Mercury Monitoring Results
Santa Ana River 1995 - 2004

	SAR-6			SAR-8			SAR-12			
	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	Sample 4
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
1995	0.05	0.06	0.19	<0.02	0.06	0.07	<0.02	0.09		
1996	<0.02						<0.02		0.12	
1997	<0.02				<0.02	<0.02		<0.02	<0.02	
1998						<0.04				
1999	<0.04		0.05	0.07	<0.04		<0.04		0.06	
2000		0.06	<0.04		0.05	<0.04	<0.04	<0.04	<0.04	
2001	<0.02	<0.02	<0.02			<0.02	0.02	0.03	0.03	
2002	<0.05		<0.04	<0.04		<0.04	<0.04	<0.04	<0.05	
2003		<0.05	<0.04			<0.05	<0.05	<0.05	<0.05	<0.04
2004	0.07	0.06	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07

	Miscellaneous
1995	SAR9=.05, Chino Creek=<.02
1996	SAR11= 0.26
1999	Below Prado= 0.04, 0.07
2000	Below Prado= <0.04

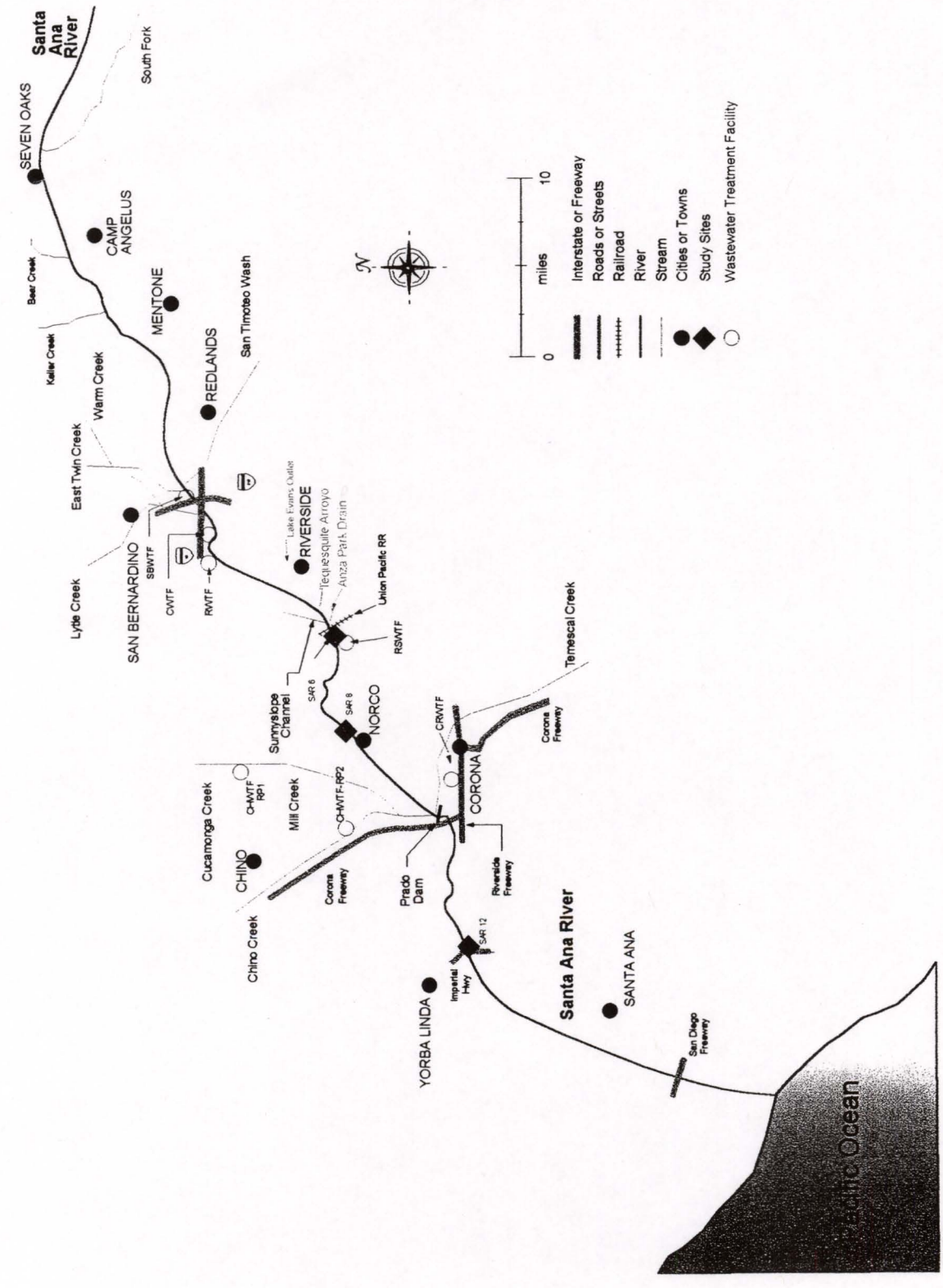

FIGURE 1: Mercury monitoring sampling sites, SAR 6, SAR 8, and SAR 12, on the Santa Ana River, California.

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MEMORANDUM

TO: SARDA Agencies
Rod Cruze, Riverside
Valerie Housel, San Bernardino
Roger Turner, Eastern Municipal
Jack Nelson, Yucaipa
John Mellin, Corona
Bonita Fan, Inland Empire
Dave Kachelski, Rialto
Bill Beam, Western Riverside
Theodore Eich, Elsinore Valley
Charles Smith, Jurupa
Jeff Pape, Lee Lake

FROM: Steve Canton

DATE: January 30 , 2006

RE: 2005 Mercury Monitoring Data for the Santa Ana River, California

This memorandum presents the data collected by Chadwick Ecological Consultants, Inc. (CEC) in October 2005 from the Santa Ana River as part of the annual mercury monitoring program. Due to complications in acquiring necessary collecting permits from the U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Game (CDFG), sampling was delayed. Rather than our typical early August sampling period, sampling was conducted in fall. Scheduling was further complicated by a period of heavy rains and higher flows as discussed below.

In October 2005, fish were collected from sites in the Santa Ana River for analysis of mercury in their tissues as part of the Mercury Monitoring Program. In addition, instream habitat assessment using the Rapid Bioassessment Protocol (RBP) habitat scoring, benthic invertebrate population sampling was also conducted in the Santa Ana River. Sampling was conducted at three sites along the Santa Ana River, SAR 6, SAR 8, and SAR 12, during October 2005 (Fig. 1). Although a site immediately below Prado Dam (SAR 10) has been sampled in the past, it has not been possible to collect any samples in the past few years due to highway construction and the resulting highway configuration which has restricted access to this site.

Prior to 1999, semi-quantitative fish population sampling was conducted at Sites SAR 6, SAR 8, and SAR 12 using electrofishing techniques under a state scientific collecting permit. These efforts provided reasonable estimates of fish abundance and detailed information on fish species composition. Electrofishing was also very effective in collecting the larger fish and crayfish desired by the Regional Board for tissue samples as part of the mercury monitoring program. However, in 2000, the USFWS listed the Santa Ana sucker as Threatened under the Endangered Species Act of 1973. All sampling now requires both state and federal collecting permits, and both prohibited the use of electofishing by CEC until 2005. The inability to use electrofishing severely limited our ability to obtain edible sized fish for tissue analysis for the mercury monitoring program from 2000 through 2004. CEC undertook efforts to have the USFWS and CDFG reinstate the use of electrofishing techniques by CEC in order to better meet the goals of the mercury monitoring program for the Santa Ana River. Permission was eventually granted by the USFWS and CDFG to conduct limited electrofishing to collect edible-sized fish for tissue analysis in October 2005.

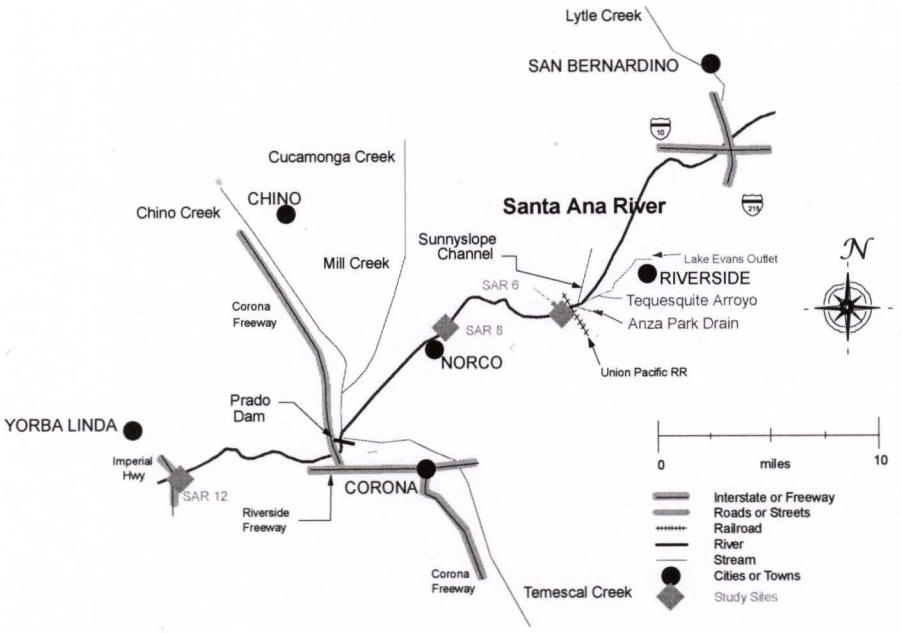

FIGURE 1: Mercury monitoring sampling Sites SAR 6, SAR 8, and SAR 12 on the Santa Ana River, California.

Annual Mercury Monitoring of Fish Tissue

As in the past, samples of representative fish and crayfish were collected according to the Mercury Monitoring Plan. Attempts were made to collect "edible sized" fish, whenever possible (the goal is to use two edible sized fish at each site - six total). However, although limited electrofishing was used to collect fish in 2005, high flows and turbid water conditions were present at the time of sampling. At Site SAR 6, one bullhead, one largemouth bass, and mosquitofish were collected for tissue analysis. No crayfish or other fish species were captured or observed. One Santa Ana sucker was observed, but not collected. The sucker was approximately 3 inches in length. At Site SAR 8, a common carp and a largemouth bass were collected. No crayfish were collected or observed. Two samples were also collected from Site SAR 12 in 2005. Common carp and largemouth bass were collected; again, no crayfish or other fish species were observed. All samples were placed in dry ice-filled coolers and shipped overnight to ACZ Laboratories in Steamboat Springs, Colorado, for analysis of total mercury and percent solids.

High flows and increased turbidity hampered efforts to collect fish and crayfish in 2005. However, target fish species (largemouth bass, yellow bullhead, and common carp) were collected at all sites reflecting an improvement over past seining efforts. No crayfish were observed at any site. Crayfish have generally been found in fairly dense aquatic vegetation and do not "float" when exposed to electricity. This made observing them and, therefore, capturing them under turbid conditions unlikely. The lack of a crayfish sample at all sites for one year should not be a big concern, as only 5 of the 22 crayfish sampled at these three sites since 1991 have even had mercury concentrations above the detection limit (range 0.05 ppm to 0.15 ppm). At Site SAR-6, a composite sample of mosquitofish was used as a substitute organism for metals analysis. At Sites SAR-8 and SAR-12, a few mosquitofish were observed, but their preferred "quiet" water habitat was limited at these two sites and not enough could be collected for metals analysis.

The flow and turbidity conditions represented unusual sampling conditions. Mean daily flow at the time of sampling (October 19, 2005) was 239 cfs compared to the average of 55.4 cfs. Additionally, mean daily flow the previous day was 953 cfs, indicating a significant flow event had occurred just prior to sampling. We are optimistic that when sampling can be conducted during the normal sampling period (early to mid-August), we will have greater success in capturing both target fish species and crayfish in the future.

Tissue data are presented in Table 1. All fish tissue samples had concentrations of mercury between <0.04 ppm and 0.16 ppm. This is well below the target concentration of 0.35 ppm in the Mercury Monitoring Plan.

TABLE 1: Tissue analysis for mercury for organisms collected in the Santa Ana River, October 2005. All mercury concentrations expressed as wet weight values.

Site/Organism	Sample Type	Total Weight (g)	Mercury Concentration (µg/g)
SAR 6			
Yellow bullhead	Individual	68	0.10
Largemouth bass	Individual	5	<0.04
Mosquitofish	Composite Sample	97	<0.04
SAR 8			
Common carp	Individual	60	<0.04
Largemouth bass	Individual	79	0.16
SAR 12			
Common carp	Individual	168	<0.04
Largemouth bass	Individual	36	0.13

Habitat Rating

Three different versions of the RBP have been used since 1991. The original RBP (Plafkin *et al.* 1989) was used during the UAA study in 1991, a revised version was used from 1995 to 1997 (Barbour and Stribling 1991), and the final version has been used since that time (Barbour *et al.* 1999). When a new version of the RBP became available, the older version was still used for at least two years to verify that overall habitat ratings were similar between RBP versions.

Sites SAR 6 and SAR 8 were rated in marginal condition in 2005. Since 1995, the habitat ratings at these sites have been consistently in marginal condition, but have been improving somewhat over time (Table 2). Site SAR 12 had shown a general decline in habitat quality over time, due to channelization activities by the Army Corp of Engineers, but has shown an improved score in recent years (Table 2). Despite improvements in habitat conditions, this site is still rated in poor condition (Table 3).

TABLE 2: Rapid Bioassessment Protocol habitat data for August/September sample periods 1991, and 1995-2005 at three sampling locations on the Santa Ana River, California.

	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SAR 6												
Original	43	19	22	29	24	24	--	--	--	--	--	--
Revised	--	24	29	37	33	34	--	--	--	--	--	--
Current	--	--	--	--	55	56	56	61	67	74	75	80
SAR 8												
Original	40	23	24	27	22	24	--	--	--	--	--	--
Revised	--	31	35	38	35	38	--	--	--	--	--	--
Current	--	--	--	--	55	58	56	65	68	72	69	75
SAR 12												
Original	39	12	16	11	4	3	--	--	--	--	--	--
Revised	--	15	20	13	4	3	--	--	--	--	--	--
Current	--	--	--	--	19	9	22	18	35	39	44	57

TABLE 3: RBP habitat parameters and scores for study sites on the Santa Ana River, October 2005.

	Habitat Parameter	SAR 6	SAR 8	SAR 12
1	Epifaunal substrate/Available cover	2	1	8
2	Pool substrate characterization	11	11	4
3	Pool variability	5	5	11
4	Sediment deposition	1	1	4
5	Channel flow status	15	15	14
6	Channel alteration	6	4	0
7	Channel sinuosity	2	3	1
8	Bank stability	5	7	6
	(score both banks)	5	7	6
9	Vegetative protection	9	5	1
	(score both banks)	8	4	1
10	Riparian vegetative zone width	5	6	1
	(score each bank riparian zone)	6	6	0
Total		**80**	**75**	**57**

Benthic Invertebrates

Benthic invertebrate data are summarized in Tables 4 - 6. In 2005, Site SAR 6 had the third highest density and the highest number of taxa and diversity observed in previous years (Table 4). Site SAR 8 had the second highest density and number of taxa reported, while diversity was the third highest compared to previous years. Density at Site SAR 12 was within the range seen in previous years, while number of taxa was higher than previous years. Diversity was the third highest observed. As in most years (the exception being 1998), sensitive groups like mayflies (Ephemeroptera) and caddisflies (Trichoptera) had low numbers at Sites SAR 6 and SAR 8 (Tables 5 and 6) where sand is the dominant substrate. Their numbers are higher at Site SAR 12, where channelization activities have resulted in a confined channel with more cobble substrate.

TABLE 4: Benthic invertebrate abundance (organisms/m²), number of taxa, and Shannon-Weaver diversity for sites on the Santa Ana River, August 1991 and 1995-2005.

Sites	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SAR 6												
Organisms/m²	39	50	155	23	2,295	53	22	91	131	156	641	598
Number of taxa	17	19	34	27	34	18	9	30	18	27	31	50
Shannon Weaver (H')	1.99	2.19	3.01	0.92	2.88	2.20	0.73	1.42	2.32	1.40	2.15	3.34
SAR 8												
Organisms/m²	34	39	36	44	9,840	10	38	67	85	54	112	503
Number of taxa	19	19	20	18	15	6	20	16	15	15	29	26
Shannon Weaver (H')	0.91	3.04	2.10	2.29	1.77	0.62	2.35	1.68	2.90	0.04	1.51	2.43
SAR 12												
Organisms/m²	6,688	2,211	3,524	4,696	1,238	1,829	459	5,160	7,024	4,015	11,332	4,991
Number of taxa	13	17	30	16	18	19	14	25	26	38	29	42
Shannon Weaver (H')	1.90	0.53	2.51	2.29	2.93	1.36	1.09	2.44	2.59	2.96	1.72	2.64

TABLE 5: Number of organisms/m^2 found within three major orders of benthic invertebrates for sites on the Santa Ana River, California, August 1991 and 1995-2005. * = Not collected in quantitative sample, but present in qualitative sweep sample.

Sites	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SAR 6												
Ephemeroptera	5	3	49	6	987	9	0*	0*	11	15	23	388
Trichoptera	0	3	0	0	887	17	0	0*	0*	11	18	7
Diptera	30	37	90	17	295	24	22	87	109	130	592	173
SAR 8												
Ephemeroptera	5	10	10	34	8,273	5	0	0*	4	0*	0*	148
Trichoptera	0	3	7	7	1,313	0	0	0*	18	0*	4	22
Diptera	29	13	19	3	254	7	34	67	58	54	97	315
SAR 12												
Ephemeroptera	2,914	13	857	2,850	624	190	68	1,285	2,414	1,477	1,757	3,685
Trichoptera	3,671	40	1,460	477	200	1,353	366	2,525	255	1,132	7,955	488
Diptera	63	2,125	1,200	1,350	56	279	25	339	1,542	625	1,088	436

TABLE 6: Benthic invertebrate abundance (#/m^2) for sites on the Santa Ana River, August 2005. S = only found in qualitative sweep sample.

	SAR 6	SAR 8	SAR 12
Insecta			
Collembola	7	4	4
Unidentified Collembola	7	4	4
Ephemeroptera	388	148	3,685
Baetidae	--	--	S
Baetis sp.	--	4	--
Baetis tricaudatus	65	36	413
Camelobaetidius sp.	104	18	11
Fallceon quilleri	208	86	1,948
Tricorythodes sp.	11	4	1,313
Odonata	4	S	--
Argia sp.	S	--	--
Coenagrionidae	4	--	--
Coenagrion/Enallagma	--	S	--
Hetaerina americana	S	--	--
Progomphus borealis	S	--	--
Hemiptera	S	7	S
Corisella sp.	--	--	S

TABLE 6: Continued.

	SAR 6	SAR 8	SAR 12
Gelastocoris sp.	S	--	--
Microvelia sp.	S	--	--
Rhagovelia sp.	S	7	--
Coleoptera	S	--	11
Enochrus sp.	S	--	--
Georyssus sp.	S	--	S
Helochares sp.	S	--	--
Helophorus sp.	--	--	11
Laccophilus sp.	S	--	S
Oreodytes sp.	S	--	--
Postelichus sp.	S	--	--
Tropisternus sp.	S	--	--
Lepidoptera	4	--	--
Pyralidae	4	--	--
Trichoptera	7	22	488
Hydropsyche sp.	7	22	488
Hydroptila sp.	--	--	S
Diptera	173	315	436
Apendilum sp.	7	4	--
Caloparyphus sp.	11	--	11
Ceratopogonidae	4	4	4
Chironomus sp.	15	4	S
Conchapelopia/Thienemannimyia gr. sp.	4	S	--
Cricotopus bicinctus	--	--	136
Cricotopus sp.	4	4	29
Cryptochironomus sp.	4	--	7
Dicrotendipes sp.	S	--	--
Dolichopodidae	4	S	--
Eukiefferiella sp.	--	4	--
Euparyphus sp.	--	--	25
Gonomyia sp.	S	--	S
Larsia sp.	S	S	--
Limona sp.	S	--	S
Nemotelus sp.	--	S	4
Ormosia sp.	22	4	11
Orthocladius/Cricotopus gr.	4	--	18
Unidentified Orthocladiinae	--	--	S
Pentaneura sp.	S	--	--
Pericoma sp.	4	S	4

TABLE 6: Continued.

	SAR 6	SAR 8	SAR 12
Polypedilum sp.	S	7	158
Pseudochironomus sp.	--	--	4
Pseudosmittia sp.	4	--	--
Psychoda sp.	--	--	S
Psychodidae	S	--	S
Rheotanytarsus sp.	14	S	--
Saetheria sp.	50	11	S
Simulium sp.	18	273	--
Tabanus sp.	S	--	--
Tanytarsus sp.	4	--	25
Tipula sp.	S	--	S
Hydracarina	--	7	--
Lebertia sp.	--	7	--
Crustacea			
Amphipoda	S	--	S
Hyalella azteca	S	--	S
Turbellaria	--	--	255
Girardia sp.	--	--	255
Annelida			
Oligochaeta	7	--	62
Lumbriculidae	--	--	11
Nais sp.	--	--	11
Pristina sp.	--	--	4
Unidentified immature Tubificidae w/ capilliform chaetae	--	--	7
Unidentified immature Tubificidae w/o capilliform chaetae	7	--	29
Branchiobdellida	--	--	7
Branchiobdellidae	--	--	7
Mollusca			
Gastropoda	8	S	--
Fossaria sp.	4	--	--
Physa/Physella	4	S	--
Pelecypoda	--	--	43
Corbicula fluminea	--	--	43
TOTAL DENSITY (#/M^2)	598	503	4,991
NUMBER OF TAXA	50	26	42
SHANNON-WEAVER DIVERSITY (H')	3.34	2.43	2.64

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October 4, 1995

AQUATIC TISSUE ANALYSIS
SANTA ANA RIVER BASIN
1995

INTRODUCTION

This report present results of analysis of fish tissues collected from the Santa Ana River basin from August 1-3, 1995. This sampling and analysis was conducted to satisfy the permit requirements of dischargers in the basin, specifically for the analysis of mercury in fish flesh. The dischargers are required to measure levels of mercury in the edible portions of fish from the river every year. The permit requirements specify that sampling shall be completed between July 1 and October 31 each year at three sites along the mainstem of the Santa Ana River. However, it also states that tissue samples will be collected from four area: above the Riverside Narrows, at a site below the Hidden Valley Wildlife Area, above the Prado pond diversion, and in the Prado Basin.

AREA

For the purposes of this collection effort, five study sites were selected to provide data from locations upstream, downstream, and "far-field" of discharge locations. These sites were selected to satisfy, as close as possible, the location criteria in the permit requirements outlined above, as well as an attempt to correspond to study site locations sampled in 1991 as part of the Use-Attainability Analysis (UAA) for the Santa Ana River basin (Chadwick & Associates, Inc. 1992). This continuity in study site location will also allow the comparison with previous aquatic sampling of tissues and other biological parameters such as benthic invertebrate populations and fish populations. Locations of the study sites are as follows:

Santa Ana River

SAR 6 - NW¼ NW¼ Sec. 30,T2SR5W: Located upstream of the Riverside Water Reclamation Facility (RSWRF) effluent, just upstream of the MWD pipe crossing in Reach 3. This site is located within the Riverside Narrows. Technically, the permit requirements specify a site upstream of the Riverside Narrows. However, past sampling in 1990-1991 showed that fish populations are sparse-to absent upstream of the Narrows (Chadwick & Associates, Inc. 1992).

SAR 8 - SW¼ NE¼ Sec. 31,T2SR6W: Located downstream of 100% of the RSWRF effluent, upstream of the Hamner Avenue bridge in Reach 3. This site is downstream of the Hidden Valley Wildlife Area.

SAR 9 - NE¼ SW¼ Sec. 10,T3SR7W: Located still further downstream of the RSWRF effluent, upstream of the Prado Dam near the Archibald Avenue/River Road bridge in Reach 3. This site is located just upstream of the Prado ponds diversion.

SAR 12 - NW¼ NE¼ Sec. 2,T4SR9W: Located downstream of Prado Dam, near the Imperial highway bridge. This site provided data that integrated upstream effects on aquatic populations.

Chino Creek

CC2 - SE¼ SW¼ Sec. 5,T3SR7W: Located downstream of the Chino Basin Municipal Water District's RP2 facility, and Prado Lakes outflow from RP1, above the confluence with Mill Creek and the Santa Ana River. This site was used to provide data from within the Prado Basin.

METHODS

Fish and crayfish (if present) were collected at each site using backpack electrofishing gear. All fish collected were weighed and measured for total length. Common carp (*Cyprinus carpio*) was the only fish species kept for tissue analysis. This species represented the largest potential food fish present at each site. Originally, the study plan had also called for collecting largemouth bass, a top predator species that was present at many of the study sites in 1991. However, during the 1995 sampling, largemouth bass were not found at any of the study sites. Crayfish (Order: Decapoda) were also collected for tissue analysis, when present, representing both another potential food item and a lower trophic level.

Fish from each site were stored in separate plastic bags, placed in a cooler on ice, and frozen within four hours of collection. Crayfish from each site were composited into one sample, stored in a plastic bag, placed on ice and then frozen. All samples were given a unique identification number that specified what study site the sample was collected at, that the sample was for tissue analysis, what fish species the sample was, whether the sample was whole body or fillet, and what date the sample was

collected. For example, sample # SAR 12 - TCARP-W-080195 specifies a carp whole body tissue sample collected from Site SAR 12 on August 1, 1995. Samples were shipped frozen to Core Laboratories in Aurora, Colorado for analysis. Whole body analyses were conducted for mercury (EPA test method SW-846 7471) and selenium (EPA test method SW-846 7740). These analyses followed established analytical techniques (Core Laboratories 1995).

RESULTS

Whole body mercury levels were low, generally less than 0.1 ppm in common carp and below the detection limit of 0.02 ppm for crayfish (Table 1). The highest level was only 0.19 ppm, recorded in a large common carp collected at Site SAR 6. Selenium levels were all less than 0.5 ppm in common carp and crayfish.

TABLE 1: Concentrations (mg/Kg - wet weight) for mercury and selenium for fish and crayfish, Santa Ana River, California, August 1995.

Site	Mercury	Selenium
SAR 6		
Carp (386 mm, 675 g)	0.19	0.40
Carp (276 mm, 268 g)	0.06	0.36
Crayfish (Composite)	0.05	0.19
SAR 8		
Carp (387 mm, 735 g)	0.07	0.19
Carp (307 mm, 368 g)	0.06	0.23
Crayfish (Composite)	< 0.02	0.11
SAR 9		
Carp (404 mm, 925 g)	0.05	0.27
SAR 12		
Carp (245 mm, 235 g)	0.09	0.46
Crayfish (Composite)	< 0.02	0.31
Chino Creek 2		
Carp (135 mm, 38 g)	< 0.02	0.25

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October 10, 1996

AQUATIC TISSUE ANALYSIS
SANTA ANA RIVER BASIN
1996

INTRODUCTION

This report presents results of analysis of fish tissues collected from the Santa Ana River basin from August 19-21,1996. This sampling and analysis was conducted to satisfy the permit requirements of dischargers in the basin, specifically for the analysis of mercury in fish flesh. As part of the "Mercury Monitoring Plan for the Santa Ana River, Reach 3 and 4", the dischargers are required to measure levels of mercury in the edible portions of fish from the river every year. The permit requirements specify that sampling shall be completed between July 1 and October 31 each year at three sites along the mainstem of the Santa Ana River. There are three levels of sampling required under this plan. Level One is the baseline monitoring plan, with the three designated sites being sampled once annually between July 1 and October 31. Levels Two and Three will be initiated based on the results of the previous year. According to the Monitoring Plan, if the sampling from the previous year shows mercury levels greater than 0.35 mg/kg, additional sites will be sampled, along with possible further action by the Santa Ana River Water Quality Control Board.

AREA

For the purposes of the collection effort, three sites sampled in 1995 (SAR 6, SAR 8 and SAR 12) were again selected in 1996 to provide data from locations upstream and downstream of discharge locations. Because results from the 1995 fish sampling indicated no mercury tissue levels greater than 0.35 mg/kg (Chadwick Ecological Consultants, Inc. 1995), these were the only sites designated for sampling in 1996. The sites sampled in 1995 and 1996 were selected to satisfy, as close as possible, the location criteria in the Monitoring Plan requirements outlined above, as well as an attempt to correspond to study site locations sampled in 1991 as part of the Use-Attainability Analysis (UAA) for the Santa Ana River basin (Chadwick & Associates, Inc. 1992). This continuity in study site location also allowed the comparison with previous (e.g. 1991, 1995) aquatic sampling of tissues. Locations of the study sites are as follows:

Santa Ana River

SAR 6 - NW¼ NW¼ Sec. 30,T2SR5W: Located upstream of the Riverside Water Reclamation Facility (RSWRF) effluent, just upstream of the MWD pipe crossing in Reach 3. This site is located within the Riverside Narrows. Technically, the permit requirements specify a site upstream of the Riverside Narrows. However, past sampling in 1990-1991 showed that fish populations are sparse-to absent upstream of the Narrows (Chadwick & Associates, Inc. 1992).

SAR 8 - SW¼ NE¼ Sec. 31,T2SR6W: Located downstream of 100% of the RSWRF effluent, upstream of the Hamner Avenue bridge in Reach 3. This site is downstream of the Hidden Valley Wildlife Area and near the upstream limit of Prado Basin.

SAR 12 - NW¼ NE¼ Sec. 2,T4SR9W: Located downstream of Prado Dam, near the Imperial highway bridge. This site provided data that integrated effects on aquatic populations from upstream sources.

SAR 11 - SW¼ NE¼ Sec. 29,T3SR8W: Located downstream of Prado Dam within the Featherly Regional Park. This site was included in 1996 because of low numbers of edible-sized fish collected at Site SAR 12, the normal sampling site.

METHODS

Fish and crayfish (if present) were collected at each site using backpack electrofishing gear. As outlined in the Monitoring Plan, a minimum of one sample and a maximum of three samples (if available) would be retained from each site and analyzed. Ideally, two fish samples and one composite crayfish sample would be analyzed. All fish collected were weighed and measured for total length. Common carp (*Cyprinus carpio*) was the only fish species kept for tissue analysis. This species represented the largest potential food fish present at each site. Originally, the study plan had also called for collecting largemouth bass, a top predator species that was present at many of the study sites in 1991. However, during the 1996 sampling, as in the 1995 tissue sampling, largemouth bass were not found at any of the study sites. Crayfish (Order: Decapoda) were also collected for tissue analysis, when present, representing both another potential food item and a lower trophic level.

Fish from each site were stored in separate plastic bags, placed in a cooler on ice, and frozen within four hours of collection. Crayfish from each site were composited into one sample, stored in a plastic bag, placed on ice and then frozen. All samples were given a unique identification number that specified what study site the sample was collected at, that the sample was for tissue analysis, what fish species the sample was, whether the sample was whole body or fillet, and what date the sample was collected. For example, sample # SAR 12 - TCARP-W-081996 specifies a carp whole body tissue sample collected from Site SAR 12 on August 19, 1996. Samples were shipped frozen to ACZ Laboratories in Steamboat Springs, Colorado for analysis. Samples were pulverized (EPA method M600/4-81-055) and whole body analyses were conducted for mercury (EPA test method M7471CVAA).

RESULTS

Although small fish were moderately abundant in the collections, few crayfish or large edible-sized fish were collected at Sites SAR 6, SAR 8, or SAR 12 (Table 1), and even additional sampling effort located few crayfish or larger fish. One crayfish composite sample (three individuals) was collected each from Sites SAR 6 and SAR 12, and one carp was collected from Site SAR 12. Although the Monitoring plan specified a minimum of one sample per site, no sample was able to be collected from SAR8, either from the standard sampling effort, nor additional effort to find these organisms. Although Site SAR 11 was not originally designated for tissue sampling, tissue samples (one carp) were also collected here because of the low number of samples obtained at SAR12, the other site downstream of Prado Dam. The reason for the lack of edible-sized fish at the sample sites is unknown, but may be related to the high flow events of the previous two winters. Note that both carp and largemouth bass are introduced species and may not be able to tolerate the flood flows.

Whole body mercury levels in 1996 were low, generally less than 0.3 ppm in common carp and below the detection limit of 0.02 ppm for crayfish (Table 1). The highest level was only 0.26 ppm, recorded in a large common carp collected at Site SAR 11. These levels are less than the action level of 0.35 mg/Kg specified in the "Mercury Monitoring Plan for the Santa Ana River, Reach 3 and 4". Mercury levels from crayfish in 1996 were within ranges observed in crayfish in 1991 and 1995, and mercury levels from carp in 1996 were similar or only slightly higher than levels in carp in 1991 and 1995.

TABLE 1: Concentrations (mg/Kg - wet weight) for mercury and selenium for fish and crayfish, Santa Ana River, California, August 1996.

Site	Mercury
SAR 6	
Crayfish (Composite)	<0.02
SAR 8	
No Crayfish or edible-sized fish collected	--
SAR 11	
Carp (480 mm, 1,450 g)	0.26
SAR 12	
Carp (400 mm, 1,075 g)	0.12
Crayfish (Composite)	< 0.02

LITERATURE CITED

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Chadwick Ecological Consultants, Inc. 1995. Aquatic Tissue Analysis, Santa Ana River Basin, 1995. Report prepared for the Santa Ana River Dischargers Association (SARDA).

ACZ

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Steve Canton

Lab Sample ID: ***L10738-03***
Client Sample ID: *SAR6-TCF-W-081996*
Client Project ID: *Santa Ana River*
ACZ Report ID: *RG32205*

Date Sampled: *8/19/96 00:00*
Date Received: *8/21/96*
Date Reported: *9/19/96*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA		U	mg/Kg	0.02	0.09	9/17/96	ch

Soil Preparation

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Fish Tissue Pulverization	M600/4-81-055						8/26/96	jm

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

Carl R. Ray

Inorganic Laboratory Supervisor: Carl R. Ray

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Lab Sample ID: *L10738-02*
Client Sample ID: *SAR12-TCF-W-081996*
Client Project ID: *Santa Ana River*
ACZ Report ID: *RG32204*

Date Sampled: *8/19/96 00:00*
Date Received: *8/21/96*
Date Reported: *9/19/96*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA		U	mg/Kg	0.02	0.1	9/17/96	ch

Soil Preparation

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Fish Tissue Pulverization	M600/4-81-055						8/26/96	jm

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

Carl R. Ray

Inorganic Laboratory Supervisor: Carl R. Ray

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Lab Sample ID: *L10738-01*
Client Sample ID: *SAR12-TCARP-W-081996*
Client Project ID: *Santa Ana River*
ACZ Report ID: *RG32203*

Date Sampled: *8/19/96 00:00*
Date Received: *8/21/96*
Date Reported: *9/19/96*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA	0.12		mg/Kg	0.02	0.1	9/17/96	ch

Soil Preparation

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Fish Tissue Pulverization	M600/4-81-055						8/26/96	jm

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

Carl R. Ray

Inorganic Laboratory Supervisor: Carl R. Ray

TABLE 1: Concentrations (mg/Kg - wet weight) for mercury and selenium for fish and crayfish, Santa Ana River, California, August 1995.

	Mercury	Selenium
SAR 6		
Carp (386 mm, 675 g)	0.19	0.40
Carp (276 mm, 268 g)	0.06	0.36
Crayfish (Composite)	0.05	0.19
SAR 8		
Carp (387 mm, 735 g)	0.07	0.19
Carp (307 mm, 368 g)	0.06	0.23
Crayfish (Composite)	< 0.02	0.11
SAR 9		
Carp (404 mm, 925 g)	0.05	0.27
SAR 12		
Carp (245 mm, 235 g)	0.09	0.46
Crayfish (Composite)	< 0.02	0.31
Chino Creek 2		
Carp (135 mm, 38 g)	< 0.02	0.25

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MEMORANDUM

TO: SARDA Agencies
Doug Drury, Chino
Don Williams, Corona
Rick Wellington, Rialto
Rod Cruze/Gail Briggs-McPherson, Riverside
Bernie Kersey, San Bernardino
Joe Zoba, Yucaipa

FROM: Steve Canton, Vice President

DATE: August 25, 1997

RE: 1997 Mercury Monitoring Data for the Santa Ana River, California

Attached with this memorandum are the results of the analyses of fish and crayfish tissue sampling from the Santa Ana River in August 1997. Per the Mercury Monitoring Plan, three sites were sampled for tissue concentrations - SAR6, SAR8, and SAR12. As in 1996, the target organisms (i.e., largemouth bass, common carp, and crayfish) were rarely encountered this year. Crayfish were collected at all three sites. However, no edible sized fish were collected at SAR6. One good-sized carp (approximately 10") was collected at SAR 8, and a Bluegill/Green Sunfish hybrid (approximately 6") was found at SAR12. The only largemouth bass collected was found at SAR8, but was only 4" long.

All the samples had mercury concentrations below the detection limit of 0.02 ppm, well lower than the trigger level of 0.35 µg/g. Thus, next year's collection can, again, remain limited to the three primary sites.

The data from the fish population and benthic invertebrate sampling at these three sites will follow within a month. If you have any questions regarding these data, please call.

ACZ

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Steve Canton

Client Project ID:
ACZ Report ID: *RG49608*
Date Reported: *8/20/97*
Sample Matrix: *Fish Tissue*

Metals Analysis — Mercury, total — M7471 CVAA

Lab Sample ID	Client Sample ID	Sample Date	Receive Date	Result	Qual	Units	MDL	PQL	Date	Analyst
L14960-01	SAR6-TCFW080597	8/5/97	8/7/97	U		mg/Kg	0.02	0.09	8/20/97	kr
L14960-02	SAR12-TBGRW-080597	8/5/97	8/7/97	U		mg/Kg	0.02	0.09	8/20/97	kr
L14960-03	SAR12-TCFW-080597	8/5/97	8/7/97	U		mg/Kg	0.02	0.1	8/20/97	kr
L14960-04	SAR8-TCFW-080597	8/6/97	8/7/97	U		mg/Kg	0.02	0.09	8/20/97	kr
L14960-05	SAR7CARPW-080697	8/6/97	8/7/97	U		mg/Kg	0.02	0.09	8/20/97	kr

Note: Fish Tissue Pulverization by method M600/4-81-055 was performed on 8/13/97 by as.

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

RV Poulsen

Vice President of Operations: Ralph Poulsen

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TECHNICAL MEMORANDUM

TO: SARDA Agencies
Doug Drury, Chino
Dave Commons, Corona
Rick Wellington, Rialto
Rod Cruze/Gail Briggs-McPherson, Riverside
Bernie Kersey, San Bernardino
Joe Zoba, Yucaipa

FROM: Steven P. Canton, Vice President

DATE: December 4, 1998

RE: 1998 RBP Habitat, Fish, Benthic Invertebrate, and Mercury Monitoring Data for the Santa Ana River and Tributaries, California

This memorandum presents the data collected on instream habitat, fish, benthic invertebrates, and tissue analysis in the Santa Ana River and tributaries. Data were collected in August 1998 at 15 sites (SAR1 through SAR9, SAR12, Lake Evans Outlet, Tequesquite Arroyo, Anza Park Drain, Chino1, and Chino2).

Habitat

Instream habitat was evaluated using the Rapid Bioassessment Protocol (RBP) habitat scoring. Habitat scoring was conducted using the current (1998) EPA rating system as well as two previous versions, the one in place during the UAA and a subsequent version published soon thereafter that incorporated three new metrics. The current system includes several new categories and scoring methods not in the original version.

For the Santa Ana River mainstem, SAR7 had the highest rated habitat according to the current RBP system and the older versions. In the tributaries, Chino1 had the highest rated habitat. Depending on the version of RBP used, either SAR2 or SAR12 had the lowest habitat ratings in the mainstem. This was due low flows at SAR2 and to extensive channelization at SAR12.

Fish Populations

Fish populations were sampled at each site using backpack electrofishing gear, using the same methods as used in the Santa Ana River UAA.

Eleven species of fish were collected in the Santa Ana River and in the tributaries (Table 2). Nine species were common to both the mainstem river and the tributaries. Distribution of fish was variable within the portion of the basin sampled, with Site SAR7 having the highest species richness of the mainstem sites.

Santa Ana suckers were collected at three sites, all on the mainstem (SAR3, SAR4, and SAR6). Arroyo chubs were observed at three mainstem sites (SAR3, SAR4, and SAR7) and one tributary (Anza Park Drain).

Relative abundance estimates in the Santa Ana River ranged from 0 fish/km at SAR1 to 1,265 fish/km at SAR3, and in tributaries from 65 fish/km at Anza Park Drain to 522 fish/km at Chino2. Biomass estimates in the mainstem ranged from 0 g/km at SAR1 to 4,438 g/km at SAR8, and in the tributaries from 468 g/km at Tequesquite Arroyo to 23,357 g/km at Chino1. The high biomass at Chino1 and Chino2 reflects the presence of adult common carp at these two sites.

Benthic Invertebrate Populations

Benthic invertebrates were sampled at each site using a modified Hess sampler and a sweep net, consistent with methods employed during the Santa Ana River UAA. The Hess samples are collected in "riffle" habitats in the main channel, while the qualitative sweep net sample collects organisms from all available habitats (i.e., riparian vegetation, snags, etc.)

Benthic invertebrate abundance (based on the Hess samples) in the Santa Ana River ranged from 545 organisms/m^2 at SAR7 to 9,840 organisms/m^2 at SAR8 (Table 3). Abundance in the tributaries varied from 10 organisms/m^2 at Chino1 to 9,344 organisms/m^2 at Chino2. Taxa richness in the Santa Ana River ranged from 12 taxa at SAR2 to 34 taxa at SAR6, and in the tributaries from 10 taxa at Anza Park Drain to 23 taxa at Tequesquite Arroyo. Shannon-Weaver diversity in the Santa Ana River ranged from 1.38 at SAR2 to 2.93 at SAR12, and in the tributaries from 0 at Anza Park Drain to 2.38 at Lake Evans Outlet. Although diversities at many of the sites were less than 2.00, this was primarily due to the predominance of one or two mayfly species, an order that is considered sensitive to pollution.

Although species densities varied between sites in 1998, the composition of major invertebrate groups was generally similar between sites (Table 3). Most sites were dominated by mayflies, caddisflies, and true flies.

Mercury Monitoring

Also attached to this memorandum are the results of the analysis of aquatic tissue sampling from the Santa Ana River in August, 1998. As outlined in the Mercury Monitoring Plan, three sites were sampled for tissue concentrations - SAR6, SAR8, and SAR12. As in 1996 and 1997, the target organisms (i.e., largemouth bass, common carp, and crayfish) were rarely encountered this year. No edible fish were collected at any site, and crayfish only at SAR8.

The only tissue sample collected (crayfish) had a mercury concentration less than the detection limit of 0.04 mg/Kg, well below the trigger level of 0.35 µg/g.

If you have any questions regarding these data, please call.

TABLE 1: RBP Habitat parameters and scores for study sites on the Santa Ana River, August 1998. LEO=Lake Evans Outlet, TEQ=Teqesquite Arroyo, APD=Anza Park Drain.

OLDER VERSION OF RBP

	Habitat Parameter	SAR-1	SAR-2	SAR-3	SAR-4	SAR-5	SAR-6	SAR-7	SAR-8	SAR-9	SAR-12	LEO	TEQ	APD	CHINO1	CHINO2
1	Bottom substrate/instream cover	5	0	1	1	2	1	1	1	1	0	1	1	5	12	1
2	Embeddedness	6	1	1	0	1	0	2	0	1	1	0	0	2	11	0
3	Flow	11	11	1	1	15	4	8	3	8	1	2	3	3	10	4
4	Channel alteration	1	1	1	0	1	2	3	2	2	0	0	4	3	7	4
5	Bottom scouring and deposition	1	0	0	0	1	1	5	2	1	0	1	3	2	8	2
6	Pool/riffle, run/bend ratio	4	0	0	1	1	1	3	3	1	1	4	4	3	9	8
7	Upper bank stability	2	0	3	0	1	4	5	3	2	1	4	7	8	8	7
8	Bank vegetative protection Or Grazing/other disruptive pressure	0	0	3	2	3	6	7	5	1	0	6	8	8	9	6
9	Streamside cover	0	0	3	1	2	5	6	3	3	0	3	6	7	9	5
	Total	**30**	**13**	**13**	**6**	**27**	**24**	**40**	**22**	**20**	**4**	**21**	**36**	**41**	**83**	**37**
10	Canopy cover	0	1	1	0	1	4	2	5	2	0	9	11	8	10	15
11	Lower bank channel capacity	2	0	1	1	0	1	3	3	2	0	6	1	8	10	5
12	Riparian vegetative zone width	0	0	3	0	2	4	7	5	2	0	2	1	1	8	9
	New Total	**32**	**14**	**18**	**7**	**30**	**33**	**52**	**35**	**26**	**4**	**38**	**49**	**58**	**111**	**66**

NEWEST VERSION OF RBP

	Habitat Parameter	SAR-1	SAR-2	SAR-3	SAR-4	SAR-5	SAR-6	SAR-7	SAR-8	SAR-9	SAR-12	LEO	TEQ	APD	CHINO1	CHINO2
1	Epifaunal substrate/Available cover	1	0	1	1	2	1	1	1	1	1	0	1	5	11	1
2	Embeddedness	7	0	0	0	1	0	2	0	0	0	0	0	2	11	0
3	Velocity/depth regime	1	0	0	1	2	4	3	3	2	0	1	3	3	8	4
4	Sediment deposition	0	0	0	0	1	1	5	2	2	1	0	3	2	7	2
5	Channel flow status	2	1	0	6	6	16	18	13	16	15	19	7	19	19	19
6	Channel alteration	2	1	1	0	7	2	14	3	6	0	2	3	3	15	4
7	Frequency of riffles (or bends)	1	1	0	1	2	1	5	3	1	0	2	2	8	7	13
8	Bank stability	1	1	2	1	3	4	8	8	1	1	8	5	8	8	9
	(score both banks)	1	1	2	0	5	4	8	7	4	1	8	6	8	8	9
9	Vegetative protection	0	0	1	2	2	6	2	1	1	0	7	3	7	8	8
	(score both banks)	0	0	1	1	5	6	2	3	5	0	7	3	7	7	8
10	Riparian vegetative zone width	0	0	3	2	2	4	7	6	0	0	4	2	1	4	10
	(score each bank riparian zone)	0	0	3	1	2	6	7	5	2	0	2	1	5	8	10
	Total	**16**	**5**	**14**	**16**	**40**	**55**	**82**	**55**	**41**	**19**	**60**	**39**	**78**	**121**	**97**

TABLE 2: Summary of fish abundance (#/km) and biomass (g/km) for sites on the Santa Ana River, California, August 1998. NS = Not Sampled

Site	Relative abundance (#/km)	Biomass (g/km)
SAR 1	No fish	No fish
SAR 2		
Mosquitofish	18	7
Total	**18**	**7**
SAR 3		
Arroyo chub	18	16
Fathead minnow	129	219
Mosquitofish	231	46
Santa Ana sucker	887	444
Total	**1265**	**725**
SAR 4		
Arroyo chub	56	134
Fathead minnow	9	3
Mosquitofish	37	11
Santa Ana sucker	9	3
Total	**111**	**151**
SAR 5		
Fathead minnow	161	338
Total	**161**	**338**
SAR 6		
Fathead minnow	300	240
Mosquitofish	366	110
Santa Ana sucker	9	72
Yellow bullhead	56	112
Total	**731**	**534**
SAR 7		
Arroyo chub	112	2150
Common carp	9	198
Fathead minnow	9	4
Green sunfish	19	1178
Largemouth bass	9	414
Mosquitofish	28	20
Tilapia	9	3
Yellow bullhead	47	94
Total	**242**	**4061**

TABLE 2: Continued

Site	Relative abundance (#/km)	Biomass (g/km)
SAR 8		
Common carp	37	344
Fathead minnow	216	432
Largemouth bass	75	952
Mosquitofish	19	8
Prickly sculpin	9	30
Yellow bullhead	131	2672
Total	**487**	**4438**
SAR 9		
Fathead minnow	712	1353
Largemouth bass	56	605
Mosquitofish	37	11
Yellow bullhead	19	68
Total	**824**	**2037**
SAR 12		
Common carp	101	1101
Fathead minnow	455	455
Largemouth bass	30	27
Owens sucker (?)	30	34
Yellow bullhead	10	860
Total	**626**	**2477**
Lake Evans Outlet		
Black crappie	40	428
Bluegill	13	143
Fathead minnow	332	664
Largemouth bass	27	1820
Mosquitofish	13	9
Total	**425**	**3064**
Teqesquite Arroyo		
Fathead minnow	184	405
Mosquitofish	157	63
Total	**341**	**468**
Anza Park Drain		
Arroyo chub	13	221
Fathead minnow	13	25
Santa Ana sucker	13	572
Prickly sculpin	13	32
Yellow bullhead	13	1508
Total	**65**	**2358**

TABLE 2: Continued

Site	Relative abundance (#/km)	Biomass (g/km)
Chino1		
Common carp	14	21700
Fathead minnow	87	139
Green sunfish	188	1448
Mosquitofish	159	64
Yellow bullhead	14	6
Total	**462**	**23357**
Chino2		
Common carp	49	14161
Fathead minnow	130	234
Mosquitofish	310	124
Yellow bullhead	33	264
Total	**522**	**14783**

TABLE 3: Benthic invertebrate population parameters for sites on the Santa Ana River and selected tributaries, 1998. LEO=Lake Evans Outlet, TEQ=Teqesquite Arroyo, APD=Anza Park Drain. S=Present only in sweep sample.

TAXA	SAR-1	SAR-2	SAR-3	SAR-4	SAR-5	SAR-6	SAR-7	SAR-8	SAR-9	SAR-12	LEO	TEQ	APD	CHINO1	CHINO2
INSECTA															
EPHEMEROPTERA (Mayflies)	607	1660	3734	1016	3337	987	390	8273	6800	624		10		8874	7
Baetis tricaudatus	10	7	S	S		7	13	27						220	7
Callibaetis californicus			17	S							S	S			
Callibaetis sp.							3								
Camelobaetidius warreni	207	467	390	473	1957	87	27	3553	1737	87				320	
Fallceon quilleri	390	1163	2950	523	1360	760	320	4573	4910	317	S	10		8147	
Labiobaetis sp.	S													187	
Tricorythodes sp.	S	23	377	20	20	133	27	120	153	220		S			S
TRICHOPTERA (Caddisflies)	3	3	127	137	126	887	124	1313	940	200				67	
Agraylea sp.			67		43			80				S		7	S
Hydropsyche sp.	3		60	137	83	580	37	1233	897	190		S	S	60	S
Hydroptila sp.				S		307	87		43	10					
Rhyacophila brunnea gr.		3													
ODONATA (Damselflies & Dragonflies)				3		84			3					53	
Argia alberta						27									
Argia sedula												S	S	53	
Argia sp.				S											
Enallagma sp.						S	S				S				
Gomphidae							S								
Hetaerina americana				S	S	57	S		S				S		
Neurocordulia sp.					S										
Paltothemis lineatipes				S											
Progomphus borealis			S	3	S				3						
Progomphus sp.															

TABLE 3: Continued

TAXA	SAR-1	SAR-2	SAR-3	SAR-4	SAR-5	SAR-6	SAR-7	SAR-8	SAR-9	SAR-12	LEO	TEQ	APD	CHINO1	CHINO2
HEMIPTERA (True bugs)	3		27			3	3			7	46				
Ambrysus sp.						3									
Aquarius remigis												S			
Belastoma fluminea					S										
Cenocorixa blaisdelli											3				
Corisella inscripta					S										S
Corisella sp.				S					S						
Corixidae	3		27							7	33				S
Gerridae													S		
Rhagovelia sp.						S	3						S		
Salda buenoi											S				S
Saldidae												S			
Saldula sp.											10				
LEPIDOPTERA (Moths)						3	3								
Parapoynx sp.						3	3								
COLEOPTERA (Beetles)		3		14		13	3		57			3			
Dytiscus sp.		S													
Helichus sp.				S											
Heterlimnius corpulentus		3							13						
Laccophilus decipiens					S									S	
Microcylloepus pusillus				7											
Optioservus divergens				S					27						
Paracymus sp.			S									3			
Peltodytes callosus			13												
Peltodytes sp.						3									
Postelichus sp.			27	7	S				S						
Stenus sp.			3									S		S	S
Stictotarsus funereus			7												
Tropisternus sp.							3		17						
Tropisternus obscurus					S										

TABLE 3: Continued

TAXA	SAR-1	SAR-2	SAR-3	SAR-4	SAR-5	SAR-6	SAR-7	SAR-8	SAR-9	SAR-12	LEO	TEQ	APD	CHINO1	CHINO2
DIPTERA (True flies)	560	109	143	69	164	295	22	254	450	56	36	20		83	3
Antocha sp.	3														
Caloparyphus sp.			3			17	3								
Ceratopogonidae				13		3									3
Chaogorus sp.															S
Chironomus sp.	S	3	S	S			3	27	10	10		S			
Cricotopus tremulus	S	3	67	27	77	17		13	3	30	3	S		3	S
Demicryptochironomus sp.						S	S		50	S	17	S			
Dolichopodidae				S		3			13						
Ehpydra/Setacera												S			
Ephydra sp.			S		S										
Ephydridae				S			S		7			S			
Euparyphus sp.					S	3		S	S						
Glyptotendipes sp.			10	13		13	3	27	10						S
Hemerodromia sp.						3		S					S		
Heterotrissocladius sp.							S				3				
Limonia sp.	7	43	10	3		S	S					S			
Mallochohelea sp.															S
Pericoma sp.						3									
Polypedilum sp.											13				S
Rheotanytarsus sp.			3	3		S	S		10	3				7	
Saetheria sp.	3					13		47	3	3		17			
Simulium sp.	540	57	7	S	87	137	3	33	227			S	S	73	S
Stratiomys sp.												3			
Tabanus punctifer						S									
Tipulidae						10									
Zavrelimyia sp.	7	3	43	10	Ss	73	10	107	117	10		S			
TURBELLARIA (Flatworms)						20				237				120	
Dugesia sp.						20	S			237				120	
ANNELIDA															
OLIGOCHAETA (Segmented worms)										57	20	10		147	
Aulodrilus americanus												7			
Eiseniella tetraedra										7					
Homochaeta naidina										27				80	
Lumbriculus variegatus												3		20	
Stephensoniana tandyi	S									23					
Unid. Immature Tubificidae w/o Capilliform Chaetae											20			47	

TABLE 3: Continued

TAXA	SAR-1	SAR-2	SAR-3	SAR-4	SAR-5	SAR-6	SAR-7	SAR-8	SAR-9	SAR-12	LEO	TEQ	APD	CHINO1	CHINO2
HIRUDINEA (Leeches)						3									
Glossiphonia complanata															S
Mooreobdella fervida						3									
Mooreobdella microstoma						S									
CRUSTACEA															
AMPHIPODA (Scuds)													27		
Hyalella azteca											S		27		S
DECAPODA (Crayfish)															
Procambarus clarki											S		S		
GASTROPODA (Snails)				3								7			
Ferrissia sp.							S								
Fossaria sp.	S														
Menetus sp.										S					
Physa sp.	S			3		S	S	S			S	7	S		S
PELECYPODA (Clams)										57	77				
Corbicula fluminea										57	77				
TOTAL DENSITY (#/sq. meter)	1173	1775	4081	1242	3627	2295	545	9840	8250	1238	179	50	27	9344	10
NUMBER OF TAXA	17*	12*	23*	27*	18*	34*	26*	15*	23*	18*	16*	23*	10*	16*	18*
SHANNON-WEAVER DIVERSITY (H')	1.71	1.38	1.58	1.97	1.5	2.88	2.1	1.77	1.82	2.93	2.38	2.33	0	0.94	0.62
TOTAL EPT TAXA	6*	5*	7*	7*	5*	6*	7*	4*	5*	5*	2*	3*	1*	6*	2*
EPT INDEX (% of Total Taxa)	35*	42*	30*	26*	28*	18*	27*	27*	22*	28*	13*	13*	10*	38*	11*
EPHEMEROPTERA ABUNDANCE (% of Total Density)	52	94	91	82	92	43	72	84	82	50	0	20	0	95	70
HILSENHOFF BIOTIC INDEX	4.93	4.04	4.07	4.11	4.09	4.36	4.09	4.07	2.24	4.52	8.06	7.32	8	4.14	4.6

* Includes taxa from the sweep sample

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Lab Sample ID: ***L19737-01***
Client Sample ID: *SAR8-CF-T-W-8698*
Client Project ID: *Santa Ana*
ACZ Report ID: *RG74772*

Date Sampled: *8/6/98 00:00*
Date Received: *8/7/98*
Date Reported: *8/19/98*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA		U	mg/Kg	0.04	0.2	8/18/98	bg

Soil Preparation

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Fish Tissue Pulverization	M600/4-81-055						8/14/98	vv

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

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Vice President of Operations: Ralph Poulsen

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MEMORANDUM

TO: SARDA Agencies
Dave Commons, Corona
Rod Cruze, Riverside
John Dahlke, Western Riverside
Doug Drury, Inland Empire
Gary Ethridge, Eastern Municipal
Bernie Kersey, San Bernardino
Jack Nelson, Yucaipa
Rick Wellington, Rialto

FROM: Steve Canton, Vice President SPC

DATE: October 8, 1999

RE: 1999 Mercury Monitoring Data for the Santa Ana River, California

This memorandum presents the data collected in August 1999 as part of the mercury monitoring of the Santa Ana River. This data package includes instream habitat assessment in the Santa Ana River using the Rapid Bioassessment Protocol (RBP) habitat scoring, fish population data, benthic invertebrates, and tissue samples. Data were collected at three sites along the Santa Ana River, SAR6, SAR8, and SAR12, during August 1999 and compared to that collected in 1991 (during the UAA study) and as part of annual monitoring efforts from 1995 to 1998. Habitat scoring was conducted using the most current EPA rating system as well as that in place during the UAA.

Since 1995, the habitat ratings at SAR 6 and SAR 8 have been relatively constant, in poor to fair condition, with a slight decline noted at SAR 12 (Table 1). The decreased scores the past two years at SAR12 are likely due to recent rechannelization activities. SAR 12 is in poor condition. Individual habitat scores for 1999 are in Table 2.

Fish abundance decreased at SAR 8 in 1999 to levels seen in 1996 (Table 3). Abundance at SAR 12 was basically unchanged. Note that we were not allowed to sample SAR 6 this year. Apparently this site was recently sampled by the USGS-NAWQA program. California Fish and Game did not want another sample episode so close in time.

Benthic invertebrates are summarized in Tables 4-6. Populations were reduced at SAR 6 and SAR 8 compared to 1998 values (more similar to previous years).

Tissue data are presented in Table 7. No significant mercury concentrations were found in any of the samples, including some larger fish collected below Prado Dam.

TABLE 1: Rapid bioassessment protocol habitat data for August sample periods 1991 and 1995 - 1999 at three sampling locations on the Santa Ana River, California.

	1991	1995	1996	1997	1998	1999
SAR 6						
Original	43	19	22	29	24	24
With new categories	NA	24	29	37	33	34
1998 version	NA	NA	NA	NA	55	56
SAR 8						
Original	40	23	24	27	22	24
With new categories	NA	31	35	38	35	38
1998 version	NA	NA	NA	NA	55	58
SAR 12						
Original	39	12	16	11	4	3
With new categories	NA	15	20	13	4	3
1998 version	NA	NA	NA	NA	19	9

TABLE 2: RBP Habitat parameters and scores for study sites on the Santa Ana River, August 1999.

OLDER VERSION OF RBP			
Habitat Parameter	SAR-6	SAR-8	SAR-12
1 Bottom substrate/instream cover	1	1	0
2 Embeddedness	0	0	2
3 Flow	4	3	1
4 Channel alteration	2	2	0
5 Bottom scouring and deposition	1	2	0
6 Pool/riffle, run/bend ratio	1	3	0
7 Upper bank stability	4	3	0
8 Bank vegetative protection			
9 Or Grazing/other disruptive pressure	6	6	0
10 Streamside cover	5	4	0
Total	**24**	**24**	**3**
10 Canopy cover	4	6	0
11 Lower bank channel capacity	2	3	0
12 Riparian vegetative zone width	4	5	0
New Total	**34**	**38**	**3**

NEWEST VERSION OF RBP			
Habitat Parameter	SAR 6	SAR 8	SAR 12
1 Epifaunal substrate/Available cover	1	1	2
2 Embeddedness	0	0	0
3 Velocity/depth regime	4	4	0
4 Sediment deposition	1	2	1
5 Channel flow status	17	14	6
6 Channel alteration	2	3	0
7 Frequency of riffles (or bends)	1	3	0
8 Bank stability	4	8	0
(score both banks)	4	7	0
9 Vegetative protection	6	1	0
(score both banks)	6	3	0
10 Riparian vegetative zone width	4	7	0
(score each bank riparian zone)	6	5	0
Total	**56**	**58**	**9**

TABLE 3: Summary of fish abundance (#/km) and biomass (g/km) for sites on the Santa Ana River, California, August 1991 and 1995-1999.

	Relative Abundance (#/km)						Biomass (g/km)					
Site	1991	1995	1996	1997	1998	1999	1991	1995	1996	1997	1998	1999
SAR 6												
Arroyo chub	547	472	47	315	--		985	387	66	915	--	
Black bullhead	--	48	--	8	--		--	3,590	--	11	--	
Carp	7	67	--	--	--		2,520	10,155	--	--	--	
Fathead minnow	41	77	--	15	300	P*	25	37	--	22	240	NA
Mosquitofish	61	868	544	646	366		36	251	218	323	110	
Santa Ana sucker	325	232	16	869	9		3,305	264	146	1,912	72	
Yellow bullhead	14	19	--	--	56	P*	129	152	--	--	112	NA
Total	**995**	**1,783**	**607**	**1,853**	**731**		**7,000**	**14,836**	**430**	**3,183**	**534**	
SAR 8												
Black bullhead	--	35	--	--	--	--	--	1,864	--	--	--	--
Carp	18	80	--	20	37	--	288	31,088	--	3,380	334	--
Fathead minnow	127	62	9	310	216	--	127	87	7	496	432	--
Green sunfish	9	--	--	--	--	--	414	--	--	--		--
Largemouth bass	--	--	--	10	75	--	--	--	--	150	952	--
Mosquitofish	455	39	64	220	19	66	268	187	13	110	8	14
Santa Ana sucker	18	--	--	50	--	19	56	--	--	370	--	765
Mozambique tilapia	9	--	--	--	--	--	112	--	--	--	--	--
Yellow bullhead	100	18	--	20	131	9	1,630	61	--	150	2,672	54
Prickly sculpin	--	--	--	--	9	--	--	--	--	--	30	--
Total	**736**	**234**	**73**	**630**	**487**	**94**	**2,895**	**33,287**	**20**	**4,638**	**4,438**	**833**
SAR 12												
Bluegill	11	--	33	--	--	--	495	--	69	--	--	--
Blue/Green sunfish	--	--	--	10	--	--	--	--	--	550	--	--
Carp	438	136	33	20	101	--	39,157	2,682	9,570	86	1,101	--
Channel catfish	34	--	--	--	--	10	1,659	--	--	--	--	8

TABLE 3: Continued.

	Relative Abundance (#/km)						Biomass (g/km)					
Site	1991	1995	1996	1997	1998	1999	1991	1995	1996	1997	1998	1999
Fathead minnow	34	144	91	110	455	717	143	91	146	33	455	595
Goldfish	22	--	--	--	--	--	788	--	--	--	--	--
Largemouth bass	438	8	--	--	30	10	7,008	160	--	--	27	1,280
Mosquitofish	67	--	183	--	--	10	40	--	92	--	--	5
Santa Ana sucker	--	449	8	--	--	--	--	2,003	46	--	--	--
Owens sucker	--	--	--	--	10	--	--	--	--	--	34	--
Yellow bullhead	101	93	25	10	30	--	7,423	74	130	1,540	860	--
Total	**1,145**	**830**	**373**	**150**	**626**	**747**	**56,713**	**5,010**	**10,053**	**2,209**	**2,477**	**1,888**

* Note: Chadwick Ecological Consultants, Inc. was asked not to electroshock Site SAR 6 in 1999 by the California Department of Fish and Game due to recent fish sampling by the USGS-NAWQA program. These fish were collected by dip nets for tissue analysis.

TABLE 4: Benthic invertebrate abundance (organisms/m²), number of taxa, and Shannon-Weaver diversity for sites on the Santa Ana River, August 1991 and 1995-1999.

Sites	1991	1995	1996	1997	1998	1999
SAR 6						
Organisms/m²	39	50	155	23	2,295	53
Number of taxa	17	19	34	27	34	18
Shannon Weaver (H')	1.99	2.19	3.01	0.92	2.88	2.20
SAR 8						
Organisms/m²	34	39	36	44	9,840	10
Number of taxa	19	19	20	18	15	6
Shannon Weaver (H')	0.91	3.04	2.10	2.29	1.77	0.62
SAR 12						
Organisms/m²	6,688	2,211	3,524	4,696	1,238	1,829
Number of taxa	13	17	30	16	18	19
Shannon Weaver (H')	1.90	0.53	2.51	2.29	2.93	1.36

TABLE 5: Number of organisms/m² found within three major orders of benthic invertebrates for sites on the Santa Ana River, California, August 1991 and 1995-1999.

Sites	1991	1995	1996	1897	1998	1999
SAR 6						
Ephemeroptera	5	3	49	6	987	9
Trichoptera	0	3	0	0	887	17
Diptera	30	37	90	17	295	24
SAR 8						
Ephemeroptera	5	10	10	34	8,273	5
Trichoptera	0	3	7	7	1,313	0
Diptera	29	13	19	3	254	7
SAR 12						
Ephemeroptera	2,914	13	857	2,850	624	190
Trichoptera	3,671	40	1,460	477	200	1,353
Diptera	63	2,125	1,200	1,350	56	279

TABLE 6: Benthic invertebrate abundance (#/m^2) for sites on the Santa Ana River, August 1999 (S = only found in qualitative sweep sample).

	SAR 6	SAR 8	SAR 12
Insecta			
Ephemeroptera	9	S	190
Baetis tricaudatus	S	--	57
Camelobaetidius warreni	3	S	100
Fallceon quilleri	3	--	13
Labiobaetis sp.	--	--	3
Trichorythodes sp.	3	--	17
Trichoptera	17	--	1,353
Hydropsyche sp.	17	--	1,353
Hydroptila sp.	S	--	--
Odonata	--	--	3
Hetaerina americana	S	--	3
Coenagrionidae	--	S	--
Hemiptera	--	3	--
Hesperocorixa sp.	--	--	S
Sigara alternata	--	--	S
Corixidae	--	3	--
Veliidae	S	--	--
Coleoptera	--	--	3
Peltodytes sp.	S	--	S
Stenus sp.	S	--	3
Tropisternus sp.	S	--	S
Diptera	24	7	277
Caloparyphus sp.	S	--	--
Chironomus sp.	--	--	S
Cricotopus sp.	7	--	247
Cryptochironomus sp.	17	7	--
Euparyphus sp.	S	--	--
Hemerodromia sp.	--	--	30
Micropsectra sp.	S	--	--
Simulium sp.	--	S	S
Zavrelimyia sp.	S	S	S
Empididae	--	--	S

TABLE 6: Continued.

	SAR 6	SAR 8	SAR 12
Mollusca	--	--	--
Pelecypoda	3	--	3
Corbicula fluminea	3	--	3
TOTAL DENSITY (#/SQ. METER)	53	10	1,829
NUMBER OF TAXA	18*	6*	19*
SHANNON-WEAVER DIVERSITY (H')	2.20	0.62	1.36

* Includes taxa from the sweep sample.

TABLE 7: Tissue analysis for mercury for organisms collected in the Santa Ana River, August 1999.

Site/Organism	Length (in)	Weight (oz)	Mercury Concentration (µg/g)
SAR 6			
Crayfish	NA	NA	<0.04
Mosquitofish	Composite Sample		0.05
SAR 8			
Yellow bullhead	6.5	1.9	<0.04
Crayfish	NA	NA	0.07
SAR 12			
Largemouth bass	8.1	4.5	0.06
Fathead minnow	Composite Sample		<0.04
Pool below Prado Dam			
Common carp	15.6	28.2	0.04
Black bullhead	7.0	2.9	0.07

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Lab Sample ID: ***L24491-01***
Client Sample ID: *SAR6-F-CRAY-W*
Client Project ID: *Santa Ana*
ACZ Report ID: *RG100167*

Date Sampled: *8/5/99 00:00*
Date Received: *8/27/99*
Date Reported: *8/30/99*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA		U	mg/Kg	0.04	0.2	8/28/99	ms

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

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Lab Sample ID: *L24491-02*
Client Sample ID: *SAR6-F-MF-W*
Client Project ID: *Santa Ana*
ACZ Report ID: *RG100168*

Date Sampled: *8/5/99 00:00*
Date Received: *8/27/99*
Date Reported: *8/30/99*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA	0.05	B	mg/Kg	0.04	0.2	8/28/99	ms

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

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Lab Sample ID: ***L24491-06***
Client Sample ID: *SAR8-F-YBH-W*
Client Project ID: *Santa Ana*
ACZ Report ID: *RG100172*

Chadwick Ecological Consultants
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Date Sampled: *8/4/99 00:00*
Date Received: *8/27/99*
Date Reported: *8/30/99*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA		U	mg/Kg	0.04	0.2	8/28/99	ms

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

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Lab Sample ID: ***L24491-07***
Client Sample ID: *SAR8-CRAY-W*
Client Project ID: *Santa Ana*
ACZ Report ID: *RG100173*

Date Sampled: *8/4/99 00:00*
Date Received: *8/27/99*
Date Reported: *8/30/99*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA	0.07	B	mg/Kg	0.04	0.2	8/28/99	ms

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

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Lab Sample ID: ***L24491-03***
Client Sample ID: *SAR12-F-BASS-W*
Client Project ID: *Santa Ana*
ACZ Report ID: *RG100169*

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Date Sampled: *8/5/99 00:00*
Date Received: *8/27/99*
Date Reported: *8/30/99*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA	0.06	B	mg/Kg	0.04	0.2	8/28/99	ms

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

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Lab Sample ID: ***L24491-04***
Client Sample ID: *SAR12-F-FHM-W*
Client Project ID: *Santa Ana*
ACZ Report ID: *RG100170*

Date Sampled: *8/5/99 00:00*
Date Received: *8/27/99*
Date Reported: *8/30/99*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA		U	mg/Kg	0.04	0.2	8/28/99	ms

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

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Chadwick Ecological Consultants
5575 S. Sycamore St. Suite 101
Littleton, CO 80120
Steve Canton

Lab Sample ID: ***L24491-05***
Client Sample ID: *PRADO-F-CARP-W*
Client Project ID: *Santa Ana*
ACZ Report ID: *RG100171*

Date Sampled: *8/4/99 00:00*
Date Received: *8/27/99*
Date Reported: *8/30/99*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA	0.04	B	mg/Kg	0.04	0.2	8/28/99	ms

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

Vice President of Operations: Ralph Poulsen

ACZ

Analytical Results

ACZ Laboratories, Inc.
2773 Downhill Drive
Steamboat Springs, CO 80487
(800) 334-5493

Chadwick Ecological Consultants
5575 S. Sycamore St. Suite 101
Littleton, CO 80120
Steve Canton

Lab Sample ID: ***L24491-08***
Client Sample ID: *PRADO-F-BBHI-W*
Client Project ID: *Santa Ana*
ACZ Report ID: *RG100174*

Date Sampled: *8/4/99 00:00*
Date Received: *8/27/99*
Date Reported: *8/30/99*

Sample Matrix: *Fish Tissue*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Mercury, total	M7471 CVAA	0.07	B	mg/Kg	0.04	0.2	8/28/99	ms

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected at the indicated MDL

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

Vice President of Operations: Ralph Poulsen

Chadwick Ecological Consultants, Inc.
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MEMORANDUM

TO: SARDA Agencies
Rod Cruze, Riverside
Bernie Kersey, San Bernardino
Roger Turner, Eastern Municipal
Jack Nelson, Yucaipa
Don Commons, Corona
Doug Drury, Inland Empire
Rick Wellington, Rialto
Bill Beam, Western Riverside
Theodore Eich, Elsinore Valley

FROM: Steve Canton, Vice President

DATE: December 15, 2000

RE: 2000 Mercury Monitoring Data for the Santa Ana River, California

This memorandum presents the data collected in September 2000 as part of the mercury monitoring of the Santa Ana River. This data package includes results of tissue sampling for mercury, with associated instream habitat assessment in the Santa Ana River using the Rapid Bioassessment Protocol (RBP) habitat scoring, and benthic invertebrate population sampling. Data were collected at three sites along the Santa Ana River, SAR6, SAR8, and SAR12, during September 2000 (Fig. 1) and compared to those collected in 1991 (during the UAA study) and as part of annual monitoring efforts from 1995 to 1999. Habitat scoring was conducted using the most current EPA rating system.

In previous years, fish population sampling, using electrofishing techniques, was conducted at all three sampling sites. However, in 2000, the U.S. Fish and Wildlife Service listed the Santa Ana sucker as Threatened under the Endangered Species Act of 1973, thus preventing the use of electrofishing. Therefore, no fish population data were collected in 2000. A minnow seine was used to collect crayfish and fish for tissue analysis.

Annual Mercury Monitoring of Fish Tissue

As in the past, samples were collected from representative fish and crayfish according to the Mercury Monitoring Plan. Attempts were made to collect "edible-sized" fish, when possible. However, the inability to use electrofishing gear limited sampling efforts. Nevertheless, an edible-sized largemouth bass was collected at SAR 6, and edible-sized channel catfish, largemouth bass, and carp were collected at SAR 12 using the seine. Note that no crayfish were found this year at Site SAR 12. An additional fish sample was collected to ensure an average of three samples for each site.

Tissue data are presented in Table 1. No significant mercury concentrations were found in any of the samples, which included largemouth bass, catfish, common carp, and crayfish. In fact, mercury was below the detection limit of 0.04 ppm in 80% of the samples.

TABLE 1: Tissue analysis for mercury for organisms collected in the Santa Ana River, September 2000.

Site/Organism	Length (in)	Weight (oz)	Mercury Concentration (µg/g)
SAR 6			
Crayfish	NA	NA	<0.04
Largemouth bass	8.5	5.0	0.06
Yellow bullhead	4.4	0.6	<0.04
SAR 8			
Crayfish	NA	NA	<0.04
Largemouth bass	5.8	1.3	0.05
Mosquitofish	Composite Sample	0.6	<0.04
SAR 12			
Largemouth bass	7.9	4.4	<0.04
Channel catfish	9.1	3.3	<0.04
Common carp	12.9	19.1	<0.04
Pool below Prado Dam			
Black bullhead	9.6	6.4	<0.04

Habitat Rating

Since 1995, the habitat ratings at SAR 6 and SAR 8 have been relatively constant, in poor to fair condition, with a decline noted at SAR 12 over time, due to channelization activities by the Army Corps of Engineers (Table 2). The slightly increased score in 2000 at SAR12 is due to a couple of pools formed by temporary culverts, which provided slightly more heterogeneous habitat compared to the swift channelized runs of the past few years. SAR 12 is still in poor condition. Individual habitat scores for 2000 are presented in Table 3.

TABLE 2: Rapid Bioassessment Protocol habitat data for August/September sample periods 1991 and 1995-2000 at three sampling locations on the Santa Ana River, California.

	1991	1995	1996	1997	1998	1999	2000
SAR 6							
Original	43	19	22	29	24	24	--
With new categories	--	24	29	37	33	34	--
1998 version	--	--	--	--	55	56	56
SAR 8							
Original	40	23	24	27	22	24	--
With new categories	--	31	35	38	35	38	--
1998 version	--	--	--	--	55	58	56
SAR 12							
Original	39	12	16	11	4	3	--
With new categories	--	15	20	13	4	3	--
1998 version	--	--	--	--	19	9	22

Benthic Invertebrates

Benthic invertebrates are summarized in Tables 4-6. Densities at SAR 6 and SAR 8 were similar to most previous years, although actual number of taxa and diversity at SAR 6 were lower than all previous years. Number of taxa and diversity at SAR 8 were within ranges from previous years. The population at SAR 12 appeared reduced compared to previous years (Table 4). As in most years (the exception being 1998), sensitive groups like mayflies (Ephemeroptera) and caddisflies (Trichoptera) had very low numbers at SAR 6 and 8 (Table 5) where sand is the dominant substrate. Their numbers are somewhat high at SAR 12, where channelization activities often result in more cobble substrate.

TABLE 3: RBP habitat parameters and scores for study sites on the Santa Ana River, September 2000.

	Habitat Parameter	SAR 6	SAR 8	SAR 12
1	Epifaunal substrate/Available cover	1	1	4
2	Embeddedness	0	0	1
3	Velocity/depth regime	4	4	4
4	Sediment deposition	1	2	1
5	Channel flow status	16	13	6
6	Channel alteration	2	3	0
7	Frequency of riffles (or bends)	1	3	4
8	Bank stability	4	8	0
	(score both banks)	4	6	0
9	Vegetative protection	7	1	1
	(score both banks)	7	3	0
10	Riparian vegetative zone width	3	7	1
	(score each bank riparian zone)	6	5	0
	Total	**56**	**56**	**22**

TABLE 4: Benthic invertebrate abundance (organisms/m^2), number of taxa, and Shannon-Weaver diversity for sites on the Santa Ana River, August 1991 and 1995-2000.

Sites	1991	1995	1996	1997	1998	1999	2000
SAR 6							
Organisms/m^2	39	50	155	23	2,295	53	22
Number of taxa	17	19	34	27	34	18	9
Shannon Weaver (H')	1.99	2.19	3.01	0.92	2.88	2.20	0.73
SAR 8							
Organisms/m^2	34	39	36	44	9,840	10	38
Number of taxa	19	19	20	18	15	6	20
Shannon Weaver (H')	0.91	3.04	2.10	2.29	1.77	0.62	2.35
SAR 12							
Organisms/m^2	6,688	2,211	3,524	4,696	1,238	1,829	459
Number of taxa	13	17	30	16	18	19	14
Shannon Weaver (H')	1.90	0.53	2.51	2.29	2.93	1.36	1.09

TABLE 5: Number of organisms/m^2 found within three major orders of benthic invertebrates for sites on the Santa Ana River, California, August 1991 and 1995-2000. *Not collected in quantitative sample, but present in qualitative sweep sample.

Sites	1991	1995	1996	1997	1998	1999	2000
SAR 6							
Ephemeroptera	5	3	49	6	987	9	0*
Trichoptera	0	3	0	0	887	17	0
Diptera	30	37	90	17	295	24	22
SAR 8							
Ephemeroptera	5	10	10	34	8,273	5	0
Trichoptera	0	3	7	7	1,313	0	0
Diptera	29	13	19	3	254	7	34
SAR 12							
Ephemeroptera	2,914	13	857	2,850	624	190	68
Trichoptera	3,671	40	1,460	477	200	1,353	366
Diptera	63	2,125	1,200	1,350	56	279	25

TABLE 6: Benthic invertebrate abundance (#/m^2) for sites on the Santa Ana River, September 2000 (S = only found in qualitative sweep sample).

	SAR 6	SAR 8	SAR 12
Insecta			
Ephemeroptera	S	S	68
Apobaetis indeprensus	--	S	--
Baetis tricaudatus	S	S	32
Camelobaetidius warreni	--	S	36
Fallceon quilleri	--	--	S
Trichorythodes sp.	S	S	S
Trichoptera	--	--	366
Hydropsyche sp.	--	--	366
Odonata	S	S	S
Argia sp.	S	S	--
Hetaerina americana	--	S	S
Hemiptera	--	4	S
Rhagovelia sp.	--	4	S
Coleoptera	S	--	--
Hydrovatus sp.	S	--	--
Diptera	22	34	25
Ablabesmyia sp.	--	S	--
Cardiocladius sp.	--	--	7
Corynoneura sp.	--	S	--
Cricotopus sp.	--	S	18
Endotribelos sp.	--	S	S
Labrundinia sp.	--	S	S
Nanocladius sp.	--	--	S
Paraphaenocladius sp.	--	4	--
Pentaneura sp.	S	--	--
Polypedilum sp.	--	4	--
Pseudochironomus sp.	4	--	--
Rheotanytarsus sp.	S	S	S
Simulium sp.	S	4	--
Tanytarsus sp.	--	18	--
Genus near *Saetheria* sp.	18	4	S
Crustacea			
Amphipoda	--	S	--
Hyalella azteca	--	S	--
Mollusca			
Gastropoda	--	S	--
Physa sp.	--	S	--
TOTAL DENSITY (#/SQ. METER)	22	38	459
NUMBER OF TAXA	9*	20*	14*
SHANNON-WEAVER DIVERSITY (H')	0.73	2.35	1.09

* Includes taxa from the sweep sample.

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MEMORANDUM

TO: SARDA Agencies
Rod Cruze, Riverside
Bernie Kersey, San Bernardino
Roger Turner, Eastern Municipal
Jack Nelson, Yucaipa
Don Williams, Corona
Doug Drury, Inland Empire
Rick Wellington, Rialto
Bill Beam, Western Riverside
Theodore Eich, Elsinore Valley
Tom O'Neil, Jurupa

FROM: Steve Canton, Vice President

DATE: November 27, 2001

RE: 2001 Mercury Monitoring Data for the Santa Ana River, California

This memorandum presents the data collected in August 2001 as part of the mercury monitoring of the Santa Ana River. This data package includes results of tissue sampling for mercury, with associated instream habitat assessment in the Santa Ana River using the Rapid Bioassessment Protocol (RBP) habitat scoring, and benthic invertebrate population sampling. Data were collected at three sites along the Santa Ana River, SAR6, SAR8, and SAR12, during August 2001 (Fig. 1) and compared to those collected in 1991 (during the UAA study) and as part of annual monitoring efforts from 1995 to 2000. Habitat scoring was conducted using the most current EPA rating system.

In previous years, fish population sampling was conducted at all three sampling sites using electrofishing techniques under a state scientific collecting permit. This provided reasonable estimates of fish abundance and species composition, and was also effective in collecting the crayfish for tissue samples. However, in 2000, the U.S. Fish and Wildlife Service listed the Santa Ana sucker as Threatened under the Endangered Species Act of 1973. All sampling now requires both state and federal collecting permits, both of which prohibit the use of electrofishing. Therefore, no fish population data have been allowed to be collected since 1999. A minnow seine was used to collect crayfish and fish for tissue analysis. This severely limits our ability to obtain edible sized fish for tissue analysis for the mercury monitoring program.

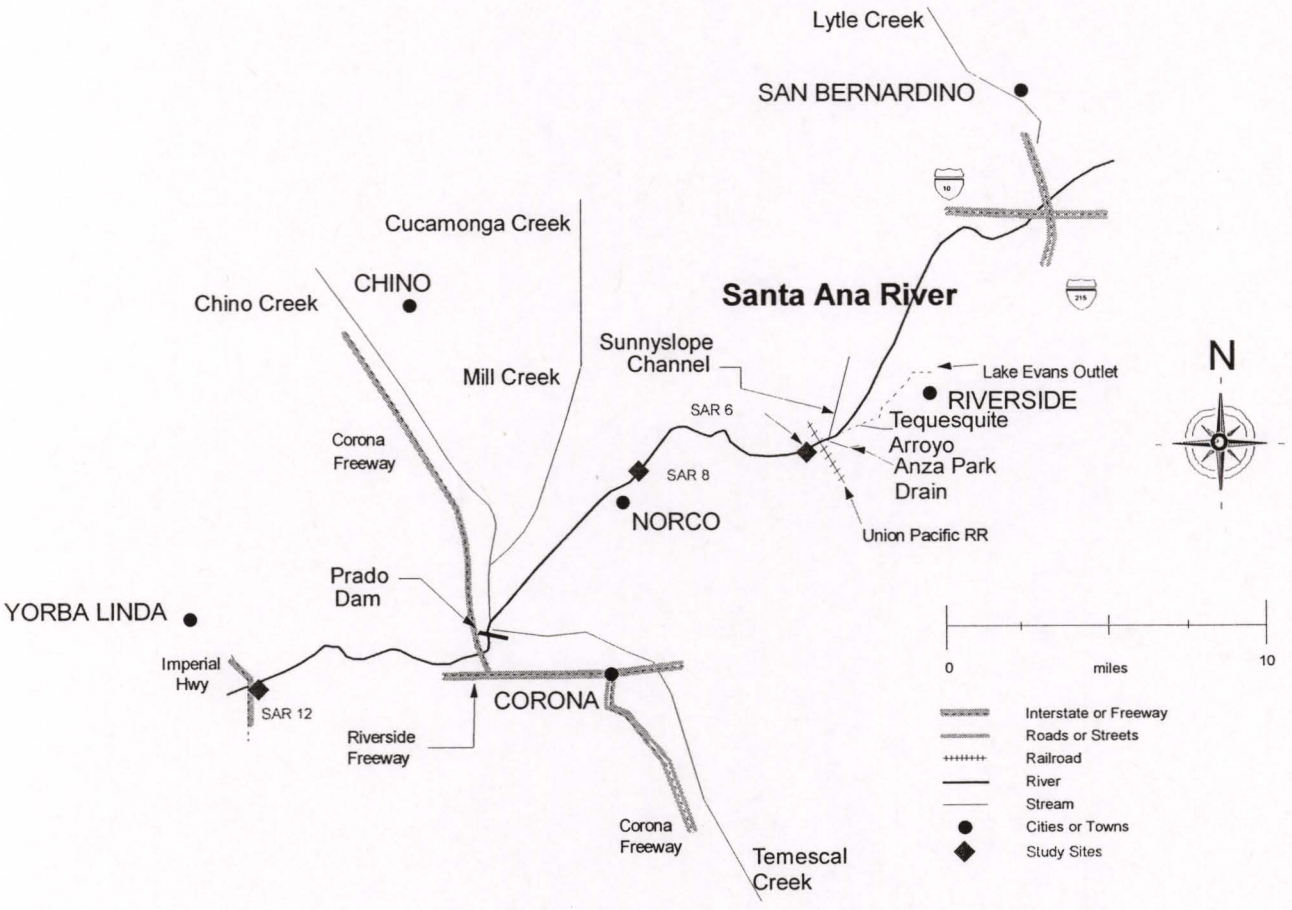

FIGURE 1: Mercury monitoring sampling sites, SAR 6, SAR 8, and SAR 12, on the Santa Ana River, California.

Annual Mercury Monitoring of Fish Tissue

As in the past, samples were collected from representative fish and crayfish according to the Mercury Monitoring Plan. Attempts were made to collect "edible sized" fish, when possible. However, the inability to use electrofishing gear limits sampling effectiveness. Consequently, sampling in 2001 resulted in only one "edible sized" fish being caught (the goal is to use two edible sized fish at each site - six total). The remaining fish samples were necessarily composites of small fish species. An edible sized carp was collected at SAR 12 using the seine. Note that no crayfish were found this year at Sites SAR 8 and 12. Only mosquitofish were captured at Site SAR 8, so only one composite fish sample was available for this site. One large common carp was observed at this site, but escaped capture by jumping over the seine.

Tissue data are presented in Table 1. No significant mercury concentrations were found in any of the samples, which included fathead minnow, mosquitofish, inland silverside, common carp, and crayfish. In fact, mercury was below the detection limit of 0.02 ppm in four of the samples, at the detection limit in one of the samples, and only 0.01 ppm over the detection limit in two samples.

TABLE 1: Tissue analysis for mercury for organisms collected in the Santa Ana River, August 2001.

Site/Organism	Length (mm)	Weight (g)	Mercury Concentration (µg/g)
SAR 6			
Crayfish	Composite Sample	46	<0.02
Fathead minnow	Composite Sample	16	<0.02
Mosquitofish	Composite Sample	7	<0.02
SAR 8			
Mosquitofish	Composite Sample	32	<0.02
SAR 12			
Fathead minnow	Composite Sample	44	0.02
Inland silverside	Composite Sample	44	0.03
Common carp	135	30	0.03

Habitat Rating

Since 1995, the habitat ratings at SAR 6 and SAR 8 have been relatively constant, in poor to marginal condition, with a decline noted at SAR 12 over time, due to channelization activities by the Army Corps of Engineers (Table 2). SAR 12 is still in poor condition. Individual habitat scores for 2001 are presented in Table 3.

Benthic Invertebrates

Benthic invertebrates are summarized in Tables 4-6. Densities, number of taxa, and diversity at SAR 6 and SAR 8 were similar to most previous years. The population at SAR 12 appeared higher compared to most

previous years (Table 4). As in most years (the exception being 1998), sensitive groups like mayflies (Ephemeroptera) and caddisflies (Trichoptera) had very low numbers at SAR 6 and 8 (Table 5) where sand is the dominant substrate. Their numbers are higher at SAR 12, where channelization activities often result in a confined channel with more cobble substrate.

TABLE 2: Rapid Bioassessment Protocol habitat data for August/September sample periods 1991 and 1995-2001 at three sampling locations on the Santa Ana River, California.

	1991	1995	1996	1997	1998	1999	2000	2001
SAR 6								
Original	43	19	22	29	24	24	--	--
With new categories	--	24	29	37	33	34	--	--
1998 version	--	--	--	--	55	56	56	61
SAR 8								
Original	40	23	24	27	22	24	--	--
With new categories	--	31	35	38	35	38	--	--
1998 version	--	--	--	--	55	58	56	65
SAR 12								
Original	39	12	16	11	4	3	--	--
With new categories	--	15	20	13	4	3	--	--
1998 version	--	--	--	--	19	9	22	18

TABLE 3: RBP habitat parameters and scores for study sites on the Santa Ana River, August 2001.

Habitat Parameter	SAR 6	SAR 8	SAR 12
1 Epifaunal substrate/Available cover	1	1	3
2 Pool substrate characterization	6	6	1
3 Pool variability	3	4	1
4 Sediment deposition	1	2	1
5 Channel flow status	17	14	6
6 Channel alteration	2	3	0
7 Channel sinuosity	1	3	0
8 Bank stability	4	8	3
(score both banks)	4	6	3
9 Vegetative protection	6	2	0
(score both banks)	6	4	0
10 Riparian vegetative zone width	4	7	0
(score each bank riparian zone)	6	5	0
Total	**61**	**65**	**18**

TABLE 4: Benthic invertebrate abundance (organisms/m²), number of taxa, and Shannon-Weaver diversity for sites on the Santa Ana River, August 1991 and 1995-2001.

Sites	1991	1995	1996	1997	1998	1999	2000	2001
SAR 6								
Organisms/m²	39	50	155	23	2,295	53	22	91
Number of taxa	17	19	34	27	34	18	9	30
Shannon Weaver (H')	1.99	2.19	3.01	0.92	2.88	2.20	0.73	1.42
SAR 8								
Organisms/m²	34	39	36	44	9,840	10	38	67
Number of taxa	19	19	20	18	15	6	20	16
Shannon Weaver (H')	0.91	3.04	2.10	2.29	1.77	0.62	2.35	1.68
SAR 12								
Organisms/m²	6,688	2,211	3,524	4,696	1,238	1,829	459	5,160
Number of taxa	13	17	30	16	18	19	14	25
Shannon Weaver (H')	1.90	0.53	2.51	2.29	2.93	1.36	1.09	2.44

TABLE 5: Number of organisms/m² found within three major orders of benthic invertebrates for sites on the Santa Ana River, California, August 1991 and 1995-2001. *Not collected in quantitative sample, but present in qualitative sweep sample.

Sites	1991	1995	1996	1997	1998	1999	2000	2001
SAR 6								
Ephemeroptera	5	3	49	6	987	9	0*	0*
Trichoptera	0	3	0	0	887	17	0	0*
Diptera	30	37	90	17	295	24	22	87
SAR 8								
Ephemeroptera	5	10	10	34	8,273	5	0	0*
Trichoptera	0	3	7	7	1,313	0	0	0*
Diptera	29	13	19	3	254	7	34	67
SAR 12								
Ephemeroptera	2,914	13	857	2,850	624	190	68	1,285
Trichoptera	3,671	40	1,460	477	200	1,353	366	2,525
Diptera	63	2,125	1,200	1,350	56	279	25	339

TABLE 6: Benthic invertebrate abundance (#/m^2) for sites on the Santa Ana River, August 2001 (S = only found in qualitative sweep sample).

	SAR 6	SAR 8	SAR 12
Insecta			
Ephemeroptera	S	S	1285
Baetis sp.	--	S	--
Baetis tricaudatus	S	S	535
Camelobaetidius warreni	--	--	86
Fallceon quilleri	--	--	592
Trichorythodes sp.	S	S	72
Trichoptera	S	S	2525
Hydropsyche sp.	--	--	2378
Hydroptila sp.	S	S	147
Rhyacophila sibirica gr.	--	S	--
Odonata	S	S	S
Argia sp.	S	--	S
Coenagrionidae	S	--	--
Hetaerina americana	S	S	--
Progomphus borealis	S	--	--
Hemiptera	--	--	S
Corisella decolor	--	--	S
Coleoptera	4	--	7
Enochrus pectoralis	S	--	--
Liodessus/Neoclypeodytes	S	--	--
Microcylloepus sp.	4	--	--
Tropisternus sp.	S	--	7
Diptera	87	67	339
Ablabesmyia sp.	S	--	--
Caloparyphus sp.	S	--	14
Ceratopogoninae	--	--	S
Chironomus sp.	S	--	4
Cladotanytarsus sp.	S	S	--
Corynoneura sp.	S	--	--
Cricotopus bicinctus	--	S	201
Cryptochironomus sp.	--	--	S
Dicrotendipes sp.	--	--	S
Endotribelos sp.	--	S	--
Ephydridae	4	--	--

TABLE 6: Continued.

	SAR 6	SAR 8	SAR 12
Eukiefferiella sp.	--	4	4
Euparyphus sp.	--	--	22
Labrundinia sp.	S	--	--
Orthocladius/Cricotopus spp.	S	--	90
Polypedilum sp.	--	S	--
Pseudochironomus sp.	S	--	S
Rheotanytarsus sp.	S	--	--
Saetheria sp.	68	47	--
Simulium sp.	7	4	S
Stempellinella sp.	4	4	--
Stictochironomus sp.	4	--	--
Tanytarsus sp.	--	4	--
Tipula sp.	S	--	--
Tvetenia sp.	--	4	--
Genus near *Pentaneura* sp.	S	--	4
Turbellaria	--	--	961
Dugesia sp.	--	--	961
Annelida			
Oligochaeta	--	--	36
Pristina sp.	--	--	36
Crustacea			
Amphipoda	S	--	--
Hyalella azteca	S	--	--
Mollusca			
Gastropoda	S	--	S
Fossaria sp.	S	--	--
Physa/Physella	S	--	S
Pelecypoda	--	--	7
Corbicula fluminea	--	--	7
TOTAL DENSITY (#/SQ. METER)	91	67	5160
NUMBER OF TAXA	30*	16*	25*
SHANNON-WEAVER DIVERSITY (H')	1.42	1.68	2.44

* Includes taxa from the sweep sample.

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MEMORANDUM

TO: SARDA Agencies
Rod Cruze, Riverside
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Roger Turner, Eastern Municipal
Jack Nelson, Yucaipa
Don Williams, Corona
Doug Drury, Inland Empire
Rick Wellington, Rialto
Bill Beam, Western Riverside
Theodore Eich, Elsinore Valley
Tom O'Neil, Jurupa

FROM: Steve Canton, Vice President

DATE: October 25, 2002

RE: 2002 Mercury Monitoring Data for the Santa Ana River, California

This memorandum presents the results of mercury analyses of fish and invertebrate tissue collected from the Santa Ana River in August 2002 as part of the annual mercury monitoring program. Samples were collected at three sites along the Santa Ana River, SAR6, SAR8, and SAR12, during August 2002 (Fig. 1). Although a site immediately below Prado Dam (SAR-10) has been sampled in the past, no samples were collected in 2002. Highway construction precluded access to this site.

In previous years, fish population sampling was conducted at all three sampling sites using electrofishing techniques under a state scientific collecting permit. These efforts provided reasonable estimates of fish abundance and species composition, and were also very effective in collecting the larger fish and crayfish desired by the Regional Board for tissue samples. However, in 2000, the U.S. Fish and Wildlife Service listed the Santa Ana sucker as Threatened under the Endangered Species Act of 1973. All sampling now requires both state and federal collecting permits, and both **prohibit** the use of electrofishing. Therefore, no fish population data have been allowed to be collected since 1999, and only a minnow seine can be used to collect crayfish and fish for tissue analysis. The inability to use electrofishing has severely limited our ability to obtain edible sized fish for tissue analysis for the mercury monitoring program over the past three years.

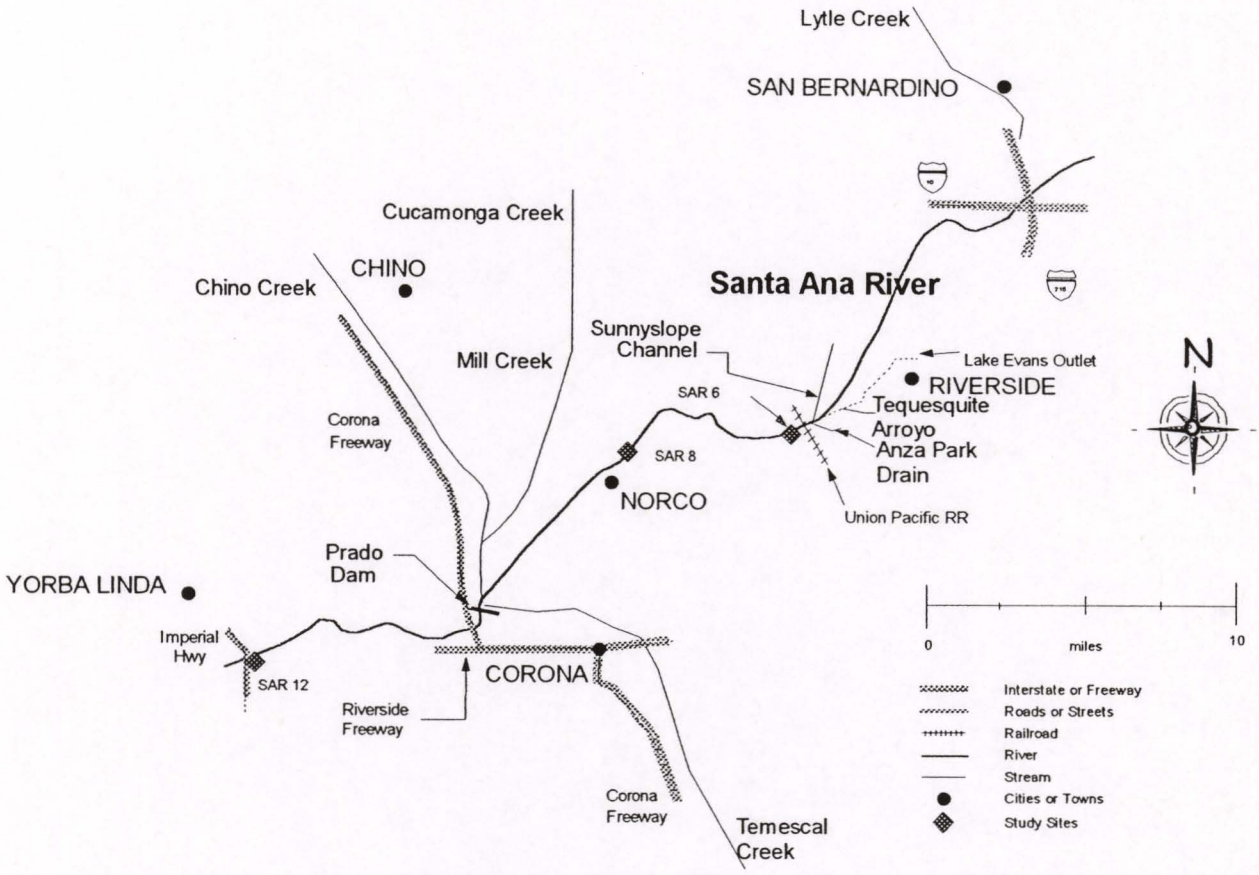

FIGURE 1: Mercury monitoring sampling sites, SAR 6, SAR 8, and SAR 12, on the Santa Ana River, California.

Annual Mercury Monitoring of Fish Tissue

As in the past, samples of representative fish and crayfish were collected according to the Mercury Monitoring Plan. Attempts were made to collect "edible sized" fish, whenever possible (the goal is to use two edible sized fish at each site - six total). However, as noted above, the inability to use electrofishing gear severely limits sampling effectiveness. Unfortunately, as a result, no "edible sized" fish were collected during sampling in 2002. All fish samples analyzed for mercury were necessarily composites of small fish species. Crayfish were collected at all three sites sampled this year. Additionally, a composite sample of Asian clams (*Corbicula fluminea*) were collected from SAR 12 and analyzed for mercury content.

Tissue data are presented in Table 1. All samples of both fish and invertebrates at all three sites were found to contain undetectable concentrations of mercury (less than 0.04 or 0.05 ppm). This is well below the target concentration of 0.35 ppm in the Mercury Monitoring Plan.

TABLE 1: Tissue analysis for mercury for organisms collected in the Santa Ana River, August 2002. All mercury concentrations expressed as wet weight values.

Site/Organism	Length (mm)	Weight (g)	Mercury Concentration (ug/g)
SAR 6			
Crayfish	Composite Sample	50	<0.05
Mosquitofish	Composite Sample	35	<0.04
SAR 8			
Mosquitofish	Composite Sample	15	<0.04
Crayfish		30	<0.04
SAR 12			
Mosquito fish	Composite Sample	20	<0.04
Largemouth bass	Not measured	15	<0.04
Asian clam	Composite Sample	45	<0.05

Habitat and benthic macroinvertebrate community data are also collected as part of the monitoring program and are currently being processed. Upon completion of the analyses, these data will be transmitted. We anticipate the transmittal of these data by the end of November.

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MEMORANDUM

TO: SARDA Agencies
Rod Cruze, Riverside
Bernie Kersey, San Bernardino
Roger Turner, Eastern Municipal
Jack Nelson, Yucaipa
Don Williams, Corona
Doug Drury, Inland Empire
Rick Wellington, Rialto
Bill Beam, Western Riverside
Theodore Eich, Elsinore Valley
Tom O'Neil, Jurupa

FROM: Steve Canton, Vice President

DATE: December 19, 2002

RE: 2002 Mercury Monitoring Data for the Santa Ana River, California

This memorandum presents the results of the instream habitat assessment in the Santa Ana River using the Rapid Bioassessment Protocol (RBP) habitat scoring, and benthic invertebrate population sampling conducted on the Santa Ana River in August 2002. Sampling was conducted at three sites along the Santa Ana River, SAR 6, SAR 8, and SAR 12, during August 2002 (Fig. 1). This document is a follow-up to the memorandum dated October 25, 2002, which presented the results of mercury analysis of fish and invertebrate tissue, and completes this year's efforts for the mercury monitoring program in the Santa Ana River.

Habitat Rating

Three different versions of the RBP habitat assessment have been used since 1991. The original RBP (Plafkin *et al.*1989) was used during the UAA study in 1991, a revised version was used from 1995 to 1997 (Barbour and Stribling 1991), and the final version (Barbour *et al.* 1999) has been used since 1998 (a draft version was used in 1998, which became finalized in 1999). When new versions of the RBP became available, the older version was still used for at least two year years to verify that overall habitat ratings were similar between RBP versions.

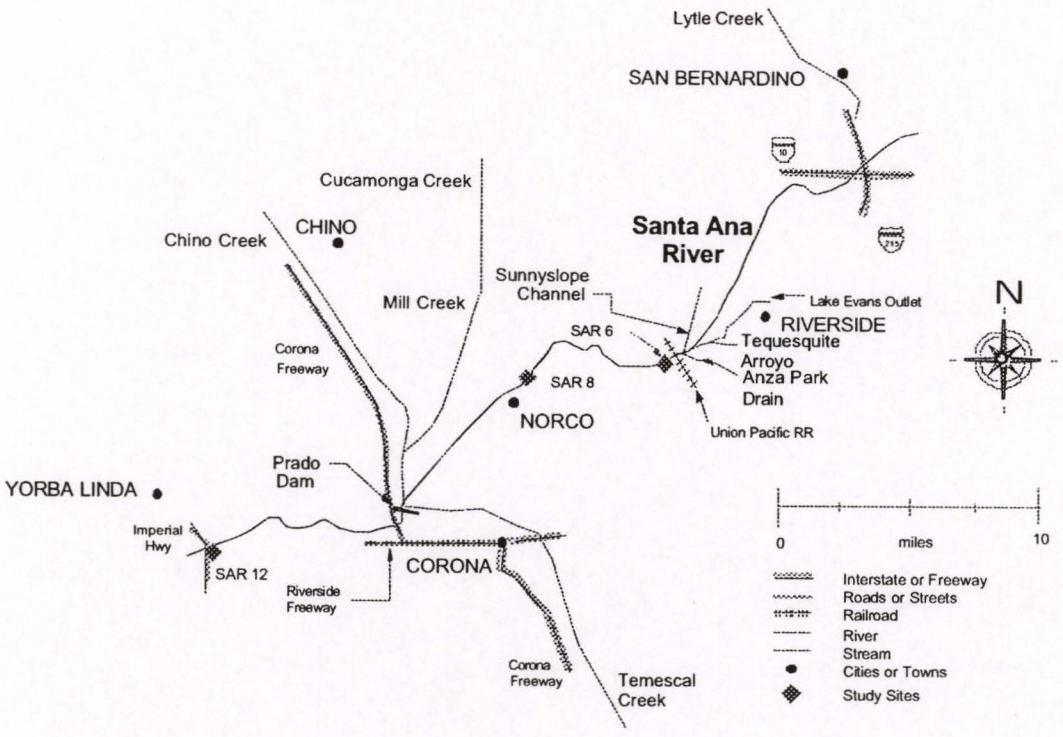

FIGURE 1: Monitoring sampling sites, SAR 6, SAR 8, and SAR 12, on the Santa Ana River, California.

Sites SAR 6 and SAR 8 were rated in marginal condition in 2002. Since 1995, the habitat ratings at these sites have been relatively constant, in poor to marginal condition. Site SAR 12 has shown a general decline in habitat quality over time, due to channelization activities by the Army Corp of Engineers, but did show an improved score for 2002 (Table 1). The improvement was the result of generally better flows, substrate quality, and bank vegetation (Table 2). Despite these improved habitat conditions, the site was still rated in poor condition.

Benthic Invertebrates

Benthic invertebrate data are summarized in Tables 3-5. Densities, number of taxa, and diversity at Sites SAR 6 and SAR 8 remain fairly low, but were within the ranges seen in previous years. The population at SAR 12 was higher compared to previous years (Table 3). As in most years (the exception being 1998), sensitive groups like mayflies (Ephemeroptera) and caddisflies (Trichoptera) had very low numbers at SAR 6

and SAR 8 (Tables 4 and 5) where sand is the dominant substrate. Their numbers are higher at SAR 12, where channelization activities have resulted in a confined channel with more cobble substrate.

TABLE 1: Rapid Bioassessment Protocol habitat data for August/September sample periods 1991 and 1995-2002 at three sampling locations on the Santa Ana River, California.

	1991	1995	1996	1997	1998	1999	2000	2001	2002
SAR 6									
Original	43	19	22	29	24	24	--	--	--
With new categories	--	24	29	37	33	34	--	--	--
Current version	--	--	--	--	55	56	56	61	67
SAR 8									
Original	40	23	24	27	22	24	--	--	--
With new categories	--	31	35	38	35	38	--	--	--
Current version	--	--	--	--	55	58	56	65	68
SAR 12									
Original	39	12	16	11	4	3	--	--	
With new categories	--	15	20	13	4	3	--	--	
Current version	--	--	--	--	19	9	22	18	

TABLE 2: RBP habitat parameters and scores for study sites on the Santa Ana River, August 2002.

Habitat Parameter	SAR 6	SAR 8	SAR 12
1 Epifaunal substrate/Available cover	1	1	6
2 Pool substrate characterization	6	6	3
3 Pool variability	3	5	2
4 Sediment deposition	1	2	2
5 Channel flow status	17	14	8
6 Channel alteration	4	3	0
7 Channel sinuosity	1	3	0
8 Bank stability	4	8	5
(score both banks)	5	7	5
9 Vegetative protection	7	2	2
(score both banks)	7	5	2
10 Riparian vegetative zone width	5	7	0
(score each bank riparian zone)	6	5	0
Total	**67**	**68**	**35**

TABLE 3: Benthic invertebrate abundance (organisms/m²), number of taxa, and Shannon-Weaver diversity for sites on the Santa Ana River, August 1991 and 1995-2002.

Sites	1991	1995	1996	1997	1998	1999	2000	2001	2002
SAR 6									
Organisms/m²	39	50	155	23	2,295	53	22	91	131
Number of taxa	17	19	34	27	34	18	9	30	18
Shannon Weaver (H')	1.99	2.19	3.01	0.92	2.88	2.20	0.73	1.42	2.32
SAR 8									
Organisms/m²	34	39	36	44	9,840	10	38	67	85
Number of taxa	19	19	20	18	15	6	20	16	15
Shannon Weaver (H')	0.91	3.04	2.10	2.29	1.77	0.62	2.35	1.68	2.90
SAR 12									
Organisms/m²	6,688	2,211	3,524	4,696	1,238	1,829	459	5,160	7,024
Number of taxa	13	17	30	16	18	19	14	25	26
Shannon Weaver (H')	1.90	0.53	2.51	2.29	2.93	1.36	1.09	2.44	2.59

TABLE 4: Number of organisms/m² found within three major orders of benthic invertebrates for sites on the Santa Ana River, California, August 1991 and 1995-2002. *Not collected in quantitative sample, but present in qualitative sweep sample.

Sites	1991	1995	1996	1997	1998	1999	2000	2001	2002
SAR 6									
Ephemeroptera	5	3	49	6	987	9	0*	0*	11
Trichoptera	0	3	0	0	887	17	0	0*	0*
Diptera	30	37	90	17	295	24	22	87	109
SAR 8									
Ephemeroptera	5	10	10	34	8,273	5	0	0*	4
Trichoptera	0	3	7	7	1,313	0	0	0*	18
Diptera	29	13	19	3	254	7	34	67	58
SAR 12									
Ephemeroptera	2,914	13	857	2,850	624	190	68	1,285	2,414
Trichoptera	3,671	40	1,460	477	200	1,353	366	2,525	255
Diptera	63	2,125	1,200	1,350	56	279	25	339	1,542

TABLE 5: Benthic invertebrate abundance (#/m^2) for sites on the Santa Ana River, August 2002 (S = only found in qualitative sweep sample).

	SAR 6	SAR 8	SAR 12
Insecta			
Ephemeroptera	11	4	2,414
Baetis sp.	S	--	7
Baetis tricaudatus	--	S	208
Camelobaetidius sp.	S	S	4
Fallceon quilleri	7	4	1,980
Tricorythodes sp.	4	S	215
Trichoptera	S	18	255
Hydropsyche sp.	S	4	--
Hydroptila sp.	S	14	255
Oxyethira sp.	--	--	S
Odonata	S	S	7
Coenagrion/Enallagma	--	--	7
Hetaerina americana	S	S	--
Coleoptera	--	--	11
Hydroporus sp.	--	--	11
Diptera	109	58	1,542
Ceratopogoninae	--	--	11
Chironomus sp.	4	--	--
Cricotopus bicinctus	--	14	1,463
Dicrotendipes sp.	18	4	--
Dolichopodidae	4	--	--
Hemerodromia sp.	--	--	14
Limonia sp.	--	--	S
Orthocladius/Cricotopus gr.	--	22	29
Paratanytarsus sp.	4	--	--
Rheocricotopus sp.	S	--	--
Rheotanytarsus sp.	S	S	--
Saetheria sp.	72	11	--
Simulium sp.	7	S	S
Thienemanniella sp.	--	7	--
Unid. Orthocladiinae	--	--	25
Turbellaria	--	--	2,245
Dugesia sp.	--	--	2,245

TABLE 5: Continued.

Annelida			
Oligochaeta	--	--	366
Lumbriculidae	--	--	22
Nais sp.	--	--	265
Ophidonais serpentina	--	--	54
Unid. Immature Tubificidae w/o capilliform chaetae	--	--	25
Crustacea			
Amphipoda	4	--	4
Hyalella azteca	4	--	4
Hydracarina	--	--	11
Sperchon/Sperchonopsis	--	--	11
Mollusca			
Gastropoda	7	--	97
Ferrissia sp.	--	--	4
Physa/Physella	7	--	93
Pelecypoda	S	4	72
Corbicula fluminea	S	4	72
TOTAL DENSITY (#/M^2)	131	84	7,024
NUMBER OF TAXA	18	15	26
SHANNON-WEAVER DIVERSITY (H')	2.32	2.90	2.59

Literature Cited

Barbour, M.T., and J.B. Stribling. 1991. Use of habitat assessment in evaluating the biological integrity of stream communities. Pages 25-38. IN: Gibson, G. (ed.). *Biological Criteria: Research and Regulation, Proceedings of a Symposium, 12-13 December 1990, Arlington Virginia*. EPA-440-5-91-005. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Barbour, M.T., J. Gerritsen, B.D. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish*, 2nd Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Invertebrates and Fish.* EPA 440-4-89-001. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C.

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Bill Beam, Western Riverside
Theodore Eich, Elsinore Valley
Tom O'Neil, Jurupa

FROM: Steve Canton

DATE: December 8, 2003

RE: 2003 Mercury Monitoring Data for the Santa Ana River, California

This memorandum presents the data collected by Chadwick Ecological Consultants, Inc. (CEC) in August and October 2003 from the Santa Ana River as part of the annual mercury monitoring program. In August 2003, instream habitat assessment using the Rapid Bioassessment Protocol (RBP) habitat scoring, and benthic invertebrate population sampling were conducted in the Santa Ana River. Fish and macroinvertebrate sampling for tissue analysis were conducted in October 2003. Fish and macroinvertebrate sampling for tissue analysis had to be sampled later in the year due to delays in obtaining a California Department of Fish and Game (CDFG) Scientific Collecting Permit. Sampling was conducted at three sites along the Santa Ana River, SAR 6, SAR 8, and SAR 12, during August and October 2003 (Fig. 1). Although a site immediately below Prado Dam (SAR 10) has been sampled in the past, it has not been possible to collect any samples in the past few years due to highway construction and the resulting highway configuration which has restricted access to this site.

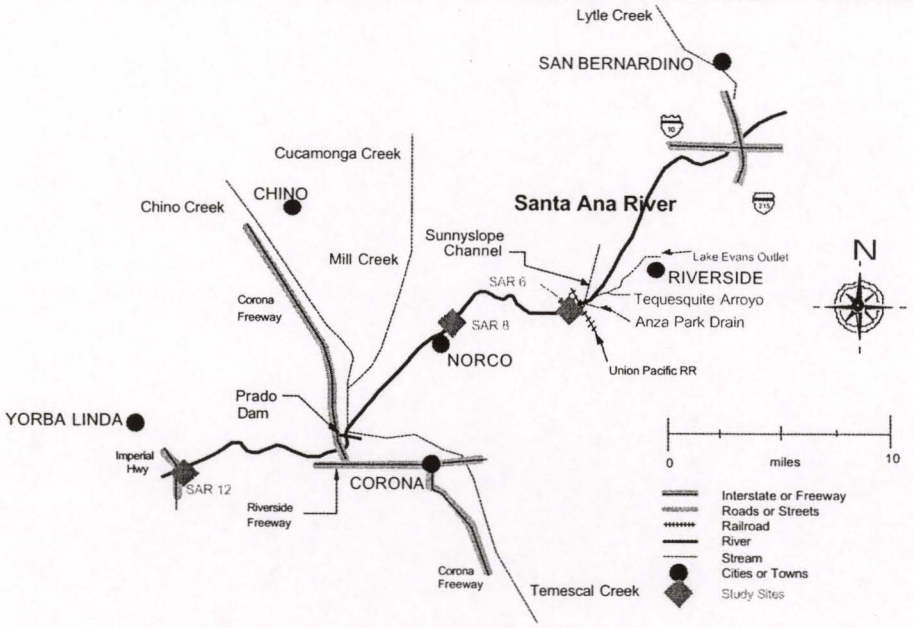

FIGURE 1: Mercury monitoring sampling Sites SAR 6, SAR 8, and SAR 12 on the Santa Ana River, California.

Prior to 1999, semi-quantitative fish population sampling was conducted at Sites SAR 6, SAR 8, and SAR 12 using electrofishing techniques under a state scientific collecting permit. These efforts provided reasonable estimates of fish abundance and detailed information on fish species composition. Electrofishing was also very effective in collecting the larger fish and crayfish desired by the Regional Board for tissue samples as part of the mercury monitoring program. However, in 2000, the U.S. Fish and Wildlife Service (USFWS) listed the Santa Ana sucker as Threatened under the Endangered Species Act of 1973. All sampling now requires both state and federal collecting permits, and both have prohibited the use of electofishing by CEC. Therefore, no fish population data have been allowed to be collected since 1999, and only a minnow seine can be used to collect crayfish and fish for tissue analysis. The inability to use electrofishing has severely limited our ability to obtain edible sized fish for tissue analysis for the mercury monitoring program over the past four years. CEC is undertaking efforts to have the USFWS and CDFG reinstate the use of electrofishing techniques by CEC in order to better meet the goals of the mercury monitoring program for the Santa Ana River. It is our hope this method will be in place for the 2004 monitoring efforts.

Annual Mercury Monitoring of Fish Tissue

As in the past, samples of representative fish and crayfish were collected according to the Mercury Monitoring Plan. Attempts were made to collect "edible sized" fish, whenever possible (the goal is to use two edible sized fish at each site - six total). However, as noted above, the inability to use electrofishing gear severely limits sampling effectiveness. At Site SAR 6, only fathead minnows and mosquitofish were collected for tissue analysis. No edible size fish or crayfish were captured or observed. One Santa Ana sucker and five arroyo chubs were collected while seining. These fish were immediately released. At Site SAR 8, only 10 grams of mosquitofish were collected during four hours of seining. No other fish or crayfish were observed. The heavy growth of non-native giant reed (*Arundo donax*) along the shoreline, lack of island development at the site, and lack of slow water habitat around the bridge abutment this year all combined to make habitat conditions very poor for seining in 2003. Four samples were collected from Site SAR 12 in 2003. Crayfish, common carp, fathead minnow, and inland silversides were all collected. All samples were placed in dry ice-filled coolers and shipped overnight to ACZ Laboratories in Steamboat Springs, Colorado, for analysis of total mercury and percent solids.

Tissue data are presented in Table 1. All samples of both fish and invertebrates at all three sites were found to contain undetectable concentrations of mercury (less than 0.04 or 0.05 ppm). This detection limit is well below the target concentration of 0.35 ppm in the Mercury Monitoring Plan.

Habitat Rating

Three different versions of the RBP have been used since 1991. The original RBP (Plafkin *et al.* 1989) was used during the UAA study in 1991, a revised version was used from 1995 to 1997 (Barbour and Stribling 1991), and the final version (Barbour *et al.* 1999). When a new version of the RBP became available, the older version was still used for at least two years to verify that overall habitat ratings were similar between RBP versions.

Sites SAR 6 and SAR 8 were rated in marginal condition in 2003. Since 1995, the habitat ratings at these sites have been relatively constant, in poor to marginal condition (Table 2). Site SAR 12 had shown a general

decline in habitat quality over time, due to channelization activities by the Army Corp of Engineers, but has shown an improved score in recent years (Table 2). Despite improvements in habitat conditions, the site is still rated in poor condition (Table 3).

TABLE 1: Tissue analysis for mercury for organisms collected in the Santa Ana River, October 2003. All mercury concentrations expressed as wet weight values.

Site/Organism	Sample Type	Weight (g)	Mercury Concentration (• g/g)
SAR 6			
Fathead minnow	Composite Sample	12	<0.05
Mosquitofish	Composite Sample	30	<0.04
SAR 8			
Mosquitofish	Composite Sample	10	<0.05
SAR 12			
Common carp	Individual	50	<0.05
Fathead minnow	Composite Sample	15	<0.04
Inland silversides	Composite Sample	20	<0.05
Crayfish	Individual	25	<0.05

TABLE 2: Rapid Bioassessment Protocol habitat data for August/September sample periods 1991 and 1995-2003 at three sampling locations on the Santa Ana River, California.

	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003
SAR 6										
Original	43	19	22	29	24	24	--	--	--	--
With new categories	--	24	29	37	33	34	--	--	--	--
Current version	--	--	--	--	55	56	56	61	67	74
SAR 8										
Original	40	23	24	27	22	24	--	--	--	--
With new categories	--	31	35	38	35	38	--	--	--	--
Current version	--	--	--	--	55	58	56	65	68	72
SAR 12										
Original	39	12	16	11	4	3	--	--	--	--
With new categories	--	15	20	13	4	3	--	--	--	--
Current version	--	--	--	--	19	9	22	18	35	39

TABLE 3: RBP habitat parameters and scores for study sites on the Santa Ana River, August 2003.

Habitat Parameter	SAR 6	SAR 8	SAR 12
1 Epifaunal substrate/Available cover	3	1	7
2 Pool substrate characterization	7	6	3
3 Pool variability	4	4	3
4 Sediment deposition	1	2	3
5 Channel flow status	15	15	8
6 Channel alteration	5	4	0
7 Channel sinuosity	2	3	0
8 Bank stability	5	8	5
(score both banks)	5	7	5
9 Vegetative protection	8	5	2
(score both banks)	8	5	2
10 Riparian vegetative zone width	5	7	1
(score each bank riparian zone)	6	5	0
Total	**74**	**72**	**39**

Benthic Invertebrates

Benthic invertebrate data are summarized in Tables 4 - 6. Densities, number of taxa, and diversity at Sites SAR 6 and SAR 8 remain fairly low, but were within the ranges seen in previous years. Very low diversity values were obtained for Site SAR 8 due to only one taxon being present in the Hess samples (Table 6). However, an additional 14 taxa were collected in qualitative sweep samples. The population at Site SAR 12 was within the range seen in previous years at this site and was again substantially higher than Sites SAR 6 and SAR 8. As in most years (the exception being 1998), sensitive groups like mayflies (Ephemeroptera) and caddisflies (Trichoptera) had very low numbers at Sites SAR 6 and SAR 8 (Tables 5 and 6) where sand is the dominant substrate. Their numbers are higher at Site SAR 12, where channelization activities have resulted in a confined channel with more cobble substrate.

TABLE 4: Benthic invertebrate abundance (organisms/m²), number of taxa, and Shannon-Weaver diversity for sites on the Santa Ana River, August 1991 and 1995-2003.

Sites	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003
SAR 6										
Organisms/m²	39	50	155	23	2,295	53	22	91	131	156
Number of taxa	17	19	34	27	34	18	9	30	18	27
Shannon Weaver (H')	1.99	2.19	3.01	0.92	2.88	2.20	0.73	1.42	2.32	1.40
SAR 8										
Organisms/m²	34	39	36	44	9,840	10	38	67	85	54
Number of taxa	19	19	20	18	15	6	20	16	15	15
Shannon Weaver (H')	0.91	3.04	2.10	2.29	1.77	0.62	2.35	1.68	2.90	0.04
SAR 12										
Organisms/m²	6,688	2,211	3,524	4,696	1,238	1,829	459	5,160	7,024	4,015
Number of taxa	13	17	30	16	18	19	14	25	26	38
Shannon Weaver (H')	1.90	0.53	2.51	2.29	2.93	1.36	1.09	2.44	2.59	2.96

TABLE 5: Number of organisms/m² found within three major orders of benthic invertebrates for sites on the Santa Ana River, California, August 1991 and 1995-2003. *Not collected in quantitative sample, but present in qualitative sweep sample.

Sites	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003
SAR 6										
Ephemeroptera	5	3	49	6	987	9	0*	0*	11	15
Trichoptera	0	3	0	0	887	17	0	0*	0*	11
Diptera	30	37	90	17	295	24	22	87	109	130
SAR 8										
Ephemeroptera	5	10	10	34	8,273	5	0	0*	4	0*
Trichoptera	0	3	7	7	1,313	0	0	0*	18	0*
Diptera	29	13	19	3	254	7	34	67	58	54
SAR 12										
Ephemeroptera	2,914	13	857	2,850	624	190	68	1,285	2,414	1,477
Trichoptera	3,671	40	1,460	477	200	1,353	366	2,525	255	1,132
Diptera	63	2,125	1,200	1,350	56	279	25	339	1,542	625

TABLE 6: Benthic invertebrate abundance (#/m^2) for sites on the Santa Ana River, August 2003 (S = only found in qualitative sweep sample).

	SAR 6	SAR 8	SAR 12
Insecta			
Ephemeroptera	15	--	1,477
Baetidae	S	--	--
Camelobaetidius sp.	S	S	S
Fallceon quilleri	11	S	987
Tricorythodes sp.	4	S	490
Odenata	S	S	S
Argia sp.	S	S	S
Hetaerina americana	S	S	S
Ischnura sp.	--	--	S
Progomphus borealis	S	--	--
Plecoptera	S	--	--
Zapada cinctipes	S	--	--
Hemiptera	S	S	S
Ambrysus sp.	S	--	
Corixidae	--	S	--
Gelastocoris sp.	--	S	--
Microvelia sp.	--	--	S
Coleoptera	S	S	--
Chaetarthria sp.	S	--	--
Curculionidae	--	S	--
Helochares sp.	--	S	--
Peltodytes sp.	S	--	--
Tropisternus sp.	S	--	--
Trichoptera	11	S	1,132
Hydropsyche sp.	S	S	102
Hydroptila sp.	11	S	1,030
Oxyethira sp.	--	--	S
Diptera	130	54	625
Ablabesmyia sp.	--	--	S
Caloparyphus sp.	4	S	--
Chironomus sp.	S	--	S
Cricotopus bicinctus	--	--	24
Cricotopus sp.	--	--	54
Crytochironomus sp.	4	--	S
Dicrotendipes sp.	S	--	22
Endotribelos sp.	--	--	S
Euparyphus sp.	--	S	--

TABLE 6: Continued.

	SAR 6	SAR 8	SAR 12
Micropsectra sp.	--	--	14
Orthocladius/Cricotopus sp.	S	--	511
Paracladopelma sp.	S	--	--
Polypedilum sp.	S	--	--
Pseudochironomus sp.	S	--	--
Rheotanytarsus sp.	S	S	--
Saetheria sp.	118	54	--
Simulium sp.	4	S	S
Tanytarsus sp.	--	--	S
Thienemanniella sp.	--	S	S
Genus near *Thienemanniella*	S	--	--
Hydracarina	--	--	8
Sperchon/Sperchonopsis	--	--	8
Crustacea			
Amphipoda	--	--	3
Gammarus lacustris	--	--	S
Hyalella azteca	--	--	3
Turbellaria	--	--	140
Girardia sp.	--	--	140
Nemertea	--	--	54
Unidentified Nemertea	--	--	54
Annelida			
Oligochaeta	--	--	471
Limnodrilus sp.	--	--	16
Lumbriculidae	--	--	S
Nais sp.	--	--	6
Paranais sp.	--	--	390
Unidentified immature Tubificidae w/o capilliform chaetae	--	--	59
Mollusca			
Gastropoda	S	S	3
Ferrissia sp.	--	--	S
Physa/Physella	S	--	3
Stagnicola sp.	--	S	--
Pelecypoda	--	--	102
Corbicula fluminea	--	--	102
TOTAL DENSITY (#/M^2)	156	54	4,015
NUMBER OF TAXA	27	15	38
SHANNON-WEAVER DIVERSITY (H')	1.4	0.04	2.96

Literature Cited

Barbour, M.T., and J.B. Stribling. 1991. Use of habitat assessment in evaluating the biological integrity of stream communities. Pages 25-38. IN: Gibson, G. (ed.). *Biological Criteria: Research and Regulation, Proceedings of a Symposium, 12-13 December 1990, Arlington Virginia.* EPA-440-5-91-005. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

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MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-6
SAMPLED: 08/12/03

TAXA	REP 1	REP 2	REP 3	COMPOSITE	SWEEP
INSECTA					
EPHEMEROPTERA		**22**	**22**	**15**	
Baetidae					X
Camelobaetidius sp.					X
Fallceon quilleri		11	22	11	X
Tricorythodes sp.		11		4	X
ODONATA					
Argia sp.					X
Hetaerina americana					X
Progomphus borealis					X
PLECOPTERA					
Zapada cinctipes					X
HEMIPTERA					
Ambrysus sp.					X
COLEOPTERA					
Chaetarthria sp.					X
Peltodytes sp.					X
Tropisternus sp.					X
TRICHOPTERA	**11**	**11**	**11**	**11**	
Hydropsyche sp.					X
Hydroptila sp.	11	11	11	11	X
DIPTERA	**43**	**140**	**205**	**130**	
Caloparyphus sp.	11			4	X
Chironomus sp.					X
Cryptochironomus sp.			11	4	X
Dicrotendipes sp.					X
Orthocladius/Cricotopus sp.					X
Paracladopelma sp.					X
Polypedilum sp.					X
Pseudochironomus sp.					X
Rheotanytarsus sp.					X
Saetheria sp.	32	140	183	118	X
Simulium sp.			11	4	X
Genus nr. Thienemanniella					X
MOLLUSCA					
GASTROPODA					
Physa/Physella					X
TOTAL (#/sq. meter)	54	173	238	156	
NUMBER OF TAXA	3	4	5	27 *	27
SHANNON-WEAVER (H')				1.40	
TOTAL EPT TAXA	1	3	2	7 *	
EPT INDEX (% of Total Taxa)	33	75	40	26 *	
EPHEMEROPTERA ABUNDANCE (% of Total Density)	0	13	9	10	

*Includes taxa from the sweep sample

MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-8
SAMPLED: 08/12/03

TAXA	REP 1	REP 2	REP 3	COMPOSITE	SWEEP
INSECTA					
EPHEMEROPTERA		NO			
Camelobaetidius sp.					X
Fallceon quilleri		MA			X
Tricorythodes sp.		CR			X
ODONATA		RO			
Argia sp.		IN			X
Hetaerina americana		VE			X
HEMIPTERA		RT			
Microvelia sp.		EB			X
TRICHOPTERA		RA			
Hydropsyche sp.		TE			X
Hydroptila sp.					X
DIPTERA	**86**	S	**75**	**54**	
Caloparyphus sp.		FO			X
Euparyphus sp.		UN			X
Rheotanytarsus sp.		D			X
Saetheria sp.	86		75	54	
Simulium sp.					X
Thienemanniella sp.					X
MOLLUSCA					
GASTROPODA					
Stagnicola sp.					X
TOTAL (#/sq. meter)	86	0	75	54	
NUMBER OF TAXA	1	0	1	15 *	14
SHANNON-WEAVER (H')				0.04 **	
TOTAL EPT TAXA	0	0	0	5 *	
EPT INDEX (% of Total Taxa)	0		0	33 *	
EPHEMEROPTERA ABUNDANCE (% of Total Density)	0		0	0	

*Includes taxa from the sweep sample
** Should be interpreted cautiously when total abundance is less than 100 organisms

MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-12
SAMPLED: 08/12/03

ΛXA	REP 1	REP 2	REP 3	COMPOSITE		SWEEP
ΞMERTEA		**22**	**194**	**54**		
Unid. Nemertea		22	194	54		X
ΛNELIDA						
OLIGOCHAETA		**366**	**1518**	**471**		
Limnodrilus sp.			65	16		
Lumbriculidae						X
Nais sp.		22		6		
Paranais sp.		172	1388	390		
Unid. Immature Tubificidae w/o Capilliform Chaetae		172	65	59		X
ΟLLUSCA						
GASTROPODA			**11**	**3**		
Ferrissia sp.						X
Physa/Physella			11	3		X
PELECYPODA	**22**	**247**	**140**	**102**		
Corbicula fluminea	22	247	140	102		X
ΟTAL (#/sq. meter)	464	7468	8127	4015		
JMBER OF TAXA	5	13	18	38	*	33
ΗANNON-WEAVER (H')				2.96		
ΟTAL EPT TAXA	2	4	4	6	*	
ΡT INDEX (% of Total Taxa)	40	31	22	16	*	
ΡHEMEROPTERA ABUNDANCE (% of Total Density)	23	42	33	37		

ıcludes taxa from the sweep sample

MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-12
SAMPLED: 08/12/03

TAXA	REP 1	REP 2	REP 3	COMPOSITE	SWEEP
INSECTA					
EPHEMEROPTERA	**108**	**3142**	**2658**	**1477**	
Camelobaetidius sp.					X
Fallceon quilleri		2227	1722	987	X
Tricorythodes sp.	108	915	936	490	X
ODONATA					
Argia sp.					X
Hetaerina americana					X
Ischnura sp.					X
HEMIPTERA					
Corixidae					X
Gelastocoris sp.					X
COLEOPTERA					
Curculionidae					X
Helochares sp.					X
TRICHOPTERA	**301**	**2281**	**1948**	**1132**	
Hydropsyche sp.		183	226	102	X
Hydroptila sp.	301	2098	1722	1030	X
Oxyethira sp.					X
DIPTERA	**22**	**1001**	**1475**	**625**	
Ablabesmyia sp.					X
Chironomus sp.					X
Cricotopus bicinctus			97	24	X
Cricotopus sp.		65	151	54	X
Cryptochironomus sp.					X
Dicrotendipes sp.		32	54	22	X
Endotribelos sp.					X
Micropsectra sp.			54	14	
Orthocladius/Cricotopus sp.	22	904	1119	511	X
Simulium sp.					X
Tanytarsus sp.					X
Thienemanniella sp.					X
HYDRACARINA			**32**	**8**	
Sperchon/Sperchonopsis			32	8	
CRUSTACEA					
AMPHIPODA			**11**	**3**	
Gammarus lacustris					X
Hyalella azteca			11	3	X
TURBELLARIA	**11**	**409**	**140**	**140**	
Girardia sp.	11	409	140	140	X

MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-12
SAMPLED: 08/12/03

TAXA	REP 1	REP 2	REP 3	COMPOSITE		SWEEP
NEMERTEA		**22**	**194**	**54**		
Unid. Nemertea		22	194	54		X
ANNELIDA						
OLIGOCHAETA		**366**	**1518**	**471**		
Limnodrilus sp.			65	16		
Lumbriculidae						X
Nais sp.		22		6		
Paranais sp.		172	1388	390		
Unid. Immature Tubificidae w/o Capilliform Chaetae		172	65	59		X
MOLLUSCA						
GASTROPODA			**11**	**3**		
Ferrissia sp.						X
Physa/Physella			11	3		X
PELECYPODA	**22**	**247**	**140**	**102**		
Corbicula fluminea	22	247	140	102		X
TOTAL (#/sq. meter)	464	7468	8127	4015		
NUMBER OF TAXA	5	13	18	38	*	33
SHANNON-WEAVER (H')				2.96		
TOTAL EPT TAXA	2	4	4	6	*	
EPT INDEX (% of Total Taxa)	40	31	22	16	*	
EPHEMEROPTERA ABUNDANCE (% of Total Density)	23	42	33	37		

*Includes taxa from the sweep sample

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MEMORANDUM

TO: SARDA Agencies
Rod Cruze, Riverside
Bernie Kersey, San Bernardino
Roger Turner, Eastern Municipal
Jack Nelson, Yucaipa
Don Williams, Corona
Doug Drury, Inland Empire
John Menke, Rialto
Bill Beam, Western Riverside
Theodore Eich, Elsinore Valley
Charles Smith, Jurupa
John Pastore, Lee Lake

FROM: Steve Canton

DATE: December 9, 2004

RE: 2004 Mercury Monitoring Data for the Santa Ana River, California

This memorandum presents the data collected by Chadwick Ecological Consultants, Inc. (CEC) in August 2004 from the Santa Ana River as part of the annual mercury monitoring program. In August 2004, fish were collected from sites in the Santa Ana River for analysis of mercury in their tissues as part of the Mercury Monitoring Program. In addition, instream habitat assessment using the Rapid Bioassessment Protocol (RBP) habitat scoring, macroinvertebrate sampling for tissue analysis, and benthic invertebrate population sampling were also conducted in the Santa Ana River. Sampling was conducted at three sites along the Santa Ana River, SAR 6, SAR 8, and SAR 12, during August 2004 (Fig. 1). Although a site immediately below Prado Dam (SAR 10) has been sampled in the past, it has not been possible to collect any samples in the past few years due to highway construction and the resulting highway configuration which has restricted access to this site.

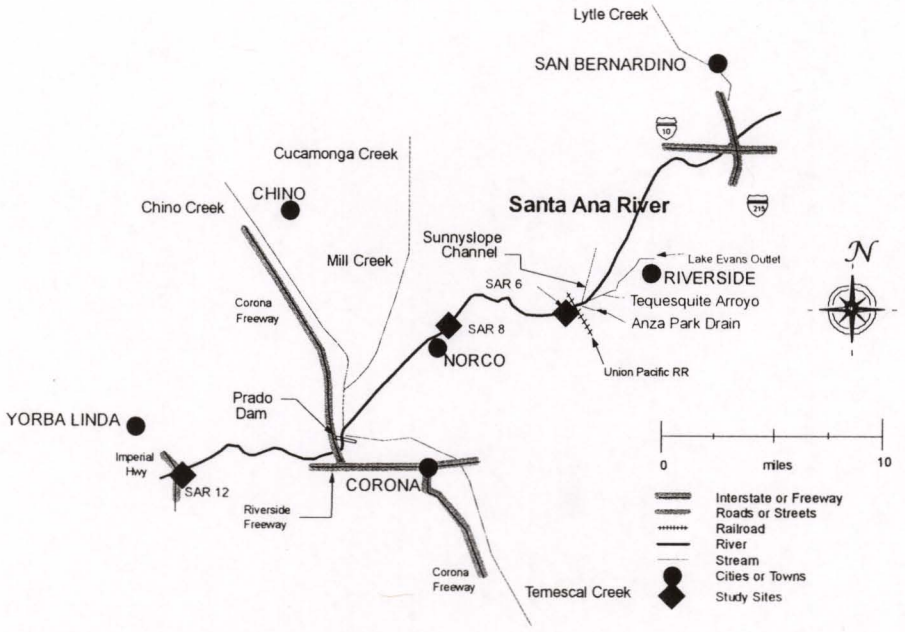

FIGURE 1: Mercury monitoring sampling Sites SAR 6, SAR 8, and SAR 12 on the Santa Ana River, California.

Prior to 1999, semi-quantitative fish population sampling was conducted at Sites SAR 6, SAR 8, and SAR 12 using electrofishing techniques under a state scientific collecting permit. These efforts provided reasonable estimates of fish abundance and detailed information on fish species composition. Electrofishing was also very effective in collecting the larger fish and crayfish desired by the Regional Board for tissue samples as part of the mercury monitoring program. However, in 2000, the U.S. Fish and Wildlife Service (USFWS) listed the Santa Ana sucker as Threatened under the Endangered Species Act of 1973. All sampling now requires both state and federal collecting permits, and both have prohibited the use of electofishing by CEC. Therefore, no fish population data have been allowed to be collected since 1999, and only a minnow seine can be used to collect crayfish and fish for tissue analysis. The inability to use electrofishing has severely limited our ability to obtain edible sized fish for tissue analysis for the mercury monitoring program over the past five years. CEC is undertaking efforts to have the USFWS and CDFG reinstate the use of electrofishing techniques by CEC in order to better meet the goals of the mercury monitoring program for the Santa Ana River. It is our hope this method will be in place for the 2005 monitoring efforts.

Annual Mercury Monitoring of Fish Tissue

As in the past, samples of representative fish and crayfish were collected according to the Mercury Monitoring Plan. Attempts were made to collect "edible sized" fish, whenever possible (the goal is to use two edible sized fish at each site - six total). However, as noted above, the inability to use electrofishing gear severely limits sampling effectiveness, especially for the larger fish. At Site SAR 6, fathead minnows, mosquitofish, and crayfish were collected for tissue analysis. No edible size fish were captured or observed. Five Santa Ana suckers and ten arroyo chubs were collected while seining. These fish were immediately released. At Site SAR 8, only mosquitofish and one small yellow bullhead were collected. No other fish or crayfish were collected, although two large common carp were observed. The heavy growth of non-native giant reed (*Arundo donax*) along the shoreline, lack of island development at the site, and lack of slow water habitat around the bridge abutment this year all combined to make habitat conditions very poor for seining in 2003. Four samples were collected from Site SAR 12 in 2004. Crayfish, common carp, fathead minnow, and largemouth bass were all collected. All samples were placed in dry ice-filled coolers and shipped overnight to ACZ Laboratories in Steamboat Springs, Colorado, for analysis of total mercury and percent solids.

Tissue data are presented in Table 1. All samples of both fish and invertebrates had concentrations of mercury between 0.05 ppm and 0.07 ppm. This is well below the target concentration of 0.35 ppm in the Mercury Monitoring Plan.

Habitat Rating

Three different versions of the RBP have been used since 1991. The original RBP (Plafkin *et al.* 1989) was used during the UAA study in 1991, a revised version was used from 1995 to 1997 (Barbour and Stribling 1991), and the final version has been used since that time (Barbour *et al.* 1999). When a new version of the RBP became available, the older version was still used for at least two years to verify that overall habitat ratings were similar between RBP versions.

Sites SAR 6 and SAR 8 were rated in marginal condition in 2004. Since 1995, the habitat ratings at these sites have been relatively constant, in poor to marginal condition (Table 2). Site SAR 12 had shown a general

decline in habitat quality over time, due to channelization activities by the Army Corp of Engineers, but has shown an improved score in recent years (Table 2). Despite improvements in habitat conditions, the site is still rated in poor condition (Table 3).

TABLE 1: Tissue analysis for mercury for organisms collected in the Santa Ana River, August 2004. All mercury concentrations expressed as wet weight values.

Site/Organism	Sample Type	Weight (g)	Mercury Concentration (µg/g)
SAR 6			
Fathead minnow	Composite Sample	16	0.06
Mosquitofish	Composite Sample	29	0.05
Crayfish	Composite Sample	20	0.07
SAR 8			
Yellow bullhead	Individual	18	0.06
Mosquitofish	Composite Sample	28	0.06
Mosquitofish (replicate)	Composite Sample	17	0.05
SAR 12			
Common carp	Individual	61	0.06
Fathead minnow	Composite Sample	15	0.06
Largemouth bass	Individual	21	0.07
Crayfish	Individual	61	0.06

TABLE 2: Rapid Bioassessment Protocol habitat data for August/September sample periods 1991 and 1995-2004 at three sampling locations on the Santa Ana River, California.

	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SAR 6											
Original	43	19	22	29	24	24	--	--	--	--	--
With new categories	--	24	29	37	33	34	--	--	--	--	--
Current version	--	--	--	--	55	56	56	61	67	74	75
SAR 8											
Original	40	23	24	27	22	24	--	--	--	--	--
With new categories	--	31	35	38	35	38	--	--	--	--	--
Current version	--	--	--	--	55	58	56	65	68	72	69
SAR 12											
Original	39	12	16	11	4	3	--	--	--	--	--
With new categories	--	15	20	13	4	3	--	--	--	--	--
Current version	--	--	--	--	19	9	22	18	35	39	44

TABLE 3: RBP habitat parameters and scores for study sites on the Santa Ana River, August 2004.

	Habitat Parameter	SAR 6	SAR 8	SAR 12
1	Epifaunal substrate/Available cover	2	1	8
2	Pool substrate characterization	8	6	4
3	Pool variability	3	5	4
4	Sediment deposition	1	1	4
5	Channel flow status	15	16	8
6	Channel alteration	6	4	0
7	Channel sinuosity	2	3	1
8	Bank stability	5	7	6
	(score both banks)	5	7	6
9	Vegetative protection	9	5	1
	(score both banks)	8	4	1
10	Riparian vegetative zone width	5	6	1
	(score each bank riparian zone)	6	4	0
	Total	**75**	**69**	**44**

Benthic Invertebrates

Benthic invertebrate data are summarized in Tables 4 - 6. Site SAR 6 had the second highest density and the third highest number of taxa observed since sampling began, while diversity was within the range seen in previous years (Table 4). Similar results were observed at Site SAR 8, with density also having the second highest recorded value and number of taxa being the highest observed (Table 4). Density at Site SAR 12 was higher than had been seen in previous years and was again substantially higher than Sites SAR 6 and SAR 8. As in most years (the exception being 1998), sensitive groups like mayflies (Ephemeroptera) and caddisflies (Trichoptera) had low numbers at Sites SAR 6 and SAR 8 (Tables 5 and 6) where sand is the dominant substrate. Their numbers are higher at Site SAR 12, where channelization activities have resulted in a confined channel with more cobble substrate.

TABLE 4: Benthic invertebrate abundance (organisms/m²), number of taxa, and Shannon-Weaver diversity for sites on the Santa Ana River, August 1991 and 1995-2004.

Sites	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SAR 6											
Organisms/m²	39	50	155	23	2,295	53	22	91	131	156	641
Number of taxa	17	19	34	27	34	18	9	30	18	27	31
Shannon Weaver (H')	1.99	2.19	3.01	0.92	2.88	2.20	0.73	1.42	2.32	1.40	2.15
SAR 8											
Organisms/m²	34	39	36	44	9,840	10	38	67	85	54	112
Number of taxa	19	19	20	18	15	6	20	16	15	15	29
Shannon Weaver (H')	0.91	3.04	2.10	2.29	1.77	0.62	2.35	1.68	2.90	0.04	1.51
SAR 12											
Organisms/m²	6,688	2,211	3,524	4,696	1,238	1,829	459	5,160	7,024	4,015	11,332
Number of taxa	13	17	30	16	18	19	14	25	26	38	29
Shannon Weaver (H')	1.90	0.53	2.51	2.29	2.93	1.36	1.09	2.44	2.59	2.96	1.72

TABLE 5: Number of organisms/m² found within three major orders of benthic invertebrates for sites on the Santa Ana River, California, August 1991 and 1995-2004. *Not collected in quantitative sample, but present in qualitative sweep sample.

Sites	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SAR 6											
Ephemeroptera	5	3	49	6	987	9	0*	0*	11	15	23
Trichoptera	0	3	0	0	887	17	0	0*	0*	11	18
Diptera	30	37	90	17	295	24	22	87	109	130	592
SAR 8											
Ephemeroptera	5	10	10	34	8,273	5	0	0*	4	0*	0*
Trichoptera	0	3	7	7	1,313	0	0	0*	18	0*	4
Diptera	29	13	19	3	254	7	34	67	58	54	97
SAR 12											
Ephemeroptera	2,914	13	857	2,850	624	190	68	1,285	2,414	1,477	1,757
Trichoptera	3,671	40	1,460	477	200	1,353	366	2,525	255	1,132	7,955
Diptera	63	2,125	1,200	1,350	56	279	25	339	1,542	625	1,088

TABLE 6: Benthic invertebrate abundance (#/m^2) for sites on the Santa Ana River, August 2004 (S = only found in qualitative sweep sample).

	SAR 6	SAR 8	SAR 12
Insecta			
Ephemeroptera	23	S	1,757
Baetidae	S	--	--
Baetis sp.	--	--	--
Baetis tricaudatus	--	--	7
Caenis amica	S	--	--
Camelobaetidius sp.	4	S	8
Fallceon quilleri	11	S	1,244
Paracloeodes sp.	4	--	--
Tricorythodes sp.	4	S	466
Odonata	S	S	--
Argia sp.	--	S	--
Coenagrion/Enallagma	S	--	--
Hetaerina americana	--	S	--
Progomphus borealis	S	--	--
Plecoptera	--	11	--
Sweltsa sp.	--	4	--
Taenionema sp	--	7	--
Hemiptera	--	S	S
Corisella decolor	--	--	S
Microvelia sp.	--	--	S
Rhagovelia sp.	--	S	--
Coleoptera	8	S	4
Dryopidae (adult)	--	S	--
Liodessus sp.	4	--	--
Postelichus sp.	4	S	--
Tropisternus sp.	--	--	4
Trichoptera	18	4	7,955
Hydropsyche sp.	--	S	7,916
Hydroptila sp.	18	4	39
Diptera	592	97	1,088
Ablabesmyia sp.	S	S	--
Antocha sp.	--	--	8
Caloparyphus sp.	11	--	--
Ceratopogonidae	S	--	S
Chironomus sp.	S	--	--
Cricotopus bicinctus	7	S	58
Cricotopus sp.	7	--	344

TABLE 6: Continued.

	SAR 6	SAR 8	SAR 12
Cricotopus trifascia	--	--	S
Cryptochironomus sp.	--	--	S
Dicrotendipes sp.	S	--	22
Empididae	4	--	--
Euparyphus sp.	--	S	--
Labrundinia sp.	S	S	--
Micropsectra sp.	S	S	--
Nanocladius sp.	S	S	--
Orthocladius/Cricotopus gr.	--	--	574
Unidentified Orthocladiinae	--	--	22
Pentaneura sp.	S	S	--
Polypedilum sp.	14	4	90
Pseudochironomus sp.	22	--	--
Rheotanytarsus sp.	11	S	--
Saetheria sp.	391	82	--
Simulium sp.	111	7	S
Tanypus sp.	--	--	S
Tanytarsus sp.	S	4	--
Thienemanniella sp.	14	--	--
Crustacea			
Amphipoda	--	--	S
Hyalella azteca	--	--	S
Decapoda	--	--	S
Pacifastacus leniusculus	--	--	S
Annelida			
Oligochaeta	--	S	198
Aeolosoma sp.	--	S	--
Limnodrilus sp.	--	--	5
Lumbriculidae	--	--	36
Nais sp.	--	S	6
Unidentified immature Tubificidae w/o capilliform chaetae	--	--	162
Branchiobdellidae	--	--	S
Branchiobdellidae	--	--	S
Hirudenia	--	--	11
Mooreobdella microstoma	--	--	11
Mollusca			
Gastropoda	S	S	S
Fossaria sp.	--	S	--
Physa/Physella	S	S	S

TABLE 6: Continued.

	SAR 6	SAR 8	SAR 12
Pelecypoda	--	--	319
Corbicula fluminea	--	--	319
TOTAL DENSITY (#/M^2)	641	112	11,332
NUMBER OF TAXA	31	29	29
SHANNON-WEAVER DIVERSITY (H')	2.15	1.51	1.72

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MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-6
SAMPLED: 08/10/04

TAXA	REP 1	REP 2	REP 3	COMPOSITE		SWEEP
INSECTA						
EPHEMEROPTERA	**43**		**22**	**23**		
Baetidae						X
Caenis amica						X
Camelobaetidius sp			11	4		
Fallceon quilleri	32			11		X
Paracloeodes sp.	11			4		
Tricorythodes sp.			11	4		X
ODONATA						
Coenagrion/Enallagma						X
Progomphus borealis						X
COLEOPTERA	**11**		**11**	**8**		
Liodessus sp.	11			4		X
Postelichus sp.			11	4		
TRICHOPTERA	**22**	**32**		**18**		
Hydroptila sp.	22	32		18		
DIPTERA	**1173**	**324**	**279**	**592**		
Ablabesmyia sp.						X
Caloparyphus sp.	32			11		
Ceratopogoninae						X
Chironomus sp.						X
Cricotopus bicinctus	22			7		
Cricotopus sp.		22		7		
Dicrotendipes sp.						X
Empididae	11			4		
Labrundinia sp.						X
Micropsectra sp.						X
Nanocladius sp.						X
Pentaneura sp.						X
Polypedilum sp.	32	11		14		X
Pseudochironomus sp.	54	11		22		X
Rheotanytarsus sp.	32			11		X
Saetheria sp.	732	237	204	391		X
Simulium sp.	226	32	75	111		X
Tanytarsus sp.						X
Thienemanniella sp.	32	11		14		
MOLLUSCA						
GASTROPODA						
Physa/Physella						X
TOTAL (#/sq. meter)	1249	356	312	641		
NUMBER OF TAXA	13	7	5	31	*	22
SHANNON-WEAVER (H')				2.15		
TOTAL EPT TAXA	3	1	2	7	*	
EPT INDEX (% of Total Taxa)	23	14	40	23	*	
EPHEMEROPTERA ABUNDANCE (% of Total Density)	3	0	7	4		

*Includes taxa from the sweep sample

MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-8
SAMPLED: 08/10/04

TAXA	REP 1	REP 2	REP 3	COMPOSITE	SWEEP
INSECTA					
EPHEMEROPTERA					
Camelobaetidius sp					X
Fallceon quiller					X
Tricorythodes sp.					X
ODONATA					
Argia sp.					X
Hetaerina americana					X
PLECOPTERA	**11**	**22**		**11**	
Sweltsa sp.	11			4	
Taenionema sp		22		7	
HEMIPTERA					
Rhagovelia sp					X
COLEOPTERA					
Dryopidae (adult					X
Postelichus sp.					X
TRICHOPTERA		**11**		**4**	
Hydropsyche sp.					X
Hydroptila sp		11		4	X
DIPTERA		**151**	**140**	**97**	
Ablabesmyia sp					X
Cricotopus bicinctus					X
Euparyphus sp.					X
Labrundinia sp					X
Micropsectra sp.					X
Nanocladius sp.					X
Pentaneura sp					X
Polypedilum sp		11		4	X
Rheotanytarsus sp					X
Saetheria sp		118	129	82	X
Simulium sp.		22		7	X
Tanytarsus sp.			11	4	

MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-8
SAMPLED: 08/10/04

TAXA	REP 1	REP 2	REP 3	COMPOSITE	SWEEP
ANNELIDA					
OLIGOCHAETA					
Aeolosoma sp					X
Nais sp.					X
Slavina sp.					X
MOLLUSCA					
GASTROPODA					
Fossaria sp.					X
Physa/Physella					X
TOTAL (#/sq. meter)	11	184	140	112	
NUMBER OF TAXA	1	5	2	29 *	26
SHANNON-WEAVER (H')				1.51	
TOTAL EPT TAXA	1	2	0	7 *	
EPT INDEX (% of Total Taxa)	100	40	0	24 *	
EPHEMEROPTERA ABUNDANCE (% of Total Density)	0	0	0	0	

*Includes taxa from the sweep sampl

MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-12
SAMPLED: 08/11/04

TAXA	REP 1	REP 2	REP 3	COMPOSITE	SWEEP
INSECTA					
EPHEMEROPTERA	**2367**	**1679**	**1227**	**1757**	
Baetis sp.					X
Baetis tricaudatus			22	7	
Camelobaetidius sp		54	65	40	
Fallceon quiller	2044	893	796	1244	X
Tricorythodes sp.	323	732	344	466	X
HEMIPTERA					
Corisella decolo					X
Microvelia sp					X
COLEOPTERA			**11**	**4**	
Tropisternus sp.			11	4	
TRICHOPTERA	**13773**	**5681**	**4412**	**7955**	
Hydropsyche sp.	13773	5649	4326	7916	X
Hydroptila sp.		32	86	39	X
DIPTERA	**1454**	**754**	**1055**	**1088**	
Antocha sp.					X
Ceratopogoninae					X
Cricotopus bicinctus	54	22	97	58	X
Cricotopus sp.	194	344	495	344	X
Cricotopus trifascia					X
Cryptochironomus sp					X
Orthocladius/Cricotopus gr	1076	291	355	574	X
Unid. Orthocladiinae	65			22	
Polypedilum sp	65	97	108	90	X
Tanypus sp.					X
CRUSTACEA					
AMPHIPODA					
Hyalella azteca					X
DECAPODA					
Pacifastacus leniusculus					X
ANNELIDA					
OLIGOCHAETA	**76**	**269**	**248**	**198**	
Limnodrilus sp.					X
Lumbriculidae	22	75	11	36	X
Unid. Immature Tubificidae w/o Capilliform Chaeta	54	194	237	162	X

MACROINVERTEBRATE DENSITY
CLIENT: SANTA ANA
SITE: SAR-12
SAMPLED: 08/11/04

TAXA	REP 1	REP 2	REP 3	COMPOSITE		SWEEP
BRANCHIOBDELLIDA						
Branchiobdellidae						X
HIRUDINEA		**11**	**22**	**11**		
Mooreobdella microstom:		11	22	11		X
MOLLUSCA						
GASTROPODA						
Physa/Physella						X
PELECYPODA	**699**	**215**	**43**	**319**		
Corbicula fluminea	699	215	43	319		X
TOTAL (#/sq. meter)	18369	8609	7018	11332		
NUMBER OF TAXA	11	13	15	29	*	25
SHANNON-WEAVER (H')				1.72		
TOTAL EPT TAXA	3	5	6	7	*	
EPT INDEX (% of Total Taxa)	27	38	40	24	*	
EPHEMEROPTERA ABUNDANCE (% of Total Density)	13	20	17	16		

*Includes taxa from the sweep sampl

EASTERN MUNICIPAL
WATER DISTRICT

August 11, 1999

Mr. Gerard J. Thibeault
Executive Officer
California Regional Water Quality Control Board,
Santa Ana Region
3737 Main Street, Suite 500
Riverside, CA 92501-3339

SUBJECT: ORDER No. 99-5, NPDES No. CA8000188

Dear Mr. Thibeault:

Pursuant to Order No. 99-5 (NPDES No. CA80001888), section (F) Required Notices and Reports, condition number two, Eastern Municipal Water District herewith submits notification of its involvement in the shared monitoring program for a comprehensive mercury investigation currently being conducted for the Santa Ana River.

The attached agreement, monitoring plan, and sampling protocol to perform fish tissue testing for mercury in the Santa Ana River was signed on July 13, 1999. This completes the requirement for this condition.

Sincerely,

Anthony J. Pack
Deputy General Manager
Operations\Administration

Attachments

RWT

cc: G. Ethridge
A. Briggs
M. Luker
R. Turner

c:\correspo\gjtsarwb.wpd

Mailing Address: Post Office Box 8300 Perris, CA 92572-8300 Tel (909) 928-3777 Fax (909) 928-6177
Location: 2270 Trumble Road Perris, CA 92570

AGREEMENT TO PERFORM FISH TISSUE TESTING FOR MERCURY IN THE SANTA ANA RIVER

This agreement is entered into in consideration of the following:

A. Beginning in 1995 the Santa Ana Regional Water Quality Control Board (SARWQCB) through their permitting actions allowed POTWs to directly measure the accumulation of mercury in receiving water organisms in lieu of long term end of pipe permit limits.

B. The SARWQCB allows dischargers to coordinate their sampling activities and share data where appropriate.

C. Significant cost savings can be realized by the dischargers by pooling their sampling efforts.

NOW, THEREFORE, the parties do agree as follows:

1. **PURPOSE OF AGREEMENT:**
The purpose of this agreement is to meet NPDES permit requirements along the upper Santa Ana River through a shared river monitoring program. The program shall be known as the Upper Santa Ana Mercury Monitoring Program (USAMMP).

2. **EFFECTIVE DATE/TERM AND ADDITIONAL PARTIES:**
This agreement shall become effective at such time as it is executed by one or more participating agencies from each of three zones defined below:

   - Upper Zone: Santa Ana River above Riverside Narrows
   - Middle Zone: Santa Ana River above Hamner Ave. and below the Riverside Narrows
   - Lower Zone: Santa Ana River above Prado Dam and below Hamner Ave.

   This agreement shall remain in effect until December 31, 2000, unless terminated at an earlier date by unanimous agreement of the signatories.

   Any local agency may become a signatory of this agreement.

3. **PROGRAM ADMINISTRATION:**
Administration of this program, as may be necessary, will be by mutual consent of representatives from each of the signatories. Such administration will be performed as part of the regular meetings of the Santa Ana River Dischargers Association.

Potential consultant(s) will be nominated by program participants and will be chosen by majority vote of those participants based on qualifications and previous experience of the nominated consultant.

4. **ALLOCATION OF COSTS:**
The allocation of costs is based on the level of effort required as specified in the "Mercury Monitoring Plan For the Santa Ana River, Reach 3&4"(attached).

The cost of sampling, analysis, and reporting of the three baseline sample sites (SAR 5, SAR 8, SAR 12) will be shared equally by all program participants. If sampling indicates the need for an increased level of sampling in one or more zones, as defined previously, the added cost of that sampling will be the responsibility of the POTW(s) discharging to that zone. Combined baseline costs are expected to be less than $7,500 per year.

The cost of work requested of the contractor beyond the scope of the Mercury Monitoring Plan will be the responsibility of the requesting signatories.

5. **PAYMENT:**
Program participants will be billed directly by the consultant(s) for any work performed. The consultant(s) as well as the participants, will be advised of the distribution of costs prior to the performance of work.

6. **PROCEDURE FOR EXECUTION:**
This agreement may be signed in counterparts, and provided it has been executed by at least one agency from each of the three SAR zones previously defined, shall be binding upon all signatories.

IN WITNESS WHEREOF, each Participating Agency has executed this Agreement on the date adjacent to the signature of its representative.

DATED: July 13, 1999

AGENCY: EASTERN MUNICIPAL WATER DISTRICT

BY: _____

TITLE: GENERAL MANAGER

ATTEST: Mary C. White

ADDRESS: P.O. Box 8300
PERRIS, CA 92572-8300

TELEPHONE: (909) 928-3777

DATED:_____

ATTEST:_____

AGENCY:_____

_____

BY:_____

TITLE:_____

ADDRESS:_____

_____

_____

TELEPHONE:_____

DATED:_____

ATTEST:_____

AGENCY:_____

_____

BY:_____

TITLE:_____

ADDRESS:_____

_____

_____

TELEPHONE:_____

MERCURY MONITORING PLAN FOR THE SANTA ANA RIVER, REACH 3 AND 4

BACKGROUND:

In 1995 the Santa Ana Regional Water Quality Control Board (SARWQCB) began to allow dischargers to directly measure bioaccumulation of mercury in aquatic organisms in lieu of traditional permit limits. This is a more accurate measurement of health risk due to bioaccumulation. Under this plan, fish residing downstream of the dischargers are collected annually and analyzed directly for mercury. If this testing indicates mercury at or above .35 mg/kg (approximately one third the FDA action level of 1 mg/kg) the permit may be reopened to include a conventional effluent limit. A conventional limit is based on a presumed bioconcentration factor and is applied at the permit holders point of discharge, not instream.

Although there is general agreement among all the parties involved that this is the preferred method of monitoring chronic mercury, consideration needs to be given to the high cost of this type of monitoring over traditional end of pipe methods. To that end, the SARWQCB allowed the dischargers to pool their resources. It is understood that this type of monitoring may not, in the absence of other data, be used to incriminate an individual discharger. However, it can indicate if and where further investigation may be warranted.

SAMPLE SITES:

Sample site locations will be identical, when possible, to sites used in the Santa Ana Use Attainability Analysis(UAA). The UAA site codes will be used to differentiate site locations. Please see the attached (Appendix A) site map and site descriptions for clarification.

Effluent from POTWs enters the upper Santa Ana River (SAR) in three general zones. The first zone is comprised of discharges from San Bernardino, Colton and Rialto. There is very limited habitat in this section of the river. Given this limitation, site SAR 6, downstream of the narrows but upstream of the Riverside treatment plant, was chosen as the initial sample site.

Riverside Regional Water Quality Control Plant is the only POTW in the middle section of the upper Santa Ana. SAR 8 (SAR at Hamner Ave.) which is downstream of all of Riverside's outfalls has been chosen as the second sample site.

The lower Santa Ana receives effluent from three Chino Basin POTWs; RP1, RP2 and Carbon Canyon. The flow from these plants enters the Santa Ana at Prado Dam. In order to assure that these and all flows are accounted for, site SAR 12 (SAR at Imperial Hwy.) was chosen as the third and final baseline monitoring site. Site SAR 11 (SAR at Gypsum Canyon) which is closer to the Prado outfall would be preferable and may be used in place of SAR12. However, the high depth and speed of the water at SAR 11 may preclude its use.

Other sites which may be used as described below or as deemed desirable by the discharging coalition include:

- SAR 5 — SAR at Mission Bridge
- SAR 9 — SAR at Archibald Ave./River Road Bridge
- MC1 — Mill Creek downstream of CHWTF RP1 (access may be limited)
- CC2 — Chino Creek below Prado Lakes outfall

SAMPLE PROTOCOL:

Under normal conditions, a minimum of one and a maximum of three samples will be analyzed for total mercury from each site. Fish and invertebrates are candidates for sampling. Older, larger fish will be selected when available. At least one invertebrate will be sampled annually if available. It may be necessary to use several small fish to constitute one laboratory sample. See appendix B for detailed sampling methods.

SAMPLE PLAN:

There are three levels of sampling required under this plan.

Level one is the baseline monitoring plan. Under this plan sites SAR 6, SAR 8 and SAR 12 will be sampled once annually between July 1 and September 30.

Level two monitoring will be initiated based on the results of the previous years monitoring results. If baseline monitoring results indicate Mercury levels between .35 mg/kg and 1 mg/kg at any of the sites, additional sampling will be performed as follows.

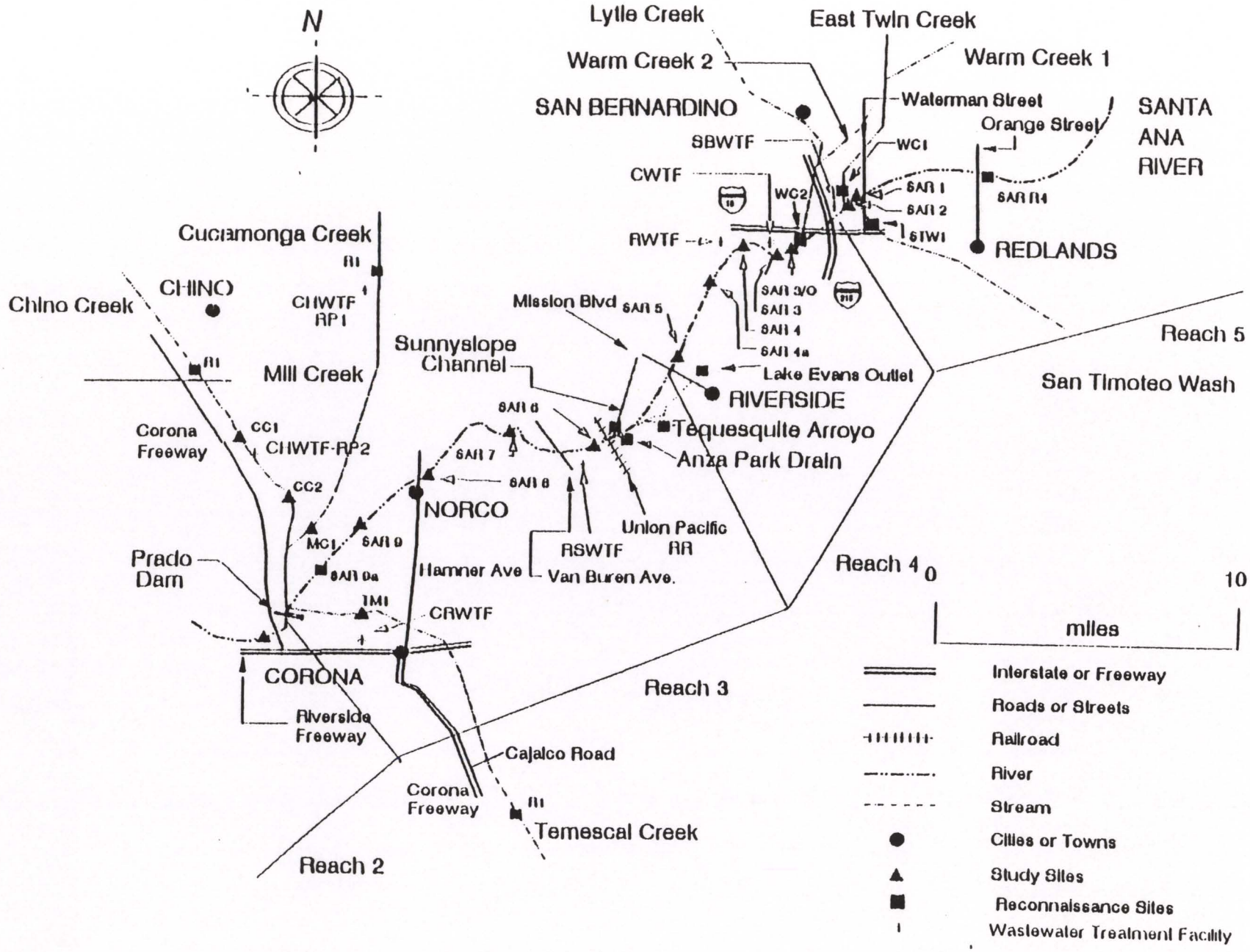
Site	Action
° SAR 6	SAR 5 will be added to the sample site list. If there are no fish at this site three extra samples will be taken at SAR 6.
° SAR 8	SAR 9 will be added to the sample site list.
° SAR 12	If SAR 8 does not show elevated levels, CC2 and MC1 will be added to the sample list. If MC1 is not accessible SAR 11 or the Prado reservoir may be sampled depending on accessibility and safety considerations. If SAR 8 shows elevated levels SAR 9 will be added to the sample list.

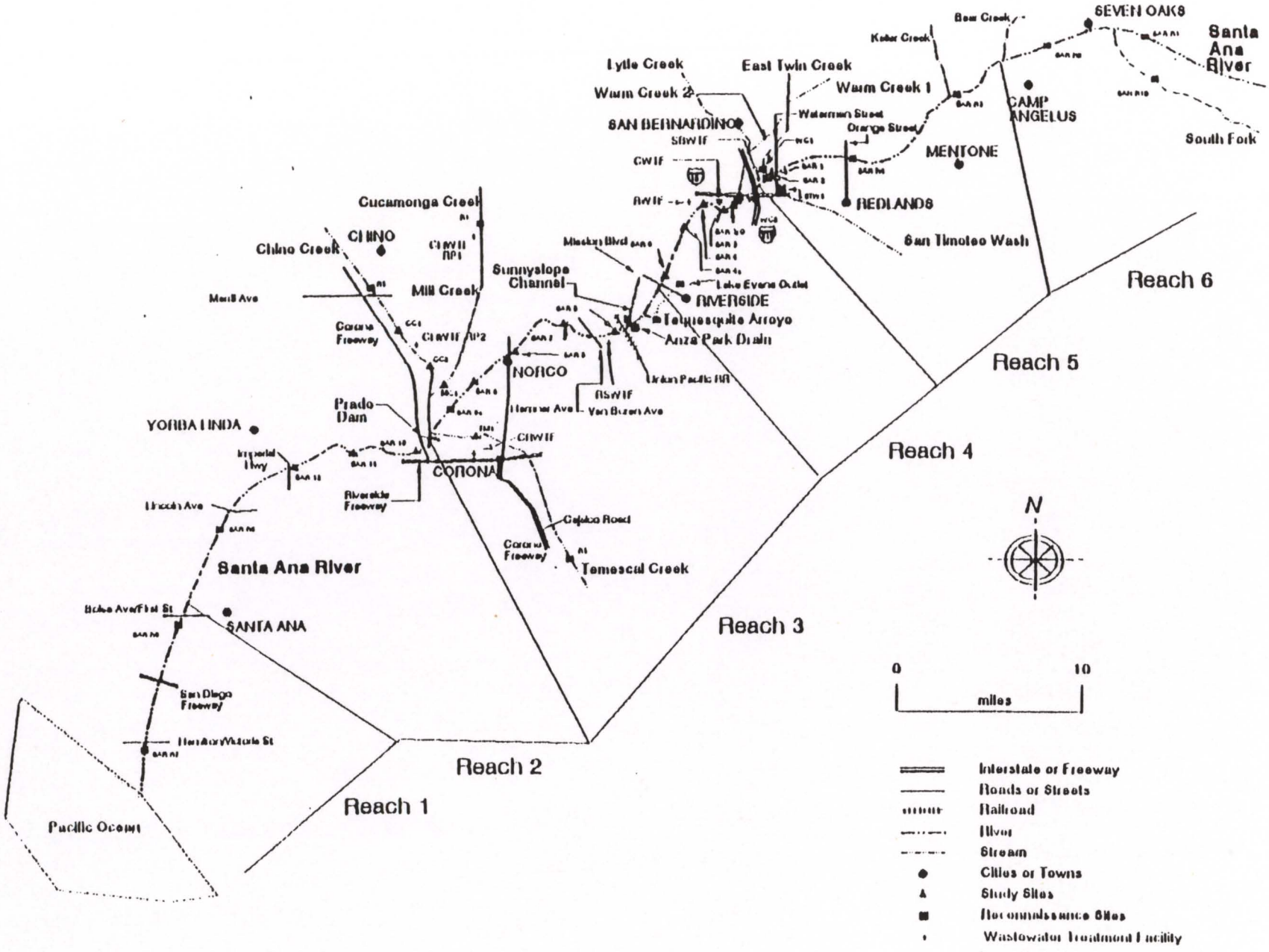
Level three monitoring will be initiated whenever any test result indicates a concentration of 1 mg/kg or higher in any sample. Upon notification by the laboratory that sample results exceed 1 mg/kg, the SARWQCB will be notified and immediate retesting will be scheduled. The failed site(s) will be retested along with additional sites as laid out in level two above. Further action, if required, will be negotiated with the SARWQCB.

APPENDIX A

SITE DESCRIPTIONS

SAR 5	Located downstream of the RWTF effluent, just upstream of the Mission Boulevard bridge at the base of reach 4.
SAR 6	Located upstream of the Riverside Regional Water Quality Control Plant(RRWQCP) effluent, just upstream of the MWD pipe crossing in segment 3.
SAR 8	Located downstream of 100% of the RRWQCP effluent, upstream of the Hamner Avenue bridge in reach 3.
SAR 9	Located further downstream of the RRWQCP effluent, upstream of Prado Dam near Archibald Avenue/River Road bridge in reach 3.
SAR 11	Located downstream of Prado Dam near the downstream end of Featherly Regional Park and the Santa Ana Canyon at the Gypsum Canyon bridge in reach 2.
SAR 12	Located further downstream of Prado Dam, near the Imperial Highway bridge.
MC1	Located on Mill Creek downstream of Chino Basins RP1 facility. (access limited)
CC2	Located on Chino Creek downstream of the Chino Basin RP2 facility, and the Prado Lakes outfall from RP1, above the confluence with the Mill Creek and the Santa Ana River.


N
Lytle Creek
East Twin Creek
Warm Creek 2
Warm Creek 1
SAN BERNARDINO
Waterman Street
Orange Street
SANTA ANA RIVER
SBWTF
WC1
CWTF
WC2
SAR 1
SAR 2
SAR R4
STW1
RWTF
REDLANDS
Cucamonga Creek
R1
CHINO
Chino Creek
CHWTF RP1
Mission Blvd
SAR 5
SAR 3/0
SAR 3
SAR 4
SAR 4a
Sunnyslope Channel
Lake Evans Outlet
Reach 5
San Timoteo Wash
RIVERSIDE
Mill Creek
R1
SAR 6
Tequesquite Arroyo
Corona Freeway
CC1
CHWTF-RP2
Anza Park Drain
SAR 7
SAR 8
CC2
NORCO
MC1
SAR 9
Union Pacific RR
RSWTF
Prado Dam
SAR 9a
Hamner Ave
Van Buren Ave.
Reach 4
0
10
miles
TM1
CRWTF
CORONA
Interstate or Freeway
Roads or Streets
Railroad
River
Stream
Cities or Towns
Study Sites
Reconnaissance Sites
Wastewater Treatment Facility
Reach 3
Riverside Freeway
Cajalco Road
Corona Freeway
R1
Temescal Creek
Reach 2


SEVEN OAKS
Santa Ana River
Bear Creek
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SAN BERNARDINO
Waterman Street
Orange Street
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MENTONE
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CWIF
REDLANDS
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San Timoteo Wash
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Telegraph Arroyo
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Reach 6
Reach 5
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ATSFRR
Hamner Ave
Van Buren Ave
Prado Dam
YORBA LINDA
CIWF
Imperial Hwy
CORONA
Riverside Freeway
Lincoln Ave
Cajalco Road
Corona Freeway
Temescal Creek
Santa Ana River
Reach 4
N
Reach 3
Edinger Ave/First St
SANTA ANA
0
10
miles
San Diego Freeway
Harbor Blvd/Victoria St
Reach 2
Reach 1
Pacific Ocean
Interstate or Freeway
Roads or Streets
Railroad
River
Stream
Cities or Towns
Study Sites
Reconnaissance Sites
Wastewater Treatment Facility

APPENDIX B

SAMPLING PROTOCOL

Fish and crayfish collection will be conducted using backpack electrofishing gear. Ideally, two whole body fish samples and one composite whole body crayfish sample will be collected at each study site, for a maximum of three samples from each study site.

Preference will be given to edible-sized (>6 inches) largemouth bass and common carp, since these two species are probably the most likely species in this section of the Santa Ana River to reach 6 inches in length and to be kept by the general public for human consumption. If edible-sized largemouth bass or common carp are not present, other edible-sized species will be substituted. If no edible-sized fish are present at a study site, smaller individuals or fathead minnows will be composited into one or two samples, depending on the need. If no crayfish are found, an additional fish sample would be collected. Although Santa Ana suckers and arroyo chubs are potentially present at the study sites, these two species are potentially listed as threatened or endangered, and will not be collected for tissue analysis. Following is a list of fish species that will be considered for tissue analysis, in order of preference.

1. Largemouth bass
2. Common carp
3. Green sunfish
4. Yellow bullhead
5. Fathead minnow

At each study site, all fish retained for tissue analysis will be identified, measured for total length, and weighed. Edible-sized fish will be stored in separate plastic bags. If needed, small fish will be separated by species and composited into plastic bags. If present, crayfish will be composited into one sample at each site. All fish and crayfish samples will be placed in a cooler on ice and frozen within four hours. All samples will be labeled with unique sample numbers, which will include the study site, date, species, and that the tissue samples are whole body samples for tissue analysis.

All samples will be shipped frozen to an analytical lab for testing. Mercury analysis will be conducted using EPA test method M7471 CVAA.

TO: Jim Petersen

FROM: Gary Ethridge

DATE: July 9, 1999

SUBJECT: Toxicity Testing Contract

Interoffice Memorandum

EASTERN MUNICIPAL WATER DISTRICT

No. 00000

NPDES Permit No. CA8000188 (Order No. 99-5) contains permit conditions and reporting requirements related to the District's "live stream" discharges to the Temescal Creek. One of the conditions states:

> "By October 1, 1999, the discharger shall notify the Executive Officer of its continuous involvement with the comprehensive mercury investigation program currently being conducted by a group of Santa Ana River system dischargers. If the discharger discontinues its involvement with this comprehensive program, the discharger shall, within 60 days of that date, submit for the approval of the Executive Officer its plan for annual testing of the mercury levels in fish flesh samples collected from the Santa Ana River, upstream of, at, and downstream of the point of the River's confluence with Temescal Creek."

In order to meet this requirement, I am recommending that the District enter into an existing agreement that other dischargers have been participating in since 1995 (See attached). The agreement will allow the District to meet the above stated requirement at a far lower cost than by independently performing the same task. Estimated cost for participating in the group effort is approximately $1,100 per year. The contract (which has been in place since 1995) was written for a five year period and expires on December 31, 2000. We would, at that time and as I read the contract, have the option of pursuing an alternative method for meeting this requirement.

Please let me know if there is any further information you need at this time.

cc: Tony Pack
Mike Luker
Anne Briggs

MERCURY MONITORING PLAN FOR THE SANTA ANA RIVER, REACH 3 AND 4

BACKGROUND:

In 1995 the Santa Ana Regional Water Quality Control Board (SARWQCB) began to allow dischargers to directly measure bioaccumulation of mercury in aquatic organisms in lieu of traditional permit limits. This is a more accurate measurement of health risk due to bioaccumulation. Under this plan, fish residing downstream of the dischargers are collected annually and analyzed directly for mercury. If this testing indicates mercury at or above .35 mg/kg (approximately one third the FDA action level of 1 mg/kg) the permit may be reopened to include a conventional effluent limit. A conventional limit is based on a presumed bioconcentration factor and is applied at the permit holders point of discharge, not instream.

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There are three levels of sampling required under this plan.

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APPENDIX A

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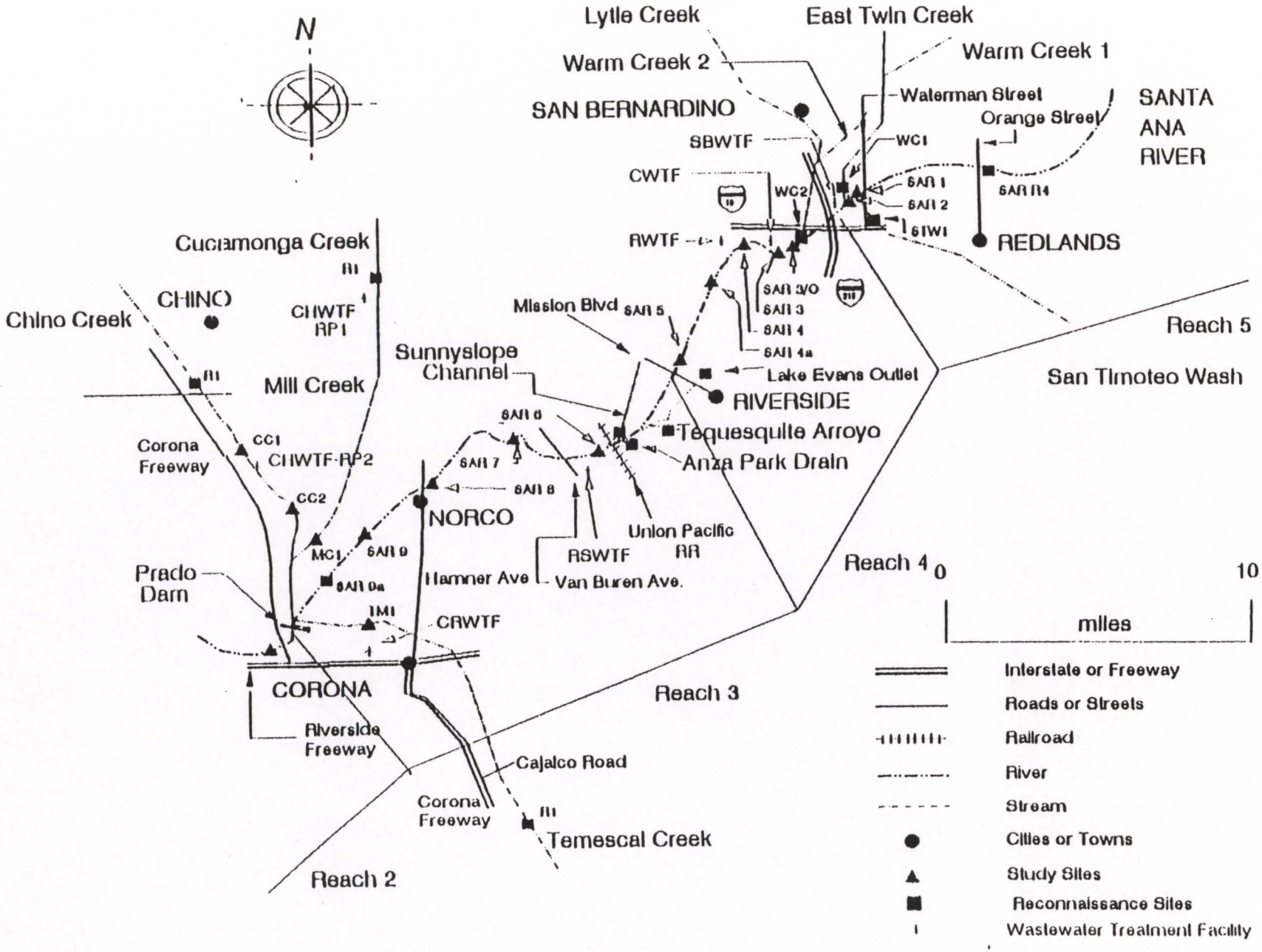
N
Lytle Creek
East Twin Creek
Warm Creek 2
Warm Creek 1
SAN BERNARDINO
Waterman Street
Orange Street
SANTA ANA RIVER
SBWTF
WC1
CWTF
WC2
SAR 1
SAR 2
SIWI
SAR R4
REDLANDS
RWTF
SAR 3/O
SAR 3
SAR 4
SAR 4a
Cucamonga Creek
CHINO
CHWTF RP1
Chino Creek
Mission Blvd
SAR 5
Reach 5
Sunnyslope Channel
Lake Evans Outlet
San Timoteo Wash
RIVERSIDE
Mill Creek
SAR 6
Tequesquite Arroyo
Corona Freeway
CC1
CHWTF-RP2
Anza Park Drain
SAR 7
SAR 8
CC2
NORCO
Union Pacific RR
MC1
SAR 9
RSWTF
Reach 4
Prado Dam
SAR 9a
Hamner Ave
Van Buren Ave.
IM1
CRWTF
CORONA
Reach 3
Riverside Freeway
Cajalco Road
Corona Freeway
Temescal Creek
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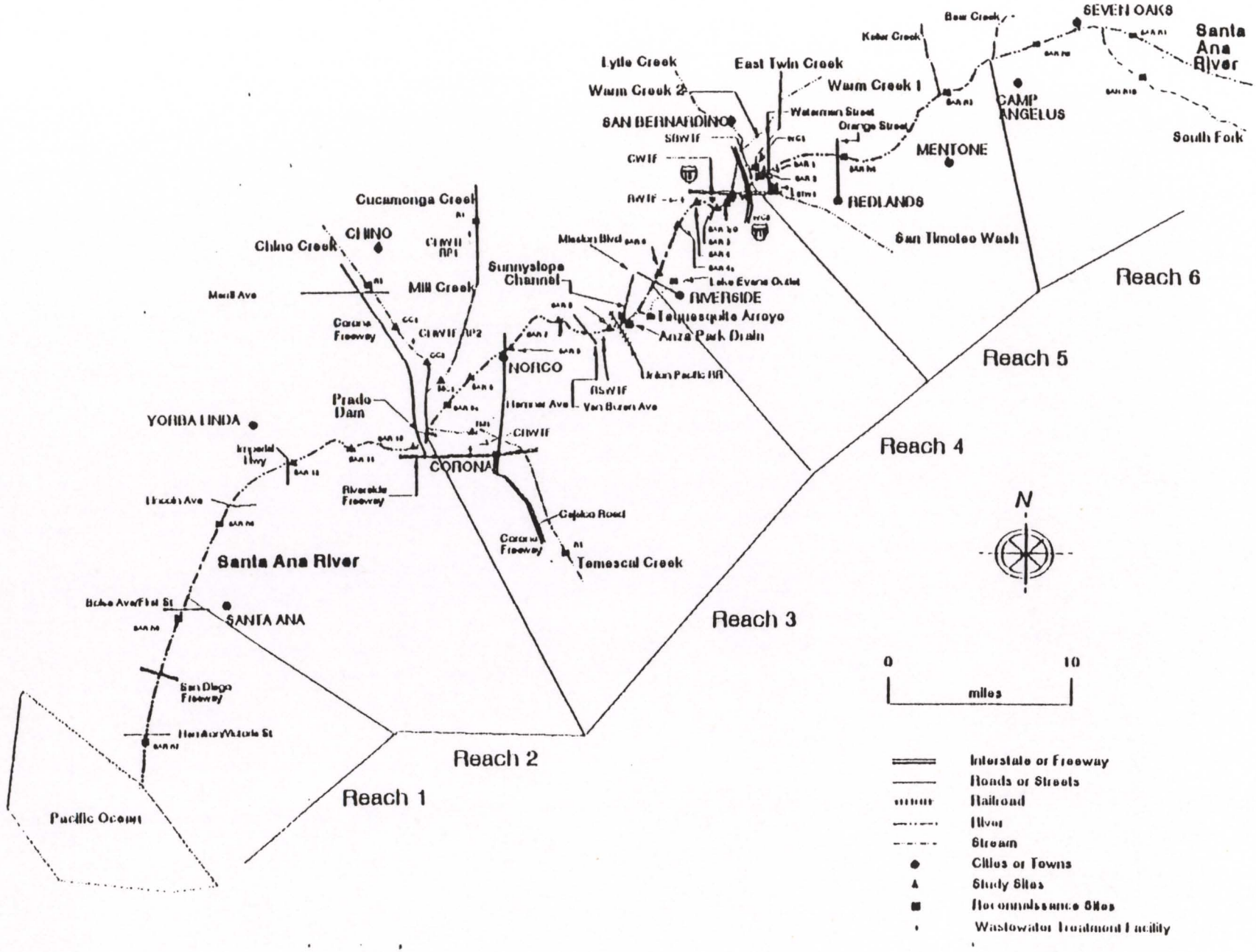
Reconnaissance Sites
Wastewater Treatment Facility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Tequisquite Arroyo
Anza Park Drain
Main Ave
Corona Freeway
CIWTF NP2
NORCO
Union Pacific RR
RSWTF
Hamner Ave
Van Buren Ave
Prado Dam
YORBA LINDA
CIWTF
CORONA
Imperial Hwy
Riverside Freeway
Lincoln Ave
Cajalco Road
Corona Freeway
Temescal Creek
Santa Ana River
Euclid Ave
Edinger Ave/First St
SANTA ANA
San Diego Freeway
Harbor Blvd/Victoria St
Pacific Ocean
Reach 1
Reach 2
Reach 3
Reach 4
Reach 5
Reach 6
N
0
10
miles
Interstate or Freeway
Roads or Streets
Railroad
River
Stream
Cities or Towns
Study Sites
Reconnaissance Sites
Wastewater Treatment Facility

APPENDIX B

SAMPLING PROTOCOL

Fish and crayfish collection will be conducted using backpack electrofishing gear. Ideally, two whole body fish samples and one composite whole body crayfish sample will be collected at each study site, for a maximum of three samples from each study site.

Preference will be given to edible-sized (>6 inches) largemouth bass and common carp, since these two species are probably the most likely species in this section of the Santa Ana River to reach 6 inches in length and to be kept by the general public for human consumption. If edible-sized largemouth bass or common carp are not present, other edible-sized species will be substituted. If no edible-sized fish are present at a study site, smaller individuals or fathead minnows will be composited into one or two samples, depending on the need. If no crayfish are found, an additional fish sample would be collected. Although Santa Ana suckers and arroyo chubs are potentially present at the study sites, these two species are potentially listed as threatened or endangered, and will not be collected for tissue analysis. Following is a list of fish species that will be considered for tissue analysis, in order of preference.

1. Largemouth bass
2. Common carp
3. Green sunfish
4. Yellow bullhead
5. Fathead minnow

At each study site, all fish retained for tissue analysis will be identified, measured for total length, and weighed. Edible-sized fish will be stored in separate plastic bags. If needed, small fish will be separated by species and composited into plastic bags. If present, crayfish will be composited into one sample at each site. All fish and crayfish samples will be placed in a cooler on ice and frozen within four hours. All samples will be labeled with unique sample numbers, which will include the study site, date, species, and that the tissue samples are whole body samples for tissue analysis.

All samples will be shipped frozen to an analytical lab for testing. Mercury analysis will be conducted using EPA test method M7471 CVAA.

AGREEMENT TO PERFORM FISH TISSUE TESTING FOR MERCURY IN THE SANTA ANA RIVER

This agreement is entered into in consideration of the following:

A. Beginning in 1995 the Santa Ana Regional Water Quality Control Board (SARWQCB) through their permitting actions allowed POTWs to directly measure the accumulation of mercury in receiving water organisms in lieu of long term end of pipe permit limits.

B. The SARWQCB allows dischargers to coordinate their sampling activities and share data where appropriate.

C. Significant cost savings can be realized by the dischargers by pooling their sampling efforts.

NOW, THEREFORE, the parties do agree as follows:

1. **PURPOSE OF AGREEMENT:**
The purpose of this agreement is to meet NPDES permit requirements along the upper Santa Ana River through a shared river monitoring program. The program shall be known as the Upper Santa Ana Mercury Monitoring Program (USAMMP).

2. **EFFECTIVE DATE/TERM AND ADDITIONAL PARTIES:**
This agreement shall become effective at such time as it is executed by one or more participating agencies from each of three zones defined below:

- Upper Zone: Santa Ana River above Riverside Narrows
- Middle Zone: Santa Ana River above Hamner Ave. and below the Riverside Narrows
- Lower Zone: Santa Ana River above Prado Dam and below Hamner Ave.

This agreement shall remain in effect until December 31, 2000, unless terminated at an earlier date by unanimous agreement of the signatories.

Any local agency may become a signatory of this agreement.

3. **PROGRAM ADMINISTRATION:**
Administration of this program, as may be necessary, will be by mutual consent of representatives from each of the signatories. Such administration will be performed as part of the regular meetings of the Santa Ana River Dischargers Association.

Potential consultant(s) will be nominated by program participants and will be chosen by majority vote of those participants based on qualifications and previous experience of the nominated consultant.

4. **ALLOCATION OF COSTS:**

The allocation of costs is based on the level of effort required as specified in the "Mercury Monitoring Plan For the Santa Ana River, Reach 3&4"(attached).

The cost of sampling, analysis, and reporting of the three baseline sample sites (SAR 5, SAR 8, SAR 12) will be shared equally by all program participants. If sampling indicates the need for an increased level of sampling in one or more zones, as defined previously, the added cost of that sampling will be the responsibility of the POTW(s) discharging to that zone. Combined baseline costs are expected to be less than $7,500 per year.

The cost of work requested of the contractor beyond the scope of the Mercury Monitoring Plan will be the responsibility of the requesting signatories.

5. **PAYMENT:**

Program participants will be billed directly by the consultant(s) for any work performed. The consultant(s) as well as the participants, will be advised of the distribution of costs prior to the performance of work.

6. **PROCEDURE FOR EXECUTION:**

This agreement may be signed in counterparts, and provided it has been executed by at least one agency from each of the three SAR zones previously defined, shall be binding upon all signatories.

IN WITNESS WHEREOF, each Participating Agency has executed this Agreement on the date adjacent to the signature of its representative.

DATED:_____

AGENCY:_____

_____

BY:_____

TITLE:_____

ATTEST:_____

ADDRESS:_____

_____

_____

TELEPHONE:_____

DATED:_____

ATTEST:_____

AGENCY:_____

_____

BY:_____

TITLE:_____

ADDRESS:_____

_____

_____

TELEPHONE:_____

DATED:_____

ATTEST:_____

AGENCY:_____

_____

BY:_____

TITLE:_____

ADDRESS:_____

_____

_____

TELEPHONE:_____

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