

4.1 Introduction

High quality water is vital to natural processes and human activities within a watershed. Water quality is thus essential to the vitality of any area; all stakeholders within the region value high water quality, however, there is often conflict on how to best manage other resources and activities to achieve the high water quality. This chapter describes the water quality issues in the CABY region and the current and historic activities that have caused the degradation.

4.2 Water Quality Issues

Sediment, mercury, overall contamination, and water temperature are all issues that must be considered now and in the near future to ensure continued high-quality water in the CABY region.

4.2.1 Sediment

Sediment has been identified as a water quality problem in the CABY region. Sedimentation is a natural process on lands of varying elevation (all lands within the CABY region, and the vast majority of lands in the State). This process can be accelerated, however by human activity such as logging, unpaved roads, inadequate maintenance and/or overuse, recreation activities off roads and trails. Additionally, the housing and commercial development boom throughout the 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. Increased recreational demands on forested lands and development of privately owned lands have both contributed to increased sediment in CABY region waters.

It is recognized that natural levels of erosion and sediment deposition are important for such things as gravels for spawning, and sediment deposition for stream bank and floodplain

development. However, sediment deposition in the CABY region is beyond natural levels.

Sedimentation causes a substantial reduction in reservoir capacity, increases water treatment costs, frequently causes water quality standard violations, and can adversely impact aquatic biota and habitat.

Findings and Studies

Cosumnes Watershed

The Cosumnes River contains fine sediment loads that are likely caused by upstream land uses. Recent surveys of spawning gravel indicate that they are cemented by silt. This silt may have been introduced into the river primarily by past mining, grazing, road construction, and forestry practices.¹

In the Middle Fork Cosumnes River, sediment is being deposited and bank stability is being affected near Dogtown Creek due to suction dredging. Most of the disturbance consists of channel excavations, cobble piles, and bank cuts in the active channel, lower banks, and floodplain areas. All areas of the watershed have relatively high road densities and near-stream road densities compared to other watersheds in the Sierra Nevada.²

¹ Philip Williams and Associates (PWA) and The Nature Conservancy of California (TNCC) (1997). Analysis of opportunities for restoring a natural flood regime on the Cosumnes River floodplain. San Francisco, CA: TNCC.

The Nature Conservancy of California (TNCC) (1992). Cosumnes River Watershed strategic plan. San Francisco, CA: TNCC.

Hart and Engilis (1995). Middle Cosumnes River Watershed: River corridor and vernal pool / grassland study areas. San Francisco, CA: The Nature Conservancy of California.

Quidachay, K.B., Britting, S., Ehrgott, A. (2000). Upper Cosumnes River watershed conservation project: environmental assessment. Coloma, CA: American River Conservancy.

² USDA Forest Service, El Dorado National Forest (2002). Middle Fork Cosumnes River Watershed landscape and road analysis. Placerville, CA: USDA Forest Service.

In the North Fork Cosumnes River, as on other CABY rivers, many land use activities, past and present, have the potential to cause excessive erosion. Potential consequences of accelerated erosion include a reduction in the productive capacity of the soil, adverse effects on water quality, and heightened potential for landslides.³

A recent inventory of the Cosumnes watershed focused on channel and watershed processes as sources of sediment within the watershed. In the context of this inventory, channel processes are those processes that contribute sediment through either lateral movement of the stream channel (bank erosion and bar formation) or vertical movement of the streambed (degradation and aggradation). The project components that addressed these processes included channel classification, a bank stability survey, a ground disturbance survey, and an analysis of historical geomorphology. The bank stability survey found that for the Mountain Section (in the upper watershed), 81 percent of the stream banks surveyed had negligible amounts of bank instability, 17 percent had moderate amounts, and 2 percent had significant amounts of instability. In the Foothill and Valley Sections, 8% of stream banks surveyed had negligible amounts of bank instability, 33% had moderate amounts, and 59% had significant amounts of instability. Findings from the ground disturbance survey of 244 disturbed sites (representing 5,381 acres), indicated that almost half the sites (120) were located in the upper watershed.⁴ The sediment loads in the Cosumnes River as a result of erosion from land use activities, roads, and OHV use throughout the watershed are creating a water quality problem throughout the Cosumnes River watershed.

³ USDA Forest Service, El Dorado National Forest (2002). North Fork Cosumnes River Watershed landscape and road analysis. Placerville, CA: USDA Forest Service.

⁴ Jones & Stokes and Northwest Hydraulic Consultants (NHC) (2003). Cosumnes River Watershed inventory and assessment: phase two. Sacramento, CA: Jones & Stokes.

American Watershed

Past management activities in the watershed have resulted in soil compaction and erosion (e.g., roads, landings, and skid trails) in some areas. Eroded areas, due to these past management activities in addition to present land use activities such as timber harvest, recreation, and other uses, have reduced soil productivity and altered hydrologic functions. These areas are also at increased risk of surface runoff and gully erosion. Gully erosion is typically initiated by channelized water runoff from areas where water cannot infiltrate the soil such as roads.⁵

Many of the tributaries to the MFAR have been negatively impacted by past management activities such as over-grazing, road construction, and timber harvesting. In addition, many acres of the watershed burned during the Volcano and other wildfires. The Volcano burn area was windrowed and planted using management techniques considered state of the art for the time period (about 60 years ago). Pine trees were planted to the edge of streams. All of the past management activities have contributed to a stream system that shows evidence of bank cutting and undercutting, excessive sedimentation with pool filling and a lack of riparian vegetation.

Duncan Canyon, which flows into the MFAR downstream of French Meadows Reservoir periodically transports large amounts of bedload (cobble and gravel deposition), even though the channel is relatively stable. This sediment is principally derived from natural channel downcutting in the numerous unstable seasonal tributaries, as well as from some bank undercutting along the main channel that is exacerbated by periodic peak flow events.⁶

⁵ MacDonald, L. and Coe, D. (2005). Sediment production and delivery from the unpaved forest roads in the Sierra Nevada. Geophysical Research Abstracts, Vol. 7, 08831.

⁶ USDA Forest Service, Tahoe National Forest (n.d.) Middle Fork American River watershed assessment. Nevada City, CA: USDA Forest Service.

Spruce Creek, a high gradient perennial stream dominated by gravels and cobbles, flows into Duncan Canyon. Its channel is severely downcut for most of its length, with unstable banks and pool filling. Mining activities have been prevalent in this drainage as evidenced by tailings found frequently along the stream. Deep Canyon and Screwauger Canyon have also been affected by mining disturbance, resulting in a lack of riparian vegetation, undercut stream banks, sedimentation, and pool filling. Grouse Creek, a very steep gradient, gravel and coarse fines-dominated channel that empties into the North Fork of the MFAR, contains unstable channels (in the reaches above its confluence with Frazier Creek) characterized by extensive downcutting. Heavy amounts of sediment have deposited behind debris dams, causing flow to become subsurface in many areas. Frazier Creek is a moderately steep bedrock channel that has an extensive amount of downcutting. The headwaters flow through a meadow area that has been impacted by cattle, resulting in bank instability.

El Dorado Canyon is a bedrock-dominated perennial stream that flows into the North Fork of the MFAR. Its main stem is steep, entrenched and dominated by step pool formations. These steep reaches have high sediment transport potential.⁷

In summary, sediment is a prevalent water quality issue in the American River watershed. Erosion from land use activities, past and present, roads, and recreational use throughout the watershed contribute to the instream sediment problem.^{8,9}

West Placer Creeks

The West Placer Creeks are in an excellent position to facilitate a repopulation of

⁷ Ibid; USDA Forest Service.

⁸ Ibid, MacDonald and Coe.

⁹ Placer County Water Agency (PCWA) (2006). 2005 Physical Habitat Characterization Study Report-Middle Fork American River Hydroelectric Project (FERC No. 2079). Auburn, CA: PCWA.

anadromous fish. Because of a present population for fish and the accessibility of the fish to the creek network, there is a very real possibility for augmenting the fish population in this area.¹⁰ There are, however, some restoration efforts and improvements in water quality needed. In many portions of Antelope Creek and Clover Valley Creek the stream channel has high sediment loads and a lack of pools. Creating pool habitats, reducing sediment input to the channel, cleaning stream gravels to promote increased aquatic insect production, and ensuring that riparian vegetation is allowed to reproduce would improve conditions here and in many other areas. Improving sediment transport through the system would be an overall benefit to aquatic organisms in general. The physical habitat conditions in the channel, specifically the amount of sediment, are a limiting factor for juvenile fish production. A major reduction in the quantity of sediment entering the channel is critical to improving hatching and emergence success and long-term juvenile rearing capability.¹¹

Bear Watershed

The Bear River contains a large volume of mining sediment stored in its main channel that is subject to continual erosion. Due to its low-elevation headwaters, relatively low average annual discharge (around 273,000 acre-feet), and protracted sediment releases from water storage reservoirs, this sediment has not been flushed, but continues to cause problems for fish habitat in the river.¹² In addition to sediment,

¹⁰ Donald Bren School of Environmental Science and Management, Master of Environmental Science and Management Class of 2003 Group Project Brief (2003). Available on the web at www.bren.ucsb.edu.

¹¹ Bailey Environmental (2003). Streams of western Placer County aquatic habitat and biological resources resource assessment. *Prepared for Placer County Planning Department*. Lincoln, CA: Bailey Environmental.

¹² James, L. A. (1988). Historical transport and storage of hydraulic mining sediment in the Bear River, California: A study of the timing, volume and character of hydraulic mining sediment production and channel responses to the sediment as well as present conditions.

the lower Bear is listed on the EPA 303(d) list for mercury, mostly due to legacy mining tailings. This high volume of mining sediment, in combination with restricting levees, has caused the Lower Bear channel to become deeply incised.¹³ Additionally, the Bear River channel has not returned to pre-mining levels due to two main factors: 1) as mentioned, the Bear River headwaters are at relatively low elevations, resulting in discharges of low-to-moderate magnitude, and 2) hydraulic mining sediment was of much larger magnitude than in other local watersheds.¹⁴

Yuba Watershed

The Yuba River watershed contains a significant amount of sediment as a result of historic mining. Historic hydraulic mining involved directing high-pressure water cannons at exposures of Eocene gravel and washing the excavated sediment slurry through mercury-laden sluice boxes. Hydraulic mine tailings were conveyed into adjacent watercourses, leading to dramatic increases in sediment loads and severe aggradation. Gilbert (1917) estimated that hydraulic mining contributed approximately 682 million cubic yards of sediment to Yuba River channels. Extensive remobilization of stored hydraulic-mining sediment began as early as 1861 when severe winter storms delivered substantial volumes of sediment to the Central Valley. In 1941, the California Debris Commission built Englebright Dam to trap hydraulic-mining sediment mobilized in the Upper Yuba River watershed. The majority of the Middle Yuba River and South Yuba River channels have since recovered their pre-mining bed elevations; however, significant volumes of hydraulic mining sediment remain stored in wide main stem reaches and in smaller upland tributaries of these two rivers. Studies of the Yuba River and adjacent watersheds suggest

¹³ Eberhart, Allan (2006). White Paper: Bear River Watershed Assessment. Retrieved June 6, 2006, from <http://motherlode.sierraclub.org/4-BearRiver.htm>.

¹⁴ Ibid, James, L. A.

that these smaller tributaries are asymptotically incising toward pre-mining channel-bed elevations; therefore, remobilization of hydraulic mining sediment continues to affect sediment yields from impacted basins.¹⁵

Sediment loads in the Yuba watershed can also be attributed to other human activities such as road construction associated with rural housing development, logging, and recreation. A tributary of the South Yuba River, Humbug Creek, is listed as a 303(d) water body under the Clean Water Act for sediment. The Upper Yuba is also considered a “priority watershed” for action by the State under the California Unified Watershed Assessment. There are many impacts within the watershed that contribute to these listings, including dams and diversions, abandoned mine lands, high road densities, and poor logging practices. The high concentrations of suspended sediment in the Humbug Creek watershed can be attributed to abandoned mines in the Malakoff Diggins Historical State Park and clearcuts on private lands.¹⁶

Sediment is a water quality issue in the Yuba River watershed. Mining legacy and erosion from roads and OHV use throughout the watershed contribute to the instream sediment problem.¹⁷

4.2.2 Mercury

In the mid to late 1900’s mercury was mined from coastal California and brought to the foothills of the Sierra Nevada to amalgamate with gold, making the precious metal more easily found in the sand and gravel of the streams of Nevada, Placer, and El Dorado

¹⁵ Curtis, J.A., Flint, L.E., Alpers, C.N., Wright, S.A., and Snyder N.P. (2006). Sediment transport in the Upper Yuba River Watershed, California, 2001–03. In *U.S. Geological Survey Scientific Investigations Report 2005-5246*, 74 pp. Retrieved October 23, 2006, from <http://pubs.usgs.gov/sir/2005/5246/>

¹⁶ Schilling, F. (n.d.). State of the Yuba: an assessment of the Yuba River watershed. Nevada City, CA: University of California.

¹⁷ Rainey, Jason (Executive Director, South Yuba River Citizens League). Personal Interview. April 25, 2006.

Counties. Mercury use presents a mining legacy of extensive, often toxic water quality challenges throughout the CABY region. In many places mercury concentrations violate federal water quality limits. Deposition of mercury with sediments is a problem in reservoirs and streams, as it leads to bioaccumulation in the environment and fish, leading to public health concerns.

Findings and Studies

Management and restoration of the Bay-Delta ecosystem is complicated by mercury contamination from historic mining sites in the Sacramento and San Joaquin river watersheds, the principal sources of fresh water for the Bay-Delta system. Mercury-enriched sediment now contaminates extensive downstream reaches of streams and rivers. A challenge to scientists and managers involved with restoration of this ecosystem is to avoid increasing exposure of biota to methylmercury, a highly toxic form of mercury occurring when the metal is exposed to higher-temperature waters. This form of mercury readily accumulates in exposed organisms and biomagnifies (concentrates) in fish and wildlife at the top of aquatic food webs. It is important that methylmercury exposure in this ecosystem be reduced to levels where fishery resources, wildlife, and human health are unaffected. The development of an effective approach for remediation, however, is presently hampered by our very limited knowledge of mercury cycling in this ecosystem. The production of methylmercury via the microbial methylation of inorganic divalent mercury in the environment is a key process affecting methylmercury concentrations in biota at all trophic levels. Natural processes and human activities – including both infrastructure-type and ecosystem restoration projects – that alter the net production of methylmercury (i.e., methylation minus demethylation) can influence the abundance of methylmercury in the ecosystem and the associated exposure of resident biota and humans who consume fish and other aquatic biota from the ecosystem. For information regarding actions CABY is taking to investigate the effects of water temperature on mercury methylation

(especially as related to climate change concerns), please see Chapters 9 and 10)

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.

From 1900 to 1960 several billion cubic meters of alluvial material was dredged for gold, and millions of pounds of mercury was discharged. These alluvial “dredge fields” are generally downstream from dams on the major tributaries – including the Yuba, American, and Bear rivers – and are situated in floodplains that provide critical habitat to anadromous fish. Many of the dredge fields contain mercury-contaminated tailings from hydraulic-mining activities that took place further upstream before dams were constructed. Additional mercury was released in association with dredging processes at these alluvial sites. The release of mercury from gold mines in the Sierra, and the form of mercury in those mines has not been extensively studied (relative to mercury mines); however initial observations indicate that it may be more readily methylated. Elemental mercury and gold-mercury amalgam are often visible in streams draining hydraulically mined areas of the Sierra Nevada and in the dredged goldfields downstream, such as those on the Yuba and American rivers. Data concerning mercury and methylmercury in water, sediment, and biota from sites in the Bear River watershed are available online (<http://ca.water.usgs.gov/mercury/bear-yuba/>).¹⁸

In addition to mercury contamination, historic hydraulic mining has left the Bear and Yuba

¹⁸ Wiener, J.G., Gilmore, C.C., and Krabbenhoft, D.P. (2003). Mercury strategy for the Bay-Delta Ecosystem: a unifying framework for science, adaptive management, and ecological restoration. La Crosse, Wisconsin: University of Wisconsin.

Rivers and watersheds with a legacy of eroding hillsides and excess sediment. The USGS estimates that 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. The mercury is present in the bottom (benthos) of rivers and reservoirs, as well as in pits, sluices, and tunnels remaining in abandoned mine lands where it can be mobilized. It is transported by erosion and runoff as elemental mercury and in ionic form (e.g., Hg²⁺), in dissolved form, adsorbed to particles, and as droplets of the metal. The 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, [ppm]). The accumulation of near toxic levels of mercury in many low- to middle-elevation reservoirs of the western Sierra¹⁹ 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.

Mercury contamination is a pervasive issue in the Bear²⁰, American and Yuba River watersheds.²¹ The findings in the most recent

¹⁹ SNEP Science Team and Special Consultants (1996). Summary of the Sierra Nevada ecosystem project report. *Centers for Water and Wildland Resources*. Davis: CA: University of California.

²⁰ Alpers, C.N., Hunerlach, M.P., May, J.T., Hothem, R.L., Taylor, H.E., Antweiler, R.C., De Wild, J.F., and Lawler, D.A. (2005). Geochemical characterization of water, sediment, and biota affected by mercury contamination and acidic drainage from historical gold mining, Greenhorn Creek, Nevada County, California, 1999–2001. In *U.S. Geological Survey Scientific Investigations Report 2004-5251*, 278 p. Retrieved October 23, 2006, from <http://pubs.usgs.gov/sir/2004/5251/>

²¹ Rainey, Jason (Executive Director, South Yuba River Citizens League). Personal Interview. April 25, 2006.

Templin, Bill (American River Watershed Group). Personal Interview. April 27, 2006.

and comprehensive survey of fish in the Yuba and Bear watersheds meet and exceed EPA/Office of Environmental Health Hazard Assessment and Food and Drug Administration levels:

- 1) Englebright Reservoir: all smallmouth and spotted bass that were >1 foot and >250 grams (1/2 lb) had levels >0.3 ppm;
- 2) Scotts Flat Reservoir: most largemouth bass >1 foot and 500 grams (1 lb) had levels >0.3 ppm;
- 3) Rollins Reservoir: most channel catfish and most largemouth bass >1 foot and >400 grams had levels >0.3 ppm;
- 4) Lake Combie: all largemouth bass >1 foot and >400 grams had levels >0.7 ppm
- 5) Camp Far West: all spotted and largemouth bass and channel catfish >1 foot and >300 grams had levels >0.5 ppm, half of the spotted bass exceeded FDA level of 1.0 ppm; and
- 6) Bear River at Dog Bar Road and Little Deer Creek at Pioneer Park: half of brown trout sampled >10 inches and >200 grams had levels >0.3 ppm.

In addition to abandoned mines in the watersheds, mercury can originate from the atmosphere. The USGS and others are conducting measurements of mercury and methylmercury in the biota, sediments, and waters in reservoirs and near/within abandoned mine lands of the Yuba/Bear systems. There does not appear to be direct measurements for the atmospheric deposition of mercury. There are also few measurements for the waters and sediments of the Upper Bear and Yuba rivers and their tributaries. Though research is limited, it is known that mercury is leaking gradually from abandoned mine tunnels, sluice boxes, and pits. Dredge tailings are also thought to be a potential hotspot, as is sediment disturbance during secondary mining near abandoned mine features, or in contaminated sediments. Mercury is also assumed to be slowly migrating downstream in the creeks and rivers,

Leimbach, Julie (Sierra Nevada Alliance). Personal Interview. April 27, 2006.

Osterholm, Lesa (Watershed Coordinator, Bear River Watershed Group). Personal Interview. April 28, 2006.

temporarily lodging in the benthic sediments and pockets in the channel bedrock.²²

4.2.3 Contamination

Contamination of water resources from pollutants other than mercury and sediments occurs throughout the CABY watersheds. Biological contamination in the CABY region comes from many sources including recreational activity, failing septic systems, and/or areas of high concentration of stock animals. For example, the South Fork American River is one of the most heavily used white water rafting rivers in the State, and it also supports hundreds of kayakers, hikers, fishermen, and swimmers each summer. Other rivers within the region are equally utilized by persons seeking recreational activities. In addition, many residences along the rivers within the CABY region have septic and waste water management systems that may be contributing to biological contamination. Identifying sources and management strategies regarding biological contamination requires more research, especially as recreational use increases.

Increasing development and the resulting conversion of pervious (or permeable) lands to impervious surfaces results in pollutant spikes during storm events.²³ Extreme runoff from urban areas results in unnatural flow surges and carries hydrocarbons, bacteria, lawn chemicals, and a host of other pollutants to the river systems.

Findings and Studies

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 mercury), intensive land-use zones, and biological contamination by human pathogens, especially *Giardia*.²⁴ Non-sediment, non-mercury contaminants in the CABY region include other metals, microbes and biological contamination, pesticides, nutrients, and hydrocarbon fuel. 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.²⁵

Additionally, runoff from illegally dumped household refuse and official municipal waste dumps can contribute towards the problem of contamination.

Urbanization is a CABY-wide issue, affecting water quality throughout the region.²⁶ For example, the conversion from range and forest to housing subdivisions and commercial developments is occurring in the Bear River watershed. This conversion increases the amount of impervious surfaces, introducing urban pollutants to stream systems.²⁷ Wolf Creek, a tributary to the Bear River, is listed as a 303(d) water body for *E. coli* (see Table 4.1). Failing septic systems, leaking pipes from urban areas, leaking landfills, and the occasional failure of sewage treatment plants causes the introduction of partially treated or untreated sewage in water bodies.²⁸ This is not

²² Schilling, F. (n.d.). Mercury contamination in the Yuba and Bear Watersheds. Nevada City, CA: University of California.

²³ Schmitt, J., and A. Michael (2004). Rainfall infiltration under urban soil surface conditions – experiment and model results. In *13th Annual Soil Conservation Organisation Conference: Conserving Soil and Water for Society: Sharing Solutions*. Brisbane, July 2004.

²⁴ SNEP Science Team and Special Consultants. 1996. Summary of the Sierra Nevada Ecosystem Project Report. Centers for Water and Wildland Resources, University of California at Davis.

²⁵ Black & Veatch Corporation and Standish-Lee Consultants (2002). Watershed sanitary survey update and source water assessment. Sacramento, CA: Black & Veatch Corporation.

²⁶ Booth, D.B. and C.R. Jackson. 1997. Urbanization of aquatic systems-degradation thresholds, Stormwater detention, and the limits of mitigation. *Journal of the American Water Resources Association*, v. 22:1-20.

²⁷ Ibid. Booth, D.B.

²⁸ Nevada County Resource Conservation District (NCRCD) (2004). Bear River watershed management plan. Grass Valley, CA: NCRCD.

Watershed	Water Body	Pollutant/ Stressor	Potential Sources	TMDL Completion (proposed)	Estimated Size Affected
Cosumnes	Cosumnes River	Exotic Species	Source Unknown	Low	53 miles
American	South Fork American River	Mercury	Source Unknown	Low	37 miles
Bear	French Ravine	Bacteria	Land Disposal	Low	1.7 miles
	Wolf Creek	Fecal Coliform	Agriculture, Urban Runoff/ Storm Sewers, Recreational Activities (non-boating)	Low	23 miles
	Lake Combie	Mercury	Resource Extraction	Medium	362 acres
	Bear River, Upper	Mercury	Resource Extraction	Medium	10 miles
	Camp Far West Reservoir	Mercury	Resource Extraction	Medium	1945 acres
	Rollins Reservoir	Mercury	Resource Extraction	Medium	774 acres
Yuba	Deer Creek (Yuba County)	Mercury	Resource Extraction	Medium	4.3 miles
	Humbug Creek	Mercury, Copper, Sediment/ Siltation, Zinc	Resource Extraction	Low	2.2 miles
	Kanaka Creek	Arsenic	Resource Extraction	Low	9.7 miles
	Little Deer Creek	Mercury	Resource Extraction	Medium	4.1 miles
	Englebright Reservoir	Mercury	Resource Extraction	Medium	754 acres
	Scotts Flat Reservoir	Mercury	Resource Extraction	Medium	660 acres

Table 4.1. - 2006 (proposed) Clean Water Act Section 303 (d) list of Water Quality Limited Segments within the CABY region.

uncommon in parts of the CABY region, and, given the population and urbanization trends in these watersheds, reducing these contaminant levels and preventing further contamination of stream systems is critical to maintaining water quality in these watersheds.

Additionally, increasing pressure from recreational activities in the upper watershed has the potential to result in compromised water quality. Public lands within the CABY region have seen increased recreation activity. From 1982 to 2000, the number of people driving motor vehicles off-road in the United States increased over 109 percent.²⁹ Recent decades have seen like advances in the power, range, and capabilities of OHVs. Whole new classes of vehicles have been introduced by manufacturers and are growing in popularity. From 1997 to 2001, the number of ATVs in use increased by almost 40 percent. These advances expand opportunities for Americans

²⁹ Cordell, H., C. Betz, J.M. Bowker, D. English, S.H. Mou, J.C. Bergstrom, R. J. Teasley, M.A. Tarrant, J. Loomis. (2004) Outdoor Recreation for 21st Century America: A Report to the Nation, The National Survey on Recreation and the Environment. Champaign, IL: Sagamore Publishing.

to enjoy the National Forest System lands. However: soil health, water quality, and wildlife habitat are negatively affected. The Tahoe and El Dorado National Forests are currently conducting environmental analysis studies to determine the effects of motorized vehicle use on National Forest System lands and develop guidelines for that use.

4.2.4 Temperature

Water temperature is also a significant water quality concern in the CABY region. Increased water temperatures stress aquatic ecosystems by reducing the ability of water to hold essential dissolved gases such as oxygen, as well as affecting the methylation of mercury, as mentioned in 4.2.2. Temperatures are affected by dams, releases of surface water from reservoirs, water diversions, inadequate shading by limited riparian canopy, low instream flows, and climate change.

Findings and Studies

In 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, coastal and Central Valley forms of steelhead rainbow trout, Lahontan cutthroat trout, razorback sucker and Delta smelt.

California constitutes the warm, southern end of the geographic range of most of these species. By 2100, climate change is expected to raise average air temperatures by about 1.4 to 5.8 degrees (C) in California, raise stream water temperatures by at least as much, greatly reduce snow pack volume, 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 fishes. In many low- and middle-elevation California streams today, summer temperatures often come close to the upper tolerance limits for salmon and trout. Thus, anticipated climate change that raises air temperatures a few degrees Celsius may be enough to raise water temperatures above the tolerance limits for salmon and trout in many streams, favoring instead non-native fishes such as carp and sunfish.³⁰

Unsuitable summer temperatures are a problem because many of the threatened and endangered fishes spend the summer in cold-water streams, either as adults or juveniles. Adults of some populations, such as spring-run Chinook, spend the summer near their upstream spawning grounds waiting for conditions suitable for spawning in fall or winter. Chinook salmon and steelhead, for example, prefer temperatures of less than 20 degrees Celsius in mountain streams, although

they may tolerate higher temperatures for short periods.³¹

Due to the extensive dam system in the Middle Fork American River watershed, there is a water temperature monitoring program in place at 20 different locations. This program also has 12 monitoring locations on the Rubicon River, seven sites on Long Canyon Creek, and three locations on the North Fork American River. During spring and summer storm events, when water spills from the top of reservoirs in the American River watershed, water temperatures are increased immediately downstream. Water temperatures below the powerhouses tend to be cooler while operating, and increase when the powerhouses are not operating. Because of reservoir spilling, water temperatures were coldest in early June and warmest during mid-July at some sites.³²

On the South and Middle Yuba rivers, low flows, high water temperatures, and sediment (from hydraulic mining) have contributed to problems for the cold-water adapted aquatic communities.^{33, 34}

4.3 Data Collection and Current Monitoring Activities

Current water quality monitoring activities in the CABY region occur under the auspices of city, county, and/or local governments (water agencies, county environmental health, etcetera), and local watershed groups and environmental NGOs. Though much of this

³⁰ California Department of Water Resources (DWR) (2006). Progress on Incorporating Climate Change into Planning and Management of California's Water Resources; Technical Memorandum Report. Sacramento, CA: DWR.

³¹ Moyle (2002). Inland fishes of California. Merced, CA: University of California Press.

³² Placer County Water Agency (PCWA) (2006). Draft 2005 water temperature study report (Middle Fork American River). Auburn, CA: PCWA.

³³ Schilling, F. (n.d.). State of the Yuba: an assessment of the Yuba River watershed. Nevada City, CA: University of California.

³⁴ Upper Yuba River Studies Program Study Team, for DWR. (June 2006) Upper Yuba River Watershed Chinook Salmon and Steelhead Habitat Assessment.

data is gathered in the public domain, there is currently not a system for sharing the data between groups or amassing the data under one large database for CABY watershed information. This type of tool is not used within counties or watersheds, either. On a larger scale, the closest example of data sharing is the State's SWAMP database. All data gathered within the CABY region, however, either doesn't fit the SWAMP parameters or is just not reported in that capacity. Future efforts will align data collection methods and reporting to SWAMP and GAMA protocols in order to report more data of higher quality.

There is also the question of quality control. Citizen-collected data, as opposed to professional, has not been shown to be legally defensible throughout the United States. This brings up the question of data consistency with regards to collection method, modernity of tools, uniformity of analysis methods, or any number of uncontrollable variables. Several citizen water quality monitoring training sessions have become available throughout the region in the past few years. These sessions have been held primarily by or through the efforts of two of the largest environmental NGOs in the CABY region: the Sierra Nevada Alliance and the Natural Heritage Institute. Investigation into these methods is necessary in order to further streamline the CABY water quality data gathering process. The potential for a trained cadre of monitoring personnel would greatly expedite region-wide monitoring efforts. CABY is committed to supporting and proving this method of data collection to bolster the volume of data collected and diversity of sites sampled.

The CABY regional entity will be assembling these data sets to create a CABY-wide database, potentially connected to an internet-available GIS mapping system through partnership with the Sacramento River Watershed Program. The database will be designed and implemented with CABY participants. Many of the participating organizations, such as SYRCL, Friends of Deer Creek, and Yuba-Bear Watershed Group, have extensive experience in data collection and management, as well as essential location-

specific experience. After successful implementation, the database will be housed at the CABY regional entity office and overseen by permanent CABY staff. All data will be considered for input into the state's SWAMP and, if applicable, GAMA databases. This project will contribute to IRWMP implementation and measures of performance for both the regional entity and for the individual projects.

4.3.1 Current Monitoring Activities

The state of California encourages and promotes citizen-based water quality monitoring as a cost-effective means of monitoring water quality throughout the state to help assess basin water quality objectives. In the past five to six years, numerous citizen monitoring programs have taken root throughout the CABY region. These groups vary from the many-member, multi-objective Sierra Nevada Alliance to the small, volunteer-only Wolf Creek Community Alliance. Most of these groups were aided through past state grants, and are still going strong with the same equipment and methodologies. The data being collected displays the range of indicators these volunteers and NGO groups are experienced in collecting and analyzing:

- air and water Temperature (T) measured monthly;
- Dissolved Oxygen (DO) measured monthly;
- Total Suspended Solids (TSS) measured monthly and during and after storm events;
- fecal coliform bacteria (CB) including *Enterococcus* and *E. coli*, measured monthly and during and after storm events;
- mercury measured quarterly and during and after storm events;
- arsenic measured quarterly and during and after storm events;
- zinc measured quarterly and during and after storm events;
- copper measured quarterly and during and after storm events;
- iron measured quarterly and during and after storm events;

- dissolved solids/salt measured monthly and during and after storm events (conductivity);
- conductivity measured monthly and during and after storm events;
- pH measured monthly;
- flow; and
- benthic macroinvertebrates sampled annually.

As scientific understanding of water quality conditions improves, adjustments are made, ensuring that scientific rigor drives monitoring protocols. Project managers and volunteers are aware of the challenges of getting their data into a format easily transmittable into SWAMP, and are currently working on that challenge.

In addition to the citizen monitoring being done, agencies throughout the region are also doing monitoring. Some of the agency monitoring and testing is done as a result of state and federal mandates, but some is done voluntarily, to gain understanding of the region and to acquire baseline knowledge. One example of voluntary agency data collection is EID's work on Silver Lake. The lake is at high elevation (6,000 feet), but has heavy recreational use in the summer. Additionally, there is a large population of Canada geese (*Branta canadensis*) at the site. EID chose to examine this lake because of its relative remoteness, along with the complication of increased recreation and growing water fowl population. Past water quality analysis has shown a high coliform level, and the District is collecting more data in order to determine the source and to manage for the water quality issue.

Agency water quality data is collected in many forms throughout the CABY region. This data is collected for a variety of reasons; in some cases they wish to establish base line conditions. In other cases, data collection and monitoring is used to address expected or anticipated problems, provide data for infrastructure design, or assess on going water quality. This data is the result of testing for different contaminants at different times of the year, with the goal of addressing a variety of management issues. Federal, state, and local

agencies have historically gathered data across the watershed and continue to have both sporadic and systematic monitoring programs in place. CABY is in active coordination with these agencies to develop a system of mutual reporting for data that is not considered confidential or proprietary.

Efforts such as the ones mentioned above add to regional knowledge. It is hoped that these discrete efforts throughout the region will become part of an overall CABY water quality monitoring effort to better share information and experience between CABY agencies and organizations.