# CHAPTER 2 – DESCRIPTION OF ALTERNATIVES

## 2.1 INTRODUCTION

This chapter discusses the process used to define the No Action Alternative and develop a range of possible interim surplus criteria alternatives and summarizes various alternatives that were considered but eliminated from further analysis. It then describes the alternatives analyzed in this DEIS. The modeling procedures and assumptions are discussed in Section 3.3.

## 2.2 DEVELOPMENT OF ALTERNATIVES

This DEIS considers four interim surplus criteria alternatives as well as a No Action Alternative/baseline that was developed for comparison of potential effects. The four action alternatives considered include the Flood Control Alternative, the Six States Alternative, the California Alternative, and the Shortage Protection Alternative (as described in Section 2.3). Section 2.2.1 discusses the strategies and origins of the action alternatives and describes alternatives that were considered but eliminated from further analysis.

### 2.2.1 OPERATING STRATEGIES FOR SURPLUS DETERMINATION

#### 2.2.1.1 THE R STRATEGY

In 1986, Reclamation developed an operating strategy for distributing surplus water and avoiding spills (Reclamation, 1986). That analysis founded the Spill Avoidance or "R" strategy. The development of this strategy was an outcome of sustained flood control releases at Lake Mead from 1983 through 1986. The R strategy assumes a particular percentile historical runoff, along with normal depletion projections, for the next year. Applying these values to the current reservoir storage, the projected reservoir storage at the end of the next year is calculated. If the calculated space available at the end of the next year is less than the space required by flood control criteria, then a surplus condition is determined to exist.

Two alternatives considered in this DEIS use variations of the R strategy. The 70R strategy uses an annual runoff of 17.3 maf while 75R strategy uses 18.1 maf. The 70R strategy was eliminated from consideration as an alternative in this DEIS because modeling results from 70R strategy are very similar to the Flood Control Alternative, which is evaluated in this DEIS (described in Section 2.3.2). The 70R strategy is very similar to the 75R strategy. The 75R strategy was used to represent the baseline as described in Section 2.3.1.

#### 2.2.1.2 THE A STRATEGY

In the early and mid-1990s, Reclamation continued discussing surplus criteria strategies with the Colorado River Management Work Group (CRMWG). A technical committee was formed to develop a consensus, and additional surplus criteria strategies were developed.

One of the strategies developed through the CRMWG analysis was the Flood Control avoidance or "A" strategy. This strategy determines when there is insufficient storage space in Lake Mead and upstream reservoirs to avoid flood control releases from Lake Mead with a particular percent assurance.

The most common usage became the 70 percent assurance level (70A strategy). This alternative was eliminated because the modeling results were so similar to the Flood Control Alternative and the No Action/baseline (75R strategy) that it was not necessary to analyze it.

#### 2.2.1.3 THE P STRATEGY

Another strategy is the Shortage Protection or "P" strategy. This strategy is based on making surplus water available while maintaining storage sufficient to meet a 7.5 maf Lake Mead release requirement, while avoiding the likelihood of a future shortage determination. Through a separate modeling study, Reclamation determined the Lake Mead storage for each year into the future necessary to meet Lower Basin and Mexico demands, with a specified percent assurance of Lake Mead not dropping below a specified elevation. Water stored in Lake Mead in excess of that storage requirement is deemed surplus to be made available to the Lower Basin states. The Shortage Protection Alternative, formerly known as 80P, used in this DEIS is described in more detail in Section 2.3.5.

#### 2.2.1.4 FLOOD CONTROL STRATEGY

Under a flood control strategy, surplus conditions are determined only when flood control releases from Lake Mead are occurring or projected to occur in the subsequent year. In the 1998, 1999 and 2000 AOPs, Reclamation used the projection of flood control releases as the basis for making surplus water available to the Lower Division States. The Flood Control Alternative in this DEIS uses this strategy and is described in Section 2.3.2.

### 2.2.2 ORIGINS OF THE CALIFORNIA AND SIX STATES ALTERNATIVES

On December 17, 1997, California presented to the other Basin States its draft 4.4 Plan, a plan to achieve a reduction in its dependence on surplus water from the Colorado River, through various conservation measures, water exchanges and

conjunctive use programs. One of the elements of the 4.4 Plan was the expectation that the Secretary would continue to determine surplus conditions on the Colorado River until 2015. California proposed criteria for determination of surplus water conditions by which the Secretary would base his determinations of surplus conditions during the interim period.

In 1998, in response to California's 1997 proposal of interim surplus criteria, the other six states within the Colorado River Basin (Six States) submitted a proposal with surplus criteria that were similar in structure to those in California's proposal. The Six States' criteria were based on Lake Mead surface elevations to be used by the Secretary in making surplus determinations. However, under the Six States' plan, surplus water supplies would be limited to specific uses depending upon the occurrence of various specified Lake Mead surface elevations. The interim surplus criteria proposed by the Six States, presented in Attachment D, were used to formulate the "Six States Alternative" presented in Section 2.3.3.

California proposed specific interim surplus criteria attached to the October 15, 1999, *Key Terms for Quantification Settlement Among the State of California, Imperial Irrigation District, Coachella Valley Water District, and The Metropolitan Water District of Southern California*. That proposal, presented in Attachment E, was used to formulate the "California Alternative" detailed in Section 2.3.4.

### 2.2.3 PACIFIC INSTITUTE PROPOSAL

On February 15, 2000, a consortium of environmental organizations led by the Pacific Institute for Studies in Development, Environment, and Security (Pacific Institute) presented an interim surplus criteria proposal for consideration by the Secretary. This proposal contained interim surplus criteria, which are similar to the criteria under the Six States Alternative. The Pacific Institute Proposal also suggested that, during years when Lake Mead's surface elevation exceeds 1120.4 feet mean sea level (msl), an additional 35,000 af of water be delivered to Mexico for the purpose of restoring and/or maintaining habitat in the upper reaches of the Colorado River delta at the Sea of Cortez. The proposal also included 260,000 af to be delivered to the Colorado River delta when reservoir elevations are high. The letter from the Pacific Institute containing the proposal is included as Attachment F to this DEIS.

Water delivery to Mexico is regulated by the Treaty and various treaty modifications based on consultation between the United States and Mexico. The delivery of water to or through Mexico would require modification of the Treaty. Because the Pacific Institute's alternative for proposed interim surplus criteria is similar to, and within the range of, those already being analyzed, and because the delivery of additional water to Mexico is beyond the purpose of and need for interim surplus criteria addressed in this DEIS, the Pacific Institute's proposal is not analyzed in this DEIS.

### 2.2.4 FORMULATION OF ALTERNATIVES

In response to the 4.4 Plan and the Six States Plan proposals, and the dialogue engendered among Reclamation and the seven Basin States, Reclamation initiated a NEPA process to provide structure to evaluating potential interim surplus criteria alternatives and to determine and disclose the potential effects of these interim surplus criteria. At the initiation of the NEPA process, Reclamation began a public scoping process. Under that process, Reclamation conducted a series of public meetings in 1999 to inform interested parties of the consideration being given to the development of interim surplus criteria, to show options and proposals developed up to that time, and to solicit public and agency comments and suggestions regarding the formulation and evaluation of alternatives for the criteria.

The alternatives below were presented at the public meetings.

Flood Control Alternative
Spill Avoidance Alternative (70R)
Flood Control Avoidance Alternative (70A)
Multi-tier Alternative (based on the Six States Plan)
Shortage Protection Alternative (80P)

A description of the scoping process and issues identified, including those associated with alternatives development, are discussed in Chapter 5 of this DEIS. Following the public meetings, and in consideration of comments received, Reclamation added the interim surplus criteria proposals of the Six States and the California Plan for evaluation in this DEIS. It should be noted that while the California and Six States alternatives analyzed in the DEIS were based on criteria proposed by California and the Six States, the respective alternatives presented in this DEIS do not necessarily contain all the specific elements of those plans.

### 2.2.5 NO ACTION ALTERNATIVE AND BASELINE CONDITION

As required by NEPA, a No Action alternative must be considered during the environmental review process. Under the No Action Alternative, determinations of surplus would continue to be made on an annual basis, in the AOP, pursuant to the LROC and the Decree as discussed in Chapter 1. The No Action Alternative represents the future AOP without interim surplus criteria. Surplus determinations consider such factors as end-of-year system storage, potential runoff conditions, projected water demands of the Basin States and the Secretary's discretion in addressing year-to-year issues. However, the year-to-year variation in the conditions considered by the Secretary in making surplus water determinations makes projections of surplus water availability highly uncertain.

The approach used in this DEIS for analyzing the hydrologic aspects of the interim surplus criteria alternatives was to use a computer model that simulates specific

operating parameters and constraints. In order to follow CEQ guidelines calling for a No Action alternative for use as a "baseline" against which to compare project alternatives, Reclamation selected a specific operating strategy for use as a baseline condition, which could be described mathematically in the model.

The baseline is based on a 75R spill avoidance strategy. Reclamation has utilized a 70R strategy for both planning purposes and studies of surplus determinations in past years. When Reclamation reviewed previous surplus determinations as part of this DEIS effort, the data indicated that the 1997 surplus determination did not precisely fit the 70R strategy. Therefore, in an attempt to characterize recent operational decisions in a manner that could be modeled for baseline purposes, Reclamation determined that a 75R strategy would provide a more accurate representation of "no action" than a 70R strategy. After analysis, Reclamation selected the 75R strategy for use as the baseline condition in this DEIS. While the 75R strategy is used to represent baseline conditions, it does not represent a decision by Reclamation to utilize the 75R strategy for determination of future surplus conditions. It should be noted that the 70R (planning) strategy and 75R (baseline model representation) strategy yield very similar results for the purpose of determining impacts associated with the action alternatives analyzed in this DEIS. Figure 2-1 illustrates the similarly between the 70R and 75R strategies (see Section 2.3.1.2).

In the formulation of the baseline conditions, Reclamation considered available information for its baseline representation. Reclamation is requesting additional information or comments on the use of 70R versus 75R to represent baseline conditions during the pubic comment period for this DEIS.

## 2.3 DESCRIPTION OF ALTERNATIVES

This section describes the four interim surplus criteria alternatives analyzed in this DEIS, and No Action, which is represented by the baseline condition for comparison purposes. The Secretary would base his annual determination of surplus conditions on the criteria selected, if any, as part of the AOP process unless extraordinary circumstances arise. Such circumstances could include operations necessary for safety of dams or other emergency situations, the failure of California to meet its commitment to reduce dependence on Colorado River water, or other activities arising from actual operating experiences. The interim surplus criteria would remain in effect through calendar year 2015, subject to five-year reviews concurrent with the LROC reviews.

As noted above, the 75R operating strategy is not presented as an alternative for adoption. If an interim surplus criteria alternative is not implemented, it is presumed that the Secretary would determine surplus conditions using the same dynamic considerations currently used in the Secretary's annual determination (in the AOP), as discussed previously.

At the end of 2015, the interim surplus criteria would terminate, and, in the absence of subsequently-specified surplus criteria, surplus determinations would be made by future Secretaries based on factors such as those that are currently considered, as discussed in Chapter 1.

Because the selected baseline and the interim surplus criteria alternatives deal with operations, rather than construction or other physical Colorado River system changes, the alternatives are described below in terms of their operating rules.

### 2.3.1 NO ACTION ALTERNATIVE AND BASELINE CONDITION

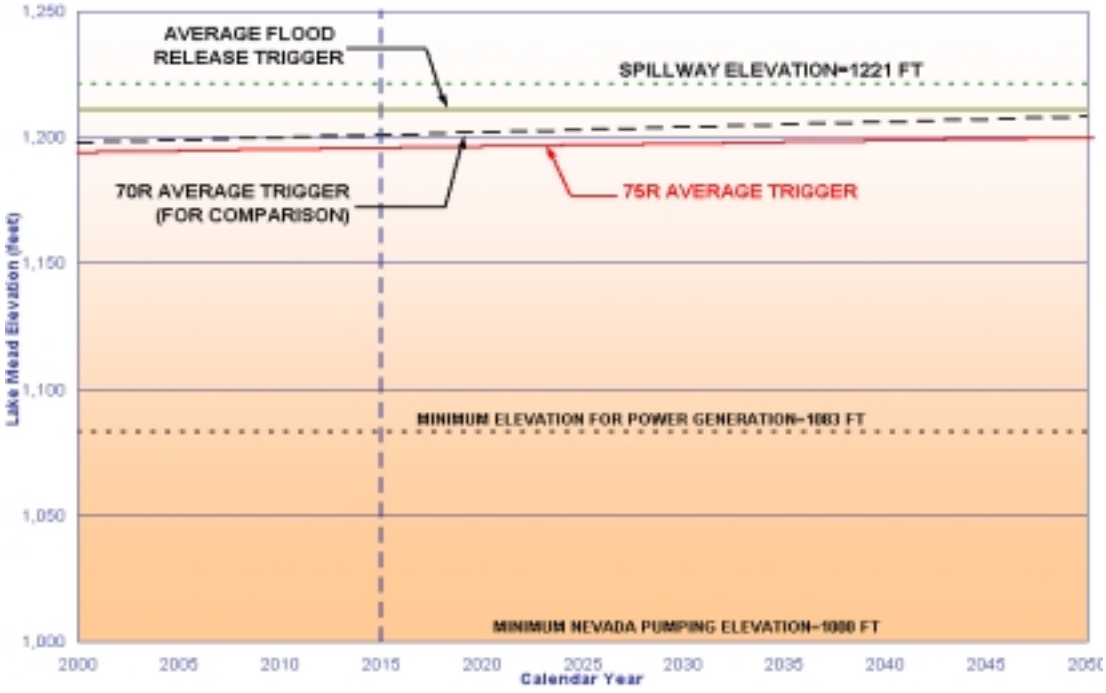
#### 2.3.1.1 APPROACH TO SURPLUS WATER DETERMINATION

As discussed above in Section 2.2.5, the 75R operating strategy is being used as a baseline to show possible future operating conditions in the absence of interim surplus criteria. The effect of simulating operation with the 75R operating strategy would be that surplus conditions would be determined when Lake Mead is nearly full.

#### 2.3.1.2 75R BASELINE SURPLUS TRIGGERS

The 75R baseline strategy involves assuming a higher than average inflow into the system, subtracting out the consumptive uses and system losses, and checking the results to see if all of the water could be stored or if flood control releases are required. If flood control releases are required, additional water is made available to the Lower Basin states beyond 7.5 maf. This strategy is illustrated on Figure 2-1, which shows the minimum Lake Mead water surface elevation that would trigger a surplus. In practice, the 75R surplus determination would not be based on the trigger line shown, but would be determined each January using available system space. The graph is a visual representation to illustrate the differences between the alternatives.

**Figure 2-1**
**Baseline Surplus Trigger Elevations**




The notation 75R refers to the specific inflow where 75 percent of the historical natural runoff is less than this value (18.1 maf) for the Colorado River basin at Lee Ferry. The minimum 75R trigger line rises from approximately 1194 feet msl to 1196 feet msl during the period through 2015 for which interim surplus conditions are being considered. The gradual rise of the 75R trigger line is the result of increasing water use in the Upper Basin.

Under the baseline conditions, when a surplus condition is determined to occur, surplus water would be made available for all established uses by contractors for surplus water in the Lower Division States as shown in the use schedules outlined in Attachment G.

## 2.3.2 FLOOD CONTROL ALTERNATIVE

### 2.3.2.1 APPROACH TO SURPLUS WATER DETERMINATION

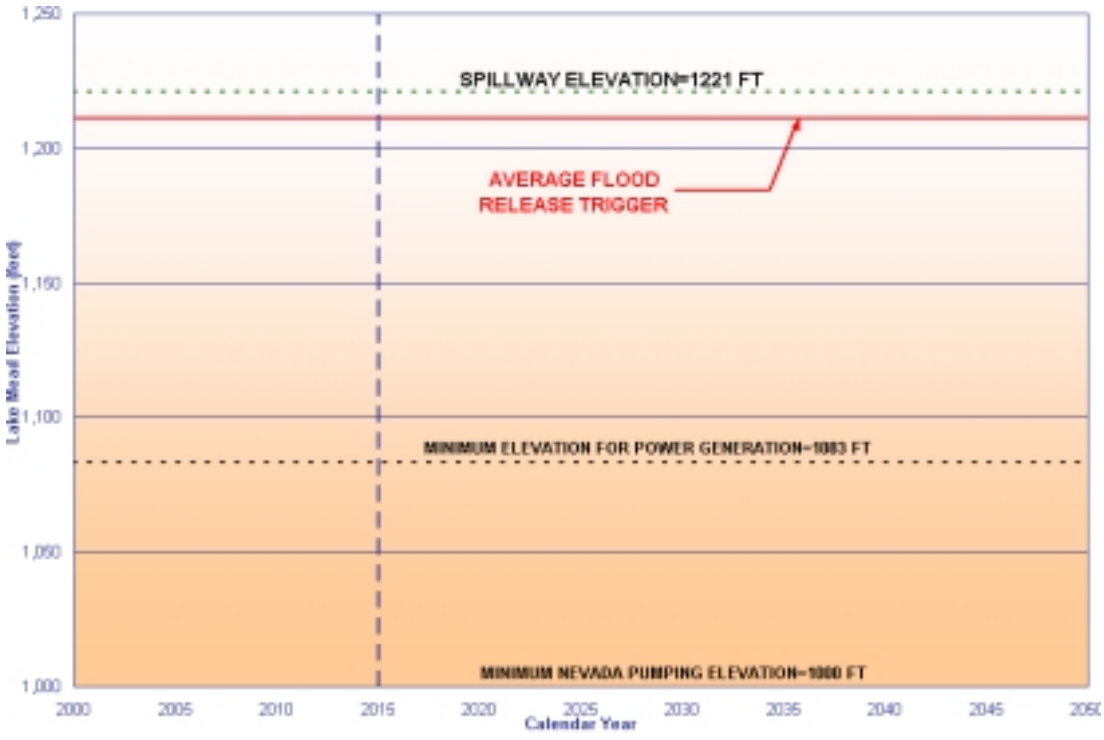
Under the Flood Control Alternative, a surplus condition is determined to exist when flood control releases from Lake Mead are occurring or projected to occur in the subsequent year. The method of determining need for flood control releases is based on flood control regulations published by the Los Angeles District of the Corps and the Field Working Agreement between the Corps and Reclamation, which are discussed in Section 1.3.6, Flood Control Operation.

### 2.3.2.2 FLOOD CONTROL ALTERNATIVE SURPLUS TRIGGERS

The flood control strategy involves making flood releases from Lake Mead, based on the maximum forecasted inflow to Lake Mead, to prevent filling of the reservoir beyond its 1.5 maf minimum flood control storage space. The specific operating provisions are described in Section 1.3.6, Flood Control Operation. If flood control releases are required, surplus conditions are determined to be in effect. This strategy is illustrated on Figure 2-2, which shows the average Lake Mead water surface elevation that would trigger flood control releases. The average triggering elevation is a level line at approximately 1211 feet msl. In practice, the flood control releases are not based on the average trigger line shown, but would be determined each month by following the Corps regulations. The graph is a visual representation to illustrate the differences between the alternatives.

When a flood control surplus is determined, surplus water would be made available for all established uses by contractors for surplus water in the Lower Division States as shown in the use schedules provided in Attachment G.

**Figure 2-2**
**Flood Control Alternative Surplus Trigger Elevations**



#### 2.3.2.3 DRAFT GUIDELINES

Draft guidelines for implementation of the Flood Control Alternative are presented in Attachment H.

### 2.3.3 SIX STATES ALTERNATIVE

#### 2.3.3.1 APPROACH TO SURPLUS WATER DETERMINATION

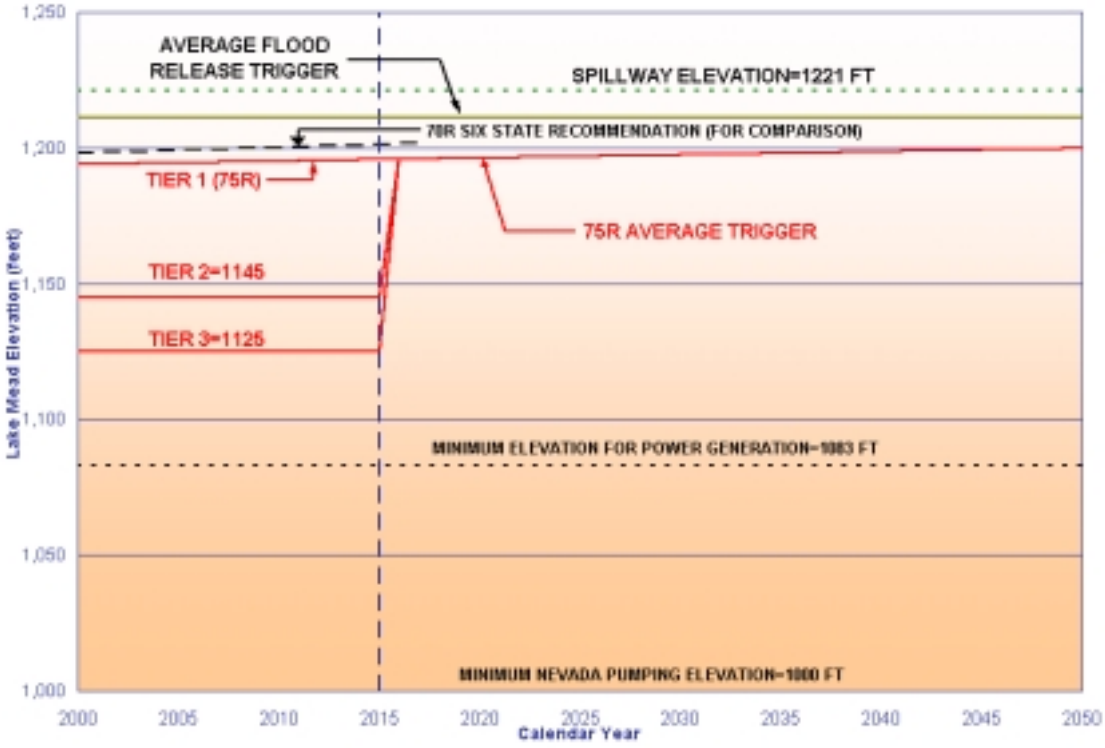
The Six States Alternative specifies ranges of Lake Mead water surface elevations to be used through 2015 for determining the availability of surplus water. The elevation ranges are coupled with uses of surplus water in such a way that, if Lake Mead's surface elevation were to decline, the permitted uses of surplus water would become more restrictive, thereby reducing delivery of surplus water. The interim criteria would be reviewed at five-year intervals and as needed based upon actual operational experience.

#### 2.3.3.2 SIX STATES ALTERNATIVE SURPLUS TRIGGERS

The surplus determination elevations under the Six States Alternative consist of the tiered Lake Mead water surface elevations listed below, each of which is associated with certain stipulations on the purposes for which surplus water could be used. The tiered elevations are shown on Figure 2-3. They are as follows, proceeding from higher to lower water levels:

Tier 1 - 75R Line
Tier 2 - 1145 feet msl
Tier 3 - 1125 feet msl

**Figure 2-3**
**Six States Alternative Surplus Trigger Elevations**




The following sections describe the various tiers and the associated purposes for which surplus water may be used at those tiers under the Six States Alternative. When flood control releases are made, any and all beneficial uses would be met, including unlimited off-stream storage.

#### 2.3.3.2.1 Six States Alternative Tier 1

Six States Alternative Tier 1 Lake Mead surplus trigger elevations follow the 75R line and range from approximately 1194 feet msl to 1196 feet msl of the interim period. When Lake Mead surface elevations are at or above the 75R line surplus water would be available to Lower Division States as outlined in the use schedules in Attachment G.

It should be noted that the original Six States Plan uses the 70R strategy as the Tier 1 trigger. However, for modeling consistency with the baseline, the 75R strategy was used in this analysis for the Six States Alternative Tier 1 trigger.

#### 2.3.3.2.2 Six States Alternative Tier 2

The Six States Alternative Tier 2 Lake Mead surplus trigger elevation is 1145 feet msl. At or above this Tier 2 elevation (and below Tier 1), surplus water is available as outlined in the use schedules in Attachment G.

#### 2.3.3.2.3 Six States Alternative Tier 3

The Six States Alternative Tier 3 Lake Mead surplus trigger elevation is 1125 feet msl. At or above this Tier 3 elevation (and below Tier 2), surplus water is made available as outlined in the use schedules in Attachment G.

When Lake Mead water levels are below the Tier 3 trigger elevation, surplus water would not be available.

#### 2.3.3.2.4 Draft Guidelines

Draft guidelines for the Six States Alternative are presented in Attachment H.

### 2.3.4 CALIFORNIA ALTERNATIVE

#### 2.3.4.1 APPROACH TO SURPLUS WATER DETERMINATION

The California Alternative specifies Lake Mead water surface elevations to be used for the interim period through 2015 for determining the availability of surplus water. The elevation ranges are coupled with uses of surplus water in such a way that, if Lake Mead's surface elevation declines, the permitted uses of surplus water would become more restrictive, thereby reducing deliveries of surplus water. This combination of "tiered" surplus trigger elevations would limit the use of surplus water to priority M&I needs at lower water levels. The trigger elevations for each tier are not static, but are expressed by lines as discussed below. The California Alternative also provides periodic adjustment of the triggering line elevations in response to changes in Upper Basin water demand projections to 2015, as described below.

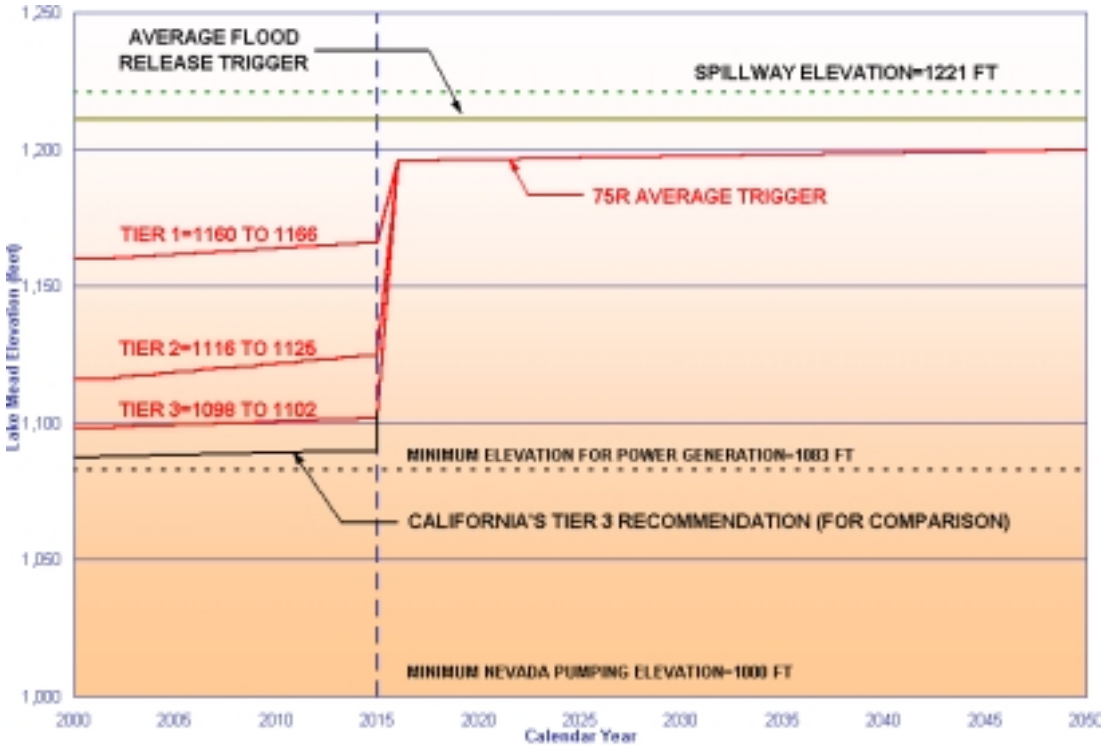
#### 2.3.4.2 CALIFORNIA ALTERNATIVE SURPLUS TRIGGERS

The Lake Mead elevations at which surplus conditions would be determined under the California Alternative are indicated by a series of tiered, sloping lines from the present to 2015. Each tiered line would be coupled with stipulations regarding the purposes for which surplus water may be used at that tier. Figure 2-4 shows the structure of these tiered lines. Each tier is defined as a trigger line that rises gradually year by year to 2015, in recognition of the gradually increasing water demand of the Upper Division States. As configured under current Upper Basin

demand projections, the elevations associated with the three tiers are approximately as follows:

Tier 1 - 1160 feet msl to 1166 feet msl
Tier 2 - 1116 feet msl to 1125 feet msl
Tier 3 - 1098 feet msl to 1102 feet msl

**Figure 2-4**
**California Alternative Surplus Trigger Elevations**




Each tier under the California Alternative would be subject to adjustment during the interim period based on changes in Upper Basin demand projections or other factors during the five-year reviews or as a result of actual operating experience. The following sections describe the California Alternative tiers. When flood control releases are made, any and all beneficial uses would be met, including unlimited off-stream storage and additional water for Mexico.

#### 2.3.4.2.1 California Alternative Tier 1

California Alternative Tier 1 Lake Mead surplus trigger elevations range from a current elevation of 1160 feet msl to 1166 feet msl in 2015 (based on Upper Basin demand projections). Lake Mead water surface elevations at or above the Tier 1 trigger line would permit surplus water diversions by the Lower Division States as shown in the use schedules outlined in Attachment G.

#### 2.3.4.2.2 California Alternative Tier 2

California Alternative Tier 2 Lake Mead surplus trigger elevations range from 1116 feet msl to 1125 feet msl (based on Upper Basin demand projections). Lake Mead water surface elevations at or above the Tier 2 line (and below the Tier 1 line) would permit surplus water diversions as outlined in the use schedules shown in Attachment G.

#### 2.3.4.2.3 California Alternative Tier 3

California Alternative Tier 3 trigger elevations range from 1098 feet msl to 1102 feet msl (based on Upper Basin demand projections). Lake Mead water surface elevations at or above the Tier 3 line (and below the Tier 2 line) would permit surplus water diversions as outlined in the use schedules shown in Attachment G.

It should be noted that the original California Plan Tier 3 used trigger elevations ranging from 1088 feet msl to 1098 feet msl. For modeling purposes, Reclamation moved the Tier 3 trigger elevations up to be consistent with modeling assumptions as described in Section 3.3.3.3, General Modeling Assumptions.

When Lake Mead water levels are below the Tier 3 trigger elevation, surplus water would not be made available.

#### 2.3.4.2.4 Draft Guidelines

Draft guidelines for implementation of the California Alternative are presented in Attachment H.

### 2.3.5 SHORTAGE PROTECTION ALTERNATIVE

#### 2.3.5.1 APPROACH TO SURPLUS WATER DETERMINATION

The Shortage Protection Alternative is based on maintaining an amount of water in Lake Mead necessary to provide an annual Lower Division normal supply of 7.5 maf, 1.5 maf for Mexico, plus storage necessary to provide an 80 percent probability of avoiding future shortages. The modeling assumptions for shortage

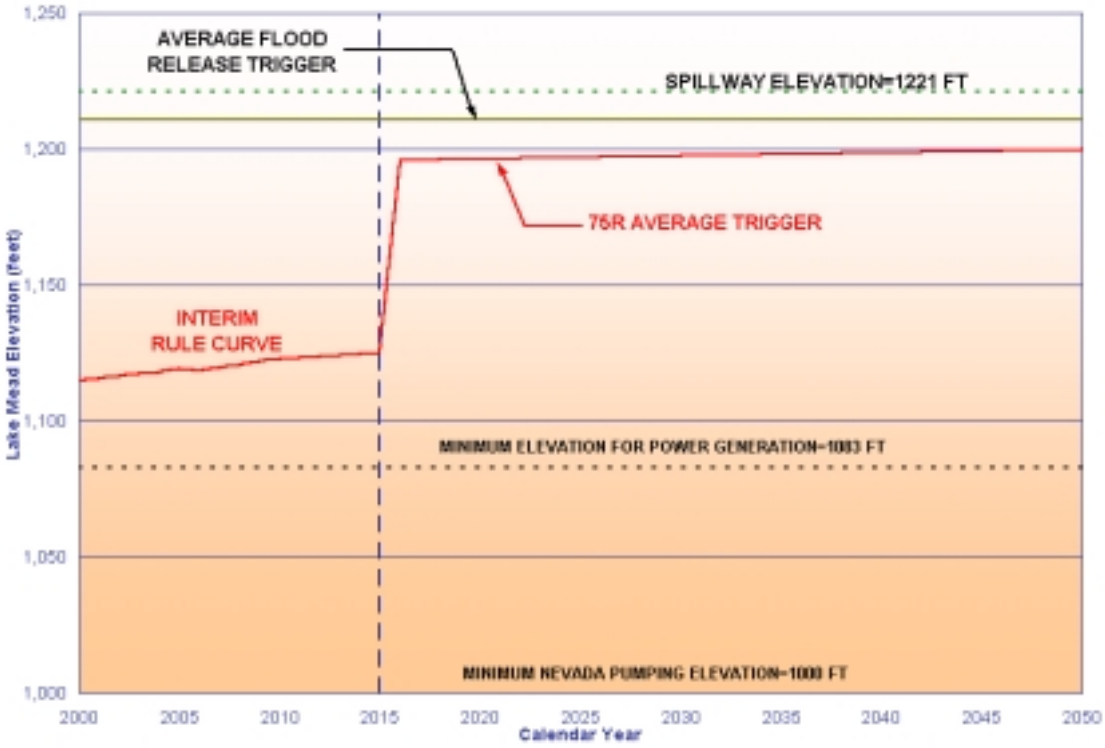
protection are discussed in Section 3.3.3.4, Lake Mead Water Level Protection Assumptions.

The Shortage Protection Alternative criteria would be in effect through 2015. In 2016, the Shortage Protection Alternative criteria would terminate, and in the absence of any subsequently-specified surplus criteria, surplus determinations would be made by future Secretaries based on factors including those that are currently considered, as discussed in Chapter 1.

### 2.3.5.2 SURPLUS TRIGGERS

The surplus triggers under this alternative range from an approximate Lake Mead elevation of 1116 feet msl in year 1 to an elevation of 1121 feet msl in year 15, as shown on Figure 2-5. At Lake Mead elevations above the rule curve, surplus conditions would be determined to be in effect, and all surplus schedules are met, which are shown in Attachment G. Below the rule curve, surplus water is not made available.

**Figure 2-5**
**Shortage Protection Alternative Trigger Elevations**



#### 2.3.5.3 DRAFT GUIDELINES

Draft guidelines for the Shortage Protection Alternative are presented in Attachment H.

## 2.4 SUMMARY TABLE OF IMPACTS

Table 2-1 presents a summary of the potential effects of the baseline operation and the interim surplus alternatives. Chapter 3 contains detailed descriptions of these effects.

**Table 2-1**
**Summary of Potential Effects of Implementing Interim Surplus Criteria[1]**

| Resource/Issue | Baseline Conditions/No Action | Effects of Alternatives[2] |
|---|---|---|
| **Reservoirs Elevations and River Flows** | | |
| ***Lake Powell Water Surface Elevations***<br>Analyzed potential changes in Lake Powell water surface elevations. | Reservoir water levels exhibit gradual declining trend during interim surplus criteria period as a result of increasing Upper Division States' consumptive use. Median water surface elevation in 2015 is 3663 feet. The probability of Lake Powell being full[3] in 2015 is 28%.<br><br>After 2015, levels stabilize and then increase due to 602(a) storage and less frequent equalization releases. | Flood Control Alternative has probability for highest lake water levels in comparison to the other alternatives and baseline conditions, although results are similar to baseline. Median water surface elevation in 2015 is 3664 feet. The probability that Lake Powell would be full[3] in 2015 is 28%, the same as the baseline.<br><br>Other surplus alternatives: The Shortage Protection Alternative has potential to result in the lowest lake water levels. The Six States and California alternatives provide results that generally occur between the Flood Control and Shortage Protection alternatives. The results of the Six States and California alternatives are similar to each other with the Six States Alternative yielding potentially higher lake water levels than the California Alternative. Median elevations at Lake Powell in year 2015 under the Six States, California and Shortage Protection alternatives are 3650, 3642 and 3838 feet, respectively. The probability of Lake Powell being full[3] in 2015 under the Six States, California and Shortage Protection alternatives are 25, 24 and 22%, respectively.<br><br>After 2015, Lake Powell water levels under all four alternatives tend to stabilize and then increase similar to the baseline. Water levels under the Six States, California and Shortage Protection alternatives tend to converge with the baseline and the Flood Control Alternative by about year 2030. |

**Table 2-1**
**Summary of Potential Effects of Implementing Interim Surplus Criteria[1]**

| Resource/Issue | Baseline Conditions/No Action | Effects of Alternatives[2] |
|---|---|---|
| ***Lake Mead Water Surface Elevations***<br>Analyzed potential changes in Lake Mead water surface elevations. | Reservoir water levels exhibit gradual declining trend during interim surplus criteria period as a result of increasing Upper Division States' consumptive use. Median water surface elevation in 2015 is 1171 feet.<br><br>After 2015, median water surface elevations at Lake Mead tend to continue to decline due to increased Upper Basin water use and less frequent equalization releases from Lake Powell. | The Flood Control Alternative has the potential to result in the highest lake water levels in comparison to the other alternatives and baseline conditions, although the results are similar to baseline. The median water surface elevation for Lake Mead in 2015 is 1171 feet, the same as the baseline.<br><br>Other surplus alternatives: The Shortage Protection Alternative has the potential to yield the lowest lake water levels. The Six States and California alternatives provide results that generally occur between the Flood Control and Shortage Protection alternatives. The results of the Six States and California alternatives are similar to each other with the Six States Alternative yielding potentially higher lake water levels than the California Alternative. Median elevations at Lake Mead in year 2015 under the Six States, California and Shortage Protection alternatives are 1156, 1147 and 1144 feet, respectively.<br><br>After 2015, Lake Mead water levels under the four action alternatives tend to gradually decline like the baseline. Water levels under the Six States, California and Shortage Protection alternatives tend to converge with the baseline and Flood Control Alternative by about year 2030. |
| ***River Flows***<br>Analysis considers Glen Canyon and Hoover Dam releases and flows downstream of Lake Mead. | Flows downstream of Glen Canyon Dam would be managed in accordance with the 1995 EIS and the 1996 ROD.<br><br>Flows downstream of Hoover Dam would gradually decline as Basin States consumptive use increases and surplus conditions become less frequent. | Flood Control Alternative: Similar to baseline.<br><br>Other three alternatives: Flows below Glen Canyon Dam would be similar to baseline conditions. Flows form Hoover Dam to Parker Dam would be moderately higher until 2015 because of surplus deliveries. After 2015, flows would be similar to baseline conditions. |

**Table 2-1**
**Summary of Potential Effects of Implementing Interim Surplus Criteria[1]**

| Resource/Issue | Baseline Conditions/No Action | Effects of Alternatives[2] |
|---|---|---|
| **Water Supply** | | |
| ***California Water Supply***<br>Probabilities of normal, surplus and average shortage conditions | Normal: 2001 through 2015 – 100%<br>2016 through 2050 – 100%<br>Surplus: 2001 through 2015 – 49%<br>2016 through 2050 – 26%<br>Shortage: 2001 through 2015 – 0%<br>2016 through 2050 – 0% | Flood Control Alternative: Similar to baseline.<br>Other Alternatives: Greater probability of surplus through 2015; same as baseline to 2050. Approximately same probability of shortage. |
| ***Arizona Water Supply***<br>Probabilities of normal surplus and average shortage conditions. | Normal: 2001 through 2015 - 99%<br>2016 through 2050 - 70%<br>Surplus: 2001 through 2015 – 32%<br>2016 through 2050 – 26%<br>Shortage: 2001 through 2015 - <1%<br>2016 through 2050 - 30% | Flood Control Alternative: Similar to baseline.<br>Other Alternatives: Greater probability of surplus through 2015; same as baseline to 2050. Approximately same probability of shortage. |
| ***Nevada Water Supply***<br>Probabilities of normal, surplus and average shortage conditions. | Normal: 2001 through 2015 - 99%<br>2016 through 2050 - 71%<br>Surplus: 2001 through 2015 – 42%<br>2016 through 2050 – 27%<br>Shortage: 2001 through 2015 - <1%<br>2016 through 2050 - 29% | Flood Control Alternative: Greater probability of surplus to 2015.<br>Other alternatives greater probability of surplus through 2015; same as baseline to 2050. Approximately same as baseline otherwise. |
| ***Mexico Treaty Delivery***<br>Probabilities of meeting Treaty delivery average obligations | Normal: 2001 through 2015 –100%<br>2016 through 2050 –100%<br>Surplus: 2001 through 2015 – 34%<br>2016 through 2050 – 23%<br>Shortage: 2001 through 2015 - 0%<br>2016 through 2050 - 0% | The Flood Control Alternative would provide slightly higher probabilities of surplus. The rest of the alternatives provide slightly lower probabilities of surpluses. No shortages would occur. |

**Table 2-1**
**Summary of Potential Effects of Implementing Interim Surplus Criteria[1]**

| Resource/Issue | Baseline Conditions/No Action | Effects of Alternatives[2] |
|---|---|---|
| **Water Quality** | | |
| ***Colorado River Salinity***<br>Analysis considers potential change in salinity below Hoover Dam. | Baseline projections assume compliance with numeric criteria along the river. The basin states are committed to meeting the numeric criteria. | Modeling indicates potential for slight decreases in salinity at Hoover and slight increases at locations below Hoover. Under all alternatives except Flood Control Alternatives. However, effects would be prevented by the salinity control program. |
| ***Lake Mead Water Quality and Las Vegas Water Supply***<br>Contaminant concentrations in Boulder Basin of Lake Mead, in proximity to the SNWS intakes at Saddle Island. | Increased potential for lower Lake Mead levels and increased inflow channel lengths under baseline projections could increase potential of contaminant concentration. | Due to increased potential for lower Lake Mead levels as compared to baseline projections, the alternatives, except the Flood Control Alternative, would result in slightly increased potential for increased contaminant concentrations in Boulder Basin, compared to baseline projections. |
| **Flow-Related Issues** | | |
| ***Beach/Habitat-Building Flow Releases***<br>Analysis considers the probability of BHBF release conditions from Glen Canyon Dam. | Probable frequency of BHBF releases:<br>1 year in 5 to 2015<br>1 year in 8 during 2016 to 2050 | All alternatives have probabilities similar to baseline. |
| ***Low Steady Summer Flows***<br>Analysis considers the probability of conditions for their release from Glen Canyon Dam. | Probable frequency of low steady summer flows:<br>1 year in 4 to 2015<br>1 year in 2 during 2016 to 2050 | All alternatives have probabilities similar to baseline. |
| ***Flooding Downstream of Hoover Dam***<br>Analysis considers the probability of threshold damage flows at Davis and Parker Dams. | Percent of years:<br>Parker Dam – 13.9% through 2015;<br>19.7% to 2050.<br>Davis Dam - 12.5% through 2015;<br>15.2% to 2050. | Flood Control Alternative: Slightly more than baseline.<br>Other alternatives: Slightly less than baseline. |

**Table 2-1**
**Summary of Potential Effects of Implementing Interim Surplus Criteria[1]**

| Resource/Issue | Baseline Conditions/No Action | Effects of Alternatives[2] |
|---|---|---|
| **Aquatic Resources** | | |
| ***Lake Habitat and Sport Fisheries***<br>Analysis considers potential effects on Lake Mead and Lake Powell fisheries and associated aquatic habitat. | Species adapted to fluctuating reservoir levels, therefore, increased potential for lower Lake Mead and Lake Powell surface levels is not expected to adversely affect aquatic species. | Increased potential for slightly higher reservoir levels under the Flood Control Alternative and lower reservoir levels under the other alternatives would not be expected to result in substantial changes to lake habitat. |
| **Special-Status Species** | | |
| ***Special-Status Plants***<br>Potential effects on special-status plants were considered for areas influenced by Lake Powell and Lake Mead water levels. | Under baseline conditions, special-status plant species would continue to be affected by fluctuating water levels, which would expose and inundate areas were the plants occur. | All alternatives would be similar to baseline conditions. |
| ***Special-Status Wildlife***<br>Consideration of potential effects on special-status wildlife species associated primarily with potential effects on riparian habitat at the Lake Mead and Virgin River deltas, and the lower Grand Canyon. | Under baseline conditions, increased potential over time for lower reservoir levels could increase potential for development of temporary riparian habitat at the deltas, which would benefit special-status wildlife species that utilize such habitat. | Flood Control Alternative would have slightly lower potential, and other alternatives would have increased potential for lower reservoir elevations and associated potential increases in delta habitat. |
| ***Special-Status Fish***<br>Consideration of potential effects of Lake Mead and Lake Powell reservoir level changes on special-status fish species. | Increased potential for lower elevations in the future are not expected to have differing effects on special-status species fish than those that occur at present. | Changes in potential for lower reservoir levels under the various alternatives would not change potential for effects. |

**Table 2-1**
**Summary of Potential Effects of Implementing Interim Surplus Criteria[1]**

| Resource/Issue | Baseline Conditions/No Action | Effects of Alternatives[2] |
|---|---|---|
| **Recreation** | | |
| ***Reservoir Marinas Boat Launching***<br>Consideration of potential effects on shoreline recreation facilities from changes in Lake Mead and Lake Powell surface elevations. | Baseline projections indicate increased potential for reservoir levels lower than those considered within the normal operating range for existing facilities. Such occurrence would likely result in the relocation of facilities. | The Flood Control Alternative would have a slightly decreased potential for lower reservoir levels, with each of the other alternatives having an increased potential for lower levels and necessary relocations. |
| ***Reservoir Boating/Navigation***<br>Considers potential effects that may result from changes in Lake Mead and Lake Powell surface elevations. | Baseline projections indicate an increased potential for the occurrence of lower Lake Mead and Lake Powell reservoir levels which may result in potential increases in navigation hazards and decreased safe boating capacity (based on reservoir surface area). | The Flood Control Alternative would have a slightly lower potential, and other alternatives would result in increased potential for navigation hazards and reduced carrying capacity. |
| ***River and Whitewater Boating***<br>Analysis considers potential effects on river boating at Lake Powell and Lake Mead inflow areas. | Boaters may have reduced take-out opportunities due to increased potential for lower reservoir surface elevations. | Flood Control Alternative would have decreased potential and other alternatives would have increased potential for reduced take-out opportunities resulting from lower reservoir elevations. |
| ***Reservoir Sport Fishing***<br>Considers potential effects on sport fishing in Lake Mead and Lake Powell. | Potential effects on sport fisheries are minimal under baseline conditions. | Similar to baseline. |
| ***Recreation Facilities Relocation Costs***<br>Analysis considers increased costs associated with relocating shoreline facilities to remain in operation with lower reservoir elevations. | Baseline projections indicate increased relocation costs associated with future increased potential for lower reservoir levels. | Flood Control Alternative would be similar to baseline. Other alternatives would have increased potential for increased relocation costs based on an average incremental per-foot cost associated with relocating facilities. |

**Table 2-1**
**Summary of Potential Effects of Implementing Interim Surplus Criteria[1]**

| Resource/Issue | Baseline Conditions/No Action | Effects of Alternatives[2] |
|---|---|---|
| **Energy Resources** | | |
| ***Hydroelectric Power Production***<br>Analysis evaluates potential for changes in energy production at Glen Canyon and Hoover Powerplants. | Glen Canyon Powerplant average energy:<br>To 2015–4,732 gWh; to 2050-4238 gWh<br>Hoover Powerplant average energy:<br>To 2015-4,979 gWh; To 2050-4,275 gWh | Flood Control Alternative would be similar to baseline.<br>Other alternatives:<br>Average energy increase of <1% to 2015; decrease of 1% to 2035. |
| ***Pumping Power Needs for Southern Nevada Water System***<br>Analysis evaluates potential change in the cost of power to pump Lake Mead water through the Southern Nevada Water System (SNWS). | Lower average water levels in the future will require more energy to pump water from Lake Mead to the SNWS. | Energy requirement to pump water to the SNWS:<br>The Flood Control Alternative would reduce the energy cost an average of $45,000 per year.<br>The Six States would increase average pumping costs by approximately $150,000 per year.<br>The Shortage Protection and California alternatives would increase the average pumping cost by approximately $250,000 per year. |
| **Air Quality** | | |
| ***Fugitive Dust Emissions from Exposed Reservoir Shoreline***<br>Analysis considers potential for fugitive dust emissions from shoreline exposure at Lake Mead and Lake Powell. | Increased potential for lower reservoir levels would increase potential for shoreline exposure under baseline conditions. Fugitive dust emissions increases would be minimal due to low emission potential of shoreline. | Slightly decreased shoreline exposure under Flood Control Alternative would lower fugitive dust emission potential. Other alternatives would have slightly increased potential for lower reservoir levels, which would increase potential for fugitive dust emissions. Minimal changes in fugitive dust emissions would be expected. |

**Table 2-1**
**Summary of Potential Effects of Implementing Interim Surplus Criteria[1]**

| Resource/Issue | Baseline Conditions/No Action | Effects of Alternatives[2] |
|---|---|---|
| **Visual Resources** | | |
| ***Visual Attractiveness of Reservoir Scenery, Lake Mead and Lake Powell***<br>Considers potential effects of lower reservoir elevations. | Increasing probability of temporary degradation of visual attractiveness of shoreline vistas resulting from declining minimum probable water levels in Lake Mead and Lake Powell. | Flood Control Alternative: Same as baseline.<br>Other alternatives: More rapid increase in probability of degradation of visual attractiveness in the to 2015 from accelerated decline of minimum reservoir levels. |
| **Cultural Resources** | | |
| ***Effects on historic structures or cultural sites in zone of reservoir fluctuation.*** | Not significant due to past water level fluctuations. Impacts have already occurred. | Not significant due to past water level fluctuations. Impacts have already occurred. |
| **Indian Trust Assets** | | |
| ***Effects on water supply for Indian Tribes and Communities*** | The water available to members of Ten Tribes Partnership would not be affected by future baseline changes. There is a probability of shortages of CAP priority water for tribes in central Arizona | No effect on water available to members of Ten Tribes Partnership.<br>Greater probability of shortages of CAP priority water for tribes in central Arizona. |
| **Environmental Justice** | | |
| ***Exposure of Minority or Low Income Communities to Health or Environmental Hazards*** | No impacts are anticipated. | Same as baseline conditions. |
| **Transboundary Effects** | | |
| ***Treaty Water Delivery Obligations*** | See Water Supply, above | See Water Supply, above. |

**Table 2-1**
**Summary of Potential Effects of Implementing Interim Surplus Criteria[1]**

| Resource/Issue | Baseline Conditions/No Action | Effects of Alternatives[2] |
|---|---|---|
| ***Flow Below Morelos Dam***<br>Amount of excess flow that may reach the Colorado River delta | Excess flows below Morelos Dam would gradually decline under baseline conditions. | The decline in excess flows below Morelos Dam would be similar to baseline conditions. |

1. Effects identified are based on probabilities developed through modeling of possible future conditions through 2050, discussed in detail in Chapter 3.
2. In general, the differences between the alternatives and baseline conditions would be greatest at or near 2015, the year in which the interim surplus criteria would terminate.
3. Lake Powell is considered to be essentially full when the lake elevation reaches 3695 feet (5 feet below the top of the spillway gates).