the respective Basins' use of water to meet the United States' Treaty obligations to Mexico.[11] Article III(d) then provides that the "States of the Upper Division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series beginning with the first day of October next succeeding the ratification of this compact."[12]

From these provisions, we construct the "Compact obligation": how much water must the Upper Division States deliver to the Lower Division States. Some things are noncontroversial. Whatever the obligation is, it must be fulfilled at Lee Ferry, which is defined in the Compact as a point in the mainstream of the Colorado River, one mile below the mouth of the Paria

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9. Because hydrology and operations change faster than law journals can publish, we do not include any prediction on when noncompliance may occur in the near future.

10. Colorado River Compact, *supra* note 2, art. III(a) (1928).

11. *Id.* art. III(b)–(c).

12. *Id.* art. III(d).

River.[13] It is measured as a ten-year consecutive period, and that ten-year period starts on October 1st,[14] which is the start of a Water Year ("WY").[15] Beyond these points, there is not much agreement on what else must happen at Lee Ferry.

At one time, the academic discussion centered on whether Article III(d) created a "delivery" obligation versus a "non-depletion" obligation. Other interstate compacts used the word "deliver,"[16] whereas Article III(d) uses the word "deplete."[17] Thus, the Upper Basin's obligation becomes one not to deplete the flow of the river below 75.0 million acre-feet (MAF) over ten years, not a guarantee of 75.0 MAF over ten years.[18] If the Upper Basin's obligation at Lee Ferry is considered in terms of "depletion," and depletion is defined as reductions in virgin flow from man-made diversions or improvements, then the Upper Basin would not be responsible for mitigating insufficient flows that are not caused by its diversions.[19] This would include insufficient flows caused by climate change.[20] This is dubbed the "Upper Basin climate change squeeze," where the Article III(d) obligation and requirement to deliver water to Mexico result in the Upper Basin being left with the "last priority on the river."[21]

Another variation or interpretation of the Article III(d) obligation offered in academic literature is the assertion that the Compact's equitable apportionment was intended to be an "equal" apportionment based on the equal division in Article III(a), with each Basin entitled to 7.5 MAF.[22] Additionally, Article III(c) requires the respective Basins to equally share the burden of any deficiency in supply to meet the Treaty requirement.[23] Following this logic, if the Lower Basin gets to use 7.5 MAF, then the Upper

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13. *Id.* art. II(e).
14. *Id.* art. III(d).
15. The water year begins October 1 to September 30. *Explanations for the National Water Conditions*, USGS, https://water.usgs.gov/nwc/explain_data.html [https://perma.cc/2HZV-8CRS].
16. *See* Rio Grande Compact, Pub. L. No. 76-96, art. III, 53 Stat. 785, 787 (1939); *see also* La Plata River Compact, Pub L. No. 68-346, art. II, 43 Stat. 796, 797 (1925).
17. Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, art. III(d) (1928).
18. *Id.*
19. *See* Douglas Kenney et al., *The Colorado River and the Inevitability of Institutional Change*, 32 PUB. LAND & RES. L. REV. 103, 118 (2011).
20. *Id.*
21. *Id.* at 113–14.
22. *Id.* at 118.
23. Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, art. III(c) (1928).

Basin should also get to use 7.5 MAF. With today's hydrology, those "equal" numbers for each Basin would be much lower.[24]

But the concept of an "equal" apportionment and an "equitable" apportionment are not the same. Equitable apportionment is a judicial doctrine that the Supreme Court has employed to resolve disputes between and among states over interstate waters.[25] Equitable apportionment cases are different from Compact cases. In an equitable apportionment case, the Court seeks to provide a resolution that apportions water so that each state has an *equal right* to the use of water, considering a balancing of the needs/uses of the other states.[26] Compact cases are quite different because the "balancing" and the "apportionment" are done in the Compact itself based upon an agreement of the Parties concurred in by Congress.[27] Of course, here we have a Compact that apportions the interstate water among seven states, and that apportionment is not "equal."[28] The Lower Basin is entitled to use an additional 1.0 MAF under Article III(b).[29] The Court has been clear that it cannot order relief inconsistent with a compact's express terms.[30] "[C]ourts have no power to substitute their own notions of an 'equitable apportionment' for the apportionment chosen by Congress."[31] A compact is "a law of the United States, and [the Court's] first and last order of business is interpreting the compact."[32]

Of course, the Lower Basin argues that the Compact means what it says: 75 MAF over ten years at Lee Ferry, plus the Upper Basin's share of deliveries to Mexico.[33] Although the provision addresses "depletions," how depletions are measured, for the purpose of Compact compliance, is based upon delivery requirements calculated over a period of years.[34] Whether this is a requirement to "deliver" or to "not deplete" is a purely academic question

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24. *See* Kenney et al., *supra* note 16, at 114 (describing how climate change and flow reductions could decrease Upper Basin water availability).

25. *See* Kansas v. Colorado, 206 U.S. 46 (1907) (discussing how Colorado's depletion of Arkansas's waterways injured Kansas's interests without destroying the equitable apportionment of benefits between the two states); *see also* Mississippi v. Tennessee, 595 U.S. 15, 24 (2021) (listing the Court's equitable apportionment cases).

26. *See* Kansas v. Colorado, 206 U.S. at 117–18.

27. *See, e.g.*, Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324 (1928); Kansas v. Nebraska, 574 U.S. 445, 455 (2015); Texas v. New Mexico, 462 U.S. 554, 557–60 (1983).

28. *See* Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324 (1928).

29. *Id.* art. III(b)

30. Kansas v. Nebraska, 574 U.S. at 456 (citing Texas v. New Mexico, 462 U.S. at 564).

31. Texas v. New Mexico, 462 U.S. at 568 (quoting Arizona v. California, 373 U.S. 546, 565 (1963)).

32. *Id.* at 567–68 (citation omitted).

33. *See* Kenney et al., *supra* note 19, at 122.

34. *See* Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, art. III(d) (1928).

because the requirement itself is embedded into the Compact in express language.[35] That is, if flow at Lee Ferry is below an aggregate of 75 MAF for a period of ten consecutive years, then the Upper Basin has violated Article III(d) of the Compact.[36] This has been described by at least one commentator as a *de facto* delivery requirement.[37]

B. The Physical Framework: Calculating Compliance at Lee Ferry

1. Location of Lee Ferry and Relevant Flow Gages

As explained below, measurement of flow at Lee Ferry, or projection of future flows, involves three components: Glen Canyon Dam releases, Paria River inflows, and accretion.

Lee Ferry is defined as "a point in the mainstream of the Colorado River one mile below the mouth of the Paria River."[38] There is currently no streamgage at this precise location; therefore, flow at the Lee Ferry[39] location defined in the Compact is calculated as the sum of flow at the U.S. Geological Survey (USGS) gages upstream on the Paria and Colorado Rivers, shown on Figure 1.[40] The USGS monitors streamflow at these locations at fifteen-minute intervals; once verified, the raw data is reported in cubic feet per second, and the average daily, monthly, and annual flow at each location is available to download.[41] The values are converted to AF per year (AF/yr).

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35. *See* Kenney et al., *supra* note 19, at 116–18 (discussing commentary and scholarly article interpretations of the Article III(d) requirement).

36. *See* Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, art. III(d) (1928).

37. *See, e.g.*, Kenney et al., *supra* note 19, at 116.

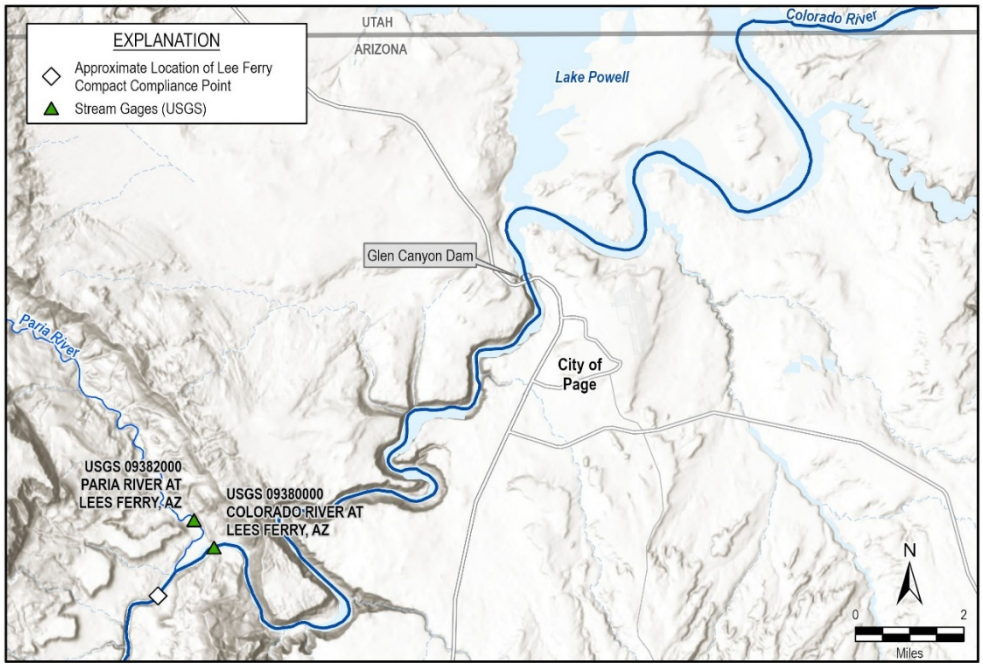
38. Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, art. II(e) (1928).

39. *Lees Ferry* is the name of the USGS stream gage. *Lee Ferry*, the point where Colorado River Compact compliance is measured, is one mile downstream of the mouth of the Paria River.

40. *See A Century of Watching the Colorado River*, USGS (Sept. 22, 2021), https://www.usgs.gov/news/featured-story/a-century-watching-colorado-river [https://perma.cc/HQ62-FS6B] ("The Lees Ferry gage as well as a streamgage on the Paria River are used as critical, continuous measurement points to determine how much water passes to the Lower Basin each year.").

41. *See, e.g.*, *Monitoring Location: Colorado River at Lees Ferry, AZ - USGS-09380000*, USGS, https://waterdata.usgs.gov/monitoring-location/USGS-09380000/#dataTypeId=%E2%80%8Bcontinu%E2%80%8Bo%E2%80%8Bu%E2%80%8Bs%E2%80%8B-%E2%80%8B00065--%E2%80%8B1212571048&showFieldMeasurements=false [https://perma.cc/Z2RM-XPLF].

Figure 1. Location of Lee Ferry, USGS Streamgages, and Glen Canyon Dam[42]



The record for the gage on the Paria River (USGS 09382000) begins in October 1923.[43] Paria inflows to the Colorado River are highly variable.[44] Over the past ten WYs (WY 2016 – 2025), flow measured at the Paria River gage ranged from approximately 7,500 AF/yr to 22,600 AF/yr, with an average of 16,000 AF/yr.[45]

The record for the Colorado River gage upstream of Lee Ferry (USGS 09380000 "Lees Ferry") begins in October 1921.[46] The measured flow at this location reflects both Glen Canyon Dam releases and accretion. Accretion is the difference between Glen Canyon Dam releases reported by the Bureau of Reclamation (Reclamation) and downstream flow measured by the USGS

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42. Original figure created by Montgomery & Associates.

43. *USGS Surface-Water Annual Statistics for the Nation: USGS 09382000 Paria River at Lees Ferry, AZ*, USGS, https://waterdata.usgs.gov/nwis/inventory/?site_no=09382000&agency_cd=USGS [https://perma.cc/UAA8-THJF] [hereinafter *USGS 093820000*].

44. *Id.*

45. *See id.*

46. *USGS Surface-Water Annual Statistics for the Nation: USGS 09380000 Colorado River at Lees Ferry, AZ*, U.S. GEOLOGICAL SURV., https://waterdata.usgs.gov/nwis/inventory/?site_no=09380000&agency_cd=USGS [https://perma.cc/3FTE-7MB9] [hereinafter *USGS 09380000*].

streamgage. The difference is positive on a water year basis, indicating greater flow volumes downstream due to seepage from Lake Powell, groundwater contributions, or other discrepancies that would require further investigation.[47] Between WY 2016–2025, Glen Canyon Dam releases have ranged from 7 to 9 MAF/yr, and accretion has contributed an additional 24,000 AF/yr to 239,800 AF/yr, with an average of 122,800 AF/yr.[48]

Figure 2 below depicts these three components of flow at Lee Ferry from 2002 to 2025 and tracks the ten-year flow at Lee Ferry. The ten-year total increased as 9 MAF releases from WY 2015–2019 replaced 8.23 MAF of earlier years. Similarly, ten-year flow total will decrease in the near future if releases are below 9 MAF.

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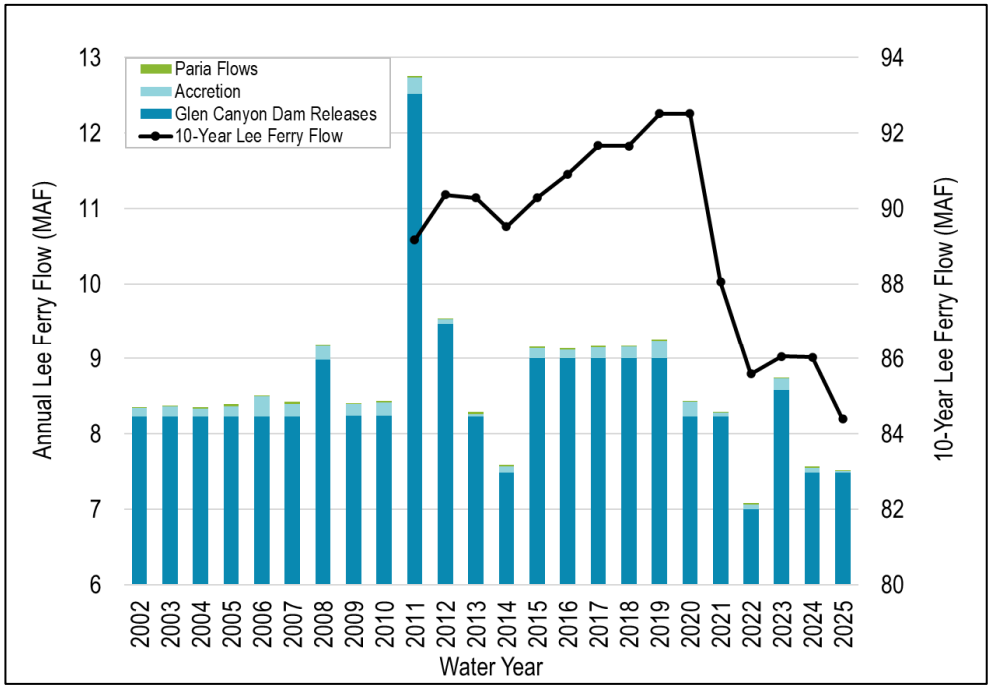
47. *See* JIAN WANG & JOHN C. SCHMIDT, STREAM FLOW AND LOSSES OF THE COLORADO RIVER IN THE SOUTHERN COLORADO PLATEAU 8–10 (Ctr. For Colo. River Studs. 2020).

48. These numbers were calculated by downloading data from the following sources and converting to acre-feet per year, for each water year: (1) monthly Glen Canyon Dam releases, *Upper Colorado Region,* BUREAU OF RECLAMATION, https://www.usbr.gov/rsvrWater/HistoricalApp.html [https://perma.cc/3DH3-3LYY]; (2) daily flows at the Colorado River Lees Ferry gage 09380000, *USGS 09380000*, *supra* note 46.

Accretion was calculated as the difference between Glen Canyon Dam releases and flow at streamgage 09380000 on a WY basis. These WY totals were then averaged for WY 2015 to 2024.

Figure 2. Components of Flow at Lee Ferry[49]



2. Projecting Future Releases from Glen Canyon Dam

Looking forward to projecting anticipated Compact compliance, each component requires a different methodology to predict flows and how the system will be operated.

On a monthly basis, Reclamation releases a Most Probable 24-Month Study using the Colorado River Mid-term Modeling System (CRMMS).[50] The study estimates reservoir operations (inflows, releases, evaporation losses) and projects elevation and storage for all major Colorado River reservoirs on a monthly basis for a two-year period.[51] Results of the Most

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49. *See USGS 09382000*, *supra* note 43 (providing Paria river flows); *Upper Colorado Region*, BUREAU OF RECLAMATION, https://www.usbr.gov/rsvrWater/HistoricalApp.html [https://perma.cc/4UBR-S42K] (providing Glen Canyon Dam releases); *see also USGS 09380000*, *supra* note 46 (providing USGS gage information for the Colorado River at Lees Ferry). Original figure created by Montgomery & Associates.

50. *See, e.g.*, *Lower Colorado Region: 24-Month Study Projections*, BUREAU OF RECLAMATION, https://www.usbr.gov/lc/region/g4000/riverops/24ms-projections.html (Feb. 2, 2025) [https://perma.cc/6S33-F8SW].

51. *Id.*; *see, e.g.*, BUREAU OF RECLAMATION, DECEMBER 2025 MOST PROBABLE 24-MONTH STUDY (2025).

Probable 24-Month Study released in August are used to determine the coordinated operation of Lakes Powell and Mead.[52]

Glen Canyon Dam releases for the following water year are determined by the August 24-Month Study projections of reservoir elevation on January 1 of the following year.[53] For example, the planned WY 2026 Glen Canyon Dam release was determined by the January 1, 2026 Lake Powell elevation projected by the August 2025 24-Month Study.[54] Glen Canyon Dam releases are currently based on the Operational Tiers specified in the Supplement to the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and the Coordination Operations for Lake Powell and Lake Mead, which expire at the end of 2026.[55] Releases are specified by Lake Powell elevation and may be adjusted upward or downward based on Lake Mead elevation, as summarized in Figure 3.[56]

The current operational guidelines modified the 2007 Interim Guidelines to protect critical elevations of 1,000 feet in Lake Mead and 3,525 feet in Lake Powell.[57] One operational modification under the new guidelines allows Glen Canyon Dam releases to be reduced to no less than 6 MAF when Lake Powell is in the Mid or Lower Elevation release tier and the Minimum Probable 24-Month Study projects that Lake Powell could fall below elevation 3,500 feet.[58] A 7.48 MAF release is planned for WY 2026.[59] However, the Probable Minimum 24-Month Study shows Lake Powell could fall below an elevation of 3,500 feet in 2026, which means the WY 2026 release may be adjusted down to no less than 6 MAF.[60]

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52. U.S. DEP'T OF THE INTERIOR, RECORD OF DECISION: COLORADO RIVER INTERIM GUIDELINES FOR LOWER BASIN SHORTAGES AND THE COORDINATED OPERATIONS FOR LAKE POWELL AND LAKE MEAD FINAL ENVIRONMENTAL IMPACT STATEMENT 49 (Dec. 2007), https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf [https://perma.cc/T5CY-JLYT].

53. *See Glen Canyon Dam*, BUREAU OF RECLAMATION, https://www.usbr.gov/uc/water/crsp/cs/gcd.html (Oct. 15, 2025) [https://perma.cc/9ME8-WGRU].

54. *Id.*

55. BUREAU OF RECLAMATION, SUPPLEMENT TO THE 2007 COLORADO RIVER INTERIM GUIDELINES FOR LOWER BASIN SHORTAGES AND THE COORDINATED OPERATIONS FOR LAKE POWELL AND LAKE MEAD: RECORD OF DECISION 2, 17–18 (2024).

56. *See id.* at 17–18.

57. *See* U.S. DEP'T OF THE INTERIOR, *supra* note 52, at 52–55; BUREAU OF RECLAMATION, *supra* note 55, at 4, 18.

58. BUREAU OF RECLAMATION, *supra* note 55, at 4.

59. BUREAU OF RECLAMATION, AUGUST 2025 MOST PROBABLE 24-MONTH STUDY 1–2, 11–12, (2025), https://www.usbr.gov/uc/water/crsp/studies/24Month_08.pdf [https://perma.cc/CAW8-WQPL].

60. BUREAU OF RECLAMATION, 24-MONTH STUDY INFLOW SCENARIOS 3 (Aug. 15, 2025), https://www.usbr.gov/uc/water/crsp/studies/images/PowellElevations.pdf [https://perma.cc/74TB-NW68]; BUREAU OF RECLAMATION, *supra* note 55, at 18.

Future Glen Canyon Dam releases are uncertain. For Compact delivery analysis purposes, we assumed a range of possible release volumes from 6 to 9 MAF, informed by the current operational guidelines. To date, our analysis has incorporated historical release volumes through WY 2025 and employs a range of assumptions starting in WY 2026.

Figure 3. Lake Powell Operational Tiers through 2026[61]

Lake Powell Operational Tiers (subject to April adjustments or mid-year review modifications)		
Lake Powell Elevation (feet)	**Lake Powell Operational Tier**	**Lake Powell Active Storage** (maf)
3,700	**Equalization Tier** Equalize, avoid spills, or release 8.23 maf	**23.31**
3,636–3,666 (see Table 2.3-1 in the 2007 FEIS)	**Upper Elevation Balancing Tier** Release 8.23 maf; if Lake Mead <1,075 feet, balance contents with a minimum/maximum release of 7.0/9.0 maf	**14.65–18.36** (2008–2026)
3,575	**Mid-Elevation Release Tier** Release 7.48 maf; if Lake Mead <1,025 feet, release 8.23 maf If any minimum probable Lake Powell elevation projection shows Lake Powell <3,500 feet, begin planning to reduce releases to no less than 6.0 maf	**8.90**
3,525	**Lower Elevation Balancing Tier** Balance contents with a minimum/maximum release of 7.0/9.5 maf If any minimum probable Lake Powell elevation projection shows Lake Powell <3,500 feet, begin planning to reduce releases to no less than 6.0 maf	**5.55**
3,500	The Secretary reserves the right to operate Reclamation facilities to protect the Colorado River system if hydrologic conditions require such action as described in Sections 6 and 7(D) in the 2007 Interim Guidelines ROD	**4.22**
3,370		**0**

61. BUREAU OF RECLAMATION, *supra* note 55, at 18 (depicting the original Figure 3 as shown above).

3. Projecting Future Flows at the Paria River Gage

For Compact delivery analysis purposes, we assumed future Paria River flows to be the average of the five most recent completed water years. To date, our analysis has incorporated historical observed streamflow through WY 2025 and employs the assumption starting in WY 2026. Paria River flows for WY 2026 and onward are assumed to be 15,000 AF/yr, which is the WY 2021–2025 average observed flow at the USGS streamgage.[62]

4. Projected Future Accretions Below Glen Canyon Dam and Lee Ferry

Annual accretion volumes are the difference between Colorado River gage at Lees Ferry (USGS 09380000) and Glen Canyon Dam releases.[63] The Most Probable 24-Month Study includes projections of both flows, providing monthly estimates of accretion for the next two years.[64] These values are updated with the release of each new study.[65] For Compact delivery analysis purposes, we rely on Reclamation's estimated accretion for the current water year and assume a five-year average beyond that. To date, our analysis has incorporated Reclamation's estimate of accretion for WY 2026, and WY 2027 onward is assumed to be the WY 2022–2026 average.

II. DELIVERIES AT LEE FERRY FOR MEXICO

A. The Legal Framework: How Much Water Must Be Delivered at Lee Ferry for Delivery to Mexico?

Article III(c) of the Colorado River Compact provides that, in the event of a treaty with Mexico recognizing a right to the use of waters of the Colorado River System,

> such waters shall be supplied first from the waters which are surplus over and above the aggregate of the quantities specified in paragraphs (a) and (b); and if such surplus shall

62. *USGS 09382000*, *supra* note 43.

63. BUREAU OF RECLAMATION, DRAFT ENVIRONMENTAL IMPACT STATEMENT: POST-2026 OPERATIONAL GUIDELINES AND STRATEGIES FOR LAKE POWELL AND LAKE MEAD A-4 (Jan. 2026), https://www.usbr.gov/ColoradoRiverBasin/post2026/draft-eis/docs/vol-2/P26-DEIS-Appendix-A.pdf.

64. *See, e.g.*, BUREAU OF RECLAMATION, *supra* note 59.

65. *Id.*; *see also* U.S. DEP'T OF THE INTERIOR, *supra* note 52.

> prove insufficient for this purpose, then, the burden of such deficiency shall be equally borne by the Upper Basin and the Lower Basin, and whenever necessary the States of the Upper Division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in paragraph (d).[66]

Thus, in addition to what is owed under Article III(d), the Upper Division States must also deliver "one-half of the deficiency" and "equally" bear the burden of deliveries to Mexico.[67]

The language in Article III(c) was reached in 1922,[68] and the treaty with Mexico was executed by the United States in 1944.[69] Under the 1944 Treaty, 1.5 MAF is guaranteed, except "[i]n the event of extraordinary drought or serious accident to the irrigation system in the United States," in which case the quantity "will be reduced in the same proportion as consumptive uses in the United States are reduced."[70] Under Minutes 319, 323, and 330, Mexico has agreed to take reductions in deliveries due to the drought conditions and critical lake elevations.[71] In 2024, for example, Mexico committed to providing 50,000 acre-feet of system water.[72] Articles 11 and 15 of the 1944 Treaty specify the delivery point and schedules.[73] Water is delivered to Mexico at the Northerly International Boundary, the Limitrophe, and the Southerly International Boundary, shown on Figure 4.[74]

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66. Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, art III(c) (1928).

67. *Id.*

68. *See id.*

69. Treaty Between the United States of America and Mexico Respecting Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, Mex.-U.S., Feb. 3, 1944, 59 Stat. 1219, T.S. No. 994.

70. *Id.* art. 10.

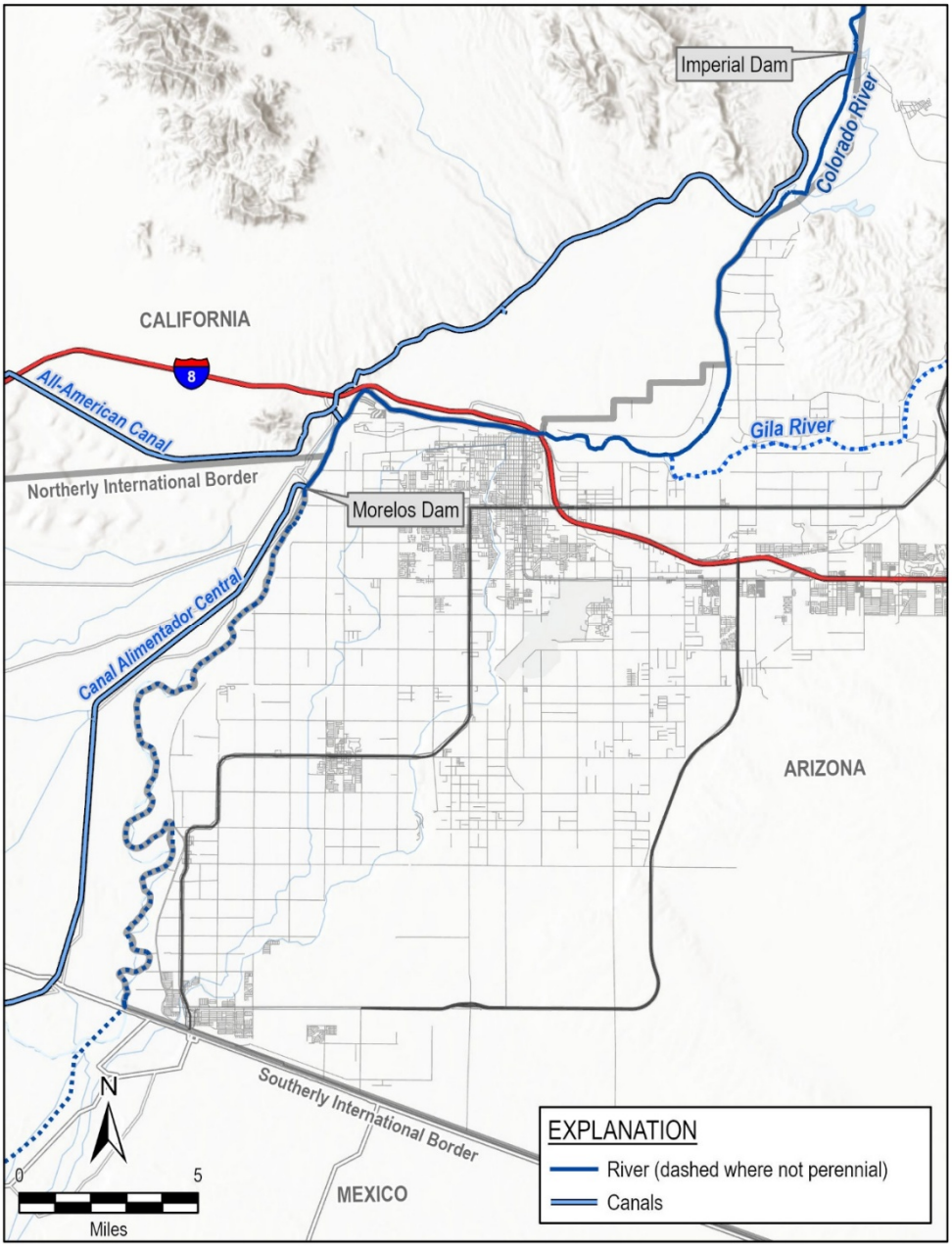
71. Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California, Mex-U.S., § III.3.a, Nov. 20, 2012, T.I.A.S. No. 12-1127, https://www.state.gov/wp-content/uploads/2019/02/12-1127-Mexico-Boundary-Waters-Min-319.pdf [https://perma.cc/9CGM-ZC5G]; Press Release, Int'l Boundary & Water Comm'n, 2026 Colorado River Water Allocations Announced for the United States and Mexico, 1–2 (Aug. 15, 2025), https://www.ibwc.gov/wp-content/uploads/2025/08/2026-COLORADO-RIVER-WATER-ALLOCATIONS-ANNOUNCED-FOR-THE-UNITED-STATES-AND-MEXICO.pdf [https://perma.cc/ZFP6-KZ5V].

72. *See* BUREAU OF RECLAMATION, COLORADO RIVER ACCOUNTING AND WATER USE REPORT: ARIZONA, CALIFORNIA, AND NEVADA 6 (May 2025), https://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2024/2024.pdf [https://perma.cc/ZFP6-KZ5V].

73. Treaty Between the United States of American and Mexico Respecting Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, *supra* note 69, art. 11, art. 15.

74. *See* BUREAU OF RECLAMATION, *supra* note 72, at 31.

Figure 4. Delivery Locations to Mexico[75]



The long-range operating criteria for Lake Powell and Lake Mead adopted in 1970 provided for this minimum objective release of 8.23 MAF per year.[76] At that time, the Upper Basin maintained that 75 MAF over a ten-year period was the limit of its obligation.[77] It acquiesced to the use of 8.23 MAF as a

minimum release before the full development of Upper Basin consumptive use to allow for more power generation.[78] But the Upper Basin did not want 8.23 MAF to be interpreted as a figure implementing Article III(c) and (d) of the Compact, even though the math worked out: 8:23 MAF being the sum of 7.5 MAF per year (the annual average of the 75 MAF over ten-year period), plus one-half of the 1.5 MAF Mexico Treaty obligation, less an allowance of 20,000 acre-feet for inflow from the Paria River above Lee Ferry.[79] The 2007 Guidelines carried over the 8.23 MAF release and came to define the Lake Powell Operational Tier under the equalization criteria.[80]

However, Article III(c) does not state that the Upper Division States and the Lower Division States must provide an equal share of the future Treaty obligation; it states that the "burden of such deficiency shall be equally borne" and that the Upper Division "shall deliver at Lee Ferry water to supply one-half of the deficiency."[81] The boundary with Mexico, of course, is many river miles downstream from Lee Ferry where the Upper Division States deliver water to the Lower Division States. For purposes of compliance with Article III(c) of the Compact, the question is whether the Upper Basin's obligation to supply water under a "deficiency" condition includes enough water to cover evaporative losses between Lee Ferry and the point of delivery to Mexico.[82]

The Upper Basin contends that by specifically designating the point of delivery at Lee Ferry, the Compact does not require the Upper Basin to compensate for evaporative losses below Lee Ferry, including for the losses incurred to make deliveries to Mexico.[83] The Lower Basin contends that the

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75. Original figure created by Montgomery & Associates.

76. Colorado River Reservoirs: Coordinated Long-Range Operations, 35 Fed. Reg. 8951 (June 10, 1970). However, even in that publication, the Secretary noted that "the release may be greater than 8.23 million acre-feet if necessary to deliver 75 million acre-feet at Lee Ferry for the 10-year period ending September 30, 1972." *Id.*

77. MILTON N. NATHANSON, U.S. DEP'T OF THE INTERIOR, BUREAU OF RECLAMATION, UPDATING THE HOOVER DAM DOCUMENTS 117 (1978).

78. *See id.* (stating that "in the early years before full development in the Upper Basin a greater release will be made for power generation" and "[t]herefore, they acquiesced to Reclamation's use of 8.23 maf minimum annual release").

79. *Id.* at 119.

80. *See* U.S. DEP'T OF THE INTERIOR, *supra* note 52, at 50–52.

81. Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, art III(c) (1928).

82. COLORADO RIVER GOVERNANCE INITIATIVE, RESPECTIVE OBLIGATIONS OF THE UPPER AND LOWER BASINS REGARDING THE DELIVERY OF WATER TO MEXICO: A REVIEW OF KEY LEGAL ISSUES 41 (Nat. Res. L. Ctr., Univ. of Colo. L. Sch. 2012), https://scholar.law.colorado.edu/cgi/viewcontent.cgi?article=1007&context=books_reports_studies [https://perma.cc/EY3V-XZKR].

83. *Id.*

obligation to share the burden equally includes one-half of 1.5 MAF, but also one-half of the water necessary to move the Treaty water through the Lower Basin to the points of delivery at the international boundary.[84]

The Colorado River Basin Project Act of 1968 adds another layer of disagreement about who is responsible for the water supply obligated to Mexico. In that statute, "Congress declares that the satisfaction of the requirements of the Mexican Water Treaty from the Colorado River constitutes a national obligation which shall be the first obligation of any water augmentation project."[85] The United States does not have an entitlement to the Colorado River, nor has it built an augmentation project to add water that is required to deliver 1.5 MAF to Mexico at the international boundary.[86] It remains open to debate how the United States is supposed to fulfill this "national obligation."[87]

B. The Physical Framework: Estimating Upper Basin Delivery Obligation for Mexico

1. Estimating Evaporation Losses in the Lower Basin and Attributing a Portion to Mexico Deliveries

Reclamation issued the Lower Colorado River Mainstream Evaporation and Riparian Evapotranspiration Losses Report in 2023.[88] The study estimates 1,304,207 AF/yr of evaporative losses along the Lower Colorado River from Lake Mead to the Northerly International Boundary ("NIB") with

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84. *Id.*

85. Colorado River Basin Project Act of 1968, Pub. L. No. 90-537, § 202, 82 Stat. 885, 887 (codified at 43 U.S.C. § 1512).

86. *See Lower Colorado River Basin Project: Hearing on H.R. 4671 and Similar Bills Before the Subcomm. on Irrigation & Reclamation of the H. Comm. on Interior & Insular Affs.*, 89th Cong. 1005, 1057–58 (1966) (statement of Rep. Morris K. Udall, Subcomm. Member, and Ival V. Goslin, Executive Director, Upper Colo. River Comm'n). The "Tipton Report" identified the approximately 1.195 MAF deficiency in the total water supply for the Lower Colorado River. TIPTON & KALMBACH, INC., WATER SUPPLIES OF THE COLORADO RIVER 7 (1965), http://www.livingrivers2.org/pdfs/LRlibrary/TiptonReport1965.pdf [https://perma.cc/J9FF-654C].

87. *See generally* Rhett B. Larson, *A National Obligation to Mexico in the Colorado River Basin*, 57 ARIZ. ST. L.J. ___ (2025).

88. BUREAU OF RECLAMATION, LOWER COLORADO RIVER MAINSTREAM EVAPORATION AND RIPARIAN EVAPOTRANSPIRATION LOSSES REPORT (2023) [hereinafter LOWER COLORADO RIVER LOSSES REPORT], https://www.usbr.gov/lc/region/g4000/4200Rpts/LCRBEvapReport/LCRBEvapReport.pdf [https://perma.cc/VT5B-9XGQ].

Mexico.[89] Estimated losses include open water evaporation and riparian evapotranspiration ("ET").[90] The study does not include seepage to groundwater, stating, "[d]ata regarding seepage to groundwater were not included in this report. Seepage along the mainstream of the lower Colorado River is not considered to be a loss from the system as water entering the aquifer will re-emerge further downstream within the Colorado River."[91]

The 1.3 MAF estimate covers the reaches shown on Figure 5 below, which is a map from the Reclamation's 2023 report depicting the study extent.[92] Evaporation from Lakes Mead, Mohave, and Havasu was estimated from the lake elevation and corresponding surface area, and monthly evaporation coefficients.[93] Open water evaporation and riparian evapotranspiration for the remainder of the area downstream of Hoover Dam are derived from the Lower Colorado River Annual Summary (LCRAS) datasets.[94] Based on aerial imagery, the LCRAS dataset classifies open waters into three categories: main channel (including smaller reservoirs), backwaters, and marinas.[95] Based on remote sensing data, riparian areas were classified into six categories: barren, cottonwood/willow, marsh, mixed vegetation-low, mixed vegetation-medium, and salt cedar-dense.[96] Open water and riparian ET were calculated using the acreage of each water/land type and ET coefficients specific to each category.[97]

For Compact delivery analysis purposes, we used the ratio of allocations among the Lower Basin states and Mexico to attribute a portion of total Lower Colorado River evaporative losses to deliveries to Mexico. Mexico's allocation is 1.5 MAF, or 16.67% of the 9 MAF allocated to the Lower Basin states and Mexico. Proportionally, 16.67% of Reclamation's 1.3 MAF evaporation estimate is approximately 217,400 AF/yr.[98] Thus, under this methodology, to supply water for the proportional amount of evaporative losses (open water and riparian evapotranspiration), we assumed the Upper Division States would have to deliver half that volume, which is 108,700 AF/yr of additional water at Lee Ferry.

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89. *Id.* at 23.
90. *Id.*
91. *Id.* at 3.
92. *See id.* at 23.
93. *Id.* at 5.
94. *Id.*
95. *Id.* at 8–9.
96. *Id.* at 9.
97. *Id.* at 1.
98. Treaty Between the United States of America and Mexico Respecting Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, *supra* note 69, art. 10.

2. Accounting for Mexico's Reductions

If the Upper Basin's delivery obligation for Mexico is tracked as half of Mexico's 1.5 MAF allocation, the obligation is 750,000 AF/yr. If the reduction volumes agreed to by Mexico are considered, the Upper Basin delivery obligation could be reduced by half of Mexico's reduction volume.

Depending on the terms of the Minute, Mexico's delivery reductions can result in the creation of either water stored in Lake Mead for the benefit of the system (system water) or water stored in Lake Mead temporarily that can be recovered by Mexico at a later date (recoverable water).[99] For Compact delivery analysis purposes, we only adjust the Upper Basin delivery requirement based on reduction volumes that result in system water, and do not account for recoverable water savings. We also do not account for any delivery of Mexico's water reserve to offset reductions. For example, in 2022, Mexico agreed to delivery reductions of 50,000 AF resulting in system water.[100] For Compact delivery analysis purposes, we therefore consider a scenario in which the Upper Basin delivery obligation to Mexico is 725,000 AF in 2022 (750,000 AF less half of Mexico's reduction). This approach results in a ten-year delivery obligation that changes over time.

Mexico's system water reduction volumes through 2026 under Minute 323 are based on Lake Mead's elevation[101] For Compact delivery analysis purposes, we use the projected Lake Mead elevation in Reclamation's Most Probable 24-Month Study to estimate 2026 reductions. Additionally, future volumes of system water reductions under Minute 330 were assumed from information presented during a September 2025 Central Arizona Project Board meeting.[102] For 2027 and onward, we assume reductions of 250,000 AF/yr from Mexico, which is the static reduction zone proposed in the Lower

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99. Int'l Boundary and Water Comm'n United States and Mexico, Minute No. 323 7–11 (Sept. 21, 2017), https://www.ibwc.gov/wp-content/uploads/2023/03/Min323.pdf; Int'l Boundary and Water Comm'n United States and Mexico, Minute No. 330 1–3 (Mar. 21, 2024), https://www.ibwc.gov/wp-content/uploads/2024/04/Minute-330-English-Spanish-Version-Signed-Clean.pdf.

100. BUREAU OF RECLAMATION, COLORADO RIVER ACCOUNTING AND WATER USE REPORT: ARIZONA, CALIFORNIA, AND NEVADA Table 1 n.2 (2022), https://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2022/2022.pdf.

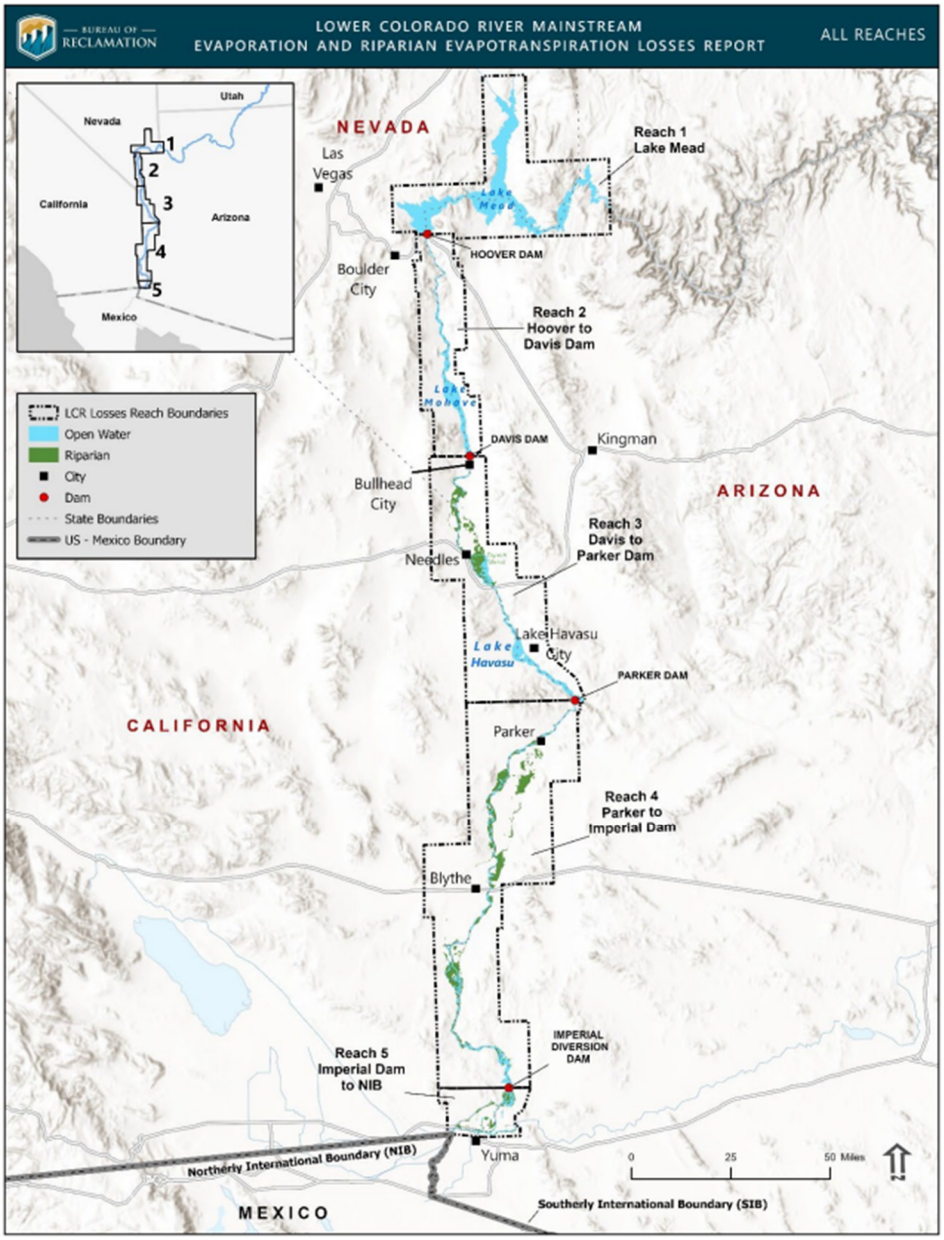
101. Int'l Boundary and Water Comm'n United States and Mexico, Minute No. 323 4 (Sept. 21, 2017), https://www.ibwc.gov/wp-content/uploads/2023/03/Min323.pdf.

102. *See* Vineetha Kartha, Colorado River Water Supply Report CAWCD Board Meeting (Sept. 4, 2025), https://capaz.portal.civicclerk.com/event/466/files/attachment/6027.

Division States Alternative for the Post-2026 Coordinated Operation of the Colorado River Basin.[103]

103. Letter from the Colo. River Basin States Reps. of Ariz., Cal., and Nev., to Camille Calimlim Touton, Comm'r, U.S. Bureau of Reclamation (Mar. 6, 2024) (on file with the U.S. Bureau of Reclamation), https://www.usbr.gov/ColoradoRiverBasin/documents/post2026/alternatives/2024-03-06_Lower_Basin_Alternative_Letter_Submittal_508.pdf [https://perma.cc/8878-V7Z9].

Figure 5. Map of Reaches Identified in the Lower Colorado River Mainstream Evaporation and Riparian Evapotranspiration Losses Report[104]



104. LOWER COLORADO RIVER LOSSES REPORT, *supra* note 88, at ix, fig.1.

III. COMPACT OBLIGATIONS IN SURPLUS YEARS

A. The Legal Framework: How Much Water Must Be Delivered at Lee Ferry in Surplus Years?

Yet another variation of what Compact compliance means concerns the Upper Division States' obligation in "surplus." Article III(c) includes the only mention of "surplus" in the Compact.[105] Specifically, water to satisfy any right of Mexico to the Colorado River System "shall be supplied first from the waters which are surplus over and above the aggregate of the quantities specified in paragraphs (a) and (b)."[106] The quantities specified in paragraphs (a) and (b) are 7.5 MAF for the Upper Basin and Lower Basin and an additional 1.0 MAF for the Lower Basin.[107] Thus, "surplus," for purposes of Article III(c) means 16.0 MAF,[108] and deliveries to Mexico are intended to be satisfied from the amount of natural flow in the Colorado River System over 16.0 MAF.[109]

The notion of "surplus" becomes relevant because the Upper Division States have long claimed that the Lower Division States use more than 8.5 MAF of their apportionment when accounting for the use of the tributaries in the Lower Basin.[110] The Compact defines "Colorado River System" in Article II(a) as the "portion of the Colorado River and its tributaries within the United States of America."[111] The next inferential step in the Upper Division States' argument is that the Upper Division States do not have to provide any water at Lee Ferry under Article III(c) because there is more than 16 MAF in the Colorado River System if the tributary use in the Lower Basin is included in the accounting.

But this interpretation of Article III(c) gives the benefit of "surplus" to the Upper Division States without the acceptance of the burden of "deficiency." If the Colorado River System is in "surplus," then 8.5 MAF is flowing to the Lower Basin at Lee Ferry under Articles III(a) and (b), and the Mexico obligation is supplied from the water above 16.0 MAF in the system.[112] If the Colorado River System is not in "surplus" and there is a "deficiency," then

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105. Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, art. III(c) (1928).

106. *Id.*

107. *Id.* art. III(a)–(b).

108. COLO. RIVER GOVERNANCE INITIATIVE, RESPECTIVE OBLIGATIONS OF THE UPPER AND LOWER BASINS REGARDING THE DELIVERY OF WATER TO MEXICO: A REVIEW OF KEY LEGAL ISSUES 58–59 (Getches-Wilkinson Ctr. for Nat. Res., Energy, and the Env't 2012).

109. *Id.* at 26–27.

110. *See id.* at 27.

111. Colorado River Compact, Nov. 24, 1922, 70 CONG. REC. 324, art. II(a) (1928).

112. *Id.* art. III(a)–(b).

the Upper Division States must share equally in the burden of the deficiency and deliver water to supply one-half of the deficiency at Lee Ferry.[113] And then in some years, "surplus" can be insufficient to supply the entire Mexico allocation, resulting in the need for delivery of both surplus and one-half of the deficiency.[114] If consideration of "surplus" were truly applied operationally, then mainstream surplus water should be released by the Upper Basin at Lee Ferry. Then, the remaining deficiency is shared by the Upper and Lower Basins.

After the adoption of the 1970 long-range operating criteria and the minimum release from Lake Powell of 8.23 MAF, Reclamation does not account for whether the Colorado River System is in "surplus" for purposes of Article III(c).[115] Indeed, there is no basin-wide acceptance for tributary accounting, as federal accounting of tributary use for Compact purposes has traditionally been considered a "nonstarter" for the Lower Basin in negotiating consensus-based operations.[116]

B. The Physical Framework: Where and How Reclamation Calculates Natural Flow for the Colorado River System

Reclamation calculates natural flow at twenty-nine streamgages in the Colorado River system.[117] Natural flow refers to an estimate of what flow at a location would have been in the absence of human development, including reservoir operations and consumptive uses such as agriculture.[118] Figure 6 shows the locations where natural flow is calculated below Lake Powell. Farthest upstream, the sum of the natural flow at the Colorado and Paria River gages provides an estimate of natural flow at the Lee Ferry compact compliance point. Farthest downstream, Reclamation calculates natural flow above Imperial Dam.

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113. *Id.* art. III(c).

114. *Id.*

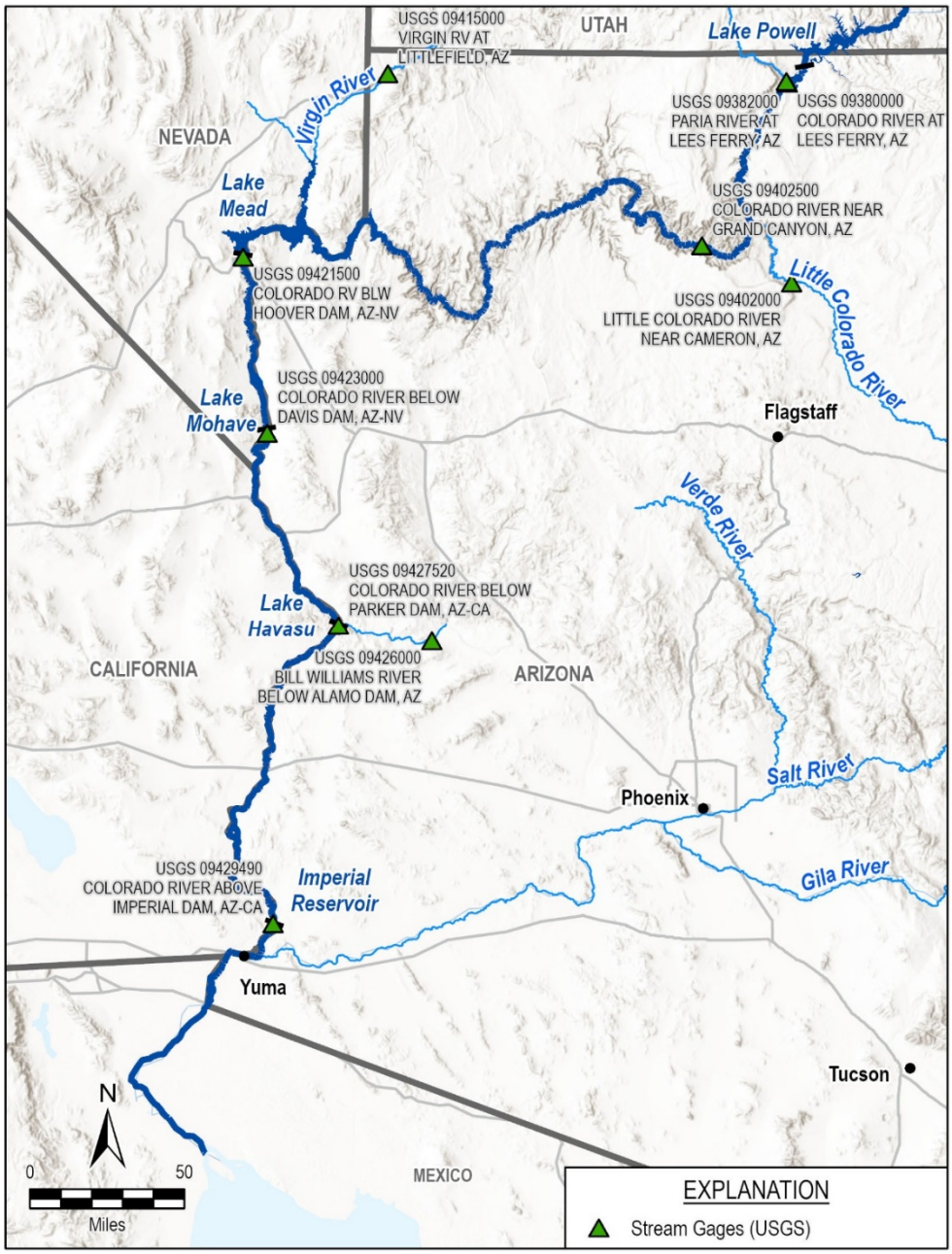
115. *See generally* BUREAU OF RECLAMATION, *supra* note 72 (showing that there is no surplus accounting).

116. *See* W. Patrick Schiffer et al., *From a Colorado River Compact Challenge to the Next Era of Cooperation Among the Seven Basin States*, 49 ARIZ. L. REV. 217, 221 n.20 (2007).

117. BUREAU OF RECLAMATION, COLORADO RIVER BASIN NATURAL FLOW AND SALT DATA (2022), https://www.usbr.gov/lc/region/g4000/NaturalFlow/documentation.html.

118. JAMES PRAIRIE & RUSSELL CALLEJO, U.S. BUREAU OF RECLAMATION, NATURAL FLOW AND SALT COMPUTATION METHODS: CALENDAR YEARS 1971–1995 18 (2005), https://www.usbr.gov/lc/region/g4000/NaturalFlow/Final-MethodsCmptgNatFlow.pdf [https://perma.cc/E7EN-N3A2].

Figure 6. Locations below Lake Powell where Reclamation Calculates Natural Flow[119]



To date, Reclamation has calculated natural flow for the period 1906 to 2020.[120] Natural flow is calculated by summing gaged flow and estimated

consumptive use and adjusting for reservoir operations.[121] Calculations are based on the following data:

- Observed streamflow data at each gage[122]
- Estimated consumptive uses and losses (CUL)[123]
    - For the Upper Basin, all CUL data is from Reclamation's Consumptive Uses and Losses Reports, which include use by irrigated agriculture, reservoir evaporation, stock ponds, livestock, thermal power production, mineral production, municipal and industrial, and accounts for Colorado River Basin exports/imports.[124]
    - For the Lower Basin, CUL data is compiled from three datasets. Mainstream CUL data comes from the Decree Accounting reports, reservoir evaporation is calculated using reservoir surface area and ET coefficients, and phreatophyte ET comes from the LCRAS reports.[125]
- Change in reservoir storage based on reservoir operations data
    - Change in bank storage is also estimated for Flaming Gorge, Lake Powell, and Lake Mead.[126]

Reclamation provides provisional 2021 to 2024 estimates of natural flow at the Colorado River gage upstream of Lee Ferry (USGS 09380000) based on a statistical relationship between unregulated inflow to Powell and natural flow at the gage.[127] For analysis purposes, we estimated WY 2021–2024 natural flow at the Lee Ferry compact compliance point as the sum of Reclamation's provisional estimate for gage 09380000 and USGS measured flow at the Paria River gage upstream of Lee Ferry (09382000).

We estimated natural flow above Imperial Dam for WY 2021–2024 as the sum of Reclamation's provisional estimate for 09380000 and measured inflow at the intervening Lower Basin tributaries used in Reclamation's

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119. Original figure created by Montgomery & Associates.

120. *Current Natural Flow Data 1906-2020 (Excel file, 1.5 MB) - Updated 12/15/22*, BUREAU OF RECLAMATION, https://www.usbr.gov/lc/region/g4000/NaturalFlow/current.html [https://perma.cc/85BE-3NCZ].

121. PRAIRIE & CALLEJO, *supra* note 118, at 4 (providing a flow chart outlining the Bureau of Reclamation's computational methods for natural flow).

122. *Id.* at 6.

123. *Id.* at 7.

124. *Id.* at 7–10.

125. *Id.* at 21–22.

126. *Id.* at 10, 22–23.

127. *Provisional Natural Flow Data 1906-2024 (Excel File 0.3 MF) Based on August, 2024 24-MS.*, BUREAU OF RECLAMATION, https://www.usbr.gov/lc/region/g4000/NaturalFlow/provisional.html.

natural flow estimates below Lake Powell (Paria (USGS 09382000), Little Colorado (USGS 9402000), Virgin (USGS 09415000), and Bill Williams (USGS 09426000) Rivers)).[128] This approach to estimating natural flow above Imperial Dam for 2021 to 2024 does not account for the mainstream consumptive use, reservoir evaporation, reservoir operations, or phreatophyte ET components included in Reclamation's approach for the preceding years.

Table 1 provides a compilation of natural flow estimates for WY 2000–2024. During this time, natural flow both at Lee Ferry and above Imperial Dam is over 16 MAF in the same years: 2005, 2008, 2011, 2017, 2019, and 2023. Under the assumption that surplus conditions exist when mainstream natural flow exceeds 16 MAF, under an interpretation of the Compact where there is no delivery obligation for Mexico in any year Lower Basin use exceeds 8.5 MAF, there would be no delivery obligation in years such as 2005, 2008, 2011, 2017, 2019, and 2023.[129] Further, under an interpretation of the Compact where mainstream surplus water at Lee Ferry is the first source of water to supply Mexico, the delivery obligation increases in years when natural flow at Lee Ferry is greater than 16 MAF. Surplus up to 1.5 MAF at Lee Ferry would be released, with deficit shared equally by the Upper and Lower Basin.

Future flow is too uncertain to predict natural flow. For compact delivery analysis purposes, we assumed all future years to have a natural flow below 16 MAF at both Lee Ferry and above Imperial.

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128. *See* PRAIRIE & CALLEJO, *supra* note 118, at 20, Table 9.
129. *See* MILTON N. NATHANSON, *supra* note 77, at 117.

Table 1. Natural Flow

Water Year	Colorado River at Lees Ferry, AZ (USGS 09380000)[130]	Paria River at Lees Ferry, AZ (09382000)[131]	Lee Ferry Compact Compliance Point	Colorado River Above Imperial Dam, AZ (09429490)[132]
2000 [a]	10,561,407	8,374	10,569,781	10,831,639
2001 [a]	11,039,634	19,713	11,059,347	11,495,402
2002 [a]	5,933,609	8,067	5,941,676	6,027,722
2003 [a]	10,531,406	11,674	10,543,080	10,856,058
2004 [a]	9,593,965	12,664	9,606,629	9,801,644
2005 [a]	16,892,373	33,491	16,925,864	19,145,843
2006 [a]	12,613,809	14,779	12,628,588	12,772,904
2007 [a]	12,556,011	24,111	12,580,122	12,827,297
2008 [a]	16,210,962	15,758	16,226,720	16,692,495
2009 [a]	14,266,330	10,198	14,276,528	14,598,612
2010 [a]	12,318,773	17,747	12,336,520	12,873,649
2011 [a]	20,158,868	22,866	20,181,734	20,891,177
2012 [a]	8,499,849	15,328	8,515,177	8,938,460
2013 [a]	9,114,932	24,800	9,139,732	9,689,121
2014 [a]	13,982,281	22,166	14,004,447	14,320,958
2015 [a]	13,411,497	20,947	13,432,444	13,775,904
2016 [a]	13,439,430	20,899	13,460,329	13,872,340
2017 [a]	16,396,512	17,184	16,413,696	16,961,019
2018 [a]	8,633,462	13,630	8,647,092	8,774,849
2019 [a]	17,672,049	22,606	17,694,655	18,234,121
2020 [a]	9,887,593	10,565	9,898,158	10,202,316
2021	7,152,000 [b]	14,209 [c]	7,166,209	7,323,432 [d]
2022	9,851,000 [b]	17,431 [c]	9,868,431	10,173,678 [d]
2023	17,408,000 [b]	18,464 [c]	17,426,464	18,173,359 [d]
2024	11,875,000 [b]	17,280 [c]	11,892,280	12,087,248 [d]

[a] *Data through 2020 last updated by Reclamation 11/15/2022.*
[b] *Provisional estimate based on a statistical relationship between unregulated inflow to Lake Powell and natural flow, last updated by Reclamation 9/12/2024.*
[c] *Water year total flow from reported USGS data for gage 09382000.*
[d] *Sum of Reclamation Provisional estimate for natural flow at Lee Ferry and flow reported at USGS gages on Paria (USGS 09382000), Little Colorado (USGS 9402000), Virgin (USGS 09415000), and Bill Williams (USGS 09426000) Rivers.*

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130. *Current Natural Flow Data 1906–2020 (Excel file, 1.5 MB) - Updated 12/15/22*, *supra* note 120.
131. *Id.*
132. *Id.*

IV. COMPACT DELIVERY SCENARIOS

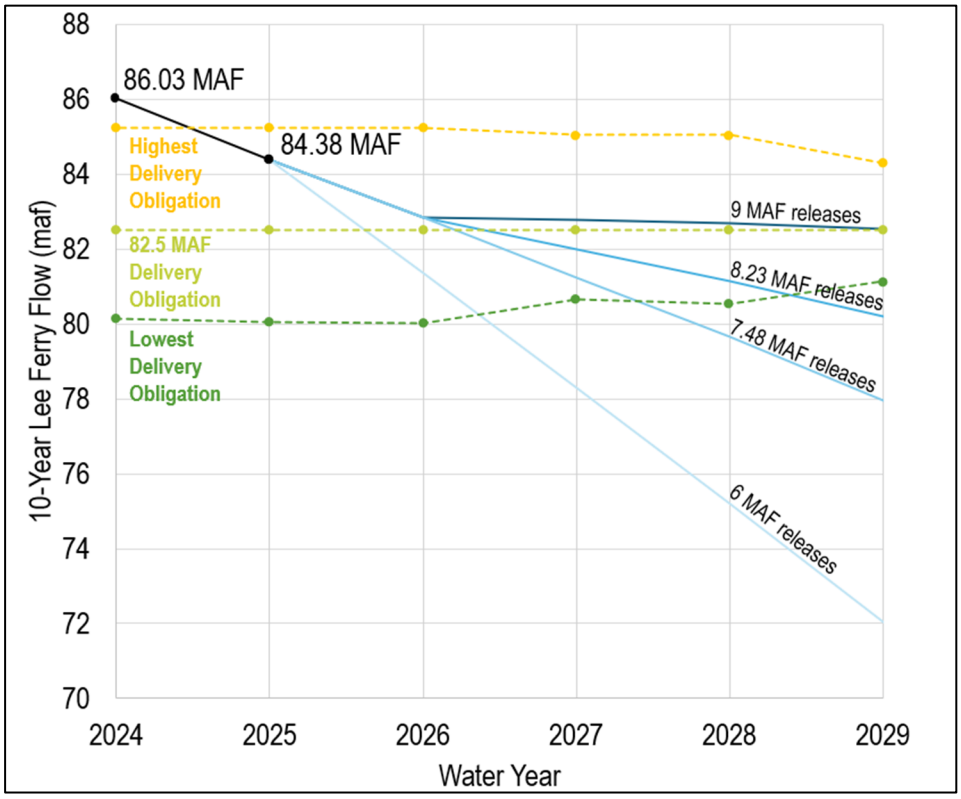
The legal framework and data sources detailed in this article make it clear that the ten-year Lee Ferry delivery obligation is a moving target that is evaluated using a variety of datasets, each available at different times of the year. As future flow conditions present themselves, 24-Month Studies are published, and operational guidelines change, the range of flow possibilities and delivery obligations would need to be revisited. Still, at this critical time when ten-year Lee Ferry flow is decreasing and operational guidelines are under negotiation, it is useful to take a look at where the numbers stand today.

On Figure 7, we present a range of Lee Ferry flows and Compact delivery obligation interpretations using available data through the end of WY 2025. The range of ten-year Lee Ferry flow is based on data and assumptions described in Section I.B. As 9 MAF releases drop out of the ten-year running total, future releases below 9 MAF significantly reduce the ten-year total. The delivery obligation lines vary based on interpretations of how the Upper Basin obligation to Mexico could be adjusted to account for evaporative losses, Mexico's system water reductions, and requirements in surplus years, as described in Sections II and III.

The highest delivery interpretation assumes: 1) the Upper Basin is required to deliver half of the evaporative losses attributed to delivering water to Mexico, 2) the Upper Basin's delivery obligation does not reduce when Mexico takes system water reductions, and 3) the Upper Basin delivery obligation increases in years when natural flow at Lee Ferry exceeds 16 MAF. Under this set of interpretations, the ten-year flow fell below delivery obligations at the end of WY 2025. Conversely, the lowest delivery interpretation assumes: 1) the Upper Basin is not required to deliver additional volumes for evaporative losses, 2) the Upper's Basins delivery obligation reduces when Mexico takes system water reductions, and 3) the Upper Basin has no delivery obligation to Mexico when natural flow at Lee Ferry exceeds 16 MAF. Under this set of interpretations, the ten-year flow could fall below delivery obligations between WY 2027 and 2029 depending on Glen Canyon Dam releases. These bookend scenarios are compared to the common 82.5 MAF interpretation, under which flows could fall below obligations in WY 2026 or 2027.

Combining different interpretations on these three components of the delivery obligation to Mexico can result in a wide variety of results that fall between the lines presented on Figure 7. But regardless of the combination of interpretations chosen, flows are likely to fall below obligations within the next few water years unless future 9 MAF releases sustain the ten-year flow total.

Figure 7. Lee Ferry Flow Scenarios and Delivery Obligation Interpretations[133]



V. CONCLUSION

So what does compliance with the Lee Ferry obligation in the Colorado River Compact mean? What is the numeric threshold that must be crossed before the Lower Basin can say that the Upper Basin is in violation of the Compact and make a "call" or demand "curtailment"?[134] Whatever the number is, we know that we are getting closer to it.

"Compact compliance" has not been top of mind in the Basin in past years because the ten-year period included years with high equalization releases

133. Original figure created by Montgomery & Associates.

134. *See* ANNE CASTLE & JOHN FLECK, THE RISK OF CURTAILMENT UNDER THE COLORADO RIVER COMPACT 33–35 (2019) (describing the administration of Compact "curtailment" in Colorado).

from Lake Powell like 2011 (12.52 MAF) and 2015–2019 (9.0 MAF).[135] Yet, Lake Powell was at its lowest elevation in recent history in 2023. Water Year 2025 has been terrible, which is not a hydrological term, but one that captures the mood of the challenge the current hydrology brings. As those high-release years drop out of the ten-year period and are replaced with years with a 6.0 MAF Lake Powell release, for example, we will be staring at that threshold in the near future. We should expect the Basin States to act accordingly, with pressure to avoid a Compact violation and take one more problem to solve off the table for now.

135. *See Lake Powell - Release Volume*, U.S. BUREAU OF RECLAMATION, https://www.usbr.gov/uc/water/hydrodata/reservoir_data/919/charts/release_volume.html (providing visual data of Lake Powell releases since 1963) [https://perma.cc/VRC6-UDKC].