4.0 Water Resource Issues

4.1 Introduction

CHAPTER 4

This chapter describes the issues and conflicts identified by the SFAR Watershed Group. The following issues and conflicts are:

- Water Quality
- Water Supply
- Environment and Habitat
- Social and Cultural
- Flooding
- Fire
- Air Quality

In the following sections, each issue is described in detail including the current and historic activities that contribute to management challenges.

4.2 Water Quality

Generally high water quality within the SFAR and its tributaries is essential to human and natural communities found in the watershed and is important for maintaining beneficial uses. Overall, the SFAR watershed has excellent quality water (EDCWA 2007). This is due largely to the mostly natural setting of the watershed and the high percent of watershed lands managed as public lands, which includes an abundance of undeveloped land and lack of substantial point source discharges. Nonetheless, while huge strides have been made to reduce pollution from and lack thereof point sources, non-point sources including areas of high erosion remain a huge threat to water quality.

Urban storm water runoff and other non-point sources such as silviculture and hydromodification are responsible for much of the pollution observed today in major streams and lakes (SWRCB 2008). Non-point source pollutants are carried by environmental processes such as rain, snow, and wind and transported into our water systems. These pollutants include: pesticides, fertilizers, oils, organic materials, and sediment. Reducing the transport of pollutants from non-point sources has become a major challenge for public and resource agencies.

The protection of water is critical because poor quality water can lead to degraded biological habitats and riparian zones, public health issues, and increased clean-up costs. From 2002 through 2004, SMUD and PG&E conducted water quality monitoring studies within eleven reservoirs of the Upper American River to support FERC relicensing. Seven of the eleven reservoirs are located within the SFAR watershed. The water quality studies tested for hardness, total suspended and total dissolved solids, metals, nitrates, and organic compounds.

In general, the studies revealed that the waters are clear and cold with low concentrations of nutrients and high oxygen content (SMUD/PG&E 2004). However, the studies also revealed portions of the watershed with higher metals and *E. Coli* concentrations and a trend showing increased ion concentrations from the upper to the lower reservoirs.

4.2.1 Temperature

Water temperature is a significant concern within the SFAR watershed as temperature affects the chemical make-up of water and the aquatic organisms. Water temperature influences the:

- amount of oxygen that can be dissolved in water;
- methylation rate of mercury into methylmercury (see 4.1.3 for further discussion);
- rate of photosynthesis by algae and other aquatic plants;
- metabolic rates of organisms;
- sensitivity of organisms to toxic wastes, parasites, and diseases, and;
- timing of reproduction, migration, and aestivation of aquatic organisms (SWRCB 2004).

Water temperatures are affected by pooling, as created behind dams, storm water runoff, reservoir water releases, water diversions, shading by riparian canopy, stream geomorphology (e.g., pool depth), turbidity (suspended sediment absorbs heat), and climate change. The Water Quality Control Plan for the Sacramento River Basin, which includes the SFAR watershed states that a 5º F increase in temperatures above natural receiving water temperatures is prohibited.

Changes in water temperature affect the availability of dissolved oxygen. Dissolved oxygen (DO), which is the amount of gaseous oxygen (O2) dissolved in the water column, decreases as temperatures increase and is released into the air as gas. Dissolved oxygen enters the water by direct absorption from the atmosphere or by plant photosynthesis. The Water Quality Control Plan for the Sacramento River Basin, which includes the SFAR watershed, states that DO concentrations should not fall below 7.0 mg/L for cold waters, which is the majority of waters within the SFAR watershed.

As a result, an increase in water temperature reduces DO concentration and the availability of oxygen for aquatic animal and plant species, which can cause changes in the types and numbers of aquatic species. As DO concentrations decrease, pollutant intolerant species are replaced by pollution tolerant species (e.g., worms).

Throughout California, the timing and amounts of water released from reservoirs and diverted from streams are limited by their effects on various native fishes, especially those listed as threatened or endangered under the Federal and State Endangered Species Acts. These include winter-run and spring-run Chinook salmon, Coho salmon, and Central Valley forms of steelhead rainbow trout. Although, these species are no longer direct inhabitants of this watershed, water operations and management have temporal affects downstream thereby affecting downstream fisheries.

California constitutes the warm, southern end of the geographic range of most of these fish species. By 2100, climate change is expected to result in the following changes in California (ESF 2006):

- Raise average air temperatures by 1.4 to 5.8 degrees (C);
- Raise stream water temperatures by at least 1.4 degrees (C);
- Reduce snow pack volume, leading to increased year-round water temperatures;
- Shift the seasonal pattern of surface-water runoff to more in winter and less in spring and summer; and,
- Raise sea level by 0.3 foot to 2.9 feet.

These physical changes are likely to influence the ecology of aquatic life in California and have several major effects – all of them negative – on cold water fisheries. Increased water temperatures may affect local resident fish populations, including native rainbow trout species, which due to their sensitivity to temperature, is an indicator species.

4.2.2 Sedimentation

Excessive sediment yield into streams remains a widespread water-quality problem in the Sierra Nevada (UC 1996). Excessive sedimentation can cause a substantial reduction in reservoir capacity, increases water treatment costs, can result in water quality standard violations, and can adversely impact aquatic biota and habitat. Erosion and sedimentation from past and present land use activities, recreational use, and runoff from land stricken by wildfire, all contribute to water quality problems within the SFAR watershed.

However, natural levels of sedimentation occur on land with varying elevation within the SFAR. These natural levels contribute gravel for fish spawning and assist in developing stream banks and floodplains. Although natural levels of sedimentation are important, this process can be accelerated through ground disturbance activities such as logging, increased recreational demands (i.e., OHV activities on roads and trails), and inadequate maintenance and overuse of unpaved roads. Likewise, the buildup of these sediments behind water impoundments can create a sediment-starved stream below.

Given the numerous recreational opportunities within the SFAR watershed, public lands have seen an increase in recreational activities, such as hiking, dispersed camping, biking equestrian use, and OHV activities. From 1997 to 2001, the number of OHVs in use increased by almost 40 percent. With technological advances in the power, range, and capabilities of OHVs, new classes of vehicles have been introduced by manufacturers and are growing in popularity. While these advances expand opportunities for Americans to enjoy the public lands, these activities may have unfavorable affects to: soil health, water quality, and wildlife habitat.

In 2007 and 2008 the ENF studied the more than 2,400 miles of roads and trails throughout the Forest, and in late 2008 restricted motor vehicle use to 1,800 miles of designated roads and trails. From January 1 to March 31 each year, further restrictions will be implemented with the closure of designated dirt roads and trails, as this is the time of year when these routes are most susceptible to rutting and erosion, and is the period when water quality is most often affected (ENF 2008).

The housing and commercial development boom in the late 1990s and early 2000s contributed largely to the sediment load – both through the construction process as well as development's effect on infiltration and urban runoff. Additionally, with current trends in climate change, the Sierra may soon experience longer periods of drier conditions, which increases the risks of catastrophic wildfire. Wildfires create open and barren lands that are more susceptible to erosion due to higher peak runoff and limited ground cover, and have an increased potential to release a significant amount of sediment into surface waters.

4.2.3 Mercury

In 2007, the SWRCB placed a 37-mile stretch of the SFAR, from Slab Creek Reservoir to Folsom Lake (Figure 4-1), on the 303(d) list for mercury contamination. This listing means that the waters do not meet water quality standards for mercury, even after point sources of pollution have installed the minimum required levels of pollution control technology (SWRCB 2007).

This listing may have resulted from a hotspot within the SFAR identified in 2003 by a recreational gold miner. The hotspot, located a few miles downstream of Marshall Gold Discovery Park in Coloma, was further investigated by the SWRCB, the U.S. Forest Service (USFS), and the CDFG. From their investigation, mercury concentrations in the waste and suspended sediment were more than an order of magnitude higher than the minimum concentration necessary for classification as a California hazardous waste (SWRCB 2005). This exemplifies the magnitude of the mercury problem within the SFAR.

Mercury occurs both naturally and as an introduced contaminant in the environment (USGS 2000). Mercury is released through natural processes such as the weathering of rocks and volcanic activity. These processes release small amounts of mercury into the environment. However, mercury has become a major public health concern in recent years as a result of human activities releasing or introducing additional mercury into the environment. There are several ways in which mercury is introduced into the environment from human activities, including through the burning of fossil fuels (primarily coal), its use in medical and scientific equipment, from disposal sites, and, most importantly for the SFAR region, from its use in gold mining.

As a result of historic mining practices mercury has become a challenging water quality problem throughout the SFAR watershed. In the mid to late 1800's elemental mercury (Hg) was mined from coastal California and brought to the foothills of the Sierra Nevada to amalgamate with gold, making the precious metal more easily identifiable in the sand and gravel of surface waters. Mercury has been found in the bottom (benthos) of rivers and reservoirs, as well as in pits, sluices, and tunnels remaining in abandoned mines where it can be mobilized.

During additional gold recovery processes in the 1900 to 1960's several billion cubic meters of alluvial material was dredged for gold, and millions of pounds of mercury was used to enhance gold recovery. Historical records indicate that more mercury was used and lost at hydraulic mines than at any other type of mining operation. In total, the USGS estimates up to 8,000,000 of the 26,000,000 pounds of mercury used in the Sierra Nevada may have been "lost" during gold recovery.

Mercury can be transported by erosion and runoff as elemental mercury and in ionic form (e.g., Hg^{2+}), dissolved form, adsorbed to particles, and as droplets of the metal. Mercury can be converted (through several pathways, including warming, microbial activity, and agitation) into methylmercury, which can then be absorbed by microbes, plants, and animals. As methylmercury bioaccumulates in the food chain, it is concentrated, so that in larger predatory fish (e.g., trout and bass) concentrations can exceed levels of concern for human consumption (>0.3 parts per million). The accumulation of near toxic levels of mercury in many low- to middle-elevation reservoirs of the western Sierra is a public health concern; however, there are very few areas where mercury concentrations in surface water are high enough to warrant concern for public health from consuming the water itself.

Concerns about mercury pollution stem largely from the potential adverse effects of dietary exposure to methylmercury in fish, avian species, and mammals (including humans). Documented consequences of methylmercury pollution include: (1) direct adverse effects on the health of fish, wildlife, and humans; (2) contamination of fishery resources that diminishes their nutritional, cultural, socioeconomic, and recreational benefits; and (3) socio-cultural damage to indigenous peoples who fish for subsistence.

4.2.4 pH and Electrical Conductivity

The concentration of hydrogen ions in the water column is expressed as pH. Low pH (less than 7) corresponds to high hydrogen ion concentrations and is acidic while high pH (greater than 7) corresponds to low hydrogen ion concentrations and is basic. The Water Quality Control Plan for the Sacramento River Basin, which includes the SFAR watershed, states that pH shall not fall below 6.5 nor rise above 8.5 and that changes in normal ambient pH levels of fresh, cold surface waters shall not exceed 0.5.

Because pH can be affected by chemicals in the water, pH is an important indicator of water that is changing chemically. The pH of water determines the solubility and biological availability of chemical constituents such as nutrients and heavy metals (USGSb 2008). For instance, mercury, which is a heavy metal, has become a major water quality problem in the SFAR watershed. The availability of mercury in the water column, in addition to other factors (i.e., temperature), is directly related to the acidity or pH levels of the water. At lower pH levels, the solubility of mercury has increased thereby increasing the toxicity levels of mercury in water.

Potential sources that would affect pH in the water column include: mining activities, runoff containing fertilizers, acid rain, and illegal disposal activities, including the illegal dumping of construction waste.

Electrical Conductivity (EC), expressed in microSiemens/centimeter (µs/cm), is a measure of the total dissolved salts or the total amount of dissolved ions in the water.

Environmental processes, such as the weathering of rocks, contribute a natural amount of salt into water. The amount of natural salt found in the individual waterbodies is dependent upon the geology (rock type) and size of the watershed.

Rock composition contributes to the chemical make-up of the watershed. Rocks such as limestone and dolomite, increase EC in the watershed due to the dissolution of carbon minerals. Additionally, the size of the watershed in relation to the size of the water bodies (catchment area) has an affect on EC. The bigger the watershed to water body area means a bigger contact area of water to soil, which can increase EC.

There are a number of other sources that contribute unnatural level of salts into the waters and increase EC, at times beyond natural levels. These sources are: 1) runoff from roads, particularly roads containing deicing materials, 2) wastewater from sewage treatment plants, 3) wastewater from septic sewer and personal waste water disposal systems, and 4) urban and agricultural runoff.

4.2.5 Bacterial Contamination

Contamination of water resources from pollutants other than mercury and sediments occurs throughout the SFAR watershed. However, given the recent development boom in the 1990s to early 2000s, the SFAR watershed has become more susceptible to contamination from biological and nutrient sources.

Biological contamination comes from many sources including recreational activity, failing septic systems, and/or areas of high concentration of stock animals. The SFAR is the most heavily used whitewater rafting river in California and it also supports hundreds of kayakers, hikers, fishermen, and swimmers each summer. In addition, many residences within the SFAR watershed have septic and personal waste water disposal systems that may be contributing to biological contamination, as has been found in communities with similar geology in the Sierra Nevada.

The increased pressure from recreational activities in the SFAR watershed has resulted in some compromised water quality. During water quality monitoring studies performed by SMUD and PG&E from 2002 to 2004, as discussed in Section 4.1 above, studies revealed levels of *E. Coli* exceeding acceptable standards in locations where high levels of dispersed recreational activities occur (SMUD/PG&E 2004). Identifying sources (human or otherwise) and management strategies regarding biological contamination requires further research, especially as recreational use increases.

The rapid increase in development, from the housing boom in the 1990s to the early 2000s has resulted in an increase in the conversion of pervious (permeable) to impervious surfaces. Impervious surfaces increase runoff rates, resulting in unnatural flow surges and the transport of hydrocarbons, bacteria, lawn chemicals, and a host of other pollutants to the river systems. This increase has resulted in pollutant spikes during storm events.

Some of the major water-quality impacts on the Sierra are impairment of water quality downstream of urban centers, mines (which can cause heightened levels of many heavy metals in addition to Hg), intensive land-use zones, and biological contamination by human pathogens, especially *Giardia*. Non-sediment, non-mercury contaminants in the SFAR watershed include other metals, microbes, pesticides, nutrients, and hydrocarbon fuels. Possible sources of these pollutants can include agriculture, ranching, recreation, farming, stream and bank alterations, illegal dumping, pesticide use, septic systems, timber harvest, and wildlife. Additionally, runoff from illegally dumped household refuse and official municipal waste dumps can contribute to contamination of waters.

4.2.6 Nutrient Contamination

Across the United States, nutrient contamination of groundwater and streams continues to be one of the most significant and widespread of the environmental issues faced by government agencies (USGSa 2008). Sources of nutrient contamination include: agriculture, urban runoff (e.g., fertilizers), and animal husbandry.

Three major factors govern the magnitude and extent of nutrient contamination of streams and aquifers:

1) Differences in the sources of nutrients.
2) Differences in the physical properties of nitrogen and phosphorus.
3) Regional differences in soils, geology, and climate (USGSa 2008).

The most vulnerable streams commonly are in watersheds with relatively: high rainfall, poorly drained soils, steep slopes, and limited vegetation to reduce overland runoff (USGSa 2008). In contrast, the most vulnerable ground water is typically: less than 100 feet below the land surface, in areas of high rainfall or irrigation, in areas with relatively well-drained soils with low amounts of organic material that are underlain by permeable sand and gravel, fractured rock, or karst, and in areas with low slopes (USGSa 2008).

The SFAR watershed in general, when compared to other watersheds that have a greater percentage of land developed into urban areas or used for agricultural and farming practices (i.e., San Joaquin River watershed), water quality pollution from nutrient contamination does not seem to be a substantial problem. Nonetheless, because these land uses exist within our watershed, there may be individual streams, lakes, or drainages where contamination exists.

4.3 Water Supply

The quantity, quality, and availability of water resources are vital to natural processes and human activities within a watershed or region. Water is thus essential to the vitality of any area. Wise and prudent planning combined with management of surface and groundwater resources is fundamental to providing a substantial economic base for the residents of the SFAR watershed and the immediate surrounding area served by the SFAR watershed resources. This planning is also an essential component in the restoration and/or preservation of native species and habitats. This section presents a broad water supply and demand forecast for the SFAR region (“region” in this section refers to an area slightly larger than the “watershed”). Understanding the magnitude of future water demands allows managers to make recommendations that will meet and manage water demands into the future (CDM 2004). How growth is accommodated and land use planning decisions are made by cities and counties have important implications for future water use, and the subsequent health of the river ecosystem.

4.3.1 Natural Resources

There is a growing demand in the SFAR region to conserve or restore the ecological health and functioning of rivers and their associated wetlands and riparian systems for the benefit of people and biodiversity. It is widely recognized that any artificial alteration to a river flow regime will change the river ecosystem. Managers need to be able to define the river environmental flow regime that will support the desired ecosystem and to quantify the ecological impacts of changes to the flow regime caused by artificial influences, such as water withdrawals, dam operations, and water releases for recreational rafting. There is no simple figure that can be given for the environmental flow requirements of river ecosystems. Rivers are complex biological systems, knowledge is limited and much depends on federal, State, and local policies and other factors that determine the desired character of the river ecosystem that is being managed. The challenge for managers and scientists is to support decision makers in defining the flow regime that best meets the objectives set, often making the trade-off that society finds most acceptable.

Various factors determine the health of a river ecosystem. These include flow variation and quantity, the physical structure of the channel and riparian zone, water quality, channel management and resource use such as dredging and mining, level of utilization (e.g. fishing), and the presence of physical barriers to connectivity (e.g. dams). Environmental water demand or instream flows for rivers, is the determination of the quantity or volume, through time, required to maintain river health in a particular state. This state may be predetermined or agreed upon based on a trade-off with other considerations. Initially, environmental flows or instream water demand was focused on the concept of a minimum flow level, which considered all river health issues to be related to low flows; as long as the flow was kept at or above a critical minimum level, the river ecosystem was thought to be maintained. However, it is increasingly recognized that all elements of a flow regime, including floods, medium and low flows are important (Hill et al., 1991). Thus, any changes in flow regime will influence the river ecosystem.

Instream flow is the water maintained in a stream or river for beneficial uses such as fisheries, wildlife, aesthetics, recreation, and navigation. Instream flow is a major factor influencing the productivity and diversity of California’s rivers and streams. Instream flow requirements are established by the SWRCB in consultation with the CDFG to protect and maintain aquatic ecosystems. It is difficult to forecast future regulatory actions and agreements that could change existing instream flow requirements. The DWR published instream flow requirements for many California water bodies in 1982.

Such flows support fisheries, wildlife, recreation, and streamside vegetation. The DWR states that their calculations are simplifications of reality, as they underestimate applied instream flow requirements on streams having multiple instream flow requirements.

Groves et al. (2005) forecasted environmental water demand for 2030 by adding a percentage of the State's unmet environmental objectives determined by Environmental Defense to the 2001 environmental water use for each hydrologic region. According to this study the American River had an unmet objective of 55,000 acre-feet. The unmet objective on the American River is undelivered water needed to meet the CALFED Anadromous Fisheries Restoration Program. The Lower American River Flow Management Standard has been developed to manage flows to benefit the fishery on the lower American (SWRI 2004). The new minimum required flow in the FMS, as measured by the total release at Nimbus Dam, would be established between 800 and 2,250 cfs from October through May. During June through September, required flow would be established between 800 and 1,750 cfs. Actual required flow would be determined based on specified reservoir conditions at biologically significant times of the year. Previous minimum flows were set at between 250 and 500 cfs. These additional flows will need to come, in-part, from the SFAR.

4.3.2 Current and Future Consumptive Water Demands

Much of California's developed water supply originates within the Mountain Counties Area in which the SFAR watershed is located. As defined by the California Water Plan Update, the Mountain Counties Area includes portions of the Sacramento River Hydrologic Region. Water supplies from the SFAR watershed comprise a significant portion of California's overall water supply amounting to approximately 78,664 acre-feet per year, which represents about 4.7% of the Sacramento River's total supply. Although the region has abundant surface water supplies, much of it is unavailable locally because of prior water rights appropriations for downstream or out-of-basin users (CDM 2004).

Water supplies vary seasonally and from year to year depending on the amount of precipitation and corresponding runoff. In the Sacramento River Hydrologic Region in which part of the planning area is located, the average precipitation is 52.4 inches per year, and the average runoff is 22.4 maf per year. Supply sources in the region for municipal and domestic use and irrigation generally come from surface waters in the form of watershed runoff, carry over storage in surface reservoirs, contract purchases (such as PG&E), and recycled water (upgrading wastewater to meet standards for domestic use). Melting snow from the Sierra Nevada provides a water supply source that usually lasts until June or July (CDM 2004).

Table 4-1 provides a summary of normal year water supplies available to the water agencies from these facilities for consumptive use by right or contract.

The main reservoirs that supply the surface water needs in the watershed and for export in the immediate surrounding region are listed along with the agency or utility that operates them, in Table 4-2.

The use of recycled water, which involves treating wastewater to meet standards for domestic use, is becoming an increasingly important source of new water in the SFAR region. Though recycled water is currently used in the region, the increased demand for water is fueling efforts to expand its use and develop alternative water sources. EID is leading the recycled water use campaign having produced recycled water for over 30 years. Today, EID delivers tertiary treated recycled water for landscape irrigation to more than 3,200 homes, 170 commercial sites, and two golf courses in the El Dorado Hills area alone (EID 2006). In the future, the use and application of recycled water will need to be expanded to help meet the region's growing water demand.

Present projections forecast the population of California to increase 41 percent by 2030, which will substantially increase the statewide urban water uses. With the dramatic population increase in the region, one of the major issues facing the SFAR watershed is water supply and the need to improve the reliability of the various water delivery systems.

According to the El Dorado County Water Agency (EDCWA) in the Final 2007 Water Resources Development and Management Plan (WRDMP), existing water supply infrastructure and operations have been able to absorb substantial urban growth in western El Dorado County, primarily the EID service area. Based on the approved 2004 El Dorado County General Plan (EDCGP) and updated agricultural water needs projections, the estimated total water demand in the County in 2025 for the SFAR region will be approximately 112,878 acre-feet. Build-out of the EDCGP in SFAR region will require about 181,259 acre-feet (EDCWA 2007).

In accordance with the 2004 EDCGP, the additional delivered water supply needed in the SFAR region by 2025 is 34,214 acre-feet, and a total of 102,595 acre-feet of additional supplies will be needed to meet projected build-out demands. Table 4-3 provides a summary of existing water supplies, projected 2025 and build-out demands, and the additional water supplies needed throughout El Dorado County (EDCWA 2007). Water supply administration in the SFAR region is the responsibility of federal, State, county, city government agencies, and public water purveyors. The primary entities administrating the region's water supplies are EID, GDPUD, and EDCWA**.**

In an effort to meet the projected demands, EID, GDPUD, and EDCWA continue to pursue a Central Valley Project Water Supply Contract under PL 101-514 (Fazio), and have also been successful in negotiating annual storage delivery of up to 40,000 ac-ft from SMUD's Upper American River Project. In conjunction with the El Dorado-SMUD Cooperation Agreement, EDCWA is pursuing a water rights transfer from appropriations currently controlled by the City of Sacramento on the upper reaches of the SFAR and from the United States Bureau of Reclamation.

The SFAR Watershed Group as a unit generally does not support the transfer of water to areas outside the region, unless a banking or "repayment" contract is in effect. The negative effects accruing to the natural resources, recreation activities, and municipal and agricultural water supplies due to outside-area transfers is inestimable. While stakeholders do not want to tie the hands of participants or other agencies within the SFAR watershed, it is important to acknowledge this stance, and attempt with best effort to keep local resources within the watershed.

4.3.3 Agriculture

Agriculture consumes a large portion of the water supply in California, exceeding domestic use. However, recent analysis has shown that water for residential development (domestic use) will continue to exceed demands from agriculture in the SFAR region (EDCWA 2007). Although agriculture is a major economic land use in California, agricultural land has been gradually decreasing statewide. In El Dorado County, however, demand for agricultural water supply is likely to increase due to General Plan policies which encourage agricultural development (EDCGP 2004). This growth will occur in the SFAR watershed, primarily in the Apple Hill area, as well as the Cosumnes watershed in the south part of El Dorado County, where the primary crop is wine grapes grown using ground water supply.

In the SFAR region, agriculture occurs primarily in the lower foothills below 3,000 feet. The upper elevations are steep and dominated by forested lands that are not suitable for agriculture. For the purposes of this Watershed Plan, timber harvest and production is not considered agriculture. Thus, the amount of agricultural land in the planning area is small relative to other parts of California. El Dorado County wide, approximately 233,000 acres are used for dryland pasture, while only 1,143 acres is irrigated pasture or hay (EDCDA 2007). Other agricultural land is used primarily for vineyards, Christmas trees, citrus trees, berries, nuts, and deciduous orchards in El Dorado County (DWR 2005). Fruit and nut crops account for 3,436 acres.

The assumed expansion of agriculture in the SFAR area assumes an increased availability of reliable water sources. The EID forecast for agricultural demand jumps from 5,950 acre-feet/year (af/y) in 1999 to 22,100 af/y in 2025, resulting in a total increase from 15 percent of the total demand to 27 percent (EDCWA 2007). Likewise, in the same time period, the GDPUD forecasts agricultural demand to jump from 4,351 to 11,770 af/y, representing a change from 40 to 56 percent of the total demand (EDCWA 2007). GDPUD, which services the more remote northwest portion of the SFAR watershed area, supplies most of its water for irrigation rather than domestic use.

4.3.4 Recreation

Boating occurs along the South Fork American River on eight distinct whitewater runs between the rural area of Strawberry, along Highway 50, and Folsom Reservoir, and along many of the river's tributaries as well. Most boating occurs below Chili Bar Reservoir, where sufficient flows are available nearly all year as a result of negotiated releases from SMUD-managed reservoirs (GDRCD 2003). The whitewater runs attract thousands of visitors to the SFAR watershed on a yearly basis. In fact, the lower portion of the South Fork American River is the most heavily used whitewater rafting river in California and it is one of the most popular whitewater rafting rivers in the United States (EDC 2003).

4.3.5 Groundwater

Groundwater supplies make up a small portion of the water supply in the SFAR region, due to the limited amount of useable groundwater and overall lack of knowledge with regards to the resource. Unavailable and/or inaccessible groundwater in the watershed is due to the limitations of the fractured granite formations that constitute much of the foothills and western slopes of the Sierra Nevada (EID 2006). A cooperative study completed by the Department of Water Resources in 1992, entitled *Georgetown Divide Water Management Study*, describes water supply alternatives available to the Georgetown Divide area and includes a discussion of the groundwater situation on the western slope of El Dorado County (EDCWA 2007). The following is an example from that study.

Many private wells are drilled in hard crystalline rock that lies at or near the ground surface or under the thin layers of alluvium. In rock formations, water moves through and is stored in fractures in the rock mass. The width of each fracture usually decreases with depth, causing diminished storage capacity. The amount of water that can be stored and transmitted in such fractures is generally small compared to the amount that can be held and conveyed in a porous alluvial aquifer, but both quantity and dependability of these fractured rock aquifer systems varies vastly by location.

Additional surveys completed within the SFAR region indicate that groundwater quality may be satisfactory in most areas, however the water source is often found by the purveyor to be inadequate as a dependable resource. As future development occurs in areas beyond pipeline service and climate change alters the recharge rates throughout the Sierra, both the quantity and quality of groundwater sources could be threatened (EDCWA 2007).

4.3.6 Cultural Issues

People have been attracted to water sources for millennia. Native American Indians were attracted to water sources such as rivers and lakes in the SFAR watershed for the purposes of sustenance and places of spiritual gathering. In addition, water sources in the SFAR watershed attract local people and tourists for boating and other water sports, or for just relaxing near the water’s edge enjoying the natural surroundings.

4.3.7 Hydro-power Generation

There are five hydroelectric projects operating within the SFAR watershed including:

1) **El Dorado Hydroelectric Project** (FERC No. 184) operated by the EID. The El Dorado Hydroelectric Project is a 21-megawatt (MW) project consisting of four storage reservoirs, the El Dorado Diversion Dam, water conveyance facilities, a forebay, penstock, a powerhouse, and seven small diversions. This project was recently re-licensed through October 1, 2046.

2) **Upper American River Hydroelectric Project** (FERC No. 2101) operated by SMUD. The Upper American River Hydroelectric Project is a 688 MW project consisting of 11 reservoirs (including Slab Creek Dam), approximately 28 miles of power tunnels and penstocks, and eight power plants. This project is currently going through a FERC relicensing process.

3) **Chili Bar Hydroelectric Project** (FERC No. 2155) operated by Pacific Gas and Electric. The Chili Bar Hydroelectric Project is a 7 MW project including one power plant on the South Fork American River. This project is currently in the final stages of the FERC relicensing process in conjunction with the Upper American River Hydroelectric Project relicensing process.

4) **Rock Creek Project** (FERC #3189) located on Rock Creek, a tributary to South Fork American River. The Rock Creek Project is a 3.6 MW hydroelectric project. Facilities include a six foot high dam, a 0.8 mile long water conduit, and a powerhouse containing two generating units situated approximately 200 feet upstream of the confluence of Rock Creek and the SFAR. The current license expires in 2033

5) **29 Mile Creek Project** (FERC #7931) is a 0.3 MW hydroelectric project on an unnamed tributary to the South Fork American River. FERC transferred the license from the original holder to Eugene Mark Souza in 2000. The license includes a two foot high dam on the unnamed tributary, a 0.3 mile long penstock, and a powerhouse. The license expires in 2036 (PG&E 2005).

On the lower American River, the Bureau of Reclamation operates the Folsom Hydroelectric Plant, which is part of the Central Valley Project.

Various stakeholders in the SFAR watershed, including EID, GDPUD, EDCWA and El Dorado County Citizens for Water, are considering the feasibility of developing new hydroelectric facilities and new water supply infrastructure within the project region (EDCWA 2007). This County-wide hydro-development plan would evaluate different hydroelectric options and the appropriate approach for sequencing various projects.

According to the EDCWA's 2007 WRDMP, the following projects and concepts should be fully considered prior to developing a specific hydro-development plan, as they could be significant in shaping and focusing such an effort:

- Expand the hydroelectric project vision beyond the SFAR to include a larger geographic area of consideration;
- Study the possibility of developing partnerships outside El Dorado County (such as PG&E for energy and South Delta purveyors);
- Evaluate SMUD's requirement for large increases in energy capacity (e.g., the Iowa Hill Project);
- Include future El Dorado County water supply demands;
- Consider ability to develop and transfer water for environmental purposes;

- Consider the feasibility of El Dorado County purveyors' direct use of energy from a new hydroelectric project (i.e., to supply EID pumping out of Folsom Reservoir, GDPUD pumping out of the Middle Fork of the American River, water treatment plants, and other high energy use facilities);
- Understand project financing options and sources of project funding;
- Understand best available information on future energy values; and,
- Consider benefits under the El Dorado-SMUD Cooperation Agreement.

New water supply projects will need to be creative and flexible to satisfy multiple benefits, including power supply, environmental and recreation needs, flood control, in addition to supplies for municipal and industrial (M&I) uses, long-term drought reserves and agricultural requirements (EDCWA 2007). It is important to point out that these power-producing projects provide for much-needed energy for a growing State, but without great contributions to the greenhouse gas emissions.

Hydropower is a clean-energy contribution from the SFAR watershed. Utilization of the hydropower generated from the SFAR watershed avoids approximately 2.14 metric tons of CO_2 from being emitted into the regions' atmosphere per year, as compared to coal-burning fuel projects (Francfort 1997).

4.3.8 Water Conservation Efforts

Improving the reliability of water delivery will be challenging, as urban and agriculture water users in most of the region already have limited water supply options to meet future needs as a result of the mountainous topography; lack of significant groundwater aquifers; limited financial resources for water development; and, the fact that much of the water originating in the area is allocated to downstream users and exports through the water rights process (DWR 2005). Water conservation is therefore essential in making the best use of existing water supplies to meet growing demands. EID currently imposes aggressive conservation measures including those listed below:

- 99 percent of water deliveries are fully metered
- Volumetric billing
- Tiered pricing
- Best Management Practices (BMPs; as defined by the California Urban Water Conservation Council)
- Water conservation plans
- Agriculture Irrigation Management Service (IMS)
- Drought preparedness plans (including climate change modeling)
- Promoting citizen involvement

Conservation will remain a cornerstone of water resource management and operation in El Dorado County. Predicted climate change will also influence how water needs are planned for, and actual climate change effects will be dealt with as they come. El Dorado County, EID, and the entire CABY region are all currently analyzing the affect climate change may have on demands and the yield of existing storage reservoirs. Increased demands and reduced supply availability during extended drought points to the need for greater flexibility in water supply, delivery, storage, and treatment. Conservation will serve a large part of this need, but other avenues for demand and supply management will need to be considered.

4.4 Environment and Habitat

Land use can impact special-status species and reduce the amount of available habitat for all wildlife. These impacts include direct conversion of habitat or the cumulative indirect impacts of urban sprawl and dispersed rural development. Adverse changes include; reduced groundwater infiltration, increased erosion and sedimentation, and increased pollution loading, all of which influence the fish and wildlife of the region. Another concern related to habitat alteration is the invasion of exotic (non-native) plant and animal species.

4.4.1 Habitat degradation and loss

Habitat alteration due to land use change is a concern throughout the SFAR region. Habitat is a key component to ecosystem health and vitality. Water quality is intimately related to the native vegetation and terrestrial ecology of the entire watershed. Native plants and trees adjacent to streams and rivers serve to collect and filter the water funneling through a network of stream channels into the creek system. Plant roots absorb and slow the rate of runoff, releasing water into the streams, groundwater, and back into the atmosphere through evapotranspiration. Root systems serve as cohesive networks that protect nutrient rich surface soils and maintain bank integrity, thereby reducing excessive rates of sedimentation. Tree canopies create a microclimate maintaining cooler temperatures, reducing moisture loss to evaporation and providing protection to young trees and heat-sensitive understory plants. Riparian vegetation also provides nutrients and habitat for fish and wildlife, thus supporting a diversity of life. Oak woodlands, grass savannas, and riparian communities of the entire foothill region are the most ecologically transformed ecosystem. These areas have been converted for rangeland, agricultural uses, and are increasingly converted to residential and industrial developments.

Impacts to aquatic and riparian ecosystems in the SFAR watershed as a result of urbanization will continue to increase in the western portion of the watershed, especially along the US Highway 50 corridor where population growth is concentrated. Hydrologic changes as a result of increased impermeable surfaces (including hardened unpaved roads) are the primary cause of riparian and aquatic habitat degradation. These physical changes in the local hydrology cause changes in stream and wetland habitats, which affect the species using these habitats. Aquatic and riparian organisms evolved life history strategies which makes them adapted to normal flows. Increased runoff leading to changes in erosion rates, sedimentation, peak flows, and increased pollutants causes sensitive species to decline. Additionally, when connectivity between streams, creeks, floodplains and wetlands is restricted, ecosystem processes suffer. Genetic variability is reduced, important seasonal habitats are lost, and the natural buffering wetlands provide is lost. All of these impacts make it easier for exotic species, which are typically more adaptable, to become established. Table 4-4 summarizes the causes and effects of urbanization on the aquatic environment (Shaver et al.).

While timber harvest plans are required of all logging operations, changes to the forest landscape cannot be completely avoided. Timber operations have the potential to cause possibly damaging changes to coniferous habitats, including the alteration of forest structure and wildlife habitat. Selective harvests can change the composition of tree species and vertical stand structure. This, in turn, can change the composition of wildlife species that utilize the stand. Clear-cutting can lead to even-aged stands with overall reduced biodiversity that have a greater susceptibility to insects and disease. Top-layer soil disruption has the potential to affect the propagation and sustainability of new growth as well as determine the type of plant species that will generate, and often leads to an infestation of exotic species. Road construction associated with logging and forest management has a much greater impact on soil erosion and sedimentation of waterways than any other factor, including timber harvest (SNEP). Studies have shown that logging has a relatively minor impact on soil erosion when compared to road construction (McColl and Powers 1984).

Removing native plants or trees through vegetation clearing, grading, or timber harvest can have a cumulative impact that is often unrecognized. For example, soil erosion can cause increased nutrients and algae blooms in streams; increased turbidity in the stream can reduce sunlight and the rate of photosynthesis in algae and other autotrophs; and increased soil deposited on the stream substrate reduces macroinvertebrate habitat. Therefore, erosion can impact the beginning of the aquatic food chain and subsequently affect the entire food web.

Disturbances can have a beneficial effect on a forest habitat. Selective logging, including the removal of insect-infested or severely diseased stands can create a healthier forest, creating openings and edges that different species of plants and wildlife require. Fire can also have a positive effect, as the forests of California are adapted to regular, periodic fires; the loss of this agent of disturbance creates an un-natural condition in the forest. Without disturbance of some kind, the forest structure changes from a canopy characterized as open to that of a closed canopy; vegetation in all forms builds up until competition for limited resources causes tree mortality due to outbreaks of insects and disease. Without disturbance, fire occurrence is often larger and more intense, destroying large areas of coniferous forest habitat, including “old growth forest.”

Recognition of the accelerated conversion of oak woodlands has lead to the adoption of an Oak Woodlands Management Plan (OWMP) by El Dorado County. The foothill oak woodlands within the SFAR region below 4,000 feet are now subject to the requirements of this plan, which requires specific mitigation for projects that impact oak woodland. Projects are required to plant native oak trees suitable for the specific habitat or contribute in-lieu fees that will go toward purchasing land within “priority conservation areas”. This will have a positive impact on the plants and animals utilizing the foothill oak woodlands but additional effort from private landowners, other agencies, and non-profit groups will be required to protect and properly manage this important resource.

El Dorado County is in the process of developing an Integrated Natural Resources Management Plan (INRMP), which should, according to the 2004 EDCGP, provide an inventory of habitats, a mechanism for mitigating development impacts, and a protection strategy that involves acquisition of large contiguous blocks of habitat establishing connectivity between patches of habitat. The INRMP can draw upon this document and others for information.

The most significant threat to large expanses of habitat is wildfire. Although not as permanent as urbanization, high-intensity crown fires can destroy thousands of acres of habitat in a period of days or weeks. These types of fires have long-lasting consequences to the ecosystem, affecting species abundance and diversity of terrestrial and aquatic habitats. Vegetation communities are changed for decades or centuries. These changes are further discussed in Section 4.7, Fire.

4.4.2 Species population declines

Threats to fisheries and aquatic biota are a concern throughout the region. Native amphibian species at all elevations have severely declined throughout the Sierra Nevada. At higher elevations, introduced fish seem to be the primary cause for loss of Sierra Nevada yellow-legged frog populations throughout its historic range. Causes for the decline of native amphibians at lower elevations (such as the CRLF and the foothill yellow-legged frog (FYLF)) are not completely understood, but competition and predation from introduced species, pollution, and habitat loss have all been implicated. Over 50% of the 30 Sierran amphibians have experienced population declines (USDA 1998)

There is a significant loss of native fish and habitat in the SFAR region due to historic land and water use activities. Aquatic biota, such as amphibians and benthic macroinvertebrates, are also jeopardized and the loss of this important biota has negative impacts on fisheries. Protection of native fish and non-native game fish and their habitat is related to water flows, water quality, and overall river and creek conditions throughout the region. The construction of Folsom Dam has eliminated anadromous fish from the SFAR watershed. The extirpation of these species from the SFAR is permanent so long as there are dams on the river below; water quality as a result of practices in the SFAR watershed, however, will continue to impact the remaining populations of these species on the Lower American River.

Local degradation of habitats in the Sierra Nevada has generally led to significant impacts on aquatic invertebrates, which make up the vast majority of aquatic species in the region. The aquatic invertebrate fauna as a whole remains largely unknown, and only a fraction of the species diversity in the range has been identified or studied. In addition to more widely known aquatic habitats, such as streams and lakes, many invertebrate species occur in highly localized places such as intermittent streams, ephemeral ponds, fens, bogs, springs, and small wetlands. Due to food chain relationships, impacts to invertebrates have significant cascading effects on fish, amphibians, birds, and mammals. The introduction of non-native fishes (primarily trout) has also greatly altered aquatic ecosystems through impacts on native fish, amphibians, and invertebrate assemblages. Altered habitats are often linked to successful establishment of non-native species.

Other species with declining populations (some population trends for these species are not well known) in the SFAR watershed include:

- Willow flycatcher;
- Spotted owl and Great grey owl;
- American marten;
- native fishes including: California roach, Hardhead, Sacramento sucker, and the Sacramento pike minnow (Moyle and Nichols, 1974); and
- forest carnivores including the Pacific fisher Sierra Nevada red fox, and the California wolverine are assumed to be extirpated in the SFAR watershed region of the Sierra.

Declining populations of species that inhabit the SFAR region are primarily a result of habitat loss and degradation. The primary causes include; urbanization, logging, livestock grazing, and competition from introduced species. Numerous avian fauna are declining, and a good summary of the population status of species that inhabit the Sierra can be found in the Sierra Nevada Bird Conservation Plan (Siegel and DeSante 1999). The primary habitats that require conservation efforts for avian land birds are montane meadows, non-meadow riparian, LSOG forest, and oak woodlands.

4.4.3 Invasive Species

California is highly susceptible to the invasion of exotic species, due to its geographic location and varied habitats. The SFAR watershed is not immune from this onslaught, and because it was the epicenter of the great migration to California during the Gold Rush, invasive species have a relatively long history in the watershed. The introduction of exotic plant, animal, and insect species, whether intentional or not, can cause disruptions such as competition, predation, hybridization, and the introduction of diseases. Invasive species tend to thrive in disturbed habitats and compete with native species for moisture, nutrients, sunlight, and space and can adversely influence establishment rates for new plantings, foods, and habitat. They usually do not have natural predators, so their numbers go unchecked and they can out-compete the native species.

Invasive Plants

A variety of invasive plants have become established in the region. Numerous lists are available from agencies such as the California Department of Food and Agriculture (CDFA), the California Invasive Plant Council, and the ENF. The ENF lists 43 species, 15 of which are on the highly invasive list "A". Some of the most invasive are yellow starthistle, French, Spanish and Scotch brooms, cheat grass, and spotted knapweed. Impacts resulting from these invasive weeds include alteration of disturbance regimes, changes in the foodbase for wildlife species, soil erosion and loss of soil carbon storage, decreases in range or forest productivity, and altered recreational or aesthetic values (D'antonio et al., 2004). In general, the number and diversity of exotic plants decreases from the coast to the interior of California and very few exotics are found above 6,000 feet. The foothills of the SFAR have the greatest number and diversity of exotic, invasive plant species (D'antonio et al., 2004).

Invasive Wildlife

There are a host of introduced animals found in the SFAR watershed, many which have become naturalized and are part of the fauna. At least 15 introduced vertebrate species are well established in the Sierra Nevada. These introduced animals have had wide-ranging consequences on the ecosystem of the SFAR. Although the introduction of large vertebrates is less likely now than in the past, when many were introduced for sport or leisure, introductions are still possible, especially in aquatic ecosystems. The relatively recent introduction of Northern Pike into Lake Davis farther north in the Sierra is a good example. Resource mangers have to be constantly aware of this type of introduction. Even greater threats come from small invertebrate species.

Numerous insects, mollusks, and other invertebrates have been introduced throughout the state of California. Some of the more recent introductions that threaten fresh water habitat in the SFAR are the New Zealand mudsnail and the zebra mussel. While these species have not yet been found in the SFAR watershed, managing agencies are working together, and with the CDFG which recently prepared an Aquatic Invasive Species Management Plan which identifies a statewide strategy for dealing with these species (CDFG 2008). Animals like the zebra mussel and quagga mussel pose a serious and significant risk to water distribution and hydroelectric operations in the SFAR region and throughout the State. One estimate suggests that the cost of scraping this mussel from pipes in the Great Lakes Region is from 50 to 100 million dollars per year (CDFG 2008). The total costs incurred to society as a result of invasive species are difficult to estimate, as is the entire effect of their establishment. It is clear, however, that costs increase dramatically as management shifts from prevention to rapid-response to eradication to control and finally adaptation. Money spent on preventing the colonization of invasive species goes much further, paying huge dividends in the savings incurred by avoiding eradication and management costs.

4.5 Social and Cultural

4.5.1 Cultural Sites

The SFAR Watershed was used by American Indians to hunt and gather; burning in the valleys was also a common practice to clear hunting grounds. The American Indian tribes occupying the lower slopes of the SFAR watershed at the time of contact with European-based cultures were the Hill Nisenan or Southern Maidu, and the Sierra Miwok. These Indian tribes had many social gathering sites near the SFAR. Ceremonies related to the seasons, harvesting of food, and rituals took place at these social gathering sites where the Indian tribes made customized basketry, feather robes, and other elaborate ceremonial costumes.

The cultural legacy of the SFAR Watershed has helped shape both the small towns and the landscape of the watershed, as well as the approach of many inhabitants towards resource management. The project area is famous for some of the most significant events and individuals in the history of the West including the discovery of gold in Coloma in 1848 that triggered the Gold Rush, well known fur trappers such as Kit Carson, and remnants from the cattle and dairy industries dating back to the mid-1850's, the Pony Express, the Mormon Emigrant Trail, and historic Main Street in Placerville (GDRCD 2003).

The cultural resources of the Sierra Nevada, including the SFAR watershed are some of the main assets that attract people to the area. In addition, the cultural resources found in the watershed have contributed to our knowledge and understanding of California prehistory. These resources add to the spirit, ambiance and charm of the small communities located in the watershed, which helps promote tourism. The value of these assets is immeasurable, but more importantly, these resources cannot be replaced once they are destroyed. Archaeological resources, such as prehistoric and historic artifacts, buildings and other cultural objects, are distinctive and unique features of this landscape (GDRCD 2003).

4.5.2 Agricultural Industry

Gold miners built the initial water delivery system of ditches and flumes for use in mining operations. As the miners became outnumbered by agriculturalists settling in the foothills areas, the system was used to deliver water to crops and growing population centers. Over the years agriculture obtained resources to improve systems, install reservoirs, and increase delivery capabilities. In part, these upgrades allowed urban areas to access these systems.

Residential raw water delivery was eliminated in the mid 20th century, due to the growing concern over water borne diseases. This switch required water purveyors to install and maintain treatment facilities. Some purveyors were able to separate raw water from potable water deliveries by re-piping much of their delivery systems, but others kept to a single pipe system, delivering potable water to all customers. In the later case all customers, agriculture and residential, had rate increases to pay for the treatment costs, though agriculture customers pay a greatly reduced rate as compared to municipal customers.

This suburban-style development in rural areas has caused dramatic losses in oak woodland rangeland previously available for livestock grazing and wildlife. The growth in residential use and urban areas has furthered the conflicts between agriculture and urban development due to the need for potable water and increase in demand. Additionally, increased demand for permanent residences in these mountainous areas and an increased probability of economic gain has, in the last 20 years, promoted greater development in these formerly rural areas. Agriculturalists are concerned with urban development and increased demand for treated water for human consumption, which could possibly result in dramatic increases in raw water costs and less dependability for agricultural supply. This type of impact could irreversibly affect the economic viability of agricultural operations.

Agriculture has long been an important element of life for the people living in the SFAR watershed. Agricultural crop production and associated activities not only contribute to the economic stability of the area, but also serve as the foundation of EL Dorado County's rural lifestyle and provide a key element in the sense of community. Agricultural production in the SFAR region consists mainly of timber production, livestock grazing, vineyards, orchards, Christmas trees, nursery stock and some vegetable crops. In 2007, El Dorado County had a crop production value of more than $34.6 million, excluding timber. Agricultural lands in production for fruit and nut crops covered 3,436 acres in El Dorado County in 2007. The overall contribution of agriculture to the County's economy (through employment, sales, tourism, and other related activities) totaled approximately $440 million in 2007 (EDCDA 2007). Tourism related to agriculture has a huge impact on the local economy as evidenced by the over 10-fold increase in total agriculture-related revenue ($440 million) beyond just the $34.6 million value of the agricultural products.

The Apple Hill region is a unique and celebrated ranch-marketing area where weekend visitors can purchase a variety of locally grown fruits and vegetables and home-made crafts and food products at over 50 ranches. Growers in the area have used innovative direct marketing approaches to expand agricultural receipts (SBC 1999). A burgeoning wine making area, the El Dorado Appellation of the Sierra Foothills includes numerous small wineries where visitors can taste wine made from local mountain-grown grapes. Apple Hill is often referred to as a "model" for tourism in El Dorado County.

4.5.3 Silviculture

Since the beginning of the Gold Rush in 1849, the extraction of timber from forests in the SFAR region has been important to the economic vitality of the area. The forests in the foothills, near mining towns, were heavily harvested, removing nearly all usable timber to build the infrastructure needed to support the huge population influx. El Dorado County has always been one of the top timber producers in California with average harvest of 391 board feet/acre (bf/a) of commercial forest between 1948 and 1977. Production remained high in the County during the period between 1977 and 1994 with an average yield of 351 bf/a (STSC 1996). Timber production occurs on both public and private lands. Since the early 1990's private timber production has outpaced public timber harvests on National Forest Lands, due largely to public outcry that changed management policies at that time, placing more emphasis on ecosystem health rather than production. The SFAR watershed includes over 91,436 acres classified as Timberland Preserve Zones (TPZ) by the 2004 EDCGP, zoned for the production of timber and timber-related products.

Sierra Pacific Industries operates the last major lumber mill in El Dorado County within the SFAR region in Camino. They are the largest private land holder in California with over 1.5 million acres of timberland in northern California, including 76,476 acres within El Dorado County (EDC assessors 2007). Although revenues from timber production have been dropping over the years as less timber is harvested, it still represents a significant component of the local economy. In 2006 the combined public and private harvest of 288 million board feet (mbf) generated 29.5 million dollars (EDCDA 2007). These figures dropped to 93.5 mbf in 2007 at a value of 18.5 million dollars. Timber production will continue to be important in the region. Increasing environmental regulations and greater emphasis on managing ecosystem health within public forests will require silviculturists to use the whole range of tools available to them.

4.5.4 Recreation

The SFAR watershed stretches from the eastern boundary of Sacramento County near Folsom Reservoir to the high country of the Sierra Nevada in El Dorado, Amador, and Alpine Counties. The climate, majestic scenery, and cultural amenities of the SFAR watershed work in-concert to attract hundreds of thousands of recreationists every year. Many of the most popular recreation attractions in California, including numerous hiking and biking trails, are located in the SFAR watershed. As mentioned in Chapter 2, developed recreation sites are distributed throughout the project area ranging from campgrounds to day-use picnic grounds. Other significant developed recreation resources include river rafting put-ins and take-outs, rock climbing sites, ski resorts, reservoirs for boating and fishing, unique historic sites, and agricultural destinations.

The ENF is considered an "urban" forest due to its location within a one-hour drive from the metropolitan area of Sacramento with over one million people. In addition, the recreational opportunities within the ENF serve an even larger base that includes the eleven Bay Area Counties as well (Table 4-5). The Crystal Basin region of the forest, which includes Union Valley and Ice House Reservoirs, is a popular destination for cross-country skiing, fishing, boating, mountain bike riding, OHV use, and camping. In addition, the Desolation Wilderness (Wilderness), located in the upper reaches of the watershed is one of the most popular designated Wilderness Areas in the United States. The popularity of this Wilderness is due, in part, to its beauty and easy accessibility from major urban centers. Large portions of the western half of this Wilderness are located in the SFAR watershed. In addition to recreation sites managed by the ENF there are number of city, county and private parks scattered throughout the watershed (GDRCD 2003).

Sierra-at-Tahoe and Kirkwood Resort are the primary ski resorts in the watershed. Kirkwood is a year-round resort in Alpine County at the headwaters of the SFAR with spectacular scenery, numerous accommodations, and a variety of recreation opportunities. Folsom, Ice House, and Union Valley Reservoirs are popular boating and fishing lakes. In addition there are several popular historic sites including: Marshall Gold Discovery Park, Gold Bug Park, and historic Main Street in Placerville. Chili Bar, Salmon Falls, and Coloma are important rafting put-ins and take-outs along the SFAR, one of the most popular whitewater rafting destinations in the United States (EDC 2003).

The SFAR watershed is also home to one of the most well known rock climbing sites in the region – Lover's Leap. Close to the SFAR and Highway 50, the area contains steep-walled domes of granite that invite world class rock-climbers to the area. Most of these rock climbers stay at the nearby Lover's Leap Campground (GDRCD 2003).

4.5.5 Aesthetics

Scenic or aesthetic resources refer to those qualities of a landscape that "are aesthetically pleasing to a viewer" (EDC 1994). The scenery, open spaces, and outdoor recreation opportunities in the SFAR watershed attract millions of tourists to the area while simultaneously providing important wildlife habitat. It is these same resources that attract people to live and work in the SFAR basin area. Recreational opportunities associated with the aesthetic resources of the area include numerous campgrounds, hiking and biking trails, streams and lakes for fishing, river rafting, boating, and miles of off-highway vehicle roads. Total travel expenditures in El Dorado County in 2005 were $629.3 million, tourism business earnings were $232.1 million and taxes generated as a result of travel and tourism were $39.5 million (CED 2007).

The SFAR watershed contains several scenic roads. The State Scenic Highway System includes a list of highways that are either eligible for designation as scenic highways or have been so designated. In El Dorado County there is one designated Scenic Highway in the SFAR watershed area - U.S. Highway 50 from near Forni Road, east to the Sierra Crest. In addition, State Route 49 is eligible for designation where it traverses the project area. According to the Caltrans website all of Highway 88 where it traverses the SFAR watershed, and all of Highway 193 in the project area are designated scenic routes. There are also a number of El Dorado County roadways in the project area adopted under the previous El Dorado County Scenic Highways Element (EDCGP 2004) as local County Scenic Roadways including: Green Valley Road, North Canyon Road, Carson Road, Georgetown Road (Highway 193 between Cool and Georgetown), Wentworth Springs Road, and Icehouse Road.

In addition to scenic roads, the 2004 *El Dorado County General Plan* describes the SFAR as a "Scenic River Corridor" stating that the *Management Plan for the South Fork of the American River* provides overall guidance for the long-term use of the river and adjacent riparian lands. The protection of the environmental quality of the river and the maintenance of its values are listed as two of the important goals of the management plan.

4.5.6 Mining History

In 1847, James Marshall found the perfect spot on the SFAR, in the town of Coloma, for a sawmill John Sutter needed. In January, 1848, while working on the mill with his men, Marshall found gold in the tail race of the sawmill. At first Sutter tried to stem the knowledge of the discovery of gold, but by March of 1848, word was out. California's military governor, Richard B. Mason, led a unit of dragoons to the gold fields. California historian, Theodore Hittell described in 1897 what the dragoons saw: idle mills, vacant houses, abandoned fields and farms. San Francisco was almost deserted. "Every blacksmith, carpenter and lawyer was leaving; brick-yards, saw-mills and ranches were left entirely alone" (SEA 2003).

Coloma was a tent city of miners getting very rich, Mason reported to President James K. Polk. Polk saw the news as a way to popularize his recent unpopular war with Mexico and by December of 1848 news of the gold discovery had spread around the world. The resulting increase in California's population has never been established, but estimates place it at 100,000 by the end of 1849 and double that figure by the end of 1850 (SEA 2003).

Miners spread out from Coloma and the rivers to pan and placer mine every hill, gully and crevice in the foothills. Knowledge of where to find gold was limited at first, but that did not matter as gold was easy to find with simple and inexpensive techniques (SEA 2003). Early gold rush California had very little to offer miners. There were few roads and few hotels outside of the larger towns. There were no grocery stores or hardware stores and food supplies were extremely limited. Supply ships were abandoned as sailors jumped ship to mine. The primary need quickly became that of food; miners suffered from malnutrition and a variety of illnesses directly related to poor nutrition. Some miners shifted to gardening and farming as early as 1849-50, and often found these endeavors more profitable than panning for gold.

By 1852 gold was becoming hard to find and new techniques with greater effects on the surrounding land were used to get gold out of the ground. These techniques used water to wash hillsides (hydraulic mining) or to run quartz lode mills and crush rock. The hydraulic mines blasted away at ancient river gravels that held much gold (SEA 2003). Still evident today are the ditches dug as early as 1849-50 used to convey the water for mining operations. In fact, many of these mining ditches are still used today in water purveyors' conveyance systems throughout the Sierra Nevada.

The Deep Blue Lead mine ran from the vicinity of the SFAR through Smith Flat and over to Coon Hollow near Diamond Springs. Claims on the mine included the Fremont, Big Tunnel, Kumfa, Hook and Ladder, Lyons and Company Mine, Henry Clay and many others. These claims individually produced reported values of gold ranging from $100,000 to over ten million during the gold rush era (SEA 2003).

Some notable miners of the Deep Blue Lead included Francis A. Bishop who would engineer the railroad into part of El Dorado County and engineer the construction of the large El Dorado and Main Canals supplying mines with water throughout the Placerville and Diamond Springs areas. With World War II, gold mining was declared non-essential (Limitation Order L-208) (SEA 2003). Although the Order was rescinded later, mining never again resumed its importance in El Dorado County.

4.5.7 Hydro-power Generation

The hydroelectric power generated from the SFAR watershed supplies a number of households in the State of California. The hydroelectric projects within the SFAR watershed together generate approximately 2.8378458 billion kWh of energy annually. Considering the average house on the west coast uses about 8000 kWh per year, it is estimated the hydroelectric projects within the SFAR watershed supply power to approximately 354,730 homes. Please see figure 4.2 for a visual representation of the locations of this power producing infrastructure.

4.5.8 Urbanization and Growth

The growing metropolitan population in the Sacramento area is spilling into this region fueling demand for water and other natural resources. Population centers are mostly in the foothills of the Sierra Nevada and along the major Sierra highways. One of these highways, Highway 50, runs east through El Dorado County. Main population centers in the SFAR region include: Placerville, Pollock Pines, Shingle Springs, El Dorado Hills and Cameron Park.

The current population figure for the SFAR planning area is estimated at 176,000. Population increases are expected to climb to a staggering 100 to 500 percent for Sierra counties in the next ten years. The population in this region is overwhelmingly white (as high as 94% representation in Sierra County); the next largest ethnic group is Asians, though Black or African Americans are the largest group after whites in Amador County.

4.6 Flooding

Since the SFAR originates in the High Sierra, a tremendous amount of precipitation can fall during winter storms that originate in tropical latitudes of the Pacific, and thus the storms move east across the region. The elevation gradient “squeezes” moisture out of these storm systems as they rise over the Sierra Nevada. This process of “orographic enhancement” is responsible for the rain shadow effect on the east side of the Sierra Nevada and is driven by adiabatic cooling of the air mass. As air cools it holds less water vapor and as the water vapor condenses it falls as precipitation. In the SFAR watershed, this water makes its way down to Folsom Reservoir, a flood control/water supply project for the greater Sacramento Metropolitan Region. Activities that increase flooding and flood-related impacts in the SFAR watershed affect the entire Sacramento Region, which includes 40 billion dollars worth of damageable property, over 400,000 people, 5,000 businesses and 1,300 public facilities within the dam's protected area (SWRCB 2008).

In late 1996 a series of storms dumped a heavy snow pack in the region, followed by warm rains into New Years Day, 1997; 6-day storm totals in the SFAR region ranged from 10-14 inches (NWS 2008), causing the SFAR to peak above 71,000 cfs, as measured at the Chili Bar Gage. In addition, significant flooding occurred in the region in 1986. The flooding from these storm systems caused widespread damage throughout Northern California, and highly impacted localized areas throughout the SFAR watershed, including the City of Placerville. These flooding events forced officials to re-evaluate how 100-year flood events are estimated for the region, and what is needed to provide necessary flood protection for the entire Sacramento Basin.

4.6.1 Wastewater Overflow

Some flood-related impacts affect people and the environment. Local flooding can overwhelm wastewater treatment plants and lead to untreated water entering streams and water bodies, posing a health risk. The influx of nutrients associated with wastewater also impacts aquatic wildlife by triggering large algal blooms, which has a cascading impact on the aquatic ecosystem. The Hangtown Creek Wastewater Treatment Plant at the west end of Placerville treats wastewater for the City of Placerville. It is the only wastewater treatment plant within the SFAR watershed. It has been flooded in the past, leading to a discharge of sewage into Hangtown Creek and the SFAR. It is currently being upgraded to reduce the likelihood of future overflows.

4.6.2 Urban Runoff

New development converts permeable landscapes to less permeable areas, and therefore causes increased and more immediate runoff. These development-induced effects in the watershed increase the size and frequency of localized flooding (USGS 2003). These impacts must be addressed in the planning stages of new developments where emerging technology and innovative planning can help offset the effects of urbanization on runoff. Techniques that promote infiltration, such as vegetated swales, permeable pavement, soil amendments, and other methods to reduce impervious surface area can significantly reduce runoff (USGS 2003). In addition, applying these principles helps reduce overall water pollution associated with urban runoff (oil, pesticides, and sediment), sending clean water to local streams and rivers.

4.6.3 Slope Stability

Because of the mountainous terrain in much of the SFAR watershed, slope stability can be compromised after prolonged periods of rain. Landslides are not uncommon along El Dorado County roads and highways. Highway 50, along the upper reaches of the SFAR is particularly at risk due to landslides, especially following wildfires (See Section 4.7.4 below). The USGS has monitoring sites along the slopes above these sections of Highway 50 to serve as an early warning system. Sections of Highway 49 and 193 are also at risk and have had significant closures in the past. Mosquito Road, just north of Placerville, was closed for 204 days following a mudslide in 2005. New building and road construction projects need to consider slope stability for the safety of the public.

4.6.4 Homes and Businesses

The areas within the watershed that are most at risk from flood damage are along the SFAR itself. These areas are not heavily populated, as most of the community centers are near Highway 50 in the western portion of the region. The communities of Coloma and Lotus are the primary population centers along the SFAR. Farther east, where Highway 50 parallels the river, several small communities are at risk, including; Kyburz, Silverfork, and the numerous tracts of cabins along the river. The Highway itself is also at risk in the eastern portion of the watershed and has been closed down several times due to flood-induced landslides. As described below in Section 4.7 Fire, landslides have occurred that are associated with increased runoff from significant precipitation events followed by wildfire. These events have closed Highway 50 for weeks at a time. Loss of life and substantial economic impacts can result from flooding in the region.

Many of the tributaries of the SFAR top their banks in wetter than normal years, creating localized flooding. In particular, Hangtown Creek floods portions of the City of Placerville occasionally and a 100-year flood, as mapped by Federal Emergency Management Agency (FEMA), would put much of Main Street and a portion of Highway 50 under water (FEMA 2008). Additionally, inhabited areas along Weber, Dry, and Greenwood Creeks are at risk from 100-year flood events (FEMA 2008). While not a threat to a major population center within the watershed, flooding associated with the SFAR has a major influence on a very significant population center below Folsom Dam. As such, management of the watershed involves these stakeholders and may include future flood control projects upstream of Folsom Dam.

4.6.5 Sediment

The primary environmental concerns associated with flooding are due to changes as a result of urbanization and other disturbance around creeks and rivers. Changes in flooding patterns effect sediment transport processes. Higher flows on urban creeks and streams can result in changes to channel geomorphology and physical habitat, including stream bank erosion, stream channel instability, elevated levels of turbidity and fine sediment, channel widening or incision, stream bed scour, and the washout of in-stream structural elements (Shaver et al.. 2007). These physical changes alter aquatic and riparian habitats in a variety of negative ways as summarized in Section 4.3. An increasing number of creeks in the western portion of the SFAR watershed are subject to these changes. Examples include: Hangtown, Weber, Dry, Indian, Green Spring, New York, and Allegheny Creeks. Hangtown Creek is particularly impacted as it has been extensively altered over the years and is so close to downtown Placerville. Green Spring, New York, and Allegheny Creeks are in close proximity to sub-urban development in Cameron Park and El Dorado Hills.

Periodic flooding related to spring runoff serves a critical function in the fluvial geomorphologic process. Under natural conditions, rivers and creeks of the Sierra Nevada receive a spike of runoff related to snowmelt in the spring. This spring flood serves important ecological functions, primarily related to sediment transport and deposition. Accumulated sediments in the creek are redistributed within the floodplain area and throughout other reaches of the creek. In addition these spring floods can redistribute coarse woody debris, which provides important structure for fish and other aquatic wildlife. Moderating spring flows with controlled reservoir releases can have the effect of narrowing the channel and causing encroachment of riparian vegetation. In addition, the riparian species composition can be altered since scouring events are less frequent and water tables change due channel incision. The use of pulsed flows in reservoir-regulated creeks and rivers is an important tool for resource managers. This type of flooding can be very good for maintaining a more natural, native ecosystem through the re-supply of nutrients, sediment, and spreading of seeds.

4.7 Catastrophic Wildfire

Wildfire poses an ever-increasing risk to the people and infrastructure of the region as development expands into wildland throughout the SFAR region. This increased urban-wildland interface coupled with substantial increases in fuels throughout the region creates a condition which seriously threatens the people, infrastructure, habitats, and water quality of the SFAR watershed. The reduction of fuels is critical in minimizing the risk of catastrophic wildfire. Catastrophic fires in forested areas cause substantial erosion and sediment input from burned slopes. Past management activities such as overgrazing, selective harvesting, and fire suppression, along with periods of high moisture have increased the fuel loadings, and in turn, increased the risk of catastrophic fires. Figure 4-4 shows the relative fire hazard in the region (mapped by CDF) and locations and sizes of historic fires.

4.7.1 Infrastructure and Human Life

The U.S. Highway 50 corridor has been a focal point for population growth within the Sierra Nevada, making the SFAR watershed one of the most impacted watersheds in the Sierra Nevada. As stated above, the threat of wildfire within the increasing urban-wildland interfaces of the region presents a tremendous risk to people and infrastructure. As part of the National Fire Plan, the California Fire Alliance has created a list of communities at risk of damage from wildfire. The list was developed by multiple agencies in 2000 to assist communities with wildland fire prevention and protection. Eleven communities within the SFAR watershed are on the list: El Dorado Hills, Cameron Park, Shingle Springs, Diamond Springs, Coloma, Cool, Georgetown, Kelsey, Placerville, Pollock Pines, and Kirkwood (Alpine County). According to 2000 Census figures, well over 55,000 people reside in the communities above (Census 2000). Certainly, other communities not on the list and additional people who have moved to the area since the year 2000 would increase that number.

Not only are the people, businesses, and residences of these communities at risk, but other valuable infrastructure is also at risk. Public utility infrastructure is scattered throughout the watershed in areas at significant risk of wildfire. Above-ground, linear features are considered to be the most at-risk public utility facilities due to wildland fire. Either short-term or long-term power and/or water conveyance outages could have substantial social and economic impacts to local and regional communities. Such above-ground features would include wooden water supply conveyance flumes and high voltage transmission or sub-transmission (69 kV and above) lines, especially those that are radial, single direction feeds to communities or delivery paths from power supply sources (e.g., hydroelectric plants). Facilities that are located in areas with high fire hazard represent significant concerns for the reliability of water and power service to communities.

Utilities include numerous powerhouses and flumes associated with the UARP (SMUD), the El Dorado Hydro Project (EID), and Chili Bar Project (PG&E), and the Hangtown Creek Wastewater Treatment Plant (City of Placerville). High-voltage power lines generally run east-west through the SFAR watershed, conveying hydropower to the

Sacramento region. Irrigation ditches that are part of the Georgetown Divide system, Weber Creek system, and the Sly Park aqueduct are also at risk. Increasingly numerous telecommunications towers are at risk as well. In general, the potential for direct impacts to domestic water supply and wastewater treatment plants from fire is considered to be low because such facilities are often located in more urbanized areas of SFAR basin communities and much of the conveyance system is underground.

4.7.2 Habitat

The SFAR watershed supports a wide variety of natural resources that are at risk of loss due to an excessive build-up of flammable material. Wildfires today are often more severe than those of pre-settlement times due to fire suppression and other management activities (STSC 1996). Prior to settlement of the area, data suggests that most of the habitats within the SFAR basin had median fire return intervals of less than 20 years, except for some high-elevation conifer stands (STSC 1996). High-intensity fires such as the Cleveland Fire of 1992, which burned over 24,000 acres along the SFAR, can have long-lasting effects on the environment. These fires not only remove all of the vegetation, but can affect soil properties on the surface and at some depth. Depending on the severity of the fire, substantial portions of the litter and duff component of the soil can be lost. In fact, large and severe fires can lead to long term and broad-scale ecological impacts that effect habitats for virtually all organisms dependant on the ecosystem.

The special-status species and important habitats discussed in previous sections are of particular concern with regard to wildfires. Because these habitats (e.g. old growth forests) and species (e.g. CRLF and gabbro-endemic plants) have limited distribution, a single significant fire can wipe-out most of the known occurrences of a species or habitat. In particular, the gabbro-chaparral plants of the Pine Hill formation are at considerable risk. These species are adapted to frequent fires but intense fires could destroy the seedbank and/or destroy the living tissue below-ground, preventing re-sprouting. Some of the listed species may increase their populations dramatically after an intense fire; however, because the effects of fire frequency and intensity are not well understood for most of these species the risk of loss should be assumed (USFWSb 2002).

One potential and often over-looked implication of forest management practices (notably, fire suppression), is the effect on water supply. Fire suppression and reduced timber harvest has led to more vegetation, and therefore more water lost due to evapotranspiration (McColl and. Powers.1984).The degree of this impact on water yields would be difficult to quantify and dependent on the vegetation community and type of disturbance; a topic that should be considered for more research. Over the years we may have unwittingly reduced our potential water supply by allowing our forests and scrublands to increase in density, amplifying our current struggle with water supplies in California. As we look for ways to increase our water supply, forest and other wildland management strategies may prove to be important tools.

4.7.3 Sediment

Increased erosion and sediment transport following major fires can significantly impact terrestrial and aquatic ecosystems. Lack of surface vegetation and litter following a major fire often leads to increased erosion of topsoil. The loss of topsoil and associated nutrients reduces overall forest productivity for many years and much of the lost soil ends up in creeks and rivers. High flows following major fires will scour rivers and creeks, eroding the channel and releasing more sediments. Where sediment accumulates on previously gravel-bottom beds, salmonid spawning habitat is affected as is the composition of macroinvertebrates (STSC 1996). The length and severity of these changes is dependent upon the nature of the fire, the climatic pattern following the fire, and management activities following the fire. Nutrient levels in creeks and rivers can also increase following major fires, due to sediment deposit. These changes are usually very short-lived and have temporary effects, such as algae blooms. Algae blooms can deplete dissolved oxygen levels and affect light penetration in streams and water bodies; further impacting aquatic species diversity and richness over the short term.

4.7.4 Precipitation and Runoff

When heavy rainfall, steep slopes, and wildfire mix, as in the SFAR canyon, there is the potential for massive erosion rates and significant landslide events. Mechanical stability of the slope continues to deteriorate for about 10 years following a fire, until new tree roots increase in density to replace decaying roots from burned trees (Ziemer 1981). In the headwaters of the SFAR a heavy storm in June of 1982 caused the erosion of more than 19,000 cubic meters (15 AF) of soil (Kuehn 1987). The Highway 50 corridor has experienced a number of major landslides, often following fires. The year following the massive erosion event above, a major landslide near Whitehall closed the highway for 75 days. Again in 1997, heavy rainfall in an area recently burned along Highway 50 caused the Mill Creek landslide which closed the highway for over 4 weeks and had an estimated indirect economic impact of 1 million dollars per day on top of the 4.5 million dollar clean-up (Reid and LaHusen 1998). Additionally, the costs of water and wastewater treatment can be greatly affected by catastrophic fires because of the increased sediment and nutrient load and associated water treatment costs to achieve water quality standards.

4.7.5 Aesthetics and Recreation

Since fire is a part of the natural landscape, only very large fires have the potential to seriously affect aesthetic and recreational resources (see Section 4.5 for a discussion of recreational and aesthetic resources). Small and medium size fires are fairly common and do not dominate scenic vistas or destroy recreational sites. Aside from the direct loss of structures at significant historic or recreational sites, impacts to tourism as a result of degraded aesthetic values could be significant following a major fire, but difficult to quantify. A campsite within a severely burned landscape would surely loose its recreational appeal for many years but a lake within that same area may still draw some fisherman. Because the SFAR has so many outdoor recreational opportunities and tourism is largely based on these, it is safe to say that any large fire will have a detrimental impact on tourism and the quality of life for the people living in the region; many of whom live in the area because of the scenic beauty and recreational opportunities.

4.7.6 Soil Degradation

Fire changes the physical and chemical properties of the soil. Depending on the intensity of the fire these changes may be positive or negative. At relatively low ground temperatures, fire tends to speed up soil mineralization, leading to a short-term burst in available nutrients (STSC 1996). As fire intensity increases, the soil chemical and physical properties tend to degrade. The organic matter and nutrients in the top horizons is volatilized, accumulated ash and baked soil at the surface creates a water repellent crust leading to heavy runoff. Since surface litter and vegetation, which normally helps hold soil together and increases infiltration, have been burned away, heavy runoff transports sediments and nutrients into streams and rivers and the increased peak flows results in channel erosion. Erosion rates can increase from 200 to 400 times in the first few years following a fire, depending upon climatic conditions (STSC 1996).

4.8 Air Quality

The SFAR watershed is within two different air basins: the Mountain Counties Air Basin (MCAB) and the Lake Tahoe Air Basin (LTAB). The MCAB includes the jurisdictions of the El Dorado County Air Quality Management District (EDCAQMD) and the Amador County Air Pollution Control District (ACAPCD). The LTAB includes the Great Basin Unified Air Pollution Control District (GBUAPCD) which includes Alpine County.

El Dorado County is designated as “serious non-attainment” for the federal 8-hour ozone standard. Under the state regulation, El Dorado County is designated non-attainment for the 1-hour and 8-hour ozone standards and particulate matter less than 10 micrometers in diameter (PM_{10}) (EDCAQMD 2002). Amador County is designated as non-attainment for the state 8-hour ozone standard (CARB 2008). Alpine County is designated as non-attainment for the state 8-hour ozone standard, and particulate matter less than 10 micrometers in diameter (PM_{10}) (CARB 2008).

The MCAB and the LTAB is either designated as attainment or unclassified for the remaining federal and state standards for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), CO, sulfates, hydrogen Sulfide (H_2S), lead, and visibility reducing particles (CARB 2008).

It must be noted that the watershed air quality is largely affected by the general trend of wind currents in California, bringing coastal air through the valley and into the Sierra foothills. These currents also bring the pollution from these two intensely-populated areas, affecting the attainment of air quality standards in El Dorado County. This complicates the management of air quality within the watershed and the entire air basin.

4.8.1 Burning – Controlled and Wildfire

The MCAB Smoke Management Alliance (Alliance) is established and maintained to provide coordination and uniformity in smoke management efforts in the MCAB, recognizing the need for the role of fire in ecosystems management and for fuel reduction while protecting the public health (EDCAQMD 2002). Goals of the Alliance include: minimize smoke impacts on smoke sensitive areas, prescribed wildland burn coordination procedures for determining timing and placement of burns; cooperation of burn project public notices and cross jurisdictional notices; and, post-season/post-burn smoke management evaluations. Members of the Alliance include: MCAB Air Districts; state, federal, and private land managers, and neighboring jurisdictions with potential smoke impacts from prescribed burn operations with the MCAB.

4.8.2 Asbestos

The potential presence of naturally occurring asbestos (NOA) typically found in serpentine rock and soils is a concern associated with construction activities in western El Dorado County. Asbestos fibers are freed from the rock or soil when it goes through a crushing process and through the natural weathering process. NOA is classified as a known human carcinogen by state, federal, and international agencies, and was identified by CARB as a toxic air contaminant (TAC) in 1986 (CARB 2008).

The risk of disease depends upon the intensity and duration of exposure to NOA. Exposure to low levels of NOA for short periods of time poses minimal risk. High levels of exposure to NOA dust can cause NOA fibers to penetrate body tissues, and remain in the lungs and the tissue lining of the lungs and abdominal cavity (CARB 2008).

Concern regarding public exposure to NOA has resulted in the El Dorado County AQMD adoption of the NOA and Dust Protection Ordinance. This ordinance regulates the use of serpentine rock as a road surface, and contains general requirements for grading, excavation, and construction activities in areas identified to have NOA in the rock or soil. Areas within the SFAR Watershed that contain serpentine rock can be identified on the State Mining and Geology Board: Potential Asbestiform Minerals Map (SMGB 2008). In review of the map, the primary locations for potential asbestiform minerals take place intermittently within the western slope of El Dorado County; specifically the serpentine rock becomes more prevalent in the western portion of El Dorado County and the SFAR watershed.

4.8.3 Dust

In rural communities fugitive dust can be easily emitted into the atmosphere through vehicle use of unpaved roads, construction activities, and agricultural practices. While it is impossible to completely eliminate fugitive dust emissions, the local air districts strive to reduce the risk of dust emission through implementation of best management practices (BMPs) for grading, excavation and construction activity. In areas known to contain serpentine rock, dust must be kept at minimum. Minimal NOA dust emissions can be achieved by implementing BMPs during the construction phases of work to help ensure less-than-significant impacts to NOA air quality emissions.

4.8.4 Greenhouse Gases

California is the 12th to 16th largest emitter of CO_2 in the world (UCS ND). It is responsible for approximately two percent of the world's CO_2 emissions (CEC 2006). Prominent greenhouse gases (GHG) contributing to the global warming process include CO_2, methane, ozone, nitrous oxide, and certain fluorocarbons.

In response to the GHG issue, Assembly Bill 32 (AB 32) established legislation for the State of California to combat greenhouse gases and promote the development and use of energy-efficient technologies. Reduction of CO_2 emissions from private and public entities is the main focus of AB 32. The California Air Resources Board (CARB) is the primary state agency designated to implement the requirements outlined in AB 32.

The California forest protocols were developed by the California Climate Action Registry (CCAR) and are incorporated into AB 32. These forest protocols recognize that native forests and oak woodlands provide a benefit for reduction of man-made CO_2 in the earth's atmosphere. California forests are considered critical in the State's carbon balance, with the unique capacity to remove CO_2 from the air and store it long-term as carbon (CARB 2008).

Carbon capture and storage by sustainable forests and oak woodlands is an approach to mitigating global warming (CARB 2008). This process is known as carbon sequestration. The SFAR watershed provides a significant opportunity to increase the carbon storage on managed forest and oak woodland areas, by increasing the forest woodland growth through healthy and fully stocked stands.

The CCAR has also written a protocol for local governments, and is working on a more detailed protocol for waste water treatment plants. EID is a member of the CCAR and reports its greenhouse gas emissions on an annual basis. In the future, watershed stakeholders will need to be mindful of the greenhouse gas output and/or mitigation provided by implementation projects and transportation goals, as air quality affects all of our resources, and climate change will alter the paradigm of history-dependant planning.