Water Quality Progress Report

Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch – Mercury

(*Approved 2007*)

WATER QUALITY STATUS

- ○ TMDL targets achieved
- ○ Conditions improving
- ● Improvement needed
- ○ Data inconclusive

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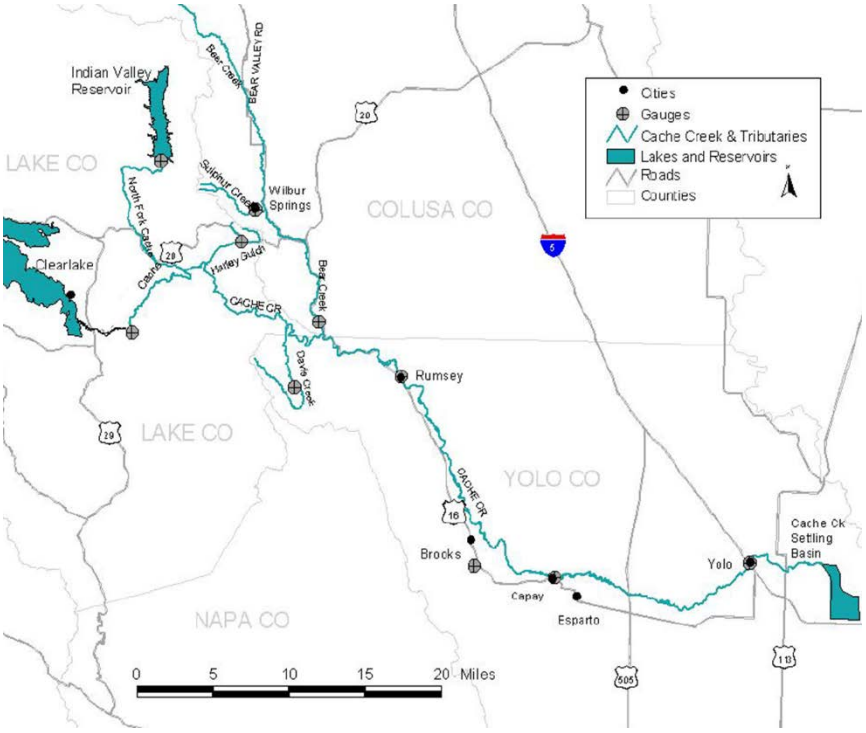
Total Maximum Daily Load (TMDL) Summary

Waterbody – The Cache Creek watershed is a 0.7 million acre drainage in the Coast Range of California. It lies in Colusa, Lake, and Yolo counties. The watershed is separated into upper and lower basins. The upper basin is above the town of Rumsey. It has three primary drainages that have year-round flow: North Fork Cache Creek, South Fork Cache Creek (downstream of Clear Lake), and Bear Creek. Downstream of Rumsey is the lower basin, which contains farmland and several small communities. At the downstream end of the lower basin, Cache Creek flows into a settling basin and then into the Yolo Bypass, which subsequently drains into the Sacramento-San Joaquin Delta Estuary.

This TMDL addresses four impaired streams in the Cache Creek Watershed (see map below). Harley Gulch is an ephemeral stream (with flow between October and June) that drains into Cache Creek just downstream of the North and South Fork Cache Creek tributaries. Farther downstream, Bear Creek drains from its headwaters into Cache Creek. This 39-mile creek travels through rangeland as well as some rugged terrain. Near the town of Wilbur Springs, Sulphur Creek drains into Bear Creek. Sulphur Creek is an intermittent stream with flowing water from October to June. Stretches of the stream are wet year-round due to the presence of springs. The total length of the impaired Cache Creek is 81 miles, spanning from Clear Lake (just upstream of the South Fork Cache Creek) to the Cache Creek Settling Basin.



The Cache Creek Watershed

Water Quality Goals

Mercury water quality objectives vary by waterbody. These objectives protect both wildlife and human health.

For Cache Creek, North Fork Cache Creek, and Bear Creek: the average methylmercury concentration shall not exceed 0.12 and 0.23 mg methylmercury per kg (mg/kg) wet weight of muscle tissue in trophic level[1] 3 and 4 fish, respectively.

For Harley Gulch: the average methylmercury concentration shall not exceed 0.05 mg methylmercury per kg wet weight in whole, tropic level 2 and 3 fish.

Representative trophic level 4 fish (250 to 350 millimeters [mm] in length) include Sacramento pikeminnow, largemouth bass, smallmouth bass and/or channel catfish, while bluegill, green sunfish, and/or Sacramento sucker are examples of tropic level 3 fish (greater than 125 mm in length, but ideally 250-350 mm). The small, resident fish associated with the Harley Gulch objective include roach and hardhead (75 to 100 mm in length).

For Sulphur Creek: There are no fish tissue objectives, as fish are not present in the vicinity of the naturally occurring thermal springs. In-stream water quality and sediment objectives do apply at the mouth of Sulphur Creek and vary by flow regime.

Low flow: During flows of less than 3 cubic feet per second (cfs), the instantaneous maximum total mercury shall not exceed 1,800 nanograms per liter (ng/L).

High flow: During flows greater than 3 cfs, the instantaneous maximum ratio of mercury to total suspended solids shall not exceed 35 mg/kg.

Site-specific, aqueous methylmercury goals are set for each creek: 0.14 ng/L in Cache Creek, 0.06 ng/L in Bear Creek, and 0.09 ng/L in Harley Gulch. These values are not water quality objectives. As an additional water quality goal, the allowable load to Cache Creek is 66 grams per year of methylmercury, which was determined through the TMDL analyses.

Targeted Attainment Date – Not specified in the TMDL; however, due to the nature of legacy pollutants such as mercury, water quality can take decades to show improvement.

Water Quality Impairment – Mercury in the Cache Creek watershed comes from historic mining activity, natural springs and enriched soils, and deposition from air due to local and global emissions. Mercury is a naturally occurring element that has been mined because it is used for electrical applications, manufacture of chemicals, and certain lighting (among other devices), although its use is decreasing. Mining of mercury occurred in California for both direct use of the mercury as well as to extract gold during California's Gold Rush. It is also released from combustion (burning coal, natural gas, or petroleum). Mercury can be found in numerous chemical forms. One organic form, methylmercury, is the most hazardous form of mercury in the environment and can cause both chronic and acute toxicity to mammals (including humans), birds, and aquatic animals. In humans, methylmercury exposure can cause neurological symptoms as well as developmental concerns for children exposed in-utero. In addition, methylmercury exposure causes reduced reproductive success in wildlife. Within an organism, rates of intake of methylmercury tend to be greater than rates of elimination, such that it accumulates within tissues as an organism ages. Methylmercury also bioaccumulates, becoming increasingly concentrated in higher trophic levels of the food chain. The primary route of exposure for humans and wildlife to methylmercury is through consumption of contaminated fish and other aquatic organisms.

[1] Trophic levels identify the position of an organism in the food chain, ranging from level one to level five where higher values are associated with carnivores and predators.

The California Department of Health Services revised their fish consumption advisory for Bear Creek in 2009 and Cache Creek in 2014. This advisory recommends limiting consumption of fish from the Cache Creek and women ages 18 to 45 and children should not consume several fish species, while no one should consume fish or shellfish from Bear Creek. The Central Valley Regional Water Quality Control Board (Water Board) and other organizations began collecting data in the Cache Creek watershed in the late 1980s. These data documented high concentrations of mercury; therefore, Cache Creek and some of its tributaries were recommended for placement on the California List of Impaired Waters. Specifically, mercury fish tissue concentrations were elevated in Cache Creek and Bear Creek and water column concentrations were above the California Toxics Rule criterion during storm events. Ultimately, the municipal and domestic water supply, contact recreation, and wildlife habitat beneficial uses were not being met in the watershed as high mercury levels in fish pose risks for humans and wildlife that consume fish from the creeks.

Pollutant Sources – The Cache Creek watershed lies within a region naturally enriched in mercury. Historic mercury mining activities are a major source of current and historic total mercury loads to the creeks (all mines are now inactive). Most of the historic loading is now distributed in the creek beds and floodplains downstream of the various mines, while mine waste from historic mine sites is an ongoing source. In addition to mine sites and contaminated creek sediment downstream of the mines, other sources of mercury include natural and anthropogenic erosion of soils with naturally occurring mercury, natural and altered geothermal springs, and atmospheric deposition. Activities in the watershed and near the creek channels can cause mobilization of mercury deposits (whether they are natural sources of mercury or anthropogenic sources). These activities, which include road maintenance, grazing, and timber activities, can cause erosion, which contributes mercury loads if the soil has elevated mercury levels.

In addition, conditions that cause the methylation of total mercury are important factors influencing methylmercury levels. Methylmercury is produced in surface sediments by bacteria. The chemicals cycle and they also flux between the water column and deposition to the sediment. The methylated mercury is bioavailable to organisms in the food chain, so the active sediment layer is also an important source of methylmercury. Wetlands and marshes have higher rates of methylation, so loads of total mercury (that are available to be converted to methylmercury) and processes affecting methylation in these waterbodies are important considerations.

Loading Capacity and Allocations – The loading capacity is the maximum amount of a contaminant or stressor that can be assimilated by the waterbody without exceeding water quality objectives. The mercury loading capacity and source load allocations in this TMDL are set as allowable loads associated with the various mercury sources to Cache Creek (including Harley Gulch and Bear Creek) and Bear Creek (including Sulphur Creek). They are expressed as a percent of existing loads and will be achieved by reducing the annual methylmercury concentrations to the site-specific aqueous methylmercury goals. The acceptable annual load for Cache Creek requires a 46 percent reduction from existing loads. Source-specific load allocations are assigned a percentages of the existing methylmercury load: 30 percent for Cache Creek, 100 percent for North Fork Cache Creek, 4 percent for Harley Gulch, 50 percent for Davis Creek, 15 percent for Bear Creek, and 65 percent for within channel production and ungauged tributaries. Sulphur Creek (within the Bear Creek drainage) has an allocation of 10 percent of existing loads. Methylmercury is a function of total mercury; therefore, reductions from these source areas contribute to the reductions in total mercury loads necessary to achieve the methylmercury load allocations. The allocations will also be achieved in part by natural erosion processes that remove mercury previously deposited in creek beds and banks.

Levels of methylmercury in fish are assumed to be directly proportional to the average methylmercury concentrations in the water column. In addition, reducing mercury sediment concentrations are expected to result in decreases of methylmercury flux to the water column. The load allocations will be achieved by reducing average annual methylmercury concentrations to site-specific, aqueous methylmercury goals, which are 0.14 ng/L in Cache Creek, 0.06 ng/L in Bear Creek, and 0.09 ng/L in Harley Gulch. There are no point sources of mercury in the watershed; the TMDL only identified nonpoint sources.

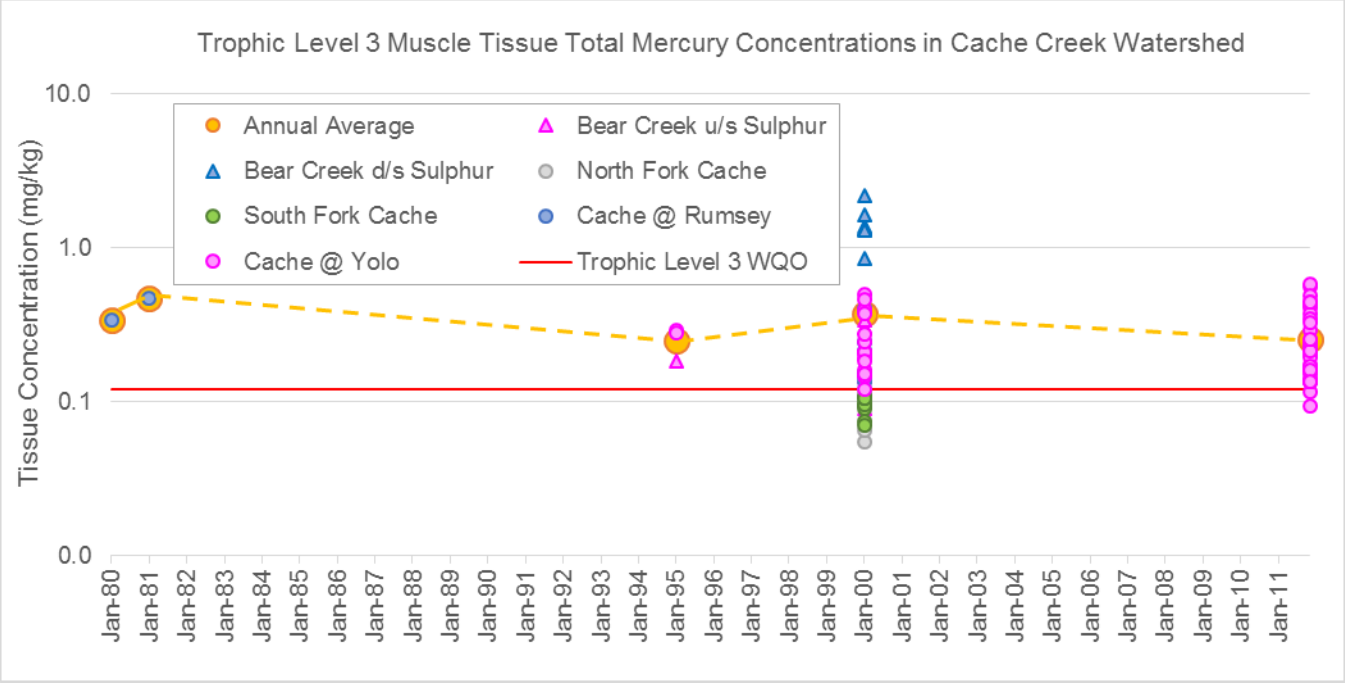
Is Water Quality Improving?

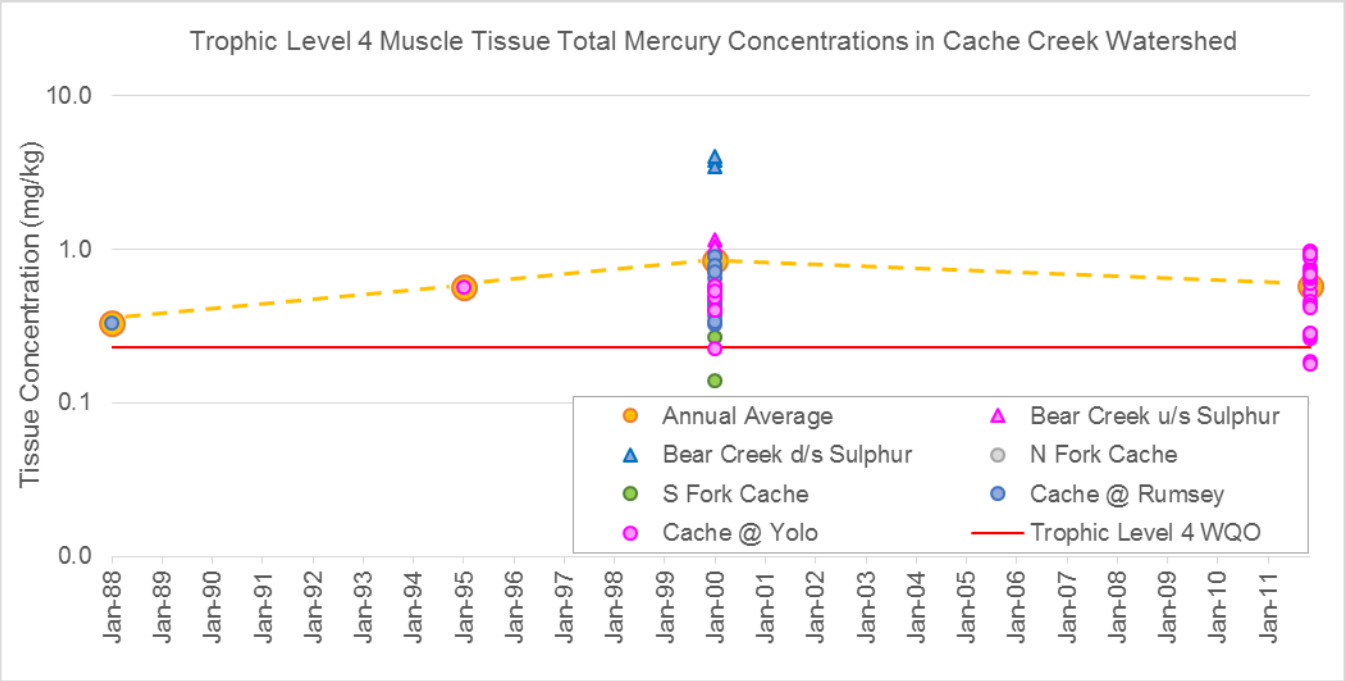
Fish tissue data are available for muscle tissue in trophic levels 3 and 4 in Cache Creek and Bear Creek. Raw data were assigned a trophic level based on the fish species and total length, consistent with the representative fish described above in the water quality objectives section. The data are graphed by date and compared to their applicable water quality objectives to investigate changes in concentration over time. A logarithmic scale is used to represent the data, which separates the measurements, which generally fall between 0.1 and 1 mg/kg.

The first graph below shows the trophic level 3 fish tissue concentrations compared to the water quality objective, while the lower graph illustrates the trophic level 4 information. When comparing the data, the maximum concentrations were higher in 2000, although the other data do not include the same stations so it is not possible to identify trends. The majority of samples have concentrations well above water quality objectives for both trophic levels 3 and 4 (note: water quality objectives are based on methylmercury, while the data are total mercury values, providing a small margin of safety). In addition, the average annual concentrations are represented by circles in the plots below. These data confirm that the concentrations have not changed much over time.

For trophic level 3 fish, all data for North Fork and South Fork Cache Creek were below the objective. The highest trophic level 3 concentrations were observed on Bear Creek downstream of Sulphur Creek. 2011 data are available for Cache Creek near Yolo and the TL3 concentrations are generally consistent with the 2000 data in the same reach. For the trophic level 4 data, South Fork Cache Creek had the lowest concentrations, while, similar to the trophic level 3 data, the highest concentrations were found in Bear Creek downstream of Sulphur Creek. The 2011 TL4 data near Yolo had higher maximum concentrations than the data along the same segment in 2000; however, the sample size in 2011 was much larger so the earlier dataset may not have been comprehensive.

These datasets indicate that concentrations have not decreased over time. Additional data should be evaluated to fully characterize conditions since TMDL approval. Through continued implementation of management measures associated with the mercury sources described above, the water column and sediment concentrations are expected to decrease. The fish tissue concentrations will subsequently decline in response to the lower loadings; however, it is expected to take decades for the tissue data to show this response.





TMDL Progress – Implementation activities and milestones

Implementation Activity	Target Date	Status	Progress Details
Water Board adopt cleanup and abatement orders or other actions to control discharges from active mines	02/06/2009	Complete	• Technical and Monitoring Report Orders R5-2010-0048 and R5-2010-0049 (issued on 5/27/2010) require investigation, characterization, and monitoring activities and compliance with the requirement that responsible parties develop plans to reduce existing loads of mercury by 95 percent. • Cleanup and abatement order for the Elgin Mercury Mine (Order No. R5-2009-0071 link).
Inactive Mines submit plans to Water Board, including a time schedule, to reduce loads of mercury from mining or other anthropogenic activities by 95% of existing loads consistent with State Water Resources Control Board Resolution 92-49.	After Water Board orders	Complete	• Homestake Mining Company submitted the "Mining-Related Materials Characterization and Remediation Work Plan" in September 2010 (attachment of this resolution).

Implementation Activity	Target Date	Status	Progress Details
Inactive Mines in Bear Creek Harley Gulch and Sulphur Creek watersheds: ***Cleanup mines, sediment, and wetlands*** (by Mine owners and other responsible parties, United States Bureau of Land Management [USBLM])	2011	In Progress	• On April 8, 2011, the Board adopted Resolution R5-2011-0020, which would release Homesake Mining Co. from liability for the Inactive Mines, provided that Homestake implements their September 2010 Work Plan and agrees to contribute an additional $50,000 for further investigative work. This Conditional Waiver allows Homestake to implement the Work Plan by permitting a mine waste repository to receive the consolidated mine waste material (link). • Conditional Waiver R5-2013-0060 approved by Water Board since remediation will occur by Homesake Mining Company plan (link). • Remediation by the Homestake Mining Company is pending a Section 404 permit from the United States Army Corps of Engineers (link). • Cleanup of the Abbott and Turkey Run mercury mines performed in the summer of 2007. United States Environmental Protection Agency (USEPA) was involved in the cleanup, and worked with the mine's responsible party and their construction contractor to complete the work (link).
Creek Sediments-Harley Gulch Delta in Harley Gulch: ***Conduct additional studies*** (by USBLM)	2006	In Progress	• Central Valley Water Board and USBLM have been in discussions about the most appropriate remediation action to pursue.
Creek Sediments-Harley Gulch Delta in Harley Gulch: ***Submit report on engineering options*** (by USBLM)	2008		
Creek Sediments-Harley Gulch Delta in Harley Gulch: ***Conduct projects, as required*** (by USBLM)	2011		
Creek Sediments-Sulphur Creek in streambed and flood plain directly below mines: the responsible parties and owners will ***develop and submit a cleanup and abatement plan to reduce anthropogenic mercury loading in the creek***	After mine cleanup is initiated	In Progress	• Draft remediation plans are underway.

Implementation Activity	Target Date	Status	Progress Details
Creek Sediments and Erosion Control-Upper Watershed in Bear, Davis, Sulphur, and Cache (Harley Gulch to Camp Haswell) creeks and Harley Gulch watersheds: ***Assessments to prioritize the need of feasibility studies and remediation*** and ***conduct studies to identify areas with enriched mercury concentrations*** (by Water Board)	02/06/2009 02/06/2008	Complete	• Mercury Inventory in the Cache Creek Canyon, February 2008 (link) • Bear Creek Mercury Inventory, June 2009 (link) • Mercury Inventory in the Cache Creek Canyon, Bear Creek Confluence to Rumsey, March 2011 (link)
Creek Sediments-Upper Watershed in Bear, Davis, Sulphur, and Cache (Harley Gulch to Camp Haswell) creeks and Harley Gulch watersheds: ***Feasibility studies and conduct projects, as required*** (by USBLM, State Lands Commission [SLC], California Department of Fish and Game, Colusa, Lake, and Yolo Counties, private landowners)	None specified	In Progress	• USBLM utilized 319h funding to assess mercury-contaminated sediment depositional areas in the Bear Creek watershed. • Feasibility studies have not been required to date.
Erosion Control-Upper Watershed in Bear, Sulphur, and Cache (Harley Gulch to Camp Haswell) creeks watersheds: ***Identify activities that increase erosion*** (by USBLM, SLC, CDFG, Colusa, Lake, and Yolo Counties, private landowners)	After studies by water board	In Progress	• To be completed if problem areas are identified.
Erosion Control-Upper Watershed in Bear, Sulphur, and Cache (Harley Gulch to Camp Haswell) creeks watersheds: ***Submit and implement erosion control plans as required*** (by USBLM, SLC, CDFG, Colusa, Lake, and Yolo Counties, private landowners)	2011	In Progress	• Erosion control plans have not yet been required by Central Valley Water Board. • Caltrans consulted the Central Valley Water Board about mercury hot spot issues and adjusted roadwork activities accordingly for work conducted on Highway 20.
Erosion Control from New Projects, 10-yr Floodplains in Bear, Sulphur, and Cache (Harley Gulch to Settling Basin) creeks and Harley Gulch watersheds: ***Implement management practices and monitoring for erosion control*** (by Yolo County, Reclamation Board, private landowners, US Army Corps of Engineers)	During and after project construction	In Progress	• Water Board prepared report documenting methods that may be used to identify projects that must follow the Cache Creek watershed mercury control program requirements (link).

Implementation Activity	Target Date	Status	Progress Details
New Reservoirs, Ponds, and Wetlands in Cache Creek watershed: ***Submit plans to control methylmercury discharges*** (by Yolo County or project proponents)	Prior to project construction	In Progress	• As of the writing of this progress report, this situation has not yet arisen.
Anderson Marsh in Cache Creek at Clear Lake watershed: ***Conduct additional studies*** (by CDPR)	2006	In Progress	• Central Valley Water Board conducted sampling and did not identify any necessary implementation actions.
Anderson Marsh in Cache Creek at Clear Lake watershed: ***Submit report on management options*** (by CDPR)	2008		
Anderson Marsh in Cache Creek at Clear Lake watershed: ***Conduct project, as required*** (by CDPR)	2011		
Cache Creek Settling Basin: Water Board will conduct methylmercury studies in the basin and work with others to develop improvement to reduce loads	None specified	In Progress	• Presentation on Cache Creek Settling Basin Delta Mercury Control Program (link) • Cache Creek Settling Basin Symposium (link) • Feasibility study to evaluate if the Cache Creek Settling Basin flood control project could be modified to trap additional mercury-laden sediment from Cache Creek watershed before it enters the Delta. • USGS study "Mercury, Methylmercury, and Other Constituents in Sediment and Water from Seasonal and Permanent Wetlands in the Cache Creek Settling Basin and Yolo Bypass, Yolo County, California, 2005–06" (link)
Geothermal and Spring Sources: Water Board will determine the suitability of geothermal source controls for offset or remediation projects.	None specified	In Progress	• This has not been deemed high priority based on reported mineral spring remediation information (link).
Outreach and Education by local county health departments regarding the risks of consuming fish containing mercury, emphasizing portions of the population that are at risk, such as pregnant women and children.	None specified	In Progress	• Lake County updated website with information on mercury in fish with links to several guides (link)
The Central Valley Water Board will review the progress toward meeting the objectives.	Every 5 years	In Progress	• Water Board TMDL review is being developed.

Implementation Activity	Target Date	Status	Progress Details
TMDL Compliance Monitoring			
Fish tissue sampling for trophic level 3 (total or methylmercury)	Every 5 to 25 years	In Progress	• Data have been collected by the University of California at Davis (UCD), among other agencies. • Data through 2001 are reported and available through CEDEN (www.ceden.org). • Yolo County conducted study on ambient mercury levels in fish and invertebrates in Lower Cache Creek in 2011-2012 (link).
Fish tissue sampling for trophic level 4 (total or methylmercury)	Every 5 to 25 years		
Methylmercury in water (ambient)	None specified	In Progress	• Data are collected as part of the annual monitoring by Yolo County (link)
Cleanup monitoring: total mercury in sediment; methylmercury, total mercury, total suspended solids, turbidity, and flow in water; mercury in suspended sediment	None specified		

What Next?

Additional reductions are needed to achieve water quality goals. Continued clean-up of mine sites in the Cache Creek watershed will be necessary to achieve the required mercury load reductions as well as completion of a TMDL and mine site remediation in the Davis Creek watershed.

Information Source Documents

- **Final staff report for Basin Plan Amendments for Control of Mercury in the Cache Creek Watershed**, October 2005 (report and appendices)
- **Cache Creek, Bear Creek, and Harley Gulch TMDL for Mercury**, Staff Report, November 2004 (report and appendices)
- **Central Valley RWQCB TMDL Resolution** – Amending the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Mercury in Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch, Resolution No. R5-2005-0146 (see Appendix I in link)
- **Final Staff Report for Basin Plan Amendment to Determine Certain Beneficial Uses are Not Applicable in and Establish Water Quality Objectives for Sulphur Creek**, March 2007 (link)
- **Central Valley RWQCB Resolution** – Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins to Determine Certain Beneficial Uses are Not Applicable in and Establish Water Quality Objectives for Sulphur Creek, Resolution No. R5-2007-0021 (link)
- **USEPA Approval of TMDL** (link)
- **USEPA Approval of Site-Specific Water Quality Objectives and COMM Beneficial Use** (link)
- **USEPA Approval of Sulphur Creek Water Quality Objectives and Beneficial Use Modification** (link)
- **Mercury Inventory in the Cache Creek Canyon**, February 2008 (link)

- **Bear Creek Mercury Inventory**, June 2009 (link)
- **Mercury Inventory in the Cache Creek Canyon, Bear Creek Confluence to Rumsey**, March 2011 (link)
- **USGS California Water Science Center Cache Creek Project Page** (link)
- **Summary and Synthesis of Mercury Studies in the Cache Creek Watershed, California, 2000–01**, U.S. Geological Survey Water-Resources Investigations Report 03-4335 (link)
- **Mercury and Methylmercury Concentrations and Loads in the Cache Creek Basin, California, January 2000 through May 2001**, U.S. Geological Survey Scientific Investigations Report 2004–5037, 56 p. (link)
- **Watershed-Based Assessment of Hydrologic and Geomorphic Conditions in Cache Creek through Capay Valley**, May 2010 (link)
- **Mercury and Erosion Control in the Cache Creek Watershed** (link)
- **Yolo County Cache Creek Annual Status Report** (link)
- **Yolo County Cache Creek Area Plan Document Library** (link)