VI. IMPACTS OF PROPOSED ACTIONS ON HABITAT AND SPECIAL STATUS SPECIES

The lower Colorado River is a dynamic system, and changes to the system as a result of human intervention over the next few decades are going to occur. Measuring the magnitude of these impacts in reference to an ever-changing baseline presents a challenge. In the present case, while a change in point of diversion of 400 kaf may not be significant, it is but a small part of a much larger identified change in point of diversion of 1.574 maf. This figure is based on projected water uses submitted to Reclamation by the Lower Basin States. This figure is the total change in point of diversion which is being analyzed under the Multi Species Conservation Program currently being developed. Therefore, impacts of smaller amounts of diversions are calculated proportional to the 1.574 maf for the following reasons:

Future changes in point of diversion may occur in increments from as little as 25 kaf initially to much larger figures. The question is, how do we apportion the impacts associated with each change in point of diversion? This is important not only ecologically, but practically, as project beneficiaries are responsible for offsetting measures for the impact. It could be argued, for instance, a change in point of diversion of 25 kaf annually is hardly measurable with insignificant environmental impacts; and indeed, it's doubtful one could place a staff gauge in the river and record the physical change in water surface elevation. However, once the change in point of diversion is made, the baseline changes accordingly. The argument could then be made for the next 25 kaf (no measurable impact) and so on. Eventually, however, the sum total of these changes in point of diversion will result in measurable ecological changes, even though individually each change is insignificant.

A. Impacts on riparian/terrestrial habitat

There are several proposed actions analyzed within this BA. Direct effects for special status species and critical habitat are discussed in section VI. Indirect and cumulative effects for the entire proposed action are discussed in section IV.C

1. Interim Surplus Criteria

Impacts on the riparian ecosystem along the lower Colorado River associated with the proposed ISC will vary for each reach of the river. The proposed ISC is discussed, in detail, in the ISC DEIS dated July 2000.

Lower Grand Canyon and Lake Mead

The ISC DEIS utilizes a hydrologic model to predict possible future hydrologic conditions within the project area (USBR, 2000) for the No Action (Baseline) and Action Alternatives. Since the future conditions are most sensitive to the inflows into the system, the model is run 85 times, each with a different inflow assumption based on historical data. The resulting set of possible outcomes (called "traces") is then statistically analyzed. These analyses consist primarily of ranking the outcomes in each future year and computing percentiles from the rankings.

Figure 9 shows the 90th, 50th (median), and 10th percentile lines for Lake Mead elevations for No Action and California Alternatives for the years 2001 through 2050. It should be noted that none of these lines are the result of any particular assumed inflow (or outcome), but rather are a statistical compilation of the set of possible outcomes. Therefore, they can be used to show general trends over the next few decades.

At the 50th percentile, under the No Action Alternative, Lake Mead is predicted to decline from approximately 1,205 feet in December 2000 to approximately 1,171 feet in December 2015. This decline is due to the relatively high reservoir levels seen in December, 1999 (the

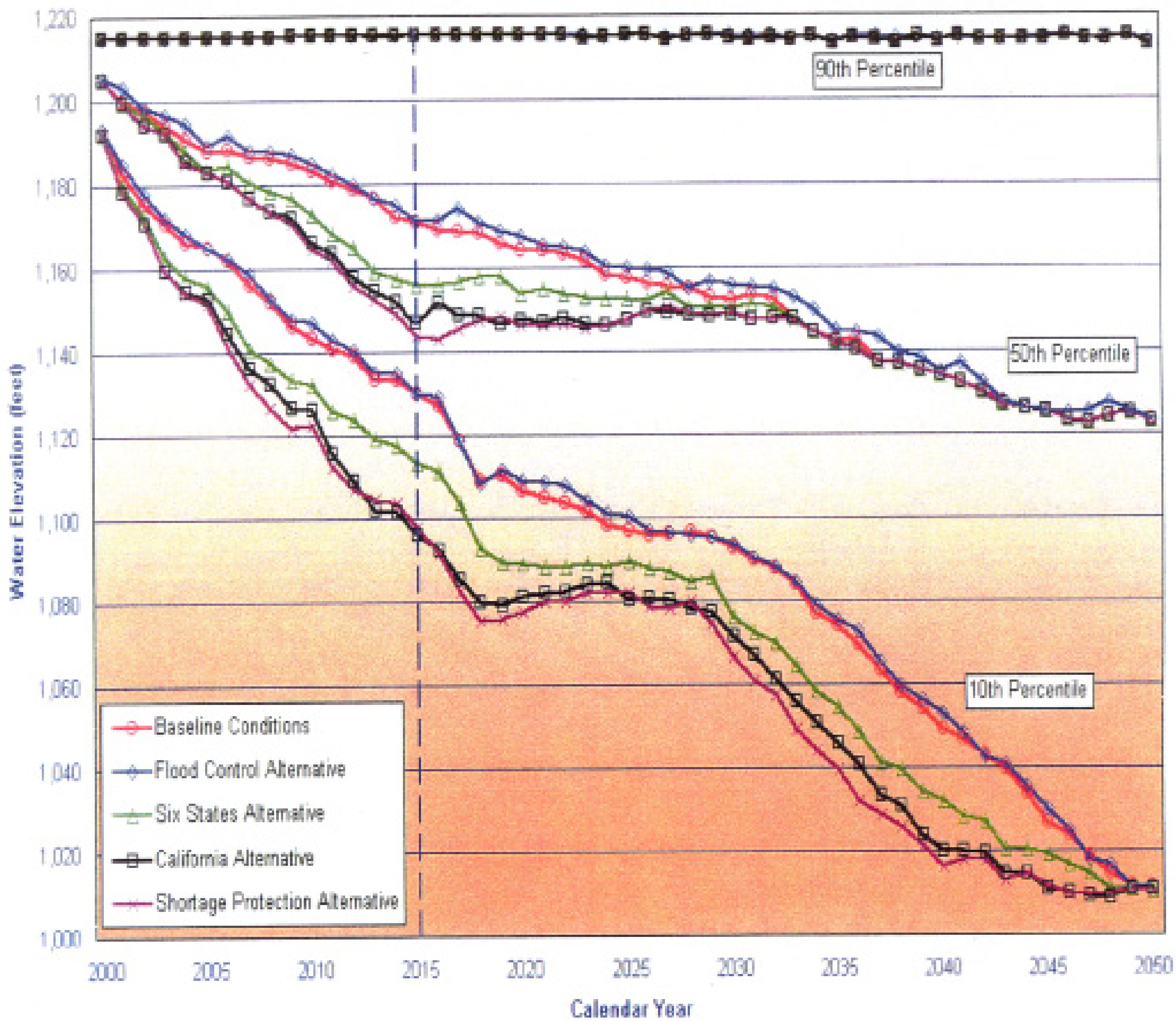

Figure 9. Lake Mead End-of-Year Water Elevations Comparison of Surplus Alternatives and Baseline Conditions 90th, 50th, and 10th Percentile Values.

initial conditions input to the model) and the increasing Upper Basin depletions, which tend to lower Lake Powell and reduce releases to the Lower Basin in excess of the minimum objective release (8.23 maf).

The alternative from the Colorado River ISC DEIS analyzed in this BA is the California Alternative (USBR, 2000). Under the California Alternative, Lake Mead levels are predicted to decline from approximately 1,205 feet in December 2000 to approximately 1,147 feet by December 2015 at the 50th percentile. This represents a reduction in Lake Mead elevation of approximately 24 feet from the No Action Alternative at the 50th percentile. By 2033, there are no predicted differences in Lake Mead elevation between the California Alternative at the 50th percentile.

To further understand the potential effects of the proposed ISC, 90th percentile and 10th percentile scenarios were also analyzed. At the 90th percentile Lake Mead stayed at its full pool elevation through the year 2050 for both the No Action Alternative and the California Alternative because the 90th percentile represents high inflow into a full system. At the 10th percentile the No Action Alternative predicted lake levels to decline to approximately 1,130 feet by 2015 and to 1,011 feet by 2050. The California Alternative predicted lake levels to decline to approximately 1,096 feet by 2015 and to 1,010 feet by 2050 at the 10th percentile (USBR, 2000).

Three major factors may influence the potential impacts of the implementation of an ISC. According to the hydrologic modeling, Lake Mead water surface elevation is projected to fluctuate between full level and progressively lower levels. Neither the timing of water level variations between the highs and the lows, nor the length of time the water level would remain high or low can be predicted. These events would depend on the future variation in basin runoff conditions. However, the timing of the decline, as it relates to the exposed sediment, will influence the future riparian habitat composition. The amount of decline may influence the establishment of riparian habitat. Also, the potential for re-filling Lake Mead must be considered.

The first factor is the timing of lake level declines. From January 1978 until June 1990, Lake Mead elevations were above 1,182 feet on a continuous basis. In June, 1990, Lake Mead elevation declined to approximately 1,182 feet and stayed below that elevation until the end of 1992. The initial decline to 1,182 feet in June, 1990, and 1,179 feet in July, 1990, coincided with seedfall for Goodding willow. Approximately 1,400 acres of predominantly Goodding willow became established at the Lake Mead delta, near Pierce Ferry, Arizona, as sediments became exposed during this time period. Willow stands also became established along the lower Grand Canyon, below Separation Rapids to the Lake Mead delta, and at the mouths of the Virgin and Muddy Rivers. In contrast, Lake Mead elevations were rarely above 1,182 feet prior to 1978, with an eleven month period from May, 1962, until March, 1963, representing the longest period that Lake Mead elevation stayed above that mark, inundating the delta area. Drought conditions in the 1950s, compounded by the filling of Lake Powell in the 1960s, produced a scenario where Lake Mead elevations exposed the delta area for periods as long as ten years. During the years when Lake Mead elevations were high enough to inundate the delta, these high lake levels almost always occurred during June and July. The Lake Mead delta only became exposed before or after cottonwood-willow seedfall. Thus, saltcedar, which seeds from early spring to late fall, became the predominant community type in the Lake Mead delta area (USBR, unpub. data).

As Lake Mead elevation declines, sediments become exposed. A second factor that may influence the type of plant community that will become established is the depth to groundwater or river surface elevation from these exposed sediments. Current lake bottom elevations are not known and may, in fact, be slightly higher than the 1,182 foot elevation seen in 1990 due to the Glen Canyon experimental beach/habitat-building flow conducted during the spring of 1996 and normal sedimentation since then. As the lake level declines and the present day lake bottom becomes exposed, the river elevation as it downcuts through the newly exposed delta will help determine whether cottonwoods or willows can survive, even if they become established. If the river surface elevation is 8-10 feet below the surface of the exposed soil, cottonwoods and willows would begin to incur mortality, thus, opening gaps for saltcedar and other species to become established.

The hydrologic modeling predicts that Lake Mead elevations are projected to fluctuate between full level and progressively lower levels during the 50-year period of analysis (2001 to 2050) under the California and No Action Alternatives. However, as wet hydrologic cycles occur in the future, Lake Mead will fill. If this event occurs after the establishment of riparian habitat due to declining lake levels, the newly established habitat would become inundated as occurred in the 1990s.

It is difficult to determine exactly how many acres of riparian habitat may be formed due to declining Lake Mead elevations. The majority of the Lake Mead shoreline does not have the soil necessary to regenerate riparian habitat. Riparian habitat created by declining lake levels would most likely occur in four areas: Lake Mead delta, Virgin River delta, Muddy River delta, and the portion of the Grand Canyon influenced by Lake Mead.

At the 50th percentile, Lake Mead elevations are predicted to decline by 34 feet under the No Action Alternative by 2015. The proposed ISC would decrease lake levels by an additional 24 feet by year 2015. This decrease in elevation is within the historic fluctuations of Lake Mead. Implementing the California Alternative ISC is unlikely to have a negative effect on river surface elevation within the delta areas around Lake Mead and may, in fact, increase the amount of exposed soil for the establishment of riparian habitat.

Hoover Dam to Parker Dam

River flows between Hoover Dam and Parker Dam are comprised mainly of flow releases from Hoover Dam and Davis Dam. Inflows from the Bill Williams River and other intermittent tributaries are infrequent and usually concentrated into short time periods due to their reliance on localized precipitation. Tributary inflows comprise less than 1 percent of the total annual flow in this reach of the river.

Seasonal, monthly, and daily releases from Hoover Dam reflect the demands of Colorado River water users with diversions located downstream of Hoover Dam, power production and storage management in Lakes Mohave and Havasu. The scheduling and subsequent release of water through Davis and Parker Dams affect daily fluctuations in river flows, depths, and water surface elevations downstream of these structures. The water surface elevation fluctuates most noticeably in the river reaches closest to the dams. Those fluctuations become more and more attenuated as the distance downstream increases. The modeling performed for the DEIS yields only mean monthly flow data. Therefore, the daily attenuation of flows in the downstream reaches were not evaluated for the DEIS or this BA.

Implementation of the California Alternative ISC may produce slightly higher mean monthly flows within this stretch of the Colorado River during the 15 year ISC period as a result of more frequent or larger surplus deliveries. At the 50th percentile, the California Alternative is predicted to increase mean monthly releases from Hoover Dam by an average of 370 cfs over the No Action Alternative, considered the baseline or 75R. At the 90th percentile, the increase in mean monthly flows average 655 cfs, while at the 10th percentile, the California Alternative is predicted to average 24 cfs less than the No Action Alternative (USBR, 2000). Beyond the 15 year interim period, there is little difference between flows predicted for the No Action Alternative conditions and those predicted under the California Alternative. This is expected as the California Alternative reverts to No Action Alternative in 2016.

Mean monthly releases from Hoover Dam differ between seasons due mainly to irrigation demands. On the Colorado River downstream of Havasu National Wildlife Refuge, the 50th (median) percentile, mean monthly flows for years 2001 to 2015 average around 9,000 cfs in the winter, 16,000 cfs in the spring, 15,000 cfs in the summer, and 10,000 cfs in the fall under both the No Action Alternative and California Alternative. During the winter season, the probability of flood releases is approximately 25% under No Action Alternative conditions. The probability declines to approximately 22% under the California Alternative. Probability of flood releases during the spring and summer are less than 2% under No Action Alternative conditions or the California Alternative (USBR, 2000).

The effects of implementing the California Alternative surplus guideline on riparian habitat between Hoover Dam and Parker Dam are negligible. Differences expected in mean monthly flows between the No Action Alternative conditions and the California Alternative are slight. The proposed surplus guideline may have a slightly positive effect on the riparian plant community within this reach of the river by providing increased flows and a corresponding increase in the groundwater table.

Parker Dam to Imperial Dam

Changes predicted by the hydrologic model in mean monthly flow between Parker Dam and Imperial Dam are influenced by the SIAs discussed in Section 1.B. The hydrologic model assumed that the SIAs were not in effect under No Action Alternative conditions while the SIAs were in effect when analyzing the ISC. Changes in mean monthly flow in this reach that may be due to the ISC are compounded by the SIAs.

One can assume that the change in normal mean monthly flows below Parker Dam due to ISC would be negligible as surplus waters are primarily diverted above Parker Dam. However, the implementation of ISC could have a slight effect on decreasing the probability of flood control releases and potential overbank flooding below Parker Dam.

The probability of flood control releases under the No Action Alternative are expected to decline from approximately 38% in 2005 to 27% in 2015. The frequency is predicted to continue to decline to approximately 18% by 2050. The decrease in probability of flood control releases is due mainly to Upper Basin development. Under the California Alternative, the probability of flood control releases are predicted to decline from 38% in 2005 to 22% in 2015, a difference of 5% in frequency from the No Action Alternative. The frequency is predicted to continue to decline to approximately 18% by 2050, the same as under the No Action Alternative (USBR, 2000).

Flood control releases do not necessarily produce the overbank flows needed for regeneration of riparian habitat. Amount, timing, and duration of potential flood events all are important elements in determining the effects of overbank flows on regeneration of riparian habitats. The best available data on the effects of overbank flooding on the lower Colorado River, since the completion of the Glen Canyon Dam in 1964, are from the 1983-87 flood event.

In January, 1983, Reclamation began flood control releases from Hoover Dam. The January 1983 average release was measured at 19,130 cfs. In early February, 1983, flood control releases were stopped. However, in April, 1983, the releases were started again, averaging 17,810 cfs in April. Releases continued to rise, peaking at 50,800 cfs on July 23, 1983. Releases continued to exceed 19,000 cfs until the spring of 1987.

The 1983-87 event impacted riparian vegetation along the Colorado River between Davis Dam and the SIB (See Table 8). Although the total amount of cottonwood-willow habitat actually decreased from 7,975 acres in 1981 to 5,754 acres in 1986, the majority of the acres lost were in the CW IV type. In the younger CW V and CW VI types, however, the amount increased slightly from 2,639 acres to 3,294 acres. Loss of older stands and an increase in recruitment is the pattern seen on the Bill Williams River when flood events occur, and is how historic flood events on the lower Colorado River would likely have affected vegetation as well. Since 1986, there has been an increase in CW III acres as the younger stands have matured. Saltcedar also increased in total acreage after the 1983-87 event, especially in the SC V type.

The 1983-87 flood event had impacts on the geomorphology of the lower Colorado River. It is estimated that the river bottom degraded at least three feet in the vicinity of the Topock Marsh inlet ditch (Bill Martin, USBR, pers. comm.). In many areas within the reach between Parker Dam and Imperial Dam, flows in excess of 50,000 cfs would be required to produce overbank flooding, without drastic manipulation of the river or adjacent floodplain. The channel bottom of the river below Davis and Parker Dams has degraded over time, but the 1983 flood event increased the degradation much more rapidly (USBR, unpub.data).

The probability of mean daily flows equal to or greater than 19,500 cfs being released at Parker Dam are 13.9% under No Action Alternative conditions and 13.0% under the California Alternative between 2001 and 2015. The probabilities increase slightly after the interim period ends in 2015 to 19.7% for the No Action Alternative and 17.9% for the California Alternative (USBR, 2000). Flows greater than this magnitude would begin to cause property damage in the Parker Strip area just south of Parker Dam. The 1983-87 event caused over $5.8 million in damage during 1983 alone. The 1984 Flood Control Benefits Report estimated that over $177 million in damage would have occurred along the lower Colorado River between 1983 and 1984 if flood control structures were not in place during this flood event (USBR file data, 1984).

2. Secretarial Implementation Agreement

Six actions are covered in the Secretarial Implementation Agreement (SIA). The major purpose of these actions is to establish a framework for the Secretary of the Interior to release Colorado River water to satisfy annual water supply needs within the annual apportionment of Colorado River water available for use in California. Implementation of the SIA will result in a change in point of diversion from Imperial Dam to Parker Dam of up to 400 kaf per year.

Concurrent with this BA, a separate biological assessment is being prepared for the Lower Colorado River Multi-Species Conservation Program (MSCP). The six actions covered under the SIA and the additional projects covered under the MSCP total 1.574 maf change in point of diversion. It must be noted, however, that this total figure may change in the future as the MSCP process evolves. If impacts to the affected habitat change as a result, this BA will be amended.

The effects on annual median flows at twenty points along the lower Colorado River between Parker Dam and Imperial Dam are shown in Appendix A, Table A-1. Changes to annual median flow due to the change in the point of diversion of the total 1.57 maf flows are projected to reduce river elevations by a minimum of 0.08 feet to a maximum of 1.55 feet at various points along this reach of the river.

The relationship between river surface elevation and groundwater elevation is dependent on several factors. Declines in groundwater elevation are roughly equal to river surface elevation declines in reaches where surface river water is not diverted for irrigation. Tributary inflows and water consumption by riparian vegetation are assumed to remain constant. In areas where surface water is diverted for irrigation, subsurface return flows raise the water table at the point of application. The groundwater table gradually declines as the water moves from the irrigated field towards the river or any other drain. Changes in irrigation practices and/or crops and cropping patterns will change the relationship between river surface elevation and groundwater elevation.

Flow in the Colorado River below Parker Dam can fluctuate significantly on a seasonal, daily, and hourly basis. These variations are the result of water orders (irrigation, municipal and industrial), power demands, and other routine operations (USBR, 1996). The change in point of diversion of 1.574 maf will affect maximum and minimum hourly flows differently, depending on the season. The tables in Appendix A show changes in river surface elevation for minimum and maximum hourly flows on a seasonal basis. However, for this analysis, only the annual median flows are examined. Frequency of fluctuation may affect the relationship between the groundwater elevation and the river surface elevation. Other factors, such as soil porosity and distance from the river, may affect the amount of time required for groundwater levels to correspond to changes in river surface elevations.

Riparian vegetation is sustained by groundwater and/or subsurface return flows from agriculture. For many habitat types, a reduction in groundwater elevation of 1.55 feet or less, due to a reduction in annual median flows, will have little or no impact on the continued survival of the vegetation itself. However, changes to the overall habitat quality and microclimate within stands of riparian vegetation may be affected. Survival of saltcedar, mesquite, arrowweed, and quailbush will not be affected by this change in groundwater elevation. Table 11 lists the acreage, by habitat type, between Parker Dam and Imperial Dam that may be found within the portion of the floodplain influenced by a change in groundwater elevation.

Table 11. Habitat Types Within the Area of Affect by Acreage.

Habitat Type	Acreage
Atriplex spp.	447
Arrowweed	2,660
Cottonwood-Willow	1,495
Honey Mesquite	3,056
Saltcedar	30,895
Saltcedar-Honey Mesquite	13,895
Saltcedar-Screwbean Mesquite	4,993

Cottonwoods, willows, and marsh types are most susceptible to changes in groundwater elevation. Changes in maximum hourly flows throughout the growing season have the potential to affect existing cottonwood-willow stands in areas where the change in river elevation is immediately reflected in a change in groundwater elevation, such as cottonwood-willow stands that border backwaters that are connected to the river. For areas not directly associated with backwaters connected to the river or areas very close to the mainstem river channel, the changes in maximum and minimum hourly flows will probably be muted. In these areas, changes in annual median flows were used to estimate the effects of groundwater depletion due to a change in point of diversion.

Cottonwood and willow are susceptible to changes in groundwater elevation depending on many factors including root development, structure type, existing depth to groundwater, and availability of alternate water sources, such as irrigation return flows. Recently established stands (types V and VI) are most susceptible to changes in water table elevations. Only 46 acres were classified in 1997 as CW V or CW VI within this stretch of the river (see Table 9). All of the CW VI stands and several of the CW V stands were new revegetation projects conducted by the Colorado River Indian Tribes (CRIT), Bureau of Reclamation, or State of California. Several of the CW V stands were naturally occurring within marsh types at

Imperial National Wildlife Refuge near Picacho and Imperial Dam.

Optimum depth to groundwater for cottonwood-willow stand maintenance is 4 feet or less. However, cottonwood-willow stands can survive up to 9 feet above groundwater (Pinkney, 1992; Zimmerman 1969 *in* Stromberg, 1993; USBR, unpub. data). If flow reductions reduce groundwater elevations to a point greater than 9 feet below existing cottonwood-willow stands, it is expected to cause mortality and potentially, a change in species composition. The condition or quality of cottonwood and willow habitat may be affected in varying degrees and at differing rates by changes in groundwater elevation. These impacts would depend on many factors including how fast the drop occurs, time of year, and existing root development, among others and precise impacts are difficult, if not impossible, to predict.

Habitat utilized by Willow Flycatchers can vary from site to site based on vegetational species composition, elevation, patchiness, humidity, temperature, and other factors. The dense structure of the vegetation and the presence of either standing water, moist soil, or water adjacent to the site are two characteristics that are generally consistent throughout the bird's range (McKernan, 1998; Sogge et al., 1997). A sufficient drop in groundwater level could have the effect of drying up soils at the surface and lowering surface water levels, thus affecting the suitability of the habitat for willow flycatchers.

Estimate of Potential Willow Flycatcher Habitat

Approximately 1,570 acres of cottonwood-willow and 32,141 acres of saltcedar of all structural types were determined to exist through 1997 vegetation mapping between Parker Dam and Imperial Dam (see Table 9). However, southwestern willow flycatchers are found in stands of dense vegetation with a component between 8 and 25 feet in height (USFWS, 1997; Sogge, 1997; McKernan, 1998). For riparian habitat, this corresponds to cottonwood-willow structural types I, II, III and IV and saltcedar structural types III and IV (Table 12).

The total area of cottonwood and willow types I, II, III, and IV, and saltcedar types III and IV is 21, 218 acres. The acreage known to be occupied southwestern willow flycatcher breeding habitat within this reach is approximately 1,500 acres. The remaining 19,718 acres of cottonwood/willow and saltcedar, between Parker and Imperial Dams is not presently suitable willow flycatcher habitat. Although it is comprised of the desired vegetational structure and composition, it is not suitable because it lacks other necessary features (R. McKernan, Pers. Comm.). Although this habitat is considered unsuitable at this time, it could be improved with appropriate management in the future.

The proposed action will have little effect on the 19,718 acres of habitat not presently suitable as willow flycatcher breeding habitat. The majority of this habitat is comprised of saltcedar types that are perched far enough above the groundwater table that surface water or saturated soils are not found within these stands (R. McKernan, per.comm.). A drop of 1.55 feet or less in the groundwater table will not affect the species composition within these stands. Although saltcedar stands are highly susceptible to disturbance, especially by wildfire, natural regeneration by native cottonwoods and willows has already been precluded due to the lack of scouring flood events. Saltcedar readily re-sprouts after a fire so saltcedar dominated stands will remain saltcedar. Any effects will be limited to cottonwood-willow stands that are not currently occupied habitat or in stands where cottonwood and/or willow compromise a small (<10%) component of a mixed saltcedar-native stand. The latter case represents stands that would not be classified as cottonwood-willow under the current vegetation classification system but may have a minor native plant component (Anderson and Ohmart, 1984). These stands would tend towards monotypic saltcedar after disturbance by fire.

Table 12. Acreage of *Potential Southwestern Willow Flycatcher Habitat Within the Proposed Action Area.

Habitat Type	Acreage for 1.57 MAF	Acreage for 400 KAF
Cottonwood/Willow I	112.6	28.7
Cottonwood/Willow II	27.8	7.1
Cottonwood/Willow III	875.4	223
Cottonwood/Willow IV	359.9	91.7
Total Cottonwood/Willow	**1375.7**	**350.5**
Saltcedar III	592.4	150.9
Saltcedar IV	19250.3	4904.5
Total Saltcedar	**19842.7**	**5055.4**
Total Potential Habitat	**21218.4**	**5405.9**

*Potential in this case is defined as suitable according to vegetation structure only.

Estimate of Occupied Willow Flycatcher Habitat

Occupied willow flycatcher habitat is defined as "a contiguous area with consistent physical and biotic characteristics where territorial males or pairs of flycatchers have been documented during previous breeding seasons (generally after June 15) at least once in the last few years, assuming the habitat has not been degraded or otherwise altered in the interim. If a portion of contiguous habitat is or was used, the entire contiguous area is considered occupied" (Cordery, pers. comm.). Since 1996, data from willow flycatcher surveys (McKernan, 1996, 1997, 1998, 1999) on all occupied habitat on the lower Colorado River has been stored in a GIS database by Reclamation.

Topographical maps and USBR GIS data were used to determine the acreage of occupied habitat within the area affected by a groundwater or surface water drop due to a change in point of diversion of 1.574 maf. In addition, hydrological data (Table 13) is available for sites between Parker Dam and Imperial Dam known to be occupied by willow flycatchers (McKernan, 1999). This data was collected during willow flycatcher breeding season; i.e. between May 15 and August 15, by taking soil samples from 30 locations within each site at 0 to 3cm depths every two weeks.

The acres of occupied habitat between Parker and Imperial Dams that will be affected by the 1.574 maf change in point of diversion totals 1,506 acres. Only one site has standing water present deep enough not to be affected by a groundwater drop between 0.08 feet and 1.55 feet, and it has been excluded from the analysis. The total acreage for all occupied willow flycatcher sites characterized by saturated soils and/or depth of standing water less than or equal to 1.55 feet is 1,460. Again, a proportional analysis brings this total to 372 acres.

The 5,404 acres of potential and 372 acres of occupied willow flycatcher habitat will not die, as even the maximum drop in elevation due to the change in point of diversion of the total 1.574 maf only decreases the median river elevation, and thus the groundwater, by 1.55 feet, and will not occur instantaneously regardless. As explained above, established cottonwood, willow and saltcedar can withstand a 1.55 foot drop in groundwater, as their roots extend below it (Fenner et al., 1984; Jackson et al., 1990; Segelquist, 1993). Even newly established cottonwood and willow can withstand a drop in groundwater as long as it does not occur faster than the roots can grow (Jackson et al., 1990). However gradual the drop in groundwater is, trees with roots in the groundwater below 1.55 feet would not incur mortality. However, there are possible impacts to the habitat due to changes in groundwater levels that are more subtle and there is a need to further study these changes.

The drop in groundwater due to a change in point of diversion would not be instantaneous, therefore, vegetational and microclimatic changes within the sites would be gradual and difficult to predict. Studies are underway to determine the general ecological processes which make habitat preferable to species. Some of these processes include establishment of new riparian vegetation, groundcover, species composition, prey selection and abundance.

Yellow-billed Cuckoos, are likely to be listed as endangered in the near future. The effects to the habitat this species is known to utilize overlaps the effects to willow flycatcher habitat in some areas on the lower Colorado River (McKernan, 1999) and is subject to the same impacts to the habitat previously discussed. Although less data are available for specific areas and acreage utilized by cuckoos between Parker and Imperial Dam than is available for willow flycatchers, the above general effects apply to both species.