APPENDIX I:

TRIBAL RESOURCES TECHNICAL INFORMATION AND ANALYSIS

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TRIBAL RESOURCES TECHNICAL INFORMATION AND ANALYSIS

Section 4.9 of the Draft Environmental Impact Statement (DEIS) assesses and compares the potential impacts Glen Canyon Dam Long-Term Experimental and Management Plan (LTEMP) alternatives could have on resources important to federally recognized Tribes. Indian Tribes have been recognized by the courts as "domestic dependent nations." They were sovereign entities before the arrival of Euro-American colonizers and continue to exercise that sovereignty within their reserved lands. Consultation between Tribes and the federal government is consultation between sovereign entities. Even when they have been removed from their ancestral lands, Tribes often retain strong ties to culturally important resources in their traditional homelands. When those resources are located on federal lands or could be affected by federal or federally licensed undertakings, federal agencies are required to take into account those potential impacts in their decision-making (see Table I-1).

The nature and degree of impacts that an undertaking could have on resources important to Tribes is best evaluated with significant input from the Tribes themselves. To this end, the Bureau of Reclamation (Reclamation) and National Park Service (NPS) have sought to include input from all federally recognized Tribes that have traditional, historical, cultural, or religious ties to the canyons. Forty-three Tribes with potential ties to the canyons were notified of the LTEMP EIS project by mail with telephone follow-up and invited to participate. Of these, six chose to become cooperating agencies; two Tribes chose to consult, but not as cooperating agencies; and nine chose not to actively consult, but to be kept informed of project developments. Thirteen Tribes chose not to participate. There was no response from the remaining twelve Tribes (see Appendix N).

Assessing the comparative impacts of the LTEMP alternatives on Tribal resources presents a challenge both (1) because of the holistic view of the canyons that Tribal members tend to take, in which all elements of the environment are interconnected, so that effects on one part of the environment affects the whole, because there is no single "Tribal view" held by all members of all Tribes, and (2) because knowledge of the location of some of the most sacred places is not shared with outsiders. Not all Tribes agree with each other on all issues, but some common themes and issues did emerge from discussions with Tribal representatives, review of canyon monitoring reports produced by the Tribes, and ethnographic sources produced by or for

TABLE I-1 Federal Regulations and Executive Orders Pertaining to Consultation with Tribes

40 CFR 1506.6 *Cooperating Agencies*
43 CFR 46.225 *How to Select Cooperating Agencies*
E.O. 13175 *Consultation and Coordination with Indian Tribal Governments*
Section 106 of the *National Historic Preservation Act (1966 as amended)*
36 CFR 800.2 (c) (2) *Participants in the Section 106 Process*

the Tribes. For many Tribes, environmental features considered inanimate in Western cultures are seen as imbued with life; in some cases, such as with the Colorado River and the Little Colorado River, they are considered deities. Various Tribes regard the canyons as sacred space, the place where their people emerged into this world, the home of their ancestors, the residence of the spirits of their dead, and the source of many culturally important plant, animal, and mineral resources. Many Tribes view themselves as connected to the Colorado River and its canyons and as stewards over the living world around them including water, earth, plant life, and animal life. This holistic view encompasses subject areas considered in this DEIS, and Tribal perspectives on these resources are found throughout the document. The values the Tribes place on the river and its canyons are significant and real, but often intangible; therefore, they are not easily or are only partially quantifiable. In addition, many of the values and resources that are most important to the Tribes are not directly affected by differences in the patterns of release of water from the Glen Canyon Dam.

Knowledge of some of the most sacred and sensitive places and resources in the canyons is esoteric, known chiefly by elders and initiated religious practitioners. Only they can provide information on what is most sacred and what can be revealed in a public format such as an EIS. Funding was provided to support Tribes in obtaining and providing these important perspectives on the river and the canyons. Appendix N details the efforts undertaken to obtain Tribal input regarding resources important to Tribes that could be affected by the operation of Glen Canyon Dam and proposed associated actions. These efforts included face-to-face meetings, webinars, and conference calls. The Tribes that chose to act as cooperating agencies also were afforded the opportunity to provide text for the DEIS, and to review and comment on the draft document before it was released to the public.

Although many aspects of the effects on Tribal resources are not quantifiable, quantifiable measures of effects on the canyon environment were found that reflect important Tribal values and could stand as proxies for those values. These include effects on the diversity of riparian vegetation, effects on marshes and other wetlands, effects of large-scale taking of nonnative fish for fish management purposes, effects on Tribal water rights, and factors that could affect Tribal economics. Tribes are concerned with natural resources beyond plant and aquatic life in the canyons. Bighorn sheep, songbirds, and butterflies are among the indicators of canyon health mentioned by Tribal members. Many of these resources are considered qualitatively in the wildlife section of the DEIS (Sections 3.7 and 4.7) and can be reviewed and considered by Tribal specialists and representatives.

I.1 QUANTIFIABLE MEASURES USED TO ASSESS IMPACTS ON TRIBAL RESOURCES

I.1.1 Riparian Diversity

Among the quantifiable projected impacts are those on riparian vegetation, the plant life likely to be most directly affected by flow management at the Glen Canyon Dam. The Western concept of “ecosystem” comes close to Tribal views of interconnectedness. Plant life is a fundamental part of most ecosystems. The state of riparian vegetation is a good indicator of the state of the canyon ecosystem as a whole. Thriving, diverse vegetation communities indicate a healthy ecosystem. Models of future plant diversity along the river provide a quantitative indicator of ecosystem health. Many Tribes give native species and nonnative plant species equal value as forms of life to be respected. Therefore the measure presented here includes plant communities dominated by both native and nonnative plants. For a discussion of diversity in native plant communities, see the Native Diversity Index in Appendix G.

A metric for vegetation community diversity in the riparian zone has been developed based on the results of a state and transition model for Colorado River riparian vegetation downstream of Glen Canyon Dam. This model has been developed to compare the effects of alternative flow regimes on Colorado River riparian vegetation. The model is discussed in Section 4.6.1. For a more detailed discussion of the model, see Ralston et al. (2014) and Appendix G. The model uses characteristics of annual dam operations to predict transitions from one plant community type to another on sandbars and channel margins in the riparian zone. The model projects transitions over a 20-year period for each alternative and long-term strategy analyzed. Relative change in the diversity of vegetation community types on sandbars and in channel margins is projected using the Shannon-Weiner Index for richness/evenness[1] and a diversity score calculated by comparing the final (modeled) diversity to the initial diversity (change in diversity = $\text{diversity}_{final}/\text{diversity}_{initial}$). A healthy ecosystem is characterized by a high degree of species diversity, represented here by diversity in vegetation community types. A total diversity score was calculated that included nonnative (primarily tamarisk) as well as native communities including the invasive arrowweed. Table I-2 shows the seven vegetation states, or plant community types, that were considered. The species associated with a state all respond similarly to Colorado River hydrologic factors such as depth, timing, and duration of inundation.

The model consists of six submodels based on the following landforms: lower separation bars, upper separation bars, lower reattachment bars, upper reattachment bars, lower channel margins, and upper channel margins. Upper and lower landforms are divided at the 25,000 cfs

TABLE I-2 Vegetation States

Vegetation States
Bare Sand
Marsh (Common Reed Temperate Herbaceous Vegetation)
Shrub Wetland (Coyote Willow-Emory Seep Willow Shrubland/Horsetail Herbaceous Vegetation)
Tamarisk (Tamarisk Temporarily Flooded Shrubland)
Cottonwood-Willow (Fremont Cottonwood/Coyote Willow Forest)
Arrowweed (Arrowweed Seasonally Flooded Shrubland)
Mesquite (Mesquite Shrubland)

1 For a discussion of the Shannon-Weiner Index, see Appendix G.

flow stage (see Section 3.3.1.1 for a description of these landforms). The model projects transitions between vegetation states, based on a set of rules developed for each submodel, driven by hydrologic events. The model includes a subset of states and transition rules for each submodel. The states and transition rules for the upper portions of the bars and channel margin are the same because of the similarity of plant community types and responses to flow characteristics. The transition rules are based on the effects of scouring, drowning, desiccation, and sediment deposition on riparian plant species. Transition rules are presented in Table G-3 in Appendix G.

Figure I-1 shows the weighted diversity scores for the seven LTEMP alternatives and their associated long-term strategies (described in Appendix C). The higher the score, the greater the diversity of plant community types. A score of 1.0 indicates that the current degree of plant community diversity is projected to be maintained. A score greater than 1.0 indicates increased diversity, less than 1.0 a loss of diversity. The mean scores for each alternative fall into a somewhat wider range than the Native Diversity scores presented in Appendix G. They range from 0.70 under Alternative F to 0.97 under long-term strategy B1. Alternative A (no action alternative) scored 0.95. Alternatives D and E scored above 0.90 under all of their associated long-term strategies.

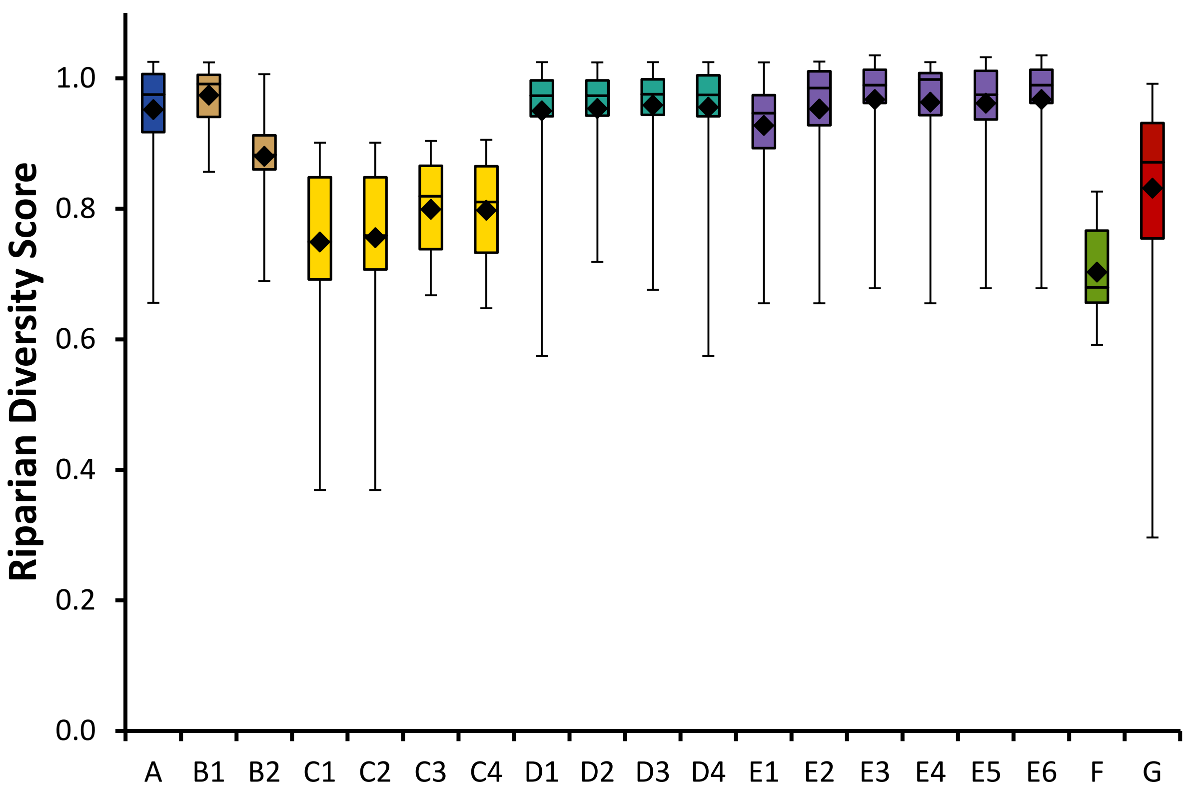

FIGURE I-1 Riparian Diversity for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

The results indicate that on average all alternatives would result in a small decrease in total vegetation state diversity over the 20-year LTEMP modeling period. The loss in diversity would be greatest under those long-term strategies where there is an increase in the area covered by the tamarisk community type (see Table 4.8-3). Alternatives where tamarisk[2] would increase are characterized by high flows (high-flow experiments [HFEs] or ≥30 days with flows >20,000 cfs), which serve to distribute seed, and/or low flows in the growing season (May–September) that allow seedlings to establish themselves. Once established, tamarisk is tenacious. When it does transition, it is most often to bare sand.

Under climate change assumptions, the modeled pattern shows very little difference from the historical-based assumptions (Figure I-2). There is a minimal overall increase in mean diversity scores, suggesting that the difference would be barely perceptible on the ground.

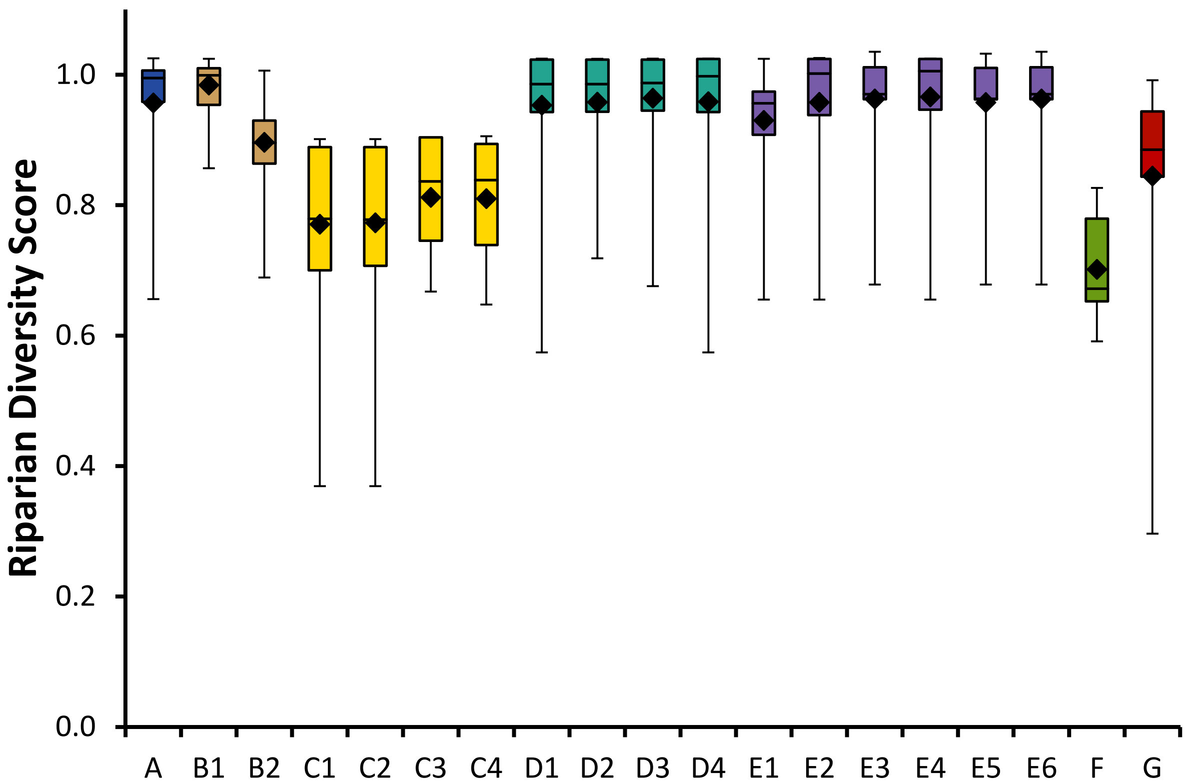

FIGURE I-2 Riparian Diversity under Climate Change Assumptions for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

2 The model takes into account the effects of scouring, drowning, desiccation, and sediment deposition, but does not account for the effects of the tamarisk leaf beetle or tamarisk weevil. These two insect species may result in a reduction in the amount of live tamarisk in the river corridor.

I.1.2 Wetland Abundance

Some Tribes (e.g., the Hopi) see the health of canyon wetlands as an indicator of canyon health (Yeatts and Huisinga 2013). Assessments of the projected state of wetland cover over the next 20 years can be derived from the state and transition model discussed above. Two of the model states listed in Table I-2 are wetland community types: Common Reed Temperate Herbaceous Vegetation, a marsh community; and Coyote Willow-Emory Seep Willow/Horsetail Herbaceous Vegetation, a shrub wetland community.

Wet marsh communities of flood-tolerant herbaceous species that occur on low-elevation areas of reattachment bars have developed in response to frequent inundation. Wet marsh communities (with common reed and cattail the dominant species) occur on fine-grained silty loam soils in low-velocity environments on lower areas of eddy complex sandbars; although they are easily scoured by high flows, they can redevelop quickly. Shrub wetland communities (with coyote willow, Emory seep willow, and horsetail the dominant species) occur on sandy soils of reattachment bars and channel margins, below the 25,000 cfs stage, that are less frequently inundated.

Wetland communities generally transition only from bare sand or other wetlands; they can transition back to bare sand or to arrowweed, tamarisk, or cottonwood-willow communities. An increased occurrence of transitions from bare sand to wetlands and/or maintenance of wetlands (lack of transitions to other community types) would result in greater wetland cover. Large daily fluctuations increase the area of saturated soil and thus the sandbar area available for wetland species establishment. The reduction of daily fluctuations may increase the establishment of wet marsh species at lower elevations and promote the transition of higher elevation marshes to woody species such as tamarisk or arrowweed. Periodic flooding and drying tends to increase diversity and productivity in wetland communities. Although low-elevation plants in marshes in Marble Canyon and Grand Canyon, such as cattail, common reed, and willow, may become buried with coarse sediment, recovery generally occurs within 6 to 8 months. Low steady flows can cause some wetland patches to dry out, resulting in considerable plant loss. Sustained high releases reduce wetland vegetation cover to less than 20% on lower reattachment bars. Extended high flows typically scour herbaceous vegetation; however, most woody plants often remain. Thus, extended high flows followed by extended low flows in the following growing season result in a transition from shrub wetland to a cottonwood-willow community on channel margins. A transition from marsh to shrub wetland occurs on lower reattachment bars with 4 years of consecutive seasons of low fluctuating flows or non-growing season sustained low flows (Ralston et al. 2014).

The relative change in cover of these wetland community types was calculated from the state and transition model results. The number of years each of the wetland states occur in each submodel is projected for the 20-year LTEMP modeling period. The results for the seven alternatives and their long-term strategies are presented in Figure I-3. A mean score of 1.0 indicates no change from initial conditions is expected. A score greater than 1.0 indicates an increase in wetland cover; a score of less than 1.0 indicates a loss in wetlands. Alternative F scored the lowest (0.14), and long-term strategy E6 scored the highest (1.10). Alternative A scored 0.72.

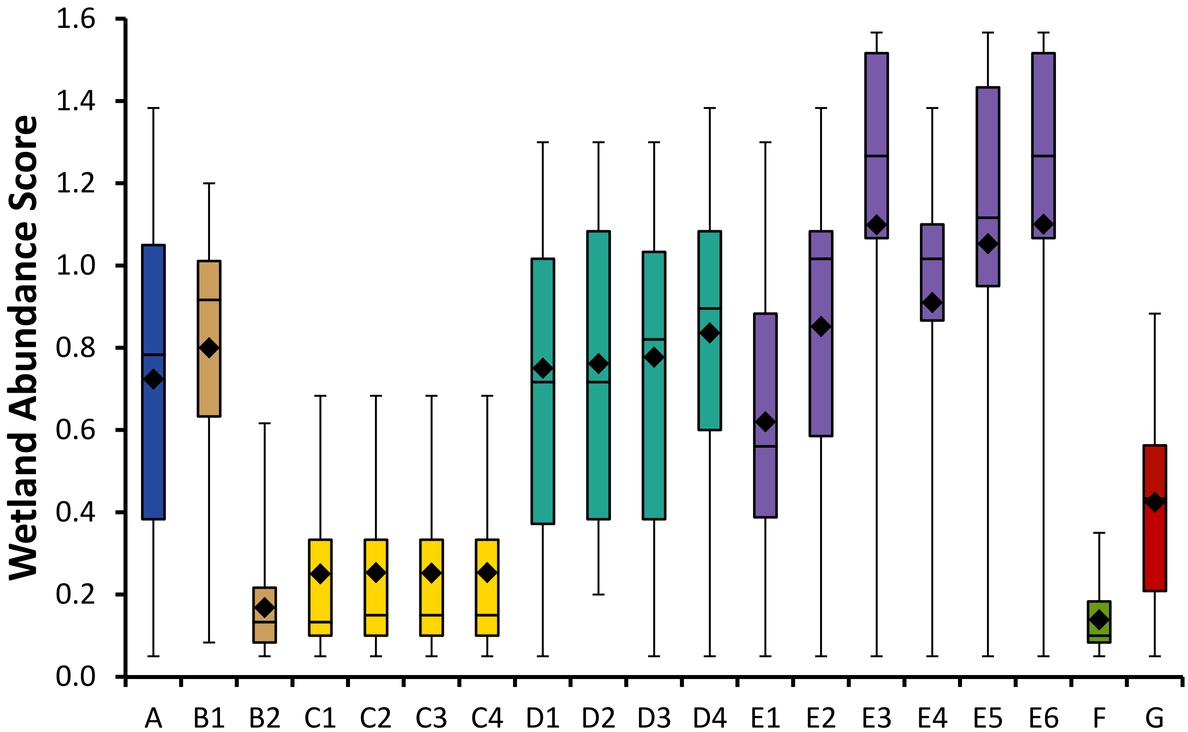

FIGURE I-3 Wetland Abundance for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

Only Alternative E, long-term strategies E3, E5, and E6—none of which have HFEs—show an increase in wetland cover (based on mean scores); all others show a decrease. However, long-term strategies B1, D1, D2, D3, D4, E2, E3, E4, E5, and E6 all scored higher than Alternative A. The alternatives with high scores are characterized by fewer extended high flows (greater than 20,000 cfs) and fewer extended low flows (less than 10,000 cfs) than Alternative A. There is enough water to sustain wetlands, but not too much inundation to support them over time. A large decrease in wetland community cover occurs under B2, all Alternative C long-term strategies, Alternative F, and to a lesser extent Alternative G. Frequent extended low flows or extended high flows followed by extended low flows tend to result in the transition of wetlands to other plant community types. Repeated seasons of extended high flows, or sufficiently high flows during one season, can remove wetlands, resulting in bare sand landforms.

Under climate change assumptions, the overall pattern remains the same for all alternatives, except that the Alternative F score increases slightly, as seen in Figure I-4. On average, scores increased by 0.08, with Alternative F showing only a negligible increase in the mean score (0.0017).

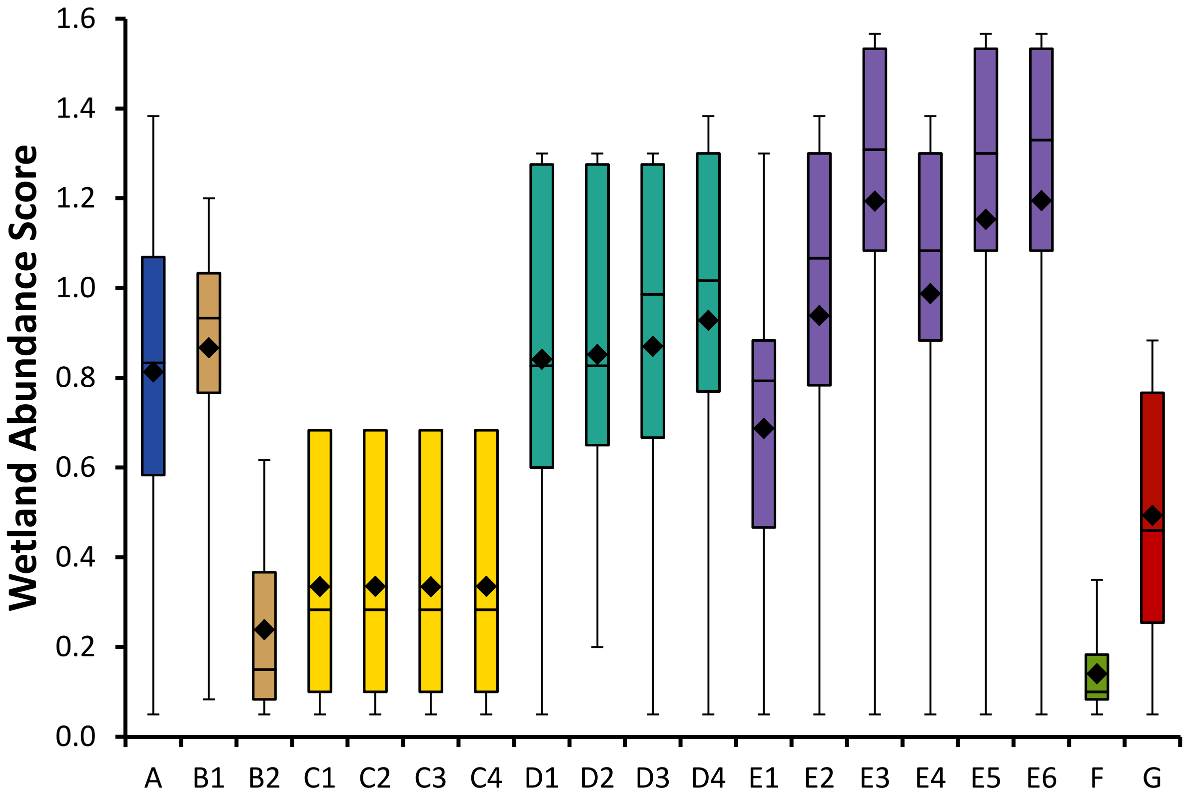

FIGURE I-4 Wetland Abundance under Climate Change Assumptions for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

I.1.3 Trout Management Flows

Reclamation and NPS are required under the U.S. Fish and Wildlife Service (FWS) biological opinion related to the *Non-native Fish Control Downstream from Glen Canyon Dam Environmental Assessment* (Reclamation 2011) to take steps to protect and encourage the recovery of endangered humpback chub (*Gila cypha*) populations in the canyons. The Little Colorado River is the home of a significant population of chub, which interact with rainbow trout at the confluence of the Colorado River and the Little Colorado River. Past and proposed methods for encouraging chub population growth involve reducing the number of nonnative trout, which prey on and compete with the chub. Large-scale killing of trout brings Reclamation and NPS into conflict with the value placed on all forms of life held by some Tribes. Although Tribes differ as to whether they consider the removal of nonnative fish species positively or negatively, many Tribes place a high value on the sanctity of life throughout the ecosystem and see themselves as its stewards. For them life, including fish and animal life, must not be wasted and must not be taken except to sustain human life. The Zuni in particular have important cultural ties to aquatic life in the canyons. The confluence of the Colorado River and the Little Colorado River is particularly sacred.

Aquatic resources models allow the comparison of the number of years trout management flows designed to strand trout larvae and fry would be triggered, and the number of years in which mechanical removal of trout would be triggered across the alternatives and their associated long-term strategies. Details of the models are presented in Appendix F.

A trout management flow is a highly variable flow pattern of water releases at Glen Canyon Dam intended to control the number of young-of-the-year trout in the Glen Canyon reach of the Colorado River. Reducing the number of trout in the Glen Canyon reach would reduce the number of trout emigrating downstream to the confluence with the Little Colorado River and other downstream areas. A typical trout management flow would consist of several days of a relatively high sustained flow (e.g., 20,000 cfs) that would prompt young fish to move into the shallows along the channel margins and, depending on the time of year, would prompt spawning fish to construct redds and lay eggs in nearshore shallow areas. The high flows would be followed by a rapid drop to a low flow (e.g., 5,000 cfs), stranding and killing young-of-the-year trout and, depending on the time of year, possibly exposing eggs in shallow redds, thus preventing them from hatching. Management flows would be triggered during years in which the production of young-of-the-year rainbow trout in the Glen Canyon reach is anticipated to be high (more than 200,000 individuals.).

Figure I-5 shows the projected number of years in which trout management flows would be triggered under each alternative and long-term strategy. Trout management flows are not elements of all alternatives and may not occur in many years, even under alternatives that allow them. Under each of the alternatives and long-term strategies in which trout management flows are included, they would first be conducted as tests and then implemented only if they prove to be effective in reducing the trout population in the Glen Canyon reach and emigration to downstream sections of the Colorado River. Trout management flows are not included as elements of nine alternatives/strategies: Alternative C long-term strategies C2, C3, and C4; Alternative D long-term strategy D3; Alternative E long-term strategies E2, E3, E4, and E5; and Alternative F. They would be only tested under Alternative A. In long-term strategies D1, D2, and D4, trout management flow experiments would be implemented without triggers during the first 5 years of the LTEMP period. Figure I-5 assumes experiments in the first 5 years of the LTEMP period. In general, trout management flows would most likely be triggered when spring HFEs, which stimulate the food base, are followed by relatively steady summer flows (May–August). These factors are associated with higher production of young-of-the-year trout and would result in conditions that would trigger trout management flows more often. Where the number of HFEs is limited, as in Alternative B, it is expected that there would be fewer years in which trout management flows would be triggered. Modeling indicates trout management flows would be triggered most often under Alternative G and long-term strategy D2. The mean number of years in which trout management flows would occur are relatively high under long-term strategies D1, D2, and D4 because of the experimental flows that would be implemented, whether trout management flows are triggered or not. If trout management flows prove successful, they would reduce the number of times mechanical removal near the Little Colorado River confluence would be triggered.

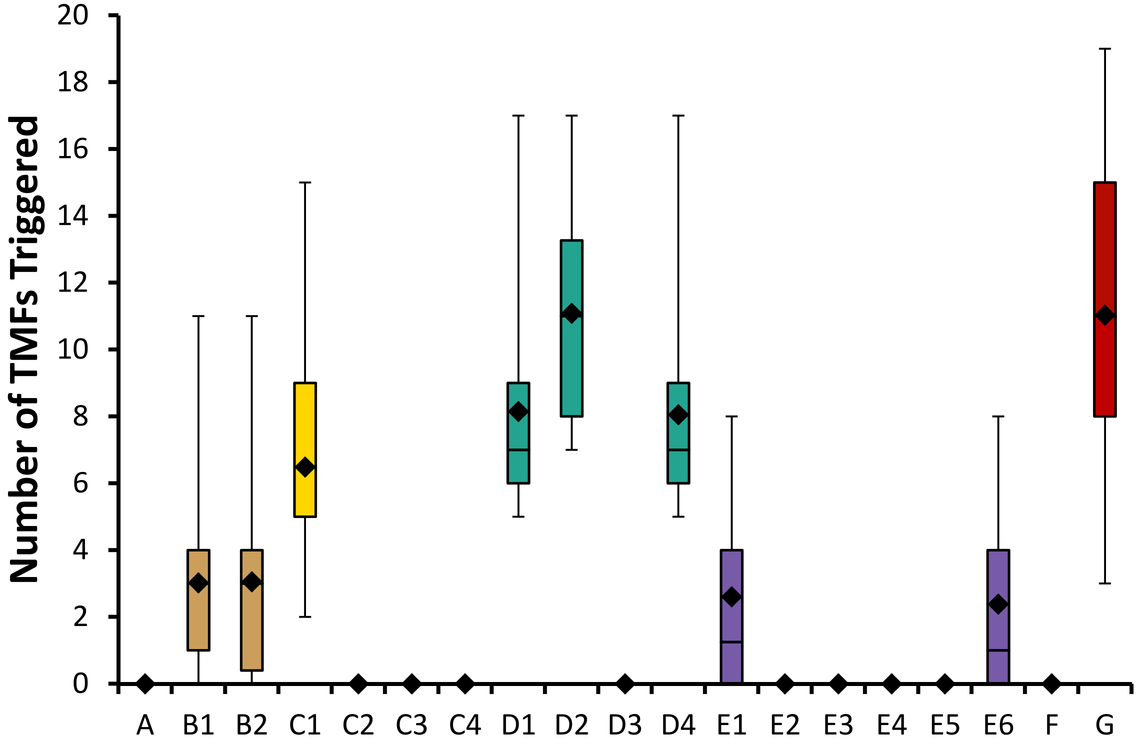

FIGURE I-5 Frequency of Trout Management Flows for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

As shown in Figure I-5, trout management flows would be triggered in just under half the alternative long-term strategies. Among the alternative long-term strategies that include trout management flows, the mean number of years during the 20-year LTEMP period in which trout management flows would occur ranges from 2.4 under E6 to 11.0 under Alternative G; the average number ranges between 2 and 4 years under six out of the nine alternative/long-term strategies where trout management flows are allowed.

Figure I-6 shows the frequency of trout management flows under climate change assumptions. A comparison of Figures I-5 and I-6 shows that the frequency distribution pattern is virtually the same for historical and climate change assumptions. On average, the mean value for each alternative/long-term strategy is 0.49 years less under climate change assumptions; this suggests that there would be somewhat fewer trout in the Glen Canyon reach, perhaps a reflection of a drier, warmer future climate.

I.1.4 Mechanical Removal of Trout

Mechanical removal would be implemented by using electrofishing to stun and remove nonnative fish.

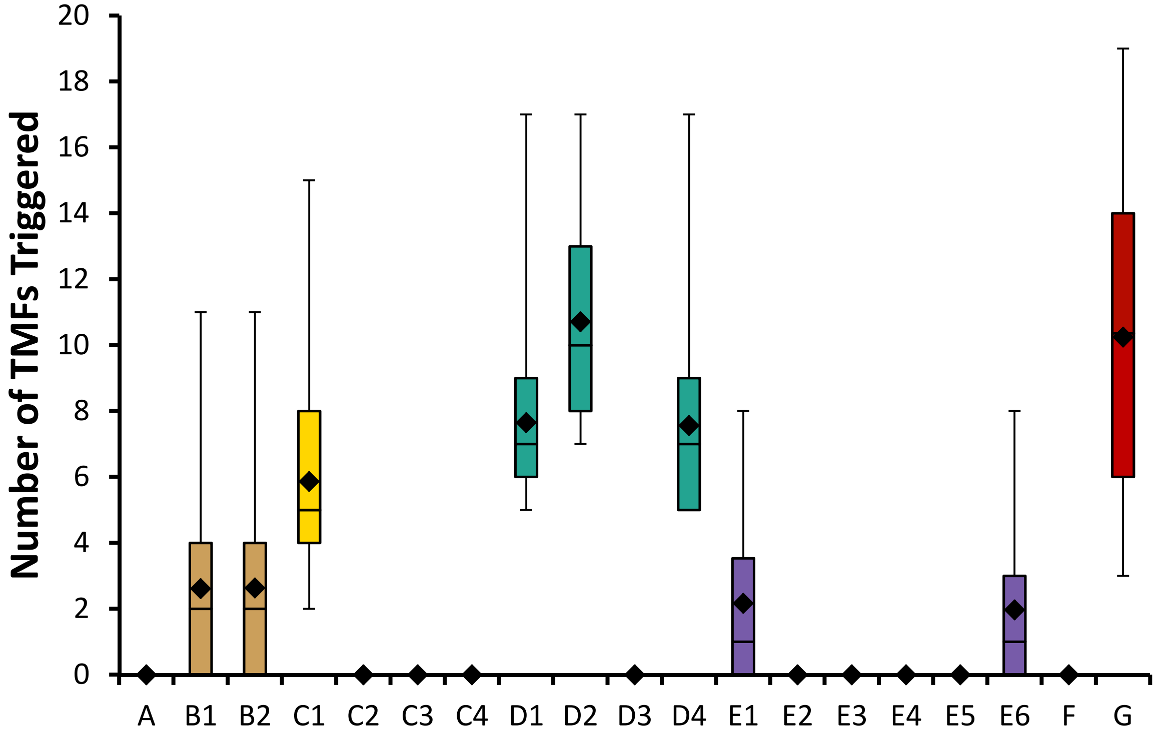

FIGURE I-6 Frequency of Trout Management Flows under Climate Change Assumptions for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

Although this does not kill the fish, usually the removed fish would be euthanized (killed) and put to some beneficial use. For example, in one mechanical removal test, the trout were emulsified and used as fertilizer in the Hualapai tribal gardens (Reclamation 2011). Grand Canyon Monitoring and Research Center (GCMRC) has modeled the number of years in which mechanical removal would be triggered under various alternatives. In the model two factors must coincide to trigger mechanical removal trips: (1) there must be more than 760 adult rainbow trout projected for the test reach in the vicinity of the Little Colorado River confluence (RM 63–RM 64.5), and (2) the projected adult humpback chub population for the canyons must be less than 7,000 individuals.

Figure I-7 shows the projected number of years in which mechanical removal from the Little Colorado River reach would be undertaken. Mechanical removal is not an allowed element of seven alternatives/strategies: Alternative C long-term strategies C1 and C2; Alternative E long-term strategies E1, E2, E5, and E6; and Alternative F. The mean number of years in which mechanical removal is modeled to occur ranges from 0.07 under Alternative A to 3.05 under Alternative G. In general, mechanical removal would be triggered in far fewer years than trout management flows. Modeling indicates that the average maximum number of years in which mechanical removal would be triggered is 6.3 out of 20, the projected maximum under D3. The overall pattern of mechanical removal events would be similar to the pattern of trout management flow occurrences and for similar reasons. Conditions that favor trout production

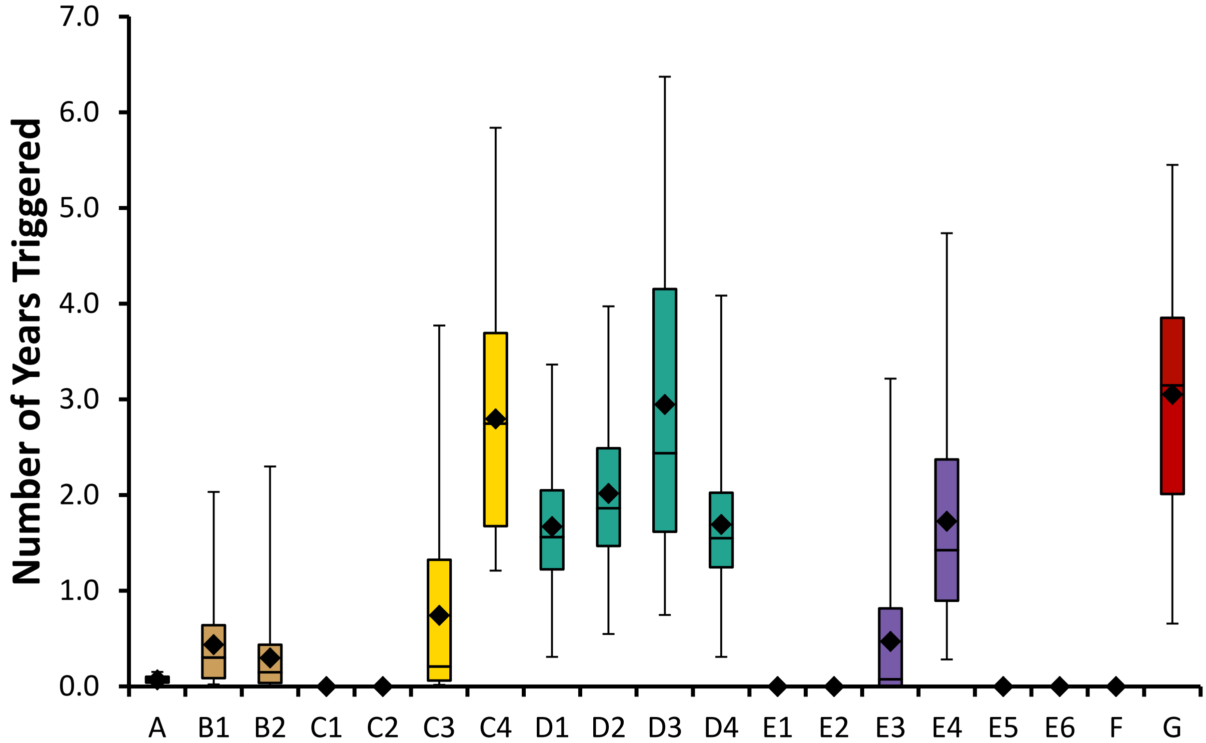

FIGURE I-7 Frequency of Mechanical Removal for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

(spring HFEs and steady summer flows) result in trout population increases in the Glen Canyon reach, thereby increasing the number of trout that move downstream to the Little Colorado River reach and triggering mechanical removal more often.

Figure I-8 shows the frequency of mechanical removal under climate change assumptions. As with trout management flows, the distribution pattern varies very little between the two plots. In all cases except Alternative G there is a slight decline in the mean number of years in which mechanical removal would be triggered. On average, those that score lower under climate change assumptions score 0.13 years less, while Alternative G scores 0.06 years more. This suggests that with the exception of Alternative G, river conditions would be slightly less favorable for trout production under climate change conditions.

I.1.5 Water Levels at Lake Powell

The domestic water supply for the LeChee Chapter of the Navajo Nation is obtained from Lake Powell through pumping and conveyance facilities that were first constructed at the time Glen Canyon Dam was built between 1957 and 1964 (NPS 2009). The current system relies on either an intake on the face of the dam at 3,480 ft above mean sea level (AMSL), or an intake off the penstocks, which are at an elevation of 3,470 ft AMSL at Lake Powell. Therefore, 3,470 ft

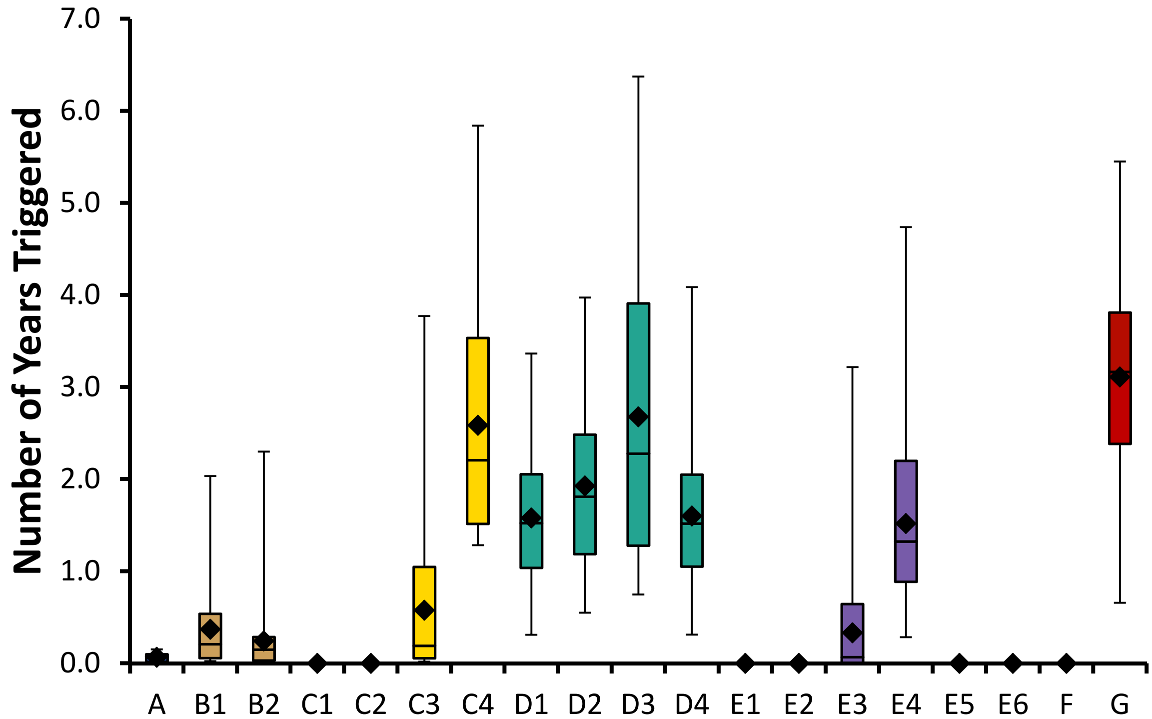

FIGURE I-8 Frequency of Mechanical Removal under Climate Change Assumptions for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

AMSL is the minimum elevation necessary for the LeChee Chapter to draw water from Lake Powell, even while penstock units are down or are undergoing maintenance.

An environmental assessment (EA) done in 2009 addresses possible future construction to provide a backup water supply to the area (NPS 2009). Three designs for new water supply systems from Lake Powell for the City of Page and the LeChee Chapter were evaluated. The EA eliminated two of the designs and narrowed the options to either no action or an entirely new pumping system which calls for six 48-in. intake pipes reaching the lake at an elevation of 3,373 ft AMSL.

The Colorado River Simulation System (CRSS) model was used for the LTEMP process to project future river and reservoir system conditions on a monthly time-step.

Because there are no known restrictions within the model for the intake pipes, an analysis was conducted to identify modeled minimum Lake Powell elevations in order to address concern regarding the LeChee Chapter's ability to draw water under LTEMP. End-of-the-month Lake Powell elevations were created as part of the LTEMP analysis (see Appendix E) for all the different hydrologic and sediment inputs (see Section 4.1 for a presentation of the overall modeling approach). A script within the MATLAB® scripting program was created to retrieve the minimum elevation possible within each alternative.

As shown in Figure I-9, there is little variation projected for Lake Powell water levels among the LTEMP alternatives. The mean water level for Lake Powell under all alternatives and long-term assumptions falls between 3,540 ft AMSL and 3,560 ft AMSL, well above intake elevations. More importantly, the minimum elevation of the lake modeled for all different input combinations and alternatives was 3,480 ft AMSL. This is the same elevation as the intake on the dam face and 10 ft above the elevation of the penstock intakes and well above elevations for any planned future intakes. Although there is always potential for modification of dam operations based on circumstantial conditions, the LeChee Chapter is projected to retain its water supply from Lake Powell under all LTEMP alternatives, with average levels slightly higher under Alternative F than the other alternatives.

As seen in Figure I-10, with the exception of Alternative F, climate change assumptions mean lake elevations are projected to fall just below 3,540 ft AMSL. Mean lake levels under Alternative F would be just above 3,540 ft AMSL. Even under climate change assumptions, minimum lake elevations are never projected to fall below 3,480 ft AMSL and are project to remain at least 10 ft above the minimum required to supply the LeChee Chapter with water. Only under Alternative F would the minimum projected Lake Powell elevation be above 3,490 ft AMSL.

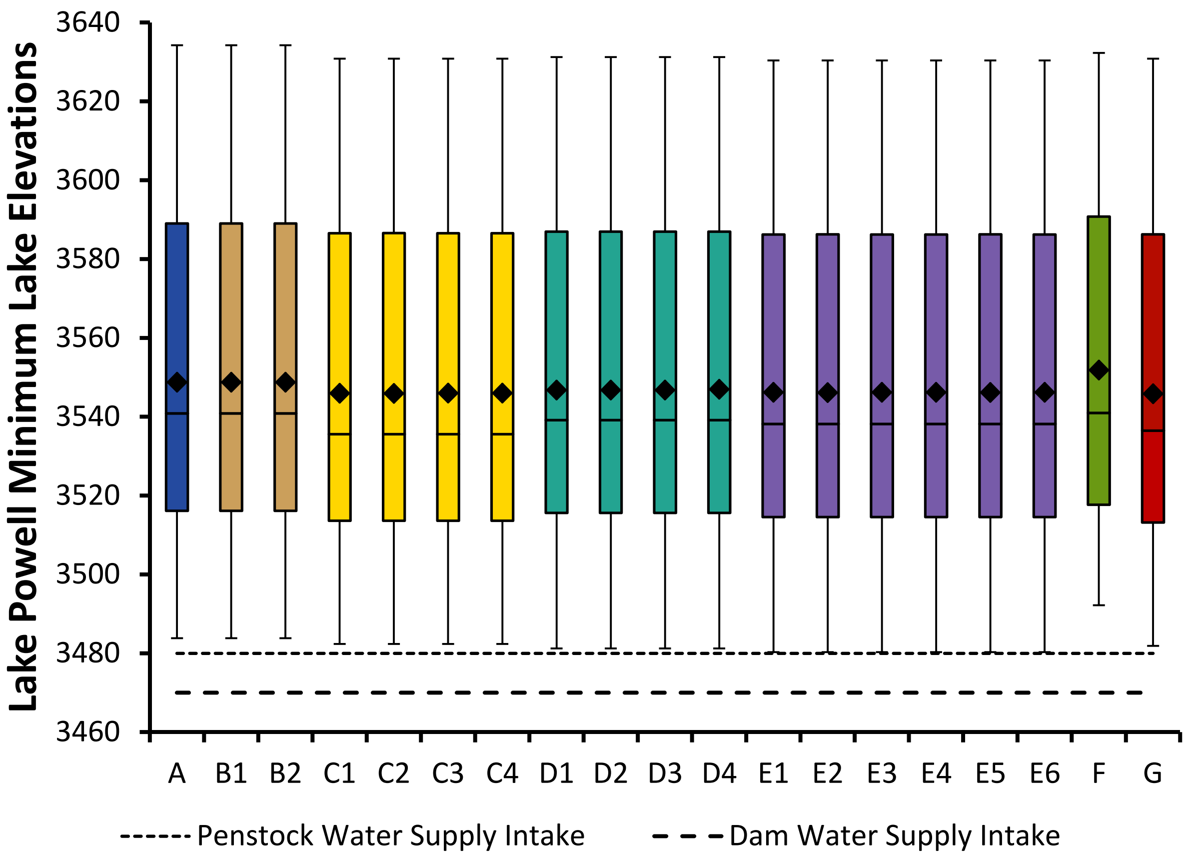

FIGURE I-9 Lake Powell Water Levels for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

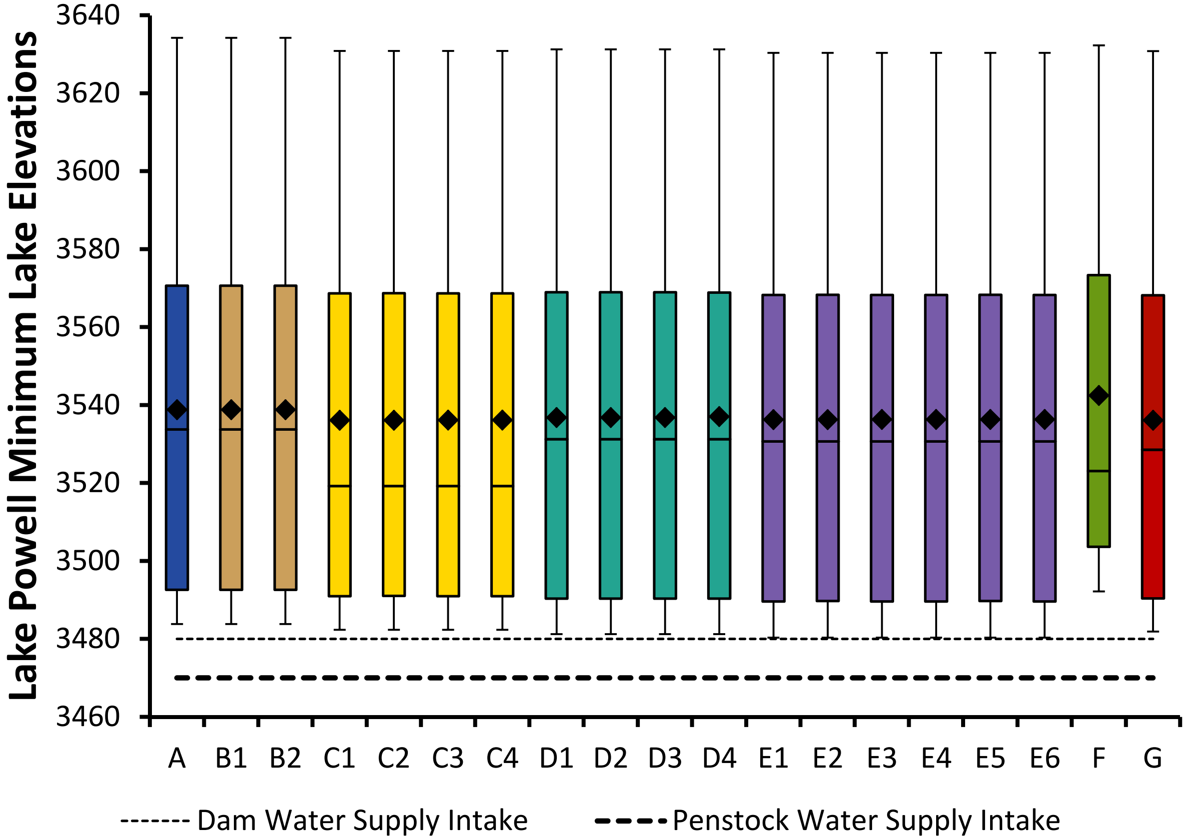

FIGURE I-10 Lake Powell Water Levels under Climate Change Assumptions for the LTEMP Alternatives (Letters) and Associated Long-Term Strategies (Numbers)

I.1.6 Access to Resources

Access to culturally important sites and resources has the potential to be a significant factor in assessing impacts from the alternatives. Resources important to the Tribes include plant resources important for food, medicinal, and ritual purposes; minerals including salt and pigments that are ritually important; and sacred places including springs and offering sites. Potential access interruption is tied to the frequency of HFEs. HFEs could cause temporary loss of access to culturally important resources through inundation of the resources or trails leading to them. These temporary interruptions can be mitigated by communication between Reclamation and the Tribes so that Tribes have notice of impending HFEs. Of the LTEMP alternatives, Alternative F and Alternative G have the most HFEs. Under the latter alternative, there are HFEs that last as long as 2 weeks. Alternative C long-term strategies C1 and C2 have a similar number of HFEs as the steady flow alternatives. Alternative C long-term strategy C4 and Alternative E long-term strategies E1, E2, and E4 have a moderate number of HFEs. Alternative A and Alternative B long-term strategies are projected to have a small number of HFEs (seven or fewer over 20 years). No HFEs are projected for Alternative C long-term strategy C3 or Alternative E long-term strategies E3, E5, and E6.

Potential impacts on archeological sites important to Tribes are discussed in technical Appendix H.

I.2 REFERENCES

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