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5.3 CUMULATIVE IMPACTS ANALYSIS

The regulations implementing the National Environmental Policy Act define a cumulative effect as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions” (40 CFR §1508.7). Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower development.

The Proposed Action is the relicensing, with the implementation of the measures described in the Applications for New License, of the four Big Creek ALP Projects (See Section 3.1.7, New Environmental Measures). Other actions considered in this cumulative effects analysis include the contributing effects from other hydropower projects as well as non-hydropower activities.

Other hydropower projects considered in this analysis include three other SCE Projects located in the Big Creek Basin (Big Creek No. 4 Project (FERC No. 2017), Portal Project (FERC No. 2174) and Vermilion Valley Project (FERC No. 2086)), and the Pacific Gas and Electric Company (PG&E) Kerckhoff 1 & 2 Project (FERC No. 96) located immediately downstream of the BCS. The Big Creek No. 4 Project and the Kerckhoff 1 & 2 Project currently operate under existing FERC licenses issued in 2004 and 1979, respectively. The Portal and Vermilion Valley projects are awaiting the issuance of new license orders from the Commission and are currently operating under annual license renewals. The actions associated with these projects that are considered in this cumulative analysis include the terms and conditions in the existing license order for the Big Creek No. 4 Project, and the proposed terms and conditions recommended by staff in the Commission’s Final Environmental Assessment (FEA) for the Portal Project (FERC 2006), and the staff recommended measures in the Commission’s Environmental Assessment (EA) for the Vermilion Valley Project (FERC 2004). The implementation of the Proposed Action in conjunction with the measures implemented under these other hydroelectric projects will benefit environmental (aquatic, terrestrial and recreation), cultural, economic, and societal values in the vicinity of the Big Creek ALP Projects.

The “non-hydropower activities” considered in this evaluation include the Big Creek ALP Settlement Agreement Appendix B terms that are not to be included in the Commission-issued licenses for the Big Creek ALP Projects, but instead will be contractual commitments among the signatories to the Settlement Agreement. These Settlement Agreement Appendix B terms are not related to adverse impacts associated with the operation and maintenance of the Big Creek ALP Projects (SCE 2007a; Volume 4, SD-H (Book 20)). The development of a historical museum by the Central Historic Society Museum is another non-Project activity considered in this evaluation. The implementation of the Proposed Action in conjunction with the Non-FERC Settlement Agreement Appendix B terms, the Portal and Vermilion licenses, and the development of the Central Historic Society Museum will benefit environmental, cultural, economic, and societal values in the vicinity of the Big Creek ALP Projects.

5.3.1 Target Resources

The target resources considered for inclusion in the cumulative impacts analysis were identified based on a review of the technical information developed in support of this APDEA; comments received during formal scoping meetings; and discussions with resource agencies, Native American Tribes, local and regional authorities, non-government organizations, local communities and businesses, and other members of the public during the Big Creek ALP.

For this analysis, target resources that may be affected cumulatively by the incremental actions of the four Big Creek ALP Projects in combination with other past, present, and reasonably foreseeable future actions primarily include water resources (hydrology, water temperature, and sediment transport), aquatic biological resources (resident fish, anadromous fish, and native amphibians), cultural resources, recreation, hydroelectric generation, and air quality.

5.3.1.1 Geographic Scope

The geographic scope for the cumulative impact analysis defines the physical limits or boundaries of the effects on target resources from the implementation of the Proposed Action when considered with the contributing effects from other hydropower and non-hydropower activities. Eight hydroelectric projects were considered in this analysis including the seven Projects comprising SCE's Big Creek System (BCS) (Table 5.3-1) and the Kerckhoff Project operated by PG&E.

Table 5.3-1. Southern California Edison's Big Creek Hydroelectric Projects in the Upper San Joaquin River Basin.

Project Name	FERC Project Number	License Expiration Date	Dependable Operation Capacity (MW)
Big Creek No. 4	2017	November 30, 2039 ¹	100.2
Vermilion Valley Hydroelectric Project	2086	August 31, 2003 ²	-- ³
Portal Hydroelectric Power Project	2174	March 31, 2005 ²	10.5
Mammoth Pool	2085	November 30, 2007	187.0
Big Creek Nos. 1 and 2	2175	February 28, 2009	150.0
Big Creek Nos. 2A, 8 and Eastwood	67	February 28, 2009	370.0
Big Creek No. 3	120	February 28, 2009	181.9

¹Big Creek No. 4 Project was granted a new FERC License in December 2003.

²Vermilion Valley Hydroelectric Project and Portal Hydroelectric Power Project are currently operating under annual licenses.

³Vermilion Valley Hydroelectric Project does not generate power.

For the four Big Creek ALP Projects under consideration in the APDEA, the geographic scope appropriate for evaluating cumulative effects is the Upper San Joaquin River Basin upstream of Millerton Reservoir. In the cumulative impacts analysis completed for three other Big Creek Projects (Big Creek No. 4 (FERC Project No. 2017)); Portal Hydroelectric Power Project (FERC Project No. 2174); and Vermilion Valley Hydroelectric Project (FERC Project No. 2086)), the Commission limited the geographic scope to the Upper San Joaquin River Basin above Millerton Reservoir. The rationale for not including the San Joaquin River downstream of Friant Dam is that Millerton Reservoir has sufficient storage capacity to control the timing of discharge from Friant Dam regardless of the timing of inflows from the SCE projects in the upper basin area. However, occasionally during periods of high run-off, the combined storage capacity at the BCS projects and the storage capacity at Millerton may be insufficient to store or control all the water run-off. Therefore, any shifts in the timing or volume of flows from Friant Dam, that are controllable, are under the control of the U.S. Bureau of Reclamation, and not as a consequence of the operation of the hydroelectric projects comprising the BCS.

5.3.1.2 Temporal Scope

The temporal scope for the cumulative impact analysis for the four Big Creek ALP Projects defines the length of time that should be considered when evaluating resource effects of the Proposed Action in the context of past and reasonably foreseeable future actions. Evaluations of past and future actions are limited by the amount of available information for each target resource and by information defining future projects and actions. Based on the anticipated term of the new license for the four Projects, the temporal scope for this analysis looks 44 years into the future, concentrating on potential resource effects from reasonably foreseeable future actions.

5.3.2 Cumulative Effects on Water Resources

5.3.2.1 Hydrology

The prior development and operations of the seven Big Creek Projects in the basin resulted in modification of the timing and magnitude of natural flows in the bypass reaches and flow augmented streams, particularly in non-spill years. The four Big Creek ALP Projects contributed to these changes in hydrology in the basin. Detailed information on the hydrologic effects of operations of the Projects are provided in CAWG 6, Hydrology, 2003 Technical Study Report (TSR) (SCE 2004; Volume 4, SD-D (Books 13 and 23)). Under existing Project operations, minimum instream flow (MIF) requirements were established as conditions in the existing FERC licenses to maintain and protect aquatic resources and represent current baseline environmental setting. The SCE construction of six major reservoirs (four ALP reservoirs and two non-ALP BCS reservoirs) to store water for hydroelectric generation has impounded portions of stream and river (converting these free-flowing reaches to reservoir conditions) and has contributed to modification of the hydrology in the basin.

Under the Proposed Action, new or higher instream flow releases are recommended in the majority of bypass and augmented streams to enhance aquatic and riparian habitat, enhance wilderness values in the upper basin, address water quality concerns, and provide greater whitewater recreational opportunities. These proposed instream flow recommendations include implementing higher MIF requirements in the bypass reaches below Project diversions; establishing channel riparian maintenance flows (CRMF) in selected bypass reaches through scheduled flow releases or establishing time periods when diversions may not be operated; and scheduling releases of water prior to expected spills over dams/spillways. Implementation of higher instream flows for the four Big Creek ALP Projects combined with recently established higher instream flows for the Big Creek No. 4 Project and anticipated higher instream flow requirements for the Portal and Vermilion Projects, cumulatively contribute to the incremental improvement of the hydrology of the basin while still providing for hydroelectric generation.

Under the Proposed Action, the timing and magnitude of flows leaving the BCS (downstream of the Big Creek No. 4 Project) are similar to the No Action Alternative. The higher MIF releases recommended in the Proposed Action result in only a small change relative to the volume of water routed through the seven Big Creek Projects for generation. This is because the total flow volume will not change, but will cause relatively more water to be in the Project bypass reaches. However, the increase in instream flows is relatively small compared to the capacity of the flows through the Big Creek No. 4 Powerhouse. Therefore, implementation of measures recommended in the Proposed Action will have little effect on flow conditions downstream of the BCS, although generation throughout the BCS will appreciably decrease.

5.3.2.2 Water Temperature

Water temperatures in the streams and rivers with modified flow regimes as a result of operations of the BCS have changed from pre-project conditions. The presence of dams and associated reservoirs generally has resulted in the storage of cool water during spring run-off in thermally stratified reservoirs over the summer. Reservoir outlets located below the thermocline in the larger reservoirs allow the release of cool water into bypass stream reaches and the release of water into Project intakes for power generation for extended periods. This maintains cool water outflows from the BCS until fall, when thermal stratification breaks down in the reservoirs and the stratified water layers mix. Water released during the summer into bypass reaches experiences warming as it flows downstream due to solar heating and high ambient air temperatures, until more cool water is again added at the next powerhouse tailrace.

The future operation of the four Big Creek ALP Projects, under the Proposed Action, may cause localized shifts in the timing and persistence of cool water releases to downstream locations. The Proposed Action would result in cooler water temperatures in bypass reaches associated with the four Projects in the early summer. In general, daily mean water temperatures in bypass reaches during the warm summer months would be reduced to about 20°C or less, where temperature is controllable. This

temperature is considered consistent with trout growth and a beneficial impact of the Proposed Action. Water temperatures stressful to trout would be virtually eliminated.

The future operation of the Portal and Vermilion Valley Project will require SCE to release greater instream flows into the downstream bypass reaches of Camp 61 Creek and Mono Creek, respectively. The increased volume of water released into these bypass reaches will be less subject to thermal heating than maintaining cool water temperatures within those reaches. Camp 61 Creek and Mono Creek flow into the South Fork San Joaquin River. Under the Proposed Action, higher MIF releases will be provided to the South Fork San Joaquin River from Florence Lake and its tributaries. The decommissioning of various small diversions will supply some additional water to the South Fork San Joaquin River, as well as assure that diversions that are currently out of operation remain that way. The implementation of higher MIF releases into Camp 61 Creek, Mono Creek, Bear Creek, other small diversions, and the South Fork San Joaquin River will cumulatively benefit aquatic habitat in the lower reaches of the South Fork San Joaquin River.

It is unlikely that the slightly higher instream flows under the Proposed Action would result in any adverse effect on water temperatures in Kerckhoff Reservoir or Millerton Reservoir, located downstream of the BCS.

Currently, the Bureau of Reclamation is developing additional information regarding Millerton Reservoir water release temperatures. This investigation may provide future information on any potential effects of upstream operations on Millerton Reservoir. If information developed through this investigation shows that the Big Creek Projects affect anadromous fish or their habitat downstream of Friant Dam, those effects will be evaluated in that process.

5.3.2.3 Sediment Transport

The development and operations of the seven Big Creek Projects in the basin have cumulatively resulted in the alteration of sediment storage and transport in selective bypass and flow-augmented streams reaches. The four Big Creek ALP Projects contribute to these changes in sediment transport, storage, and supply in the basin. Changes to flow and sediment regimes caused by Project operations have affected channel form and aquatic and riparian habitats. The magnitude of these changes varies depending on the specific watershed characteristics and magnitude of alteration of the sediment supply, storage, and transport. Detailed information on the effects of operations of the Projects on sediment transport and supply, and concomitant effects on aquatic and riparian habitats, by stream are provided in Sections 5.2.3, Geomorphology; 5.2.4, Aquatic Resources, and 5.2.6, Riparian Resources.

Under the Proposed Action, adverse effects to sediment transport are addressed by increasing the frequency and magnitude of sediment transport flows in selected reaches, by establishing CRMF through scheduled flow releases and establishing time periods when diversions may not be operated. The proposed recommendations also include development and implementation of sediment management prescriptions that

will describe operations and maintenance measures to reduce sediment inputs and enhance aquatic and riparian habitats. The future operation of the Portal and Vermilion Valley projects will address adverse effects to sediment transport by establishing CRMF through scheduled flow releases that will increase the frequency and magnitude of sediment transport flows in Camp 61 Creek and Mono Creek respectively. The implementation of the Proposed Action, in combination with the CRMF releases for the Portal and Vermilion projects, will cumulatively restore some of the natural flow and promote sediment transport in Project streams, particularly during spring run-off of wetter years.

SCE will also investigate the feasibility of implementing a gravel augmentation program in the San Joaquin River below Mammoth Pool Dam, to enhance the aquatic environment for fishery development. This program is part of the Settlement Agreement Appendix B terms that are not going to be a part of the Commission licenses because SCE is not convinced that the Project is adversely affecting gravel recruitment to such a degree that it adversely impacts the fishery in the Mammoth Pool bypass reach (SCE 2007a; Volume 4, SD-H (Book 20)). If feasible, the program will involve the placement of gravel in the Mammoth Pool Spillway Channel to have naturally occurring spill transport the gravel into and through the downstream reach of the San Joaquin River in order to augment spawning gravel and enhance the fishery. Cumulatively, the sediment management prescription to release flows from the Howell Bunger (HB) valve at Mammoth Pool Dam that is proposed to be a part of the Commission-issued license and the gravel augmentation program identified in the Appendix B terms should improve sediment conditions; and may provide additional gravel for spawning habitat, thereby potentially enhancing trout recruitment and recreational fishing in the reach.

Under the Proposed Action, sediment delivery to stream reaches from Project Roads will be reduced by the implementation of a Transportation System Management Plan (TSMP) that describes road maintenance activities to be conducted by SCE along Project roads (SCE 2007b; Volume 4, SD-G (Books 19 and 24)). A similar TSMP has been prepared for the Big Creek No. 4 Project and similar TSMPs will be prepared for the Portal and Vermilion Valley projects, (proposed as license conditions in FERC's FEA for the Portal Project (FERC 2006) and the EA for the Vermilion Valley Project (FERC 2004)). These TSMPs describe road maintenance activities that include the implementation of best management practices (BMPs) to reduce road-related erosion and delivery of fine sediments from Project roads to stream reaches. In addition, to the Project roads identified in the TSMP, SCE will also maintain a number of select Non-Project USDA-FS roads that are used by the public to access recreation opportunities and by SCE personnel to travel to widespread areas throughout the basin. Maintenance of selected non-Project roads is required by Settlement Agreement Appendix B terms (SCE 2007a; Volume 4, SD-H (Book 20)). This agreement includes measures to conduct road maintenance and complete road improvements that will reduce sediment delivery from selected Non-Project roads. Cumulatively, the implementation of the TSMPs for SCE's seven Big Creek projects and the Transportation Agreement Appendix B terms, will benefit sediment conditions and aquatic habitat in stream reaches by reducing the delivery of fine sediments from Project and selected Non-Project roads. The Transportation System Management Plan

was designed to be consistent with the management practices for Project roads associated with the other Projects comprising the BCS (Vermilion Valley, Portal and Big Creek No. 4). Therefore, the cumulative impact of the new conditions on sediment transport in streams in the vicinity of the BCS will be a net positive effect.

The implementation of the sediment transport and sediment management measures under the Proposed Action and the future operation of the Portal and Vermilion Valley Projects will not result in adverse effects to reservoirs downstream of the BCS (Kerckhoff Reservoir and Millerton Reservoir). Sediments transported through the Big Creek Basin are captured by Redinger Lake (a component of the Big Creek No. 4 Project). No adverse sediment conditions or management issues were identified in the Big Creek No. 4 bypass reach. Periodic spill events from Redinger Lake into the bypass reach continue to provide flushing flows and prevent sediment accumulation in the bypass reach (FERC 2002).

5.3.3 Cumulative Effects on Aquatic Resources

5.3.3.1 Resident Fish

Under the Proposed Action, new or increased MIF are recommended in the majority of bypass and augmented reaches of diverted streams to enhance aquatic habitat. These minimum instream flows also address water quality concerns (i.e., dissolved oxygen and temperature) in several of the bypass streams. In addition, the establishment of CRMF in selective bypass reaches through scheduled flow releases, or establishing time periods when diversions may not be operated will improve sediment transport and should improve the quality of fish habitat including spawning habitat. Implementation of increased instream flows for the four Big Creek ALP Projects combined with recently established higher instream flows for Big Creek No. 4 and the anticipated higher instream flows for the Portal and Vermilion projects will cumulatively contribute to the enhancement of aquatic habitat for resident fish in the basin.

Stocking of trout in the upper basin by the CDFG transformed streams above 5,000 feet (ft) in elevation, which were originally barren of fish, into streams currently supporting populations of rainbow trout, brook trout, golden trout hybrids and brown trout. Historic and on-going stocking in reservoirs associated with the seven Big Creek Projects has resulted in the development of populations of rainbow trout, brown trout, smallmouth bass, and kokanee salmon sufficient to support an active recreational fishery. Under the Proposed Action, SCE has committed to partially fund stocking of trout and kokanee into Project reservoirs and selective bypass streams and rivers.

Under the Proposed Settlement Agreement Appendix B terms, SCE, in consultation with CDFG, will investigate the feasibility of restoring the operation of the Big Creek fish hatchery to educate the public about fisheries resources and management, and augment CDFG fish stocking activities in the Big Creek Basin. The operation of the Big Creek fish hatchery would be in addition to SCE's annual contribution to CDFG to support the fish stocking program in the Big Creek Basin, as described in the Recreation Management Plan. Big Creek Fish Hatchery operations could potentially

contribute approximately 60,000 (four per pound) catchable-sized trout to support recreation in the watershed. This would produce a cumulatively positive effect on fishery recreation in the area, by assisting the CDFG to achieve fish stocking targets in the watershed. It should also provide a positive cumulative effect on fisheries and angling opportunities by supporting CDFG's educational efforts for public understanding and support of fish stocking in the basin.

The implementation of CDFG's fish stocking program in conjunction with SCE's annual contribution to the fish stocking programs and the potential rehabilitation of the Big Creek Fish Hatchery will cumulatively enhance recreational fishing in the basin. However, the enhancement of angling opportunities through stocking of catchable trout may adversely effect special-status amphibian populations in the basin through increased predation.

5.3.3.2 Anadromous Fish

Impassable dams on the San Joaquin River downstream of the BCS, including Friant Dam and Kerckhoff Dam, prevent anadromous fish passage into the Big Creek System bypass reaches. Therefore, anadromous fish are not found in the vicinity of the four Big Creek ALP Projects. Under the Proposed Action, the timing and magnitude of flows leaving the BCS (downstream of the Big Creek No. 4 Project) are similar to the No Action Alternative, as described above in Section 5.3.2.1, Hydrology. Therefore, the future cumulative operation of the BCS under the Proposed Action for the four Big Creek ALP Projects; the pending license orders for the Portal and Vermilion Projects, and the existing license for the Big Creek No. 4 Project will not affect anadromous fish populations downstream of Friant Dam and Millerton Lake.

5.3.3.3 Native amphibians

The future operation and maintenance of the Big Creek ALP Projects under the proposed Action in combination with operations of three other BCS Projects under new licenses and other land and wildlife management practices in the basin will cumulatively result in adverse effects on native special-status amphibians in the future. Native aquatic amphibians known or potentially present in the vicinity of the four Big Creek ALP Projects include foothill yellow-legged frog (FYLF), Yosemite toad (YT), and mountain yellow-legged frog (MYLF). The location of these species in the vicinity of the four Big Creek ALP Projects is provided in Section 5.2.5.2, Affected Environment. Over the last 50 years, amphibian populations have declined markedly in numbers and range in the Sierra Nevada.

Under the Proposed Action, several measures are recommended to enhance aquatic habitat and address water quality issues that will also improve habitat quality for special-status amphibians. These measures include new or increased MIF's such as: implementation of BMPs for the use of herbicides and pesticides near aquatic habitats; establishment of new or increased CRMF to enhance sediment transport and riparian conditions in selected bypass reaches; development and implementation of sediment management prescriptions that describe operation and maintenance procedures to

minimize effects of sediment releases at several Project forebays and reservoirs, and implementation measures to increase the passage of large woody debris over Bear Creek Diversion. The implementation of these measures should have a positive effect on amphibian habitat in the basin.

The historic introduction of non-native amphibian (i.e. bullfrogs), and salmonids (e.g., brown trout and eastern brook trout) is thought to have resulted in extirpation of a number of native amphibians from several locations in the Sierra Nevada. Although native to California, rainbow trout did not occur in the basin above 5,000 ft in elevation and their introduction may have also contributed to the decline of native amphibian populations. On-going stocking of trout in the basin by CDFG is expected to occur and could continue to suppress FYLF and MYLF populations. Under the Proposed Action, SCE has committed to partially fund CDFG stocking of trout into Project reservoirs and selected bypass reaches and under the Settlement Agreement Appendix B terms will investigate the feasibility of renewing operation of the Big Creek Fish Hatchery, as described above in Section 5.3.3.1 Resident Fish. The CDFG is studying the distribution of native amphibians throughout the Sierra and re-evaluating its stocking practices to reduce adverse impacts. SCE will work in cooperation with the CDFG's refined stocking practices, under Settlement Agreement Appendices A and B to minimize future adverse effects on native amphibians from fish stocking.

The USDA-FS is currently evaluating their grazing management policies in the Sierra National Forest (SNF) because historic grazing has resulted in adverse effects on potential habitat for YT and MYLF in meadows in the upper basin, including but not limited to, Jackass Meadow and Hellhole Meadow, in the vicinity of the Big Creek Nos. 2A, 8 and Eastwood Project (FERC Project No. 67). Therefore, the USDA-FS may revise these policies to improve future protection of potential habitat for special-status amphibians. As part of Settlement Agreement Appendix B, SCE will assist the SNF in reconstructing an exclusion fence near the area where Tombstone Creek enters Jackass Meadow. This action, in combination with the proposed decommissioning of the Tombstone Creek Diversion (as well as decommissioning the Crater Creek Diversion, which should improve conditions for native amphibians in Hellhole and/or Poison meadows), should produce a positive cumulative effect on native amphibian populations in this area.

Cumulatively, the measures related to increased flow releases (both MIF and CRMF); control of herbicide and pesticide use, decommissioning of small backcountry diversion, grazing exclusion, and sediment and large woody debris management either required or proposed for the seven Big Creek Projects will improve aquatic and riparian habitat conditions in bypass streams in the basin. The improved habitat conditions will likely result in higher fish and amphibian populations. Although the quality of potential habitat for special-status amphibians will increase in the basin in the future, higher fish populations may suppress any increase in amphibian populations in reaches where both are present. The enhancement of resident fish populations may adversely effect special-status amphibian populations in the basin through increased predation. The effects of the four Big Creek ALP Projects when evaluated cumulatively with other past, present, and future projects in the basin will likely result in small overall improvement in

habitat quality for special-status amphibians, especially in locations such as Ross and Tombstone creeks where fish and bullfrogs are currently not present and grazing will be excluded.

5.3.4 Cumulative Effects on Cultural Resources

Under the Proposed Action, proposed enhancement will reduce the cumulative effects to cultural resources. These enhancements include the finalization of a Historic Properties Management Plan (HPMP) (SCE 2005; Volume 4, SD-I (Book 27)) and the Settlement Agreement Appendix B terms designed to enhance cultural resources. Further protection of cultural resources in the Big Creek vicinity is provided by the Cultural Resources Management Plan (CRMP) that was developed for the Big Creek No. 4 Project and proposed as license conditions in FERC's FEA for the Portal Project (FERC 2006) and the EA for the Vermilion Valley Project (FERC 2004). The HPMPs for the Big Creek Projects will include provisions for the protection of cultural resources. Cumulatively, the implementation of HPMPs associated with the seven Big Creek Projects will benefit cultural resources in the Big Creek Basin.

Under the Proposed Action, improvements to existing recreational facilities (campgrounds, day-use areas, boat ramps) associated with the four Big Creek ALP Projects, the Vermilion Valley Project, and the Portal Project may adversely affect cultural resources. These recreation facility improvements are described in Sections 5.2.8, Cultural Resources and 5.2.9, Recreation Resources. The cumulative effects of recreation facilities and improvements on cultural resources will remain unknown until detailed plans of these improvements have been completed and potential effects have been determined by the licensing and land management agencies in consultation with the State Historic Preservation Officer (SHPO). Implementation of the recreation facility improvements will be implemented in a manner, as prescribed in the HPMP, to reduce existing and future impacts to cultural resources. Provisions in the HPMP and Recreation Management Plan require consultation with appropriate agencies prior to implementing recreation enhancement measures that could result in adverse effects to Historic Properties. However, improvements to recreation facilities associated with Historic Properties may contribute to the continuing or increasing use of these areas by visitors who may degrade cultural resources by removing artifacts and other materials from sites.

Under the Proposed Action, reservoir operations at the four Big Creek ALP Projects and Vermilion Valley Project will cause impacts to Historic Properties and other cultural resources, as described in Section 5.2-6, Cultural Resources. On-going reservoir operation has the effect of continuing the erosion of certain archaeological sites, especially those periodically exposed and subject to wave and wind erosion. Artifacts from sites may be eroded from their original contexts, lose scientific value, or be exposed for incidental collecting by visitors to reservoirs. Inundated sites, trail routes and other cultural resources within the reservoirs are lost to Native Americans who can no longer visit or use such resources in accordance with their cultural values. Mitigation measures for these impacts are discussed in the HPMP and include archaeological data

recovery, site avoidance, advisory signage, and public interpretation. However, the loss of cultural values associated with archaeological sites cannot be entirely mitigated.

Cultural Resources in the vicinity of the four Big Creek Projects will be enhanced through the implementation of cultural resource based Settlement Agreement Appendix B terms. These terms provide: (1) a forum for the development of a Native American Advisory Group; (2) lands for Native American use; (3) a Native American scholarship fund; (4) access for Native Americans to SCE lands; (5) protection of cultural resources; (6) training to Native Americans; (7) enhancements to Cultural and Environmental Awareness training programs for SCE employees; (8) contributions to the Sierra Mono Museum to assist in achieving curation improvements; (9) contributions to the Huntington Lake Big Creek Historical Conservancy to assist in interpretation of Big Creek historical contributions and local history; (10) development and installation of interpretive signage at various locations throughout the basin; and (11) contributions to the Shaver Crossing Railroad group to enhance historical interpretation of the San Joaquin and Eastern Railroad, the BCS, and logging in the area. These agreements are provided in Appendix B Settlement Agreement (SCE 2007a; Volume 4, SD-H (Book 20)).

The Central Sierra Historical Society Museum is planning construction on a 19-acre parcel near the SCE Camp Edison facility at Shaver Lake. The museum will be operated by the Central Sierra Historical Society as a learning center that will preserve the heritage of the Central Sierra; provide educational programs and activities to the public, and preserve and protect historical artifacts. Cumulatively, the construction and operation of the museum, the implementation of the HPMPs for the Big Creek projects, and the Settlement Agreement Appendix B terms will provide a combined benefit to cultural resource preservation and protection in the Big Creek Basin.

5.3.5 Cumulative Effects on Recreation

The Project reservoirs and associated shorelines are used extensively by the public for boating, fishing, overnight camping, and day-use activities. By far, the majority of fishing in the basin occurs in Project reservoirs. A complete list of recreation activities associated with the Project reservoirs is provided in Section 5.2.9, Recreation Resources. The operation of the four Big Creek ALP Projects combined with the other Big Creek Projects has cumulatively enhanced recreational opportunities in the basin.

Under the Proposed Action, new recreational measures are recommended to enhance recreation opportunities and experiences in the vicinity of the four Big Creek ALP Projects. These new recreational measures address recreation facility operations and maintenance; facility rehabilitation, capital improvements (i.e., development of new recreational facilities), interpretative programs, reservoir recreation, fish stocking, whitewater boating, and protection of other resources (i.e., environmental and cultural resources). A detailed description of each of these recreation enhancement measures is provided in Section 5.2.9, Recreation Resources.

In addition to the recreational enhancements described above, the three other projects comprising SCE's BCS will have new recreational enhancements implemented. These enhancements are either required in a new license order for the Big Creek No. 4 Project or proposed as license conditions in FERC's FEA for the Portal Project (FERC 2006) and the EA for the Vermilion Valley Project (FERC 2004). Recreation facilities enhancements associated with the Portal Project include rehabilitation of campsites and campground roads, replacement of toilets, development of walking paths, and installation of informational signs. The Settlement Agreement Appendix B also provides for a one-time donation to the USDA-FS for the development of a water supply system at the Portal Forebay Campground. Recreation facility enhancements at the Vermilion Valley Project include improvements or measures at the Vermilion Campground (campsite and road rehabilitation), Lake Edison Boat Launch (resurfacing and developing accessible access), and the Vista Overlook (accessible access).

Recreation opportunities and facilities will be further enhanced through the implementation of recreation based Settlement Agreement Appendix B terms. These terms provide: (1) funding to the USDA-FS for operation and maintenance activities at developed recreation facilities and at select locations of concentrated dispersed recreational use; (2) funding to the USDA-FS and local NGO's to support interpretative programs in the vicinity of the four Big Creek ALP Projects; (3) support of local NGO's at Huntington Lake to improve existing boat docks; (4) one time contributions to the local emergency service organizations; (5) funding to support segments of the San Joaquin River Trail in the vicinity of the Big Creek ALP Projects; and (6) funding to assist the USDA-FS in development and implementation of a water system at the Portal Campground. These terms are provided in Appendix B, of the Settlement Agreement (SCE 2007a; Volume 4, SD-H (Book 20)). Cumulatively, the new recreational measures under the Proposed Action, the Portal and Vermilion recreation conditions, and the Settlement Agreement Appendix B terms, when implemented, will benefit recreation in the vicinity of the ALP Projects by maintaining recreational facilities, providing additional or improved recreation facilities, increasing recreational opportunities, and thereby improving recreational experiences in the basin and the region. In addition to the recreation enhancements described above, SCE will also implement the TSMP under the Proposed Action. The TSMP describes the road maintenance activities that will be conducted to maintain access to Project facilities. In addition to the Project roads identified in the TSMP, SCE will maintain a number of select Non-Project USDA-FS roads that are used by the public to access recreation facilities. Maintenance of these select Non-Project roads is required by Settlement Agreement Appendix B terms related to transportation. These terms describe the road maintenance activities that SCE will implement to maintain the accessibility over select Non-Project roads. Cumulatively, the implementation of the TSMP and the Transportation terms in Settlement Agreement Appendix B, when implemented, will benefit recreation opportunities by maintaining access to recreation facilities in the vicinity of the four Big Creek ALP Projects (SCE 2007a; Volume 4, SD-H (Book 20)).

5.3.6 Cumulative Effects on Hydroelectric Generation and Air Quality

SCE currently uses the electricity from the seven Big Creek Projects to partially meet the demand of 4.6 million businesses and residential customers residing in its 50,000 square mile service area. SCE system generation serves all customers through an extensive transmission system and with a diverse generation mix based on many different resources such as gas, coal, nuclear, and hydroelectric. Currently, SCE is unable to meet customer electrical demand from its existing generation resources and must rely on purchases from other power producers to meet demand.

SCE uses the electricity from the Big Creek Projects to displace the use of gas-fired energy and to reduce air pollutant emissions. Any reduction in generation resulting from the implementation of new Proposed Action measures (i.e., higher MIF and CRMF) required in new license conditions for the four Big Creek ALP Projects would have to be replaced (purchased from the market) to meet load requirements. The most likely sources of the replacement power would come from fossil-fueled power generation. The higher cost of purchasing the replacement power to meet demand in the service area would be passed onto the ratepayers.

Under the Proposed Action, higher instream flow releases are recommended in bypass streams associated with the four Big Creek ALP Projects. These higher instream flow releases not only reduce power generation in the four individual Projects, but also have cumulative effects throughout the BCS from the interrelationship, conveyance system capacities, and synchronized operations of the seven hydroelectric Projects. SCE developed a water routing model (HydroBasin) as part of the Big Creek ALP to determine the approximate value of overall generation losses in the BCS resulting from proposed flow modifications.

Under the Proposed Action, the recommended MIF increases and CRMFs for the four Big Creek ALP Projects result in an annual loss of generation of approximately 5.89% (187GWh) compared to the No Action Alternative. An additional annual loss of generation of 1,947 MWh is incurred at the Portal Project and Big Creek No. 4 Projects combined.

This cumulative generation loss under the Proposed Action for the four Big Creek ALP Projects, Portal Project, and Big Creek No. 4, would require that other generation sources be utilized to meet current demand (e.g., fossil fuel). Use of this alternative method for generation would result in an increase in annual total carbon dioxide emissions estimated at 88,756 tons/yr based upon the use of natural gas as a substitute fuel. The effects of the four Big Creek Projects when evaluated cumulatively with other past, present, and future projects in the basin will result in an overall decrease in hydroelectric generation, higher electric rates, and an increase in air emissions associated with increased fossil-fuel replacement generation.