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5.1 GENERAL DESCRIPTION OF THE BIG CREEK BASIN

5.1.1 Basin Geography

The Basin is located in central California on the western slope of the Sierra Nevada mountain range within the Sierra National Forest (SNF), about 25 miles northeast of the City of Fresno. Yosemite National Park, a popular tourist destination in central California, is located approximately 20 miles north of the Basin, and Kings Canyon National Park is located approximately 20 miles south of the Basin. The Basin has an elongated oval shape and is approximately 40 miles long by 20 miles wide. The Basin boundaries are formed by the slopes of the Sierra Nevada to the east. To the west, the Basin is bounded by the eastern foothills of the San Joaquin Valley.

The headwaters of the San Joaquin River, the primary river in the Basin, originate in Kings Canyon National Park, approximately 20 miles south of the Basin. The Basin encompasses the South Fork San Joaquin River downstream of Florence Lake, and extends northward around Kaiser Ridge to the confluence with the middle and north forks of the San Joaquin River, located upstream of Mammoth Pool Reservoir. Below Mammoth Pool Reservoir, Big Creek and Stevenson Creek join the main stem of the San Joaquin River and the Basin extends generally southwestward to a location immediately downstream of the Big Creek No. 4 Powerhouse. Pacific Gas & Electric's (PG&E's) Kerckhoff Project (FERC Project No. 96) and the U.S. Bureau of Reclamation's (Bureau) Friant Dam (Millerton Reservoir) are located southwest and downstream of the Basin. PG&E's Crane Valley Project (FERC Project No. 1354) is located northwest of the Basin. There are a total of 90.4 river miles associated with the four Big Creek ALP Projects in the Basin. The total drainage area of the Basin is about 1,478 square miles.

The Basin is located near the exact geographical center of California within an approximate six hour drive from either San Francisco or Los Angeles, and a three hour drive from Sacramento. The closest major urban areas to the Basin include the City of Fresno, (population approximately 471,000) located about 25 miles southwest, and the City of Madera (population approximately 52,600) located about 37 miles west of the Basin. Small communities located within or near the Basin include: Shaver Lake, Auberry, Prather, North Fork, South Fork, Big Creek, and Huntington Lake.

The nearest sizable population center to the Big Creek ALP Projects is the City of Fresno, located approximately 40 miles southwest of the Project area. In 2004, the City of Fresno had an estimated population of 457,160 and Fresno County's population was estimated at 865,620. The community of Big Creek, the private ownership portion of the small community next to Big Creek No.1 Powerhouse, company housing and support facilities, is the closest community to the Projects. It is primarily made up of Big Creek employees and their families, and retirees and their families. Lakeshore, at Huntington Lake, is the next nearest community to the Projects. It has a small year round population that increases significantly during the summer recreation months. Permanent human habitation in the wilderness areas surrounding the Projects is prohibited.

Two of the four Big Creek ALP Projects are located in northeastern Fresno County: Big Creek Nos. 1 and 2 (FERC Project No. 2175) and Big Creek Nos. 2A, 8 and Eastwood (FERC Project No. 67). The other two projects, Mammoth Pool (FERC Project No. 2085) and Big Creek No. 3 (FERC Project No. 120), straddle the Fresno and Madera county lines. The San Joaquin River is the boundary between Fresno and Madera counties in the vicinity of the Projects.

5.1.2 Major Land Uses

Land holdings in the Basin consist predominantly of federal land in the SNF with some private in-holding parcels. Existing land uses within the Basin can be characterized as rural, and consist of small communities and private residences or vacation homes, hydroelectric power generation, range land, timber production, mining, research areas, floodplains, wilderness areas, wildlife conservation, and recreation.

5.1.3 Topography

Elevations of the Basin in the vicinity of the four Big Creek ALP Projects range from about 1,400 feet above mean sea level (msl) at Big Creek Powerhouse No. 4 to about 9,000 feet msl at Crater Creek Diversion. The large elevation change in the Basin over its relatively short length of approximately 40 miles served as the initial attraction for hydroelectric development in the area.

The western half of the Basin generally consists of gentle to steep hills and valleys deeply incised by the San Joaquin River and its tributaries (e.g., Big Creek, Stevenson Creek, and Willow Creek). The precipitous, narrow gorge in which the river presently flows in the area north of Shaver Lake actually lies within a wide valley formed during a long tectonically inactive period during the Miocene epoch (7-26 million years ago). Remnants of the Miocene valley are present 1,600 to 2,000 feet above the river. Renewed uplift and westward tilting of the Sierra Nevada following the Miocene stability instigated severe downcutting of the river (Lockwood and Bateman 1976).

Variability in terms of resistance to erosion is one of the primary controls of topographical features in the Basin. A series of irregular “steps” have formed, ranging in thickness from a few hundred to a few thousand feet, where resistant rocks outcrop. For example, the 4,082-foot Castle Peak is composed of resistant rocks that have remained mostly intact, while the more weatherable granitics surrounding it have eroded away (Lockwood and Bateman 1976). As another example, the high resistance of old sedimentary and volcanic rocks of Graveyard Peak was a major factor in the formation of Kaiser Ridge and Silver Divide (north of Huntington Lake and Lake Thomas A. Edison, respectively). In the eastern half of the Basin above 6,000 feet msl, glaciation has been responsible for the formation of many topographically important features. Glaciers occupied the upper parts of Big Creek and Bear Creek and carved U-shaped valleys in their upper reaches (Bateman and Wones 1972). These contrast strongly with the more deeply incised reaches of the San Joaquin River at lower elevations.

The four Big Creek ALP Projects are situated along the western side of the Sierra Nevada Mountains, which are part of the Sierra Nevada geomorphic province of California. The Sierra Nevada Mountains are formed by a westerly-tilted fault block, which is approximately 400 miles long and 40 to 80 miles wide extending from the Mojave Desert in the south to the Cascade Range in the north (Feth et al. 1964). The range trends northwest and is asymmetric in shape with the eastern side characterized by a high, steep escarpment and the western side consisting of a relatively gentle slope. Accordingly, drainages on the eastern flank tend to be steeper and narrower than those on the western flank (USDA-FS 1995).

The southern Sierra Nevada exhibits a distinctive "stepped" topography along the west facing slopes and along the canyon walls of the major drainages. The steps are believed to have formed in response to the weathering characteristics of granitic rock in combination with uplift and fluvial erosion (Wahrhaftig 1965). Elevations along the western slope of the Sierra Nevada vary from a few hundred feet above msl in the foothill areas of the San Joaquin Valleys to 14,496 feet msl at Mount Whitney, approximately 40 miles southeast of the basin.

5.1.4 Geology

Formation of the modern Sierra Nevada began approximately 50 million years ago with the uplift of the Sierra Nevada batholith. Tectonic activity along the Basin and Range fault system situated to the east of the Sierra Nevada Range, resulted in the asymmetric, westward tilting form of the Sierra Nevada. This fault system is still active and uplift of the Sierra Nevada continues today (Huber 1981); however, no known active or potentially active fault zones are located in the vicinity of the four Big Creek ALP Projects.

The geology and topography of the modern Sierra Nevada is the result of extensive weathering and erosion occurring during uplift of the batholith and overlying rock. In particular, three successive periods of glaciation have eroded large quantities of material from higher elevations and deposited this material down valley in moraines situated along the sides and termini of the glaciers. The glaciers were responsible for creating various landforms including U-shaped valleys, hanging valleys, and cirques.

The geology in the vicinity of the four Big Creek ALP Projects consists predominately of Mesozoic granitic rock (granite and granodiorite) with localized areas of Mesozoic volcanic and metavolcanic rock and quaternary glacial deposits (2002 Technical Study Report (TSR) CAWG 2, Geomorphology, (SCE 2003; Volume 4, SD-C (Books 7 and 21); CDMG 2000). Granitic rock comprises approximately 76% of the San Joaquin River Basin above Kerckhoff Reservoir, with glacial deposits and volcanic/metavolcanic rock making up approximately 9.5% and 8%, respectively.

Mesozoic volcanic and metavolcanic rock is found primarily in the San Joaquin River watershed upstream of the confluence with the South Fork San Joaquin River, the South Fork San Joaquin River upstream of Florence Lake, and in the Hooper Creek and Bear Creek watersheds. Glacial deposits are found primarily in the eastern portion (east of Huntington Lake) of the San Joaquin River Watershed at elevations above 6,000 feet msl, although glaciers extended down to approximately 3,000 feet msl on the main stem of the San Joaquin River (Wahrhaftig 1965). The Mesozoic volcanic and metavolcanic rock units and the glacial deposits are the predominant gravel-bearing sources in the San Joaquin River Watershed.

5.1.4.1 Faulting and Seismicity

The portion of the Basin in which the four Big Creek ALP Projects are located is generally an area of low seismicity. No known active or potentially active fault zones are located within the vicinity of the Projects (USDA-FS 1991). However, several regionally active fault zones exist. In 1872, the Owens Valley fault, located about 80 miles to the southeast of the Basin, broke and generated an estimated magnitude 8.2 (Richter scale) earthquake (Ellsworth 1990). Other important fault zones in the general region include the Hilton Creek, Round Valley, Sierra Nevada, Foothills, and San Andreas systems.

The Hilton Creek and Round Valley systems are located approximately 30 miles northeast of the Basin. The Hilton Creek fault marks the eastern front of the Sierra Nevada just south of Crowley Lake. The Round Valley fault also marks the eastern front of the Sierra Nevada to the southeast of the Hilton Creek fault. Both of these zones have been recently active, producing a series of magnitude 6-plus (Richter scale) earthquakes near the Mammoth Lakes area in the early 1980’s (Ellsworth 1990), and smaller-magnitude tremors even more recently.

The Sierra Nevada fault zone marks the southernmost extent of the mountain range and is approximately 180 miles south of the Basin. The Foothills fault system trends in a northwestward direction and is located about 40 miles northwest of the San Joaquin River Basin in the western foothills of the Sierra Nevada mountain range.

5.1.5 Soils

Soils in the portion of the Basin where the four Big Creek ALP Projects are located consist primarily of residual granitic soils, non-granitic bedrock soils, glacial soils (till and outwash), alluvial soils, colluvial soils, and volcanic soils (USDA-FS 1983; USDA-FS 1995). Residual granitic soils are the oldest and most common soils in the area, and are comprised of coarse-grained sands with little clay. The non-granitic residual bedrock soils are similar to granitic soils, but are formed from the weathering of basalt and andesite bedrock. Glacial soils consist of either till-derived soils that are poorly sorted with a wide range of particle sizes, or glacial outwash soils that are well sorted, but also include a wide range of particle sizes. Alluvial soils consist of accumulations of water-transported deposits that occur in active drainageways and floodplains, localized depressions such as former lakes, and at higher elevations or beneath slopes where there may be collections of glacial debris or colluvium. Colluvial soils are those formed in parent material deposited as a result of gravitational movement. Volcanic soils occur in areas with significant accumulations of volcanic ash and cinders.

5.1.6 Climate

The Basin's Mediterranean climate (comprised of cool, moist winters and warm, dry summers) is variable due to the range in topography. Temperature decreases and precipitation significantly increases with increasing elevation. Extreme precipitation events can deposit more than double the average amount of rainfall and, when coupled with spring snowmelt, can initiate slides in the Basin (ESA 1985). Winds in the upper San Joaquin River Basin are less predictable than surface winds in the San Joaquin Valley and can attain high velocities (FERC 1982).

5.1.7 Temperature

The mean temperature in the Basin is approximately 80ºF in the summer and 20ºF in the winter (USDA-FS 1991). At lower elevations, summer weather is hot and dry with daytime temperatures ranging from 90ºF to greater than 100ºF. Winter daytime temperatures range from 20ºF to 50ºF. At higher elevations in the Basin, temperatures are cooler. Generally, with every 1,000 feet of elevation gain, average air temperatures will decrease about 3ºF.

5.1.8 Precipitation

Precipitation in the Basin varies from year to year. The average annual precipitation in the area (rain and snow) is about 42 inches, with over half falling in January, February, and March. Higher elevations may receive over 80 inches of precipitation (mostly snow), while lower elevations receive about 20 inches of rainfall each year (USDA-FS 1991). Summers are usually dry, with the exception of isolated thunderstorms at higher elevations that are typically of high intensity, short duration, and limited coverage (FERC 1982). Overall, summer storms only account for about 3% of the total annual precipitation (USDA-FS 1991). In the winter months, precipitation comes as both rain and snow. The snowline is typically at an elevation of about 3,500 to 4,000 feet msl. Precipitation records of rainfall and snowfall accumulation are available for review on the California Data Exchange Center (http://cdec.water.ca.gov/snow_rain.html) (2000 Initial Information Package, SCE 2000; Volume 4, SD-A (Books 6 and 21)).

Elevation is not the only factor affecting the amount of precipitation falling in different areas of the Basin. Kaiser Ridge creates a rain shadow. The aspect of the ridge influences storm systems approaching from the west so that most of the precipitation is released over the western slopes. In the case of Kaiser Ridge, about twice as much precipitation falls on the range's western slopes as on the eastern slopes (ESA 1985).

Streamflow conditions in the Basin respond rapidly to rainfall, snowmelt, and rain on snow events. Run-off during rainfall and rain on snow events is often quick and of short duration. This creates a run-off pattern that quickly reaches peak flow and rapidly returns to a controlled flow condition. During the snowmelt season, the peak flow may last one to two months but returns to controlled flow after that point.

5.1.9 Vegetation/Wetlands

The botanical and wildlife resources in the Basin are diverse, and consist of a wide variety of habitats that support many wildlife species. Habitats range from foothill woodlands and lower montane chaparrals at lower elevations through ponderosa pine and other lower montane forests at mid-elevations to upper montane fir and pine forests or subalpine forests at the highest elevations. Wildlife resources in this area include resident migratory populations of general wildlife species, as well as those considered locally important such as game, raptors, and special-status species of invertebrates, reptiles, amphibians, birds and mammals. Wetland and riparian habitats, not well developed in many areas, are found in moist areas and along the waterways of the Basin. However, the Project area's steep terrain limits the amount of potential wetlands. Within the Project vicinity, some potential wetland habitat types have been identified, including wet meadows and riparian floodplain communities. Floodplain development along Basin streams is limited, due to the boulder/bedrock substrate and steep narrow topography of the canyon through which the river and streams flow. The majority of these stream segments are steep bedrock and boulder channels, such that minimal floodplain areas are present,

5.1.10 Winds

Solar radiation drives the development of thermal gradients and pressure gradients that create wind and weather patterns. Intramountain winds vary, based upon the degree of solar radiation directed toward the mountain sides, as well as elevation, terrain composition, and plant cover. In general, air above the mountain sides in the upper San Joaquin River Basin heats up more quickly than air above the Valley floor, creating updrafts of air to higher elevations. This process reverses in the evening, when mountain sides cool more quickly than the Valley, creating downdrafts of air that flow along the mountain slopes. At this time, relatively warm air wells up from the Valley to replace the down drafted, cooler air. As a result, air currents develop and high velocity winds can occur. At high elevations, winds can exceed 100 miles per hour when accompanied by winter storms (FERC 1982). In the summer, the Basin occasionally experiences summer winds known locally as Monos. The Monos are strong, dry winds originating in the east that greatly increase the summer fire hazard (USDA-FS 1991).

5.1.11 Air Basin, Circulation, and Air Quality

The Basin is located in the San Joaquin Valley Air Basin (SJVAB), which is a 27,000 square mile basin comprised of eight counties. The SJVAB is bounded by the Sierra Nevada Mountain Range on the east, the Tehachapi Range on the south, and the Coast Range on the west, forming bowl-shaped valley topography. The influences of topography, climate, and wind flow patterns in the SJVAB, which includes Fresno and Madera counties, play a significant role in the dispersion and dilution of air pollutants from the Valley up to the SNF and surrounding national forests. The mountain ranges interfere with air circulation to the east from the Pacific Ocean coastal weather patterns and they restrict movement of air pollutants by blocking air flow out of the Valley (Fresno County 2000). Complex daytime up-valley and up-slope winds and nighttime down-valley and down-slope winds occur in these mountain ranges due to the rugged terrain and intense daytime solar radiation during the summer (Ewell et al. 1989).

The Basin is located downwind from pollutant sources within the San Francisco Bay area and the San Joaquin Valley. Vehicle emissions account for a large portion of the total emissions of key air pollutants transported into the Sierra Nevada national forests. These pollutants include ground-level atmospheric ozone (O3), oxides of nitrogen (NOx), sulfur dioxide (SO2), carbon monoxide (CO), and particulates. Fresno County is a non-attainment area (does not meet federal air quality standards) for oxidants and specific particulates and Madera County is a non-attainment area for ozone and specific particulates (Fresno County 2000; Madera County 1995).

Important local sources of air pollutants in the Basin, that directly affect air quality, include: road construction, road traffic, winter sports activities and smoke from prescribed fires, wildfires, campfires, and fireplaces (USDA-FS 1991). The practice of prescribed burning, to reduce woody materials and other vegetation, emits particulates and aerosols into the local atmosphere, causing short periods of reduced air quality. Wildfires and prescribed fires, in particular, have a significant periodic effect on Forest air quality that is noticeable to the Forest visitor.

The California Air Resources Board specifies conditions for accomplishing prescribed burns to limit or exclude smoke from sensitive areas of the Forest and Basin. Along with the adjoining Sequoia and Inyo National Forests, the SNF also monitors vegetative resources for smog damage and can quantify air quality trends. USDA-FS air quality designations exist to protect the Forest from anthropogenic present and future impairments of air quality (USDA-FS 1991).

Additionally, lakes and streams in the Sierra Nevada national forests are prone to acidification by fugitive dust and acidic precipitation containing nitrate, sulfur dioxide, and carbon monoxide. Acid deposition may impair lake and stream water quality and destroy wildlife habitat and forest stands (Fresno County 2000). Monitoring of pH is conducted for various streams and lakes within the Forest (USDA-FS 1991).