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FISH SAMPLING IN PUTAH CREEK (PHASE II)

LABORATORY FOR ENERGY RELATED HEALTH RESEARCH

DAVIS, YOLO COUNTY, CALIFORNIA

CERCLIS NO. CA2890190000

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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HEALTH CONSULTATION

FISH SAMPLING IN PUTAH CREEK (PHASE II)

LABORATORY FOR ENERGY RELATED HEALTH RESEARCH

DAVIS, YOLO COUNTY, CALIFORNIA

CERCLIS NO. CA2890190000

Prepared by:

Energy Section
Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

PURPOSE

The purpose of this health consultation is to report the results from an ATSDR fish survey of the fish in Putah Creek in 1997, and report our conclusions and public health recommendations from that survey. The survey was conducted to better define the concentrations of mercury and lead in different fish species in Putah Creek.

BACKGROUND

This report is the second health consultation issued by the Agency for Toxic Substances and Disease Registry (ATSDR) which addresses fish in Putah Creek near the Laboratory for Energy-Related Health Research (LEHR) Superfund site on the University of California at Davis (UCD) campus, in Davis, California.

ATSDR recommended in a Site Summary report in December 1995 that fish in Putah Creek should be sampled and analyzed for hazardous substances, because people were eating fish from Putah Creek and there had been no previous analyses of the fish [1]. The U.S. Environmental Protection Agency (EPA) Region IX collected fish and crayfish, water, and sediment samples from four locations along the creek, and the EPA National Air and Radiation Environmental Laboratory (NAREL) analyzed the samples for ATSDR. ATSDR released a health consultation in April 1997 describing the results of the first fish survey [2].

The most important conclusion in the first health consultation was that mercury and lead concentrations in some fish collected from Putah Creek pose a public health hazard to people who eat the fish. However, NAREL composited many of the fish and crayfish before analyzing them because the laboratory required certain sample volumes to do all the analyses planned (18 pesticides and other organic chemicals, 14 metals, gross alpha, gross beta, and gamma spectrometry). Compositing the fish was appropriate for an initial screening survey of this kind.

Because mercury and lead were elevated in composite fish samples, ATSDR recommended in the first health consultation that an additional fish study be conducted to better define the concentrations of mercury and lead in different fish species. EPA agreed to assist ATSDR again, to collect a second round of fish and crayfish from Putah Creek. This health consultation reports the results of those efforts.

EPA Region IX collected a total of 152 fish and crayfish, plus water and sediment samples, at five locations along Putah Creek in October and November 1997. EPA staff were assisted by staff from Thomas R. Payne & Associates, Inc. (TRPA). TRPA is an independent contractor conducting fisheries monitoring on lower Putah Creek for the Solano County Water Agency. TRPA has sampled fish in Putah Creek for six years. Their staff shared their fishing expertise and their knowledge of Putah Creek with EPA staff for this ATSDR program. EPA Region IX scientists packaged the samples and sent them to the NAREL in Montgomery, Alabama, for analysis. NAREL scientists homogenized the whole fish or crayfish. Composite samples of two

or more fish were prepared of some of the fish, of a single species and size range from a single location.

We have attached the data from the laboratory analyses of fish, water, and sediment collected from Putah Creek to the end of this report. ATSDR scientists and NAREL scientists reviewed the NAREL data. ATSDR offers the following results, conclusions, recommendations, and follow-up public health actions based on these data.

RESULTS

1. All largemouth bass samples contained mercury. The mercury concentrations in the samples ranged from 0.11 milligrams of mercury per kilogram of fish (mg/kg-fish) to 0.81 mg/kg-fish. The largemouth bass contained the highest levels of mercury that were found in this survey.

2. The highest levels of lead were found in crayfish. All crayfish samples contained lead. The lead concentrations in the samples ranged from 0.15 mg/kg-fish to 1.1 mg/kg-fish.

CONCLUSIONS

1. The concentrations of mercury in some largemouth bass in Putah Creek are at levels of health concern for fetuses and nursing children whose mothers eat these fish.

2. The concentrations of lead and other metals in crayfish in Putah Creek are *not* at levels of health concern for people who eat these fish.

3. The 101 bluegill, 4 carp, 1 channel catfish, and 1 black bullhead fish that we caught did not contain toxic metals at levels of public health concern.

4. None of the radiological analyses of any of the fish indicate that radionuclides in the fish pose a public health hazard.

5. None of the analyses indicate that metals or radionuclides in water pose a public health hazard.

6. None of the analyses indicate that metals or radionuclides in sediment pose a public health hazard.

RECOMMENDATIONS

Women of child bearing age, especially those who are pregnant or are nursing, should refrain from eating largemouth bass from Putah Creek.

FOLLOW-UP PUBLIC HEALTH ACTIONS

1. ATSDR representatives will meet with local health officials to develop and implement a plan for providing information about the fish survey to people who eat fish from Putah Creek. This information will include a brochure that outlines the results of the fish survey, provides suggestions to reduce exposure to mercury, and provides names of agency representatives who can answer questions about the study.

2. ATSDR will work with representatives from the local health departments to distribute information to local health care providers who provide care to pregnant or lactating women who may consume fish from Putah Creek. This information will include a summary of the fish survey and health implications of mercury exposure, and will be targeted to the interests of health care providers.

DISCUSSION

Although we were able to catch a substantial number of bluegill and we had enough fish of each species to adequately complete our laboratory analyses, we had important gaps in some fish species and fish sizes that limit what we can state about the hazards from eating these fish. The low numbers of channel catfish, carp, and black bullhead we collected mean that we have less certainty that the concentrations of metals and radionuclides we measured are typical of the concentrations we would find throughout these species in Putah Creek. In addition, the numbers of fish of different species that we caught may not be representative of what local fishers typically catch and eat. For example, we collected only one channel catfish. However, catfish are a species sought by fishers, and people who fish from Putah Creek likely catch and eat more of these fish than our data suggest.

Largemouth bass:

Mercury was detected in all the largemouth bass that we caught. The large-sized largemouth bass have more mercury and higher concentrations of mercury in them than the small-sized largemouth bass; thus, the largemouth bass are bioaccumulating mercury. As a first approximation, mercury concentration increases in largemouth bass by one unit (1 mg/kg-fish) for every two kilogram increase in body mass of the fish. See Figure 1. We have also plotted milligrams of mercury vs. fish mass for largemouth bass in Figure 2 to show how mercury content increases with (largemouth bass) fish size.

There is no indication that the location where we caught largemouth bass had any significant bearing on the accumulation of mercury. When we take into consideration the size of the fish, mercury accumulation in largemouth bass was consistent at all locations where we caught those fish. However, we only caught large-sized largemouth bass at locations 1 and 2, and no largemouth bass at location 4. We would have liked to have caught fish from each size range at each location to better determine whether location had any affect on mercury accumulation. We

suspect, however, that these data gaps are not important because the fish do not stay at one location and mercury concentrations in sediment were similar at all locations (0.7 ± 0.4 mg mercury per kilogram sediment dry weight). Therefore, until more or better data become available, we expect that other largemouth bass caught in this area of Putah Creek will contain mercury at concentrations similar to those we found in this survey.

ATSDR has proposed a minimum risk level (MRL) for chronic oral exposure to methylmercury of 0.0005 milligrams of methylmercury per kilogram body weight per day (0.0005 mg/kg/day) [3]. An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without an appreciable risk of adverse noncancerous health effects over a specified duration of exposure. ATSDR derived this proposed MRL primarily from a study designed to test the hypothesis that prenatal exposure to low concentrations of methylmercury through maternal ingestion of fish is related to child development outcomes [4]. The child development outcome that was noted in the study that apparently arose from the lowest exposure levels of mercury that were above the proposed MRL is decreased physical activity in male infants.

We have assumed that all the mercury in the fish we caught in Putah Creek is methylmercury. We considered, as we did in our previous health consultation, an average consumption rate of 54 grams of fish per day [5]. This amount (54 grams = 1.9 ounces) is an average daily rate derived from an equivalent of approximately two meals of fish per week (e.g., 1.9 ounces/day x 7 days = 13.3 ounces per week). For a 60 kilogram adult female eating 54 grams of fish per day, the proposed MRL equates to approximately 0.56 mg/kg-fish, or 0.56 ppm in fish. We used 0.56 mg/kg-fish as our screening value for mercury in fish. Mercury concentrations in the two largest largemouth bass exceeded this value.

The concentrations of mercury we observed in the two largest largemouth bass could have an effect on the development of the fetus or the nursing child whose mother eats these fish more than once a week. We acknowledge that a typical fish meal from Putah Creek will likely contain fish other than largemouth bass, and mercury levels in the majority of the largemouth bass caught in this survey are below the ATSDR proposed MRL. However, Putah Creek may also contain larger largemouth bass than the ones we caught, and we expect larger largemouth bass will have higher levels of mercury than those we measured[1]. Therefore, we recommend that pregnant and nursing women avoid eating largemouth bass from Putah Creek because of the possibility they will eat larger fish than those we caught, as well as the uncertainties in the consumption rates of women eating fish from Putah Creek.

Crayfish:

Crayfish contained the highest levels of lead we measured in this fish survey. Lead was detected in all the crayfish samples.

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[1] The state record for the largest largemouth bass caught in the State of California, i.e., 21.75 lbs., is more than five times larger than the largest one we caught, though we don't know whether Putah Creek could support larger fish than those we caught [6].

Lead is a toxic metal that affects virtually every system in the body. It is particularly toxic to developing fetuses and young children. Developmental neurobehavior effects have been observed in humans following prenatal exposure to low levels of lead [7]. In 1991, the Centers for Disease Control (CDC) recommended a threshold for intervention of 10 micrograms of lead per deciliter of blood (10 μg/dL) in children [8]. We evaluated lead in fish by considering whether the concentrations of lead in the crayfish could lead to blood lead levels of 10 μg/dL.

We used a consumption rate of 54 grams of crayfish per day and a diet slope factor of 0.034 μg/dL per μg of lead ingested per day to calculate the blood lead level of a pregnant woman eating crayfish at the highest concentration of lead in crayfish that we measured [5, 9].

We considered that people may eat more crayfish (total mass) per meal than they eat of finfish, but they eat fewer meals of crayfish per month (on average) than meals of finfish. There are few fish consumption surveys available that estimate shellfish consumption separate from total fish consumption. It appears that the consumption of shellfish among fishers and their families may be half, or less, than that of finfish [10]. For our calculations, and to be conservative, we used the same consumption rate (54 grams per day) as we used for finfish.

Our calculations indicate the blood lead level of a woman eating crayfish with the maximum levels of lead we measured would be approximately 2 μg/dL. Inhalation of dust and consumption of other food and beverages will contribute an additional 0.5 μg lead per dL blood [7]. The combined blood lead concentration (2.5 μg/dL) from crayfish and other environmental sources is well below the threshold for intervention (10 μg/dL) for blood lead levels in children. Therefore, the lead levels in the fish we collected from Putah Creek are not a public health hazard to fetuses or infants whose mothers eat those fish.

OTHER RESULTS AND ISSUES

In addition to the fish, EPA staff collected water and sediment samples at the five fishing locations along Putah Creek. None of the concentrations of metals or radionuclides detected in water or sediment samples were at levels of health concern. The only radionuclides detected in these samples that are not naturally occurring are cesium-134, cesium-137, and iodine-131. Iodine-131 was detected in water and the cesium isotopes were detected in sediment. Neither iodine nor cesium were detected in fish[2]. The concentrations of metals and radionuclides in sediment were similar at all five locations. We are providing those data at the end of this report along with the fish data.

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[2] Based on our results in the first fish survey, our highest analytical priority for these fish samples was mercury and lead concentrations. Therefore, NAREL analyzed the metals first to insure compliance with sample holding times specified by the analytical methodologies for mercury and lead. Because we did not expect to find short-lived radionuclides in the fish, gamma spectrometry was not performed early enough to have been able to detect iodine-131 in the fish.

This health consultation does not address whether some fish in Putah Creek may be safe to eat. We did not collect a sufficient quantity of some fish species (e.g., black bullhead, channel catfish) to know whether the contaminant levels we measured in these fish are representative of the concentrations in their respective populations in Putah Creek. In addition, we have only incomplete data describing concentrations of toxic organic substances, such as pesticides, in the fish in Putah Creek. (The NAREL laboratories did not analyze any of the fish collected in this survey for toxic organic substances.) None of the information we do have— except mercury in largemouth bass as described in this report— indicates the fish in Putah Creek pose a health hazard to people who eat them. However, the data we have do not fully address whether toxic organic substances are at levels of health concern in the fish.

We have found, after two surveys, that it is not a simple matter to collect sufficient numbers of fish of different species to perform all the laboratory analyses we need to reach conclusions and make public health recommendations. This suggests that we may not be able to catch enough fish to answer all the questions about the safety of the fish as a food source that we would like to have answered. An alternate approach, such as conducting a more thorough survey of creek sediment, or surveying an indicator species, such as freshwater clams (*Corbicula fluminea*) may provide more useful information. ATSDR is currently evaluating the information that is available. We welcome any comments and suggestions and will evaluate these fully before recommending further investigations of Putah Creek.

Figure 1.

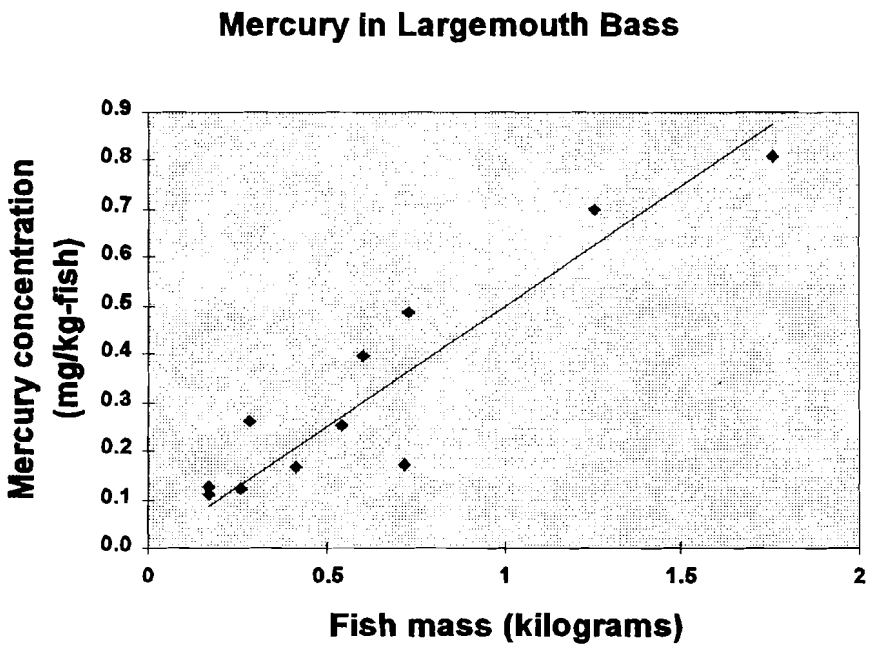
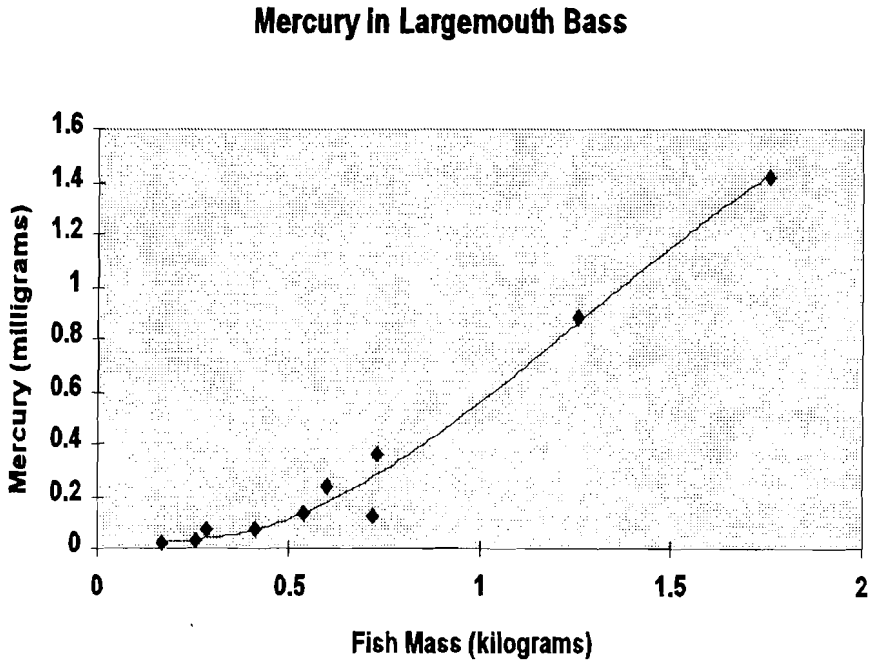


Figure 2.



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RESOURCES

For further information, or to request copies of our documents, including Toxicological Profiles and Case Studies in Environmental Medicine, contact ATSDR on our toll-free number: 1-800-447-1544, or visit our Internet Home Page at http://atsdr1.atsdr.cdc.gov:8080/.

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Table 1 - Description of Putah Creek Sampling Locations

Location Number	Latitude / Longitude	Location Description
1	N 38° 31' 01.59" W 121° 45' 23.37"	Downstream of Old Davis Road and adjacent to the LEHR site.
2	N 38° 31' 03.20" W 121° 44' 37.39"	One mile downstream of Old Davis Road and 0.6 miles downstream of storm drain on eastern edge of LEHR site.
3	N 38° 31' 5.99" W 121° 41' 44.36"	Above Mace Blvd., about 3 miles downstream of Old Davis Road and 2.5 miles downstream of storm drain on eastern edge of LEHR site.
4 (background)	N 38° 31' 36.37" W 121° 48' 14.08"	Upstream of the LEHR site, west of Davis at Pedrick Road crossing.
5	N 38° 31' 28.78" W 121° 47' 22.67"	Between sites #1 and #4, at the APO picnic grounds (where Arden Way meets Putah Creek).

Compared to the fishing locations in the earlier fish survey conducted in 1996, locations #3 and #4 moved downstream. A map of the fishing locations is included in the EPA report, *Metals and Radionuclide Concentrations in Fish, Sediment, and Water Samples Taken from the Putah Creek* (1998).

Table 2 - Putah Creek Fish Caught in October and November 1997

Species	Size	Location Number				
		1	2	3	4	5
Largemouth Bass	Small	2 fish 346 g ave 173 g	2 fish 829 g ave 415 g	2 fish 516 g ave 258 g		3 fish 854 g ave 285 g
	Medium	1 fish 600 g	1 fish 730 g	2 fish 1439 g ave 720 g		1 fish 541 g
	Large	1 fish 1256 g	1 fish 1757 g			
Channel Catfish	N / A	1 fish 121 g				
Bluegill	Small	13 fish 360 g ave 28 g	6 fish 187 g ave 31 g	3 fish 37 g ave 12 g	2 fish 54 g ave 27 g	27 fish 762 g ave 28 g
	Medium	6 fish 307 g ave 51 g	4 fish 230 g ave 58 g		1 fish 48 g	29 fish 1706 g ave 59 g
	Large	4 fish 342 g ave 86 g	2 fish 343 g ave 172 g	1 fish 125 g	1 fish 92 g	2 fish 251 g ave 126 g
Crayfish	N / A	2 crayfish 21.4 g ave 11 g	7 crayfish 203 g ave 29 g	3 crayfish 77.3 g ave 26 g	15 crayfish 302 g ave 20 g	2 crayfish 39 g ave 20 g
Carp	Small		1 fish 216 g			
	Large		1 fish 2395 g	1 fish 2641 g		1 fish 1850 g
Black Bullhead	N / A			1 fish 258 g		

Note: Blank entries indicate that no fish of the species and size were caught at that location.

Table 3A - Metals Concentrations in Fish Collected from Putah Creek

NAREL ID	Location	Species	Size	Average Mass (g)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead (AA)
9709533	3	Black Bullhead	N/A	258	8.76e+00 [B]	7.58e-03 [B]	5.12e-02 [B]	2.87e+00 [B]	3.14e-03 [B]	1.73e-02 [B]	6.28e+03	7.31e-01	2.54e-01 [B]	4.42e+00	4.27e+01	2.69e-01
9709514	1	Bluegill	Small	28	1.51e+02	9.30e-03 [B]	1.73e-01 [B]	1.24e+01	3.55e-03 [B]	1.72e-02 [B]	1.67e+04	9.77e-01	1.74e-01 [B]	1.28e+00	2.18e+02	1.64e-01
9709521	2	Bluegill	Small	31	2.57e+01	2.02e-02 [B]	2.27e-01 [B]	9.45e+00 [B]	1.69e-03 [U]	2.93e-02 [B]	2.34e+04	5.67e-01	7.37e-02 [B]	5.79e-01 [B]	7.30e+01	8.99e-02 [B]
9709529	3	Bluegill	Small	12	1.64e+01	6.57e-03 [B]	1.63e-01 [B]	6.82e+00 [B]	1.70e-03 [U]	5.54e-02 [B]	1.60e+04	7.14e-01	8.14e-02 [B]	6.67e-01 [B]	6.33e+01	8.06e-02 [B]
9709534	4	Bluegill	Small	27	8.02e+01	2.43e-03 [B]	1.63e-01 [B]	4.14e+00 [B]	4.06e-03 [B]	8.17e-03 [B]	1.35e+04	8.69e-01	1.09e-01 [B]	8.46e-01 [B]	1.06e+02	7.93e-02 [B]
9709540	5	Bluegill	Small	28	3.49e+01	3.34e-03 [B]	8.23e-02 [B]	4.48e+00 [B]	2.54e-03 [B]	9.63e-03 [B]	1.20e+04	5.79e-01	9.02e-02 [B]	1.03e+00 [B]	5.57e+01	7.24e-02 [B]
9709515	1	Bluegill	Medium	51	4.54e+01	1.55e-03 [U]	1.73e-01 [B]	4.40e+00 [B]	1.70e-03 [U]	3.53e-03 [B]	1.40e+04	5.01e-01	5.72e-02 [B]	7.42e-01 [B]	7.80e+01	8.40e-02 [B]
9709522	2	Bluegill	Medium	58	8.61e+00 [B]	3.43e-03 [B]	9.13e-02 [B]	3.14e+00 [B]	1.70e-03 [U]	6.81e-03 [B]	1.31e+04	1.98e-01 [B]	1.17e-01 [B]	1.44e+00	3.17e+01	4.58e-02 [B]
9709535	4	Bluegill	Medium	48	3.95e+00 [B]	2.50e-02 [B]	1.09e-01 [B]	5.37e+00 [B]	1.71e-03 [U]	2.77e-02 [B]	2.38e+04	4.88e-01 [B]	5.70e-02 [B]	5.17e-01 [B]	5.86e+01	4.70e-02 [B]
9709541	5	Bluegill	Medium	59	2.24e+01	1.50e-02 [B]	1.50e-01 [B]	6.79e+00 [B]	1.69e-03 [U]	2.52e-02 [B]	2.01e+04	6.54e-01	1.09e-01 [B]	6.99e-01 [B]	5.89e+01	9.05e-02 [B]
9709516	1	Bluegill	Large	86	9.14e+00 [B]	8.57e-03 [B]	1.80e-01 [B]	5.47e+00 [B]	1.70e-03 [U]	9.71e-03 [B]	1.27e+04	3.45e-01 [B]	4.67e-02 [B]	1.57e+00	3.55e+01	8.57e-02 [B]
9709523	2	Bluegill	Large	172	7.87e+00 [B]	3.44e-03 [B]	1.13e-01 [B]	6.49e+00 [B]	2.13e-02 [B]	1.13e-02 [B]	1.42e+04	1.73e+00	1.26e-01 [B]	2.14e+00	4.10e+01	5.93e-02 [B]
9709530	3	Bluegill	Large	125	6.22e+00 [B]	6.84e-03 [B]	8.91e-02 [B]	4.89e+00 [B]	6.54e-03 [B]	7.68e-03 [B]	1.62e+04	8.51e-01	1.02e-01 [B]	1.30e+00	4.49e+01	1.44e-01 [B]
9709536	4	Bluegill	Large	92	1.34e+02	7.75e-03 [B]	1.26e-01 [B]	5.44e+00 [B]	2.25e-02 [B]	8.35e-03 [B]	1.83e+04	6.75e-01	1.54e-01 [B]	8.85e-01 [B]	1.48e+02	1.00e-01 [B]
9709542	5	Bluegill	Large	126	1.84e+01	5.16e-03 [B]	1.03e-01 [B]	8.05e+00 [B]	1.69e-03 [U]	1.49e-02 [B]	2.55e+04	4.92e-01 [B]	5.80e-02 [B]	2.70e+00	6.75e+01	1.19e-01 [B]
9709525	2	Carp	Small	216	3.01e+01	4.49e-03 [B]	1.79e-01 [B]	1.21e+00 [B]	1.70e-03 [U]	1.79e-02 [B]	2.09e+03	3.31e-01 [B]	3.95e-02 [B]	7.79e-01 [B]	2.90e+01	5.94e-02 [B]
9709526	2	Carp	Large	2395	4.08e+01	1.55e-03 [U]	1.75e-01 [B]	1.50e+00 [B]	1.59e-02 [B]	1.17e-02 [B]	3.54e+03	7.26e-01	6.51e-02 [B]	3.93e+00	6.61e+01	2.04e-01
9709532	3	Carp	Large	2641	7.57e+01	2.03e-03 [B]	2.08e-01 [B]	4.03e+00 [B]	7.89e-03 [B]	2.65e-02 [B]	9.21e+03	9.83e-01	1.54e-01 [B]	1.55e+00	1.31e+02	1.52e-01
9709544	5	Carp	Large	1850	1.64e+02	1.41e-02 [B]	1.48e-01 [B]	3.40e+00 [B]	8.90e-03 [B]	1.97e-02 [B]	5.16e+03	7.40e-01	1.41e-01 [B]	1.82e+00	1.36e+02	1.03e-01 [B]
9709513	1	Channel Catfish	N/A	121	1.49e+00 [B]	3.61e-02 [B]	1.49e-01 [B]	2.15e+00 [B]	1.70e-03 [U]	4.86e-02 [B]	1.55e+04	4.48e-01 [B]	1.31e-01 [B]	1.81e+00	3.52e+01	1.81e-01
9709517	1	Crayfish	N/A	11	4.17e+02	1.21e-02 [B]	6.11e-01	1.60e+02	7.80e-03 [B]	4.75e-02 [B]	4.91e+04	1.93e+00	3.58e-01 [B]	4.05e+01	4.71e+02	7.84e-01
9709524	2	Crayfish	N/A	29	1.86e+02	3.04e-02 [B]	4.75e-01 [B]	1.36e+02	4.25e-03 [B]	4.96e-02 [B]	5.82e+04	9.94e-01	2.49e-01 [B]	2.00e+01	2.35e+02	2.75e-01
9709531	3	Crayfish	N/A	26	8.13e+01	7.84e-03 [B]	4.02e-01 [B]	8.41e+01	1.16e-02 [B]	2.57e-02 [B]	3.97e+04	9.12e-01	2.49e-01 [B]	3.20e+01	1.87e+02	1.46e-01 [B]
9709537	4	Crayfish	N/A	20	2.12e+02	1.95e-02 [B]	4.94e-01 [B]	1.40e+02	9.57e-03 [B]	5.07e-02 [B]	4.40e+04	1.42e+00	4.02e-01 [B]	2.95e+01	2.28e+02	2.54e-01
9709543	5	Crayfish	N/A	20	3.47e+02	3.07e-02 [B]	6.41e-01	1.65e+02	1.32e-02 [B]	5.47e-02 [B]	4.69e+04	1.37e+00	5.58e-01 [B]	2.06e+01	4.91e+02	1.08e+00
9709510	1	Largemouth Bass	Small	173	5.28e+00 [B]	2.69e-03 [B]	7.49e-02 [B]	1.20e+00 [B]	1.70e-03 [U]	1.30e-02 [B]	9.10e+03	2.10e-01 [B]	3.70e-02 [B]	5.98e-01 [B]	2.56e+01	5.04e-02 [B]

NAREL ID	Location	Species	Size	Average Mass (g)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead (AA)
9709518	2	Largemouth Bass	Small	415	5.61e+00 [B]	6.30e-03 [B]	1.68e-01 [B]	1.45e+00 [B]	1.69e-03 [U]	3.95e-02 [B]	9.80e+03	1.83e+00	7.13e-02 [B]	2.18e+00	4.61e+01	1.67e-01
9709527	3	Largemouth Bass	Small	258	1.57e+00 [B]	1.55e-03 [U]	4.75e-02 [B]	9.92e-01 [B]	1.83e-03 [B]	4.31e-03 [B]	5.40e+03	6.51e-01	6.85e-02 [B]	1.70e+00	2.17e+01	2.58e-02 [B]
9709538	5	Largemouth Bass	Small	285	1.57e+01	1.55e-03 [U]	9.53e-02 [B]	1.97e+00 [B]	5.02e-03 [B]	6.32e-03 [B]	1.04e+04	4.93e-01 [B]	9.85e-02 [B]	8.99e-01 [B]	1.40e+02	5.07e-02 [B]
9709511	1	Largemouth Bass	Medium	600	4.77e+00 [B]	8.56e-03 [B]	8.19e-02 [B]	1.65e+00 [B]	5.37e-03 [B]	4.98e-03 [B]	7.53e+03	3.82e-01 [B]	1.81e-02 [B]	1.08e+00 [B]	1.83e+01	4.78e-02 [B]
9709519	2	Largemouth Bass	Medium	[illegible]	3.80e+00 [B]	2.53e-03 [B]	1.24e-01 [B]	5.84e-01 [B]	1.69e-03 [U]	7.93e-03 [B]	7.34e+03	3.96e-01 [B]	2.77e-02 [B]	2.82e+00	1.99e+01	1.80e-01
9709528	3	Largemouth Bass	Medium	720	7.02e+00 [B]	8.12e-03 [B]	1.01e-01 [B]	6.12e-01 [B]	1.70e-03 [U]	9.01e-03 [B]	4.51e+03	8.11e-01	3.89e-02 [B]	7.26e-01 [B]	2.56e+01	7.07e-02 [B]
9709539	5	Largemouth Bass	Medium	541	5.53e+00 [B]	1.56e-03 [U]	2.75e-02 [B]	2.74e+00 [B]	1.71e-03 [U]	5.20e-03 [B]	1.24e+04	4.89e-01 [B]	1.35e-01 [B]	7.57e-01 [B]	2.90e+01	5.40e-02 [B]
9709512	1	Largemouth Bass	Large	1256	3.37e+01	5.87e-03 [B]	1.56e-01 [B]	7.69e+00 [B]	3.98e-03 [B]	5.82e-03 [B]	5.85e+03	3.36e-01 [B]	1.26e-01 [B]	1.62e+00	6.49e+01	1.03e-01 [B]
9709520	2	Largemouth Bass	Large	1757	4.58e+00 [B]	2.08e-02 [B]	1.06e-01 [B]	1.45e+00 [B]	1.09e-02 [B]	2.00e-02 [B]	8.71e+03	3.36e-01 [B]	2.39e-02 [B]	2.30e+00	2.24e+01	1.19e-01 [B]

All concentrations of metals have units of mg / kg-fresh whole fish.
The [B] qualifier indicates that the reported value is less than the Reporting Limit but greater than or equal to the Instrument Detection Limit.
The [U] qualifier indicates that the compound was analyzed for but not detected. The Instrument Detection Limit is reported with the [U] qualifier.
AA indicates lead analyzed by Graphite Furnace Atomic Absorption. ICPMS indicates lead analyzed by Inductively Coupled Plasma Mass Spectrometer.

Table 3B - Metals Concentrations in Fish Collected from Putah Creek

NAREL ID	Location	Species	Size	Average Mass (g)	Lead (ICPMS)	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
9709533	3	Black Bullhead	N/A	258	2.51e-01	3.35e+02	3.33e+00	9.94e-02	1.52e+00 [B]	2.96e+03	3.47e-01	3.09e-02 [B]	9.93e+02	1.33e-02 [U]	3.03e-01 [B]	1.59e+01
9709514	1	Bluegill	Small	28	1.26e-01 [B]	5.53e+02	8.46e+00	6.33e-02	2.38e+00	2.55e+03	6.73e-01	3.57e-02 [B]	1.03e+03	1.33e-02 [U]	5.40e-01 [B]	2.46e+01
9709521	2	Bluegill	Small	31	8.62e-02 [B]	6.14e+02	1.24e+01	7.49e-02	1.94e+00 [B]	2.83e+03	7.45e-01	1.45e-02 [B]	1.29e+03	1.32e-02 [U]	3.69e-01 [B]	2.38e+01
9709529	3	Bluegill	Small	12	7.52e-02 [B]	5.31e+02	6.71e+00	1.35e-01	2.61e+00	2.89e+03	9.72e-01	7.61e-03 [B]	1.04e+03	1.32e-02 [U]	3.74e-01 [B]	2.77e+01
9709534	4	Bluegill	Small	27	6.60e-02 [B]	4.59e+02	5.63e+00	1.08e-01	2.34e+00	3.49e+03	7.22e-01	1.29e-03 [U]	1.11e+03	1.32e-02 [U]	3.67e-01 [B]	2.62e+01
9709540	5	Bluegill	Small	28	7.35e-02 [B]	4.52e+02	4.38e+00	1.06e-01	2.15e+00	2.89e+03	5.38e-01	1.30e-03 [U]	1.01e+03	1.33e-02 [U]	2.46e-01 [B]	2.21e+01
9709515	1	Bluegill	Medium	51	6.61e-02 [B]	4.57e+02	4.69e+00	7.92e-02	1.64e+00 [B]	2.81e+03	7.90e-01	1.01e-02 [B]	1.04e+03	1.32e-02 [U]	2.91e-01 [B]	1.84e+01
9709522	2	Bluegill	Medium	58	3.56e-02 [B]	4.62e+02	2.45e+00	1.07e-01	1.42e+00 [B]	2.66e+03	4.91e-01	1.69e-02 [B]	1.16e+03	1.32e-02 [U]	1.26e-01 [B]	1.46e+01
9709535	4	Bluegill	Medium	48	6.29e-02 [B]	7.21e+02	5.64e+00	1.15e-01	3.93e+00	3.46e+03	7.23e-01	2.43e-02 [B]	1.23e+03	1.33e-02 [U]	2.65e-01 [B]	2.92e+01
9709541	5	Bluegill	Medium	59	7.39e-02 [B]	6.05e+02	6.08e+00	1.10e-01	2.54e+00	2.85e+03	7.30e-01	1.35e-02 [B]	1.11e+03	1.32e-02 [U]	3.25e-01 [B]	2.24e+01
9709516	1	Bluegill	Large	86	6.39e-02 [B]	4.32e+02	6.88e+00	8.53e-02	1.41e+00 [B]	2.71e+03	6.30e-01	9.21e-03 [B]	1.15e+03	1.33e-02 [U]	1.55e-01 [B]	1.65e+01
9709523	2	Bluegill	Large	172	3.72e-02 [B]	4.73e+02	2.99e+00	1.95e-01	1.63e+00 [B]	2.92e+03	5.75e-01	2.08e-02 [B]	1.28e+03	1.33e-02 [U]	1.72e-01 [B]	3.23e+01
9709530	3	Bluegill	Large	125	1.29e-01 [B]	5.25e+02	6.52e+00	1.27e-01	2.34e+00	3.02e+03	6.67e-01	1.44e-02 [B]	1.26e+03	1.32e-02 [U]	3.16e-01 [B]	1.75e+01
9709536	4	Bluegill	Large	92	9.09e-02 [B]	5.33e+02	9.30e+00	8.63e-02	3.43e+00	2.84e+03	6.82e-01	2.75e-03 [B]	1.51e+03	1.33e-02 [U]	4.62e-01 [B]	2.20e+01
9709542	5	Bluegill	Large	126	1.13e-01 [B]	6.17e+02	7.75e+00	2.37e-02 [U]	3.49e+00	2.41e+03	6.77e-01	2.48e-03 [B]	1.46e+03	1.32e-02 [U]	2.61e-01 [B]	2.47e+01
9709525	2	Carp	Small	216	3.59e-02 [B]	2.84e+02	5.96e-01 [B]	5.65e-02	5.50e-01 [B]	2.78e+03	5.09e-01	2.55e-02 [B]	9.28e+02	1.33e-02 [U]	1.47e-01 [B]	1.82e+01
9709526	2	Carp	Large	2395	1.86e-01	2.79e+02	9.15e-01	1.11e-01	1.22e+00 [B]	2.60e+03	9.03e-01	4.01e-02 [B]	9.64e+02	1.32e-02 [U]	2.48e-01 [B]	5.97e+01
9709532	3	Carp	Large	2641	1.47e-01 [B]	4.05e+02	2.71e+00	8.02e-02	2.31e+00	2.38e+03	1.48e+00	1.35e-02 [B]	9.66e+02	1.32e-02 [U]	4.24e-01 [B]	1.29e+02
9709544	5	Carp	Large	1850	1.05e-01 [B]	3.15e+02	3.01e+00	1.08e-01	1.41e+00 [B]	2.40e+03	5.66e-01	2.01e-02 [B]	9.29e+02	1.32e-02 [U]	4.80e-01 [B]	5.75e+01
9709513	1	Channel Catfish	N/A	121	1.84e-01	4.62e+02	5.34e+00	8.55e-02	1.71e+00 [B]	2.86e+03	5.57e-01	1.69e-02 [B]	1.18e+03	3.50e-02 [B]	2.29e-01 [B]	2.44e+01
9709517	1	Crayfish	N/A	11	7.07e-01	1.66e+03	3.48e+01	4.30e-02	6.70e+00	1.75e+03	8.07e-01	7.41e-01	1.91e+03	1.32e-02 [U]	1.13e+00 [B]	3.73e+01
9709524	2	Crayfish	N/A	29	2.37e-01	1.45e+03	4.24e+01	5.60e-02	6.15e+00	1.61e+03	6.93e-01	2.43e-01 [B]	2.16e+03	1.94e-02 [B]	5.44e-01 [B]	2.49e+01
9709531	3	Crayfish	N/A	26	1.51e-01	1.11e+03	2.91e+01	5.56e-02	6.30e+00	1.75e+03	7.92e-01	2.69e-01 [B]	2.25e+03	1.32e-02 [U]	3.80e-01 [B]	2.61e+01
9709537	4	Crayfish	N/A	20	2.36e-01	1.41e+03	5.64e+01	4.36e-02	7.29e+00	1.71e+03	5.32e-01	4.91e-02 [B]	1.98e+03	1.33e-02 [U]	5.97e-01 [B]	2.51e+01
9709543	5	Crayfish	N/A	20	7.21e-01	1.47e+03	7.43e+01	4.31e-02	8.39e+00	1.40e+03	6.62e-01	3.46e-02 [B]	1.93e+03	1.32e-02 [U]	1.43e+00 [B]	2.71e+01
9709510	1	Largemouth Bass	Small	173	2.04e-02 [B]	3.98e+02	8.85e-01	1.27e-01	9.21e-01 [B]	3.14e+03	5.57e-01	3.99e-03 [B]	1.02e+03	2.24e-02 [B]	8.76e-02 [B]	1.30e+01

NAREL ID	Location	Species	Size	Average Mass (g)	Lead (ICPMS)	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
9709518	2	Largemouth Bass	Small	415	1.60e-01	5.02e+02	1.45e+00	1.68e-01	2.63e+00	3.44e+03	9.41e-01	4.22e-03 [B]	9.08e+02	1.32e-02 [U]	1.42e-01 [B]	1.15e+01
9709527	3	Largemouth Bass	Small	258	3.06e-02 [B]	3.85e+02	1.00e+00	1.23e-01	1.35e+00 [B]	3.54e+03	5.94e-01	3.76e-03 [B]	9.14e+02	1.32e-02 [U]	1.88e-01 [B]	1.31e+01
9709538	5	Largemouth Bass	Small	285	3.83e-02 [B]	4.74e+02	2.29e+00	2.63e-01	2.06e+00	3.19e+03	5.58e-01	1.30e-03 [U]	1.29e+03	1.32e-02 [U]	2.04e-01 [B]	1.29e+01
9709511	1	Largemouth Bass	Medium	600	2.76e-02 [B]	3.36e+02	3.72e+00	3.95e-01	8.87e-01 [B]	3.51e+03	5.32e-01	1.92e-02 [B]	7.42e+02	1.32e-02 [U]	5.98e-02 [B]	7.43e+00
9709519	2	Largemouth Bass	Medium	730	1.62e-01	4.15e+02	4.34e-01 [B]	4.85e-01	1.26e+00 [B]	3.28e+03	7.63e-01	3.87e-03 [B]	9.49e+02	1.32e-02 [U]	1.10e-01 [B]	1.13e+01
9709528	3	Largemouth Bass	Medium	720	4.41e-02 [B]	3.42e+02	7.48e-01	1.71e-01	1.05e+00 [B]	3.40e+03	8.09e-01	9.71e-03 [B]	1.05e+03	1.33e-02 [U]	2.60e-01 [B]	8.92e+00
9709539	5	Largemouth Bass	Medium	541	4.68e-02 [B]	4.93e+02	2.35e+00	2.52e-01	2.13e+00	3.51e+03	4.79e-01	1.31e-03 [U]	1.12e+03	1.33e-02 [U]	2.28e-01 [B]	1.17e+01
9709512	1	Largemouth Bass	Large	1256	7.83e-02 [B]	4.13e+02	1.06e+01	6.99e-01	1.10e+00 [B]	3.40e+03	5.76e-01	1.87e-02 [B]	1.12e+03	1.32e-02 [U]	1.92e-01 [B]	7.20e+00
9709520	2	Largemouth Bass	Large	1757	1.12e-01 [B]	3.89e+02	4.63e-01 [B]	8.08e-01	1.38e+00 [B]	3.18e+03	5.05e-01	2.03e-02 [B]	1.21e+03	1.33e-02 [U]	1.24e-01 [B]	8.63e+00

All concentrations of metals have units of mg / kg-fresh whole fish.
The [B] qualifier indicates that the reported value is less than the Reporting Limit but greater than or equal to the Instrument Detection Limit.
The [U] qualifier indicates that the compound was analyzed for but not detected. The Instrument Detection Limit is reported with the [U] qualifier.
AA indicates lead analyzed by Graphite Furnace Atomic Absorption. ICPMS indicates lead analyzed by Inductively Coupled Plasma Mass Spectrometer.

Table 4A - Metals Concentrations in Sediment Collected from Putah Creek

NAREL ID	Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead (AA)
9708512	1	2.07e+04	1.53e-01 U	4.75e+00	1.44e+02	4.06e-01	1.53e-01 B	6.89e+03	4.11e+02	1.85e+01	2.21e+01	3.94e+04	7.65e+00
9708779	1 (FD)	1.68e+04	1.62e-01 U	5.06e+00	1.21e+02	3.4e-01 B	1.47e-01 B	5.65e+03	3.85e+02	1.95e+01	2.35e+01	3.66e+04	1.46e+01
9708511	2	2.35e+04	1.44e-01 U	4.75e+00	1.58e+02	3.71e-01	1.02e-01 B	3.42e+03	1.16e+02	1.29e+01	2.02e+01	2.65e+04	4.95e+00
9708510	3	2.58e+04	1.60e-01 U	5.13e+00	2.02e+02	4.54e-01	1.22e-01 B	4.92e+03	2.91e+02	1.84e+01	2.67e+01	4.27e+04	8.87e+00
9708514	4	1.58e+04	1.50e-01 U	5.31e+00	1.25e+02	3.66e-01 B	1.40e-01 B	4.42e+03	2.11e+02	1.78e+01	2.07e+01	3.32e+04	8.74e+00
9708513	5	2.50e+04	1.47e-01 U	4.86e+00	1.79e+02	3.98e-01	6.99e-02 B	6.55e+03	3.14e+02	1.80e+01	2.11e+01	3.91e+04	6.16e+00

Table 4B - Metals Concentrations in Sediment Collected from Putah Creek

NAREL ID	Location	Lead (ICPMS)	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
9708512	1	9.49e+00	3.10e+04	4.50e+02	4.14e-01	2.72e+02	2.46e+03	4.72e-01	3.89e-01 B	2.81e+02 B	1.48e-01 B	5.86e+01	8.08e+01
9708779	1 (FD)	1.87e+01	3.81e+04	4.25e+02	5.36e-01	3.03e+02	1.57e+03	4.97e-01	4.18e-01 B	2.01e+02 B	1.08e-01 B	4.82e+01	7.43e+01
9708511	2	7.65e+00	1.30e+04	2.67e+02	4.18e-01	8.64e+01	2.86e+03	4.68e-01	2.67e-01 B	2.12e+02 B	1.70e-01 B	5.12e+01	5.96e+01
9708510	3	1.10e+01	3.12e+04	4.56e+02	5.00e-01	2.73e+02	2.58e+03	7.92e-01	3.53e-01 B	2.80e+02 B	1.75e-01 B	6.57e+01	7.62e+01
9708514	4	1.05e+01	2.47e+04	3.38e+02	1.38e+00	2.29e+02	1.54e+03	4.29e-01	2.57e-02 B	1.63e+02 B	1.05e-01 B	4.61e+01	7.12e+01
9708513	5	7.56e+00	2.62e+04	4.41e+02	8.73e-01	2.35e+02	3.00e+03	3.97e-01	4.14e-02 B	2.53e+02 B	1.27e-01 B	5.69e+01	5.85e+01

All concentrations of metals have units of mg / kg-dry weight of sediment.
The U qualifier indicates that the compound was analyzed for but not detected. The Instrument Detection Limit is reported with the U qualifier.
The B qualifier indicates that the reported value is less than the Reporting Limit but greater than or equal to the Instrument Detection Limit.
AA indicates lead analyzed by Graphite Furnace Atomic Absorption.
ICPMS indicates lead analyzed by Inductively Coupled Plasma Mass Spectrometer.
FD = Field Duplicate sample.

Table 5A - Metals Concentrations in Water Collected from Putah Creek

NAREL ID	Location	Prep	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead (AA)
9708500	1	Unfiltered	3.40e+02	1.00e+01 U	1.90e+00 B	1.10e+02 B	5.00e-02 U	6.00e-02 U	3.60e+04	7.90e+00 B	7.00e-02 U	5.40e+00 B	4.30e+02	9.00e-01 U
9708796	1	Certified clean container	9.90e+02	1.00e+01 U	2.40e+00 B	1.10e+02 B	5.00e-02 U	6.00e-02 U	3.10e+04	6.80e+00 B	7.00e-02 U	4.90e+00 B	9.70e+02	9.00e-01 U
9708501	1	Filtered	2.70e+01 U	1.00e+01 U	2.10e+00 B	1.10e+02 B	5.00e-02 U	6.00e-02 B	3.60e+04	7.90e+00 B	1.50e-01 B	4.30e+00 B	2.90e+01 U	9.00e-01 U
9708502	2	Unfiltered	1.90e+03	1.00e+01 U	2.10e+00 B	1.30e+02 B	5.00e-02 U	4.50e-01 B	3.60e+04	9.90e+00 B	4.70e-01 B	7.10e+00 B	1.80e+03	9.00e-01 U
9708797	2	Certified clean container	8.70e+02	1.00e+01 U	2.10e+00 B	1.10e+02 B	5.00e-02 U	6.00e-02 U	3.20e+04	6.60e+00 B	7.00e-02 U	3.00e+00 B	8.60e+02	9.00e-01 U
9708503	2	Filtered	2.70e+01 U	1.00e+01 U	1.90e+00 B	1.10e+02 B	5.00e-02 U	1.70e-01 B	3.60e+04	4.80e+00 B	7.00e-02 U	6.60e+00 B	2.90e+01 U	9.00e-01 U
9708504	3	Unfiltered	9.60e+02	1.00e+01 U	1.80e+00 B	1.20e+02 B	5.00e-02 U	6.00e-02 U	3.60e+04	8.10e+00 B	2.20e+00 B	4.30e+00 B	7.60e+02	9.00e-01 U
9708798	3	Certified clean container	8.30e+02	1.00e+01 U	2.40e+00 B	1.10e+02 B	5.00e-02 U	6.00e-02 U	3.40e+04	8.20e+00 B	1.40e+00 B	3.90e+00 B	7.80e+02	9.00e-01 U
9708505	3	Filtered	5.20e+02	1.00e+01 U	1.90e+00 B	1.10e+02 B	6.00e-02 B	2.50e-01 B	3.50e+04	5.60e+00 B	7.00e-02 U	4.80e+00 B	4.40e+02	9.00e-01 U
9708506	4	Unfiltered	5.60e+02	1.00e+01 U	1.40e+00 B	1.20e+02 B	5.00e-02 U	3.90e-01 B	3.50e+04	9.10e+00 B	2.80e+00 B	4.00e+00 B	4.80e+02	9.00e-01 U
9708799	4	Certified clean container	4.40e+03	1.00e+01 U	2.80e+00 B	1.40e+02 B	9.00e-02 B	6.00e-02 U	3.20e+04	1.50e+01	1.50e+00 B	6.90e+00 B	3.90e+03	9.00e-01 U
9708507	4	Filtered	2.70e+01 U	1.00e+01 U	1.30e+00 B	1.10e+02 B	5.00e-02 U	1.50e-01 B	3.50e+04	7.10e+00 B	7.00e-02 U	1.70e+00 B	2.90e+01 U	9.00e-01 U
9708508	5	Unfiltered	8.80e+02	1.00e+01 U	1.60e+00 B	1.20e+02 B	5.00e-02 U	6.00e-02 U	3.60e+04	8.50e+00 B	1.80e+00 B	6.40e+00 B	7.20e+02	9.00e-01 U
9708800	5	Certified clean container	1.80e+03	1.00e+01 U	1.90e+00 B	1.20e+02 B	5.00e-02 U	6.00e-02 U	3.20e+04	8.80e+00 B	9.50e-01 B	3.00e+00 B	1.40e+03	9.00e-01 U
9708509	5	Filtered	2.70e+01 U	1.00e+01 U	1.30e+00 B	1.10e+02 B	5.00e-02 U	9.00e-02 B	3.60e+04	8.80e+00 B	2.00e+00 B	2.80e+00 B	2.90e+01 U	9.00e-01 U

All concentrations of metals have units of μg / L of water.
The U qualifier indicates that the compound was analyzed for but not detected. The Instrument Detection Limit is reported with the U qualifier.
The B qualifier indicates that the reported value is less than the Reporting Limit but greater than or equal to the Instrument Detection Limit.
AA indicates lead analyzed by Graphite Furnace Atomic Absorption.

Table 5B - Metals Concentrations in Water Collected from Putah Creek

NAREL ID	Location	Prep	Lead (ICPMS)	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
9708500	1	Unfiltered	1.60e-01 U	3.80e+04	1.60e+01	1.21e-01 U	6.40e+00 B	2.30e+03 B	1.60e+00 U	9.00e-02 B	4.40e+04	7.00e-02 U	8.10e+00 B	1.10e+00 U
9708796	1	Certified clean container	1.60e-01 U	3.40e+04	2.20e+01	1.21e-01 U	7.20e+00 B	2.40e+03 B	2.10e+00 B	3.00e-02 U	3.90e+04	7.00e-02 U	8.50e+00 B	2.00e+00 B
9708501	1	Filtered	1.60e-01 U	4.10e+04	6.60e+00 B	1.21e-01 U	3.70e+00 B	2.30e+03 B	2.00e+00 B	3.00e-02 U	4.60e+04	1.10e-01 B	7.10e+00 B	1.10e+00 U
9708502	2	Unfiltered	4.20e-01 B	3.70e+04	3.60e+01	1.21e-01 U	9.80e+00 B	2.30e+03 B	1.60e+00 U	3.00e-02 U	3.40e+04	7.00e-02 U	1.10e+01 B	3.20e+00 B
9708797	2	Certified clean container	1.60e-01 U	3.50e+04	2.00e+01	1.21e-01 U	5.90e+00 B	1.90e+03 B	2.20e+00 B	3.00e-02 U	2.90e+04	7.00e-02 U	7.40e+00 B	1.10e+00 U
9708503	2	Filtered	1.60e-01 U	4.20e+04	4.40e+00 B	1.21e-01 U	6.90e+00 B	2.00e+03 B	1.60e+00 U	3.00e-02 U	4.00e+04	7.00e-02 U	6.60e+00 B	1.10e+00 U
9708504	3	Unfiltered	1.60e-01 U	4.20e+04	1.50e+01	1.21e-01 U	1.20e+01 B	2.30e+03 B	1.60e+00 U	3.00e-02 U	4.00e+04	7.00e-02 U	9.10e+00 B	1.10e+00 U
9708798	3	Certified clean container	1.60e-01 U	3.80e+04	1.60e+01	1.21e-01 U	9.30e+00 B	2.10e+03 B	2.60e+00 B	3.00e-02 U	3.40e+04	7.00e-02 U	7.80e+00 B	1.10e+00 U
9708505	3	Filtered	1.60e-01 U	4.00e+04	9.90e+00 B	1.21e-01 U	6.90e+00 B	2.10e+03 B	1.60e+00 U	3.00e-02 U	3.90e+04	1.00e-01 B	8.10e+00 B	1.10e+00 U
9708506	4	Unfiltered	2.80e-01 B	4.10e+04	1.50e+01	1.21e-01 U	1.10e+01 B	1.60e+03 B	1.60e+00 U	3.00e-02 U	2.60e+04	7.00e-02 U	5.50e+00 B	1.20e+00 B
9708799	4	Certified clean container	8.30e-01 B	3.40e+04	6.30e+01	1.21e-01 U	1.60e+01 B	1.90e+03 B	3.60e+00 B	3.00e-02 U	2.30e+04	7.00e-02 U	1.50e+01 B	5.50e+00 B
9708507	4	Filtered	1.60e-01 U	4.00e+04	4.80e+00 B	1.21e-01 U	7.80e+00 B	1.50e+03 B	1.60e+00 U	3.00e-02 U	2.60e+04	7.00e-02 U	3.90e+00 B	1.10e+00 U
9708508	5	Unfiltered	1.60e-01 U	4.10e+04	1.90e+01	1.21e-01 U	1.20e+01 B	1.80e+03 B	1.60e+00 U	3.00e-02 U	2.60e+04	7.00e-02 U	6.40e+00 B	3.40e+00 B
9708800	5	Certified clean container	1.60e-01 U	3.50e+04	2.70e+01	1.21e-01 U	1.00e+01 B	1.60e+03 B	1.60e+00 U	3.00e-02 U	2.20e+04	7.00e-02 U	8.20e+00 B	1.10e+00 U
9708509	5	Filtered	1.60e-01 U	4.00e+04	3.80e+00 B	1.21e-01 U	9.60e+00 B	1.50e+03 B	1.60e+00 U	3.00e-02 U	2.60e+04	7.00e-02	4.10e+00 B	1.10e+00 U

All concentrations of metals have units of μg / L of water.
The U qualifier indicates that the compound was analyzed for but not detected. The Instrument Detection Limit is reported with the U qualifier.
The B qualifier indicates that the reported value is less than the Reporting Limit but greater than or equal to the Instrument Detection Limit.
ICPMS indicates lead analyzed by Inductively Coupled Plasma Mass Spectrometer.

Table 6 - Concentrations of Gamma Emitting Radionuclides in Fish Collected from Putah Creek

NAREL ID	Location	Species	Size	Average Mass (g)	Bi-212	Bi-214	K-40	Pb-212	Pb-214	Ra-224	Ra-226	Th-234	Tl-208
9709533	3	Black Bullhead	N/A	258			2.00e+00 ± 2.3e-01	2.16e-02 ± 2.4e-02					
9709514	1	Bluegill	Small	28			2.49e+00 ± 1.7e-01						
9709521	2	Bluegill	Small	31			2.54e+00 ± 3.5e-01		8.02e-02 ± 4.0e-02				
9709529	3	Bluegill	Small	12			2.54e+00 ± 8.1e-01						
9709534	4	Bluegill	Small	27			2.55e+00 ± 4.8e-01	2.76e-02 ± 5.2e-02					
9709540	5	Bluegill	Small	28			2.26e+00 ± 1.3e-01		2.15e-02 ± 1.2e-02				
9709515	1	Bluegill	Medium	51			2.48e+00 ± 1.6e-01				2.72e-01 ± 2.0e-01		
9709522	2	Bluegill	Medium	58		4.28e-02 ± 2.8e-02	2.60e+00 ± 2.4e-01	3.84e-02 ± 2.5e-02					
9709535	4	Bluegill	Medium	48			3.29e+00 ± 5.3e-01						3.53e-02 ± 4.3e-02
9709541	5	Bluegill	Medium	59			2.08e+00 ± 8.7e-02	7.21e-02 ± 6.2e-03					
9709516	1	Bluegill	Large	86			2.14e+00 ± 1.7e-01					1.36e-01 ± 1.7e-01	
9709523	2	Bluegill	Large	172			2.29e+00 ± 2.8e-01	2.73e-02 ± 3.0e-02					
9709530	3	Bluegill	Large	125			2.39e+00 ± 3.6e-01			2.95e-01 ± 3.1e-01			
9709536	4	Bluegill	Large	92			2.54e+00 ± 4.0e-01	7.12e-02 ± 5.6e-02					2.28e-02 ± 3.4e-02
9709542	5	Bluegill	Large	126			2.70e+00 ± 3.8e-01	4.54e-02 ± 4.6e-02					
9709525	2	Carp	Small	216			2.20e+00 ± 3.7e-01						
9709526	2	Carp	Large	2395			2.17e+00 ± 6.6e-02					3.55e-02 ± 3.8e-02	
9709532	3	Carp	Large	2641	3.34e-02 ± 2.6e-02		2.26e+00 ± 7.9e-02						2.26e-03 ± 3.5e-03
9709544	5	Carp	Large	1850			2.15e+00 ± 6.7e-02	3.88e-03 ± 4.3e-03					2.88e-03 ± 3.1e-03
9709513	1	Channel Catfish	N/A	121			2.52e+00 ± 4.1e-01	7.55e-02 ± 4.4e-02					
9709517	1	Crayfish	N/A	11			1.43e+00 ± 1.7e+00						9.35e-02 ± 1.7e-01
9709524	2	Crayfish	N/A	29			1.46e+00 ± 3.6e-01						
9709531	3	Crayfish	N/A	26		1.10e-01 ± 6.3e-02	1.45e+00 ± 4.3e-01	1.04e-01 ± 5.1e-02			5.41e-01 ± 6.3e-01		2.54e-02 ± 3.8e-02
9709537	4	Crayfish	N/A	20			1.59e+00 ± 2.6e-01						1.09e-02 ± 1.3e-02
9709543	5	Crayfish	N/A	20			1.39e+00 ± 1.1e+00	1.04e-01 ± 1.2e-01					
9709510	1	Large-mouth Bass	Small	173		4.22e-02 ± 2.3e-02	2.45e+00 ± 2.0e-01	3.79e-02 ± 1.9e-02					
9709518	2	Large-mouth Bass	Small	415			2.35e+00 ± 2.0e-01						

NAREL ID	Location	Species	Size	Average Mass (g)	Bi-212	Bi-214	K-40	Pb-212	Pb-214	Ra-224	Ra-226	Th-234	Tl-208
9709527	3	Large-mouth Bass	Small	258			2.67e+00 ± 2.6e-01			8.64e-02 ± 7.3e-02			
9709538	5	Large-mouth Bass	Small	285			2.36e+00 ± 1.9e-01						
9709511	1	Large-mouth Bass	Medium	600			2.95e+00 ± 2.3e-01	1.42e-02 ± 2.4e-02					1.04e-02 ± 1.5e-02
9709519	2	Large-mouth Bass	Medium	730			2.35e+00 ± 2.0e-01						
9709528	3	Large-mouth Bass	Medium	720			2.63e+00 ± 1.3e-01						
9709539	5	Large-mouth Bass	Medium	541			2.53e+00 ± 1.6e-01						
9709512	1	Large-mouth Bass	Large	1256			2.77e+00 ± 1.6e-01						5.85e-03 ± 9.1e-03
9709520	2	Large-mouth Bass	Large	1757			1.99e+00 ± 8.8e-02						

Entries for nuclide concentrations show concentration and 2-σ counting error.
Blank entries indicate that the nuclide was not detected in the sample.
Concentration are in pCi / g-fresh whole fish.

Table 7A - Concentrations of Gamma Emitting Radionuclides in Sediment Collected from Putah Creek

NAREL ID	Location	Bi-212	Bi-214	Cs-134	Cs-137	K-40	Pa-234m	Pb-212
9708512	1	4.21e-01 ± 1.1e-01	3.59e-01 ± 2.3e-02	1.09e-02 ± 5.6e-03	2.79e-02 ± 8.1e-03	9.89e+00 ± 2.7e-01	9.34e-01 ± 9.4e-01	3.91e-01 ± 2.0e-02
9708779	1 (FD)	4.01e-01 ± 1.9e-01	3.76e-01 ± 2.9e-02	1.07e-02 ± 7.8e-03	1.77e-02 ± 9.6e-03	1.05e+01 ± 3.2e-01		4.67e-01 ± 2.7e-02
9708511	2	4.56e-01 ± 1.7e-01	4.07e-01 ± 3.3e-02		2.24e-02 ± 1.2e-02	1.36e+01 ± 4.7e-01		5.00e-01 ± 2.7e-02
9708510	3	4.69e-01 ± 1.5e-01	4.60e-01 ± 3.2e-02		4.17e-02 ± 1.2e-02	1.21e+01 ± 3.7e-01		6.16e-01 ± 2.8e-02
9708513	5	4.34e-01 ± 1.1e-01	3.87e-01 ± 2.2e-02		8.46e-03 ± 7.5e-03	1.05e+01 ± 2.5e-01		4.32e-01 ± 2.2e-02
9708514	4	4.43e-01 ± 1.5e-01	4.18e-01 ± 2.6e-02		2.46e-02 ± 9.8e-03	1.17e+01 ± 2.9e-01		5.14e-01 ± 2.5e-02

Table 7B - Concentrations of Gamma Emitting Radionuclides in Sediment Collected from Putah Creek

NAREL ID	Location	Pb-214	Ra-224	Ra-226	Ra-228	Th-234	Tl-208	U-235
9708512	1	3.73e-01 ± 2.1e-02	2.76e-01 ± 2.3e-01	8.26e-01 ± 2.1e-01	3.39e-01 ± 3.0e-02	4.67e-01 ± 1.3e-01	1.24e-01 ± 1.2e-02	
9708779	1 (FD)	4.14e-01 ± 2.7e-02	2.09e-01 ± 2.9e-01	1.11e+00 ± 2.8e-01	4.17e-01 ± 3.9e-02	3.42e-01 ± 1.2e-01	1.41e-01 ± 1.5e-02	
9708511	2	4.32e-01 ± 2.8e-02	4.95e-01 ± 2.6e-01	1.06e+00 ± 2.4e-01	4.57e-01 ± 4.2e-02		1.59e-01 ± 1.6e-02	
9708510	3	5.20e-01 ± 2.7e-02	5.07e-01 ± 2.7e-01	1.55e+00 ± 2.6e-01	5.05e-01 ± 3.9e-02	5.60e-01 ± 2.5e-01	1.93e-01 ± 1.6e-02	9.34e-02 ± 1.6e-02
9708513	5	4.22e-01 ± 2.2e-02	4.44e-01 ± 2.6e-01	8.78e-01 ± 2.3e-01	3.78e-01 ± 2.9e-02	3.47e-01 ± 1.5e-01	1.36e-01 ± 1.1e-02	
9708514	4	4.73e-01 ± 2.5e-02	3.53e-01 ± 2.9e-01	1.01e+00 ± 3.1e-01	4.10e-01 ± 3.3e-02	7.57e-01 ± 2.4e-01	1.48e-01 ± 1.4e-02	

Entries for nuclide concentrations show concentration and 2-σ counting error.
Blank entries indicate that the nuclide was not detected in the sample.
Concentration are in pCi / g dry-weight of sediment.

Table 8 - Concentrations of Gamma Emitting Radionuclides in Water Collected from Putah Creek

NAREL ID	Location	Prep	I-131	K-40	Pb-212	Tl-208
9708500	1	Unfiltered				
9708501	1	Filtered		3.20e+01 ± 4.3e+01		
9708502	2	Unfiltered				2.28e+00 ± 4.0e+00
9708503	2	Filtered				
9708504	3	Unfiltered	1.62e+01 ± 8.0e+00	2.84e+01 ± 3.7e+01	2.76e+00 ± 4.8e+00	
9708505	3	Filtered	1.39e+01 ± 7.1e+00			
9708506	4	Unfiltered				
9708507	4	Filtered			4.31e+00 ± 5.8e+00	2.34e+00 ± 3.5e+00
9708508	5	Unfiltered				
9708509	5	Filtered				

Entries for nuclide concentrations show concentration and 2-σ counting error.
Blank entries indicate that the nuclide was not detected in the sample.
Concentration are in pCi / L of water.

Table 9 - Gross Alpha and Gross Beta Concentrations in Fish Collected from Putah Creek

NAREL ID	Location	Species	Size	Average Mass (g)	Gross Alpha		Gross Beta	
					Concentration ± 2-σ Counting Error	MDA	Concentration ± 2-σ Counting Error	MDA
9709533	3	Black Bullhead	N/A	258	-1.25e-01 ± 5.9e-01	1.4e+00	1.56e+00 ± 1.1e+00	1.8e+00
9709514	1	Bluegill	Small	28	2.93e-01 ± 6.4e-01	1.2e+00	2.59e+00 ± 1.2e+00	1.7e+00
9709521	2	Bluegill	Small	31	1.56e-01 ± 5.8e-01	1.2e+00	2.13e+00 ± 1.2e+00	1.8e+00
9709529	3	Bluegill	Small	12	-2.23e-01 ± 5.2e-01	1.4e+00	3.19e+00 ± 1.3e+00	1.7e+00
9709534	4	Bluegill	Small	27	2.92e-01 ± 7.2e-01	1.4e+00	3.19e+00 ± 1.3e+00	1.8e+00
9709540	5	Bluegill	Small	28	5.36e-02 ± 5.1e-01	1.2e+00	2.62e+00 ± 1.2e+00	1.7e+00
9709515	1	Bluegill	Medium	51	0.00e+00 ± 4.9e-01	1.1e+00	3.72e+00 ± 1.2e+00	1.6e+00
9709522	2	Bluegill	Medium	58	1.69e-01 ± 6.5e-01	1.3e+00	2.22e+00 ± 1.2e+00	1.8e+00
9709535	4	Bluegill	Medium	48	3.42e-02 ± 6.5e-01	1.5e+00	8.76e-01 ± 1.2e+00	1.9e+00
9709541	5	Bluegill	Medium	59	7.26e-02 ± 4.7e-01	1.1e+00	2.13e+00 ± 1.2e+00	1.7e+00
9709516	1	Bluegill	Large	86	1.95e-01 ± 4.8e-01	9.7e-01	2.62e+00 ± 1.2e+00	1.7e+00
9709523	2	Bluegill	Large	172	-7.84e-02 ± 5.6e-01	1.3e+00	2.69e+00 ± 1.2e+00	1.8e+00
9709530	3	Bluegill	Large	125	-3.09e-01 ± 9.4e-01	2.1e+00	2.66e+00 ± 1.2e+00	1.8e+00
9709536	4	Bluegill	Large	92	1.34e+00 ± 1.1e+00	1.6e+00	2.89e+00 ± 1.3e+00	1.9e+00
9709542	5	Bluegill	Large	126	2.09e-01 ± 8.7e-01	1.8e+00	2.12e+00 ± 1.2e+00	1.8e+00
9709525	2	Carp	Small	216	3.92e-02 ± 4.9e-01	1.1e+00	1.74e+00 ± 1.1e+00	1.7e+00
9709526	2	Carp	Large	2395	1.18e-01 ± 5.5e-01	1.2e+00	3.52e+00 ± 1.2e+00	1.7e+00
9709532	3	Carp	Large	2641	-7.06e-02 ± 5.0e-01	1.2e+00	7.65e-01 ± 9.7e-01	1.6e+00
9709544	5	Carp	Large	1850	-1.19e-01 ± 8.0e-01	1.7e+00	1.33e+00 ± 1.1e+00	1.8e+00
9709513	1	Channel Catfish	N/A	121	-2.47e-02 ± 4.7e-01	1.1e+00	1.32e+00 ± 1.1e+00	1.7e+00
9709517	1	Crayfish	N/A	11	1.63e-01 ± 7.7e-01	1.7e+00	2.20e+00 ± 1.2e+00	1.8e+00
9709524	2	Crayfish	N/A	29	-4.93e-01 ± 7.0e-01	2.2e+00	1.95e+00 ± 1.2e+00	1.8e+00
9709531	3	Crayfish	N/A	26	1.66e-01 ± 7.7e-01	1.6e+00	1.89e+00 ± 1.1e+00	1.7e+00
9709537	4	Crayfish	N/A	20	-9.91e-02 ± 8.5e-01	2.0e+00	1.53e+00 ± 1.1e+00	1.8e+00
9709543	5	Crayfish	N/A	20	9.99e-01 ± 1.2e+00	2.0e+00	2.27e+00 ± 1.2e+00	1.8e+00
9709510	1	Largemouth Bass	Small	173	-9.38e-02 ± 6.0e-01	1.5e+00	2.89e+00 ± 1.3e+00	1.8e+00

NAREL ID	Location	Species	Size	Average Mass (g)	Gross Alpha		Gross Beta	
					Concentration ± 2-σ Counting Error	MDA	Concentration ± 2-σ Counting Error	MDA
9709518	2	Largemouth Bass	Small	415	-3.84e-01 ± 3.7e-01	1.3e+00	3.06e+00 ± 1.3e+00	1.8e+00
9709527	3	Largemouth Bass	Small	258	-1.19e-02 ± 3.5e-01	9.5e-01	2.05e+00 ± 1.1e+00	1.6e+00
9709538	5	Largemouth Bass	Small	285	1.08e-01 ± 5.7e-01	1.2e+00	1.29e+00 ± 1.1e+00	1.7e+00
9709511	1	Largemouth Bass	Medium	600	-2.56e-01 ± 3.8e-01	1.2e+00	2.70e+00 ± 1.3e+00	1.9e+00
9709519	2	Largemouth Bass	Medium	730	6.64e-01 ± 1.0e+00	1.7e+00	2.41e+00 ± 1.2e+00	1.8e+00
9709528	3	Largemouth Bass	Medium	720	4.18e-01 ± 6.9e-01	1.2e+00	2.52e+00 ± 1.2e+00	1.8e+00
9709539	5	Largemouth Bass	Medium	541	2.72e-02 ± 5.1e-01	1.2e+00	1.83e+00 ± 1.1e+00	1.8e+00
9709512	1	Largemouth Bass	Large	1256	-2.97e-01 ± 4.2e-01	1.3e+00	2.55e+00 ± 1.2e+00	1.8e+00
9709520	2	Largemouth Bass	Large	1757	-2.57e-02 ± 4.2e-01	1.1e+00	2.41e+00 ± 1.2e+00	1.7e+00

Concentrations are in pCi / g-fresh whole fish.
MDA is the minimum detectable activity.

Table 10 - Gross Alpha and Gross Beta Concentrations in Sediment Collected from Putah Creek

NAREL ID	Location	Gross Alpha		Gross Beta	
		Concentration ± 2-σ Counting Error	MDA	Concentration ± 2-σ Counting Error	MDA
9708512	1	9.34e+00 ± 6.1e+00	7.2e+00	1.43e+01 ± 3.4e+00	4.1e+00
9708779	1 (FD)	9.07e+00 ± 5.5e+00	5.9e+00	1.73e+01 ± 3.5e+00	3.8e+00
9708511	2	6.85e+00 ± 5.9e+00	8.3e+00	1.74e+01 ± 3.6e+00	4.0e+00
9708510	3	5.95e+00 ± 4.8e+00	6.5e+00	1.68e+01 ± 3.4e+00	3.8e+00
9708513	5	6.15e+00 ± 4.9e+00	6.6e+00	1.33e+01 ± 3.2e+00	3.7e+00
9708514	4	6.33e+00 ± 5.1e+00	6.8e+00	1.01e+01 ± 3.0e+00	3.8e+00

Table 11 - Gross Alpha and Gross Beta Concentrations in Water Collected from Putah Creek

NAREL ID	Location	Prep	Gross Alpha		Gross Beta	
			Concentration ± 2-σ Counting Error	MDA	Concentration ± 2-σ Counting Error	MDA
9708500	1	Unfiltered	2.14e+00 ± 3.1e+00	5.3e+00	4.06e+00 ± 2.4e+00	3.7e+00
9708501	1	Filtered	1.17e+00 ± 2.5e+00	4.7e+00	3.12e+00 ± 2.4e+00	3.8e+00
9708502	2	Unfiltered	5.06e+00 ± 3.6e+00	4.5e+00	2.48e+00 ± 2.2e+00	3.6e+00
9708503	2	Filtered	2.75e+00 ± 2.9e+00	4.4e+00	5.70e+00 ± 2.5e+00	3.6e+00
9708504	3	Unfiltered	-2.60e-01 ± 1.1e+00	3.2e+00	5.57e+00 ± 2.5e+00	3.5e+00
9708505	3	Filtered	1.68e+00 ± 2.6e+00	4.5e+00	2.87e+00 ± 2.3e+00	3.6e+00
9708506	4	Unfiltered	1.54e+00 ± 2.6e+00	4.5e+00	1.59e+00 ± 2.2e+00	3.7e+00
9708507	4	Filtered	1.83e+00 ± 2.3e+00	3.7e+00	3.45e+00 ± 2.3e+00	3.6e+00
9708508	5	Unfiltered	3.91e+00 ± 4.2e+00	6.6e+00	1.18e+00 ± 2.3e+00	3.9e+00
9708509	5	Filtered	9.74e-01 ± 2.0e+00	3.9e+00	1.53e+00 ± 2.1e+00	3.6e+00

Concentrations are in pCi / L water.
MDA is the minimum detectable activity.