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July 5, 2009

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NORTH COAST REGIONAL
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Via email: MDougherty@waterboards.ca.gov

COMMENTS ON SONOMA COUNTY MS4 NPDES STORM WATER PERMIT

Dear Ms. Dougherty;

Thank you for this opportunity to comment on the Sonoma County MS4 NPDES Storm Water Permit ("permit"). We have found the permit to be generally very good. However, we are concerned that a number of troublesome pollutants known to exist—even in tertiary-treated sewage effluent and in processed sludge—have been overlooked and that the permit appears not to account for significant, scientific, peer-reviewed research that specifies such materials.

Because storm water runoff collects from a considerable amount of acreage that receives various sewage treatment products (e.g., treated effluent and sewage sludge) runoff flow may contain certain contaminants contained in raw sewage that survive sewage treatment as well as other contaminants that are created by the sewage treatment process itself. Many of these contaminants by themselves, not to mention others that result from the combination, reaction or other transformation of two or more of these compounds, are considered toxic and therefore fall under the purview of existing legislative and regulatory stipulations discussed below.

We are organizing this letter so that it covers a range of water quality considerations. Additionally, full text copies of the abstracts and papers referenced in the footnotes of this letter accompany this letter for the Board's convenience.

Emerging Contaminants

We are particularly concerned that parts of this permit would allow treated sewage to mix with storm water. Considerable evidence has accumulated over the past 20 years demonstrating: 1) the inadequacy of sewage treatment, including so-called "tertiary" treated sewage; 2) the ability of sewage treatment plants to actually produce new toxicants from the ingredients contained in raw sewage; and 3) the role that sewage treatment plays in increasing and spreading antibiotic resistance.

The rise of antibiotic resistance in sewage plants was once believed to be a passive process of simply killing off vulnerable pathogens and leaving only a miniscule number of hardy pathogens. No doubt this process continues apace (see below). But as early as 1990, Nakamura and Shirota¹ discovered that multi-drug resistant ("MDR") pathogens do not just survive treatment, they can actually increase as treatment progresses. Additionally, a disturbing number of these survivors carry extra packets of DNA coded for multi-drug resistance called "R plasmids."

"Of a total of 900 isolates, 45.7% were drug resistant and 51.1% of them carried R plasmids. The further along that wastewater had progressed through the treatment process the greater the tendency was for appearance of the multiresistant isolates. These isolates also were shown to simultaneously carry transferable R plasmids. Observed resistant patterns of R plasmids were mainly multiple and encoded to resistance to tetracycline, chloramphenicol, streptomycin and sulfisoxazole. ***It became clear that multiplication of R plasmids took place in the activated sludge digestion tank.*** This study show [sic] that drug resistance transfer mediated by these R plasmids may occur in actual wastewater treatment plants." [emphasis added]

Observations of increased resistance after treatment have become common worldwide. For example, da Silva², et. al. observed rather dramatic increases of MDR *E. faecium* compared to levels detected earlier in raw sewage. In other words, antibiotic resistant

¹ Behavior of drug resistant fecal coliforms and R plasmids in a wastewater treatment plant, Nakamura S, Shirota H., Department of Food and Nutrition, Ube College, Japan, Nippon Koshu Eisei Zasshi. 1990 Feb;37(2):83-90

² Antibiotic resistance of enterococci and related bacteria in an urban wastewater treatment plant, Miguel Ferreira da Silva, Igor Tiago, Antonio Verissimo, Rui A. R. Boaventura, Olga C. Nunes & Célia Manaia, Federation of European Microbiological Societies FEMS Microbiol Ecol 55 (2006) 322–329, Published by Blackwell Publishing Ltd., 7 August 2005

pathogens actually increased from the amounts detected in the raw state because of treatment. Such examples can be multiplied many fold³.

Antibiotic Resistance, a Rising Tide

It is difficult to exaggerate the danger of antibiotic resistance. Without antibiotic drugs, modern medicine would revert to a level of care not seen since World War I. In addition to curing a host of often lethal bacterial infections, virtually every surgical procedure performed today would be impossible without antibiotic drugs. Developing resistance to antibiotics eventually will render these drugs obsolete—unless something is done to curtail the spread of resistance.

Many factors contribute to antibiotic resistance but it has been well established that sewage treatment plays an integral role in reducing the efficacy of these so-called “miracle drugs.” If permits like the one under consideration continue to allow antibiotic-resistant pathogens and antibiotic-resistant genes to be spread via open dumping, and then to travel to surface waters via runoff, the dramatic increase in antibiotic resistance will continue until we no longer have any “miracles” left. It is cheaper to stop the flow of contaminated material in the first place than it is to fight bugs that have become resistant.

“The cost of treating one person with multidrug-resistant TB is a hundred times greater than the cost of treating non-resistant cases. New York City needed to spend nearly US\$1 billion to control an outbreak of multi-drug resistant TB in the early 1990s; a cost beyond the reach of most of the world's cities.⁴”

Sonoma County has already experienced a frightening rise in antibiotic-resistant pathogens. Methicillin-resistant *Staphylococcus aureus* (“MRSA”) is a “fairly significant” problem in homeless shelters in Petaluma⁵. MRSA now exists in at least five varieties⁶ of varying virulence some of which are exceedingly difficult if not impossible to cure, e.g. USA300-MRSA. USA300 is well established next door in San Francisco. New drug resistant pathogens are being discovered with disturbing regularity, including strains that have developed resistance to Vancomycin, once regarded as the antibiotic of last resort.

The danger from antibiotic-resistant pathogens and genes qualifies as a serious pollutant under existing California law and sewage treatment plays an important role in

³ Occurrence and fate of antibiotic resistant bacteria in sewage, Luca Guardabassi, Anders Dalsgaard, The Royal Veterinary and Agricultural University, Department of Veterinary Microbiology, Environmental Project No. 722 2002, Miljøprojekt, Danish Environmental Protection Agency, etc.

⁴ DRUG RESISTANCE THREATENS TO REVERSE MEDICAL PROGRESS, Press Release WHO/41, 12 June 2000

⁵ Homeless People at Higher Risk for CA-MRSA, HIV and TB, Healing Hands, HCH Clinician's Network, Vol. 10, No. 5 n December, 2006

⁶ Understanding The Impact Of MRSA On Limb Preservation, Loan Lam, DPM, Peter Blume, DPM, FACFAS, and Michael Palladino, DPM, FACFAS, Podiatry Today, Issue Number: 7, VOLUME: 20, Jul 01 2007

amplifying this danger. The permit is obliged to discuss possible methods of curtailing the spread of antibiotic resistance via storm runoff and other discharge.

Antibiotic-Resistant Genes

A study by Pruden ⁷, et. al., describes antibiotic-resistant genes (“ARG”) as emerging contaminants in treated sewage. Pruden showed that ARGs not only survive sewage treatment they can be detected in drinking water supplies when the effluent is discharged into surface waters. ARGs are, by definition, injurious pollutants that can be transported via storm runoff.

Antibiotic-resistant genes and antibiotic-resistant pathogens have been detected in so-called “recycled” or “reclaimed” water used to irrigate everything from public parks, golf courses and agricultural acreage. As a result, there is significant risk that storm water runoff carries ARGs.

Even if MDR pathogens are destroyed during treatment, the genes these pathogens once carried, encoded for antibiotic-resistance, are deposited in the sewage matrix making them available to other pathogens to incorporate and become resistant to specific antibiotic drugs. If ARGs enter the body, they can exchange genetic information with gut flora and transfer antibiotic resistance to persons unlucky enough to ingest them. Waste water treatment plants (“WWTP”) are not necessarily free of ARGs. We discuss the implications and efficacy of Ultra Violet (“UV”) disinfection below.

Why ARGs and Antibiotic-Resistant Pathogens are Important

Wastewater treatment plants are unique environments that collect a multitude of pathogens from entire sanitary districts—pathogens that would not ordinarily find themselves in close proximity. In addition to this unique population of pathogens is a concomitant collection of antibiotic drugs. Both humans and livestock excrete up to 95% of the antibiotic drugs they ingest⁸, and antibiotics tend to be stable compounds making the presence of pure, not metabolized, antibiotic pharmaceuticals significant.

This unique environment, consisting of scores of pathogens mixed with a profusion of antibiotics, initiates a process where weak, susceptible pathogens die off and ever stronger, resistant pathogens are selected. In a very real sense, sewage treatment facilities are evolution accelerators creating antibiotic resistance on an industrial scale.

⁷ Antibiotic Resistance Genes as Emerging Contaminants: Studies in Northern Colorado, Amy Pruden, RuoTing Pei, Heather Storteboom, and Kenneth H. Carlson, Environ. Sci. Technol. 2006, 40, 7445-7450

- Report on Antibiotic Resistance and Recycled Water to Marty Blum, Mayor of Santa Barbara, California by Edo McGowan, Ph.D., May 8, 2009

⁸ Pruden, et. al.

A March 24, 2009 study of antibiotic-resistance in WWTP flatly concluded:

“These results suggest that [the] wastewater treatment process contributes to the selective increase of antibiotic resistant bacteria and the occurrence of multi-drug resistant bacteria in aquatic environments.⁹”

To further underscore the public health threat, an American Medical Association study determined that, in 2005, 19,000 Americans died from Methicillin Resistant *Staphylococcus aureus*¹⁰. This death toll is greater than the number of Americans who died from complications resulting from HIV-AIDS.

The rise of community-associated MRSA (“CA-MRSA”) appears to coincide with the EPA easing Clean Water Act restrictions on sewage sludge and allowing open dumping¹¹. The suspicion that hospital-acquired MRSA (“HA-MRSA”) escaped the hospital setting because of the open dumping of sewage sludge is compelling. More research is needed to confirm these suspicions but it is clear that “treated” sewage plays a not-insignificant role in spreading antibiotic-resistance and WWTP operators should be taking pro-active steps to curtail the spread of ARGs, MRSA, or any other material contributing to the antibiotic-resistant epidemic.

The Board is aware that widespread open dumping of sewage sludge now occupies considerable acreage in Sonoma County¹² and contaminants contained in sewage products will contribute to storm water runoff. By practice, sludge is not plowed into land but rather applied to the surface where it is more likely to yield pollutants during rain events.

The permit does not discuss ARGs, antibiotic-resistant pathogens or the means by which the Co-Permittees intend to reduce or eliminate the pernicious effects of these materials. The Co-Permittees are obliged to account for these risks in some detail and

⁹ Wastewater treatment contributes to selective increase of antibiotic resistance among *Acinetobacter* spp., Zhang Y, Marrs CF, Simon C, Xi C., Department of Environmental Health Sciences, University of Michigan, Ann Arbor, USA., *Sci Total Environ.* 2009 Jun 1;407(12):3702-6.

-Sewage Plants May Be Creating "Super" Bacteria, Andrew McGlashen and Environmental Health News, *Scientific American*, April 16, 2009

¹⁰ Infection Killed 19,000 in 2005, Study Says, *New York Times*, October 16, 2007, Kevin Sack

¹¹ cf. 40 CFR Part 503, promulgated on February 19, 1993.

¹² cf. Sonoma County General Plan: PF-2q: Encourage application of sludge generated in Sonoma County to agricultural lands in the County. Consider sludge application projects as designated in the Land Use Element of the General Plan for purposes of compliance with Section 66796.41 of the Government Code if they meet all of the following criteria. In the event that one or more of the criteria are not met, a general plan amendment shall be required.

- 1) The project's primary purpose is to enhance agricultural use. The rate of sludge application shall be designed to enhance existing agricultural operations or designed in conjunction with a detailed management plan for proposed agricultural use.
- 2) The rate of sludge application shall not result in any future limitations on the potential agricultural use of the area of application.
- 3) The project shall be subject to the approval of the applicable Regional Water Quality Control Board.

offer means to mitigate or eliminate the potential threats because they pose significant risk to public health.

Treated Sewage Can Systemically Contaminate Plants

Several studies have found that vegetation, including agricultural crops, readily uptake pharmaceuticals, pathogens, antibiotic-resistant genes and other micro pollutants from treated sewage effluent and sludge, sometimes with lethal effect.

The U.S. Environmental Agency ("EPA") presented data¹³ at the recent Micropol & Ecohazard 2009 conference in San Francisco that clearly demonstrates the uptake of antibiotics and illegal drugs in various plants watered with treated effluent or fertilized with treated sewage solids. Yates¹⁴ similarly demonstrated plant uptake of both bacterial and viral pathogens as well as parasites. All these contaminants entered the plants as a result of using treated—and declared safe but still contaminated—sewage.

The EPA authors note that they were able to detect:

" . . . Azithromycin and Methamphetamine in Bermuda roots sampled from a field that had been treated for several years with biosolids . . . There were traces of uptake of clindamycin into spinach leaves and possibly lettuce root . . . Trace amounts of roxithromycin were detected in lettuce roots. Carrots showed the greatest amount of uptake of roxithromycin, 110 ng/g, from 1000 ng/L of roxithromycin watered into the carrot plots. All of the plants, except the carrots, from the field crops watered with Tucson wastewater effluent showed uptake of n,n'-dimethylphenethylamine, an industrial chemical used in manufacturing, food industry, etc."

The mechanism of vegetative uptake of pollutants is so well established that some alternative sewage treatment technologies actually rely on doing exactly this to "trap" pollutants in trees or other plants¹⁵.

There is genuine concern that watering vineyard grapes, for example, with treated sewage could contaminate the grapes and ultimately the wine made from them. There is nothing in the winemaking process that would necessarily remove, sanitize, disinfect or otherwise render harmless the host of possible contaminants demonstrated to exist in

¹³ A Case Study: Crop (Lettuce, Spinach, and Carrots) Uptake of Three Macrolide Antibiotics (Azithromycin, Clindamycin and Roxithromycin) and Other Drugs, Tammy L. Jones-Lepp, Charles A. Sanchez, Research Chemist U.S. EPA ORD, NERL, Environmental Sciences Division, Las Vegas, NV and University of Arizona Department of Soil, Water, and Environmental Sciences, Yuma Agricultural Center, Yuma AZ, respectively.

¹⁴ PATHOGENS IN RECLAIMED WATER, M.V. Yates, P.h.D., Professor of Environmental Microbiology College of Natural and Agricultural Sciences, University of California Riverside, Informational handout at lecture, 1989.

¹⁵ Wastewater Management Using Hybrid Poplar, Agroforestry Notes, USDA Forest Service, USDA Natural Resources Conservation Service, April 2000

treated sewage¹⁶. Exposing grape stock to treated sewage effluent risks polluting both grape and wine.

The risk of contaminating grapes used by the North Bay wine industry could set in motion incalculable economic repercussions. This scenario is particularly credible since every alcoholic beverage business in the world ultimately relies on the perception of pristine water as the foundation for the product. This is true whether the product is beer, wine or whiskey. Contaminated effluent of any description is by definition anathema to this universal principle and very far from the perception of pristine water.

Plant uptake of pollutants in crops eaten raw, e.g. strawberries, lettuce, carrots, etc., require extra careful laboratory analysis to guarantee that these food crops are contaminant free.

Deaths from Contaminated Plants

In 2008, several hundred dairy cattle in the State of Georgia died from eating hay that had been grown on land fertilized with sewage sludge. The court trials that resulted from this case of mass poisoning documented a clear instance where toxic materials, in this case heavy metals, passed from treated sewage applied to soil into growing plants rendering the feed lethal to consume¹⁷. Worse, even the milk was contaminated. The Augusta Chronicle, a local newspaper, noted: “In one case, according to test results provided to the AP, the level of thallium—an element once used as rat poison—found in the milk was 120 times the concentration allowed in drinking water by the Environmental Protection Agency.”¹⁸

The permit is obliged to consider storm water runoff quality from any acreage where sewage sludge has been applied with extra scrutiny due to the elevated risk to public health. We commend the Board for the work it has already done in recognizing toxic materials in runoff. However, open dumping of treated sewage products creates an additional complication to these efforts that requires even closer examination.

¹⁶ Validity of the Indicator Organism Paradigm for Pathogen Reduction in Reclaimed Water and Public Health Protection, Valerie J. Harwood, Audrey D. Levine, Troy M. Scott, Vasanta Chivukula, Jerzy Lukasik, Samuel R. Farrah, and Joan B. Rose, APPLIED AND ENVIRONMENTAL MICROBIOLOGY, June 2005, p. 3163–3170, Vol. 71, No. 6

¹⁷ R.A. McELMURRAY, III, R.A. McELMURRAY, JR., RICHARD P. McELMURRAY, and EARL D. McELMURRAY, V. UNITED STATES DEPARTMENT OF AGRICULTURE, NO. CV105-15 9, Feb 25, 2008

-UNITED STATES SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS Briefing on “Oversight on the State of Science and Potential Issues Associated with EPA’s Sewage Sludge Program” September 11, 2008 TESTIMONY OF ROBERT A. (ANDY) McELMURRAY, III

-Researchers Link Increased Risk Of Illness To Sewage Sludge Used As Fertilizer, Science Daily, July 30, 2002

¹⁸ “National policy brought sludge to Augusta farms: Ruling for farmer disputes government data”, Augusta Chronicle, Sunday, March 09, 2008

Phthalate Toxicity and Dosage

Researchers, water suppliers and others can be misled by terms like “trace” or “insignificant” when used to quantify amounts of pollutants that remain after sewage treatment. Increasingly, researchers are discovering appreciable effects from pollutant levels previously believed to be below safe thresholds¹⁹. Additionally, other chemicals known to survive the treatment process, for example phthalates, behave as endocrine disruptors and therefore mimic hormones.

Hormones are some of the most potent chemicals known to science; vanishingly small doses can provoke impressive, often harmful, biological reactions.²⁰ In the past, agencies, municipalities, boards and other custodians of water quality, supply and safety have been able to discount very small amounts of contaminants and declare them as safe. Nevertheless, mounting research shows that ignoring contaminants like phthalates, even in miniscule amounts, would contradict prudent scientific practice.

Hormones, and the chemicals that mimic them, can be biologically active in parts per trillion²¹ (*i.e.*, 1×10^{12}).

The permit does not discuss this threat to public health nor does it present the results of studies done to determine the extent of damage that the permit would contribute to endocrine disruption in human and animal populations. Co-Permittees offer no means to ameliorate or eliminate this threat.

Chlorine and Residual Pollutants

The permit makes no mention of interactions known to take place amongst residues found in treated sewage products and amongst contaminants known to exist in lands irrigated with sewage products or fertilized with sewage solids and therefore that contribute to runoff.

Chlorinated Triclosan Derivative Products

Triclosan (5-chloro-2-(2,4-dichlorophenoxy)phenol; “TCS”) is a ubiquitous antimicrobial found in soaps, shampoos, toothpastes and many other products. Triclosan is routinely detected in WWTP sludge and effluent and is most likely not removed with the efficiency once assumed to exist, as noted by Heidler and Halden: “. . . conventional sewage treatment was demonstrated to be much less effective in destroying the antimicrobial

¹⁹ Counterintuitive toxicity: increasingly, scientists are finding that they can't predict a poison's low-dose effects, Raloff, Janet, Jan 20, 2007, Science News, ISSN: 0036-8423

²⁰ Effects of relatively low levels of mono-(2-ethylhexyl) phthalate on cocultured Sertoli cells and gonocytes from neonatal rats, Li LH, Jester WF Jr, Orth JM., Department of Anatomy and Cell Biology, Temple University School of Medicine, Philadelphia, Pennsylvania, 19140, USA. Toxicol Appl Pharmacol. 1998 Dec;153(2):258-65.

²¹ DETECTION OF HORMONE MIMICS IN WATER USING A MINITURISED SPR SENSOR, ADAMA M. SESAY and DAVID C. CULLEN, Cranfield Biotechnology Centre, Institute of BioScience and Technology, Cranfield University at Silsoe, Silsoe, Bedfordshire, U.K., Environmental Monitoring and Assessment 70: 83–92, 2001

[TCS] than the aqueous-phase removal efficiency of the plant would make believe. Furthermore, study findings indicate that the common practice of sludge recycling in agriculture results in the transfer of substantial quantities of TCS to US soils used, in part, for animal husbandry and crop production.”²²

Triclosan and chlorine are known to react and create chlorinated triclosan derivative (“CTD”) products. When exposed to sunlight, CTDs will photolyse in water and form polychlorodibenzo-*p*-dioxins, dioxin is a potent toxicant and regulated under California’s Water Code Section 7. “It is important to determine the amount of CTDs formed from triclosan during wastewater disinfection, because they may give rise to more highly toxic dioxins.”²³

The permit does not mention CTD products or the “more highly toxic dioxins” they may form. There is no mention of any studies performed by the Co-Permittees to determine the polychlorodibenzo-*p*-dioxin load destined for public waters or any suggested methods to eliminate it.²⁴

Chlorine and MRSA

Exposure to chlorine has been demonstrated to magnify the virulence of Methicillin-resistant *Staphylococcus aureus* by inducing amino acid synthesis genes as well as enhancing exotoxins, hemolysins, leukocidins, coagulases, and surface adhesion proteins—the very mechanisms that make MRSA so dangerous²⁵. Since sewage treatment facilities in Sonoma County do not guarantee the removal of all *Staphylococcus aureus*, we reasonably can assume that a certain number exist in “recycled” water²⁶ and therefore will contribute to storm runoff.

The permit does not discuss these enhancements to MRSA nor the increased risk they represent by permitting non-storm water runoff to mix with surface waters.

²² Mass balance assessment of triclosan removal during conventional sewage treatment, Jochen Heidler, Rolf U. Halden, Johns Hopkins University, Bloomberg School of Public Health, Department of Environmental Health Sciences, Johns Hopkins University Center for Water and Health, 25 April 2006

²³ Formation and Occurrence of Chlorinated Triclosan Derivatives (CTDs) and their Dioxin Photoproducts, Jeffery M. Buth, William A. Arnold, Kristopher McNeill, University of Minnesota, Department of Chemistry, buthx007@umn.edu

²⁴ *Nota Bene*: Only manufacturers of dioxin products (American Chemical Council members) have attempted to depreciate the CTD study. However, the nexus of profit motive versus negative publicity render these depreciations specious.

²⁵ Toxicogenomic Response to Chlorination Includes Induction of Major Virulence Genes in *Staphylococcus aureus*, Matthew Wook Chang,, Freshteh Toghrol, and, William E. Bentley, Environmental Science & Technology 2007 41 (21), 7570-7575

²⁶ A seasonal study of the *mecA* gene and *Staphylococcus aureus* including methicillin-resistant *S. aureus* in a municipal wastewater treatment plant. Börjesson S, Melin S, Matussek A, Lindgren PE. Department of Clinical and Experimental Medicine, Division of Medical Microbiology, Linköping University, SE-581 85 Linköping, Sweden, stefan.borjesson@liu.se

-Antibiotic Resistance in Wastewater: Methicillin-resistant *Staphylococcus aureus* (MRSA) and antibiotic resistance genes, Börjesson, Stefan, Linköping University, Medical Microbiology, Doctoral thesis, 2009.

-Harwood, supra at fn. 5

Chlorine and the Immune System

When chlorine is used as a disinfectant, weak bacteria die and strong bacteria survive. This process has gone on long enough for microbiology to recognize many chlorine-resistant bacteria²⁷. Chlorine-resistant bacteria present a serious health challenge because the body's leucocytes destroy pathogens by injecting them with hypochlorite. When disease-causing bacteria become immune to chlorine then the body has, in effect, no working immune system.

The permit contains no discussion of chlorine-resistant bacteria, their effect on the human immune system or the MPN of such bacteria found in sewage effluent that will contribute to storm water runoff. The permit lacks estimates of the permit's contribution to chlorine-resistant pathogen populations in general and the overall effect, if any, the permit will have on public health as a result.

Chlorine and Acetaminophen

Regardless of the efficacy that chlorination may have in reducing or destroying pathogens, chlorine has been demonstrated to transform certain common chemicals with significant health risks into vastly more potent chemicals with much greater health risks. Chlorine is known to transform acetaminophen (Tylenol®) into two separate toxicants neither of which were introduced to the waste stream²⁸. Acetaminophen is not only one of the most widely consumed drugs in the world, making it relatively prevalent in sewage, it is the leading cause of acute liver failure in the United States²⁹. In other words, the WWTP process itself generates toxicants from ingredients found in raw sewage and during the treatment process itself. However, the permit does not account for potential dangers occasioned by chlorine reactions with acetaminophen during the treatment process nor on the fate of such substances once released into the environment.

²⁷ Phenotypic and Genetic Diversity of Chlorine-Resistant *Methylobacterium* Strains Isolated from Various Environments, AKIRA HIRAIISHI, KATSUNORI FURUHATA, ATSUIHIKO MATSUMOTO, KAZUKO A. KOIKE, MASAFUMI FUKUYAMA, AND KIYOSHI TABUCHI, APPLIED AND ENVIRONMENTAL MICROBIOLOGY, June 1995, p. 2099–2107 Vol. 61, No. 60099-2240/95 Copyright 1995, American Society for Microbiology

²⁸ Transformation of Acetaminophen by Chlorination Produces the Toxicants 1,4-Benzoquinone and N-Acetyl-p-benzoquinone Imine, Mary Bender, William A. McCrehan, Analytical Chemistry Division, National Institute of Standards and Technology, ENVIRON. SCI. & TECHNOL.,

²⁹ Acetaminophen-Induced Acute Liver Failure: Results of a United States Multicenter, Prospective Study, Anne M. Larson, Julie Polson, Robert J. Fontana, Timothy J. Davern, Ezmina Lalani, Linda S. Hynan, Joan S. Reisch, Frank V. Schiødt, George Ostapowicz, A. Obaid Shakil, William M. Lee, and the Acute Liver Failure Study Group; HEPATOLOGY 2005;42:1364-1372, September 12, 2005

What You Don't Know Can Hurt You

Numerous reports³⁰ attest to the persistence of a wide variety of pharmaceutical compounds in treated sewage and treated wastewater. These discoveries sometimes note that the amounts of drugs detected were below therapeutic dosages and therefore —incorrectly—considered them to be harmless. Low dosage notwithstanding, endocrine disruptors, can be biologically active in parts per trillion, as noted *supra* page 6 and in *fn.14*.

Also, the permit does not take into account possible chemical reactions amongst the unusually large numbers of pathogens, pharmaceuticals, illegal drugs, industrial chemicals, endocrine disruptors, antimicrobial products, and other material found in treated sewage and spread on land that contributes to storm water runoff. As noted with acetaminophen and chlorine, some contaminants react with each other and produce entirely new toxicants all of which becomes available to storm water runoff.

Ultra-Violet Light Disinfection

Ultra-Violet (“UV”) light disinfection in the sewage treatment process is often considered more efficient than chlorine and also avoids some of the problems associated with chlorine. However, UV disinfection has no effect on endosymbiont bacteria nor on the genetic material they contain. Antibiotic-resistant endosymbionts present a particular challenge because the ARGs stand an excellent chance of surviving disinfection attempts, whether by UV or chlorine or both. The permit does not discuss the endosymbiont problem nor its solution.

Regulatory Compliance

Even given the small sample of scientific, peer-reviewed literature referenced in this short letter, there appears to be considerable reason to doubt that the permit complies with the California Health and Safety Code (“CHSC”) §§ 5410-5416 inclusive. For example:

§ 5410(d): "Contamination" means an impairment of the quality of the waters of the state by waste to a degree which creates a hazard to the public health through poisoning or through the spread of disease. "Contamination" shall include any equivalent effect resulting from the disposal of waste, whether or not waters of the state are affected.

³⁰ AP: Drugs found in drinking water, Jeff Donn, Martha Mendoza and Justin Pritchard, Associated Press, USA Today, 2008-03-10;

-Where rivers run high on cocaine, NIGEL HAWKES, Times (UK) Online, August 05, 2005;

-PRESENCE OF PHARMACEUTICALS IN WASTEWATER EFFLUENT AND DRINKING WATER, METROPOLITAN ATLANTA, GEORGIA, JULY–SEPTEMBER 1999, Elizabeth A. Frick, Alden K. Henderson, Ph.D., M.P.H., Deborah M. Moll, Ph.D, Edward T. Furlong, Ph.D., and Michael T. Meyer, Ph.D., Proceedings of the 2001 Georgia Water Resources Conference , held March 26-27, 2001

§ 5410(f): "Nuisance" means anything which: (1) is injurious to health, or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property, and (2) affects at the same time an entire community or neighborhood, or any considerable number of persons, although the extent of the annoyance or damage inflicted upon individuals may be unequal, and (3) occurs during, or as a result of, the treatment or disposal of wastes.

§ 5411: No person shall discharge sewage or other waste, or the effluent of treated sewage or other waste, in any manner which will result in contamination, pollution or a nuisance.

Similarly, the Code of Federal Regulations and the Porter-Cologne Water Quality Control Act prohibit discharges that would impair present or future beneficial uses of water, will cause pollution, nuisance, or contamination, or will unreasonably degrade the quality of any waters of the state. The pollutants and contaminants mentioned in this letter, if permitted to be discharged into receiving waters and not removed or otherwise rendered harmless would appear to violate a host of stipulations outlined in the California Water Code Division 7.

Exacerbating community acquired antibiotic-resistance; the spread and even creation of antibiotic-resistant pathogens; the creation and spread of chlorine-resistant pathogens; contamination of waterways with endocrine-disrupting phthalates; and threatening both the wine and agricultural produce industries, would each appear to contravene both the spirit and letter of these regulatory stipulations. It appears unclear to us how the permit will satisfy these legal hurdles in its present state.

One Possible Remedy

Upgrading sewage treatment facilities so that the above-named contaminants are completely removed from effluent and sludge in the first place would obviously allow the Co-Permittees to not only comply with current legislation but to substantially increase protection of the public's health. Upgrades should include multiple membrane technologies to enable reverse osmosis; a complete reassessment of UV disinfection; nanofiltration; ozone disinfection and other techniques not specified that remove, disable, disinfects or otherwise sterilizes and renders harmless these contaminants.

Historical Perspective

In the past, in fact in the very recent past, the use of so-called "recycled" water seemed reasonable and safe to both scientists and environmentalists. However, in light of the scientific investigations herein submitted, so-called "recycled" water now occupies an historical moment analogous to that of cigarettes in the 1950's or DDT in the 1970s.

In 1957, most people did not take seriously the warnings of Surgeon General Leroy Burney, M.D., when he declared cigarette smoke injurious to health. Indeed, it took decades of scientific evidence and a slow but inexorable gathering of social opprobrium before Americans fully realized the danger and stopped smoking on a large scale. The number of smokers today is miniscule compared to people who smoked in 1957.

In 1948, the Swiss chemist Paul Müller actually received the Nobel Prize in Physiology or Medicine for his discovery that DDT was an effective contact poison for certain insects. At first, DDT seemed to be a boon for public health and comfort. But by 1972, the United States had banned DDT after discovering that it is a carcinogen and that it posed a serious and particular threat to avian life.

The widespread use of partially-cleaned sewage effluent appears to be following a similar trajectory of acceptance and rejection. In the end, we will have to recycle water, not only to comply with regulations, but to survive. "Recycle", however, means to remove all contaminants, not just some of them.

Sincerely,

A handwritten signature in black ink, appearing to read 'H.R. Downs', with a stylized flourish extending to the right.

H.R. Downs
President
O.W.L. Foundation