

NATIONAL WATER RESEARCH INSTITUTE

Revised Final Report

of the May 28-29, 2009, Meeting of the

Independent Advisory Panel

for the

**Orange County Water District's
Santa Ana River Monitoring Program**

on Reviewing

Studies of Contaminants of Emerging Concern

February 16, 2010
Fountain Valley, California

Disclaimer

This report was prepared by an NWRI Independent Advisory Panel (Panel), which is administered by the National Water Research Institute (NWRI). Any opinions, findings, conclusions, or recommendations expressed in this report are those of the Panel. This report was published for informational purposes.

1. INTRODUCTION

The Orange County Water District (OCWD) in Fountain Valley, California, manages a groundwater basin in northern and central Orange County, California, that supplies water for over 2.3 million residents. OCWD primarily replenishes the groundwater basin with water from the Santa Ana River (SAR) via recharge ponds in the Cities of Anaheim and Orange. Much of the SAR flow is tertiary treated wastewater from upstream treatment facilities in San Bernardino and Riverside Counties.

OCWD has been proactive in monitoring and assessing the quality of the SAR water to prevent adverse effects on groundwater quality and to ensure the protection of public health.

OCWD initiated the Santa Ana River Water Quality and Health (SARWQH) Study in 1994 to address questions about the use of SAR water for recharging the groundwater basin because of the high percentage of treated wastewater in the base flow of the river. At OCWD's request, the National Water Research Institute (NWRI) of Fountain Valley, California, formed a Scientific Advisory Panel in the Spring of 1996 to provide independent review and guidance to the SARWQH Study.

The Scientific Advisory Panel, in a report published in August 2004,¹ concluded that the recharge of SAR water into the groundwater basin does not currently threaten water quality or public health; however, water quality in the SAR will continue to change, and these changes may influence OCWD recharge operations. The Scientific Advisory Panel made several recommendations, among them that OCWD should continue to characterize and monitor constituents in the SAR, including emerging contaminants.

That same year, OCWD requested an NWRI Independent Advisory Panel be formed to: 1) measure OCWD's progress in implementing recommended monitoring from the SARWQH Study; and 2) evaluate the monitoring effort on an annual basis. This Panel, referred to as the SAR Panel, has met every year since 2004.

In 2007, an NWRI-sponsored study of contaminants of emerging concern (CECs) in the SAR (referred herein as the NWRI CEC Study) was undertaken by the Metropolitan Water District of Southern California (MWD) and OCWD that involved the collection of quarterly samples at a number of locations to characterize various inputs from wastewater treatment plants and changes occurring within the river itself. The study was entitled "Source, Fate, and Transport of Pharmaceuticals and Personal Care Products in the Santa Ana River Watershed" (NWRI Project No. 07-WQ-004). Progress reports of the study were presented at SAR Panel meetings in 2007 and 2008. Final results of the study were presented by MWD researchers at the May 28-29, 2009, meeting of the SAR Panel.

¹ National Water Research Institute (2004). *Report of the Scientific Advisory Panel "Orange County Water District's Santa Ana River Water Quality and Health Study, August 2004*. National Water Research Institute, Fountain Valley, CA.

2. CHARGE TO THE PANEL

Now that the NWRI CEC Study has concluded, the SAR Panel was asked to come together in a meeting on May 28-29, 2009, at OCWD's headquarters in Fountain Valley, California, to answer specific questions related to findings at Imperial Highway (SAR-IMPERIAL-01) near the point of diversion for OCWD's spreading basins.

The SAR Panel was asked to consider the following questions:

- In terms of using SAR water to recharge the groundwater basin, is there any public health significance to the NWRI CEC Study findings in the SAR at Imperial Highway (assuming the SAR water is recharged and there is no removal or dilution and the SAR concentrations are observed in groundwater)?
- Is OCWD's proposed framework for emerging contaminant water quality monitoring adequate to follow-up on the findings?
- Does the Panel have any recommendations on risk communication regarding the findings?

3. PANEL MEMBERS

Members of the SAR Panel who participated in this meeting included:

- *Chair:* Harvey F. Collins, Ph.D. P.E., Consulting Environmental Engineer (Sacramento, CA)
- W. Richard Laton, Ph.D., California State University, Fullerton (Fullerton, CA)
- Jack Skinner, M.D., American Board of Internal Medicine (Newport Beach, CA)
- George Tchobanoglous, Ph.D., P.E., University of California, Davis (Davis, CA)
- David E. Williams, Ph.D., Oregon State University (Corvallis, OR)

Because monitoring of the groundwater basin for chemical and microbial constituents is an issue that affects both OCWD's SAR Monitoring Program and its Groundwater Replenishment (GWR) System (an indirect potable reuse project), select members of the NWRI GWR System Panel were also invited to participate in this special meeting. These Panel members were:

- Richard J. Bull, Ph.D., MoBull Consulting (Richland, WA)
- Joseph A. Cotruvo, Ph.D., Joseph Cotruvo Associates (Washington, D.C.)
- James Crook, Ph.D., P.E., Environmental Engineering Consultant (Boston, MA)

Drs. Bull, Cotruvo, and Crook attended the meeting and participated in the preparation of this SAR Panel report.

Brief biographies of each of the participating Panel members may be found in Appendix A

4. MEETING AGENDA AND SUMMARY

The agenda for the meeting on May 28-29, 2009, is provided in Appendix B. A complete list of meeting attendees is included in Appendix C. The focus of the meeting was on presentations by OCWD and its consultants and MWD detailing the results of the NWRI CEC Study. The following topics were discussed:

- Overview of SAR portion of the NWRI CEC Study and review of sampling locations.
- Quality assurance/quality control data from the NWRI CEC Study.
- Sampling Results from the SAR portion of the NWRI CEC Study.
- Toxicology of constituents detected in the SAR in the NWRI CEC Study.
- Framework for future trace organics monitoring.

5. FINDINGS AND RECOMMENDATIONS

The findings and recommendations that resulted from this meeting are presented in this report.

5.1 Introduction

As reported above, during the NWRI CEC Study, quarterly samples were collected at a number of locations thought to characterize various inputs from wastewater treatment plants and changes occurring within the river itself.

OCWD retained Intertox, Inc. to review the water quality data collected during the NWRI CEC Study at the Santa Ana River at Imperial Highway with respect to Acceptable Daily Intakes (ADIs). Intertox provided a screening assessment of the 16 CECs that were detected (see Appendix D).

As soon as the findings became available, a meeting of the SAR Panel (with members from the NWRI GWR System Panel) was convened on May 28-29, 2009, to answer specific questions related to findings at the Imperial Highway diversion since the water quality at this sampling point is most representative of the quality of water being recharged in Orange County. During the meeting, findings of the NWRI CEC Study were presented by MWD researchers. Intertox also made a presentation of their health screening assessment of the CECs identified in samples collected from the SAR at the Imperial Highway sampling point described above.

Specifically, the questions presented to the Panel and Panel findings are as follows:

5.2. Response to Question 1

Question 1. In terms of using SAR water to recharge the groundwater basin, is there any public health significance to the NWRI CEC Study findings in the SAR at Imperial Highway (assuming the SAR water is recharged and there is no removal or dilution and the SAR concentrations are observed in groundwater)?

Regarding the above question, the Panel noted that it is extremely conservative to assume that there would be no removal or dilution during recharge. For example, many CECs would be reduced via soil-aquifer treatment, and all CECs would be diluted in the groundwater. Be that as it may, prior to formulating an answer to the above question, and at the risk of being somewhat redundant, the Panel considered the facts presented below.

5.2.1 Water quality data were collected for the NWRI CEC Study at the Santa Ana River at the Imperial Highway (SAR-IMPERIAL-01) near the point of diversion for the spreading basins. The data consisted of an analysis of 49 constituents (Appendix E) in four quarterly samples from this location. The 49 constituents analyzed were selected as a cross section of the types of contaminants being detected usually at parts per trillion levels in numerous surface water supplies impacted by upstream wastewater discharges. They included pharmaceuticals, personal care product ingredients, pesticides, flame retardants, and hormones and other endocrine active compounds. To aid in the assessment of these data, OCWD retained Intertox to provide a risk analysis of these data. Findings presented by Intertox included:

- Only 16 of the 49 constituents were detected. For those 16, maximum concentrations were less than the screening levels (screening levels are derived by standard assessment procedures using available toxicological data and therapeutic dosage data for pharmaceuticals; they represent daily exposures that would not be expected to result in any adverse effect upon lifetime exposures). Based on their analysis, Intertox concluded that these 16 constituents were not present in concentrations of health concern, with a substantial margin of safety.
- Thirty-three of the 49 constituents were not detected at the analytical limits of detection.

5.2.2 For the detected constituents, conservative screening levels to identify concentrations below which they would not expect any adverse health effects were developed:²

- Where available, guidance was obtained from published or regulatory sources (e.g., U.S. EPA, CalEPA).
- In the absence of that information, Intertox calculated an ADI in a manner consistent with methodology used by the California Office of Environmental Health Hazard Assessment and U.S. EPA.

5.2.3 Based on a review of the water quality data presented by MWD and the risk assessment presented by Intertox, the Panel unanimously concluded that none of the detected constituents were present in concentrations that would cause any health concern.

² Intertox, Inc. (2009). *Comparison of Analytical Results for Trace Organics in the Santa Ana River to Health-Based Screening Levels*. Draft Report dated May 21, 2009, for the Orange County Water District (CA). Intertox, Inc., Seattle, WA.

5.3. Response to Question 2

Question 2. Is OCWD's proposed framework for emerging contaminant water quality monitoring adequate to follow-up on the findings?

Based on the results of the NWRI CEC Study and past studies, it is clear that the framework for the evaluation of emerging contaminants should be dynamic and responsive to new analytical, health and water treatment information. The Panel reviewed the proposed framework for future trace organics monitoring presented by OCWD and is in agreement on several recommendations. The final monitoring program should take into account the following factors:

- Constituents that were previously detected at 10 percent or greater of the value of the Drinking Water Equivalent Level (DWEL) calculated from the reference dose (RfD) should be included in the monitoring program.
- Constituents of concern or interest to the public should also be included.
- OCWD should review potential constituents to be monitored and develop a preferred list specific to the needs of OCWD.
- The list of target analytes should include constituents, including surrogates, that are useful for investigating the fate and transport of constituents that might be found in the SAR and groundwater.
- Assess the applicability to OCWD of the work being done by the SAWPA's Emerging Contaminants Task Force, the State of California Blue Ribbon Panel on Emerging Contaminants, and other agencies.
- OCWD should also develop a long-range monitoring program to periodically reassess constituents on the active list and make appropriate deletions and additions.
- OCWD should develop a monitoring program that is designed to assess critical locations within the OCWD recharge area. The monitoring program may include collecting samples at different frequencies at different locations.
- The recommended monitoring programs should be submitted to the SAR Panel for review and comments.

5.4. Response to Question 3

Question 3. Does the Panel have any recommendations on risk communication regarding the findings?

The Panel believes that OCWD should continue to communicate with the public about water quality and safety for the recharge system and existing operations. OCWD should include efforts related to trace constituents and associated risk, if any, identified in the monitoring program.

In communicating the results of the monitoring program, it is important to inform the public that this is part of a much larger study designed as a scoping study to determine the presence of trace constituents in water supplies of the MWD, and that these constituents are not unique to the SAR. Emphasize that OCWD contracted with Intertox to provide a risk assessment of the data

collected at the Imperial Highway sampling point, which serves as a diversion point to OCWD's spreading basins. Also, emphasize that OCWD requested a special meeting of the SAR Panel to examine and evaluate the proposed findings as soon as the risk assessment had been completed. And, as pointed out above, continue to emphasize, that this is part of a continuing effort by OCWD. In the presentation of this information to the recipients, OCWD should also use simple, recognizable terms that the public can understand. The following facts should be emphasized in the communication of the findings of the study:

- No natural hormones or synthetic mimics that are used in medicine were detected. These are the most important as they are among the most biologically active compounds that have a potential for occurring in the SAR.
- Provide an explanation of the function and health effect endpoints of all 49 constituents, as many of these constituents have been the focus of public attention.
- None of the 16 constituents that were detected and identified were present in concentrations of health concern.
- OCWD should also point out that the analytical procedures used were sensitive enough to detect constituents in the parts per trillion (ppt) range or one millionth of a part per million (ppm). Another example that OCWD could use is that a part per trillion (ppt) is equivalent to a single drop in twenty Olympic-sized swimming pools.
- Table 3 in Appendix D gives an illustration of the very large margins of safety in terms of numbers of glasses of water that would need to be consumed per day to equal the screening values, which already have large margins of safety built in.

APPENDIX A: Panel Biographies

HARVEY F. COLLINS, PH.D., P.E. (Chair)

Environmental Engineer Consultant (Sacramento, California)

Harvey Collins has over 30 years of experience in California state government, working in all fields of sanitary/environmental engineering and environmental health. He served as Deputy Director of Public Health at the California Department of Health Services, and was Chief of the Division of Drinking Water and Environmental Management when he retired in 1995. Since then, he has consulted on various water and wastewater engineering projects and has served on several blue ribbon panels. He also has received numerous awards, including a Rudolf Hering Medal of the American Society of Civil Engineers, Walter F. Synder Award from the National Environmental Health Association and NSF International, and Special Recognition Award from the California Department of Health Services. Collins received a B.S. in Civil Engineering from Oregon State University, an M.S. in Sanitary Engineering from the University of Missouri, Columbia, and a Ph.D. in Sanitary Engineering from the University of California, Berkeley. He is a licensed Civil Engineer in the State of California.

RICHARD BULL, PH.D.

Consulting Toxicologist

MoBull Consulting (Richland, Washington)

Since 2000, Richard Bull has been a Consulting Toxicologist with MoBull Consulting, where he conducts studies on the chemical problems encountered in water for water utilities, as well as federal, state, and local governments. Bull is a Professor Emeritus at Washington State University, where he maintains Adjunct Professor appointments in the College of Pharmacy and the Department of Environmental Science. Formerly, he served as a senior staff scientist at DOE's Pacific Northwest National Laboratory, Professor of Pharmacology/Toxicology at Washington State University, and Director of the Toxicology and Microbiology Division in the Cincinnati Laboratories for the U.S. Environmental Protection Agency. Bull has published extensively on research on central nervous system effects of heavy metals, the carcinogenic and toxicological effects of disinfectants and disinfection by-products, halogenated solvents, acrylamide, and other contaminants of drinking water. He has also served on many international scientific committees convened by the National Academy of Sciences, World Health Organization, and International Agency for Research on Cancer regarding various contaminants of drinking water. Bull received a B.S. in Pharmacy from the University of Washington and a Ph.D. in Pharmacology from the University of California, San Francisco.

JOSEPH A. COTRUVO, PH.D.

President

Joseph Cotruvo & Associates, LLC (Washington, D.C.)

Joe Cotruvo is President of Joseph Cotruvo & Associates, an environmental and public health consulting firm, and is active in the World Health Organization (WHO)/NSF International Collaborating Centre for Drinking Water Safety and Treatment. Previously, he served as Director of the Criteria and Standards Division of the U.S. Environmental Protection Agency (EPA) Office of Drinking Water, where he developed the *Drinking Water Health Advisory System* and *National Drinking Water-Quality Standards and Guidelines*. He was also Director of the EPA's Risk Assessment Division and a former Vice President at NSF International. At present, Cotruvo is a member of WHO Drinking Water Guidelines development committees and a manager of WHO's Desalination Guidance project. He was engaged in studies on antiterrorism and water supplies through the American Water Works Association Research Foundation and currently in studies of metabolism and detoxification of bromate. In addition, he is active in water reuse applications. He is a member alternate on the Board of Directors of the District of Columbia Water and Sewer Authority, and chairman of the drinking water quality (retail services) committee. Cotruvo received a B.S. in Chemistry from the University of Toledo and a Ph.D. in Physical Organic Chemistry from Ohio State University.

JAMES CROOK, PH.D., P.E.

Environmental Engineering Consultant (Boston, Massachusetts)

Jim Crook is an environmental engineer with more than 37 years of experience in state government and consulting engineering arenas, serving public and private sectors in the U.S. and abroad. He has authored more than 100 publications and is an internationally recognized expert in water reclamation and reuse. He has been involved in numerous projects and research activities involving public health, regulations and permitting, water quality, risk assessment, treatment technology, and all facets of water reuse. Crook spent 15 years directing the California Department of Public Health's water reuse program, during which time he developed California's first comprehensive water reuse criteria. He also spent 15 years with consulting firms overseeing water reuse activities and is now an independent consultant specializing in water reuse. He has served on several advisory panels and committees convened by the National Academy of Sciences, NWRI, and others. Among his honors, he was selected as the American Academy of Environmental Engineers' 2002 Kappe Lecturer and the WaterReuse Association's 2005 Person of the Year. Crook received a B.S. in Civil Engineering from the University of Massachusetts and both an M.S. and Ph.D. in Environmental Engineering from the University of Cincinnati. He is a registered professional engineer in California and Florida.

W. RICHARD LATON, PH.D.

*Associate Professor of Hydrogeology, Department of Geological Sciences
California State University, Fullerton (Fullerton, California)*

Richard Laton is an Associate Professor of Hydrogeology in the Department of Geological Sciences at California State University, Fullerton. His areas of expertise include hydrogeology, field hydrology, wetlands, coastal monitoring/geomorphology, and environmental remote sensing/Geographic Information System (GIS). His classes at the university encompass topics including: water quality, environmental sampling, groundwater modeling, advanced hydrogeology, oceanography, and basic geology. He also acts as a consultant for a variety of companies and agencies that need input on the above subjects, as well as natural hazard and/or water resources assessment and mapping. Laton received a B.S. Earth Science (Oceanography) from Saint Cloud State University, Minnesota, and both an M.S. in Environmental Earth Science (Coastal Geomorphology) and a Ph.D. in Geology, with an emphasis in Hydrogeology, from Western Michigan University. He is a Professional Geologist in the states of California, Arizona, Indiana, Oregon, Minnesota, Texas, and Washington.

JACK SKINNER, M.D.

*Diplomate, American Board of Internal Medicine
Public Representative, Scientific Advisory Panel*

A medical doctor, Jack Skinner has been interested in water-quality issues for 20 years. He has become an outspoken advocate for clean water, alerting the public, governmental agencies, and dischargers of the human health effects that result from recreational water contaminated with human waste. Having practiced internal medicine for 30 years, he has cared for patients with complications from human enteric viruses, including hepatitis, viral meningitis, and myocarditis. As a result, he has a continuing interest in the treatment train for reclaimed water used for recharge purposes to ensure the removal of pathogens, toxic organics, and pharmaceutical products of concern. In this respect, he has served on a number of committees reviewing these water-quality issues and has testified at the request of the U.S. Environmental Protection Agency and Justice Department. His medical experience includes serving as Assistant Clinical Professor of Medicine at the University of California, Irvine, Medical School and later as Director of Continuing Medical Education at Hoag Memorial Hospital in Newport Beach. Skinner received his undergraduate and medical training from Stanford University.

GEORGE TCHOBANOGLIOUS, PH.D., P.E.

Professor Emeritus

University of California, Davis (Davis, California)

For over 35 years, wastewater expert George Tchobanoglous has taught courses on water and wastewater treatment and solid waste management at the University of California, Davis, where he is Professor Emeritus in the Department of Civil and Environmental Engineering. He has authored or coauthored over 350 publications, including 13 textbooks and five engineering reference books. Tchobanoglous has been past President of the Association of Environmental Engineering and Science Professors and currently serves as a national and international consultant to both government agencies and private concerns. Among his honors, he received the Athalie Richardson Irvine Clarke Prize from NWRI in 2003, was inducted to the National Academy of Engineers in 2004, and received an Honorary Doctor of Engineering degree from the Colorado School of Mines in 2005. Tchobanoglous received a B.S. in Civil Engineering from the University of the Pacific, an M.S. in Sanitary Engineering from the University of California, Berkeley, and a Ph.D. in Environmental Engineering from Stanford University.

DAVID E. WILLIAMS, PH.D.

Director, NIEHS Superfund Research Program

Professor, Department of Environmental and Molecular Toxicology

Oregon State University (Corvallis, Oregon)

David Williams serves as Director of the NIEHS Superfund Research Program and as Professor of the Department of Environmental and Molecular Toxicology at Oregon State University, where he has taught since 1986. His research interests include the characterization and regulation of microsomal monooxygenase enzymes (Cytochromes P450 and Flavin-Containing Monooxygenases) active in drug metabolism and their involvement in the detoxication and/or bioactivation of drugs, xenobiotics, and endogenous compounds. In addition, a major focus of his current research efforts is on diet and cancer, specifically addressing the potential role of the aryl hydrocarbon receptor and estrogen receptor binding in tumor modulation by dietary phytochemicals. He is also an Investigator in the Linus Pauling Institute and the Marine/Freshwater Biomedical Sciences Center at Oregon State University. Williams received a B.S. in Biology from Reed College and both an M.S. and Ph.D. in Biochemistry from Oregon State University.

APPENDIX B: Meeting Agenda

NATIONAL WATER RESEARCH INSTITUTE

**Independent Advisory Panel Meeting
Review of Orange County Water District's
Santa Ana River Monitoring (SAR) Program**

**Revised Final Meeting Agenda
May 28-29, 2009**

Meeting Location

OCWD Board Room
18700 Ward Street
Fountain Valley, CA 92708
Phone: 714-378-3300

On-Site Contacts:

Jeff Mosher (NWRI)
Cell: (714) 705-3722
Greg Woodside (OCWD)
Cell: (714) 315-4449

Meeting Objectives:

1. Review results from monitoring SAR for trace organics as part of MWD-OCWD-NWRI water quality study.
2. Develop conclusions regarding the significance of the findings and recommendations for future monitoring
3. Prepare detailed outline of panel report and preliminary written conclusions.

Day 1 – Thursday May 28, 2009

9:00 am	Introductory remarks - Review agenda - Review schedule for panel report	Jeff Mosher (NWRI) Harvey Collins (Panel Chair)
9:10 am	Overview of SAR portion of MWD-OCWD-NWRI Water Quality Study and review of sampling locations	Greg Woodside/OCWD
9:20 am	Quality Assurance/Quality Control data from MWD-OCWD-NWRI Water Quality Study	Carrie Guo, MWD and Steve Fitzsimmons, OCWD
9:50 am	Panel Discussion	
10:00 am	Sampling results from SAR portion of MWD-OCWD-NWRI Water Quality Study	Stuart Kranser and Carrie Guo, MWD
11:00 am	Break	
11:15 am	Sampling results from SAR (con't)	
11:45 am	Panel Discussion	

12:30 pm	Lunch (Working)	
1:00 pm	Panel Discussion (con't)	
2:00 pm	Discussion of toxicology of constituents detected in SAR in MWD-OCWD-NWRI Water Quality Study	Rick Pleus and Gretchen Bruce, InterTox
3:00 pm	Break	
3:15 pm	Open Discussion: - Issues for discussion - Panel recommendations - Preparation of Panel report	Harvey Collins (Panel Chair)
5:00 pm	Adjourn	

Day 2 – Friday May 29, 2009

8:30 am	Introductory remarks - Harvey Collins (Panel Chair)	OCWD Board Room
8:40 am	Panel Only Discussion - Issues for discussion - Panel recommendations - Prepare detailed outline and preliminary conclusions	
12:00 noon	Lunch	
12:30 pm	Ongoing panel discussion & drafting panel report	Harvey Collins (Panel Chair)
3:00 pm	Adjourn	

Appendix C: Meeting Attendees

SAR Panel Members:

- *Chair:* Harvey F. Collins, Ph.D. P.E., Consulting Environmental Engineer
- Jack Skinner, M.D., American Board of Internal Medicine
- W. Richard Laton, Ph.D., California State University, Fullerton
- George Tchobanoglous, Ph.D., P.E., University of California, Davis
- David E. Williams, Ph.D., Professor, Oregon State University

GWR System Panel Members:

- Richard J. Bull, Ph.D., MoBull Consulting
- Joseph A. Cotruvo, Ph.D., Joseph Cotruvo Associates
- James Crook, Ph.D., P.E., Environmental Engineering Consultant

NWRI Staff:

- Jeff Mosher, Executive Director
- Gina Melin Vartanian, Outreach and Communications Manager

Orange County Water District Staff:

- Jason Dadakis
- Steve Fitzsimmons
- Gina Pineda
- Michael Wehner
- Greg Woodside
- Nira Yamachika

Orange County Water District Research Collaborators:

- Gretchen Bruce, InterTox
- Richard C. Pleus, InterTox

Metropolitan Water District of Southern California Research Collaborators:

- Carrie Guo
- Stuart Krasner

California Department of Public Health Representatives:

- Brian Bernados
- Heather Collins
- Sean McCarthy
- Oliver Pacifico

Santa Ana Regional Water Quality Control Board Representatives:

- Gerald Thibeault

Orange County Health Care Agency:

- Larry Honeybourne

APPENDIX D: List of Risk Assessment for 16 CECs (from Intertox)

TABLE 3. Daily Water Consumption Required to Equal Health Risk-Based Screening

Levels. Required consumption rates are the amount of water with the reported concentration that a person would have to consume each day to ingest a dose equal to the health risk-based screening level. The source of the health risk-based DWEL is indicated in Table 1. The calculation method is summarized in Section 3.2 of the Intertox report.³

Compound	Maximum Conc. (µg/L)	Health Risk-Based DWEL (µg/L)	Consumption Rate Required to Equal Health Risk-Based Screening Level (L/day)	Consumption Rate Required to Equal Health Risk-Based Screening Level (8-oz glasses/day)
Acetaminophen	0.430	12,000	56,000	240,000
Atrazine	0.0029	0.15	100	440
Caffeine	1.255	87,500	140,000	590,000
Carbamazepine	0.120	12	200	850
Ciprofloxacin	0.022	21	1,900	8,100
DEET	0.156	81	1,000	4,400
Diclofenac	0.015	2,300	310,000	1,300,000
Dilantin (Phenytoin)	0.143	6.7	94	400
Diuron	0.954	70	150	620
Gemfibrozil	0.023	46	4,000	17,000
Ibuprofen	0.309	34	220	930
Primidone	0.087	0.84	19	82
Simazine	0.060	4	130	560
Sulfamethoxazole	0.084	18,000	430,000	1,800,000
TCEP	0.217	4.2	39	160
Triclosan	0.009	2,600	560,000	2,400,000

ADI– Acceptable daily intake; DEET– N,N-Diethyl-meta-toluamide; DWEL– Drinking water equivalent level; NA–Value not available; TCEP– Tris(2 carboxyethyl)phosphine.

³ Intertox, Inc. (2009). *Comparison of Analytical Results for Trace Organics in the Santa Ana River to Health-Based Screening Levels*. Report dated June 25, 2009, for the Orange County Water District (CA). Intertox, Inc., Seattle, WA.

APPENDIX E: List of Constituents in the NWRI CEC Study

Name	Use
Bisphenol A	Plastics manufacturing
Caffeine	Stimulant
Carbamazepine	Anti-convulsant medicine
DEET	Insect repellent
Gemfibrozil	Anti-cholesterol medicine
Ibuprofen	Analgesic medicine
4-n-Nonylphenol	Detergent metabolite
4-n- and 4-t Octylphenol	Detergent metabolite
Primidone	Anti-convulsant medicine
Sulfamethoxazole	Antibiotic medicine
Triclosan	Antibacterial
Anthracene	Industrial compound
Atrazine	Herbicide
Atrazine-Desethyl	Atrazine metabolite
Atrazine-Desisopropyl	Atrazine metabolite
Benzo(a)pyrene	Industrial compound
Butylparaben	Antibacterial
Cyanazine	Herbicide
Cyprazine	Herbicide
o,p-DDD	DDT metabolite
Diclofenac	Anti-inflammatory medicine
Dilantin	Anti-convulsant medicine
Diuron	Herbicide
Ethylparaben	Preservative and antibacterial compound
Lindane	Pesticide
Linuron	Herbicide
Methoxychlor	Pesticide
Methylparaben	Preservative and antibacterial compound
Propazine	Herbicide
Propylparaben	Preservative and antibacterial compound
Simazine	Herbicide
TCEP	Flame retardant
Acetaminophen	Analgesic medicine
Azithromycin	Antibiotic medicine
Ciprofloxacin	Antibiotic medicine
Diethylstilbestrol	Hormone
Ethinylestradiol	Synthetic birth control medicine
Epitestosterone	Hormone

Name	Use
17a-Estradiol	Hormone
17b-Estradiol	Hormone
Estriol	Hormone
Estrone	Hormone
Nonylphenol ethoxylates (total)	Detergent metabolite
Pentachlorophenol	Fungicide, wood preservative, fumigant
4-Phenylphenol	Fungicide
Progesterone	Hormone
Testosterone	Hormone
Tetrabromobisphenol A	Flame retardant
2,4,6-Trichlorophenol	Pesticide, fungicide

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