Western Consortium for Public Health

CITY OF SAN DIEGO STUDY OF DIRECT POTABLE REUSE OF RECLAIMED WATER: FINAL RESULTS

Fact Sheet **Winter 1992**

ABSTRACT

The City of San Diego, California, received a Clean Water Grant to build and operate a 0.5 million gallon per day facility, to investigate a wastewater treatment system that utilizes a unique combination of treatment methods, and to treat wastewater to a quality so that it may be acceptable for human consumption.

This paper summarizes the results of the Health Effects Study (HES). The HES represents the product of a substantial research effort to estimate the potential health risk associated with reclaimed water relative to the City's existing raw water supply.

HEALTH EFFECT STUDY (HES)

OBJECTIVES

The primary objective of the HES was to investigate if the City's advanced wastewater treatment system could reliably reduce the contaminants of concern to levels such that the health risks posed by an assumed potable use of the treated water are no greater than those associated with the present water supply. The HES was designed to determine possible health risks of direct reuse of reclaimed wastewater[1].

Public health jurisdictions have not accepted such direct reuse because of concerns that the "raw" water supply, sewage in this instance, can be expected to contain infectious and toxic materials; because of uncertainty as to the quality requirements for a safe drinking water, regardless of the source; and because public health authorities have worked for decades to provide "pure and safe" drinking water and the deliberate reuse of wastewater runs counter to traditional patterns of water use.

ORGANIZATION

The Western Consortium for Public Health entered into a contract with the City of San Diego in July of 1985 to conduct a Heath Effects Study (HES) for the City of San Diego. In order to provide overall guidance on the project, the City of San Diego formed a Technical Advisory Committee (TAC) and a Health Advisory Committee (HAC), which was made up of representatives from the California Department of Health Services; the University of California at Berkeley, San Francisco, Davis, and Los Angeles; the San Diego County Department of Health Services; and the California Water Resources Control Board. The HAC provided guidance and review on the technical aspects of the project and is completing its final assessment of the health risks associated with the use of treated wastewater as a potable water supply.

The technical work was carried out by staff of the Western Consortium and a group of subcontractors that included professors and staff from the California Universities noted above, San Diego State University, and the infectious disease laboratories of the California Department of Health Services.

WASTEWATER TREATMENT SYSTEM (AQUA II)

The wastewater treatment system that was studied in San Diego (Aqua II, located in Mission Valley) is a unique and innovative system, utilizing channels containing water hyacinths for secondary treatment, followed by an advanced wastewater treatment (AWT) system designed to upgrade the secondary effluent water to a quality equivalent to raw water for potable reuse. The Water Hyacinth System, when operated within appropriate loading parameters, has produced secondary effluent Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) concentrations consistently below 10 mg/l. This effluent serves as the feed water to the Advanced Wastewater Treatment Plant. A more detailed discussion of the evolution of the aquatic portion of the wastewater treatment pilot plant is contained in a paper by Tchobanoglous[2].

The AWT plant contains a full range of advanced wastewater and water treatment unit processes, including coagulation, filtration, reverse osmosis, air stripping, carbon absorption, and final disinfection. The effluent from the advanced wastewater treatment represents a potential raw water supply for the City of San Diego which has been investigated in the study herein described, and has been compared to the City's present raw water supply.

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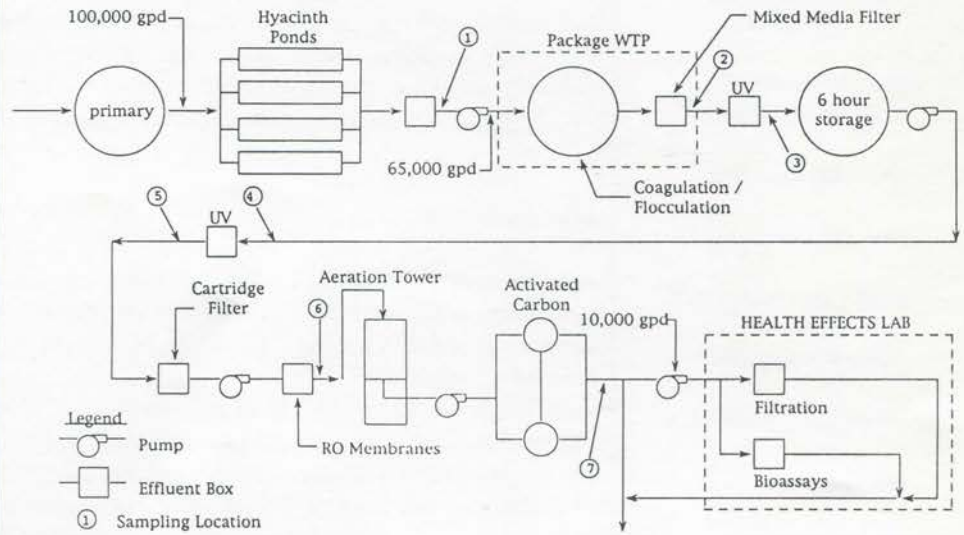
Figure 1—Schematic of Aqua II



HEALTH EFFECT STUDY ELEMENTS

The study included elements for identifying, characterizing, and quantifying infectious disease agents and potentially-toxic chemicals, and for screening mutagenicity and bioaccumulation of the chemical mixtures present, in both the treated wastewater and the City's untreated potable water supply. The untreated water supply was represented by raw water entering the Miramar water treatment plant. The study also included a reliability analysis, using data from the technical performance evaluation of unit processes in the demonstration water reclamation plant. The evaluation also included an epidemiology study to collect baseline data of the San Diego population and a chemical risk assessment on both waters. A summary of the results from each of the study elements is presented below.

Infectious Disease Agents

Data sufficient to make an informed judgment as to the public health risk of infectious disease from agents in both the reclaimed water and the untreated raw water supply were collected. The infectious agents that were measured included representative bacterial, viral, and parasitic human pathogens.

The data collected over a two and one-half year monitoring program indicates the following:

- As shown in Table 1, the AWT product water has a much higher microbiological quality than Miramar water based on indicator organism data (i.e., total and fecal coliform and enterococcus);

Table 1
Summary Statistics for Indicators in All Waters[a]

Indicator	Water Source[b]	Sample Size	Log Average	Log S.D.	Log Minimum	Log Maximum
Total Coliform	RWW	212	7.37	0.31	6.11	8.20
	MIRAMAR	428	1.51	0.82	0.30	3.70
	AWT	413	0.40	0.28	0.30	1.90
Fecal Coliform	RWW	212	7.05	0.32	6.32	8.20
	MIRAMAR	425	0.50	0.36	0.30	2.48
	AWT[b]	413	0.30	0.00	0.30	0.30
Entero-coccus	RWW	196	6.48	0.34	5.60	7.38
	MIRAMAR	425	0.95	0.77	0.00	3.20
	AWT	411	0.30	0.00	0.30	0.30

[a] Does not include duplicates.
[b] For statistical purposes values of less than 2.2 MPN/100 mL were recorded as 2 MPN/100mL. The majority of the samples were less than 2.2 MPN/mL.

- During the monitoring period, 53,576 gallons of Aqua II effluent and 43,028 gallons of Miramar water were concentrated for viruses. No **in situ** viruses were detected, in samples as large as 1,000 gallons (3800L), in either Aqua II product water or the Miramar raw water, thus indicating that there is no difference in the virus concentration found in the two waters;

STUDY PARTICIPANTS

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University of California at Los Angeles

San Diego County Department of Health Services

California Water Resources Control Board

Western Consortium

San Diego State University

- The microbiology of the AWT water, without disinfection, meets all microbiological criteria for recreational waters (fresh and marine) and raw drinking water source requirements; and

- No enteric bacterial pathogens (i.e., Salmonella, Shigella, and Campylobacter) were detected in either the Aqua II or the Miramar waters. Table 2 contains a summary of the results of some 50 samples that were collected and analyzed for Salmonella spp. on both the Aqua II and raw city water supply.

Table 2
Summary of Observed Salmonella spp.
in AWT, Miramar, and RWW Water Sources

Water Type	Number of Samples	Volume Filtered[a] (L)	Salmonella[a] Concentration (MPN/L)
RWW	84	0.76	12.5[b]
Miramar	55	10.10	<3[c]
AWT	51	10.10	<3[c]

a Median values
b Range of values 0 - >28,000 MPN/L method
c Lowest level of detection using MPN/L method

- Protozoa and metazoa of various types were absent in all waters examined. Generally, there was little difference between the type of organisms identified in the Aqua II and Miramar samples. There were no Giardia lamblia recovered from the Aqua II or the Miramar water samples even though they were commonly recovered from the raw wastewater. Because no Giardia lamblia were observed in the AWT produced water, this would indicate that the entire treatment process was capable of achieving a greater than 99.9% removal rate.

Chemical Agents

Chemical screening and monitoring of the Aqua II and Miramar waters was carried out over a three-year period. The objectives of this element were twofold: to determine which chemicals are present and their concentrations and to identify which of these chemicals are known to be of concern to human health if the AWT water were used as a municipal raw water source. What follows is a brief summary of the work[3].

Results of Chemical Analysis: Miramar and AWT waters were analyzed for inorganics, purgeable organics, extractable organics, pesticides, Polychlorinated Biphenyls (PCBs), and chlorinated dibenzodioxins/dibenzofurans. Most contaminant levels in the reclaimed water were extremely low, well below conventional detection limits. Results of the Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) analysis indicated that boron, calcium, magnesium, manganese, molybdenum, phosphorus, sodium, and strontium occurred in measurable quantities in both Miramar and AWT waters. Arsenic was identified in the Miramar water by Atomic Absorption Spectroscopy (AA) analysis at very low concentrations, mean value of 1.5 ug/L and not detected in the Aqua II water. A comparison of the Aqua II and Miramar mean water quality against a range United States

surface and groundwater quality is shown in Table 3.

Table 3
Comparison of AWT and Miramar Water Quality with U.S. Raw Water Supplies
Metals (mg/L)

Constituent	MCL	AWT[a]	Miramar[a]	U.S. Groundwater[b]	U.S. Surface Waters[b]
Arsenic	0.05	0.0003[d]	0.0017[d]	0.001-0.100	0.001-0.020
Cadmium	0.01	2E-05[d]	4E-05[d]	0.001-0.058	0.001-0.440
Chromium	0.05	0.008	0.003	0.0008-0.050	0.0002-0.650
Copper	1.0[c]	0.005	0.009	0.001-0.100	0.0004-0.200
Lead	0.05	0.0004[d]	0.0005[d]	0.002-0.100	0.0002-1.560
Nickel	NA	0.008	0.003	0.001-01.30	0.0013-0.500
Selenium	0.01	0.0001[d]	0.0007[d]	0.001-0.061	0.0001-0.047
Zinc	5.0[c]	0.025	0.017	0.0027-1.3767	0.001-8.600

a AWT and Miramar values are arithmetic mean concentrations. Data generated by University of California at Los Angeles during the chemical monitoring phase of the HES project.
b U.S. groundwater and surface water values are a range of arithmetic mean concentrations.
c Secondary drinking water standards; Title 22, CCR
d Arsenic, cadmium, lead, and selenium were analyzed using the AA method
MCL California Maximum Contaminant Level; Title 22, CCR
NA Not Applicable

Results of the purgeable organic analyses indicated that analytes measured above detection limits in AWT water were also found in a few blanks and sometimes in Miramar water. Trihalomethanes (THMs) were among the compounds detected in the Miramar water at concentrations averaging 10 ug/l; these were byproducts of upstream chlorination en route from Lake Skinner. Tests conducted to identify the THM formation potential in both waters indicated that the Miramar water's THM formation potential was ten times that of the AWT water.

The only extractable organic compounds measured above detection limits in either AWT or Miramar water were phthalates: Bis(2-ethylhexyl)phthalate, diethyl phthalate and di-n-octyl phthalate. BEHP essentially represents the only significant compound of public health concern and was identified at values in the AWT water ranging from <0.5 ug/l geometric mean to 7.6 ug/l arithmetic mean and in Miramar from <0.5 ug/l geometric mean to 4.2 ug/l arithmetic mean. No PCBs, pesticides, or dioxin/furans were identified above detection limits in either AWT or Miramar waters.

The average total organic carbon (TOC) concentration found in Aqua II water was 1.37 ug/L, while TOC concentration averaged 9.83 ug/L in Miramar water.

Results of Genetic Toxicity Testing: Genetic toxicity testing was used as a relatively cost-effective bioassay for screening the relative toxicity of the two waters being investigated. Four separate types of widely used bioassay systems were employed to assess genetic toxicity and potential cancer-causing effects of the AWT and the Miramar waters. These included the Ames Assay, Micronucleus Test, 6-Thioguanine Resistance Assay, and Cellular Transformation Assay.

Mutagenic and genotoxic activity has been frequently observed in studies of source and treated waters. Consistent with these observations, organic extracts from both the AWT and the Miramar water sources exhibit some mutagenic activity. In addition, some genotoxic activity may also be associated with fractions which were not efficiently extracted by the resin columns used in these studies. The genotoxic effects detected in this study were observed primarily in the Ames test but some indications of potential mutagenic activity were also observed in the other bioassays. Based on the Ames test data, the tested Miramar extracts exhibited somewhat higher mutagenic activity than the comparable AWT extracts. The reason for this difference in observed mutagenicity is unknown but may reflect differences in composition of the original source waters or the result of the use of disinfectants on Miramar water.

These data from short-term bioassay results of organic extracts of both AWT and Miramar water indicate that water from the AWT facility appears to exhibit less genotoxic or mutagenic activity than the low levels observed in the raw water entering the Miramar water treatment plant.

GCMS Identification of Chemical Substances: Synthetic resins were used to concentrate trace organics from AWT, Miramar, and reagent (blank) water. A total of 71 resin extracts were analyzed by gas chromatography-mass spectrometry in an effort to characterize the component mixture. The resin extract for each sample was fractionated by High Performance Liquid Chromatography (HPLC) into four fractions with one of the fractions fractionated again into three subfractions, resulting in a total of six fractions for each sample. Analysis of resin-accumulated organic residues from AWT and Miramar waters revealed the presence of many classes of organic compounds in low to trace amounts in the waters. Several herbicides were found in four of the five Miramar water samples. Only one compound found in the monthly water samples, 2-hexenal, was predicted to be an active mutagen and reported positive in the Salmonella testing.

Fish Biomonitoring

To complement information from other HES activities, the fish biomonitoring experiments were expected to provide information on chronic exposure to trace contaminants contained in the effluent from the Aqua II plant and the untreated raw city water that accumulate in tissue but are not known to be in genetic toxicity screening bioassays[4].

Juvenile fathead minnows (Pimephales promelas) were exposed to Aqua II water, Miramar water, or charcoal filtered San Diego tap water (acclimation or control water) in flow-through aquaria. Three 28-day bioaccumulation experiments were completed at each site under standardized conditions following EPA and ASTM bioconcentration guidelines. In addition, swim speed and optomotor (eye reflex) response tests were conducted.

A total of 120 fish tissue samples and 60 aquarium water samples were collected for analysis of 69 base/neutral/acid extractable organics, 27 pesticides/PCBs, and 26 inorganics by investigators at the University of California at Los Angeles (UCLA). Quadruplicate samples of fish tissue and either duplicate or triplicate samples of water were collected and analyzed for each sampling time (Days 0, 7, 14, and 28 of the 28-day

experiments). The concentrations of most analytes in these samples were either zero or below the detection limit. Statistical comparisons were made only if at least 75% of the samples exceeded the detection limit for a given analyte. Chemical analysis of fish tissue and water in the 28-day bioconcentration experiments revealed no statistically significant differences.

The fish displayed no significant difference in survival, growth, or swim speed after up to 28 days of continuous whole body exposure to either Aqua II or Miramar water under test conditions. This was a consistent finding for all three tests conducted on each of the three waters.

Plant Reliability

Evaluating the risk associated with the AWT plant effluent includes considering the ability of the treatment system to consistently achieve the level of treatment that was used as the basis for the health risk assessment. Therefore, the overall reliability of the San Diego Aqua II pilot plant was evaluated.

The objectives of the reliability analysis were to determine the reliability of the mechanical systems, characterize the treatment process variability, and present the probabilities of effluent characteristics meeting specific observed concentrations. To address these objectives, the reliability analysis included the review and analysis of plant performance and mechanical systems data.

Summary statistics of the water quality data showed very effective treatment, with virtually complete removal of biological indicator organisms, and removals on the order of 87–98% for general parameters, "conventional" pollutants, and for most inorganic ions. As shown in Table 4, the AWT plant was slightly less effective at removing metal ions.

In evaluating the inherent reliability of the AWT plant, an effort was made to identify comparable facilities and compare the effectiveness and variability of treatment at

Table 4--UNIT PROCESS AND PLANT PERFORMANCE--Metals Removal

	EFFLUENT QUALITY	UNIT PROCESS PERFORMANCE	
	Geometric Mean (mg/L)	Removal (a) (%)	95% Confidence Interval for Removal (b) (%)
Primary Treatment (Influent = RAW, Effluent = RDF)			
Arsenic	0.003	NR	[NR , 57.9]
Boron	0.263	4.7	[NR , 19.6]
Cadmium	0.003	15.4	[NR , 48.6]
Calcium	67.707	NR	[NR , 9.7]
Chromium	0.017	14.9	[NR , 50.5]
Copper	0.103	9.2	[NR , 25.4]
Iron	0.795	14.5	[NR , 33.0]
Lead	0.029	NR	[NR , 48.4]
Magnesium	29.782	0.3	[NR , 12.7]
Manganese	0.097	2.7	[NR , 18.5]
Mercury	0.001	17.2	[NR , 33.9]
Nickel	0.021	12.6	[NR , 47.9]
Potassium	12.165	8.1	[NR , 25.3]
Selenium	0.005	4.2	[NR , 87.2]
Silver	0.008	26.9	[NR , 75.0]
Sodium	127.286	5.1	[NR , 15.4]
Zinc	0.109	12.6	[NR , 24.8]

(Table 4 continued on next page)

Table 4--UNIT PROCESS AND PLANT PERFORMANCE--Metals Removal (continued)

	EFFLUENT QUALITY	UNIT PROCESS PERFORMANCE	
	Geometric Mean (mg/L)	Removal (a) (%)	95% Confidence Interval for Removal (b) (%)
Secondary Treatment (Influent = RDF, Effluent = PPI)			
Arsenic	0.002	3.2	[NR , 58.9]
Boron	0.260	NR	[NR , 12.5]
Cadmium	0.002	23.7	[NR , 58.9]
Calcium	64.400	8.7	[NR , 20.8]
Chromium	0.008	41.7	[NR , 67.5]
Copper	0.029	69.0	[60.0 , 75.9]
Iron	0.496	27.0	[NR , 47.2]
Lead	0.017	41.8	[NR , 72.0]
Magnesium	27.094	8.7	[NR , 34.9]
Manganese	0.060	35.8	[17.6 , 50.0]
Mercury	0.001	NR	[NR , 8.1]
Nickel	0.016	14.5	[NR , 52.7]
Potassium	4.808	57.0	[43.1 , 67.5]
Selenium	0.002	47.2	[NR , 96.1]
Silver	0.007	NR	[NR , 63.9]
Sodium	130.737	NR	[NR , 7.8]
Zinc	0.024	74.6	[68.4 , 79.6]
Tertiary Treatment (Influent = PPI, Effluent = CTE)			
Arsenic	0.002	37.2	[NR , 83.2]
Boron	0.230	11.5	[NR , 27.5]
Cadmium	0.001	NR	[NR , 66.3]
Calcium	3.605	94.4	[90.4 , 96.7]
Chromium	0.002	78.3	[54.7 , 89.6]
Copper	0.017	42.0	[19.3 , 58.3]
Iron	0.039	92.2	[87.4 , 95.2]
Lead	0.003	81.7	[59.1 , 91.8]
Magnesium	1.616	94.0	[89.0 , 96.8]
Manganese	0.015	75.7	[63.7 , 83.8]
Mercury	0.001	7.4	[NR , 23.1]
Nickel	0.004	72.2	[49.4 , 84.7]
Potassium	0.912	81.0	[68.8 , 88.5]
Selenium	0.003	NR	[NR , 63.7]
Silver	0.004	33.1	[NR , 85.8]
Sodium	11.348	91.3	[85.8 , 94.7]
Zinc	0.008	65.2	[50.3 , 75.7]
Entire Plant (Influent = RAW, Effluent = CTE)			
Arsenic	0.002	38.1	[NR , 84.2]
Boron	0.230	12.5	[NR , 28.2]
Cadmium	0.001	28.7	[37.1 , 76.8]
Calcium	3.605	94.7	[91.0 , 96.8]
Chromium	0.002	89.2	[78.9 , 94.5]
Copper	0.017	83.6	[78.6 , 87.5]
Iron	0.039	95.1	[92.7 , 96.8]
Lead	0.003	89.2	[77.1 , 94.9]
Magnesium	1.616	94.6	[91.4 , 96.6]
Manganese	0.015	84.8	[78.9 , 89.1]
Mercury	0.001	17.2	[NR , 36.0]
Nickel	0.004	79.2	[65.2 , 87.6]
Potassium	0.912	92.5	[88.6 , 95.1]
Selenium	0.003	NR	[NR , 75.5]
Silver	0.004	42.9	[NR , 96.3]
Sodium	11.348	91.1	[86.0 , 94.3]
Zinc	0.008	92.3	[89.7 , 94.2]

Notes:

(a) Calculated as 1 - (Geometric Effluent/Geometric Influent)
(b) Calculated from 95% C.I. for (Geometric Effluent/Geometric Influent)
NR: No Removal (Effluent > Influent)
RDF: Rotary Disk Filter
PPI: Package Plant Influent

those similar facilities. Denver Potable Water Reuse Project, the Water Factory 21 Advanced Wastewater Reclamation Project, and the Potomac Estuary Experimental Water Treatment Plant were evaluated for this purpose.

The observed treatment effectiveness at Aqua II appeared to be consistent with the experience at other similar facilities, although the effectiveness of metals removal may have been somewhat less than that which was observed at Water Factory 21.

The levels of treatment obtained at the Aqua II plant were sufficient to meet all existing drinking water standards for all of the data reviewed in this study. The results of the statistical analysis and the mechanical reliability analysis indicate that compliance with Maximum Contaminant Levels (MCLs) can be maintained at the Aqua II demonstration AWT plant, on a long-term basis, with low probability of exceeding MCL concentrations (generally less than 1 in 1000 for individual metals).

Results of the mechanical reliability analysis indicate that, over a two and one-half year period, the critical equipment is operational nearly 100% of the time. In addition, the mechanical reliability analysis confirms statistically what is known practically about the Aqua II Plant: observed equipment failures do not cause a significant interruption in operation of the plant.

Seeding Studies

Chemical and virus seeding studies were conducted at the Aqua II plant. The results of that work are described below:

- **Chemical Seeding Study**: The Aqua II plant was spiked with both organic and inorganic constituents that could potentially enter a wastewater treatment plant as a large pulse flow. A summary of the results of this work is shown in Table 5. As shown, the ponds removed 60–99% of the inorganic and organic seed, and the advanced treatment processes removed >98.5 – >99.9% of the seed. Overall, the Aqua II plant removed >99.5 – >99.997% of the seeded chemical constituents[3].

Table 5
Chemical Removal Efficiency by Hyacinth Ponds and the AWT Facility - Spike Study

Compound	Spike (µg/L)	Pond Effluent (µg/L)	% Removal by Pond	AWT Effluent (µg/L)	% Removal AWT	Overall
Chromium	182	74	59.3	<1	>98.6	>99.5
Tetrachloroethylene	900	29	96.8	<.03	>99.9	>99.997
Tetrachloroethane	224	53	76.3	<.1	>99.8	>99.996
Trichlorobenzene	813	130	84.0	<.3	>99.8	>99.996
Tetrachlorobenzene	140	2	98.6	<.03	>98.5	>99.98
Lindane	70	12	82.9	<.03	>99.7	>99.96

- **Virus Seeding Study**: Four virus seeding studies performed on the Aqua II plant indicated a very high virus removal capability. As shown in Table 6, none of the seeded virus (attenuated vaccine strain Poliovirus 2) was recovered in the final effluent, indicating a removal efficiency of as great as eight orders of magnitude (99.999999%). This removal rate is considerably greater than that reported in either the Pomona virus study[5] or the Monterey study[6], which used filtration and chlorination of secondary effluent but not reverse osmosis without final disinfection.

Table 6
Virus Removal Efficiency of the Aqua II Water Reclamation Plant

Run Number	Virus in Pond Effluent			Virus in AWT Effluent (pfu/L)	Percent Virus Removal[d]
	Expected[a] (pfu/L)	Observed (pfu/L)	% Virus Removed in Ponds		
1	4.7×10^4	1.9×10^2	99.6	ND[b]	>99.9999
2	9.6×10^4	1.2×10^4	87.5	ND[c]	>99.99999
3	1.0×10^5	4.0×10^3	96.1	ND	>99.99999
4	5.6×10^4	3.7×10^3	93.5	ND	>99.99999

a. The number expected if no virus removal occurred (based on Lithium Tracer study).

b. ND = none detected in 3800 liters.

c. The occurrences of 0.2 pfu/L in this sample was due to cross contamination.

d. Calculation based upon 3800 liter sample.

Epidemiology

The principal purpose of the epidemiology component was to develop a baseline of pertinent morbidity and mortality data for the City of San Diego so that a basis of comparison is available if recycling of municipal wastewater becomes a reality. Three different methods for epidemiological monitoring were evaluated for possible utilization should total resource recovery be adopted operationally by the City of San Diego.

The health of the residents was evaluated by characterizing the reproductive health and analyzing vital statistics of San Diego County. In addition, a neural tube defects survey was performed to establish baseline prevalence rates in California and in San Diego.

The epidemiological component provided baseline data to facilitate monitoring for actual health effects if the city decides to proceed with potable reuse of the type of treated effluent studied in this project[7].

Chemical Risk Assessment

The chemical risk estimates were driven by arsenic and THMs present in the Miramar water (THMs apparently from upstream chlorination of the raw water supply), and by bis-ethyl hexyl phthalate (BEHP) present in the Aqua II water. Arsenic accounts for approximately 80% of the risk estimate in Miramar water, and THMs account for approximately 20% of the risk estimate. The concentration of arsenic in Miramar water is well within applicable federal and state standards, approximately 2% of the existing drinking water standards. The concentration of THMs in the Miramar water is 10% of the existing drinking water standards. The water from the Aqua II system was analyzed for arsenic and does not have enough arsenic to be reliably detected.

Risk calculations, using EPA upper confidence level estimates, indicate that the Aqua II water, if used directly as potable water, would represent an estimated lifetime risk of 3.2×10^{-6} (.03 excess cancers/10,000 people) versus 1.2×10^{-4} (1.2 excess cancers/ 10,000 people) for Miramar water. These estimates indicate that the Aqua II risk estimate is approximately 40 times less than the estimated risk associated with the untreated Miramar water.

Results of the noncarcinogenic risk indicated that, for both waters, non-carcinogenic chemicals at observed low concentrations would not be anticipated to result in any significant health risk.

CONCLUSION

Based on the above research, the overall conclusion reached by the Health Advisory Committee was that the health risk associated with the use of the Aqua II (AWT water) as a raw water supply is less than or equal to that of the use of the existing raw water supply as represented by Miramar.

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