E – ENVIRONMENTAL RESOURCES

1.0 GEOLOGIC RESOURCES

1.1 Applicable Laws, Ordinances, Regulations, Statutes and Plans

Geological resources in California are protected by a variety of federal, state, and local laws, regulations, and statutes. In addition, comprehensive plans and programs have been developed that include detailed policies and guidelines for management of geological resources present in the vicinity of the Project. These laws, regulations, statutes, and plans and their application to geological resources in the Project area are summarized below.

1.1.1 Eldorado National Forest Land and Resource Management Plan, as Amended

The Forest and Rangeland Renewable Resources Planning Act, as amended by the Sierra Nevada Forest Plan Amendment (SNFPA), requires each Forest Supervisor to develop a Land and Resource Management Plan (LRMP) that directs management activities on the national forest and to revise these plans when conditions change significantly, or at least every 15 years. The existing Eldorado National Forest (ENF) LRMP has been in effect since the Environmental Impact Statement (EIS) for it and the corresponding Record of Decision (ROD) were approved on January 6, 1989.

On February 12, 2001, all LRMPs in Sierra Nevada national forests were amended by the SNFPA. The SNFPA EIS and ROD were developed to address five perceived problem areas: 1) old forest ecosystems and associated species; 2) aquatic, riparian, and meadow ecosystems and associated species; 3) fire and fuels management; 4) noxious weeds; and 5) lower westside hardwood forest ecosystems. The amendment identifies various management directives, goals, objectives, desired conditions, and research monitoring activities to be implemented, with the acknowledgement that full attainment of each will be influenced by Congressional budget allocations, changed circumstances, or new information. Components of existing forest LRMPs that are not affected, modified, or in conflict with the amendment's Record of Decision remain in effect (USDA 2001a). This ROD has been appealed by a number of parties, including SMUD, and is under review.

The SNFPA originated with efforts aimed at protecting the California spotted owl and was supported by information provided by several projects and reports, including: 1) Sierra Nevada Ecosystem Project (SNEP 1996), 2) Sierra Nevada Science Review (USDA 1998a), 3) Summary of Existing Management Direction (USDA 1998b), and 4) the ongoing Sierra Nevada Framework for Conservation and Collaboration (USDA 2001b).

The ENF LRMP addresses geological resources by providing general direction to: 1) secure a knowledge of properties, distribution capabilities, suitabilities, and limitations of geological resources (the Forest Geology Resources Inventory or GRI) and 2) integrate GRI information into land and resource activities in order to optimize sustained yields of goods and services without impairment of land productivity, and protect public safety.

1.1.2 Clean Water Act Section 404 Dredge and Fill Permit

Section 404 of the Clean Water Act (CWA) requires that any party wishing to dredge or place fill material in navigable waters of the United States must first consult with the US Army Corps of Engineers (USACE) to determine whether a permit is necessary and obtain the required permit. When issuing this permit, the USACE must consult with the State Water Resources Control Board (SWRCB) regarding compliance with Section 401 of the Clean Water Act and with the US Fish and Wildlife Service (USFWS) regarding compliance with Section 7 of the Federal Endangered Species Act (ESA). Section 404 guidelines direct that no permit to discharge, dredge, or fill material shall be granted if it jeopardizes water quality, a listed threatened or endangered species, or adversely affects a listed species critical habitat.

1.1.3 California Fish and Game Code Section 1601 Streambed Alteration Agreements

Sections 1600 to 1607 of the California Fish and Game Code require state or local agencies and public utilities to submit plans to the California Department of Fish and Game (CDFG) for review and approval for any activity that will: 1) divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake in which there is at any time an existing fish for wildlife form or resource, or from which these resources derive benefit; 2) use material from streambeds designated by CDFG; or 3) result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake designated by CDFG. If an existing fish or wildlife resource may be substantially adversely affected by the activity, CDFG must notify the agency or public utility of the existence of the resource, provide a description thereof, and propose reasonable modifications to the proposed project that will allow for the protection and continuance of the fish and wildlife resource, and include procedures to monitor the effectiveness of these protective measures.

1.1.4 Federal Power Act

The Federal Power Act (FPA) contains a number of sections that are particularly relevant to relicensing of the Project. First, Section 10(a)(1) sets the standard under which FERC may issue a license. This section states that FERC must assure that the project to be licensed is best adapted to a comprehensive plan for developing the waterway for beneficial public uses. Section 4(e) also requires FERC to give equal consideration to both developmental and environmental values when considering issuing a license.

The FPA also provides other federal agencies with mandatory conditioning authority. First, Section 4(e) states that in cases where a project is located on a Federal reservation, the federal agency responsible for managing the land can file terms and conditions to protect the reservation. Section 18 gives the Secretaries of Commerce and Interior the authority to proscribe such fishways as deemed necessary. Section 1701(b) of the Energy Policy Act of 1992 provides guidance on the elements that are appropriate for inclusion in a fishway definition. Section 18 is discussed in more detail in the Report of Fish, Wildlife and Botanical Resources. Under current case law, FERC must include the mandatory conditions submitted by the agencies under Sections 4(e) and 18 in the license.

Section 10(j) of the FPA states that FERC must include conditions to adequately protect, mitigate damage to, and enhance fish and wildlife (and their habitats), based on recommendations by State and Federal fish and wildlife agencies. The recommendations of these agencies are not mandatory.

1.2 Overview

1.2.1 Physiography

The South Fork American River (SFAR) drains an 804-square-mile watershed in the north, central portion of the Sierra Nevada Range and joins the North Fork American River (NFAR) at Folsom Reservoir, which is located approximately 15 miles south of the town of Auburn. The Middle Fork American River (MFAR) joins the NFAR just upstream of Auburn. The main stem of the American River originates at the confluence of NFAR and SFAR and flows southwest joining the Sacramento River in the City of Sacramento.

The headwaters of the SFAR and MFAR originate west of Lake Tahoe, with characteristics typical of the high western Sierra Nevada range: a thin soil mantle, rocky barrens, subalpine meadows, and sparse vegetation. The SFAR drops approximately 7,000 feet over a distance of 70 miles before joining the NFAR. Major tributaries to the SFAR include Silver Fork, Alder Creek, Silver Creek, Slab Creek, Rock Creek, and Weber Creek. The headwaters of the Rubicon River and the South Fork Rubicon River are located in the MFAR watershed, situated to the north of the SFAR basin. Many glacial basins and natural lakes occur in this area of the Project.
The Sierra Nevada range is a northwesterly trending tilted fault block. The average tilt is approximately 2 degrees, or 3.5 percent. The highland is characterized by large planar surfaces developed from beneath the landscape's surficial volcanic cover (Bateman and Wahrhaftig 1966) and steep eastwest-trending canyons, incised into granitic, volcanic,, and metasedimentary bedrock. The canyons were formed by rapid fluvial incision due to westward tectonic tilting and uplift of the Sierra Nevada pluton (Bateman and Wahrhaftig 1966). The drainage patterns are mostly dendritic, characterized by branching similar to that of the limbs or roots of trees, which have evolved on planar surfaces of the late Cenozoic volcanic flow rocks. Glaciation has greatly altered the crest line of the Sierra Nevada range. Former valley glaciers moved many miles down the west slope, carving out wide and steep-walled troughs and establishing modern river courses (Christensen 1966). Narrow, steep-sided canyons cutting across relatively gently rolling granitic terrain characterize the upper reaches of many high-order streams. Even though rocks in this unit were repeatedly glaciated, only narrow strips of outwash are present in the stream courses, chiefly due to the steepness and narrowness of the canyons (Bateman and Wahrhaftig 1966).

1.2.2 Geology

Upstream of the Union Valley Reservoir, the watershed is underlain primarily by the Sierra Nevada batholith, which is of Mesozoic age (approximately 80 to 130 million years old) and consists mainly of plutonic igneous rocks of granitic composition. The bedrock is resistant to weathering except in areas where it has been cut by shear zones and fractures and in areas near contact with volcanic rocks (Durrell 1966). In isolated areas within the Project area, the granitic rocks are capped by Jurassic sedimentary rocks of the Sailor Canyon Formation which were recrystallized (metamorphosed) by prolonged heating during the emplacement of the Sierra Nevada batholith in the Mesozoic period. During the Eocene period (approximately 55 to 40 million years before present), Sierran rivers cut canyons into the bedrock during a period of rapid erosion and later infilled these canyons with hundreds of feet of gold-bearing (auriferous) alluvium. During the Miocene and Pliocene periods (approximately 5 million years before present), volcanic flows that formed the Mehrten Formation buried the landscape (Bateman and Wahrhaftig 1966). As tectonic tilting and uplift resumed in the Pliocene and early Quaternary periods (approximately 5 million to 10,000 years before present), streams cut 1,500 to 2,000-foot-deep canyons into the volcanic fines of the Mehrten Formation, leaving the auriferous gravel of tertiary rivers high above the present canyon floors (Jenkins 1932; Christensen 1966). Glaciations during the Pleistocene period (2 million to 10,000 years before present) further modified the landscape above elevations of 6,000 ft by eroding the volcanic blanket, re-exposing the underlying granitic rocks, blanketing portions of the landscape with glacial till deposits and deepening and widening the modern canyons (Saucedo and Wagner 1992). Except for the mainstem SFAR, which cuts a gorge across the granitic rocks, streams draining the Project area generally have not developed deep canyons in the granitic rocks.

Downstream of the Union Valley Reservoir, the terrain is chiefly underlain by Paleozoic siliclastic sedimentary rocks which were deposited 350 to 400 million years ago in a continental margin setting and later recrystallized (metamorphosed) by prolonged heating during the emplacement of the Sierra Nevada batholith (Christensen 1966). The dominant rocks are quartzite, pelitic schist, crystalline limestone and dolomite. The Paleozoic metasedimentary rocks underlie most of the lower watershed area and are capped by Miocene-Pliocene volcanic rocks of the Mehrten Formation. Except for the mainstem SFAR, which cuts a gorge across both the granitic and metasedimentary rock formations, all high order streams in the Project area have developed deep canyons only in the Paleozoic metasedimentary rock reaches.

The Project area is characterized by the following land types and associated erosional processes:

- Streamside canyon walls subject to episodic high-rate mass wasting processes
- Glacial moraine lands where chronic low-rate surface erosion is the dominant sediment delivery process
- Granitic outcrop lands where rates of chronic surface erosion are very low due to low degree of bedrock weathering
- Gentlysloping interfluvial lands also dominated by chronic low-rate surface erosion processes

The majority of high order streams in the Project area are confined by canyon walls which, due to different mechanical properties of the various bedrock types occurring in the Project area, are variably susceptible to mass wasting. Canyons developed in the granitic terrain are typically small, while canyons developed in the Paleozoic metasedimentary terrain are up to 1,500 feet deep. Episodic deep-seated landslides, shallow-seated landslides and rockfall are common on the steep inner gorge slopes developed in the Paleozoic metasedimentary rocks (Wieczorek and Jager 1996; Spittler 1995; Spittler and Wagner 1998) and are accelerated in areas where roads have been built. Roughly 95 percent of all slides in granitic terrain occur on slopes between 35 and 42 degrees (Mehagan et al. 1978; Gresswell et al. 1979). However, mass wasting of this type in the Project area is relatively minor compared to mass wasting in canyons cutting across the metasedimentary terrain. Glaciated granitic lands are characterized by relatively unweathered granitic bedrock with thin or absent soils (this land type is dominant in the Project area upstream of the Union valley Reservoir) and unconsolidated glacial drift deposits. Both granitic land types are subject to chronic erosion by overland flow; however, surface erosion is very low in areas dominated by unweathered bedrock. Many of the perennial streams in the Project area are located in these lands. The dominant natural surface erosion processes include raveling, rilling, and gullying, particularly on steep hillslopes with low soil cohesion (Selby 1993). All of these processes are accelerated after fires (Swanson et al. 1987). Interfluvial surfaces in the Sierra Nevada are low relief planar areas lying between the divides and canyons and occupy most of the landscape in the UARP. Such areas are typically underlain by relatively undissected rocks of the Mehrten Formation or moderately dissected Paleozoic metasedimentary rocks. Surface erosion is typically the dominant process for sediment production due to the flat topography in these areas. Due to high transport capacity of inner gorge channels, and low sediment supply regime typical of most Sierra Nevada streams, the bedrock-controlled stream channels in the American River drainage naturally exhibit channel morphology of alternating scoured bedrock with infrequent alluvial deposition (alluvial deposits are expected to be forced by large boulders). The low transport capacity channels located in meadows associated with the glacial terrain are expected to be unconfined, have contiguous alluvial channel beds and moderate pool-riffle morphology (where large wood is abundant), and exhibit lateral migration. Under current conditions, channel bed characteristics in most of the channels in the SFAR drainage have likely been altered by higher sediment supply due to effects of recent land use (mainly timber harvest and road construction) and fire, and by alterations in the hydrologic regimes downstream of major reservoirs. About 400 million tons of gravel, silt, and debris from hydraulic mining operations were washed into the streams of American River watershed between 1853 and 1884 (Gilbert 1917, as cited in Laddish 1993). Most the mining took place in the NFAR drainage, about 70 million tons had been excavated in the MFAR drainage (Turner 1891; Gilbert 1917). No hydraulic mining occurred in the SFAR drainage (Turner 1891, as cited in Laddish 1993).

1.3 Geological Resources in the Project Area

The text that follows provides reach-specific conditions including geology, landscape geomorphology, channel characteristics, and potential for morphologic response to various land uses, including the Project reservoirs. These reach descriptions are based on review of maps, unpublished stream surveys, and local land use management plans (e.g., Wagner et al. 1981; Saucedo and Wagner 1992; Jordan and Brown 1993; USDA, unpublished data; CDFG 1979; WESCO 1980; EA 1980, 1982; Wagner et al 1997; Spittler and Wagner 1998; USDA 1993).

1.3.1 Rubicon River

The Project's Rubicon Dam is located in the Rubicon River watershed. The Rubicon River drains a glaciated watershed, much of which is designated as wilderness. Elevations in the watershed range from 4,745 to 9,800 ft. Approximately 75 percent of the watershed is underlain by Mesozoic granitic and dioritic rocks. The remainder consists of the Miocene Mehrten

Formation, glacial moraine deposits, and minor outcrops of the Jurassic metasedimentary rocks of the Sailor Canyon Formation. United States Forest Service (USFS) surveys indicate that the Rubicon River, in general, is characterized by long runs and riffles with frequent pools (USDA, unpublished data). The Rubicon River upstream of the Rubicon Reservoir flows through a glaciated, low relief landscape of the Rockbound Valley and is characterized by alternating alluvial and bedrock valley river segments. The reach is approximately 8 miles long, and its gradient ranges from about 3 percent in the alluvial valleys to 4 percent in the narrow bedrock valley bottoms. The average gradient is approximately 3 percent. Due to granite formations, marginal mass wasting and hillslope surface erosion are likely the main local sediment delivery processes in the bedrock valleys segments under natural conditions. These processes are absent in the alluvial valley segments, where the banks are composed of semi-consolidated deposits and bank erosion is likely the only source of local sediment.

Between Rubicon Reservoir and Placerville County Water Agency's (PCWA) Hell Hole Reservoir, the Rubicon River is confined by steep, glaciated canyon walls for most of its course. This section of the river is 11 miles long, and its average gradient is approximately 3 percent. Streamside mass wasting in the canyon reach is likely the dominant local sediment delivery process in the Rubicon River, with the exceptions of sections where the river flows through wide alluvial valleys such as the Desolation Wilderness boundary to Miller Creek and downstream of Barker Creek. In these valleys, bank erosion due to channel migration likely is the main source of sediment to the river.

1.3.2 Little Rubicon River

The Buck Island Dam is located in the Little Rubicon River watershed. The Little Rubicon River watershed is in a glaciated landscape and is underlain by Mesozoic granitic and dioritic rocks. The average gradient is approximately 3 percent. For most of its course, the river is surrounded by gently sloping hillsides and flows through alternating alluvial and bedrock valley segments. Under natural conditions, the dominant local sediment delivery processes to the stream channel are most likely hillslope and riverbank erosion, especially in the alluvial floors.

1.3.3 Gerle Creek

Loon Lake Dam and Gerle Creek Dam are located on Gerle Creek. The Gerle Creek watershed is underlain by Mesozoic granitic and dioritic rocks, glacial moraine deposits, and minor outcrops of the Jurassic metasedimentary rocks of the Sailor Canyon Formation. Gerle Creek drains Loon Lake Reservoir and flows initially to the west through a wide and swampy Holocene alluvial valley (Neck Meadow and Gerle Meadow) that is surrounded by moderately sloping and glaciated hillsides. This upper reach meandering across the alluvial valley is approximately 5 miles long, with an average gradient of approximately 2 percent. Between Johnny's Hill and Gerle Creek Reservoir (located at the confluence of Angel and Gerle creeks), the river flows along a lithologic contact between granitic rocks and glacial till deposits. This middle reach is approximately 3 miles long and has an average gradient of 4 percent. The one-mile lower reach between the Gerle Creek Reservoir and the confluence with South Fork Rubicon River is confined by a granitic canyon. The gradient in this reach is 3 percent. Due to greanite formations, marginal mass wasting and hillslope surface erosion are most likely the main local sediment delivery processes in both the middle and lower reaches. According to the USFS, stream surveys, characteristics of the channel include small bedrock falls and cascades, riffles, and silted pools; large wood and log jams are common (USDA, unpublished data). The USFS report states that "removal of logs [is] needed, [and] remove slash and log jams" in spots. There is no mention of wood in the upper and lower sections of the creek. The report continues saying "The middle section flows through an area of private land which has been heavily logged. There are several log jams and a lot of slash in the stream".

1.3.4 South Fork Rubicon River

Robbs Peak Reservoir Dam is located on the South Fork Rubicon River (SFRR). The SFRR watershed is underlain by Mesozoic granitic rocks, glacial moraine deposits, minor outcrops of the Miocene Mehrten Formation, Jurassic metasedimentary rocks of the Sailor Canyon Formation, and Paleozoic metasedimentary rocks. Upstream of the Gerle Creek confluence, the river flows through a glaciated, low relief granitic landscape. The average gradient for this reach is approximately 5 percent and hillslope surface erosion are likely the dominant local sediment delivery processes to the stream channel under natural conditions. Downstream of the Gerle Creek confluence, the river is characterized by progressive entrenchment within the surrounding canyon. For the first 2 miles, the river is confined by moderate granitic canyon slopes and has an average gradient of approximately 3 percent. A contact between granitic and Paleozoic metasedimentary rocks marks a transition from the moderate canyon to a deep gorge with 1,500-ft walls and an average gradient of 8 percent. Due to granite formations, marginal mass wasting is likely a dominant sediment delivery mechanism to the stream channel in both canyon reaches. ENF surveys document the presence of bedrock falls, cascades, shallow bedrock pools and rocky runs, large pools with silty bottoms, and pools formed by large woody jams (USDA, unpublished data).

1.3.5 South Fork Silver Creek

The only element of the Project in the South Fork Silver Creek (SFSC) watershed is Ice House Dam. The SFSC is in the southeastern portion of the Project area and is underlain by Mesozoic granitic rocks, Paleozoic metasedimentary rocks, glacial moraine deposits, and Miocene Mehrten Formation rocks. The headwaters of South Fork Silver Creek drain moraine deposits (Wright and Dry lakes), the middle reach cuts across granitic rocks (e.g. Ice House Reservoir), and the lower reach cuts across Paleozoic metasedimentary rocks. The upper reach is characterized by alternating alluvial and bedrock valley river segments and has an average gradient of approximately 3 percent. Marginal mass wasting and hillslope surface erosion are the likely main local sediment delivery processes to the stream channel under natural conditions.

Shortly downstream from Atherton Flat, the river enters a dissected granitic terrain and flows through a confined bedrock valley to Ice House Reservoir. This middle reach has an average gradient of 7 percent. In the lower reach, the river flows through a steep granitic canyon that transitions into a deep gorge as the underlying lithology shifts to Paleozoic metasedimentary rocks near the Silver Creek Campground. For the rest of its course the lower reach passes through a highly confined bedrock valley with an average gradient of 2 percent. Streamside mass wasting in the canyon is likely the dominant local sediment delivery process in both the middle and lower reaches.

ENF surveys document a number of channel types across the length of the SFSC including moderate gradient canyons with many small bedrock falls, plunge pools and boulder pools, meander pools, riffles, little spawning gravel, and an abundance of boulder or cobble substrate (USDA, unpublished data). The surveys also documented that, in some stream reaches, the residual volume of fine sediment in pools relative to the expected high transport capacity of this reach was very high (USDA, unpublished data). This volume of fine sediment stored in pools may result from increased sediment delivery from the Cleveland Fire area. In 1992, the Cleveland Fire burned approximately 75 percent of the watershed (24,000 acres) downstream of Ice House Reservoir (USDA 1993).

1.3.6 Silver Creek

The Project's Union Valley, Junction, and Camino dams and Jones Fork, Union Valley, and Jaybird powerhouses are located in the Silver Creek watershed. Upstream of the Union Valley Reservoir, the Silver Creek watershed is underlain by Mesozoic granitic rocks, andesitic mudflow rocks of the Miocene Mehrten Formation, glacial moraine deposits, and minor outcrops of Pleistocene basalt. This section of the creek and its tributaries drain a glaciated, low relief, granitic landscape. Most tributaries have gradients of approximately 5 percent and moderate riffle-step bedrock morphologies. Streamside mass wasting in canyon reaches and hillslope surface erosion are likely the dominant local sediment delivery processes to the tributary channels under natural conditions. Downstream of Union Valley Dam to the confluence with the SFAR, the watershed is underlain by Paleozoic metasedimentary rocks and rocks of the Mehrten Formation. The creek below the dam enters Paleozoic metasedimentary rocks and flows through a steep and highly confined gorge for most its course prior to the confluence with the SFAR. This reach has an average gradient of approximately 3 percent. Camino Reservoir is located in the gorge reach between the Jaybird and Round Tent canyon tributaries. The reservoir was drained in October 1999 and October 2000 (two phases) to remove sediment delivered from streamside mass wasting in Jaybird Canyon during the January 1997 floods. Under federal and state permits, approximately 300,000 cubic yards of sediment were removed from the reservoir.

ENF surveys document a number of channel unit types along the length of the river including pool, riffle, plunge pools, cascading rapids, fast flowing runs, and smooth, still pools (USDA, unpublished data). In-channel conditions include an abundance of gravel in the riffles and numerous large wood pieces in the channel. Silver Creek has a number of large tributaries including Little Silver Creek, Round Tent Canyon Creek, Sugar Pine Creek, Jaybird Canyon Creek, Jones Fork Silver Creek, South Fork Silver Creek and Big Silver Creek, and smaller tributaries include Onion Creek, Bear Creek and Davis Creek.

1.3.7 Brush Creek

The Project's Brush Creek Dam is in the Brush Creek watershed. Brush Creek is a tributary to the SFAR and drains into Slab Creek Reservoir and also provides a source of water to the Camino Powerhouse. The watershed is highly dissected and is underlain by Paleozoic metasedimentary rocks. The creek is characterized by a progressive entrenchment of its canyon prior to flowing into the Slab Creek Reservoir. Brush Creek Reservoir is located roughly in the middle of its course. The average gradient is approximately 7 percent. Unlike upper elevations which have granitic substrates, metamorphic sedimentary formations contribute to mass wasting which is likely the dominant sediment delivery process to the stream channel both upstream and downstream of the reservoir.

ENF surveys document the presence of a moderate-gradient canyon, as well as cascades, bedrock falls, and plunge pools (USDA, unpublished data). Other notable observations include abundant woody debris jams and the presence of large volumes of sand and silt in the substrate of the reach between Slab Creek and Brush Creek reservoirs.

1.3.8 South Fork American River

Project facilities on the SFAR include Camino, Slab Creek, and White Rock powerhouses, and Slab Creek Dam. El Dorado Irrigation District's (EID) Federal Energy Regulatory Commission (FERC) Project 184 (formerly PG&E's) is also located on the SFAR, about 1,000 feet upstream from the Camino powerhouse. The SFAR is underlain by Mesozoic granitic rocks, Paleozoic metasedimentary rocks, rocks of the Miocene Mehrten Formation, and glacial moraine deposits. From its confluence with Silver Creek to Slab Creek Dam, the river flows through a deep canyon composed of Paleozoic metasedimentary rocks and the average channel gradient is one percent. Downstream of Slab Creek Dam the lithology shifts from Paleozoic metasedimentary rocks to granite and the river becomes more sinuous. At the Rock Creek confluence, the lithology shifts back to metasedimentary rocks. Unlike upper elevations which have granitic substrates, metamorphic sedimentary formations contribute to mass wasting which is likely the dominant sediment delivery mechanism to the stream channel in both canyon reaches. Nearly 6 miles of the SFAR were within the boundaries of the 1992 Cleveland Fire. Increased fine sediment supply produced by surface erosion resulting from the fire may have increased fine sediment storage in the channel, as was observed on the SFSC (USDA, unpublished data). Since the establishment of the route of Highway 50 about 100 years ago, the canyon slopes, especially between Riverton and Strawberry, have exhibited a decreased slope stability and increased deep-seated and shallow-seated landsliding. Over 600 landslides, the majority of which are road-related, have been identified by the California Division of Mines and Geology in this reach (Wagner and Spittler 1997; Spittler and Wagner 1998). In January 1997, the Miller Creek landslide, located within the Cleveland Fire area, delivered about 350,000 cubic yards of debris to the river, temporarily burying the river reach and closing Highway 50 for 27 days (Sydnor 1997).

1.4. Seismicity

The central Sierra Nevada region is not as seismically active as other regions of California and Nevada (USGS 1988). Seismicity within the Project area has been addressed by a number of different researchers and agencies over the years (Bechtel Corporation, 1983; Bechtel Corporation, 1964; Bolt, B.A. et al., 1994). The nearest fault that could produce significant earthquakes is the Rescue fault strand near the Bear Mountains, located 12 miles west of the most western dam of the Project, Slab Creek Dam. Seismicity in the area, based on recent information, indicates that a few small earthquakes have occurred within 30 miles of the dam, but the maximum recorded magnitudes are about 4.0 on the Richter scale. Inspections are regularly performed on all Project facilities for effects of seismic activities, and recommendations are made in accordance with the findings. Appropriate actions are incorporated to ensure safe and efficient operations of all Project facilities in accordance with State and Federal mandates.

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