

# THE “UPPER BASIN VOLUNTARY DEMAND CAP” AS A MEANS OF MITIGATING LEGAL UNCERTAINTY IN THE COLORADO RIVER BASIN: MODELING RESULTS

A Report of the Colorado River Governance Initiative<sup>1</sup>

April, 2013

## Introduction

In previous publications of the Colorado River Governance Initiative (CRGI), we concluded one of the most important sources of uncertainty in the basin are the legal uncertainties regarding the obligations of the Upper Basin to release water to the Lower Basin. Specifically, we have highlighted three related and highly salient questions: (1) does the Upper Basin have an obligation to deliver 7.5 MAF/year downstream (on average) for Lower Basin consumption; (2) does the Upper Basin have an obligation to deliver half the Mexican Treaty obligation (0.75 MAF/year) downstream; and (3) can the failure to achieve one or both of these objectives trigger a compact call?<sup>2</sup> These are fundamental questions, as they largely determine long-term water availability in the basin. But they are also largely ignored questions, as up to this point, no ruling on these questions has been required to operate the system—a fortunate byproduct of Upper Basin demands still being low enough to allow both of the presumed “delivery obligations” to be fulfilled. Where these questions currently arise are in long-term system modeling, the latest example being work conducted for the Colorado River Basin Water Supply and Demand Study (the “Basin Study”).<sup>3</sup>

Unfortunately, due to political sensitivities, the Basin Study did not provide, or attempt to provide, a direct analysis of these questions, as the modeling assumptions were constructed in a way to minimize the need for controversial legal assumptions. This is best illustrated by the concept of “miracle water.” In modeling scenarios in which the Upper Basin could physically not deliver 7.5 MAF downstream without curtailing Upper Basin depletions, the approach was to allow Upper Basin uses to proceed without curtailment while magically conjuring up the 7.5 MAF desired by the Lower Basin and injecting it into the system downstream of Lees Ferry—even if it would not physically exist in reality. This satisfies the legal interpretations and political objectives of both basins: the Lower Basin receives the 7.5 MAF which they believe is

---

<sup>1</sup> For more information, visit [www.waterpolicy.info](http://www.waterpolicy.info) or contact [CRGI.CU@gmail.com](mailto:CRGI.CU@gmail.com) or CRGI Director Doug Kenney ([douglas.kenney@colorado.edu](mailto:douglas.kenney@colorado.edu)).

<sup>2</sup> The most complete summary of these arguments have been published as: Robison, Jason, and Douglas S. Kenney. 2013. Equity and the Colorado River. *Environmental Law*, 42(4):1157-1209 [available at: <http://law.lclark.edu/live/files/13155-robison--kenneyfinal-for-websitepdf>]. A variety of supporting documents can be found at the Colorado River Information Portal at <http://waterpolicy.info/projects/CRIP/index.html>.

<sup>3</sup> <http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/index.html>

owed to them under the Compact, and the Upper Basin does not have to make any concessions or clarifications regarding which management scenarios, if any, would require Upper Basin curtailments and/or the imposition of a Compact call. The models can keep track of the magnitude of miracle water accumulations, but there is no necessity in the modeling to subtract this from Upper Basin uses or elsewhere (such as from reservoir storage). While this is done to allow modeling to proceed forward without being blocked by disputes over legal interpretations, it can hide shortages and, more fundamentally, the relationship between legal interpretations and the distribution of shortages.

If the common assumption is utilized that the 7.5 MAF/year (average) delivery of water downstream is, in fact, a firm obligation that could be enforced by Compact call curtailments on Upper Basin use, then a “squeeze” on Upper Basin depletions can occur, especially under climate change scenarios that feature decreased long-term flows. This was graphically shown by CRGI in the following figure:

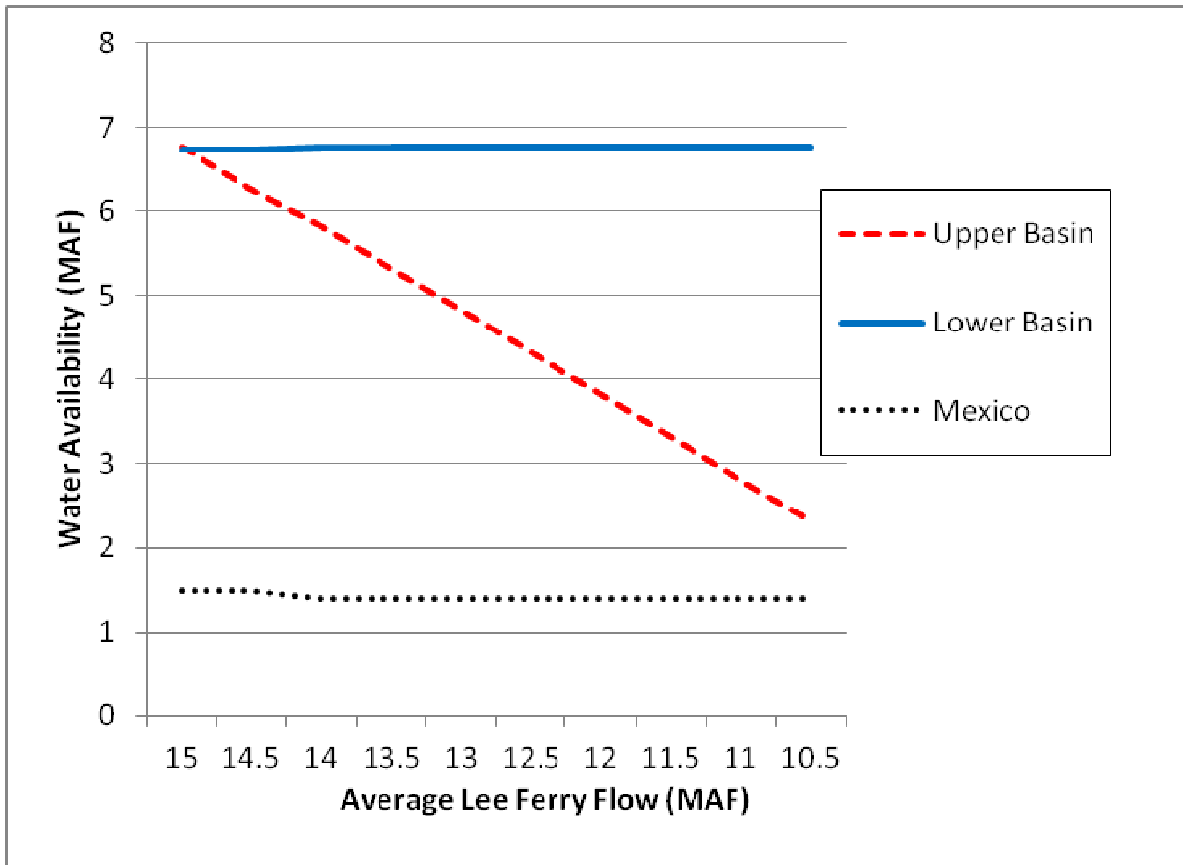


Figure 1. Water Availability (by sub-basin) as a Function of Long-Term Average Flows<sup>4</sup>

<sup>4</sup> This graphic was first published as Figure 8 in “Rethinking the Future of the Colorado River,” the Interim Report of the Colorado River Governance Initiative (December, 2010), available at the Colorado River Information Portal:

The sharp decline in Upper Basin water availability<sup>5</sup> is the unavoidable consequence of having to release water downstream before satisfying Upper Basin demands which, again, is a point of legal dispute, in part based on the Compact wording in Section III(d) that does not describe these releases as an “delivery obligation,” and in part on the premise of equity that runs through the Compact. As shown in the Figure 1, a decline in average streamflows of 20%—well within the scope of many climate change studies—could result in a situation in which Lower Basin water availability from the mainstem is roughly twice that of the Upper Basin, despite the intent of the Compact (as shown in Article III(a)) to allocate equal shares among basins. Imposing a firm obligation upon the Upper Basin to deliver part of the Mexican obligation only intensifies the effect. Obviously, this squeeze could have catastrophic consequences for Upper Basin users, leading us to speculate that the situation would either never occur—i.e., a negotiated solution or successful Upper Basin litigation would stop the curtailments—or would occur only after successful Lower Basin litigation. Any of these solutions, however, could take a variety of forms and a number of years—perhaps decades—to complete, and the outcome would have significant and immediate impacts on water availability in both basins. This legal uncertainty hangs over the basin—and has for at least 65 years<sup>6</sup>. Arguably, this source of uncertainty outweighs the climate and demand uncertainties exposed and featured in the Basin Study analysis.

There is no way to allocate water differently between the two basins that results in a net basinwide gain in water availability; it is a zero-sum effort. But there are ways to allocate water that balances the risk of climate-related shortages more equitably between basins, and which has the benefit of replacing uncertainty with certainty. In water management, the value of certainty cannot be underestimated, and as argued above, the greatest threat to certainty is the manner in which the legal ambiguities and omissions will ultimately be addressed. Remove

---

<http://waterpolicy.info/projects/CRIP/index.html>. The figure is based on a host of highly (and intentionally) debatable assumptions and simplifications; thus, it should be viewed as a starting point for discussion, rather than a formal projection or legal interpretation. Specifically, in scenarios where the long-term average Lee Ferry flow is 14.5 MAF/year or higher, it assumes that the Upper Basin will be required to maintain a minimum delivery schedule of 8.23 MAF/year in order to satisfy the Compact and Treaty, and that the Lower Basin will be required to pass 1.5 MAF/year of this water to Mexico, with the remainder available for use by the Lower Basin. In scenarios where the long-term average Lee Ferry flow is 14.0 MAF/year or less, it assumes the Upper Basin will be required to maintain a minimum delivery schedule of 8.18 MAF/year in order to satisfy the Compact and Treaty, and that the Lower Basin will be required to pass 1.4 MAF/year of this water to Mexico. (Note that this figure was developed prior to Minute 319; those rules, if modeled here, would have a negligible impact on the trend lines shown here.) All values are maximum water available for use before subtracting evaporation or other losses.

<sup>5</sup> Note that the “availability” of water and the entitlement or allocation of water are separate (but obviously related) issues. The Compact is clear that the Upper Basin is allocated 7.5 MAF/year of consumptive uses (Article III(a)), but virtually no climate scenario (paleo, historic, or future projections) suggests this is a realistic possibility if an obligation to pass water downstream exists.

<sup>6</sup> This concern is part of the subtext of the Upper Basin Compact negotiations (circa 1948) [transcripts available at <http://lawpac.colorado.edu/record=b119651>], and is reflected in the decision to allocate Upper Basin shares in percentages rather than fixed values.

these legal uncertainties and the door is open to a variety of deals and coping mechanisms, and the need to prepare for “legal shocks” to the system are avoided. This, in a nutshell, was the motivation for the “Upper Basin Voluntary Demand Cap” option submitted by the CRGI to the Basin Study for analysis. The fact that this option—and the other so-called “governance” options<sup>7</sup>—were not analyzed is the motivation for this memo.

### The Demand Cap Concept

The central idea of the Upper Basin Voluntary Demand Cap (hereafter the “Demand Cap”) is that the Upper Basin agrees to limit total Upper Basin depletions at a negotiated level (well below the theoretical 7.5 MAF/year) and, in return, is assured that neither the federal government nor the states of the Lower Basin will request or support administration of an inter-basin compact call in any period when storage in Lake Powell is insufficient to maintain the predetermined downstream release objective.<sup>8</sup> Establishing the value of the “cap” and the release objective are points to be negotiated; but the principle is to establish these numbers in advance of a crisis and without a need to litigate the omissions and ambiguities that exist in the Compact and related elements of the Law of the River. In that regard, the Demand Cap is not intended to replace or amend the Compact<sup>9</sup>, but rather, is an operational regime placed on top of this foundation—following the precedent of the 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead (Interim Guidelines). Also analogous to the Interim Guidelines, enactment of the voluntary agreement would require the unanimous agreement of the seven basin states, and in doing so, would establish a temporary arrangement. In this case, the proposed operating regime would remain in effect for a term of 40 years, subject to renewal (no later than 10 years prior to expiration) by affirmative action by a minimum of 5 of 7 states. The agreement could be modified or

---

<sup>7</sup> 41 of 160 submitted options were characterized as involving governance; see <http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/techrptF.html>.

<sup>8</sup> The Demand Cap proposal can be found in two slightly modified forms: the original version in the Basin Study materials (option 117 at

<http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20F%20-%20Development%20of%20Options%20and%20Strategies/Appendix%20F%20-%20Options%20Submitted%20to%20the%20Study/Appendix%20F%20-%20Options%20Submitted%20to%20the%20Study.pdf>), and a slightly updated version on the Colorado River Information Portal

(<http://waterpolicy.info/archives/docs/Upper%20Basin%20Voluntary%20Demand%20Cap,%20amended%20Feb%202012.pdf?p=1683>). Neither version is reprinted here in its entirety as the following section provides the most comprehensive articulation and analysis to date.

<sup>9</sup> In fact, the Demand Cap proposal is seen as a way to honor and reinforce the heart of the Compact, which is the commitment to an equal sharing of water among the two basins.

terminated at any time by unanimous agreement of the states. Once terminated, the Law of the River, as it currently exists, provides the default legal and operational regime.

The Demand Cap is not a completely new idea, as a similar idea was once floated at a Basin Study meeting in Albuquerque.<sup>10</sup> Then, as now, the idea raises several concerns. First and foremost, while the value of eliminating legal uncertainty is undeniably attractive and valuable, there is a benefit associated with uncertainty in that it allows all parties to retain hope for the legal interpretation that best suits their interests. To agree to a cap forces the Upper Basin to concede a “practical” apportionment significantly less than 7.5 MAF<sup>11</sup>; similarly, agreeing to the proposal forces the Lower Basin to concede that their apportionment is not senior to all Upper Basin uses (except Upper Basin Present Perfected Rights). For both parties, the idea makes sense only to the extent that the “concessions” involved are more than offset by the value of the reduced legal uncertainty and the other ancillary benefits of the proposal. In summary, potential benefits of the Demand Cap (as compared to the *status quo*) include:

- The threat of an inter-basin Compact call is completely eliminated—thereby protecting existing Upper Basin water users from a call, and eliminating the reliance of Lower Basin users on successfully litigating a call—as is the need for any interim litigation/negotiation concerning the existence of an Upper Basin “delivery obligation” and several related legal issues (including the Upper Basin’s share of the Mexican delivery obligation and the use of Lower Basin tributaries);
- The Demand Cap arrangement provides mechanisms (namely, the Upper Basin cap on consumption) that encourage the maintenance of storage in Lake Powell (and all the associated benefits thereof, including drought protection, and protection of recreation and hydropower industries);
- With the exception of some new administrative expenses (associated primarily with tracking Upper Basin consumption), the Demand Cap option requires no new expenditures, and in fact is likely to save significant public funds by eliminating or reducing the need for many expensive risk-coping strategies, and by reducing the financial costs (and potential impacts) of litigation; and,
- The arrangement provides a foundation upon which many emerging and new reforms could be established, while maintaining the existing Law of the River as the default

---

<sup>10</sup> See: Kuhn, Eric. 2011. Risk Management Strategies for the Upper Colorado River Basin. Draft of June 7.

<sup>11</sup> Arguably, this has already occurred in Upper Basin reports, including the seminal study by Tipton and Kalbach (1965) estimating long-term Upper Basin water availability as ranging from 4.7 to 6.3 MAF/year. (Tipton and Kalbach, Inc. 1965. *Water Supplies of the Colorado River*. Report prepared for the Upper Colorado River Commission. Denver, July.) This is also done in the Hydrologic Determinations.

condition. By largely removing or tempering the “game changing” uncertainties (associated with the effect of climate change on average and extreme flows, and the interpretation of key Law of the River issues), the Demand Cap establishes an environment encouraging further innovations (including river augmentation).

### The Modeling Effort

The following modeling was conducted in summer and fall 2012 using CRSS<sup>12</sup> by Kevin Wheeler, owner of Water Balance Consulting (and a product of the University of Colorado Center for Advanced Decision Support for Water and Environmental Systems (CADSWES)). This work was done commensurate with the Basin Study and, as such, utilized assumptions from that investigation wherever possible—with a few notable exceptions. Modeling results are shown below, preceded by a discussion of some prominent modeling assumptions and adjustments that shaped the study design.

### Methodology and Assumptions

The modeling approach was to compare the performance of the demand cap scenario against a *status quo* (hereafter the “Baseline”) scenario, primarily from the standpoint of consumption levels in both basins and reservoir storage. These are the macro level variables of interest in any operational regime that modifies the relationship between the Upper and Lower Basin. For both scenarios, inputs (supplies) derive from use of the downscaled GCM projected hydrology. That climatic scenario, which assumes warming, has the further influence of augmenting demands specified in the Basin Study’s Scenario A demand schedule.<sup>13</sup> These supply and demand elements have a variety of embedded assumptions and shortcomings, not detailed here, but were selected to dovetail the analysis with the Basin Study to the extent possible. Similarly, we utilized the Basin Study time horizon, which extends to 2060. Some of the benefits of the Demand Cap proposal are probably more evident at later dates, but we could not explore this point without access to supply and demand scenarios extending past 2060.

To perform this comparison, a few elements of CRSS had to be modified. As foreshadowed earlier, the miracle water algorithm had to be modified in two ways. First, in those instances in which miracle water was utilized in the Baseline scenarios, those quantities were subtracted from Upper Basin use to get an accurate value of how much water the Upper Basin actually

---

<sup>12</sup> CRSS is the Colorado River Simulation System, a RiverWare based model that is the official model used by the Bureau of Reclamation for system operations and scenario planning.

<sup>13</sup> The impact of assumed warming on demands is significant, average roughly 0.5 MAF/year by 2060.

consumed. Failure to do so would make comparisons of the Baseline to the Demand Cap scenario meaningless. Second, the miracle water algorithm is unlimited—i.e., the program can add in more water than would physically be made available from Upper Basin curtailments. As a matter of physics and policy, we limited miracle water to the amount that could actually be achieved through Upper Basin curtailments, subject to the protection of Upper Basin Present Perfected Rights (which we assume to be 2.2 MAF).

Also problematic was the fact that CRSS operates based on demands, not depletions. Despite the name “Demand Cap,” our proposal is, in reality, a depletion cap. Additionally, in satisfying demands, CRSS tracks of water availability and demands in various reaches/tributaries, and does not satisfy demands in a given river segment where water is physically unavailable. For the purposes of our analysis, this level of detail is somewhat counterproductive, as we assume that once a firm cap is in place, physical and institutional adjustments would be made to ensure full use of the cap. Adjustments were made to hit the Upper Basin depletion maximums described in the Demand Cap scenarios.

Both the Baseline and Demand Cap scenarios required refinements. Of the two, specifying the Baseline scenario was the larger challenge, as it requires some assumptions about how the current rules might actually be interpreted in practice. Two issues are particularly salient. First, the magnitude of the Upper Basin delivery obligation had to be specified at some level, with 7.5 MAF/year and 8.25 MAF/year being obvious candidates. Rather than choose one of the other, we utilized both values (thus creating two Baseline scenarios). Second, the Interim Guidelines are scheduled to expire in 2026 if not renewed or modified. We choose to keep these guidelines throughout the full scenario. To the extent that other legal assumptions were required, unless otherwise noted, we retained the rules already codified in CRSS.

Three adjustments to the original Demand Cap scenario are notable. First, we originally proposed using a cap value that included Upper Basin evaporation losses. Ultimately, we decided to specify an Upper Basin cap number before evaporation, which immunized the Upper Basin from the practical challenge of trying to predict evaporation precisely in any given year. (We assume those losses to be in the neighborhood of 0.5 MAF/year.) Second, in order to investigate the potential benefits of the Demand Cap proposal in protecting reservoir storage, we quickly realized that it might be advisable to prevent the Lower Basin from using surpluses attributable to enforcement of the Upper Basin cap. To do this, a Lower Basin cap of 7.5 MAF/year was imposed throughout most of the Demand Cap scenarios. And third, through initial modeling runs we determined that an Upper Basin cap of 4.5 MAF/year (not counting evaporation) was the best value for illustrating the trade-offs inherent to the Demand Cap. (The original proposal suggested 5.5 MAF—roughly 5 MAF in depletions and 0.5 MAF in

evaporation—as a starting point of analysis.) Of course, we encourage subsequent analyses that feature a broader range of values.

## Results

The results presented below are from the sixth (and final) iteration, by which time the key modeling issues described above had been identified and resolved. Each figure provides results for three scenarios:

- 75 Prot22      This baseline scenario assumes a delivery obligation averaging 7.5 MAF/year. Failure to deliver this volume results in Upper Basin curtailments as necessary to meet this delivery, with the caveat that 2.2 MAF of Upper Basin Present Perfected Rights are always protected from curtailment (hence the “Prot22” nomenclature).
  
- 82.5 Prot22    This baseline scenario assumes a delivery obligation averaging 8.25 MAF/year. As with 75 Prot22, failure to deliver this volume results in Upper Basin curtailments as necessary to meet this delivery, with the caveat that 2.2 MAF of Upper Basin Present Perfected Rights are always protected from curtailment.
  
- 4.5 Double Cap    This Demand Cap scenario allows the Upper Basin to deplete 4.5 MAF/year before evaporative losses (roughly 0.5 MAF/year), and additionally caps Lower Basin consumption at 7.5 MAF/year. No Upper Basin delivery obligation is enforced (i.e., no Compact calls).

A few figures plot two additional variables:

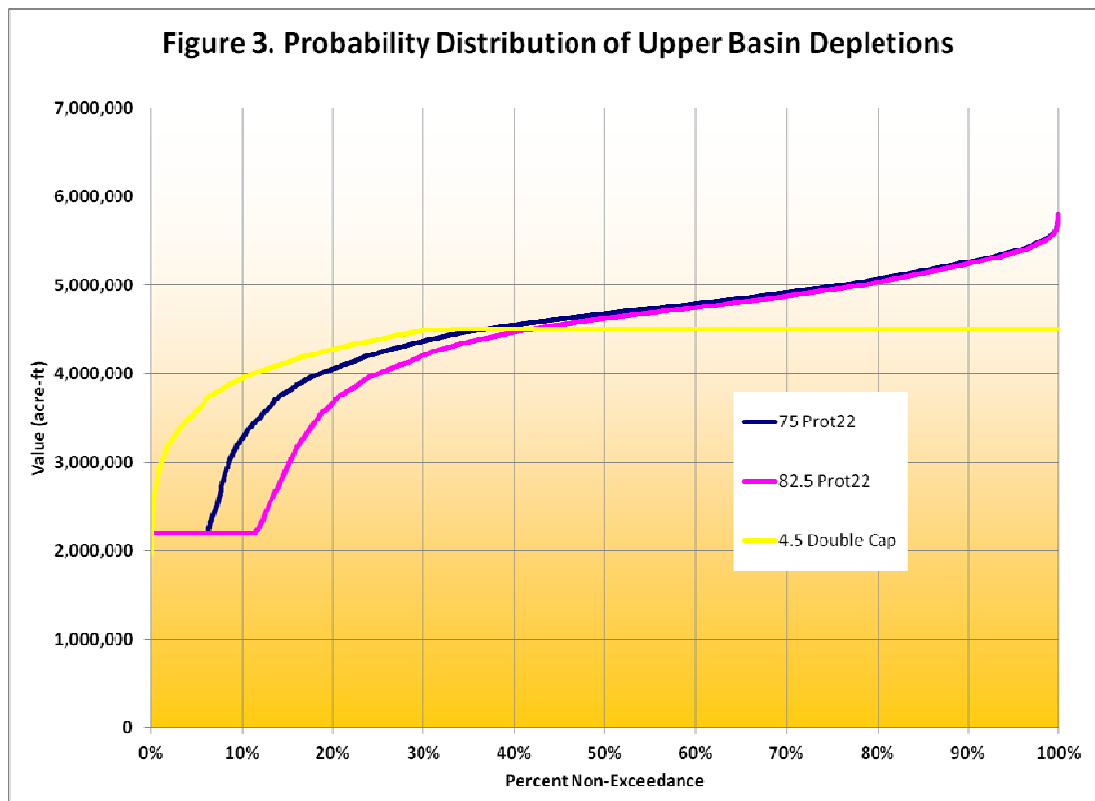
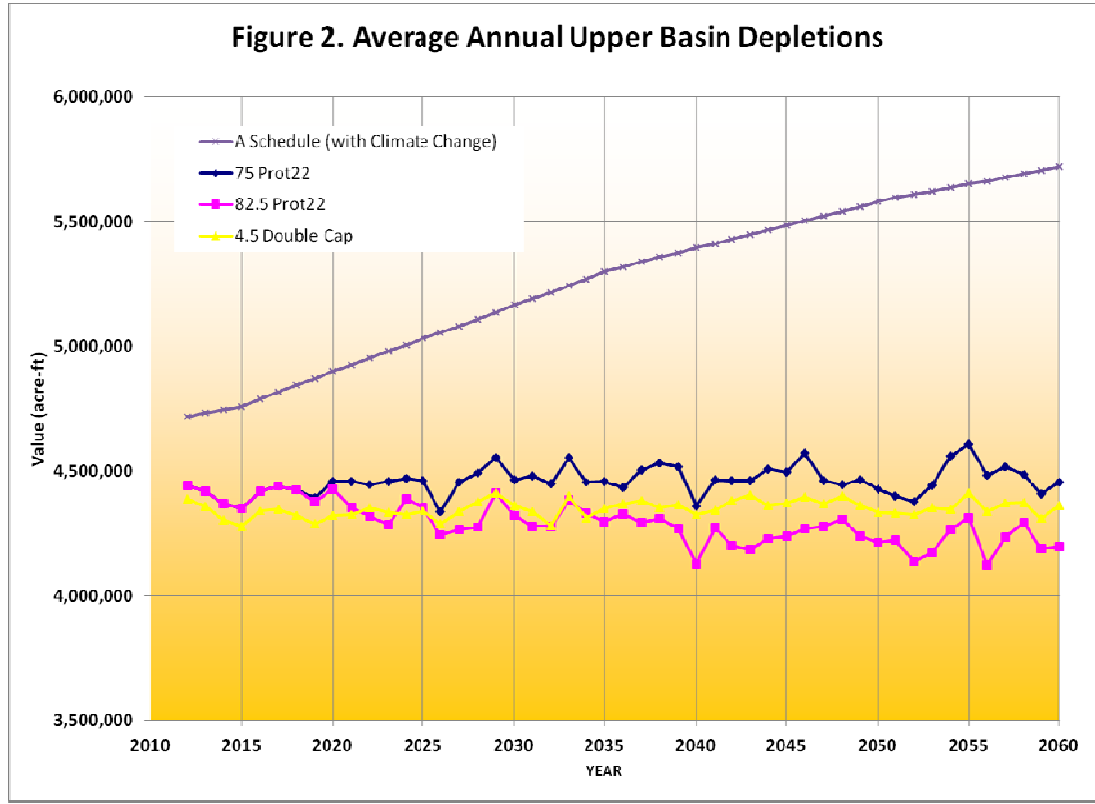
- A Schedule (with Climate Change)    These are the projected Upper Basin demands from the Basin Study “Schedule A” demand schedule as adjusted (increased) to reflect the added demands associated with the downscaled GCM projected hydrology.
  
- 4.5 Single Cap    This Demand Cap scenario allows the Upper Basin to deplete 4.5 MAF/year before evaporative losses (roughly 0.5 MAF/year). No cap on Lower Basin consumption is enforced. No Upper Basin delivery obligation is enforced (i.e., no Compact calls).



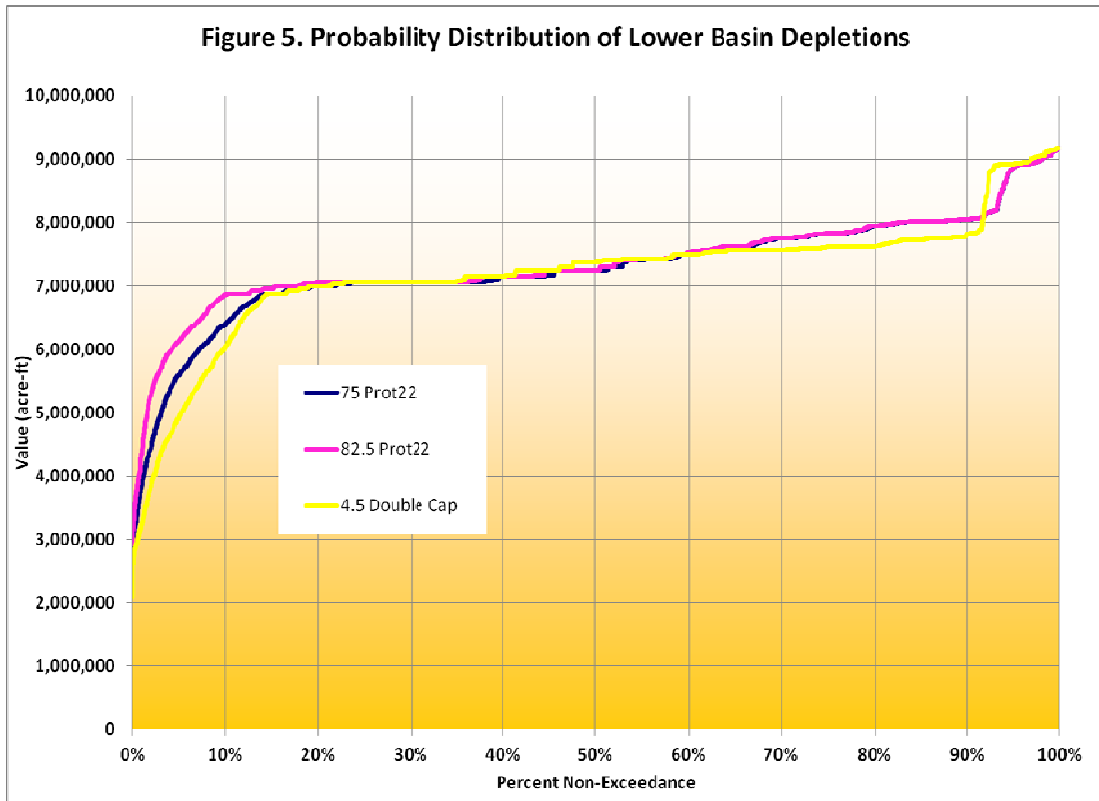
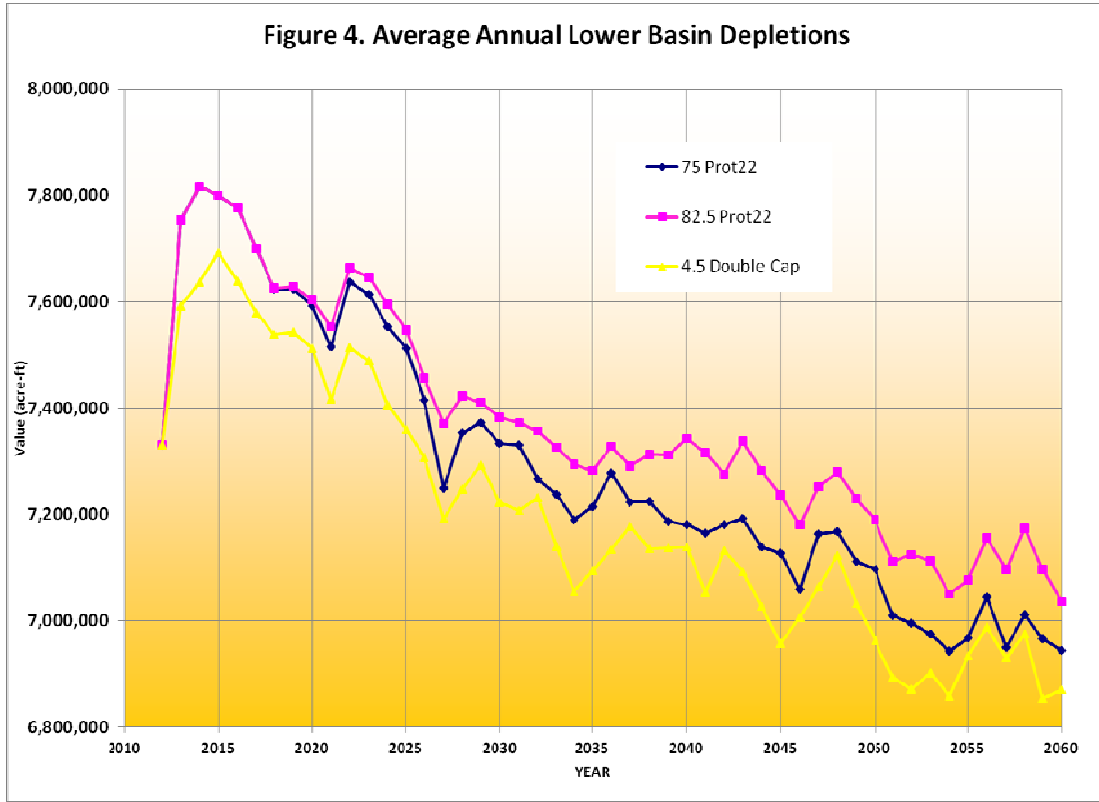
Collectively, these variables allow us to track differences in how the Demand Cap affects water availability (measured in terms of the amount of consumption allowed) and changes in reservoir storage. As a practical matter, water managers are likely to want high levels of both variables, although in reality there is a fixed quantity of water, and maximizing both consumption and storage at all times is an impossibility. Similarly, it is an impossibility to simultaneously increase water consumption and storage for all users; inputs to the system are not modified across all the scenarios—i.e., they all use the same downscaled GCM projected hydrology—so this is a zero-sum exercise. Thus, the way to evaluate the results is to compare the quantitative trade-offs in terms of supplies (as measured by consumption), storage (as measured by reservoir volume/elevation), and reliability, and to do this with respect to the non-quantitative trade-offs associated with the “ease” of maintaining the *status quo* (offered by the Baseline scenarios) versus the benefits of eliminating legal uncertainties (offered by the Demand Cap scenarios).

Given the importance of these non-quantitative variables, it is impossible for us to impartially establish any scenario as the “winner” or “best,” and thus, to argue for or against enactment of the Demand Cap policy. But that is not the point of this exercise. The point is to illustrate trade-offs and opportunities associated with the pursuit of a governance-based solution, in this case, a Demand Cap scenario. Whether or not the Demand Cap is a good approach is certainly debatable; whether or not governance-based reforms should be part of the search for solutions is not. Basin leaders will soon be forced to make decisions regarding several governance and Law of the River items, including extension of the Interim Guidelines; the definition of Upper Basin delivery obligations, if any, to the Lower Basin and/or to Mexico; the design and implementation, if any, of an interbasin Compact call; the quantification of Upper Basin Present Perfected Rights; and so on. Again, much of the appeal of the Demand Cap is that it can subordinate or completely eliminate many of the most divisive issues, and do so in a way that leaves the Compact unaltered and as the default institutional framework.

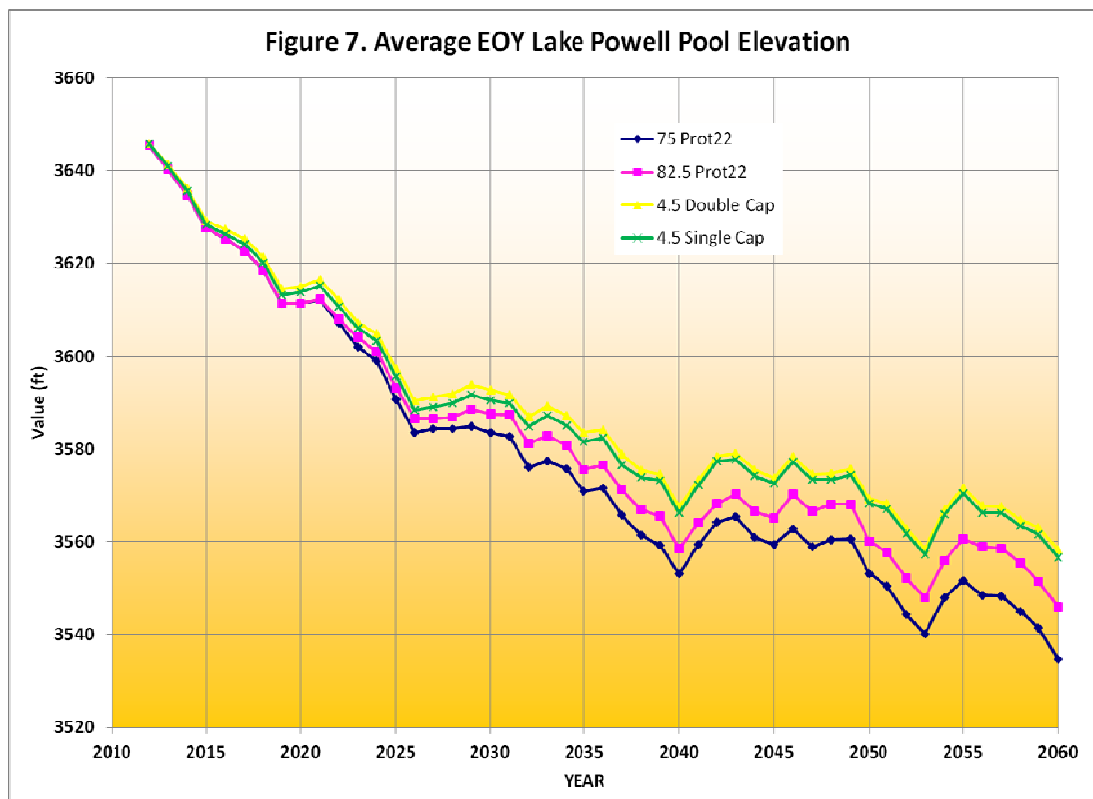
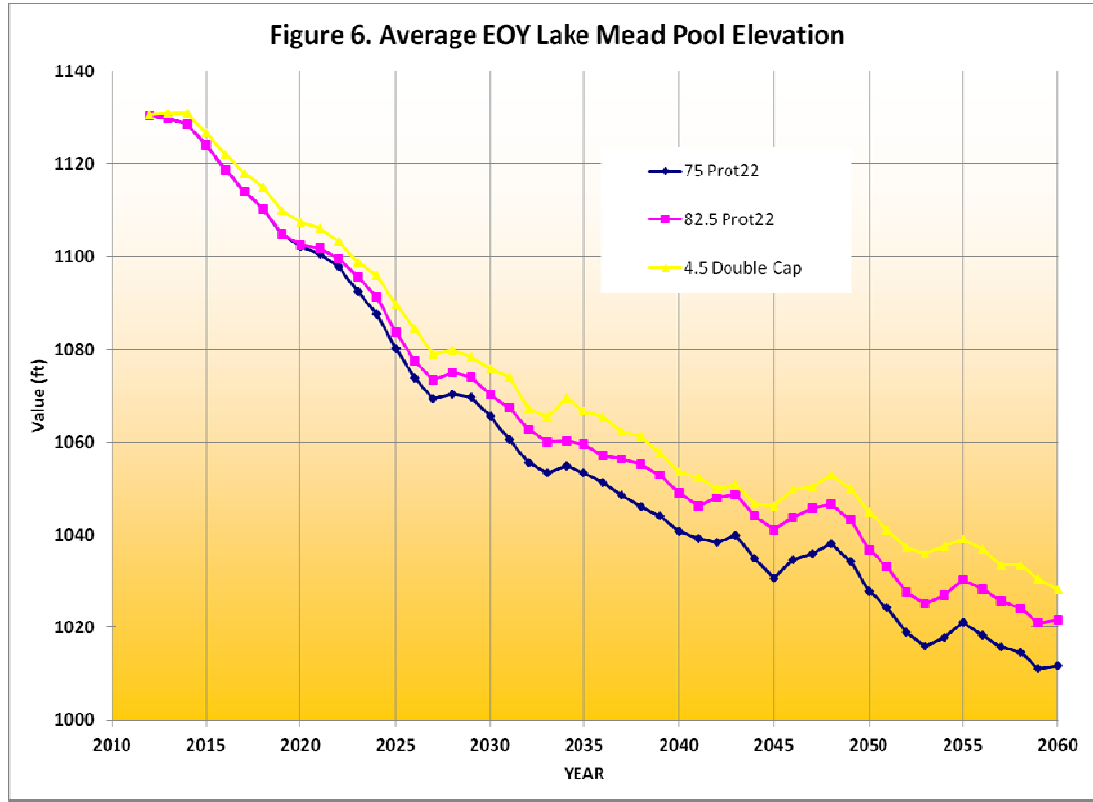
Depletions: Upper Basin



Depletions: Lower Basin



## Reservoir Storage



## Findings and Conclusions

The preceding figures illustrate some of the most important trade-offs associated with adopting the Demand Cap proposal. As noted earlier, the data does not allow us to make a definitive ruling about which approach is best, but it does allow us to speculate on the trade-offs (assuming a 4.5 MAF cap) that would be central to any decision-making. What we believe to be the salient lessons of Figures 2 through 7 are summarized below.

### Depletions: Upper Basin

The plot of average depletions (Figure 2) is perhaps most notable for showing how both the Baseline and Demand Cap scenarios fall well below the demands associated with Schedule A and downscaled GCM projected hydrology. The Demand Cap does not solve this problem of unmet demands, but neither does either Baseline.<sup>14</sup> Thus, this plot is a better illustration of the Upper Basin supply/demand mismatch than it is instructive in illuminating a solution.

The PDF (probability distribution function) shown in Figure 3 illustrates a key feature of the Demand Cap, as Upper Basin depletions are relatively flat and stable when compared to the Baseline scenarios. Overall, the Baseline scenarios offer slightly more water about 60% of the time and slightly less about 40% of the time, with big differences seen only at the extremes. Of course, much of water management is focused on management at the extremes.

Overall, the Upper Basin depletion figures illustrate that, while the Demand Cap concept might first seem like a radical and significant concession for the Upper Basin, the effect during the study period is relatively modest—at least at the 4.5 cap level. Extending the time horizon past 2060 would likely yield more dramatic results, as would changing the climate hydrology assumptions. Ultimately, for the Upper Basin, the key decisions are whether or not losing the extreme highs is worth being insulated against the extreme lows, and whether or not tabling the legal issues (for the term of the agreement) is preferable to leaving those open.

### Depletions: Lower Basin

Not surprisingly, the plot of average Lower Basin depletions (Figure 4) shows the net effect of the Demand Cap is to limit Lower Basin depletions below what would be possible given the Baseline scenarios assuming enforcement of either a 7.5 MAF/year or 8.25 MAF/year Upper

---

<sup>14</sup> It is quite possible that CRSS overestimates the UB shortages for each of these scenarios, in that the resolution of the model does not include some existing storage reservoirs and, thus, may underestimate the ability of the system to meet some demands.

Basin delivery obligation—although the differences are not extreme (note the y-axis divisions are only 200KAF). Again, whether or not the Lower Basin can realistically expect to surmount the legal and political hurdles associated with enforcing either delivery obligation is a strategic consideration that cannot be shown quantitatively. In the Demand Cap scenario, the Lower Basin is not required to pursue (or prevail in) such litigation.

The other key strategic consideration for the Lower Basin is the effect of the Demand Cap on water supply reliability. The PDF (Figure 5) shows virtually no significant differences in reliability over most of the runs, with the notable exception of the lowest tail which shows how the Demand Cap shifts some of the climate risk to the Lower Basin. This is an inherent and predictable consequence of “easing” some of the climate risk on the Upper Basin (explained earlier and shown in Figure 1). The Demand Cap is assumed to ameliorate this concern by better protecting reservoir storage, the subject of the following set of figures.

### Reservoir Storage

The impact of the Demand Cap on reservoir storage is consistently positive—i.e., better than either Baseline scenario, and especially notable in the later years of the runs. Average Lake Mead elevation, for example, is roughly 20 feet higher in the Demand Cap scenario than the 7.5 MAF/year (“75 Prot22”) scenario by 2060 (Figure 6). The story for Lake Powell is also consistently positive, in that the Demand Cap results in greater storage than either Baseline (Figure 7).

Note that Figure 7 also shows the impact of a “single cap”—i.e., just an Upper Basin cap as originally proposed—on reservoir storage. The “double cap” was utilized in this modeling for fear that, without the Lower Basin cap, any gains in Lake Powell reservoir storage might be lost to surplus uses downstream. Figure 8 shows these fears were probably overblown, as no discernible impact is seen for Lake Powell.

### Conclusions

Overall, the modeling of the Demand Cap shows that, compared to the *status quo*, this institutional reform can (a) better balance the risk of water supply perturbations associated with climate change between the Upper and Lower Basins, (b) eliminate many significant legal uncertainties, and (c) protect and enhance reservoir storage, all while having modest impacts on water available for consumptive use in both basins. Whether or not this is viewed as an improvement over the *status quo* is a matter of personal judgment, and rests on assumptions

about what the *status quo* might actually entail. It is worth noting that, for modeling purposes, specifying the Baseline (*status quo*) scenarios proved much more difficult than the Demand Cap, which is a powerful reminder that significant legal omissions and ambiguities exist in the Law of the River during periods of water scarcity.

That a governance reform can mitigate against both hydrologic (climate change) and legal uncertainties is evidence that this class of reforms need to be considered prominently in the search for solutions, despite their omission in the Basin Study analysis and the hesitancy of many parties to discuss matters of law and politics. The fact is, the thorny legal and policy issues that exist will at some point demand resolution, and the time to do that is before the reservoirs are empty and the specter of a Compact call has taken center stage. Conceptually, solutions that protect the Compact from legal challenges should have broad appeal; the Demand Cap is one pathway to that future.