

## RRWPC

### Russian River Watershed Protection Committee

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October 8, 2012

#### RRWPC COMMENTS ON REVISED RECYCLED WATER POLICY AMENDMENT

Dear Chairman Hoppin and Board Members:

I wish to express our concerns about the “*Revised Recycled Water Policy Amendment*” released for comment on September 17, 2012. **Our primary message here is to express concerns about the failure of this policy to require monitoring for endocrine disrupting chemicals in tertiary wastewater used for landscape irrigation.**

RRWPC submitted extensive comments (with attachments) on the Recycled Water Policy Amendment last July during the formal comment period. We also fully supported the comments of scientist Laura Vandenberg, PhD, and the study she submitted, of which she was lead author involving twelve key scientists. The study considered impacts to humans and wildlife of low dose exposures to endocrine disrupting chemicals and synthesized findings of over 850 studies on the topic.

*(Hormones and endocrine disrupting chemicals: Low dose effects and non-monotonic dose responses, Laura Vandenberg, PhD. et. al. Endocrine Reviews. Online Mar. 14, 2012)*

#### ***First, do no harm.....***

On Wednesday, October 3, 2012, we mailed six copies of the June, 2012 edition of San Francisco Medical Society’ s *San Francisco Medicine: Environmental Health Magazine* to the State Water Board (one for each Board member and one for staff). (#1) This issue is filled with informative articles on certain health effects from endocrine disrupting chemical exposures such as: cancer, diabetes, autism, birth defects, and more.

Also included in the magazine is a small pamphlet called, *Healthy Aging and the Environment*. It contains a wealth of recommendations on how to minimize exposure

risk and also serves as a vehicle to help federal and state agencies assess human and environmental health hazards...and reduce the use of those (chemicals) of greatest concern. For instance they recommend (page 10), “ *Prevent harm from new or existing chemicals when credible threats exist, even when some uncertainty remains.*” We interpret this to mean that they support the Precautionary Principal, similar to the physician’ s oath to “ *First, do no harm.*” The assumption that wastewater irrigation is safe, supported by findings of this policy, without proper safeguards and regular monitoring, in our view, contradicts this suggestion.

RRWPC does not have the scientific expertise to formally challenge most findings of the State’ s Scientific Panel on CEC’ s, but do wish to challenge the finding that monitoring for endocrine disrupting chemicals in tertiary water used to irrigate landscapes is not necessary.

We asked staff person Melenee Emanuel on October 2, 2012 whether she would respond to our July 2, 2012, comments before the meeting? She said staff was working on responses, but they would not be ready until after the end of the comment period deadline Oct. 9<sup>th</sup>, causing these comments to be written in a vacuum without knowledge of what the State’ s response will be. The amended policy ignored substantive comments and documents submitted by Russian River Watershed Protection Committee (RRWPC) indicating significant public concern for numerous health impacts to humans and wildlife caused by very low dose exposures to endocrine disrupting chemicals.

RRWPC is based primarily in the lower Russian River, known world wide for its incredible beauty and scenic resources. People come from all over to recreate in our area every summer. They bring their children, their families and friends. We are concerned that wastewater runoff from irrigation, at a time when flows are extremely low and assimilation capacity poor, will potentially cause human contact with toxic substances.

The Laguna de Santa Rosa, a major tributary that merges with Mark West Creek and then the Russian River just upstream of Forestville, is the receiving water body for wastewater irrigation runoff and for many years has been severely impaired as a result of wastewater discharges, urban runoff, ag irrigation, dairy runoff, etc. Problems are worse in the summer when flows are low and temperatures are high. Next year you will consider changes to Decision 1610 to permanently lower minimum flows in the Russian River, thereby exacerbating any harm this irrigation may cause. We don’ t know to what extent toxic chemicals are a problem, because the appropriate studies have not been done (or have not been made available to the public) and monitoring of wastewater for endocrine disrupting chemicals should be designated and required.

Furthermore, the Laguna is impaired for nutrients (phosphorus and nitrogen), temperature, sediments, mercury, and dissolved oxygen. Conceivably, irrigation could make it much worse. The Regional Board will not deal with this through the NPDES process and we are concerned that general permits will not adequately protect our environment from endocrine disrupting chemicals that are applied to landscapes, that may run off during wastewater irrigation.

***Harm resulting from low dose exposures is non-controversial.....***

In the case of the endocrine system, according to Dr. Vandenberg and the Endocrine Society, it is well established that exposure to low doses of E.D.'s is harmful to humans and wildlife. In fact, the most harmful exposures are usually the smallest ones. In the San Francisco magazine (#1), Dr. Vandenberg states in her opening paragraph: (page 15) “*Virtually all safety standards for chemical exposures are determined through a process that assumes that high-dose testing will reveal relevant risks because “the dose makes the poison.” For many well-studied contaminants this is a reasonable assumption, but for compounds that behave like hormones, it is demonstrably false. The public health implications of this conclusion are enormous, because it means that many—likely dozens, plausibly hundreds, possibly thousands—of today’s chemical safety standards are too weak by orders of magnitude.*”

She further explains: “*Low doses are often within the range that traditional toxicological testing has determined to be “safe.”*”

“*The question is whether EDCs are safe at the doses the typical person experiences. To determine what doses are safe, regulatory toxicology usually starts by administering large doses of a chemical to animals, identifying the highest dose at which no effect is found, and then extrapolating downward to calculate a safe dose. Those “safe” doses are rarely tested. Yet EDCs, like hormones, defy the toxicological dogma: Low doses can have effects that are not expected from high-dose exposures. In fact, these effects can be observed at doses orders of magnitude beneath the highest dose that produces no effect using traditional approaches. The mechanisms by which chemicals cause high-dose effects usually are completely unrelated to mechanisms that EDC’s employ at low doses, and the effects of high and low doses can be on completely different end points.*”

In fact, we can go back 50 years to Rachael Carson’s Silent Spring, (#2) when she said, “*The most alarming of all man’s assaults upon the environment is the contamination of air, earth, rivers, and sea with dangerous and even lethal materials. This pollution is for the most part irrecoverable: the chain of evil it initiates not only in the world that must support life but also in living tissues is for the most part irreversible. In this now universal contamination of the environment, chemicals are the sinister and little-recognized partners of radiation in changing the very nature of the world—the very nature of its life.*”

While the long established and prestigious Endocrine Society has long recognized that very low dose exposures to endocrine disrupting chemicals (sometimes in the parts per billion range) often causes an extensive range of problematic health effects in humans and wildlife, the regulatory community, bent on maintaining conventional risk assessment analysis, usually does not acknowledge this fact. In regard to this policy, we have repeatedly heard that *more study needs to be done*, although funding is seldom provided to accomplish it. The current body of scientific evidence, exemplified by the 80 page study on low dose impacts, already entered into the record on this issue, is perfectly clear.

**THERE IS NO SAFE DOSE OF ENDOCRINE DISRUPTING CHEMICALS, MANY OF WHICH HAVE BEEN CLEARLY IDENTIFIED AND (as already mentioned) INCLUDE PESTICIDES AND HERBICIDES THAT WILL RUN OFF INTO OUR**

**WATER WAYS IN INCREASED AMOUNTS AS A RESULT OF THIS POLICY.** The monitoring of receiving waters downstream of these irrigation areas is essential to provide the information needed to determine the risk. And yet no monitoring will occur and, as far as we can tell, no robust scientific rationale has been given.

Furthermore, this amended policy fails to consider the comments of the director of the National Institute of Health and Department of Health and Human Services, Linda S. Birnbaum, who states in *Environmental Health Perspectives* Online March 14, 2012 (#3): *Low internal doses of endocrine disruptors found in typical human populations have been linked to obesity, infertility, neurobehavioral disorders, and immune dysfunction, among others.* She also states the following in a Frontline interview called “ Fooling with Nature” in 1998: “ *Now, we've known that there are naturally occurring plant estrogens that, in fact, can impact reproduction. They can impact development. Farmers have known for years that you don't yet let the sheep into the clover because it can be a real problem with their ability to reproduce.*” It is pertinent that we have heard Dr. Shane Snyder, one of California’ s Scientific Panel members for this policy, talk on several occasions about natural estrogens and the fact that because they cause no harm, we should not be concerned about small amounts of synthetic estrogens in the wastewater. Based on the study on low dose exposures, Dr. Vandenberg does not agree and obviously, many others do not agree either.

***Irrigation runoff almost always occurs.....***

Originally the State’ s Scientific Panel concluded that monitoring these chemicals was unnecessary because they occurred at such low doses as to have no effect. Yet they recently changed their rationale to justify the finding that monitoring was not necessary, based on the assumption that the risk of exposure is so low, as to make monitoring unnecessary, even with the provision of extensive evidence demonstrating that the opposite is true. This assertion is contradictory to the evidence we provided on repeated irrigation overflows we have seen occur, directly contradicting this assumption.

RRWPC has documented recurrent runoff in photos in Santa Rosa and Rohnert Park at numerous locations where spray irrigation with water and/ or wastewater occurs. Evidence is included with multiple photos over time of a single example of serious ponding from runoff (#4). We have also photographed this runoff repeatedly going into drains leading to creeks. We expect that drip irrigation that is set back from waterways is far less of a problem, and should be required by the Recycled Water Policy.

When I had reported the irrigation runoff in Rohnert Park and Santa Rosa, the Regional Board merely talked to those entities about changing irrigation practices, but we never received any written response as to what had been accomplished. There were never any penalties imposed or hearing about a violation. We are concerned that the definition of ‘ incidental runoff’ may be totally unenforceable and therefore not protective of aquatic life or the environment. (I still see small amounts of runoff in Santa Rosa and I think they changed their time of irrigation so not much would show up in the morning hours. I have witnessed the same pond however, every time I go by: picture attached.)

We include the following description of incidental runoff quoted in our complaint, (#5) from the Basin Plan and submitted on Feb. 10, 2012:

The North Coast Basin Plan provides a similar definition (compared to Recycled Water Policy), but also admits: “ *Due to the unplanned nature of incidental discharges, this category of non-storm water discharges poses a slightly greater risk to water quality due to the potential for higher levels of pollutants and less opportunity to control the rate, volume, and timing of the discharge.*” Yet they don’ t describe the additional risk and continue to leave questions about what they are referring to. Even worse, they don’ t explain why this is not a violation of the Clean Water Act, which requires regulation of all waste discharges.

RRWPC and many others had consistently requested that the term “ incidental” be numerically defined. It never was, and is now up for speculation. Nevertheless, photos taken by RRWPC between December 14, 2011 and January 9, 2012 on five different dates, illustrate the on-going and non-incidental nature of the runoff.

### ***Informal Russian River Study for estrogen indicators....***

About seven years ago, the Regional Board (RB1) contributed to a study to screen several surface waterways for estrogenic endocrine disrupting chemicals and also examine some fish tissue samples for estrogenic effects. While the study was never published, it clearly stated that natural and synthetic estrogens are the most significant chemical to threaten fish populations, with the most potent E.D. being 17 $\alpha$ -ethynlestradiol (EE-2 from female contraceptives) and 17-beta estradiol (E-2). Under this policy, monitoring for direct application of highly treated wastewater into drinking water supplies will include monitoring for E-2.

Because of the potential exposure of fish to the irrigated runoff water, we strongly recommend that if you monitor nothing else, that these estrogenic chemicals be monitored in the irrigated tertiary wastewater also, since relatively small amounts can seriously affect fish, and people, especially indigent people, eat fish caught in the Laguna. **Has anyone considered what impacts could occur from exposures to fish toxins by the fish eating public?**

It’ s important to mention a potential remedy to this problem. Experts have discovered that the longer the wastewater sits in the wastewater storage pond, the more endocrine disrupting chemicals seem to dissipate and become virtually undetectable if held as much as ten days. I’ m fairly certain there have been studies on this. It would be good to learn about it’ s feasibility.

In fact, this policy virtually ignores impacts to the environment. State and Federal Water Law is extremely weak in protecting aquatic life from chemical alterations in their biological makeup. In a 1998 Frontline report, (#6) Theo Colborn stated: *Look at the chemicals that EPA has pulled off the market. The only thing they pulled off was DDT, PCBs and a few pesticides. Nothing else has come off the market. I could give you a list that would blow you away of chemicals we know are not safe, but they're still being released into the environment.*”

It is essential to study fish directly for estrogenic activity as a result of exposure to these chemicals. This has been a finding of biologist John Sumpter as well. (*Our Stolen Future*, Theo Colborn, Dianne Dumanoski, and John Peterson Myers) pages 131-134) (#7) Dr.

Sumpter studied sexually confused fish downstream of wastewater treatment plants. “...*John Sumpter, ...is a biologist from Brunel university in Uxbridge, who has studied the role of hormones in fish reproduction....Even experienced fishermen could often not tell if a fish was male or female, for they showed male and female sexual characteristics at the same time.*” Dr. Sumpter believed that if there was estrogen in the water, male fish would produce vitellogenin, a special egg yolk protein only produced by females. Indeed, this proved to be the case.

It seems like it would be relatively simple to test tertiary wastewater that is to be irrigated for estrogenic responses in fish. Of course, that does not address the likelihood of exposures to all endocrine disrupting chemicals such as herbicides and pesticides that run off the landscapes with the wastewater. That can be dealt with by best management practices such as requiring set backs from streets and streams, use of drip irrigation, and other safeguards.

The use of spray irrigation not only sends these chemicals through the air, but when runoff occurs, which often happens, it carries with it the herbicides, pesticides, etc. applied to the landscape prior to the wastewater irrigation. At a minimum, estrogen (17-beta estradiol) should be regularly monitored in the wastewater used for irrigation, particularly since summer flows cannot adequately assimilate the toxins at a time when recreational use is high and flows are low.

In our country, the importance of the Precautionary Principle is mostly ignored. Margaret Kripke wrote the article in the magazine I sent you entitled Reducing Cancer Risks (page 13) (#1) Dr. Kripke is a professor of immunology at University of Texas MD Anderson Cancer Center and was one of three scientists who served on the President’s Cancer Panel which produced the report “*Reducing Environmental Cancer Risks: What We Can Do Now*” (2010).

She states, “*I always assumed that if something was a known human carcinogen, that it would be regulated. This is clearly not the case. There are carcinogens in our environment that have been banned in Europe and Canada but still remain unregulated here. Second, I always assumed that before things were put on the market, they would be tested. And that, too, is absolutely not the case. We test very few things for cancer-causing properties. The United State has not regulated much of anything since the 1990’ s.*” Dr. Kripke then goes on to state that of the approximate 80,000 chemicals currently on the market, only about 2% have been tested for cancer causing properties. In our country, contrary to the Precautionary Principle, we don’t ban anything until it is proved harmful, rather than first proving it safe, as they do in most European and industrialized countries. What a shame!

Consumer Report’s current issue (Nov., 2012) has a six-page report on the occurrence of arsenic in rice, especially the so-called healthier brown rice, which has more arsenic than white. This is often the first solid food fed to infants. They found that some infant rice had levels of inorganic rice that were sometimes five times more that what was found in oatmeal for infants. In almost every product tested, they found measurable levels of arsenic and went so far as to advise people to limit their intake of rice. Studies show that arsenic can cause cancer in humans.

What is important here is not that we are requesting the Water Board to regulate arsenic through this policy, but rather that we have gone so long before discovering this problem because legislators are often adverse to offending the Chemistry Council and, where regulations do exist, regulators are resistant to enforcement, since they are often not funded to do their jobs properly. Because there is a high likelihood that endocrine disrupting chemicals will end up in our waterways, and, in the case of recreational areas, will potentially expose many people to dangerous toxins, we urge you to implement a monitoring program, TO ERR ON THE SIDE OF CAUTION, and assure the public that you have done all you can to protect their health and well being.

We need to also mention the October 6, 2012 New York Times article by Nickolas D. Kristof entitled “ The Cancer Lobby”. (#8) You can guess what this is about by just reading the title. Author Kristof targets formaldehyde here, but similar risks occur with residual chemicals in the wastewater and the herbicides and pesticides running off as a result of careless irrigation applications. He states, “ *The American Chemistry Council is working to delay and ultimately destroy the Report on Carcinogens*”, the scientists wrote. And, “ *The American Chemistry Council is also trying to undermine scientific reviews by the Environmental Protection Agency.*”

In expressing concerns about the Recycled Water Project, I don’ t know if the American Chemistry Council plays any role in this policy, but WateReuse of California does. They consist of a group of mostly powerful water purveyors and wastewater utilities that have a stake in avoiding regulation wherever they can. This group played a lead role in the writing of not only this policy, but also AB 2398, legislation that entirely rewrote water law in regards to recycled water and attempted to get tertiary wastewater declassified as a waste. That legislation has been killed for this year, but is probably going to be reintroduced next February.

Another important issue that has come up is the need to study the extent to which plants absorb these toxins and end up in the food supply. I do not think this was addressed in the Recycled Water Policy, at least not in light of the new study on low dose effects. I’ ve run across several small articles stating that this is an issue of concern, but have not had time or expertise to investigate this issue in any detail. It is one that can have serious ramifications however, and should be addressed before decisions are made to not require monitoring for toxins that will be applied to crops. I do know that a scientist named Chad Kinney, environmental chemist at Colorado State University has worked extensively on this issue and apparently demonstrated that this is a concern. I tried to contact him, but he has not responded as yet. It is critical that this issue be addressed.

We came across an article entitled, “ *Toxic Irrigation: Major Study Indicts Chemicals Found in Recycled Wastewater Used for Vineyards and Other Crops*”, by Lewis Perdue, (#9) where he calls attention to the “ low dose” study described extensively above, and expresses concern about the use of wastewater containing these chemicals for irrigation. He also states, “ *...the study’ s conclusions hold serious consequences for industrial and recreational landscape irrigation as well as the thousands of acres of premium California vineyards currently irrigated with highly treated wastewater.*” And, “ *it is not currently possible, using existing*

*standards and/or regulatory agency risk assessment methodology, to evaluate the endocrine effects of these chemicals, if any, at the low concentrations reported.”*

He goes on to say that, “ ***...risk-assessment, regulations and public health decisions are being made without sufficient data.***”

None of this even begins to consider individual reactions to or cumulative impacts from these many endocrine disrupting toxins that merge in the wastewater treatment process to form a probably toxic soup. That soup may meet all current regulations and be termed “almost drinkable”, but that by no means proves it safe. There is too much that has not been considered, even in terms of what is known, let alone what is not. It is critical that we refrain from letting our human arrogance make allegations of safety when we need to reserve judgment because of the vast amount that is unknown.

Sincerely,

A handwritten signature in black ink that reads "Brenda Adelman". The signature is written in a cursive, flowing style.

Brenda Adelman  
Russian River Watershed Protection Committee

## **References:**

#1: *San Francisco Medicine: Environmental Health*, San Francisco Medical Society, Vol. 85 No. 5, June, 2012

#2: *Silent Spring*, Rachel Carson, quote in *Washington Spectator*, page 2, Oct. 1, 2012, Lou Dubose, editor

#3: *Environmental Chemicals: Evaluating Low-Dose Effects*, Linda S. Birnbaum, Environ. Health Perspective, 120: a143-a144, <http://dx.doi.org/10.1289/ehp.1205179> Online: 14 March 2012

#4: Same picture of bus stop with ponding taken on several dates on 9<sup>th</sup> Street in Santa Rosa, just east of Stony Point Rd. and across the street from the Santa Rosa Utilities Building.

#5: *RRWPC Complaint to North Coast Board*, Brenda Adelman, January 30, 2012

#6: *Fooling with Nature*, Frontline, interview by Doug Hamilton with Theo Colborn, PhD. in Feb., 1998

#7: *Our Stolen Future*, Theo Colborn, et.al. Penguin Books, March 1996 pp. 131-133

#8: *The Cancer Lobby*, Nicholas D. Kristof, New York Times, Oct. 6, 2012

#9: *Toxic Irrigation: Major Study Indicts Chemicals Found in Recycled Wastewater Used for Vineyards and Other Crops*: Lewis Purdue, Wine Industry Insight, June 14, 2012

STATE WATER RESOURCES CONTROL BOARD  
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November 3, 2012

### REGARDING: REVISED RECYCLED WATER POLICY AMENDMENT

Dear Ms. Townsend:

I have enclosed six copies of the San Francisco Medical Society's magazine entitled San Francisco Medicine. This magazine is intended to supplement comments I will submit by email before the deadline on October 9, 2012. I request that you supply each of the Board members with a copy as soon as possible and before the hearing on October 16<sup>th</sup>. There is also one copy for staff.

This magazine is devoted to the issue with which I am most concerned: low dose impacts and health consequences of exposure to low doses of endocrine disrupting chemicals. The article by Laura Vandenberg, PhD about the study on low dose impacts of endocrine disrupting chemicals by twelve lead scientists in the field, is also in this issue. Dr. Vandenberg had submitted a letter and this article on this issue as part of the prior comment period, along with the 80 page study that highlights findings in about 850 studies on the topic. High level scientists, including the Endocrine Society, have concluded that there are no safe exposure levels for endocrine disrupting chemicals.

On October 3, 2012, I spoke with Melenee Emanuel of your staff and was told that response to our comments would not be available until AFTER the Oct. 9<sup>th</sup> comment period ends. This puts us at a great disadvantage. Our main goal is to challenge the finding that there should be no monitoring of CEC's in tertiary wastewater used for landscape irrigation. We have detailed our concerns in our letter submitted during the previous comment period and a new letter we will submit in the coming week. We will also submit a series of pictures of one area in Santa Rosa near a bus stop across from Santa Rosa's Utility Building where irrigated wastewater has ponded and never drains, even though we have called this to the attention of authorities many times.

We hope Board members will have time to look over the many fascinating and informative articles in this magazine to help them decide whether potential impacts are such that monitoring of CEC's in irrigated tertiary wastewater is a wise thing to do.

Sincerely,



Brenda Adelman  
Russian River Watershed Protection Committee

## **RRWPC**

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### **Russian River Watershed Protection Committee**

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### **Complaint Regarding Possible Irrigated Wastewater Violations on Stony Point Road from Santa Rosa' s recycled irrigation project**

Report by Brenda Adelman/ RRWPC  
January 30, 2012

#### **Background:**

For several years, RRWPC has provided written and verbal comments to the State Water Resources Control Board (SWRCB) and the North Coast Regional Board (RB1) on the issue of “ incidental” runoff of irrigated wastewater. We have enumerated our concerns at length regarding the State’ s Recycled Water Policy, the State’ s General Landscape Permit, the Regional Board’ s MS4 Permit, and the Basin Plan Amendment for “ Low Threat Discharges” as they have incorporated this issue. We have appeared before both boards and gave testimony on numerous occasions regarding our concerns. We have spoken with staff about this issue in numerous meetings. There is little more we could have done to call attention to the problems created by this policy. In fact, the issue was termed ‘ controversial’ by both boards.

#### **Why is RRWPC so concerned?**

Wastewater and potable water look and smell exactly alike. There are no alarm bells to tell people where that water has been. While only highly treated wastewater would be used, nevertheless treatment processes are sometimes imperfect and unreliable. Furthermore, there are many unregulated toxins such as endocrine disruptors including pesticides and herbicides, organic chemicals,

heavy metals, nutrients, and much more. These have been demonstrated in numerous studies to have significant health and other impacts on humans and wildlife. We have special concern for children who may play on lawns irrigated with wastewater.

In addition to these unidentified constituents in the wastewater, the irrigation runoff can carry toxic chemicals and soil amendments into the drainage system from treated landscapes. Most of this occurs in the summer time, when creek flows are low, recreational use is high, and toxins bio-concentrate. This is not even to mention how these chemicals interact with one another and bio-magnify their effects. (Irrigation applications are supposed to be applied only in amounts that can be utilized by the plants so as to avoid runoff. Therefore cold weather applications should not be allowed.)

In Santa Rosa' s case, runoff can get into the storm drain system and exacerbate existing nutrient problems in the Laguna, which is currently listed as impaired for nitrogen, phosphorus, dissolved oxygen, temperature, sediments, and mercury. (We thought it irresponsible that the Low Threat Discharge Amendment should have been approved BEFORE completion of the Laguna TMDL process.)

It is common for people to allow runoff in watering their lawns. Even when they are educated to irrigate responsibly, they often take short cuts when no one is looking. It is difficult to follow all the rules inherent in a recycled water program. In acknowledgement of this problem, the State included the following language in their Policy. Furthermore, the General Landscape Permit went into further detail on how to irrigate responsibly.

What is the definition of “ incidental runoff”? The State' s Recycled Water Policy states:

***Landscape Irrigation Projects  
Control of incidental runoff.***

*Incidental runoff is defined as unintended small amounts (volume) of runoff from recycled water use areas, such as unintended, minimal over-spray from sprinklers that escapes the recycled water use area. Water leaving a recycled water use area is not considered incidental if it is part of the facility design, if it is due to excessive application, if it is due to intentional overflow or application, or if it is due to negligence. Incidental runoff may be regulated by waste discharge requirements or, where necessary, waste discharge requirements that serve as a National Pollutant Discharge Elimination System (NPDES) permit, including municipal separate storm water system permits, but regardless of the regulatory instrument, the project shall include, but is not limited to, the following practices:*

- (1) *Implementation of an operations and management plan that may apply to multiple sites*

and provides for detection of leaks, (for example, from broken sprinkler heads), and correction either within 72 hours of learning of the runoff, or prior to the release of 1,000 gallons, whichever occurs first,

(2) Proper design and aim of sprinkler heads,

(3) Refraining from application during precipitation events, and

(4) Management of any ponds containing recycled water such that no discharge occurs unless the discharge is a result of a 25-year, 24-hour storm event or greater, and there is notification of the appropriate Regional Water Board Executive Officer of the discharge.

The North Coast Basin Plan defines “ incidental runoff” as, “ ..accidental discharges from potable water sources due to unexpected line breaks, incidental runoff of potable or recycled water from landscape irrigation due to an unexpected break in irrigation line or sprinkler head.....Due to the unplanned nature of incidental discharges, this category of non-storm water discharges poses a slightly greater risk to water quality due to the potential for higher levels of pollutants and less opportunity to control the rate, volume, and timing of the discharge.”

RRWPC had consistently requested that the term “ incidental” be numerically defined, which it was not. Therefore it is up for speculation. Nevertheless, the evidence we present with this complaint between December 14, 2011 and January 9, 2012, illustrates the on-going nature of the runoff.

### **Santa Rosa’ s Recycled Water Project:**

For many years, the City of Santa Rosa had been planning a recycled water pilot project on Stony Point Rd. between West College Ave. and Highway 12. Last year they completed the project and hooked up most of the City properties, business parks, public service buildings, shopping centers, and apartment complexes in that area. (We do not know which are NOT hooked up, so some of our pictures may be of potable water rather than wastewater. None the less, over-irrigating with potable water is illegal also as per the North Coast Basin Plan. Furthermore, the runoff may carry toxins with it that end up in the waterways.)

To assure the State they would be in full compliance with the Policy, the MS4 Permit and the Basin Plan Amendment, the City authored a 106 page document called the “ *Recycled Water User’ s Guide*”. This guide is reader friendly with lots of pictures and good advice. The document explained that the hookup requires a City of Santa Rosa Use Permit and that specific design and installation requirements apply. Signs announcing the use of recycled water must be posted.

We cite one page here to give a sample of the detailed requirements for administering the system:

#### *Annual Self Inspection Report and regular monitoring*

*The city requires that recycled water users conduct an inspection at least once per year while the recycled water system is in use.*

*The city of Santa Rosa will mail the report form to the site supervisor once a year. The site supervisor must submit the results to the city in the timeframe established by the city. upon completion, the site supervisor must keep a copy of the report for their records.*

*To assure full compliance with the rules and regulations governing the use of recycled water, regular monitoring of any recycled water system is necessary. For irrigation systems, weekly or twice-monthly inspection is recommended. inspection should include site observation for the following types of situations:*

- 1. is there evidence of recycled water runoff from the site? if so note location and nature of the problem.*
- 2. is there evidence of recycled water ponding, and/or evidence of mosquitoes breeding within the irrigation area due to ponded water?*
- 3. are warning signs, tags, stickers, and above ground pipe markings properly posted to inform the public that irrigation water is recycled water, which is not suitable for drinking?*
- 4. is there evidence of leaks or breaks in the irrigation system piping, or tubing?*
- 5. is there evidence of broken or otherwise faulty drip irrigation system emitters or spray irrigation sprinklers?*

*The site supervisor must follow all preventative maintenance and monitoring procedures to assure unauthorized discharge does not take place. in the event that a break in the recycled water distribution system is not detected and repaired according to the standards of this user Guide, the site supervisor must immediately turn off the recycled water system once the break is detected, and immediately contact the city.*

*The site supervisor is required to perform preventive maintenance to ensure that the recycled water system always remains in compliance with the rules and regulations of the city of Santa Rosa.*

*as part of a preventive maintenance program, the site supervisor should:*

*□perform regular inspections of the entire recycled water system. For irrigation systems this includes sprinkler heads, drip irrigation system emitters, spray nozzles, piping and valves, pumps, storage facilities, controllers etc. immediately repair all broken sprinkler heads, faulty spray patterns, leaking pipes or valves, or any other noted condition that violates the recycled water use requirements.*

*□Check all recycled water identification signs, tags, labels, and above grade pipe markings for their proper placement and legibility. replace damaged, unreadable, or missing signs, tags, labels, and pipe markings.*

It has been our concern all along that the best of intentions can be too easily undermined and the following report seems to sadly indicate that we were right. We ask that your department investigate this situation and take appropriate action. We would like to be kept informed about what is being done by your agency and also of any action(s) coming out of this investigation.

### **Recycled Wastewater Runoff Pictures and Report:**

On December 5, 2011 at 10:30 AM I was coming out of a meeting at 35 Stony Point (SR Service Center) and saw about 6-8 irrigation sprinklers irrigating the lawn directly across Stony Point Rd. at the back of the Finley Center. All sprinklers were fairly close

to the street and one of them was pointed towards the street. It is our belief that wastewater was going into the street and probably into the storm drain. I could not stop since I had another appointment. I had no way of knowing how long it had been going on or when it stopped. I knew that site is irrigated with wastewater.

Two days later I attended a City of Santa Rosa meeting where I informed Santa Rosa staff of what I saw. They denied it was wastewater irrigation and stated something about PG&E boxes being flushed out. A few days later, I also informed Regional Board Staff of what I saw and stated I would go back to take photos and subsequently write a report. This is my report.

### **Wastewater Irrigation Runoff Photographs:**

Santa Rosa's Pilot Recycled Water Project was constructed along Stony Point Road between West College and Highway 12. I visited the area between 8 and 9:30 AM on December 13<sup>th</sup> and 21<sup>st</sup> and January 4<sup>th</sup>, 6<sup>th</sup>, and 9<sup>th</sup>. The temperature was between 32 and 40 degrees at all of those times. I didn't get many pictures on Dec. 21<sup>st</sup> because it had been drizzling a little and it was hard to see runoff. On a few mornings, you could see frost on the grass. At no time did I ever see the sprinklers going again, but I did photograph plenty of evidence of irrigation runoff. On the way to and from the Stony Point Rd. area, I looked to see if irrigation was occurring on other city streets. I saw no evidence of irrigation runoff anywhere else. The sites I photographed included:

1. City Bus Stop at corner of West College and Stony Point Rd.
2. Front sidewalk & street (W. College) of Finley Community Center (no evidence of runoff in parking lot)
3. Stony Point Lake (front and back) including 100, 110, and 120 Stony Point addresses.
4. West Ninth Bus Stop (by Pizza Hut, very near Stony Point Rd.)
5. Back of Finley Community Center
6. Stony Creek Apartments (150 Stony Creek Rd.)

In addition, I had seen runoff at the apartment complex directly across the street from Oliver's Market, but could not find a safe parking spot to take pictures. The site of each photo will be identified by using the numbers above with the photo number. **SITES 3 AND 4 ARE RIGHT ACROSS THE STREET FROM SANTA ROSA'S UTILITIES BUILDING!**

What is important to note in these pictures is that most locations were repeat offenders. It is especially telling to note the sign at the City's bus stop informing the public about the wastewater project. The sign was probably up less than six months and was already badly damaged from water exposure. Parked cars in front of the Stony Creek Apartments were regularly sprayed and saturated by what I believe is wastewater. Bus stop benches were saturated with wastewater. Young children are probably being exposed to this stuff and this may cause a health problem. Furthermore, I included many photos of wastewater going down the street a long way (next to curb) and going down the drainage opening leading into the creek.

We need to mention that we had one technical problem. A group of photos are undated because the camera I generally used for these photos ran out of battery power. I didn't

realize that the date stamp was not on this group of pictures until much later. Furthermore, when I look at the date in the camera it states the pictures were taken at 2200 on January 3, 2012. This is incorrect. The pictures were all taken between 8:30 and 9:30 AM on January 4, 2012.

We got a message from Jennifer Burke of Santa Rosa asking about the situation since she heard about our presentation on this issue during Public Appearances at the recent Regional Board Meeting. (Jan. 19, 2012) She told me that not everyone along Stony Point Rd. is hooked up. We are sure you would check into this and verify whether it is potable water or wastewater. Nonetheless, over-irrigating with potable water is illegal also (according to Basin Plan). Furthermore, it is a waste of water.

We have put all photographs on a disk. They are grouped by date and the number on the photo indicates the location of the photograph. We will put this complaint letter on the disk also.

I would very much appreciate your keeping me informed about the progress of this complaint. Also, please contact me with any questions you might have.

Sincerely,

A handwritten signature in black ink that reads "Brenda Adelman". The signature is fluid and cursive, with the first name being larger and more prominent than the last name.

Brenda Adelman  
[rrwpc@comcast.net](mailto:rrwpc@comcast.net)  
(707) 869-0410

CC: Kason Grady

**ATTACHMENTS:**

Santa Rosa' s Recycled Water Standards

Recycled Water User' s Guide

Water Efficient Landscape Ordinance

TEDX (The Endocrine Disruption Exchange): List of 1518 probable endocrine disrupting chemicals

TEDX (The Male Predicament): This is the best explanation of problems with endocrine disrupting chemicals I have ever seen. It is a 40 minute lecture by Theo Colburn, the person most responsible for bringing this issue into public awareness.

Op-Ed Columnist

# The Cancer Lobby

By [NICHOLAS D. KRISTOF](#)

Published: October 6, 2012

WHO knew that carcinogens had their own lobby in Washington?



Damon Winter/The New York Times

Nicholas D. Kristof

## On the Ground

[Share Your Comments About This Column](#)

Nicholas Kristof addresses reader feedback and posts short takes from his travels.

Don't believe me? Just consider formaldehyde, which is found in everything from nail polish to kitchen countertops, fabric softeners to carpets. Largely because of its use in building materials, we breathe formaldehyde fumes when we're inside our homes.

Just one other fact you should know: According to government scientists, it [causes cancer](#).

The chemical industry is working frantically to suppress that scientific consensus — because it fears “[public confusion](#).” Big Chem apparently worries that you might be confused if you learned that formaldehyde caused cancer of the nose and throat, and perhaps leukemia as well.

The industry's strategy is to lobby Congress to cut off money for the Report on Carcinogens, a 500-page consensus document published every two years by the National Institutes of Health, containing the best information about what agents cause cancer. If that sounds like shooting the messenger, well, it is.

"The way the free market is supposed to work is that you have information," said [Lynn Goldman](#), dean of the school of public health at George Washington University. "They're trying to squelch that information."

The larger issue is whether the federal government should be a watchdog for public health, or a lap dog for industry. When Mitt Romney denounces President Obama for excessive regulation, these are the kinds of issues at stake.

"Formaldehyde is known to be a human carcinogen," declared the [most recent Report on Carcinogens](#), published in 2011. Previous editions had listed it only as a suspected carcinogen, but the newer report, citing many studies of human and animal exposure to formaldehyde, made the case that it was time to stop equivocating.

The chemical industry was outraged, because it [sells lots of formaldehyde](#) that ends up in people's homes, often without their knowledge.

"Nearly all homes had formaldehyde concentrations that exceeded guidelines for cancer and chronic irritation," according to a [2009 survey by the California Energy Commission](#).

The Report on Carcinogens also offended the chemical industry by listing styrene for the first time as "reasonably anticipated to be a carcinogen." [Styrene](#), which goes into everything from boats to shower stalls, is mostly a risk to those who work in factories where it is used, so it's less of an issue for the general public.

The chemical industry is represented in Washington by the [American Chemistry Council](#), which is the lobbying front for chemical giants like Exxon Mobil, Dow, BASF and DuPont. Those companies should understand that they risk their reputations when they toy with human lives.

The American Chemistry Council first got its pals in Congress to order a \$1 million follow-up study on formaldehyde and styrene. Then it demanded, through a [provision drafted by Representative Denny Rehberg](#), a Montana Republican, that no money be spent on another Report on Carcinogens until the follow-up was completed — meaning a four-year delay until the next report. Stay tuned for an industry effort to slip some such provision into the next budget legislation.

Let's be clear. There is uncertainty about toxic chemicals, and it is perfectly legitimate to criticize the Report on Carcinogens. But this effort to defund the report is an insult to science and democracy alike.

Barbara K. Rimer, the chairwoman of the [President's Cancer Panel](#), told me that there might be ways to improve the Report on Carcinogens but that it would be wrong to cut off money for it. "Without this program, there would be a gap in the protection of the public," she said.

Last month, 76 scientists wrote a joint [letter to Congress](#) noting that the World Health Organization also listed formaldehyde as a known carcinogen, and styrene as a possible carcinogen. They defended the Report on Carcinogens as "consistent with international scientific consensus."

"The American Chemistry Council is working to delay and ultimately destroy" the Report on Carcinogens, the scientists wrote.

The chemical council declined to speak to me on the record. It has a long record of obfuscation, borrowing the same strategies that the tobacco industry used to delay regulation of cigarettes.

“It’s the same playbook,” noted [Jennifer Sass](#), a senior scientist of the Natural Resources Defense Council.

The American Chemistry Council is also trying to undermine [scientific reviews by the Environmental Protection Agency](#). You can say this for our political system: Even carcinogens have an advocate in Washington!

The basic strategy is an old one. As David Michaels notes in his book “Doubt Is Their Product,” the first evidence that asbestos causes cancer emerged in the 1930s. But three decades later, industry executives were still railing about “ill-informed and exaggerated” press reports, still covering up staggering cancer rates, and still denouncing regulation of asbestos as “premature.” Huge numbers of Americans today are dying as a result.

Do we really want to go through that again?

I invite you to comment on this column on my blog, [On the Ground](#). Please also join me on [Facebook](#) and [Google+](#), watch my [YouTube videos](#) and follow me on [Twitter](#).

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## Toxic Irrigation: Major Study Indicts Chemicals Found in Recycled Wastewater Used For Vineyards And Other Crops

June 14, 2012 | Filed under Featured Articles | Posted by Lewis Perdue

By Lewis Perdue

*NOTE: This is the overview article in a series that will examine in detail the multiple issues given a general treatment in this piece. The article author was a biology major at Cornell University with top grades in organic chemistry.*

Recycled wastewater is likely far more hazardous to use for crop and landscape irrigation than previously thought due to fundamental flaws in the way danger thresholds are currently determined, according to a major study published this month in the peer-reviewed scientific journal *Endocrine Reviews*.

The significant scientific flaw in the current risk assessment method pertains to a class of chemicals found in treated wastewater called endocrine disrupting compounds (EDCs).

These chemicals – including estrogens from birth control pills, powerful antibiotics, plasticizers like BPA and many other chemicals — can disrupt or mimic human hormones in unpredictable ways even in the extremely small concentrations that are currently disregarded as inconsequential by government regulators. Most of the EDCs and chemicals find their way into wastewater by being flushed down a toilet or sink.

“Whether low doses of EDCs influence certain human disorders is no longer conjecture, because epidemiological studies show that environmental exposures to EDCs are associated with human diseases and disabilities,” concluded the study.

### MASSIVE SCIENTIFIC UNDERTAKING

The massive scientific paper cited 845 other studies and was created by a team of twelve scientists led by Laura N. Vandenberg of the Tufts University Center for Regenerative and Developmental Biology, Medford, MA and by J. P. Myers of Environmental Health Sciences, Charlottesville, VA.

Other institutions represented by investigators of the study included:

- The University of California,

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### TOP NEWS

- Study Indicts Toxics in Recycled Wastewater For Irrigating Vineyards, Other Uses
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- Massachusetts General Hospital,
- National Institutes of Environmental Health Sciences,
- National Institutes of Health,
- Department of Health and Human Services,
- University of Minnesota School of Public Health

Their work was supported by the National Institutes of Health and also by grants from a number of foundations including the Susan G. Komen Foundation, the Mitchell Kapor Foundation, Cornell-Douglas Foundation, the Wallace Global Fund and the Keneda Foundation.

More information about the investigators and their connections can be found at the end of this article.

#### CONSEQUENCES FOR NORTH COAST AND OTHER CALIFORNIA VINEYARDS

While the Vandenberg/Myers study did not deal specifically with irrigation, it focused on many of the same chemical compounds found in the same concentrations as in treated wastewater used for irrigation.

For that reason, the study's conclusions hold serious consequences for industrial and recreational landscape irrigation as well as the thousands of acres of premium California vineyards currently irrigated with highly treated wastewater.

Significantly for winegrape growers and ordinary citizens, every recent Environmental Impact Report (EIR) on treated wastewater irrigation conducted in Napa and Sonoma Counties acknowledges the presence of EDCs.

Those EIRs conclude, as did the North Sonoma County Agricultural Reuse Project EIR: "it is not currently possible, using existing standards and/or regulatory agency risk assessment methodology, to evaluate the endocrine effects of these chemicals, if any, at the low concentrations reported."

#### PUBLIC HEALTH DECISIONS ON "A HOPE AND A PRAYER"

Because of the lack of science, no government standards or limits have been set for most EDCs and other chemicals found in even the most highly treated wastewater: "For the majority of chemicals in commerce, there are no data on health effects and thus no established high- or low-dose range," said the Vandenberg/Myers study.

This means that risk-assessment, regulations and public health decisions are being made without sufficient data.

"They're making public health decisions about treated wastewater on a hope and a prayer," said a nationally respected organic chemist interviewed by *Wine Industry Insight* and who has participated in a number of government chemical risk assessment studies.

"They don't know if the very small levels are harmful," he continued. "But when they get to something that's one part per billion or one part per trillion, they just feel it can't be harmful, so they approve something.

"And while many chemicals may not be harmful by themselves at that level, EDCs are still potent," he said. "That's complicated by the fact that most of the hundreds of chemicals in treated wastewater have never actually been studied.

"And there are potential combinations we have no idea about. We have no clue – and probably never will – what the possible synergistic effects are ... how all of those chemicals may combine, form new compounds, create new effects or what those effects might be."

#### REGULATORY PROCESS FOR RISK ASSESSMENT OUTMODED

Ironically, the Vandenberg/Myers study comes on the fiftieth anniversary of Rachel Carson's epic environmental book, *Silent Spring*, which alerted the general public to the hazards of indiscriminate pesticide use, primarily DDT which is a potent EDC.

Initiated by her work, public awareness resulted in a slow accumulation of risk-assessment procedures developed by state and federal bureaucracies designed to assess the risks associated with the more than 10,000 chemicals that now blanket most aspects of human life.

But, the Vandenberg/Myers study in *Endocrine Reviews* points out that the current process for assessing risk relies on assumptions that are invalid when applied to EDCs.

This is because the current process, in general, tests for the toxicity of a chemical by administering relatively large doses of a chemical to test animals. The series of doses is decreased to a point to determine the lowest observed adverse effect level, or even a point where there is no observed adverse effect level. These levels typically range from concentrations of one part in a thousand (milli-) or a million (micro-).

Those calculating the risk assessment, guesstimate that concentrations in the one part per billion (nano-) to one part in a trillion (pico-) will be safe.

The Vandenberg/Myers study pointed out, "that EDCs can act in the nanomolar to micromolar range, and some show activity at picomolar levels."

("Molar" refers to a scientific method of estimating the total number of molecules of a compound in a given volume.)

"For decades, studies of endocrine-disrupting chemicals (EDCs) have challenged traditional concepts in toxicology, in particular the dogma of "the dose makes the poison," because EDCs can have effects at low doses that are not predicted by effects at higher doses," said the study.

#### MONOTONIC VERSUS NON-MONOTONIC

The lack of predictability is the second flaw in the current government method which assumes that the chemical being tested always expresses itself the same way at every concentration. It assumes a greater effect at high concentration, a lesser effect at lower doses. In scientific terms, this predictability is called a monotonic dose response.

But EDCs and many other compounds are not so predictable because they affect different biological structures when present in varying concentrations. This is especially true for natural hormones, endocrine disrupters, many pharmaceuticals and even the ethanol in wine, beer and spirits.

The Vandenberg/Myers study explained that, "For all monotonic responses, the observed effects may be linear or nonlinear, but the slope [of the plotted line or curve] does not change sign. This assumption justifies using high-dose testing as the

- [Your brand].wine, [Your brand].beer, [Your brand].sucks
- Top wine trading company 'filled vintage bottles with cheap alcohol
- Pernod Ricard New Zealand to Close a Hawkes Bay...

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## About the Author



**WII Editor Lewis Perdue**

is a former Washington, D.C. investigative reporter and has written 20 published books.

He founded *Wine Business Insider* in 1991 followed three years later by *Wine Business Monthly*. Both were sold in 1997, but remain the dominant trade publications for the North American wine business.

In 1997 he became a correspondent for CBS Marketwatch and a columnist for The Street.Com. Later, he worked as a columnist for the Wall Street Journal Online before founding an Internet payments company which went public.

He has also been a negotiator and a wine importer/distributor.

[Click here for more on Lew.](#)

standard for assessing chemical safety. When it is violated, high-dose testing regimes cannot be used to assess the safety of low doses.”

The study then pointed out that EDCs as a group violate the rule by being non-monotonic.

#### WHY DOES NON-MONOTONIC MATTER?

Many chemical compounds are simply toxic: they damage and kill cells. The higher the concentration, the more toxic and the more cells die – the dose makes the poison.

Regardless of the concentration, these chemicals kill cells the same way. And, at the level of no observed adverse effects, they stop killing, or are tolerated by cells. This is a monotonic dose response.

But non-monotonic chemicals can affect different mechanisms in the body depending on the concentration.

One well-known non-monotonic response is the “U” shaped curve of the “French Paradox” or the activity of pharmaceuticals including aspirin and many hormones.

With these compounds, there is no effect at low concentrations. As concentration levels increase, scientific studies show an increasing beneficial effect. Then, beyond that level, the beneficial effect diminishes and later, high levels can be toxic and damaging.

This odd behavior is non-monotonic because the substances act on different parts of the body at different concentrations. At high levels they are toxic. At lower levels, they act on a variety of microscopic cell receptors and structures that allow them to have a different and beneficial effect.

Indeed, research has shown that at very low levels, EDCs can magnify or suppress the effects of natural hormones in the body or cause their own unique syndromes.

But nothing in nature says non-monotonic behavior always goes from damaging to beneficial as the concentrations go from high to low. Significantly, the effects of EDCs and other low-concentration chemicals are generally unstudied and unknown. However, in those few cases where they are better understood, EDCs have been found to have damaging effects.

Clearly, EDCs are an example of non-monotonic behavior that can go from deadly toxic (poisoning cells) to invisibly deadly (tumors, genetic effects, metabolic disorders and other diseases).

Indeed, as a future article in this series will explore, an increasing number of studies indicate that EDCs may be responsible for part of the current obesity and diabetes epidemics. They may also contribute to the decline of endangered species including salmon, frogs and other “cold-blooded” animals which seem to be more susceptible than mammals to chemical compounds.

NEXT: What EDCs and other chemicals are known to be in treated wastewater used for irrigation? At what levels? And having what effects?

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#### FURTHER INFORMATION FROM THE PAPER:

##### **Hormones and Endocrine-Disrupting Chemicals:Low-Dose Effects and Nonmonotonic Dose Responses**

Laura N. Vandenberg, Theo Colborn, Tyrone B. Hayes, Jerrold J. Heindel, David R. Jacobs, Jr., Duk-Hee Lee, Toshi Shioda, Ana M. Soto, Frederick S. vom Saal, Wade V. Welshons, R. Thomas Zoeller, and John Peterson Myers

Center for Regenerative and Developmental Biology and Department of Biology (L.N.V.), Tufts University, Medford, Massachusetts 02155; The Endocrine Disruption Exchange (T.C.), Paonia, Colorado 81428; Laboratory for Integrative Studies in Amphibian Biology (T.B.H.), Molecular Toxicology, Group in Endocrinology, Energy and Resources Group, Museum of Vertebrate Zoology, and Department of Integrative Biology, University of California, Berkeley, California 94720; Division of Extramural Research and Training (J.J.H.), National Institute of Environmental Health Sciences, National Institutes of Health, U.S. Department of Health and Human Services, Research Triangle Park, North Carolina 27709; Division of Epidemiology and Community Health (D.R.J.), School of Public Health, University of Minnesota, Minneapolis, Minnesota 55455; Department of Preventive Medicine (D.-H.L.), School of Medicine, Kyungpook National University, Daegu 702-701, Korea; Molecular Profiling Laboratory (T.S.), Massachusetts General Hospital Center for Cancer Research, Charlestown, Massachusetts 02129; Department of Anatomy and Cellular Biology (A.M.S.), Tufts University School of Medicine, Boston, Massachusetts 02111; Division of Biological Sciences (F.S.v.S.) and Department of Biomedical Sciences (W.V.W.), University of Missouri-Columbia, Columbia, Missouri 65211; Biology Department (T.Z.), University of Massachusetts-Amherst, Amherst, Massachusetts 01003; and Environmental Health Sciences (J.P.M.), Charlottesville, Virginia 22902

#### ABSTRACT

For decades, studies of endocrine-disrupting chemicals (EDCs) have challenged traditional concepts in toxicology, in particular the dogma of “the dose makes the poison,” because EDCs can have effects at low doses that are not predicted by effects at higher doses.

Here, we review two major concepts in EDC studies: low dose and non-monotonicity.

Low-dose effects were defined by the National Toxicology Program as those that occur in the range of human exposures or effects observed at doses below those used for traditional toxicological studies.

We review the mechanistic data for low-dose effects and use a weight-of-evidence approach to analyze five examples from the EDC literature. Additionally, we explore non-monotonic dose-response curves, defined as a nonlinear relationship between dose and effect where the slope of the curve changes sign somewhere within the range of doses examined.

We provide a detailed discussion of the mechanisms responsible for generating these phenomena, plus hundreds of examples from the cell culture, animal, and epidemiology literature. We illustrate that non-monotonic responses and low-dose effects are remarkably common in studies of natural hormones and EDCs.

Whether low doses of EDCs influence certain human disorders is no longer conjecture, because epidemiological studies show that environmental exposures to EDCs are associated with human diseases and disabilities.

We conclude that when non-monotonic dose-response curves occur, the effects of low doses cannot be predicted by the effects observed at high doses.

Thus, fundamental changes in chemical testing and safety determination are needed to protect human health.

(Endocrine Reviews 33: 0000–0000, 2012)

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### Comments



 **Michael Heintz** · Director of Marketing at E&J Gallo  
more than a little scary, and worth thinking about. Seems like more work is needed to know the answer...  
[Reply](#) · [Like](#) · 8 minutes ago

 **Bill Easton**  
I think EDCs and other chemicals are at background levels in all water in industrialized nations and areas. They are essentially in the water cycle. They have been found in rain. Probably higher concentration in recycled waste water. Did you know that recycled waste water is nano-filtered and put back into the drinking water system stream in many SoCal cities?  
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## ABOUT WINE INDUSTRY INSIGHT

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# How Can Wine Industry Insight Help You Prevail -- Not Just Survive -- In The Most Challenging Economic Environment in Decades?

Wine Industry Insight's editor and publisher, Lewis Perdue, founded Wine Business Monthly and Wine Business Insider in 1991. After their sale in 1997, he concentrated on writing books and serving as founder or co-founder of two technology corporations and as a start-up consultant to several others.

But during this time, Perdue maintained his contacts within the industry and continued to follow it. Among other topics, Perdue's 1999 book on the wine industry, *The Wrath of Grapes*, accurately predicted the timing and extent of the millennial winegrape oversupply.

Perdue has been an award-winning journalist, and Washington correspondent covering the White House and Capitol Hill. He has also served as a columnist for *The Wall Street Journal Online*, *The Street.Com*, *Marketwatch* and other business and financial media.

In addition to his journalism experience, Lew founded and managed a Los Angeles-based wine import/wholesale firm, has been a negociant and has hands-on business start-up and management experience.

That experience allows Lew to examine news, data and trends with insight shaped by experience.

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PMCID: PMC3339483

Editorial

# Environmental Chemicals: Evaluating Low-Dose Effects

[Linda S. Birnbaum](#)

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See "[House Dust Concentrations of Organophosphate Flame Retardants in Relation to Hormone Levels and Semen Quality Parameters](#)" in volume 118 on page 318.

See "[Urinary Concentrations of Metabolites of Pyrethroid Insecticides in the General U.S. Population: National Health and Nutrition Examination Survey 1999–2002](#)" in volume 118 on page 742.

See "[Environmental Chemicals in Pregnant Women in the United States: NHANES 2003–2004](#)" in volume 119 on page 878.

Around the world, large-scale biomonitoring programs have provided extensive information about human exposure to a large number of environmental chemicals ([Barr et al. 2010](#); [Bilau et al. 2008](#); [Churchill et al. 2001](#); [Woodruff et al. 2011](#)). As these programs extend to look at vulnerable populations, including pregnant women, fetuses, and the elderly, our knowledge of the widespread distribution of many of these chemicals—including hundreds that have been classified as endocrine disruptors—continues to climb. However, the mere presence of a chemical in humans is not necessarily cause for concern. What is concerning is the increasing number of epidemiological studies showing associations between the concentration of these chemicals in the general population and adverse health end points ([Braun and Hauser 2011](#); [Crain et al. 2008](#)). Although high exposures following accidental or occupational exposures to endocrine disruptors, industrial chemicals, pesticides, and pharmaceuticals have shown striking effects, epidemiological studies suggest that low doses may also be unsafe, even for populations that are not typically considered “vulnerable.”

Making connections between the exposome and risk assessment is a difficult but important venture ([Paustenbach and Galbraith 2006](#); [Rappaport and Smith 2010](#)). Risk assessments typically examine the effects of high doses of administered chemicals to determine the lowest observed adverse effect levels (LOAELs) and no observed adverse effect levels (NOAELs); reference doses, which are assumed safe for human exposure, are then calculated from these doses using a number of safety factors. Thus, human exposures to thousands of environmental chemicals fall in the range of nonnegligible doses that are thought to be safe from a risk assessment perspective. Yet the ever-increasing data from human biomonitoring and epidemiological studies suggests otherwise: Low internal doses of endocrine disruptors found in typical human populations have been linked to obesity ([Carwile and Michels 2011](#)), infertility ([Meeker and Stapleton 2010](#)), neurobehavioral disorders ([Swan et al. 2010](#)), and immune dysfunction ([Miyashita et al. 2011](#)), among others.

For several decades, environmental health scientists have been dedicated to addressing the “low-dose hypothesis,” which postulates that low doses of chemicals can have effects that would not necessarily be predicted from their effects at high doses. More than 10 years ago, a National Toxicology Program expert

panel concluded that there was evidence for low-dose effects for a select number of well-studied endocrine disruptors ([Melnick et al. 2002](#)). Now, a diverse group of scientists has reexamined this large body of literature, finding examples of low-dose effects for dozens of chemicals across a range of chemical classes, including industrial chemicals, plastic components and plasticizers, pesticides, phytoestrogens, preservatives, surfactants and detergents, flame retardants, and sunblock, among others ([Vandenberg et al. 2012](#)). Vandenberg et al. selected several examples of controversial low-dose test cases and applied an analytical weight-of-evidence approach to determine whether there was sufficient evidence to conclude that particular environmental chemicals had effects on specific biological end points. Their analysis addresses how experimental design, choice of animal strain/species, study size, and inclusion of appropriate controls affect the outcome and interpretation of studies on bisphenol A (BPA), atrazine, dioxin, and perchlorate. Their study provides important insight into the effects of environmental chemicals on health-related end points and addresses the mechanistic questions of how chemicals with hormonal activity can have effects at external doses that are often considered safe by the regulatory community.

[Vandenberg et al. \(2012\)](#) have also collected several hundred examples of nonmonotonic dose–response curves (representing many classes of environmental chemicals) that have been observed in cultured cells, animals, and even human populations ([Vandenberg et al. 2012](#)). Most importantly, they reviewed the voluminous endocrine literature on how and why nonlinear responses manifest at different levels of biological complexity, including the combination of competing monotonic responses (such as enhanced cell proliferation and cytotoxicity), the expression of cell- and tissue-specific cofactors and receptors, and receptor down-regulation, desensitization, and competition. Thus, the question is no longer whether nonmonotonic dose responses are “real” and occur frequently enough to be a concern; clearly these are common phenomena with well-understood mechanisms. Instead, the question is which dose–response shapes should be expected for specific environmental chemicals and under what specific circumstances.

Moving forward, studies of suspected endocrine disruptors need to include doses that result in relevant internal human levels and examine a wide range of biological end points. Dose–response studies should include a range of doses to distinguish between linear monotonic and nonmonotonic responses. Nonlinear relationships should not be dismissed. Collaborations between research scientists in academia, government, and industry should be encouraged to allow for development of more sophisticated study designs to facilitate regulatory decisions. It is time to start the conversation between environmental health scientists, toxicologists, and risk assessors to determine how our understanding of low-dose effects and nonmonotonic dose responses influence the way risk assessments are performed for chemicals with endocrine-disrupting activities. Together, we can take appropriate actions to protect human and wildlife populations from these harmful chemicals and facilitate better regulatory decision making.

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## Footnotes

The author declares she has no actual or potential competing financial interests.

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# FOOLING WITH NATURE

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## interview [theo colborn, ph.d.](#)

She is Director of the Wildlife and Contaminants Program, and Senior Program Scientist, at the World Wildlife Fund. Colborn was a grandmother with a background in pharmacy when she returned to school and got her Ph.D. at the age of fifty-eight. She is the co-author of *Our Stolen Future* (1996) and organizer of a groundbreaking 1991 meeting at the Wingspread conference center in Wisconsin that brought together to discuss the evidence on endocrine disruption.



Interview conducted by Doug Hamilton, producer FRONTLINE's "Fooling With Nature." Interviewed 1998.

DH: How concerned are you about the potential health effects of endocrine disruptors?

TC: I am concerned more now than I was even in the beginning because of the evidence that is crossing our desk every day. This was a new idea back in 1991. When a group of scientists met to discuss this and to think about it, they were amazed when they began to realize the implications of their work -- even though they all worked in different disciplines. This is a multi-disciplinary type of problem that we have to address. And so since 1991 a great deal of science has been deliberately directed towards answering some of the questions that we were asking back in 1991. And now, seven years later, there is enough evidence that I would be remiss if I did not say that I think this is a serious problem.

DH: Take me back to that time when the scientists first come together. Are you referring to the Wingspread conference?

Those scientists who done the work and are going out, as far as endocrine dis, have paid a terrible price, particularly those speaking out who worked on independent or soft money from other sources from within universities. They are speaking from their heart because they are scorned. I don't think that should be discredited because.

TC: Yes. The reason these people were brought together was because we had seen such very blatant, open evidence among various wildlife species and populations concerning this problem of transgenerational exposure. In other words, the females in the populations were transferring to their offspring, either in the egg or in the womb, chemicals that appeared to be changing the course of development

of their offspring. Maybe the offspring didn't hatch or weren't born. Or if they were, oftentimes they didn't make it through to adulthood. Or were incapable of reproducing. But the obvious thing was that it was interfering with what is called their "endocrine system". There seemed to be abnormal or disturbed sexual development, behavioral development, metabolic problems. Which are all associated with the endocrine system. And we weren't sure how tightly these, these phenomena were all connected.

But it was important to bring people together and discuss this. There were people there who had never heard the wildlife evidence. There were people there who had never heard the human evidence: the DES story, diethylstilbestrol, where the mothers shared that drug with their babies during their pregnancies, and how it affected the lives of those individuals whose mothers took that pharmaceutical.

It was fascinating to watch what happened as each one of these individuals got up at this meeting and had a half an hour to present his or her work relative to the title of the meeting, which was "Chemically-Induced Alterations in Sexual Development: The Wildlife/Human Connection."

And it was, by the second day there was a change in the way the individuals were behaving at the meeting. There was a bonding also. Tremendous amount of bonding. And by the third morning, these people were so moved by what they heard that they decided they wanted to produce what was called a consensus statement. They wanted the rest of the world to know what they had discovered that weekend.

And they were willing to also provide papers that were going to go through the peer review process and

be published in a book to support their conclusions from that meeting. So that was a new process that took place. Now consensus was not reached solely at that meeting. It took us about two and a half months to get a final document to which everyone signed on.

It was those individuals, then, who went back to their respective institutions and said, "We had better look at how we have been doing science in the past." We are seeing the results of those people rethinking how they did things in various universities and regulatory agencies.

Even today, many of us have said that that meeting changed the whole course and direction of our lives. It really has.

DH: Lou Guillette, who heard about the meeting through one of the participants, said it was a revelation for him. He had been toiling out in the field on his own, working with alligators, seeing some things that didn't make sense to him really...

TC: Yes. It is amazing. Because I will walk into a lecture hall, or walk into an office with a scientist who hasn't heard this before, and they are very skeptical. That is the way we are supposed to be. Scientists are extremely skeptical. And they will listen to me and they will ask me some questions and it is amazing how what should have been a fifteen-minute discussion ends up about a two-hour discussion before I can get away from these people.

Because suddenly people say, "Why didn't we think of this?" And that is the state we are in now. If we had thought of this, the chemicals that we now are beginning to understand are affecting us would never have been released into the environment.

We still need to test chemicals that we produce to see if they cause cancer. There is no doubt about it. And gross and obvious birth defects. But what we are talking about now is a change in how an individual can function. This isn't very obvious.

What about a child whose intelligence has been hampered so that it has an IQ deficit of say, 6.2 IQ points -- which we now have as a result of one study? Or the children who don't socially integrate as well? How do you put a picture of that on television? You can't. It is a very difficult message to reach the public with.

This is not a rare event, like cancer. Cancer may hit

one in a thousand. One in every five babies born may have a functional change that is not visible and would have to be detected by trained technicians, trained laboratory technicians. But this individual will not be functioning the way that individual was programmed to function by the genes it inherited from its mother or father.

DH: You are saying that 20 percent of all children born are affected by this in some way?

TC: In one study it was demonstrated that up to 20 percent of the children were affected.

DH: Why weren't researchers looking for this earlier?

TC: I come from the area of pharmacology, which grew into toxicology when we began producing a large number of chemicals that we released into the environment. We wanted to find out what we were doing. And we felt that if we could use high-dose testing, really high doses, we wouldn't miss the probability of causing cancer. That was enough. That if we could rule that out we would certainly be protecting people from everything else as well.

So that is where we are. We have done high-dose testing. But what do you do with a population that is exposed to very, very low doses of something that can have an effect in the womb at very, very low doses and change the way the embryo develops?

DH: The general impression out there, by most people, is that there is quite a bit of testing that goes on before any product gets out on the market.

TC: There have been safety nets. But unfortunately the safety net that we used as our model was this 70 kilogram adult male. And we did not look at what happens during embryonic development in the womb or in the egg. And from the minute the sperm enters the egg, and this individual begins to develop, this whole process is driven by chemicals called hormones: first hormones that came with the egg from the mother and then gradually, as the cells split and split and divide and begin to form an organism, they begin producing some of their own hormones, but not much.

These chemicals are working at a concentration of 1/10th of a trillionth of a gram. That is all it takes of a hormone to make a change in how an individual develops in the womb.

Now, we are talking about chemicals that are getting in the human body at parts per million, parts per billion, parts per trillion. That is a lot higher than what the system operates within. And we didn't understand this. So testing chemicals on a fully grown individual who has developed and isn't developing any more, it would take a much larger dose of something to change the way that individual functions. Now we have to go back and think about what happens with humans those first 266 days from conception to birth.

DH: At one point you said it was obvious that these things were all related to the endocrine system. But it wasn't obvious to an awful lot of scientists looking at it. What triggered your curiosity here?

TC: I was working on a book on the state of the environment of the Great Lakes. And I pulled all this literature together, lots of papers, you know: fellows working in Canada, people working in the United States, one out on Lake Superior, others over, way over on Lake Ontario had done some work, written their papers, had them published in a number of different journals. None of them knew what the other was doing.

And basically, I sat in a wonderful position where I pulled all this

information together. And looking at it I said, "There is something wrong

here." And the easiest thing for me to do is to use -- thank goodness for

computers -- use a spreadsheet at a computer and start producing these

spreadsheets.

And as I plotted those names of the animals in the column on the left-hand side, this is called the "Y" column, and then on the "X" column I plotted the effects that were seen in the animals, it began to fall out that there were serious problems and actually population declines, population crashes, actually extirpation of some populations. They disappeared in some places.

Then there were reproductive effects: all kinds of reproductive problems. The youngsters didn't hatch, or if they did they didn't look good, birth defects.

And then I broke it down by what were some of the effects that the scientists were finding. They were finding thyroid problems in all the fish. In all the birds they looked at around the Great Lakes. This was the Great Lakes that we were looking at at the time.

Behavioral studies began to come out. The birds weren't behaving right: females and females pairing, the male birds not being territorial and scaring off predators.

There was a condition called "wasting" where the chicks in the eggs can't absorb the yolk sack to get energy and to produce protein. Or if they did hatch, wasting could set in after they were born, and suddenly they couldn't metabolize their food. And they would just waste away and die. Wasting was quite common in practically every species that was looked at around the Great Lakes.

Well, all of these things fall under the purview of the endocrine system. It was amazing. And, of course, the most important thing was that cancer is not the problem. Now, we were thinking cancer was the big bugaboo. This was going to be the be all and the end all. This was where we would find our answers for both wildlife and human populations.

What was the problem is that these effects were being seen in the youngsters: the offspring of the animals, not in the adult animals. And if you started reading the literature, some excellent work by Jim Ludwig and his dad, it definitely showed that the recruitment of the birds around the Great Lakes was very poor. Those birds that hatched there didn't come back. Each year there were new birds coming into the Great Lakes.

Here was a wonderful, wonderful system where birds could come and reproduce: the bald eagles coming to the shorelines of the Great Lakes, or new birds coming in from outside the area. After they are there a while, their youngsters don't survive.

And we were seeing fish with both female and male reproductive organs, male birds with female and male reproductive organs. It was quite fascinating. These were definitely endocrine effects, but they were being passed from the mother to the offspring. It didn't seem to affect the adult animals.

So that was the big concern to us. We have not tested our chemicals through a number of generations to see

what would happen.

I became very, very cautious. And that was the importance of bringing this group of individuals together. People I had never met before. The real skeptics. The real gurus in your field. These were truly experts that met that first time at Wingspread and discussed this issue.

And I had made up my mind then that if they did not see what I thought I was seeing, because at the time you think you are making it up at times, I would walk away from it because there was no way I, as an individual, could do anything about the problem.

But instead, through this epiphany that took place that weekend, they saw what I saw. And they saw more than I did, because they were each knowledgeable, far more knowledgeable in each one of these various disciplines, to understand the implications of what it meant. So with their encouragement, then, I kept moving.

But I think I first realized this probably in early 1988, and I had started working on this in August of 1987 when I began collecting this literature and putting it together. And then also in putting it together for that first book, "Great Lakes, Great Legacy," that told this story, but very simply. And that is where we first broke with the challenge that cancer is not the deal and that we have to look for more.

My family will tell you that they thought I was overly concerned. My family is not involved in the work that I am doing. So the family didn't even understand what I was feeling. But I had at least 15 or 20 very dear friend wildlife biologists who were out there who knew this. They had a gut feeling about this for years. Who really were the ones who encouraged me to keep going.

The W. Alton Jones Foundation came through and gave me a three-year grant to just focus on this particular issue.

DH: The potential problem that you are taking on is huge.

TC: It is extremely huge. When you think about it, you get a funny feeling in your stomach when you think about the implications of the very current research. It is a problem that has forced me, in my position, to say that I think we need a Manhattan Project. A Manhattan-like project. Our military and

American industry put their heads together, and within two years or so developed an atom bomb. And then we are going to have to establish an entity that takes the money and designs the research agenda to address this. We have got to come up with screens and assays to test chemicals for these effects. There is not one approved test or assay on the market today or in use to test chemicals for these effects.

Let's look at the problem that we know that hypospadias is occurring in one in a hundred boys. Hypospadias is a condition where the urethra doesn't come out of the end of the penis. The more severe form of hypospadias is where the urethra comes out of the scrotum. This is increasing. This event, that causes this problem, can only happen between days 56 and 84 during gestation. That is, 56 days after conception up to the 84th day is when that problem is laid down. Something interfered with the hormonal message at that time to tell that penis to develop properly with the urethra.

We need to do this research and it needs to be done in a hurry. The science will be done back in the industry laboratories, in the regulatory laboratories and on campuses around the country. The information that comes from these studies will then be reviewed by independent scientists and the results of the work will be communicated independently without any special interest trying to change the objective results that are reached in these studies.

DH: One of the things that strikes me when you are talking is how much we still don't know.

TC: This is one of the things that worries me. We are so hell-bent on finding out what is going on in outer space, and we don't even know how the embryo develops. We truly don't. We don't know at what concentration the hormones act in the developing embryo to tell the embryo how to develop. We are just breaking through on this now. Isn't that ridiculous?

We have got the technology to do this. We haven't paid attention to what is normal. And the problem is, now it may be too late because there isn't anyone in the world who doesn't have a large number of what we call "persistent chemicals" in their body. There isn't a child born today that hasn't been exposed to these chemicals from the day of conception. So we can't go back and find out what was back then or what was normal. This is ridiculous.

DH: How different are we today than we were before the chemical age?

TC: We don't know. We have no way to compare. There is nothing in the literature about what is normal sperm production in any wildlife species that we could find.

I think it is time we get a little more introspective now and start looking internally at how our internal systems work: the environment of our body, the environment in the womb. I hope we are going to see more of this. We need this basic research so we can understand better where the chemical can step in at each little access along the way of development.

DH: You come at this issue from a non-establishment point of view.

TC: That is probably why I got the perspective I did. Because I looked at it from an entirely different perspective. I looked at endocrinology differently. I began to look at toxicology. I was not trained in toxicology. I was trained in pharmacology until I went back to college to get my Ph.D. in my old age. Only then did I begin to sit in on toxicology courses.

There is a reductionism in scientists, in the scientific community. I have never been a reductionist. I am always thinking about the big picture. My thesis committee for my Ph.D. will tell you that. They had trouble with me.

DH: Science doesn't encourage that in some ways. There is, I have noticed, a conservative pressure on scientists to be very narrow in their focus.

TC: That is right. This is what your Ph.D. is all about: focusing on something and proving that you can do this one specific thing, and being the only expert in that. That is very, very important.

DH: You have obviously come up against a lot of resistance. What is it like to be at the spearhead of this effort that is challenging so much?

TC: I guess you ignore it. I don't take time to read what is being said about me.

DH: Has the attack been bad?

TC: I think it has been very sophisticated this time. I don't think anyone wants to stick their neck out like

they did with Rachel Carson. I think industry has been kinder. I think in many instances they'd rather ignore me. The name of the game is to ignore me and not acknowledge that there is such a thing as endocrine disruption.

Industry definitely has taken a different approach, and are spending their money on public relations to point out the good work they are doing: how they are protecting human health, the environment. They are spending more money on telling you about the wonders of their product. And they are basically building up within the American public or the television viewing public, and those who read the press, basically that "We are good companies. We would do nothing to harm you. We will take care of you." So it is basically a matter of establishing complacency, I think, within the population.

So the role they are playing now more is to obfuscate the issue, to attack the science that has been coming from scientists that have been getting NSF grants and NIH grants for years. They are trying to discredit science. And they are trying to raise questions about whether this is a real phenomenon or not. So, between that and building their image, I think they have been very successful.

DH: There is a legitimate role that the skeptic plays in science.

TC: That is right.

DH: And ultimately, over time, skepticism helps to strengthen the evidence.

TC: That is right.

DH: We interviewed Steve Safe, who is a skeptic, and he was indignant at a suggestion that his science was in any way influenced by the funding that he got from industry.

TC: It isn't what Steve is writing. It is what Steve is out saying that is different.

He is one of the best scientists in the country. We have leaned on Steve Safe's work for years. He is the one who broke out the PCB congeners. He is the dioxin expert. This guy does good work in his laboratory. He is a reductionist.

DH: So where is he having a negative effect on this

debate?

TC: I don't know whether Steve is having a negative effect or not. He is getting a lot of people upset, but he is certainly helping us bring this issue to the forefront. It is allowing us to get this issue before the public. It has attracted great crowds if we are both on the same speaking agenda. So people can hear this message. I am almost indebted to Steve Safe. The controversy is good for this issue.

It is what Steve says, not what Steve Safe does in his laboratory. He is a good scientist. But Steve has made some very derogatory remarks about the book, "Our Stolen Future". But he has also admitted he has never read it. And he doesn't intend to. By the way, I gave him a copy of my book as a gift. So we'll see. He is so funny. That is Steve. I have good times with him. We laugh a lot. He gave me a Texas A&M nightshirt. I was almost going to wear it today. I was tempted to put it on for the filming.

DH: What is the effect, then, of having him write in the "Wall Street Journal" that this is "bunk"? And to write in the "New England Journal of Medicine" that this is "paparazzi science"? What effect does that have on the legitimate debate about this issue?

TC: That is the casting the cloud. That is the confusing the public part of it that is very, very distressing. It really is.

DH: Well, the whole politicization of this issue is a fascinating thing. You don't fit the traditional role of the scientist. It is more than just the science here. There is a movement, isn't there?

TC: Believe me, I didn't plan this. This is not what I had as a career goal or how I would spend my retirement years at all. This has just sort of happened, and people depend upon me. I can tell you there are a whole bunch of scientists out there who can explain this better, who know it better than I do. I feel compelled to do something to try to make change. And I guess that is why I went back to college in my old age. I wanted to get the education so that I could maybe undo some of the things

that my generation basically foisted on society.

DH: All along the way it has led you further from the scientific laboratory, though.

TC: Oh, yes. Very much so, yes.

DH: And are you comfortable with that? Has there been a cost to you as a scientist for speaking out, for taking on the advocacy role that you have taken on?

TC: Oh, certainly. I am walking a very narrow line because of the traditional thinking that scientists must remain objective. And that is a big concern, and that may be something we are going to have to overcome if we want the truth about the things that we are doing. People are going to have to listen to the scientists and not reduce them in their status because they are speaking out because they are concerned.

And there was an excellent editorial about "Our Stolen Future" in "Science" magazine in which the authors of that editorial said, "The challenge now is up to the scientific community. Are they going to come forward and speak out?"

Those people who have done the work and who are speaking out, as far as endocrine disrupters, have paid a terrible price. Fortunately, those who have been speaking out have always worked on independent money or soft money from NSF, NIH or other sources of money from within their universities. They are speaking from their heart because they are so concerned, and I don't think that they should be discredited because of that. But that is a line, that is the tightrope that they walk. It is very difficult.

DH: Who do you blame for making this scientific debate so political, or how do you explain it? How did that happen?

TC: It is political because it goes to the core of the economy. It goes right back to international commerce and trade, and we have become dependent upon these products.

You wouldn't be sitting here today because you couldn't have flown in in an airplane that wasn't using some of these products. This equipment that you are filming me with, the electronics here, has all been dependent upon these chemicals that are now being indicted for causing endocrine disrupter type effects. That is why it is political.

You have got the vested interests. Governments don't want to put restrictions on the manufacturing of the product. The minute you start talking about this, people immediately think jobs. That is what it boils down to. Net profit. It is very political. It goes to the core of our economy and our lives.

DH: I have heard a statistic that 45 percent of American industries are in some way affected by this debate.

TC: For some companies, better than 50 percent of their profits are involved in chlorinated compounds or plastics.

DH: But it seems that both sides play the game. You have worked with PR groups. You have used focus groups to decide how to present your research to the public. You have done some opposition research. You have played the political game, too.

TC: Well we had to. We felt that we were dealing with such a serious problem, it couldn't be just dropped on the public like a bomb. What was the best way to do it? I don't think it was done for political reasons as much as it was to get people to pay attention to something like this.

Let's face it. When you first hear this, you just don't want to address it. Because I, as an individual, feel there is nothing I can do about it. How do you protect yourself from exposure to chemicals like this? That was another reason for doing focus groups: how do you get this information out without scaring people? That is the last thing you want to do.

So, yes, we did. But nowhere near, believe me, compared to what the industry people are doing. Our little effort was very, very meager. I know. It was done on a shoestring.

DH: Is it fair to say that both the environmentalists on one side and industry on the other side are trying to spin this issue to their advantage?

TC: I have never thought of putting a spin on it. All I have ever done is said it like it is. The important thing is to tell the truth from the evidence that you have.

DH: Working with a focus group, you don't see that as spinning?

TC: No. I don't think of that as spinning. See, I thought putting a spin on something was to try to find the angle that would most confuse people. Well, that is the "spin" from your perspective.

I guess the spin from our perspective then was to find the angle at which

we could not alarm people but get the message out to the public.

DH: The EPA, by mandate, is supposed to be looking out for the public.

TC: Well I have reports from the EPA, that are released by the EPA, that are counter to what their scientists have found in their laboratory at Research Triangle Park. They are letting products on the market today that we know are harmful: that the scientists who research at Triangle Park have told them are not safe.

That is why we need this independent research agenda where the message comes directly from the scientists who are doing the work and it is interpreted to the public without the spin from Research Triangle Park to 401 M Street in Washington, D.C.

This happens in state agencies. We have governors who want to remove fish advisories in their states and not issue them to the public. Yet the public health authorities are saying, "These chemicals are affecting our children."

Don't we have a right to try to figure out how to get this message out to the public, fair and square and honestly? That is why we used the focus groups.

DH: The W. Alton Jones Foundation has an agenda in their giving.

TC: Well they haven't given me any money for five, six years now. Jones put no money into the book. Absolutely none. There was a lot of money from Diane's and my pocket. We'll never get that money back, I don't think. We still owe the publishers. And unless you get into paperbacks, you don't make much money.

DH: Tell me what is to blame for endocrine disruption? What is causing this?

TC: Well, frankly, where chlorinated chemicals are concerned, we still have active sources that are out there: material products that we are still using that have PCBs in them, places where we produce DDT, big dump sites still sitting out there. But also PCBs are in construction materials, they are in the lighting equipment, they are blowing around on the air. Believe me, it is amazing.

They have done studies now. It looks like the same amount of PCBs are landing on the ground here as they are in the arctic. They have sort of become stabilized or incorporated over the surface of the earth and the atmosphere we are breathing. PCBs are everywhere. You can't get away from them.

These chemicals have definitely been shown to cause health problems, certainly with intelligence, behavior, with lactation periods -- the ability to produce milk and lactate during the normal length of period that you should. And also we know that a breakdown product of PCB is in everyone's tissue and actually can prevent normal development, physical development, as well.

A recent study, actually published in two separate papers, compared these chemicals, the PCBs and the dioxins and the furans in average food and also in fast foods. And basically found the same concentrations. You can't avoid these chemicals.

DH: You have a statement you make in all of your speeches about our own personal exposure.

TC: Well, I don't think you will find anybody on the surface of the earth today that doesn't have at least 500 measurable chemicals in their bodies that were never in anybody's body before the 1920s: chemicals that we know very little about.

DH: How do we know this is bad for us?

TC: We didn't think it was, but now we know. Because there are so many and we know that in some instances in the industrialized world, PCBs are at concentrations in the human body today where offspring all have neurological damage. And this has been traced now through age eleven.

At that particular concentration, as these children mature they will show short-term memory problems and by age eleven they may have as much as a 6.2 IQ deficit.

DH: A lot of people hear of these individual studies, like the effects of Great Lakes fish on IQ, and they think, "It is not me, because I am not there." Is that a fair assumption for them to be making?

TC: No. One of the things that came out of the Great Lakes study, and then corroborated with a study that was done in the Netherlands, is that for someone to have 1.2 parts per million of PCB in their body is not

unusual. You don't have to be a fish eater to accumulate that amount of PCB in your blood fat.

Now remember, PCBs are in practically every fatty food you eat. They are in meats. They are in dairy products and cheeses. They are in ice cream, as are dioxins and DDT. The fattier the food, the higher concentration of these chemicals. So a lot will depend upon your dietary habits more than where you are living.

DH: Is there an average PCB exposure in the population?

TC: Well the average is about 1 part per million across the industrialized world. The farther north you go, the more concentrated it gets. Women living in the eastern arctic, Inuits up on [Baffin] Island in Canada, basically are running about 7 parts per million. The western Greenlanders, across the strait from them, are running 14 parts per million.

Now of course those Greenlanders are really isolated. They don't get any outside food. They are totally dependent upon narwhal seals, beluga whales, you know bird eggs, that sort of thing. So their diet definitely has an impact on them.

But you don't have to eat fish to run about 1 part per million in your body. We are seeing effects at 1.25 parts per million. Which isn't much higher. At 1.25 parts per million in the mother's blood fat, an infant will be born with measurable neurologic damage. Now the average person in the industrialized world is walking around with one part per million in his or her blood fat. So this suggests that a sizeable proportion of our children that are being born today are being affected.

And this has been corroborated by a study from the Netherlands where they looked at PCBs and dioxins. And they didn't look at fish eaters particularly in that study. They just looked at a cross-section of the population.

And it appears now that there are other chemicals that behave the same way. We don't know as much about the movement and the activity of the plastics, but we found some very unusual plastics that we didn't expect to find in the birds in the Pacific Ocean, as well.

DH: You tend to focus a lot on the child, on the fetus. A lot of this debate is centered around that. Is that

because of what the focus groups found most effective?

TC: No. Because that is the truth. The whole problem lies during fetal and embryonic development: the early stages of development. This is what we discovered in the wildlife. All we are doing is telling the truth. These chemicals affect the very simplest forms of life, which is the single cells that begin to split and form individuals, whether it is a bird, a fish, a horse, a human being.

The problem is that our testing up until now has always been on adult animals. Our message is definitely on what has happened to the prenatal individual or the individual in the egg, and early life stages, because this is where the chemicals have their greatest effect. At extremely low concentrations. Not because focus groups told us to, believe me. This is just the science, the way the science has fallen. This is transgenerational exposure that we are talking about.

DH: It is very clear, in talking to a lot of people, that not everyone is convinced of the science yet. They feel that it is a good hypothesis, but they are not convinced that we have been able to prove the mechanism yet or firmly establish this with a degree of scientific proof that they are comfortable with.

TC: They are probably demanding too much. Remember, the endocrine system is extremely complex. It is not just sex hormones. It is the thyroid hormones. It is things called prostaglandins, which I am sure you have heard of. It involves neurotransmitters. It involves so much -- enzymes -- that to understand every mechanism of action is going to be impossible.

We have enough evidence about the mechanisms of action of some of these chemicals, and the processes that take place, that we can act now and move now. There is enough evidence to take certain chemicals off the market today. And we should. But we are not moving on that.

Using what is called the "weight of evidence" approach, it is time to do something and we should do it soon. So I think that is becoming a weaker argument as the weight of evidence piles up. And believe me, my filing cabinets are overflowing with this kind of information.

DH: When we interviewed Steve Safe, he said,

"Name the chemical, and show that it is doing something wrong, and the EPA will act."

TC: Name a chemical and the EPA will act? That is interesting. Look at the chemicals that EPA has pulled off the market. The only thing they pulled off was DDT, PCBs and a few pesticides. Nothing else has come off the market. I could give you a list that would blow you away of chemicals we know are not safe but they are still being released into the environment.

Steve's statement is not correct. And it takes forever for EPA to act. And a lot of lawsuits.

DH: Is there another way at it?

TC: Well, basically that is what the EDSTAC process is addressing. This is the Endocrine Disrupter Screening and Testing Advisory Committee that was established by EPA. Eighteen months in effect now. Tedious, with multiple-day meetings. Looking at how you are going to address the problem of 70,000 chemicals in use today. That is a conservative number, I have been told.

How we are going to look at them and decide which ones need to be tested first? Can they be tested as a class? Are there some that we know so much about now, already, that we can move on, rather than just screening and testing them for these effects, but move into the long-term multi-generational studies that we know we can do? And that process is being worked out now through a subcommittee called the Priority Setting Workgroup.

DH: And the fear of breast cancer, probably more than anything, drove policy makers to mandate this?

TC: I was amazed, believe me. I don't think any of us working in the field even knew this was going to happen.

DH: It was a big surprise for industry too.

TC: Do you really think it was the breast cancer that drove it? I don't think it was.

DH: Well, they had a big impact on Al D'Amato, who pushed for this legislation.

TC: Well maybe they did.

DH: D'Amato was motivated by the breast cancer groups.

TC: I don't know, maybe you're right. Maybe it was breast cancer. That's fascinating. We wrote into our book that I thought it was a very weak, very poor connection [between environmental contaminants and breast cancer].

DH: People have said, given that weak connection, maybe Congress should reconsider the law that they passed mandating screens for endocrine disrupters.

TC: No, I think Congress did something right. It got the process started. We have to take advantage of that. You know, basically that's how you move forward. You take advantage of opportunities when they arrive, which may never happen again.

People are becoming more and more aware of it. You hear it in the mainstream jargon, on talk radio, you see it in the newspaper, in the everyday magazines that are going into people's homes, the women's magazines. It's getting out.

It is a very difficult message to tell people: that maybe your child will be born and it won't be the same because of the presence of these chemicals in your body as it would have been if it hadn't been, if these chemicals hadn't been, around to interfere with and get the wrong messages to the genes in your body while your baby was developing. And maybe your baby won't live up to its fullest potential because of this.

DH: Some people say Lake Apopka is a really polluted lake, and "the dose makes the poison".

TC: Well, people said that about the Great Lakes. We're beginning to realize now that the Great Lakes are about average.

We went out to Midway Island where birds that fly the North Pacific Ocean -- they're albatrosses -- feed only on the surface of the ocean. We were amazed when they did the chemistry on some of the eggs and some of the blood from the birds and found that these birds have dioxins in them, believe it or not, and PCBs. And they're at a concentration just at, and slightly below, the level where we're finding troubled populations of birds around the Great Lakes.

DH: What if you're wrong about this? What if it's not endocrine disruption? What if we figure out it's

definitely something different?

TC: Let's put it this way: the amount of money that's going into research up until now has been peanuts. Are you willing to gamble? That's what it boils down to.

DH: Are we in the position now that Doctor Snow was in 1854 when he took it upon himself to disable that disease-ridden water pump?

TC: The only thing is, he cut it off dramatically. No one is suggesting that we cut this thing off dramatically. We know we can't. We want to work with industry. We want to compromise. But we have to be very careful how we compromise, and we could be sucked into this thing if we're not careful.

How far will industry go before they clean up their act? And, I think right now we've seen a perfect example of what can happen with the cigarette industry. And up until now I've been thoroughly convinced that the industrialists did not know about the products that they were producing or they would not have produced them.

DH: What about the parallels between you and Rachel Carson? She writes a book. She is vilified. You write a book. You are vilified. Do you find yourself at all thinking about her? Do you draw any strength from her?

TC: I don't compare myself with her at all. She was a beautiful writer. She didn't have to get a writer to translate her science to the public. She worked alone. She certainly was a pioneer. No, I think she stands alone. On her own pedestal. I should not be compared to her.

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