

**APPENDIX 1: FISH AND INVERTEBRATE SPECIES LISTS
FROM EFFLUENT-DEPENDENT STREAM SITES**

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Santa Ana River Near San Bernardino, California

Historical data on fish and/or invertebrate species that inhabit the effluent-dependent section of the Santa Ana River downstream of San Bernardino, California, is limited to five sources that provide data over the time period of 1991 to 2004 (Table 1). When these data sources are combined, 282 invertebrate taxa from 79 families were collected, along with 18 fish species. Of the 18 fish species collected, only two are native to the Santa Ana River, with the remaining 16 being introduced species.

To provide additional regional information, fish and invertebrate data from two effluent-dependent tributaries to the Santa Ana River are also included in this section. Invertebrate species historically found in San Timoteo Wash are found in Table 2, while data from invertebrate and fish species historically found in Chino Creek are found in Table 3. Only two sources of data were located pertaining to San Timoteo Wash; however, in both cases, fish sampling was performed, but no fish were collected. Forty-two invertebrate taxa from 16 families were collected in San Timoteo Wash, with almost all taxa found in this creek also being found in the Santa Ana River. Three data sets ranging from 1991 to 2000 were found on invertebrate and fish species in Chino Creek which, when combined, resulted in 101 invertebrate taxa from 41 families, and eight fish species. None of the fish species collected were native species. As with San Timoteo Wash, the invertebrate and fish communities of Chino Creek consisted mostly of species also found in the Santa Ana River. All sources of data for the Santa Ana River, San Timoteo Wash, and Chino Creek are documented in Tables 1, 2, and 3, respectively. The sources are briefly described below.

Chadwick & Associates, Inc ([C&A]1990) collected fish and invertebrates in August 1990 as part of the Preliminary Santa Ana Use Attainability Analysis (UAA). Three of the sites sampled were located downstream of where the San Bernardino WWTP was then located. From those three sites, two introduced fish species were collected, as well as 13 invertebrate taxa, most of which were identified at the genus or species level.

C&A (1992) again sampled for fish and invertebrates in 1991 at nine Santa Ana River sites and two Chino Creek sites considered to be effluent-dependent. Three wastewater treatment plants discharge into the Santa Ana River near and downstream of the City of San Bernardino, and these sites were located upstream and downstream of the other discharge locations. The invertebrate and fish sampling was conducted quarterly for a year for the biological portion of the Santa Ana UAA. Ninety-three invertebrate taxa were collected throughout the year at the Santa Ana River sites and identified to the lowest practical taxonomic level, generally genus or species. Twelve fish species were also collected at these sites; two were native fish species. Sampling at Chino Creek produced 55 invertebrate taxa and eight fish species. None of the fish species collected in Chino Creek were native species.

Risk Sciences and C&A (1994) performed fish and invertebrate surveys at four sites on the San Timoteo Wash in November 1993. Data from the three sites located downstream from the Yucaipa Water Reclamation Facility are included in Table 2. Twenty-two invertebrate taxa were collected and identified at these sites. Taxa were identified to the lowest practical level, generally genus or species for most groups. No fish were collected at any of the San Timoteo Wash sites.

Chadwick Ecological Consultants, Inc. ([CEC] 1995, 1996, 1997, 1998, 1999) sampled both the invertebrate and fish populations of Santa Ana River and Chino Creek in 1995 through 1999 on a yearly basis as a follow-up to the UAA (C&A 1992). Results were provided to a consortium of dischargers as part of the Santa Ana River Mercury Monitoring program, and are documented in various memos and reports (CEC 1995, 1996, 1997a, 1997b, 1998, 1999). The sites sampled corresponded to those sampled in the UAA; however, all sites were not sampled each year. Over the five years of sampling, 141 invertebrate taxa were collected and identified to the lowest practical taxonomic level, generally genus or species, and 16 fish species were collected. The same two native species as were collected in C&A (1992) were again collected in 1995 through 1998. Forty-one invertebrate taxa and seven introduced fish species were collected in Chino Creek over the same time period, although Chino Creek was only sampled for two of the five years, in 1995 and 1998.

As part of the Arid West Water Quality Research Project (2002), URS Corporation and CDM, Inc. collected invertebrate data in June 2000 for a Habitat Characterization Study. Five sites were included in the study; however, two sites were not accessible at the time of sampling. From the remaining three sites, nine

invertebrate taxa were collected and identified, generally to the family level. Cladocerans, likely transient organisms from the WWTP effluent, were also collected

U.S. Geological Survey ([USGS] 2003) documents the results of invertebrate and fish surveys performed in 1999 through 2003 in the Santa Ana River, Chino Creek, and San Timoteo Wash on their NAWQA website. Surveys were done as part of the Santa Ana River Basin study. Sampling for invertebrates and fish occurred one or two times each year in summer 1999 through 2003 for the Santa Ana River sites. Not all Santa Ana River sites were sampled each year, and the Chino Creek and San Timoteo Wash sites were sampled only once during this time period in September 2000. Ninety, 20, and 23 invertebrate taxa were collected from the Santa Ana River sites, Chino Creek sites, and San Timoteo Wash site respectively. Taxa were identified to the lowest practical taxonomic level, generally genus or species. Additionally, 16 fish species were collected at the Santa Ana River sites, including two native species. Six introduced fish species were collected at the Chino Creek sites, and no fish were collected at the San Timoteo Wash site.

CEC (2000, 2001, 2002, 2003, 2004) continued to sample the invertebrate and fish communities at effluent-dependent sites on the Santa Ana river from 2000 to 2004 as a follow-up to the UAA (C&A 1992) and the continued mercury monitoring program. These survey results are documented in yearly memorandums (CEC 2000, 2001, 2002a, 2002b, 2003, 2004). Sampling was done annually at three of the sites established by CEC previously for the UAA (C&A 1992). The species list produced from these surveys included 110 invertebrate taxa identified to the lowest practical taxonomic level, generally the species or genus level. Fish sampling was limited to collecting fish for tissue samples only during this time frame. Seven fish species were collected, none of which were native species.

References Cited

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TABLE 1: Invertebrates and fish taxa reported from studies of the effluent-dependent segment of the Santa Ana River.

Phylum	Class	Order	Family	Genus	Species	C&A 1990	C&A 1992	CEC 1995-1999	URS and CDM 2002	USGS 2003	CEC 2000-2004
Invertebrates											
Bryozoa										X	
Nemertea											X
	Enopla	Hoplonemertea	Tetrastemmatidae	<i>Prostoma</i>	sp.					X	
Platyhelminthes	Turbellaria									X	
		Tricladida	Planariidae	<i>Girardia</i>	sp.		X	X			X
					<i>dorotocephala</i>		X				
Annelida	Clitellata (Subclass Hirudinea)	Arhynchobdellidae	Erpobdellidae	<i>Mooreobdella</i>	<i>fervida</i>			X			
					<i>microstoma</i>		X	X			X
	Clitellata (Subclass Oligochaeta)									X	
		Branchiobdellida	Branchiobdellidae								X
		Haplotaxida					X				
			Enchytraidae							X	
			Lumbricidae	<i>Eiseniella</i>	<i>tetraedra</i>			X			
			Naididae							X	
				<i>Homochaeta</i>	<i>naidina</i>			X			
				<i>Nais</i>	sp.						X
				<i>Ophidonais</i>	<i>serpentina</i>						X
				<i>Paranais</i>	sp.						X
				<i>Pristina</i>	sp.						X
					<i>longiseta</i>	X					
				<i>Slavina</i>	sp.						X
				<i>Stephensoniana</i>	<i>tandyi</i>			X			
			Tubificidae				X	X		X	X
				<i>Aulodrilus</i>	<i>americanus</i>			X			
				<i>Limnodrilus</i>	sp.						X
		Lumbriculida	Lumbriculidae				X			X	X
				<i>Lumbriculus</i>	<i>variegatus</i>						
	Polychaeta	Aeolosomatida	Aeolosomatidae	<i>Aeolosoma</i>	sp.						X
Mollusca	Gastropoda								X	X	
		Basommatophora	Ancylidae	<i>Ferrissia</i>	sp.		X				X
			Lymnaeidae	<i>Fossaria</i>	sp.			X			X

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				<i>Stagnicola</i>	sp.						X
			Physidae	<i>Physa</i>	sp.	X		X		X	X
				<i>Physella</i>	sp.		X				X
			Planorbidae	<i>Gyraulus</i>	sp.		X	X			
				<i>Menetus</i>	sp.			X		X	
	Bivalvia									X	
		Veneroida	Corbiculidae							X	
				<i>Corbicula</i>	<i>fluminea</i>		X	X		X	X
			Pisidiidae	<i>Sphaerium</i>	sp.		X	X			
Arthropoda	Arachnida	Acari							X	X	
			Sperchontidae	<i>Sperchon/Sperchonopsis</i>	sp.						X
	Branchiopoda	Diplostraca*							X		
	Malacostraca	Amphipoda	Gammaridae	<i>Gammarus</i>	<i>lacustris</i>			X			X
			Hyallelidae	<i>Hyallella</i>	<i>axteca</i>		X	X			X
		Decapoda	Astacidae	<i>Pacifastacus</i>	<i>leniusculus</i>		X				X
			Cambaridae	<i>Procambarus</i>	<i>clarkii</i>		X				
		Isopoda	Asellidae	<i>Caecidotea</i>	sp.		X				
	Insecta	Collembola					X	X			
			Entomobryidae	<i>Willowsia</i>	sp.			X			
			Hypogastruridae	<i>Hypogastrura</i>	sp.			X			
			Isotomidae	<i>Isotomurus</i>	sp.		X				
					<i>palustris</i>		X				
					<i>tricolor</i>		X				
		Ephemeroptera								X	
			Baetidae						X	X	X
				<i>Apobaetis</i>	<i>indeprensus</i>						X
				<i>Baetis</i>	sp.					X	X
					<i>bicaudatus</i>		X				
					<i>tricaudatus</i>	X	X	X		X	X
				<i>Callibaetis</i>	sp.			X			
					<i>californicus</i>			X			
					<i>pictus</i>			X			
				<i>Camelobaetidius</i>	sp.			X		X	X
					<i>similis</i>			X		X	
					<i>warreni</i>			X		X	X

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				<i>Cloeodes</i>	<i>macrolamellus</i>			X			
				<i>Fallceon</i>	<i>quilleri</i>			X		X	X
				<i>Labiobaetis</i>	sp.			X			
				<i>Paracloeodes</i>	sp.						X
			Caenidae	<i>Caenis</i>	sp.		X				
					<i>amica</i>						X
			Heptageniidae					X			
			Leptophlebiidae							X	
				<i>Paraleptophlebia</i>	sp.			X			
			Tricorythidae	<i>Tricorythodes</i>	sp.		X	X			X
		Odonata (Anisoptera)							X		
			Corduliidae	<i>Neurocordulia</i>	sp.			X			
			Gomphidae					X			
				<i>Progomphus</i>	sp.		X	X			
					<i>borealis</i>			X		X	X
			Libellulidae	<i>Brechmorhoga</i>	<i>mendax</i>					X	
				<i>Paltothemis</i>	<i>lineatipes</i>			X			
		Odonata (Zygoptera)								X	
			Calopterygidae							X	
				<i>Hetaerina</i>	sp.		X	X		X	
					<i>americana</i>			X		X	X
			Coenagrionidae					X		X	
				<i>Argia</i>	sp.		X	X		X	X
					<i>alberta</i>			X			
					<i>vivida</i>					X	
				<i>Coenagrion</i>	<i>resolutum</i>			X			
				<i>Coenagrion/Enallagma</i>	sp.						X
				<i>Enallagma</i>	sp.		X	X			
				<i>Ischnura</i>	sp.						X
				<i>Zoniagrion</i>	sp.		X				
		Plecoptera	Chloroperlidae	<i>Sweltsa</i>	sp.						X
			Nemouridae	<i>Zapada</i>	<i>cinctipes</i>						X
			Taeniopterygidae	<i>Taenionema</i>	sp.						X
		Hemiptera							X		

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Phylum	Class	Order	Family	Genus	Species	C&A 1990	C&A 1992	CEC 1995-1999	URS and CDM 2002	USGS 2003	CEC 2000-2004
			Belostomatidae	<i>Abedus</i>	sp.		X				
				<i>Belostoma</i>	sp.		X	X			
					<i>flumineum</i>			X			
			Corixidae					X			X
				<i>Corisella</i>	sp.			X			
					<i>decolor</i>						X
					<i>inscripta</i>			X			
				<i>Hesperocorixa</i>	sp.		X	X			
				<i>Sigara</i>	sp.			X			
					<i>alternata</i>			X			
				<i>Trichorixa</i>	sp.		X	X			
					<i>calva</i>			X			
			Gelastocoridae	<i>Gelastocoris</i>	sp.			X			X
			Gerridae					X			
				<i>Gerris</i>	sp.			X			
				<i>Trepobates</i>	sp.			X			
			Hebridae	<i>Hebrus</i>	sp.			X			
				<i>Merragata</i>	<i>hebroides</i>			X		X	
			Macroveliidae	<i>Macrovelia</i>	sp.		X				
			Mesoveliidae	<i>Mesovelia</i>	sp.		X				
			Naucoridae	<i>Ambrysus</i>	sp.			X			X
			Notonectidae	<i>Notonecta</i>	sp.		X				
			Saldidae	<i>Salda</i>	sp.			X			
				<i>Saldula</i>	sp.			X			
			Veliidae					X			X
				<i>Microvelia</i>	sp.		X	X			X
				<i>Rhagovelia</i>	sp.		X	X		X	X
					<i>distincta</i>					X	
		Coleoptera	Curculionidae					X			X
			Dryopidae								X
				<i>Helichus</i>	sp.			X			
					<i>suturalis</i>					X	
				<i>Postelichus</i>	sp.			X			X
					<i>immsi</i>					X	
					<i>productus</i>		X			X	
			Dytiscidae	<i>Agabinus</i>	sp.			X			

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				<i>Dytiscus</i>	sp.		X	X			
				<i>Hydaticus</i>	sp.		X				
				<i>Hydroporus</i>	sp.						X
					<i>occidentalis</i>			X			
				<i>Hydrovatus</i>	sp.						X
				<i>Laccophilus</i>	sp.		X	X			
					<i>maculosus</i>			X			
				<i>Liodessus</i>	sp.						X
				<i>Liodessus/Neoclypeodytes</i>	sp.						X
				<i>Rhantus</i>	sp.		X				
				<i>Stictotarsus</i>	<i>funereus</i>			X			
				<i>Uvarus</i>	sp.		X				
			Elmidae	<i>Heterlimnius</i>	<i>corpulentus</i>			X			
				<i>Macronychus</i>	sp.		X				
				<i>Microcyloepus</i>	sp.						X
					<i>pusillus</i>			X			
				<i>Optioservus</i>	<i>divergens</i>			X			
			Georyssidae	<i>Georyssus</i>	sp.			X			
			Haliplidae	<i>Halipus</i>	sp.			X			
				<i>Peltodytes</i>	sp.		X	X		X	X
					<i>callosus</i>			X			
			Helophoridae	<i>Helophorus</i>	sp.			X			
			Hydrophilidae	<i>Anacaena</i>	sp.			X			
				<i>Cheatarthria</i>	sp.			X			X
				<i>Enochrus</i>	sp.		X	X		X	
					<i>pectoralis</i>						X
				<i>Helochares</i>	sp.						X
				<i>Laccobius</i>	sp.			X		X	
				<i>Paracymus</i>	sp.			X			
				<i>Tropisternus</i>	sp.		X	X		X	X
					<i>ellipticus</i>					X	
			Hydroscaphidae	<i>Hydroscapha</i>	<i>natans</i>					X	
			Staphlinidae	<i>Stenus</i>	sp.			X			X
		Lepidoptera	Noctuidae	<i>Bellura</i>	sp.		X				
			Pyralidae					X			

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				<i>Crambus</i>	sp.		X				
				<i>Parapoynx</i>	sp.			X			
				<i>Petrophila</i>	sp.	X				X	
		Trichoptera	Glossosomatidae				X				
			Helicopsyche	<i>Helicopsyche</i>	sp.					X	
			Hydropsychidae							X	
				<i>Cheumatopsyche</i>	sp.			X			
				<i>Hydropsyche</i>	sp.		X	X		X	X
					<i>californica</i>					X	
					<i>occidentalis</i>					X	
			Hydroptilidae							X	
				<i>Agraylea</i>	sp.		X	X			
				<i>Hydroptila</i>	sp.		X	X		X	X
				<i>Hydroptila icona</i>	sp.					X	
				<i>Orthotrichia</i>	sp.		X				
				<i>Oxyethira</i>	sp.						X
			Philopotamidae	<i>Wormaldia</i>	sp.			X			
			Rhyacophilidae	<i>Rhyacophila</i>	<i>brunnea</i> gr.			X			
					<i>sibirica</i> gr.						X
		Diptera								X	
			Ceratopogonidae					X			X
				<i>Bezzia</i>	sp.	X	X				
				<i>Dasyhelea</i>	sp.					X	
				<i>Mallochohelea</i>	sp.			X			
			Chironomidae			X		X	X	X	
			Subfamily: Chironominae							X	
				<i>Chironomus</i>	sp.	X	X	X		X	X
				<i>Cladotanytarsus</i>	sp.						X
				<i>Cryptochironomus</i>	sp.		X	X		X	X
				<i>Demicrochironomus</i>	sp.			X			
				<i>Dicrotendipes</i>	sp.	X	X			X	X
				<i>Einfeldia</i>	sp.		X	X			
				<i>Glyptotendipes</i>	sp.			X			
				<i>Micropsectra</i>	sp.			X			X
				<i>Micropsectra/Tanytarsus</i>	sp.					X	

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				<i>Microtendipes</i>	sp.	X		X			
				<i>Nilothauma</i>	sp.					X	
				<i>Parachironomus</i>	sp.					X	
				<i>Paracladopelma</i>	sp.						X
				<i>Paralauterborniella</i>	sp.					X	
				<i>Paratanytarsus</i>	sp.		X				X
				<i>Polypedilum</i>	sp.		X	X		X	X
				<i>Pseudochironomus</i>	sp.					X	X
				<i>Rheotanytarsus</i>	sp.		X	X		X	X
				<i>Saetheria</i>	sp.		X	X		X	X
				<i>Stempellinella</i>	sp.						X
				<i>Stictochironomus</i>	sp.						X
				<i>Tanytarsus</i>	sp.		X	X			X
			Subfamily: Orthocladinae							X	X
				<i>Cardiocladius</i>	sp.		X				X
				<i>Corynoneura</i>	sp.			X			X
				<i>Cricotopus</i>	sp.		X	X		X	X
					<i>bicinctus</i> gr.					X	X
					<i>festivellus</i>		X	X			
					<i>nostocicola</i>			X			
					<i>tremulus</i>		X	X			
					<i>trifascia</i>		X	X			X
				<i>Cricotopus (Isocladius)</i>	sp.		X				
					<i>sylvestris</i>		X	X			
				<i>Cricotopus/Orthocladus</i>	sp.					X	X
				<i>Doncricotopus</i>	sp.		X				
				<i>Endotribelos</i>	sp.						X
					<i>hesperium</i>					X	
				<i>Eukiefferiella</i>	sp.		X			X	X
				<i>Heterotrissocladius</i>	sp.			X			
				<i>Hydrobaenus</i>	sp.		X				
				<i>Nanocladius</i>	sp.					X	X
				<i>Orthocladus</i>	sp.	X	X				
				<i>Orthocladus (Euorthocladus)</i>	sp.						
					sp.		X				

TABLE 1: Invertebrates and fish taxa reported from studies of the effluent-dependent segment of the Santa Ana River.

Phylum	Class	Order	Family	Genus	Species	C&A 1990	C&A 1992	CEC 1995-1999	URS and CDM 2002	USGS 2003	CEC 2000-2004
				<i>Paracricotopus</i>	sp.		X				
				<i>Paraphaenocladus</i>	sp.						X
				<i>Rheocricotopus</i>	sp.					X	X
				<i>Thienemanniella</i>	sp.						X
				<i>Tvetenia</i>	sp.						X
			Subfamily: Tanypodinae							X	
				<i>Ablabesmyia</i>	sp.					X	X
				<i>Brundiniella</i>	sp.			X			
				<i>Labrundinia</i>	sp.						X
				<i>Larsia</i>	sp.		X				
				<i>Natarsia</i>	sp.		X				
				<i>Paramerina</i>	sp.					X	
				<i>Pentaneura</i>	sp.		X	X		X	X
				<i>Tanypus</i>	sp.			X			X
				<i>Thienemannimyia</i> gr.	sp.		X			X	
				<i>Zavrelymyia</i>	sp.			X			X
			Culicidae	<i>Culex</i>	sp.		X				
			Dolichopodidae					X			X
			Empididae				X	X		X	X
				<i>Hemerodromia</i>	sp.		X	X		X	X
				<i>Oreogeton</i>	sp.	X					
			Ephydriidae					X			
				<i>Ephydra</i>	sp.		X	X			X
			Muscidae					X			
				<i>Limnophora</i>	sp.		X	X			
			Psychodidae						X		
				<i>Maruina</i>	sp.		X				
				<i>Pericoma</i>	sp.		X	X			
			Simuliidae						X	X	
				<i>Simulium</i>	sp.	X	X	X		X	X
			Stratiomyidae	<i>Caloparyphus</i>	sp.			X		X	X
				<i>Euparyphus</i>	sp.			X		X	X
				<i>Odontomyia</i>	sp.		X	X			
			Tabanidae	<i>Hybomitra</i>	<i>minusculus</i>		X				
				<i>Tabanus</i>	<i>punctifer</i>			X			

TABLE 1: Invertebrates and fish taxa reported from studies of the effluent-dependent segment of the Santa Ana River.

Phylum	Class	Order	Family	Genus	Species	C&A 1990	C&A 1992	CEC 1995-1999	URS and CDM 2002	USGS 2003	CEC 2000-2004
			Tipulidae					X		X	
				<i>Antocha</i>	sp.			X			X
				<i>Dicranota</i>	sp.		X				
				<i>Erioptera</i>	sp.	X	X				
				<i>Gonomyia</i>	sp.			X			
				<i>Limonia</i>	sp.			X		X	X
				<i>Tipula</i>	sp.						X
Fish											
Chordata	Actinopterygii	Atheriniformes	Atherinopsidae	<i>Menidia</i>	<i>beryllina</i>					X	X
		Cypriniformes	Catastomidae	<i>Catostomus</i>	<i>fumeiventris</i>			X			
					<i>santaanae**</i>		X	X		X	
			Cyprinidae	<i>Carassius</i>	<i>auratus</i>		X	X		X	
				<i>Cyprinus</i>	<i>carpio</i>		X	X		X	X
				<i>Gila</i>	<i>orcuttii**</i>		X	X		X	
				<i>Pimephales</i>	<i>promelas</i>		X	X		X	X
		Cyprinodontiformes	Poeciliidae	<i>Gambusia</i>	<i>affinis</i>	X	X	X		X	X
				<i>Poecilia</i>	<i>latipinna</i>	X	X	X		X	
		Perciformes	Centrarchidae	<i>Lepomis</i>	<i>cyanellus</i>		X	X		X	
					<i>macrochirus</i>			X		X	
				<i>Micropterus</i>	<i>salmoides</i>		X	X		X	X
			Cichlidae	<i>Oreochromis</i>	<i>mossambicus</i>		X	X		X	
				<i>Tilapia</i>	sp.		X				
		Scorpaeniformes	Cottidae	<i>Cottus</i>	<i>asper</i>			X		X	
		Siluriformes	Ictaluridae	<i>Ameiurus</i>	<i>melas</i>			X		X	
					<i>natalis</i>		X	X		X	X
				<i>Ictalurus</i>	<i>punctatus</i>			X		X	X

* Diplostracans (cladocerans) are generally considered to be transient organisms when collected in lotic systems.

** Indicates native fish species. All other listed species are non-native fish.

TABLE 2: Invertebrate taxa reported from studies of the effluent-dependent segment of San Timoteo Wash (Santa Ana River Basin).

Phylum	Class	Order	Family	Genus	Species	Risk Sciences and C&A 1994	USGS 2003
Invertebrates							
Nemertea	Enopla	Hoplonemertea	Tetrastemmatidae	<i>Prostoma</i>	sp.		X
Annelida	Clitellata (Subclass Oligochaeta)						X
		Haplotaxida	Naididae				X
			Tubificidae				X
Mollusca	Gastropoda						X
		Basommatophora	Physidae	<i>Physa</i>	sp.		X
				<i>Physella</i>	sp.	X	
Arthropoda	Arachnida	Acari	Sperchontidae	<i>Sperchon</i>	sp.	X	
	Insecta	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>bicaudatus</i>	X	
					<i>tricaudatus</i>	X	
		Odonata (Anisoptera)	Libellulidae	<i>Paltothermis</i>	sp.	X	
		Odonata (Zygoptera)	Coenagrionidae				X
				<i>Argia</i>	sp.	X	X
					<i>vivida</i>		X
		Coleoptera	Hydrophilidae	<i>Laccobius</i>	sp.	X	
		Trichoptera	Hydropsychidae				X
				<i>Hydropsyche</i>	sp.	X	
			Hydroptilidae	<i>Hydroptila</i>	sp.		X
		Diptera	Chironomidae			X	X
			Subfamily: Chironominae				X
				<i>Chironomus</i>	sp.		X
				<i>Einfeldia</i>	sp.	X	
				<i>Saetheria</i>	sp.	X	
				<i>Tanytarsus</i>	sp.	X	
			Subfamily: Orthocladinae				X
				<i>Brillia</i>	sp.	X	
				<i>Cricotopus</i>	sp.		X

TABLE 2: Invertebrate taxa reported from studies of the effluent-dependent segment of San Timoteo Wash (Santa Ana River Basin).

Phylum	Class	Order	Family	Genus	Species	Risk Sciences and C&A 1994	USGS 2003
					<i>bicinctus</i> gr.		X
					<i>nostocicola</i>	X	
					<i>tremulus</i>	X	
				<i>Cricotopus/Orthocladius</i>	sp.		X
				<i>Heleniella</i>	sp.	X	
				<i>Orthocladius</i>	sp.	X	
				<i>Thienemanniella</i>	sp.	X	
			Subfamily: Tanypodinae	<i>Pentaneura</i>	sp.		X
				<i>Thienemannimyia</i> gr.	sp.	X	
			Ephydriidae				X
			Psychodidae	<i>Pericoma</i>	sp.	X	
			Simuliidae				X
				<i>Simulium</i>	sp.	X	X
			Stratiomyidae				X
				<i>Caloparyphus</i>	sp.	X	

TABLE 3. Invertebrate and fish taxa reported from studies of the effluent-dependent segment of Chino Creek (Santa Ana River Basin).

Phylum	Class	Order	Family	Genus	Species	C&A 1992	CEC 1995-1999	USGS 2003
Invertebrates								
Platyhelminthes	Turbellaria							X
		Tricladida	Planariidae	<i>Girardia</i>	sp.		X	
Annelida	Clitellata (Subclass Hirudinea)	Arhynchobdellidae	Eropdellidae	<i>Eropdella</i>	<i>punctata</i>	X		
				<i>Mooreobdella</i>	<i>microstoma</i>	X		
		Rhynchobdellida	Glossiphoniidae	<i>Glossiphonia</i>	<i>complanata</i>		X	
				<i>Helobdella</i>	<i>fusca</i>	X		
	Clitellata (Subclass Oligocheata)	Haplotaxida	Lumbricidae			X		
			Naididae					X
				<i>Homochaeta</i>	<i>naidina</i>		X	
			Tubificidae			X	X	
		Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	<i>variegatus</i>	X	X	
Mollusca	Gastropoda	Basommatophora	Ancylidae	<i>Ferrissia</i>	sp.	X		
					<i>rivularis</i>	X		
			Physidae	<i>Physa</i>	sp.		X	
				<i>Physella</i>	sp.	X		
			Planorbidae	<i>Gyraulus</i>	sp.	X		
Arthropoda	Arachnida	Acari	Unionicolidae	<i>Neumania</i>	sp.		X	
	Malacostraca	Amphipoda	Hyalidae	<i>Hyalella</i>	<i>azteca</i>	X	X	
		Decapoda	Astacidae	<i>Pacifastacus</i>	<i>leniusculus</i>	X		
			Cambaridae	<i>Procambarus</i>	<i>clarkii</i>			
		Ephemeroptera	Baetidae	<i>Baetis</i>	<i>bicaudatus</i>	X		
					<i>tricaudatus</i>	X	X	
				<i>Camelobaetidius</i>	<i>warreni</i>		X	
	Insecta			<i>Fallceon</i>	<i>quilleri</i>		X	X
				<i>Labiobaetis</i>	sp.		X	
			Tricorythidae	<i>Tricorythodes</i>	sp.		X	
		Odonata (Zygoptera)	Coenagrionidae				X	

TABLE 3. Invertebrate and fish taxa reported from studies of the effluent-dependent segment of Chino Creek (Santa Ana River Basin).

Phylum	Class	Order	Family	Genus	Species	C&A 1992	CEC 1995-1999	USGS 2003
				<i>Argia</i>	sp.	X		
					<i>sedula</i>		X	
				<i>Enallagma</i>	sp.	X		
		Hemiptera	Belostomatidae	<i>Belostoma</i>	sp.		X	
			Corixidae	<i>Corisella</i>	sp.		X	
					<i>inscripta</i>		X	
				<i>Tenagobia</i>	sp.	X		
				<i>Trichocorixa</i>	sp.	X		
			Gelastocoridae	<i>Gelastocoris</i>	sp.		X	
			Gerridae	<i>Trepobates</i>	sp.	X		
			Macroveliidae	<i>Macrovelia</i>	sp.	X		
			Saldidae	<i>Salda</i>	sp.		X	
					<i>buenoi</i>		X	
			Veliidae					X
				<i>Rhagovelia</i>	sp.	X		
		Coleoptera	Curculionidae	<i>Lixus</i>	sp.	X		
			Dytiscidae	<i>Laccophilus</i>	sp.		X	
				<i>Stictotarsus</i>	<i>funereus</i>		X	
			Hydraenidae	<i>Ochthebius</i>	sp.	X		
			Hydrophilidae	<i>Enochrus</i>	sp.			X
				<i>Tropisternus</i>	sp.		X	
			Staphylinidae	<i>Stenus</i>	sp.		X	
		Lepidoptera	Pyralidae	<i>Petrophila</i>	sp.			X
		Trichoptera	Hydropsychidae					X
				<i>Hydropsyche</i>	sp.	X	X	X
					<i>californica</i>			X
			Hydroptilidae	<i>Agraylea</i>	sp.		X	
				<i>Hydroptila</i>	sp.		X	
				<i>Ochrotrichia</i>	sp.		X	
		Diptera						X
			Ceratopogonidae				X	X

TABLE 3. Invertebrate and fish taxa reported from studies of the effluent-dependent segment of Chino Creek (Santa Ana River Basin).

Phylum	Class	Order	Family	Genus	Species	C&A 1992	CEC 1995-1999	USGS 2003
				<i>Mallochohelea</i>	sp.		X	
			Chaoboridae	<i>Chaoborus</i>	sp.		X	
			Chironomidae			X		X
			Subfamily: Chironominae	<i>Chironomus</i>	sp.	X	X	X
				<i>Cryptochironomus</i>	sp.	X		
				<i>Dicrotendipes</i>	sp.	X		
				<i>Endochironomus</i>	sp.	X		
				<i>Glyptotendipes</i>	sp.		X	
				<i>Microtendipes</i>	sp.	X		
				<i>Parachironomus</i>	sp.	X		
				<i>Paratanytarsus</i>	sp.	X		
				<i>Phaenopsectra</i>	sp.		X	
				<i>Polypedilum</i>	sp.	X	X	
				<i>Pseudochironomus</i>	sp.			X
				<i>Rheotanytarsus</i>	sp.	X	X	X
				<i>Tanytarsus</i>	sp.	X		
			Subfamily: Orthocladinae					X
				<i>Cardiocladius</i>	sp.	X		
				<i>Chaetocladius</i>	sp.	X		
				<i>Corynoneura</i>	sp.		X	
				<i>Cricotopus</i>	sp.			X
					<i>tremulus</i>	X	X	
				<i>Cricotopus(Isocladius)</i>	<i>sylvestris</i> gr.	X		
				<i>Cricotopus/Orthocladius</i>	sp.			X
				<i>Doncricotopus</i>	sp.	X		
				<i>Eukeifferiella</i>	<i>brehmi</i> gr.	X		
					<i>gracei</i> gr.	X		
				<i>Orthocladius</i>	sp.	X		
				<i>Parametriocnemus</i>	sp.	X		
				<i>Rheocricotopus</i>	sp.	X		

TABLE 3. Invertebrate and fish taxa reported from studies of the effluent-dependent segment of Chino Creek (Santa Ana River Basin).

Phylum	Class	Order	Family	Genus	Species	C&A 1992	CEC 1995-1999	USGS 2003
			Subfamily: Tanypodinae	<i>Ablabesmyia</i>	sp.			X
				<i>Brundiniella</i>	sp.		X	
				<i>Pentaneura</i>	sp.	X		
				<i>Thienemannimyia</i> gr.	sp.	X		
				<i>Zavrelimyia</i>	sp.	X		
			Culicidae	<i>Culex</i>	sp.	X		
			Empididae	<i>Hemerodromia</i>	sp.	X		
				<i>Rhamphomyia</i>	sp.	X		
			Muscidae	<i>Limnophora</i>	sp.	X		
			Psychodidae	<i>Pericoma</i>	sp.	X		
			Simuliidae	<i>Simulium</i>	sp.	X	X	
			Stratiomyidae	<i>Euparyphus</i>	sp.			
				<i>Odontomyia</i>	sp.	X		X
Fish								
Chordata	Actinopterygii	Cypriniformes	Cyprinidae	<i>Carassius</i>	<i>auratus</i>	X	X	
				<i>Cyprinus</i>	<i>carpio</i>	X	X	X
				<i>Pimphelas</i>	<i>promelas</i>	X	X	
		Cyprinodontiformes	Poeciliidae	<i>Gambusia</i>	<i>affinis</i>	X	X	X
		Perciformes	Centrarchidae	<i>Lepomis</i>	<i>cyanellus</i>	X	X	X
				<i>Micropterus</i>	<i>salmoides</i>	X		X
		Siluriformes	Ictaluridae	<i>Ameiurus</i>	<i>melas</i>	X	X	X
					<i>natalis</i>	X	X	X

** Indicates native fish species. All other listed species are non-native fish.

Santa Cruz River, New Mexico

Santa Cruz River Near Nogales, Arizona

Data on fish and/or invertebrate species found in the section of the Santa Cruz River below the Nogales International Wastewater Treatment Plant were collated from nine sources dating from 1961 to 2005 (Table 4). The majority of the sources provide data from 1990 or later, so the historical record is somewhat limited. When the sources were combined, 211 invertebrate and seven fish taxa were identified from samples collected in this reach. The invertebrate taxa collected belong to 56 different families. Four of the seven fish species collected were considered native species in this area. Fish and/or invertebrate taxa collected from each source are documented in Table 4, with brief descriptions of the sources listed below.

Miller (1961) summarized historical records of fish collected from the Santa Cruz River near Nogales dating from 1904 to 1956, and emphasized the intermittency of the flow in that stretch of the Santa Cruz River between Nogales and Tucson. Miller identified five native fish species, and results were incorporated into Minckley's *Fishes of Arizona* (1973).

The Arizona Department of Environmental Quality ([ADEQ] 1990) surveyed the macroinvertebrate populations from a single site in the Santa Cruz River below Nogales as part of a study supporting the development of water quality criteria for the protection of aquatic organisms in effluent-dependent streams. Seven invertebrate taxa were collected during this survey. Most invertebrates were identified at the species level; however, chironomid identification was not taken past the family level.

The ADEQ (1994) collected invertebrates from the Santa Cruz River below Nogales again in 1994 in order to further characterize the species composition of invertebrate communities in effluent-dominated stream reaches. One site, differing from the 1990 site, was sampled, resulting in nine taxa being collected. Taxa were identified at varying levels from family to species, with chironomids again only being identified at the family level.

Lawson (1995a, b) conducted a year-long monthly study of fish and invertebrates surveys of the portion of the Santa Cruz River downstream of the Nogales International WWTP in order to evaluate water

quality in this area. The study was begun in 1992 and involved a cooperative effort between the ADEQ and volunteers with the Friends of Santa Cruz organization. Five sites were sampled, resulting in 56 invertebrate and four fish taxa being collected and identified. Invertebrates were mainly identified at the genus or species level. All fish were identified to species, with two of the four fish collected being native species.

U.S. Geological Survey's (USGS) NAWQA website (1996) reports the results of a fish and invertebrate survey done in January 1996 as part of the "Central Arizona Basins Study." Only one site, designated as "Santa Cruz River at Tubac, AZ," was located within the stretch of the Santa Cruz River below Nogales. Twenty-two invertebrate taxa, generally identified to genus or species, along with three native fish species were collected. The results of the invertebrate survey were also incorporated into a USGS report (Gebler 1998) comparing aquatic invertebrate community characteristics and chlorophyll *a* levels in effluent-dependent and non-effluent dependent streams.

King *et al.* (1999) conducted a fish survey in 1997 as part of a study to determine if declining numbers of the endangered Gila topminnow was linked to levels of contaminants in water, sediment, fish, and birds. Samples were collected from two sites upstream and five sites downstream of the Nogales International WWTP. Five fish species, including four native species, were collected from the sites downstream of the WWTP.

As part of the Arid West Water Quality Research Project (2002), URS Corporation and CDM, Inc. conducted invertebrate surveys in May 2000 for a Habitat Characterization Study. Fourteen invertebrate taxa were collected from four sites downstream of the Nogales International WWTP. Invertebrates were identified in the field; therefore, many were only identified to order or class level, with insects typically identified at the family level. One cladoceran taxa was also collected from these sites, presumably a transient taxa from the WWTP effluent.

Boyle and Fraleigh (2003) conducted a survey in 1997-1998 of the invertebrate communities at nine sites on the Santa Cruz River as part of a study on the factors affecting benthic macroinvertebrate communities in this effluent-dominated reach. Two of the sites were located upstream of the WWTP, while the remaining seven were located downstream. Sites were sampled quarterly for a year to produce a

composite taxa list for all sites. A total of 140 invertebrate taxa were collected and identified to the lowest level practical, generally genus or species.

Walker *et al.* (2005) conducted invertebrate surveys at two sites downstream of the Nogales International WWTP in June 2003 and March 2004 as part of a study examining the nutrient and community variables of effluent-dependent streams in Arizona. Twenty-six invertebrate taxa were collected and identified to family or genus level. Organisms from one zooplankton genus were also collected, probably transients from the WWTP effluent.

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TABLE 4: Invertebrate and fish taxa reported from studies of the effluent-dependent segment of the Santa Cruz River near Nogales.

Phylum or Division	Class	Order	Family	Genus	Species	Miller, 1961; Minckley 1973	ADEQ 1990	ADEQ 1994	Lawson 1995	USGS 1996	King et al. 1999	URS and CDM 2002	Boyle & Fraleigh 2003	Walker et al. 2005
Invertebrates														
Nematoda								X		X			X	
	Adenophorea	Dorylaimida	Dorylaimidae	<i>Dorylaimus</i>	sp.									X
		Mermithida	Mermithidae										X	
Annelida	Clitellata (Subclass Hirudinea)											X		
		Rhynchobdellidae	Eropdellidae							X				
				<i>Eropdella</i>	<i>punctata</i>								X	X
		Rhynchobdellida	Glossiphoniidae						X				X	
	Clitellata (Subclass Oligocheata)							X	X			X		
		Haplotaxida	Enchytraidae							X			X	
			Lumbricidae										X	
			Naididae							X				
				<i>Dero</i>	sp.								X	
				<i>Nais</i>	<i>communis</i>								X	
				<i>Ophidonais</i>	<i>serpentina</i>								X	
				<i>Pristina</i>	sp.								X	
			Tubificidae							X			X	X
		Lumbriculida	Lumbriculidae										X	
Mollusca	Gastropoda											X		
		Basommatophora	Limnaeidae										X	
			Physidae										X	
				<i>Physa</i>	sp.				X					
Arthropoda	Arachnida	Acari							X	X				
			Eylaidae	<i>Eylais</i>	sp.								X	
			Hygrobatidae	<i>Attractides</i>	sp.								X	
			Lebertiidae	<i>Lebertia</i>	sp.								X	
			Limnesiidae	<i>Limnesia</i>	sp.								X	
				<i>Tyrrellia</i>	sp.								X	
			Sperchontidae	<i>Sperchon</i>	sp.								X	
	Branchiopoda	Diplostroaca*	Daphniidae	<i>Daphnia</i>	sp.									X
			Moinidae	<i>Moina</i>	sp.							X		
	Insecta	Collembola								X			X	
			Hypogastruridae	<i>Odontella</i>	sp.									X
		Ephemeroptera	Baetidae	<i>Baetis</i>	sp.				X					
				<i>Callibaetis</i>	sp.								X	
				<i>Fallceon</i>	<i>quilleri</i>								X	
				<i>Paracloeodes</i>	sp.								X	
			Tricorythidae	<i>Leptohyphes</i>	sp.				X				X	
				<i>Tricorythodes</i>	sp.				X					
					<i>minutus</i>								X	
		Odonata (Anisoptera)	Gomphidae									X		

TABLE 4: Invertebrate and fish taxa reported from studies of the effluent-dependent segment of the Santa Cruz River near Nogales.

Phylum or Division	Class	Order	Family	Genus	Species	Miller, 1961; Minckley 1973	ADEQ 1990	ADEQ 1994	Lawson 1995	USGS 1996	King et al. 1999	URS and CDM 2002	Boyle & Fraleigh 2003	Walker et al. 2005
				<i>Erpetogomphus</i>	sp.				X				X	
				<i>Ophiogomphus</i>	sp.				X					
				<i>Progomphus</i>	sp.		X	X	X					
					<i>borealis</i>					X			X	
			Libellulidae										X	
				<i>Brechmorhoga</i>	<i>mendax</i>								X	
				<i>Paltothemis</i>	<i>lineatipes</i>				X					
		Odonata (Zygoptera)	Calopterygidae									X		
				<i>Calopteryx</i>	sp.				X					
				<i>Hetaerina</i>	sp.				X				X	
			Coenagrionidae							X			X	
				<i>Argia</i>	sp.				X				X	
				<i>Coenagrion</i>	sp.				X					
					<i>resolutum</i>									X
				<i>Coenagrion/Enallagma</i>	sp.					X				
				<i>Hesperagrion</i>	sp.				X					
					<i>heterodoxum</i>								X	
				<i>Ischnura</i>	sp.				X					
				<i>Zoniagrion</i>	sp.				X					
		Hemiptera										X		
			Belostomatidae									X		
				<i>Abedus</i>	sp.				X					
					sp. 2								X	
					<i>herberti</i>								X	X
				<i>Belastoma</i>	<i>flumineum</i>								X	
			Corixidae									X	X	
				<i>Corisella</i>	<i>edulis</i>								X	
				<i>Graptocorixa</i>	sp.				X					
					<i>abdominalis</i>								X	
					<i>serrulata</i>								X	
			Mesoveliidae	<i>Mesovelia</i>	<i>mulsanti</i>				X					
			Naucoridae	<i>Ambrysus</i>	sp.				X					
			Nepidae	<i>Ranatra</i>	sp.				X					
					<i>quadridentata</i>								X	
			Notonectidae	<i>Notonecta</i>	sp.								X	
			Veliidae	<i>Microvelia</i>	sp.				X				X	
				<i>Rhagovelia</i>	sp.				X					
		Megaloptera												
			Corydalidae										X	
				<i>Corydalis</i>	sp.					X				
		Coleoptera	Curculionidae						X					
			Dryopidae											
				<i>Helichus</i>	<i>suturalis</i>				X				X	
				<i>Postelichus</i>	sp.					X				

TABLE 4: Invertebrate and fish taxa reported from studies of the effluent-dependent segment of the Santa Cruz River near Nogales.

Phylum or Division	Class	Order	Family	Genus	Species	Miller, 1961; Minckley 1973	ADEQ 1990	ADEQ 1994	Lawson 1995	USGS 1996	King et al. 1999	URS and CDM 2002	Boyle & Fraleigh 2003	Walker et al. 2005
					<i>confluentus</i>								X	
					<i>immsi</i>		X		X				X	
			Dytiscidae									X	X	
				<i>Agabus</i>	sp.				X					
					<i>semivittatus</i>				X					
				<i>Copelatus</i>	<i>chevrolati</i>								X	
				<i>Desmopachria</i>	<i>mexicana</i>				X					
				<i>Laccophilus</i>	sp.								X	
					<i>fasciatus</i>								X	
					<i>maculosus</i>								X	
					<i>mexicanus</i>				X				X	
					<i>pictus</i>								X	
					<i>salvini</i>								X	
				<i>Liodessus</i>	<i>affinis cx.</i>								X	
				<i>Rhantus</i>					X				X	
					<i>gutticollis</i>								X	
				<i>Stictotarsus</i>									X	
					<i>aequinoctialis</i>								X	
					<i>corpulentus</i>				X				X	
					<i>roffi</i>		X						X	
				<i>Thermonectus</i>	<i>nigrofasciatus</i>				X				X	
				<i>Uvarus</i>	<i>amandus</i>				X					
			Elmidae											
				<i>Microcylloepus</i>	sp.			X		X				
					<i>pusillus</i>								X	
				<i>Neoelmis</i>	sp.				X					
			Halipidae											
				<i>Peltodytes</i>	sp.				X				X	
			Helophoridae	<i>Helophorus</i>	sp.								X	
			Hydraenidae	<i>Gymnochthebius</i>	<i>fossatus</i>				X					
				<i>Ochthebius</i>	sp.								X	
			Hydrophilidae					X				X		
				<i>Berosus</i>	<i>peregrinus</i>								X	
				<i>Chaetarthria</i>	sp.								X	
				<i>Enochrus</i>	sp.								X	
					<i>carinatus</i>								X	
					<i>pygmaeus</i>		X		X				X	
				<i>Helochaeres</i>	sp. 2								X	
					<i>normatus</i>								X	
				<i>Laccobius</i>	<i>mexicanus</i>								X	
				<i>Tropisternus</i>	sp.				X					X
					sp. 3								X	
					<i>ellipticus</i>		X		X				X	
					<i>lateralis</i>		X		X				X	

TABLE 4: Invertebrate and fish taxa reported from studies of the effluent-dependent segment of the Santa Cruz River near Nogales.

Phylum or Division	Class	Order	Family	Genus	Species	Miller, 1961; Minckley 1973	ADEQ 1990	ADEQ 1994	Lawson 1995	USGS 1996	King et al. 1999	URS and CDM 2002	Boyle & Fraleigh 2003	Walker et al. 2005
				<i>Limonia</i>	sp.								X	
				<i>Tipula</i>	sp.								X	
Fish														
Chordata	Actinopterygii	Cypriniformes	Catostomidae	<i>Catostomus</i>	<i>clarkii</i> **	X				X	X			
					<i>insignis</i> **	X			X		X			
			Cyprinidae	<i>Agosia</i>	<i>chrysogaster</i> **	X			X	X	X			
				<i>Gila</i>	<i>robusta</i> **	X								
		Cyprinodontiformes	Poeciliidae	<i>Gambusia</i>	<i>affinis</i>				X		X			
				<i>Poeciliopsis</i>	<i>occidentalis</i> **	X				X	X			
		Perciformes	Centrarchidae	<i>Lepomis</i>	<i>cyanellus</i>				X					

* Diplostracans (cladocerans) are generally considered to be transient organisms when collected in lotic systems.

** Indicates native fish species. All other listed species are non-native fish.

Santa Cruz River Near Tucson, Arizona

Data on fish and/or invertebrate species sampled from the Santa Cruz River below the Rogers Road Wastewater Treatment Plant (WWTP) in Tucson, Arizona, were collated from seven sources dating from 1986 to 2005. These sources provided a taxa list including 41 invertebrate taxa from 27 families (Table 5). Three fish species were collected, and all are introduced species. Historical data predating 1986 and the creation of the WWTP is limited to the summary presented in Harding Lawson Associates (HLA) (1986). While biological data are somewhat limited for this section of the Santa Cruz River, all available data seem to indicate that the fish and invertebrate populations are impoverished in this stretch of the Santa Cruz River in comparison to the other effluent-dominated reaches included in this study. Fish and/or invertebrate taxa collected from the various sources are documented in Table 5, with brief descriptions of the sources listed below.

HLA (1986) surveyed fish, invertebrate, and algae communities in the Santa Cruz River from six sites located downstream of the Rogers Road WWTP in May 1985. The report citing the results of these surveys was prepared to support the derivation of site-specific water quality criteria for this reach of the Santa Cruz River. No fish were collected at any of the sites for this study. Ten invertebrate taxa were collected and identified to the lowest practical taxonomic level, generally the species level. Organisms from two cladoceran genera were also collected at these sites. These organisms are likely transients from the WWTP effluent. Along with the survey results, this report also presented a summary of flow history and fish survey records from the Santa Cruz River and its tributaries. This historical data ranges from the mid-1800s to the early 1900s, and lists six species collected in the Santa Cruz River within this time frame: *Agosia chrysogaster*, *Catasomus clarki*, *Catostomus insignis*, *Gila robusta*, *Poeciliopsis occidentalis*, and *Cyprinus carpio*. All fish species, except *Cyprinus carpio*, are considered to be native species in this area (HLA 1986). HLA (1986) goes on to state that according to historical records, the river was completely dry through the Tucson area by 1950, with the Rogers Road WWTP returning a perennial source of water to the river in 1977.

The Arizona Game and Fish Department ([AGFD] 1987) surveyed fish at sites below the Rogers Road WWTP in 1987. Three introduced species of fish were collected at one of the sites. Information about specific site locations and methods were not documented in this letter to the U.S. EPA.

ADEQ (1990) conducted two invertebrate and zooplankton surveys in October 1990 at sites located downstream of the Rogers Road WWTP. The first surveying effort documents the presence of *Daphnia* in small numbers at one of the sites, probably coming from the treatment plant. The following sampling effort resulted in five additional invertebrate taxa being collected, most of which were identified at the genus level.

U.S. Geological Survey ([USGS] 1996) documents the results of invertebrate and fish surveys performed in January 1996 as part of the Central Arizona Basins Study on the NAWQA website. Aquatic biota were collected from a location referred to as the “Santa Cruz River at Cortaro, AZ,” site (also noted to be below the Rogers Road WWTP). Nine invertebrate taxa, mainly identified at the family or genus level, and one introduced fish species, *Gambusia affinis*, was collected. The family level invertebrate data were used in a USGS study on aquatic invertebrate community characteristics and chlorophyll levels in effluent-dependent and non-effluent dependent streams (Gebler 1998).

HLA (1997) conducted fish and invertebrate sampling in April 1997 at seven sites on the Santa Cruz River downstream of the WWTP. These surveys were intended to update their findings from ten years previous (HLA 1986). Only one introduced fish species, *Gambusia affinis*, was collected. Eleven invertebrate taxa were collected and identified at the order or family level.

As part of the Arid West Water Quality Research Project (2002), URS Corporation and CDM, Inc. collected invertebrate data in May 2000 as part of a Habitat Characterization Study. From the four sites located downstream of the Rogers Road WWTP, six taxa were collected and identified in the field, usually to the family level or higher. Cladocerans were also collected, probably transient organisms from the WWTP effluent.

Walker *et al.* (2005) conducted invertebrate and algae surveys at two sites downstream of the Rogers Road WWTP in June 2003 and February 2004 as part of a study examining the nutrient and community variables of effluent-dependent streams in Arizona. Seven invertebrate taxa were collected and identified to family or genus level.

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TABLE 5: Invertebrate and fish taxa reported from studies of the effluent-dependent segment of the Santa Cruz River Below the Roger Road WWTP near Tucson.

Phylum/ Division	Class	Order	Family	Genus	Species	Harding Lawson 1986	AGFD 1987	ADEQ 1990	USGS 1996	Harding Lawson 1997	URS and CDM 2002	Walker et al. 2005
Invertebrates												
Cnidaria	Hydrozoa	Hydroida	Hydridae	<i>Hydra</i>	<i>americana</i>	X						
Nemertea										X		
Annelida	Clitellata (Subclass Oligocheata)							X			X	
		Haplotaxida	Naididae						X			
			Tubificidae						X			X
Arthropoda	Branchiopoda	Diplostraca*									X	
			Bosminidae	<i>Bosmina</i>	sp.	X						
			Daphniidae	<i>Daphnia</i>	sp.			X				
			Moinidae	<i>Moina</i>	sp.	X						
	Insecta	Collembola							X	X		
		Ephemeroptera	Baetidae								X	
		Odonata	Coenagrionidae	<i>Ischnura</i>	sp.			X				
		Plecoptera	Chloroperlidae	<i>Sweltsa</i>	sp.	X						
		Hemiptera								X	X	
			Belostomatidae	<i>Belostoma</i>	sp.			X				
			Corixidae									X
				<i>Pseudocorixa</i>	<i>beameri</i>	X						
			Gerridae	<i>Gerris</i>	sp.	X						
		Megaloptera								X	X	
		Coleoptera								X	X	
			Elmidae	<i>Heterelmis</i>	<i>glaber</i>	X						
			Hydrophilidae	<i>Tropisternus</i>	sp.	X						
			Hydroscaphidae	<i>Hydroscapha</i>	<i>natans</i>					X		
			Noteridae	<i>Pronoterus</i>	sp.	X						
		Trichoptera								X		
		Diptera	Ceratopogonidae						X			
			Chironomidae					X	X	X	X	
			Subfamily: Chironominae						X			
				<i>Chironomus</i>	sp.	X		X	X			X

TABLE 5: Invertebrate and fish taxa reported from studies of the effluent-dependent segment of the Santa Cruz River Below the Roger Road WWTP near Tucson.

Phylum/ Division	Class	Order	Family	Genus	Species	Harding Lawson 1986	AGFD 1987	ADEQ 1990	USGS 1996	Harding Lawson 1997	URS and CDM 2002	Walker <i>et al.</i> 2005
			Subfamily: Orthoclaadiinae	<i>Cricotopus</i>	<i>bicinctus gr.</i>							
				<i>Eukiefferiella</i>	sp.							X
			Culicidae	<i>Culex</i>	sp.				X			
			Dolichopodidae							X		
			Psychodidae									X
				<i>Pericoma</i>	sp.							X
				<i>Pericoma/ Telmatoscopus</i>	sp.				X			
				<i>Psychoda</i>	sp.	X						
			Simuliidae							X		
			Syrphidae							X		
			Tabanidae	<i>Tabanus</i>	sp.	X						
			Tipulidae	<i>Ormosia</i>	sp.							X
Fish												
Chordata	Actinopterygii	Cyprinodontiformes	Poeciliidae	<i>Gambusia</i>	<i>affinis</i>		X		X	X		
		Perciformes	Centrarchidae	<i>Lepomis</i>	<i>cyanellus</i>		X					
		Siluriformes	Ictaluridae	<i>Ameiurus</i>	<i>melas</i>		X					

* Diplostracans (cladocerans) are generally considered to be transient organisms when collected in lotic systems.

** Indicates native fish species. All other listed species are non-native fish.

Salt/Gila Rivers Near Phoenix, Arizona

Data on the fish and/or invertebrate species present in the stream reaches of the Salt/Gila rivers below the 91st Avenue Wastewater Treatment Plant (WWTP) in Phoenix, Arizona, were collated from 12 sources ranging in date from 1961 to 2000. When all data were combined, 44 invertebrate taxa and 40 fish taxa were recorded during this period (Table 6). The invertebrate taxa identified were comprised of 22 invertebrate families. Of the 40 fish species collected, 14 were considered native species, with the remaining 26 being introduced species. The latest study to document the presence of native fish species in this reach was conducted in 1985 (USFWS 1985). Fish and/or invertebrate taxa collected from the various sources are documented in Table 6. Brief descriptions of the sources are listed below.

Miller (1961) and Marsh and Minckley (1982) summarize historical records of fish collected in the Salt/Gila rivers in the Phoenix metropolitan area dating back to the late 1800s. Miller (1961) collected records of 20 fish species (including 13 native fish species), noting a general shift from native to introduced species occurring around the 1940s. Minckley and Marsh collected records of 37 fish species, 14 of which were native species (1982).

Greeley and Hansen (1984) collected fish and invertebrate data to support development of site-specific water quality criteria in the Salt/Gila rivers below the WWTP. The four invertebrate taxa collected were identified at the genus level or higher, with the five fish taxa identified at the species level. None of the fish collected were native species.

The U.S. Fish and Wildlife Service ([USFWS] 1985) collected 1 native and 15 introduced fish species from a single site below the confluence of the Salt/Gila rivers and the WWTP in 1985. The purpose of this study was to recapture *Xyrauchen texanus* (razorback suckers) that had been reintroduced into this section of the river in 1983 by the USFWS and the Arizona Game and Fish Department (AGFD).

The U.S. Environmental Protection Agency ([U.S. EPA] 1987) collected fish from four sites on the Gila and Salt rivers. Two sites were located downstream of the 91st Avenue WWTP. From these two sites, two unidentified *Tilapia* species plus three other introduced fish species were collected.

Parkhurst (1990) provided a summary of fish, invertebrate, and zooplankton records for sites on the Salt/Gila rivers below the 91st Avenue WWTP. These data were collected in order to support a limited aquatic life use category for these sections of the two rivers. A limited number of invertebrates from three taxa were collected, as well as one cladoceran taxa. Identification was generally at the genus level. A total of nine introduced fish species were collected. With the exception of the single cladoceran species collected, the results of the zooplankton data were not included in Table 6 as most zooplankton species are considered to be transient in lotic systems and, as such, were not the focus of this study.

The Arizona Department of Environmental Quality ([ADEQ] 1990) conducted two surveys of the macroinvertebrate and zooplankton communities at sites below the 91st Avenue WWTP. Again, rotifer, copepod, and ostracod data are not included in Table 6 for either survey. The purpose of these surveys was to support the development of water quality criteria for protection of resident aquatic organisms in effluent dominated streams. Four sites were sampled, resulting in five invertebrate taxa being identified at the genus level or higher, as well as two cladoceran taxa, presumably transients from the WWTP effluent.

ADEQ (1994) collected a single macroinvertebrate sample from a site below the WWTP, resulting in four invertebrate taxa being collected and identified at the genus level or higher. This sampling was done as part of a larger study focusing on the identification of macroinvertebrate taxa present in Arizona's effluent-dependent streams.

U.S. Geological Survey ([USGS] 1995) documented the results of fish and invertebrate surveys done in November 1995 at a reach of the Salt River immediately downstream of the 91st Avenue WWTP. These surveys were performed as part of the NAWQA Central Arizona Basins Study, and the results are documented on the NAWQA website. Eleven invertebrate taxa (identified to the lowest practical taxonomic level, generally the family level) and three introduced fish species were collected. The invertebrate family data from this location was incorporated into a 1998 USGS report comparing aquatic invertebrate community characteristics and chlorophyll levels in effluent-dependent and non-effluent dependent streams in Arizona (USGS 1998).

CH₂M Hill, Logan, Simpson, & Dye, and Ecoplan Associates (1997) reported the results of fish and invertebrate surveys conducted by the City of Phoenix (COP) in 1997 at a single site below the 91st Avenue

WWTP. These surveys were conducted as part of the baseline ecological characterization of the Salt/Gila rivers. Zooplankton data were also collected, but, as noted in the previous studies, only the cladoceran data are included in Table 6. Twelve invertebrate taxa were identified, generally at the family level, and 13 introduced fish species were collected. Additionally, five cladoceran taxa were collected, again probably transients from the WWTP effluent.

The COP (1998) reports the results of an unpublished fish survey conducted in 1998. Three sites were sampled that were located below the 91st Avenue WWTP; however, two samples were collected from adjacent ponds with only one sample collected from the river itself. Thirteen introduced fish species were collected from that site.

As part of the Arid West Water Quality Research Project (2002), URS Corporation and CDM, Inc. collected invertebrate data from four sites on the Salt and Gila River downstream of the 91st Avenue WWTP in May 2000. These data were collected in order to be included in a Habitat Characterization Report. Identification was done in the field; hence, the 13 taxa were identified at only the family level or higher.

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TABLE 6: Invertebrate and fish taxa reported from studies of the effluent-dependent segments of the Salt and Gila Rivers Below the City of Phoenix 91st Avenue WWTP.

Phylum or Division	Class	Order	Family	Genus	Species	Miller 1961	Marsh & Minckley 1982	Greeley & Hansen 1984	USFWS 1985	EPA 1987	Parkhurst 1990	ADEQ 1990	ADEQ 1994	USGS 1995	CH2MH ILL 1997	COP 1998	URS and CDM 2002
Invertebrates																	
Nematoda													X	X			
Platyhelminthes	Turbellaria																X
Annelida	Clitellata (Subclass Hirudinea)														X		X
		Clitellata (Subclass Oligocheata)											X	X		X	
			Haplotaxida	Naididae										X			
			Tubificidae											X			
Mollusca	Gastropoda													X	X		X
		Basommatophora	Physidae	<i>Physa</i>	sp.			X			X	X					
Arthropoda	Arachnida	Acari												X			
	Branchiopoda	Diplostraca*													X		
			Chydoridae	<i>Alona</i>	<i>costata</i>										X		
				<i>Chydorus</i>	<i>sphaericus</i>										X		
				<i>Kurzia</i>	<i>latissima</i>										X		
			Daphnidae	<i>Ceriodaphnia</i>	sp.							X					
			Macrothricidae	<i>Macrothrix</i>	<i>rosea</i>										X		
			Moinidae	<i>Moina</i>	sp.							X					
					<i>micrurus</i>						X						
	Malacostraca	Amphipoda															X
	Insecta	Collembola										X					
		Ephemeroptera	Baetidae												X		X
				<i>Callibaetis</i>	sp.								X				
			Caenidae														X
		Odonata (Zygoptera)													X		
			Calopterygidae														X
			Coenagrionidae	<i>Argia</i>	sp.						X						
				<i>Enallagma</i>	sp.			X									
				<i>Ischnura</i>	sp.							X			X		
			Lestidae	<i>Archilestes</i>	sp.										X		
		Hemiptera	Belostomatidae														X
			Corixidae														X
			Veliidae														X
		Hymenoptera													X		
		Coleoptera	Elmidae												X		
			Hydrophilidae														X
		Trichoptera	Hydroptilidae												X		
		Diptera	Chironomidae										X	X	X		X
			Subfamily: Chironominae											X			
				<i>Chironomus</i>	sp.			X			X	X		X			
				<i>Rheotanytarsus</i>	sp.			X									
			Subfamily: Orthoclaadiinae	<i>Cricotopus</i>	<i>bicinctus</i> gr.									X			
				<i>Cricotopus/Orthocladus</i>	sp.									X			
			Muscidae														
			Psychodidae											X			
			Simuliidae												X		

TABLE 6: Invertebrate and fish taxa reported from studies of the effluent-dependent segments of the Salt and Gila Rivers Below the City of Phoenix 91st Avenue WWTP.

Phylum or Division	Class	Order	Family	Genus	Species	Miller 1961	Marsh & Minckley 1982	Greeley & Hansen 1984	USFWS 1985	EPA 1987	Parkhurst 1990	ADEQ 1990	ADEQ 1994	USGS 1995	CH2MH ILL 1997	COP 1998	URS and CDM 2002
Fish																	
Chordata	Actinopterygii	Clupeiformes	Clupeidae	<i>Dorosoma</i>	<i>petenense</i>		X		X						X	X	
		Cypriniformes	Catostomidae	<i>Catostomus</i>	<i>clarkii</i> **	X	X										
					<i>insignis</i> **	X	X										
					<i>latipennis</i> **	X	X										
				<i>Xyrauchen</i>	<i>texanus</i> **	X	X		X								
			Cyprinidae	<i>Agosia</i>	<i>chrysogaster</i> **	X	X										
				<i>Carassius</i>	<i>auratus</i>		X	X	X		X				X	X	
				<i>Cyprinella</i>	<i>lutensis</i>			X	X		X				X	X	
				<i>Cyprinus</i>	<i>carpio</i>	X	X		X						X	X	
				<i>Gila</i>	<i>elegans</i> **	X	X										
					<i>intermedia</i> **	X	X										
					<i>robusta</i> **	X	X										
				<i>Meda</i>	<i>fulgida</i> **	X	X										
				<i>Notemigonus</i>	<i>crysoleucus</i>		X										
				<i>Pimephales</i>	<i>promelas</i>		X			X							
				<i>Plagopterus</i>	<i>argentissimus</i> **	X	X										
				<i>Ptychocheilus</i>	<i>lucius</i> **		X										
				<i>Rhinichthys</i>	<i>cobitis</i>		X										
					<i>osculus</i> **	X	X										
		Cyprinodontiformes	Cyprinodontidae	<i>Cyprinodon</i>	<i>macularis</i> **	X	X										
			Poeciliidae	<i>Gambusia</i>	<i>affinis</i>	X	X		X	X	X			X	X	X	
				<i>Poecilia</i>	sp.			X							X		
					<i>latipinna</i>		X	X	X	X	X				X	X	
					<i>mexicana</i>		X										
				<i>Poeciliopsis</i>	<i>occidentalis</i> **	X	X										
				<i>Xiphophorus</i>	<i>variatus</i>		X										
		Perciformes	Centrarchidae	<i>Lepomis</i>	<i>cyanelus</i>	X	X				X				X	X	
					<i>macrochirus</i>	X	X		X						X	X	
					<i>microlophus</i>		X										
				<i>Micropterus</i>	<i>salmoides</i>		X		X						X	X	
				<i>Pomoxis</i>	<i>nigromaculatus</i>	X	X		X							X	
			Cichlidae	<i>Oreochromis</i>	<i>aurea</i>		X		X						X		
					<i>mossambicus</i>		X				X			X			
				<i>Tilapia</i>	sp.			X		X					X	X	
					<i>zillii</i>		X				X				X		
			Moronidae	<i>Morone</i>	<i>mississippiensi</i>		X		X								
		Siluriformes	Ictaluridae	<i>Ameiurus</i>	<i>melas</i>	X	X										
					<i>natalis</i>		X		X		X					X	
				<i>Ictalurus</i>	<i>puntatus</i>		X		X		X					X	
				<i>Pylodictis</i>	<i>olivaris</i>	X	X		X								

* Diplostracans (cladocerans) are generally considered to be transient organisms when collected in lotic systems.

** Indicates native fish species. All other listed species are non-native fish.

Fountain Creek Near Colorado Springs, Colorado

Data on fish and/or invertebrate species found in the section of Fountain Creek below the Las Vegas Avenue WWTP in Colorado Springs, Colorado, were collated from eight sources dated from 1980 to 2004 (Table 7). As data were collected consistently by several of these sources throughout these years, this data set provides one of the more complete historical records of fish and invertebrate species found in arid west effluent-dependent stream sites. When the sources were combined, 253 invertebrate taxa from 73 families were identified from samples collected at these sites. Nineteen fish species were also collected, with 12 of those species being native and the remaining eight being introduced species. Fish and/or invertebrate taxa collected from each source are documented in Table 7 with brief descriptions of those sources listed below.

Colorado Springs Wastewater Division ([CSWD] 1980) reported the results of fish and invertebrate surveys done on seven sites on Fountain Creek, two of which were upstream of the Las Vegas Avenue WWTP and five of which were downstream of the plant. The surveys were conducted monthly in 1979 and 1980 to help determine beneficial use classifications for Fountain Creek and Monument Creek. Invertebrate surveys resulted in 42 invertebrate taxa being collected, most of which were identified to species or genus level. Fish surveys resulted in seven species of fish being collected. Five of the seven species of fish were native species.

CSWD conducted fish surveys in Fountain Creek in 1979-1981 that are included in CSWD (1989). Eight native and three introduced fish species were collected during these surveys.

U.S. Geological Survey ([USGS] 1989) collected benthic invertebrates quarterly from 1985 to 1988 at three sites on Fountain Creek. Two of the sites were located upstream of the Las Vegas Avenue WWTP, with one site located downstream of the plant. This study focused on sediment transport in Fountain Creek and its effect on benthic invertebrates. Fifty-one invertebrate taxa were identified to the lowest practical taxonomic level, frequently to the species level.

CSWD contracted with Chadwick & Associates, Inc. in 1989 to conduct fish and macroinvertebrate surveys from four sites within the relevant section of Fountain Creek. These data were collected as part of the UAA Update for Fountain Creek. Twenty-four invertebrate taxa were collected and identified to the

lowest practical taxonomic level, generally species or genus. Eleven fish species, including seven native species, were also collected.

Nesler *et al.* (1999) conducted fish surveys for the Colorado Division of Wildlife in 1994 and 1995 from ten sites downstream of the Las Vegas Avenue WWTP. Eleven fish species were collected, nine of which were species native to Fountain Creek.

As part of the Arid West Water Quality Research Project (2002), URS Corporation and CDM, Inc. collected invertebrate data in April 2000 for a Habitat Characterization Study. Five sites were included in the study; four of these sites were located downstream from the WWTP. Thirteen invertebrate taxa were collected from these sites. Identification was done in the field to the lowest practical taxonomic level, generally the family level.

USGS and CSWD (2004) surveyed invertebrate populations in spring and fall at seven Fountain Creek sites downstream of the Las Vegas Avenue WWTP from 1998 to 2004. The invertebrate surveys resulted in 201 invertebrate taxa being identified, most to the genus or species level.

USGS (2004) conducted fish surveys in 2003 and 2004 at five sites on the effluent-dominated portion of Fountain Creek. Ten native and four introduced species were collected.

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TABLE 7. Invertebrate and fish taxa reported from studies of the effluent-dependent segment of Fountain Creek Below the Las Vegas Avenue WWTP.

Phylum or Division	Class	Order	Family	Genus	Species	CSWD 1980	CSWD 1981	USGS 1989	CSWD 1989	Nesler et al. 1999	URS and CDM 2002	USGS and CSWD 2004	USGS 2004
Invertebrates													
Cnidaria	Hydrozoa	Hydroida						X					
Nematoda						X						X	
Nematomorpha												X	
Nemertea												X	
Platyhelminthes	Turbellaria										X		
		Tricladida	Planariidae	<i>Girardia</i>	sp.							X	
					<i>tigrina</i>							X	
				<i>Polycelis</i>	<i>coronata</i>			X				X	
Annelida	Clitellata (Subclass Hirudinea)										X	X	
		Arhynchobdellidae	Erpobdellida	<i>Erpobdella</i>	<i>punctata</i>							X	
				<i>Moorebdella</i>	<i>microstema</i>							X	
		Rhynchobdellida	Glossiphoniidae	<i>Helobdella</i>	<i>stagnalis</i>							X	
	Clitellata (Subclass Oligocheata)								X		X	X	
		Haplotaxida	Enchytraidae									X	
			Lumbricidae	<i>Eiseniella</i>	<i>tetraedra</i>	X		X				X	
			Naididae	<i>Homochaeta</i>	<i>naidina</i>							X	
				<i>Nais</i>	sp.							X	
					<i>behningi</i>							X	
					<i>bretscheri</i>							X	
					<i>communis</i>							X	
					<i>communis/variabilis</i>							X	
					<i>elinguis</i>							X	
					<i>pseudobtusa</i>							X	
				<i>Ophidonais</i>	sp.	X						X	
					<i>serpentina</i>							X	
				<i>Pristina</i>	sp.							X	
					<i>longiseta</i>							X	
				<i>Stephansoniana</i>	<i>tandyi</i>							X	
				<i>Uncinai</i>	<i>uncinata</i>				X			X	
			Tubificidae						X			X	
				<i>Ilyodrilus/Tubifex</i>	sp.							X	
				<i>Limnodrilus</i>	sp.	X		X				X	
					<i>hoffmeisteri</i>				X			X	

TABLE 7. Invertebrate and fish taxa reported from studies of the effluent-dependent segment of Fountain Creek Below the Las Vegas Avenue WWTP.

Phylum or Division	Class	Order	Family	Genus	Species	CSWD 1980	CSWD 1981	USGS 1989	CSWD 1989	Nesler et al. 1999	URS and CDM 2002	USGS and CSWD 2004	USGS 2004
				<i>Leucotrichia</i>	sp.							X	
			Leptoceridae	<i>Nectopsyche</i>	sp.							X	
			Lymniphilidae									X	
				<i>Hesperophylax</i>	sp.							X	
				<i>Limnephilus/Philartus</i>	sp.							X	
			Rhyacophilidae	<i>Rhyacophila</i>	sp.							X	
		Diptera							X			X	
			Ceratopogonidae								X	X	
				<i>Atrichopogon</i>	sp.							X	
				<i>Ceratopogon</i>	sp.							X	
				<i>Culicoides</i>	sp.							X	
				<i>Dasyhelea</i>	sp.							X	
				<i>Forcipomyia</i>	sp.							X	
				<i>Mallochohelea</i>	sp.							X	
				<i>Palpomyia cx.</i>	sp.	X		X					
			Chironomidae						X		X		
			Subfamily: Chironominae		sp.							X	
				<i>Chironomus</i>		X		X					
				<i>Cryptochironomus</i>	sp.	X		X				X	
				<i>Dicrotendipes</i>	sp.	X						X	
				<i>Einfeldia</i>	sp.								
				<i>Glyptotendipes</i>	sp.				X			X	
				<i>Micropsectra</i>	sp.			X				X	
				<i>Microtendipes</i>	sp.	X						X	
				<i>Paracladopelma</i>	sp.				X			X	
				<i>Paralauterborniella</i>	sp.							X	
				<i>Paratanytarsus</i>	sp.			X				X	
				<i>Paratendipes</i>	sp.							X	
				<i>Phaenopsectra</i>	sp.			X				X	
				<i>Polypedilum</i>	sp.							X	
					<i>fallax</i> gr.	X						X	
				<i>Rheotanytarsus</i>	sp.	X							
				<i>Saetheria</i>	sp.							X	
				<i>Stictochironomus</i>	sp.							X	
				<i>Tanytarsus</i>	sp.							X	
				<i>Tribelos</i>	sp.	X							
			Subfamily: Diamesinae		sp.							X	
				<i>Diamesa</i>				X					

TABLE 7. Invertebrate and fish taxa reported from studies of the effluent-dependent segment of Fountain Creek Below the Las Vegas Avenue WWTP.

Phylum or Division	Class	Order	Family	Genus	Species	CSWD 1980	CSWD 1981	USGS 1989	CSWD 1989	Nesler et al. 1999	URS and CDM 2002	USGS and CSWD 2004	USGS 2004
				<i>Paramerina</i>	sp.							X	
				<i>Procladius</i>	sp.	X							
				<i>Radotanypus</i>	sp.							X	
				<i>Thienemannimyia</i> gr.	sp.			X	X				
			Culicidae	<i>Culex</i>	sp.							X	
			Dixidae	<i>Dixella</i>	sp.			X					
			Dolichopodidae									X	
				<i>Hydrophorus</i>	<i>agalma</i>	X							
			Empididae	<i>Chelifera</i>	sp.							X	
				<i>Clinocera</i>	sp.							X	
				<i>Hemerodromia</i>	sp.			X				X	
				<i>Neoplasta</i>	sp.							X	
			Ephyridae									X	
				<i>Scatella</i>	sp.							X	
			Muscidae									X	
				<i>Limnophora</i>	sp.	X						X	
			Psychodidae									X	
				<i>Pericoma</i>	sp.			X				X	
				<i>Psychoda</i>	sp.	X						X	
			Simuliidae									X	
				<i>Prosimulium</i>	sp.							X	
				<i>Simulium</i>	sp.				X			X	
					<i>articum</i>			X					
					<i>vittatum</i> cx.			X					
			Stratiomyidae	<i>Allognosta</i>	sp.							X	
				<i>Caloparyphus</i>	sp.							X	
				<i>Euparypus</i>	sp.							X	
				<i>Nemotelus</i>	sp.			X					
			Tabanidae									X	
				<i>Tabanus</i>	sp.			X				X	
			Tanyderidae									X	
				<i>Protanyderus</i>	sp.							X	
					<i>margarita</i>			X				X	
			Tipulidae						X		X		
				<i>Antocha</i>	sp.							X	
				<i>Erioptera</i>	sp.	X		X				X	
				<i>Gonomyia</i>	sp.							X	
				<i>Hexatoma</i>	sp.	X						X	

TABLE 7. Invertebrate and fish taxa reported from studies of the effluent-dependent segment of Fountain Creek Below the Las Vegas Avenue WWTP.

Phylum or Division	Class	Order	Family	Genus	Species	CSWD 1980	CSWD 1981	USGS 1989	CSWD 1989	Nesler et al. 1999	URS and CDM 2002	USGS and CSWD 2004	USGS 2004
				<i>Limonia</i>	sp.							X	
				<i>Ormosia</i>	sp.			X				X	
				<i>Tipula</i>	sp.			X				X	
Fish													
Chordata	Actinopterygii	Cypriniformes	Catostomidae	<i>Catostomus</i>	<i>catostomus</i>				X				X
					<i>commersonii</i> **		X		X	X			X
			Cyprinidae	<i>Campostoma</i>	<i>anomalum</i> **	X	X		X	X			X
				<i>Cyprinellus</i>	<i>lutrensis</i> **								X
				<i>Cyprinus</i>	<i>carpio</i>								X
				<i>Notropis</i>	<i>stramineus</i> **		X		X	X			X
				<i>Pimephales</i>	<i>promelas</i> **	X	X		X	X			X
				<i>Platygobio</i>	<i>gracilis</i> **	X	X		X	X			X
				<i>Rhinichthys</i>	<i>cataractae</i> **				X	X			X
				<i>Semotilus</i>	<i>atromaculatus</i>	X	X		X				X
		Cyprinodontiformes	Fundulidae	<i>Fundulus</i>	<i>zebrinus</i> **	X	X						X
		Gasterosteiformes	Gasterosteidae	<i>Culaea</i>	<i>inconstans</i>	X	X		X	X			X
		Perciformes	Centrarchidae	<i>Lepomis</i>	<i>cyaneus</i> **	X	X		X	X			
					<i>macrochirus</i>					X			
				<i>Micropterus</i>	<i>dolomieu</i>		X						
			Percidae	<i>Etheostoma</i>	<i>cragini</i> **		X			X			X
			Salmonidae	<i>Salmo</i>	<i>trutta</i>				X				
		Siluriformes	Ictaluridae	<i>Ameiurus</i>	<i>melas</i> **								X
				<i>Ictalurus</i>	<i>punctatus</i> **					X			

** Indicates native fish species. All other listed species are non-native fish.

*** Indicates that species identification was uncertain.

South Platte River Near Denver, Colorado

Data on fish and/or invertebrate species found in the section of the South Platte River below the Metro Wastewater Reclamation District's WWTP in Denver, Colorado, were collated from nine sources dated from 1982 to 2004 (Table 8). Several of these sources sampled consistently at multiple sites on the South Platte River throughout this time period. Therefore, the compilation of these sources provided a comprehensive list of fish and invertebrate species found in an effluent-dependent stream reach. The species list for the South Platte River consists of 192 invertebrate taxa from 60 families, and 38 fish species, 26 of which are considered native species. The fish and/or invertebrate species collected in each study are documented in Table 8, with brief descriptions of those studies listed below.

Propst (1982) conducted fish surveys on the South Platte River from 1978 to 1980 as part of his doctoral dissertation. He collected 31 fish species, including 25 native fish species. The data from Propst's dissertation was obtained from a review of the literature conducted by Camp Dresser & McKee, The Cadmus Group, Habitech, Inc., and Western EcoSystems Technology, Inc. ([CDM *et al.*] 1994a) and includes only limited sampling, specifically in the segment downstream of the WWTP.

Goettl (1982) surveyed fish populations in the South Platte River for the Colorado Division of Wildlife (CDOW) to determine the possibility of establishing a sport fishery in this river. He collected 22 native and eight introduced fish species. These data were also obtained from the literature review done by CDM *et al.* (1994a).

The Metro Wastewater Reclamation District ([MWRD] 2000) and CDM *et al.* (1994a) record the results of fish and invertebrate surveys at sites on the South Platte River conducted in 1986 through 1998. The fish species listed in Table 8 are compiled from both sources, as both referred to surveys conducted by the MWRD and had overlapping time frames. The literature review compiled by CDM *et al.* (1994a) records the results of fish surveys conducted by the MWRD from 1986 through 1991, while MWRD (2000) documents unpublished results of MWRD fish surveys conducted in 1988 through 1998. These two sources together listed 24 fish species collected, 17 of which are native species. Invertebrate data was not included in CDM *et al.* (1994a), and is documented solely by MWRD (2000). The invertebrate surveys included in

this source were conducted from 1986 through 1993. Ninety invertebrate taxa were collected and identified to the lowest practical taxonomic level, generally the genus or species level.

The CDOW (1992) conducted fish surveys of the South Platte River in 1989-1990 in which 14 fish species were collected. Nine of the 14 species were native fish species. These data were also referenced in the literature review done by CDM *et al.* (1994a), which cites that the information was relayed via a personal communication with the CDOW.

CDM *et al.* (1993) collected fish and invertebrate data from sites on the South Platte River in 1992 as part of Phase 1 of the South Platte River Segment 15 Studies conducted for the MWRD. Five sites were sampled for the study, with four of the sites being located downstream of the WWTP. Table 8 includes the results from the downstream effluent-dependent sites only. The 99 invertebrate taxa collected were identified generally to genus or species. A single cladoceran species was also collected, probably transient organisms from the WWTP effluent. Of the 15 fish species collected, 10 were native species.

CDM *et al.* (1994b) recorded the results of fish surveys done in June 1994 as part of Phase 2 of the South Platte River Segment 15 Studies. Fish were collected from seven sites, six of which were downstream of the WWTP. Eight native and six introduced fish species were collected from the downstream sites.

U.S. Geological Survey ([USGS] 1995) documents the results of invertebrate and fish surveys performed in August 1993, August 1994, and September 1995 as part of NAWQA's South Platte River Basin study. These results can be found on the NAWQA website. Samples were collected at sites near Fort Lupton and Henderson, Colorado. Forty-seven invertebrate taxa were collected and identified to the lowest practical taxonomic level. Thirteen fish species, including seven native species, were also collected.

MWRD (2004) data includes the unpublished results of invertebrate surveys performed in 1994 through 2004 at sites on the South Platte River below the WWTP and fish surveys performed in 1999 through 2004. The invertebrates were collected by the MWRD and sent to Chadwick & Associates, Inc. for identification. The decade of sampling resulted in 88 invertebrates collected and identified, generally to genus or species level. Twenty-five species of fish were collected, 15 of which were native species.

As part of the Arid West Water Quality Research Project (2002), URS Corporation and CDM, Inc. collected invertebrate data from this section of the South Platte River in April 2000 for a Habitat Characterization Study. Five sites were included in the study; four of which were located downstream from the WWTP. Ten invertebrate taxa were collected from these sites. Identification was done in the field to the lowest practical taxonomic level, generally the family level. Cladocerans were also collected from these sites, again presumably transients from the WWTP effluent.

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Phylum or Division	Class	Order	Family	Genus	Species	Propst 1982	Goettl 1982	MWRD 2000 and CDM 1994a	CDOW 1992	CDM et al. 1993	CDM et al. 1994b	USGS 1995	Denver MWRD 2004	URS and CDM 2002
Invertebrates														
Nematoda								X		X		X	X	
Platyhelminthes	Turbellaria											X		X
		Tricladida	Planariidae	<i>Girardia</i>	sp.			X		X			X	
					<i>tigrina</i>			X						
		Macrostomida	Macrostomidae	<i>Macrostomum</i>	sp.			X		X				
Annelida	Citellata (Subclass Hirudinea)													X
		Arhynchobdellidae	Erpobdellidae									X		
				<i>Dina</i>	<i>dubia</i>								X	
				<i>Erpobdella</i>	<i>punctata</i>			X		X			X	
				<i>Mooreobdella</i>	<i>microstoma</i>			X		X			X	
		Rhynchobdellida	Glossiphoniidae					X		X				
				<i>Gloiobdella</i>	<i>elongata</i>			X		X				
				<i>Helobdella</i>	<i>fusca</i>			X					X	
					<i>stagnalis</i>			X		X			X	
	Citellata (Subclass Oligocheata)							X		X				X
		Haplotaxida	Enchytraidae									X	X	
			Lumbricidae	<i>Eiseniella</i>	<i>tetraedra</i>			X		X			X	
			Naididae									X		
				<i>Nais</i>	sp.								X	
					<i>bretscheri</i>								X	
				<i>Ophidonais</i>	<i>serpentina</i>								X	
				<i>Pristina</i>	sp.								X	
				<i>Uncinaxis</i>	<i>uncinata</i>			X						
			Tubificidae					X				X	X	
				<i>Ilyodrilus/Tubifex</i>	sp.								X	
				<i>Isochaetides</i> ***	sp.								X	
				<i>Limnodrilus</i>	sp.			X		X			X	
					<i>hoffmeisteri</i>			X						
Mollusca	Gastropoda													X
		Basommatophora	Ancylidae	<i>Ferrissia</i>	sp.			X		X			X	
			Physidae	<i>Physa</i>	sp.			X		X		X	X	
				<i>Physella</i>	sp.			X						
			Planorbidae	<i>Gyraulus</i>	sp.			X		X				
	Bivalvia	Veneroidea	Corbiculidae	<i>Corbicula</i>	fluminea								X	
Arthropoda	Arachnida	Acari						X		X		X		X
			Hygrobatidae	<i>Atractides</i>	sp.								X	
			Sperchontidae	<i>Sperchon/Sperchonopsis</i>	sp.								X	
	Branchiopoda	Diplostraca*												X
			Daphniidae	<i>Daphnia</i>	sp.					X				

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	Malacostraca	Amphipoda	Gammaridae	<i>Gammarus</i>	<i>lacustris</i>			X		X		X	X	
			Hyalidae	<i>Hyalina</i>	<i>azteca</i>			X				X	X	
		Decapoda	Cambaridae										X	
		Isopoda												X
			Asellidae	<i>Asellus</i>	sp.			X		X				
				<i>Caecidotea</i>	sp.			X		X		X	X	
					<i>intermedius</i>					X				
	Insecta	Ephemeroptera										X		
			Baetidae										X	X
				<i>Acentrella</i>	<i>insignificans</i>			X					X	
				<i>Baetis</i>	sp.			X		X				
					sp. B			X						
					<i>bicaudatus</i>			X		X			X	
					<i>tricaudatus</i>			X		X		X	X	
				<i>Callibaetis</i>	sp.								X	
				<i>Fallceon</i>	<i>quilleri</i>							X	X	
			Heptageniidae					X						
				<i>Epeorus</i>	sp.								X	
				<i>Heptagenia</i>	sp.			X						
			Caenidae	<i>Caenis</i>	sp.			X		X				
			Tricorythidae	<i>Tricorythodes</i>	sp.			X		X		X		
					<i>minutus</i>			X		X			X	
		Odonata (Anisoptera)	Aeshnidae	<i>Anax</i>	<i>junius</i>								X	
			Gomphidae	<i>Ophiogomphus</i>	sp.			X		X				
					<i>severus</i>								X	
			Libellulidae	<i>Libellula</i>	<i>subornata</i>								X	
				<i>Pantala</i>	<i>hymenaea</i>								X	
		Odonata (Zygoptera)	Calopterygidae	<i>Hetaerina</i>	sp.					X				
			Coenagrionidae					X		X			X	
				<i>Amphiagrion</i>	sp.					X				
				<i>Argia</i>	sp.			X		X			X	
				<i>Coenagrion/Enallagma</i>	sp.								X	
				<i>Enallagma</i>	sp.			X		X			X	
		Plecoptera								X				
			Nemouridae							X				
		Hemiptera	Corixidae	<i>Corisella</i>	sp.					X				
			Gerridae	<i>Gerris</i>	sp.			X		X				
			Notonectidae	<i>Notonecta</i>	sp.							X		
				<i>Microvelia</i>	sp.					X			X	
		Coleoptera	Carabidae					X						
			Dytiscidae	<i>Agabus</i>	sp.								X	
			Elmidae							X				

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				<i>Microtendipes</i>	sp.			X		X			X	
				<i>Parachironomus</i>	sp.								X	
				<i>Paratanytarsus</i>	sp.					X			X	
				<i>Phaenopsectra</i>	sp.			X					X	
				<i>Polypedilum</i>	sp.			X		X		X	X	
					<i>convictum</i> gr.							X		
					<i>illinoense</i> gr.							X		
				<i>Pseudochironomus</i>	sp.					X		X	X	
				<i>Rheotanytarsus</i>	sp.			X		X			X	
				<i>Saetheria</i>	sp.			X					X	
				<i>Tanytarsus</i>	sp.					X				
			Subfamily: Diamesinae	<i>Diamesa</i>	sp.								X	
			Subfamily: Orthocladinae							X		X	X	
				<i>Brillia</i>	sp.			X		X				
				<i>Cardiocladius</i>	sp.			X				X		
				<i>Cricotopus</i>	sp.			X		X		X	X	
					<i>bicintus</i> gr.					X		X	X	
					<i>cylindraceus</i>					X				
					<i>festivellus</i>			X		X				
					<i>fuscus</i>			X						
					<i>nostocicola</i>			X		X				
					<i>tremulus</i>			X		X				
					<i>trifascia</i>			X		X		X	X	
				<i>Cricotopus (Isocladius)</i>	<i>sylvestris</i>			X						
				<i>Cricotopus/Orthocladus</i>	sp.							X	X	
				<i>Eukiefferiella</i>	sp.			X		X		X	X	
					<i>claripennis</i> group sp. A							X		
					<i>devonica</i>					X				
					<i>psuedomontana</i>					X				
				<i>Hydrobaenus</i>	sp.								X	
				<i>Limnophyes</i>	sp.								X	
				<i>Nanocladius</i>	sp.			X				X	X	
				<i>Orthocladus</i>	sp.			X		X				
				<i>Orthocladus (Euorthocladus)</i>	sp.								X	
				<i>Parakiefferiella</i>	sp.								X	
				<i>Parametricnemus</i>	sp.			X		X				
				<i>Paraphaenocladus</i>	sp.			X					X	
				<i>Rheocricotopus</i>	sp.			X		X				
				<i>Synorthocladus</i>	sp.					X				
				<i>Thienemanniella</i>	sp.					X		X	X	
				<i>Tvetenia</i>	sp.							X		

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			Subfamily: Tanypodinae							X				
				<i>Conchapelopia/Thienemanimyia</i> gr.	sp.								X	
				<i>Larsia</i>	sp.					X				
				<i>Pentaneura</i>	sp.					X				
				<i>Procladius</i>	sp.			X		X				
				<i>Thienemanimyia</i> gr.	sp.			X		X		X		
			Culicidae	<i>Aedes</i>	sp.							X		
				<i>Culex</i>	sp.			X						
			Dolichopodidae										X	
			Empididae	<i>Chelifera</i>	sp.					X			X	
				<i>Hemerodromia</i>	sp.					X			X	
			Ephydriidae										X	
			Muscidae					X		X			X	
				<i>Limnophora</i>	sp.					X				
			Psychodidae										X	
				<i>Psychoda</i>	sp.			X						
			Ptychopteridae	<i>Bittacomorphella</i>	sp.			X						
			Sarcophagidae					X						
			Simuliidae									X		X
				<i>Prosimulium</i>	sp.			X		X				
				<i>Simulium</i>	sp.			X		X		X	X	
					vittatum cx.							X		
			Stratiomyidae					X						
				<i>Caloparyphus</i>	sp.								X	
			Tipulidae	<i>Gonomyia</i>	sp.								X	
				<i>Rhabdomastix</i>	sp.					X				
				<i>Tipula</i>	sp.			X		X			X	
Fish														
Chordata	Actinopterygii	Clupeiformes	Clupeidae	<i>Dorosoma</i>	<i>cepedianum</i> **	X	X							
		Cypriniformes	Catostomidae	<i>Carpoides</i>	<i>carpio</i> **	X	X							
				<i>Catostomus</i>	<i>catostomus</i> **	X	X	X	X	X	X	X	X	
					<i>commersonii</i> **	X	X	X	X	X	X	X	X	
			Cyprinidae	<i>Campostoma</i>	<i>anomalum</i> **	X	X	X						
				<i>Carassius</i>	<i>auratus</i>		X	X	X				X	
				<i>Cyprinellus</i>	<i>lutrensis</i> **	X	X							
				<i>Cyprinus</i>	<i>carpio</i>	X	X	X	X	X	X	X	X	
				<i>Hybognathus</i>	<i>hankinsoni</i> **	X								
					<i>placitus</i> **	X	X							
				<i>Luxilus</i>	<i>cornutus</i> **	X	X						X	
				<i>Notropis</i>	<i>dorsalis</i> **	X	X						X	
					<i>hudsonius</i>								X	
					<i>stramineus</i> **	X	X	X	X	X	X		X	

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				<i>Phenacobius</i>	<i>mirabilis</i> **	X	X							
				<i>Phoxinus</i>	<i>eos</i> **	X								
				<i>Pimephales</i>	<i>promelas</i> **	X	X	X	X	X	X	X	X	
				<i>Rhinichthys</i>	<i>cataractae</i> **	X	X	X		X	X	X	X	
				<i>Semotilus</i>	<i>atromaculatus</i> **	X	X	X		X		X	X	
		Cyprinodontiformes	Fundulidae	<i>Fundulus</i>	<i>sciadicus</i> **	X	X	X						
					<i>zebrinus</i> **	X	X	X	X				X	
			Poeciliidae	<i>Gambusia</i>	<i>affinis</i>			X	X	X	X	X	X	
		Gasterosteiformes	Gasterosteidae	<i>Culaea</i>	<i>inconstans</i> **	X	X	X	X	X	X	X	X	
		Perciformes	Centrarchidae	<i>Lepomis</i>	<i>cyaneus</i> **	X	X	X	X	X	X	X	X	
					<i>gibbosus</i>		X			X				
					<i>humilis</i> **	X	X	X					X	
					<i>macrochirus</i>	X							X	
				<i>Micropterus</i>	<i>dolomieu</i>							X	X	
					<i>salmoides</i>	X	X	X	X	X	X	X	X	
				<i>Pomoxis</i>	<i>annularis</i>		X	X			X		X	
					<i>nigromaculatus</i>	X	X	X	X		X	X	X	
			Percidae	<i>Etheostoma</i>	<i>exile</i> **	X		X	X					
					<i>nigrum</i> **	X	X	X			X		X	
				<i>Perca</i>	<i>flavescens</i>	X	X	X		X	X	X	X	
				<i>Sander</i>	<i>vitreus</i> **			X					X	
		Siluriformes	Ictaluridae	<i>Ameiurus</i>	<i>melas</i> **	X	X	X	X	X			X	
					<i>nebulosis</i>	X								
				<i>Ictalurus</i>	<i>punctatus</i> **	X	X	X		X				

* Diplostracans (cladocerans) are generally considered to be transient organisms when collected in lotic systems.

** Indicates native fish species. All other listed species are non-native fish.