WASTE LANDS

THE THREAT OF TOXIC FERTILIZER

Matthew Shaffer, Toxics Policy Advocate
CALPIRG Charitable Trust
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California Public Interest Research Group Charitable Trust
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EXECUTIVE SUMMARY

The recycling of hazardous industrial wastes into fertilizers introduces several dozen toxic metals and chemicals into the nation's farm, lawn and garden soils, including such well-known toxic substances as lead and mercury. Many crops and plants extract these toxic metals from the soil, increasing the chance of impacts on human health as crops and plants enter the food supply chain. This report documents the highly toxic substances found by testing fertilizers, as well as the strict regulations needed to protect humans and the environment from these toxic hazards.

Between 1990 and 1995, 600 companies from 44 different states sent 270 million pounds of toxic waste to farms and fertilizer companies across the country.[1] The steel industry provided 30% of this waste. Used for its high levels of zinc, which is an essential nutrient for plant growth, steel industry wastes can include lead, arsenic, cadmium, chromium, nickel and dioxin, among other toxic substances. Although the industrial facilities that generate these toxic wastes report the amount of chemicals they transfer off-site to the U.S. Environmental Protection Agency's (U.S. EPA) Toxics Release Inventory every year, they only report the total amount of a given chemical contained in wastes transferred over the course of a year, making it difficult to determine the chemical make-up of a given waste shipment.

With little monitoring of the toxics contained in fertilizers and fertilizer labels that do not list toxic substances, our food supply and our health are at risk.

TESTED FERTILIZERS CONTAIN HARMFUL TOXIC METALS

California Public Interest Research Group (CALPIRG) Charitable Trust and Washington's Safe Food and Fertilizer tested 29 fertilizers from 12 states[2] for 22 toxic metals. This report documents the results of these fertilizer samples, demonstrates that the problem of toxic fertilizers is widespread, and details concerns with proposed regulations for the practice.

Twenty-nine tested fertilizers contained twenty-two toxic heavy metals. These metals are linked to either ecological or human health hazards. Most noticeable is the wide array of toxic metals that exist in fertilizers.

Table E-1: Twenty-nine Fertilizers Tested Contained Toxic Heavy Metals

Metal Tested	Number of Fertilizers Containing the Metal	Metal Tested	Number of Fertilizers Containing the Metal
Aluminum (Al)	29	Lead (Pb)	29
Antimony (Sb)	29	Manganese (Mn)	29
Arsenic (As)	29	Mercury (Hg)	29
Barium (Ba)	29	Molybdenum (Mo)	29
Berylium (Be)	29	Nickel (Ni)	29
Boron (B)	29	Selenium (Se)	29
Cadmium (Cd)	29	Silver (Ag)	29
Chromium (Cr)	29	Thallium (Tl)	29
Cobalt (Co)	29	Vanadium (V)	29
Copper (Cu)	29	Uranium (U)	29
Iron (Fe)	29	Zinc (Zn)	29

[1] "Factory Farming: Toxic Waste and Fertilizer in the United States, 1990-1995," Environmental Working Group, 1998.
[2] In addition to California, Georgia, Idaho, Indiana, Michigan, Minnesota, Montana, North Carolina, Pennsylvania, Texas, Virginia, and Washington states, the tested fertilizers (See Appendix B) are available in many other states. This is especially true for home and garden fertilizers like Scotts.

All commercial fertilizers made from recycled materials such as hazardous wastes, and produced for the general public's use are subject to the federal Land Disposal Restrictions (LDRs).[3] Land disposal restriction standards, which are levels of concern that are limits for keeping hazardous wastes from leaching from a lined landfill, exist for thirteen of the twenty-two metals for which we tested.[4] Land disposal standards do not protect human health and the environment. While exceeding these levels of concern is not an indication that a fertilizer has violated the law, such exceedences indicate that some tested fertilizers have the potential to violate federal regulations.

Twenty fertilizers tested higher than levels of concern. One fertilizer, The Andersons 0-0-0, 36% Zinc [from Michigan] exceeded six levels of concern. It also contained the highest levels of antimony, cadmium, chromium, nickel, silver and lead of any fertilizer we tested and the second highest levels of beryllium, selenium and mercury. In all, the twenty fertilizers exceed levels of concern for nine toxic heavy metals. The most frequently exceeded levels of concern were for cadmium, chromium and vanadium.

These results indicate that fertilizers often contain high levels of harmful toxic metals that exceed levels of concern and could violate federal law.

Labeling is inadequate. Because fertilizer labeling laws only require beneficial nutrients, like zinc or phosphate, to be listed, fertilizers are sold directly to the public and farmers without warnings or information that informs consumers about the presence and quantity of toxic metals. Also, there is no indication on fertilizer labels as to whether or not the fertilizers we tested have been further treated to meet federal land disposal standards.

Inadequate labeling requirements mean consumers do not have the necessary information to make informed decisions about products at the time that they are purchased to best protect the health of their families.

Each of these metals is suspected or known to be toxic to humans and the environment by the U.S. EPA. Nine metals, like arsenic and lead, are known or suspected to cause cancer and ten metals, like mercury, are linked to developmental effects. Three of the tested metals – lead, cadmium and mercury – are also persistent bioaccumulative toxins (PBTs). PBTs persist for long periods of time in the environment – some indefinitely – and they can accumulate in the tissues of humans and wildlife, increasing the long-term health risks at even low levels of exposure. These three metals cause cancer, birth defects, or reproductive problems.[5]

TOXIC FERTILIZERS THREATEN HUMAN HEALTH

The toxic substances found in the tested fertilizers have been linked to adverse human health impacts. The metals found in these fertilizers are known or suspected carcinogens, reproductive and developmental, liver, and blood toxicants. For example, beryllium is a suspected carcinogen, chromium and arsenic are known to cause cancer and barium can cause kidney and lung damage.

Children are most susceptible to the toxic effects of most metals, especially lead, which has been the subject of intense government efforts to reduce lead exposure to children. Products like fertilizer are of great concern as children spend more time on or near the ground and are often exposed to ground level substances through hand-to-mouth behavior.

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[3] 40 CFR 266.20, 40 CFR 268.40 (i)

[4] Zinc fertilizers are subject to less stringent Phase III Land Disposal Restrictions, which do not include beryllium and vanadium. Zinc fertilizers made from electric arc furnace dust (K061) are not subject to standards. 40 CFR Part 268, [FRL-6153-2], RIN 2050-AE05, EPA, 1998.

[5] "Visualizing Zero: Eliminating Persistent Pollution in Washington State." Washington Toxics Coalition, 2000.

TOXIC FERTILIZERS THREATEN AGRICULTURAL SOILS, FOOD SAFETY AND WATERWAYS

As demonstrated in this report, the tested fertilizers contain toxic substances at high levels. These substances can accumulate in agricultural soils, become available for plant uptake, and run off into waterways.

AGRICULTURAL SOIL QUALITY

Farming, especially single-crop farming, requires consistent and dependable soil conditions. The introduction to farm soils of toxic substances like lead and cadmium can adversely affect growing conditions and result in increased toxic accumulation as these metals are highly persistent in soils. This can negatively affect critical growing requirements, such as soil acidity or the solubility of beneficial metals like zinc in the soils.

PLANT UPTAKE

Some crops are more likely than others to absorb non-nutrient toxic substances from soils. For example, fruits and grains can absorb lead, and lettuce, corn and wheat can absorb cadmium from soils.[6] This means that our food supply is at risk of contamination by toxic substances that could threaten human health.

WATER QUALITY

The overall health of the nation's waterways has declined dramatically over the last quarter-century. Forty percent of our rivers, lakes, and estuaries are still too polluted for safe fishing or swimming[7]. Agricultural runoff is a common cause of waterway pollution. A 1998 U.S. EPA report found that metals are the second most common pollutants found in lakes, ponds, reservoirs, and estuaries. In fact, agriculture is the industry most responsible for lake pollution.[8] The introduction of toxic substances from fertilizers to agricultural environments will only add to their concentrations in waterways that state and federal agencies are working to make safe for fishing and swimming.

MISGUIDED POLICIES AND TOXIC LOOPHOLES

Labeling is inadequate. Fertilizer labeling laws do not require listing toxic metals like lead, cadmium and chromium that are not essential to plant and crop growth. Without listing all the ingredients present in fertilizers, consumers cannot make decisions that will protect their soils, crops and plants, or their health.

Existing standards for toxic metals in fertilizers are inadequate for protecting our soils, crops, plants, water, air and health. All commercial fertilizers made from recycled materials, such as hazardous wastes, and produced for the general public's use are subject to the federal Land Disposal Restrictions.[9] [10] The U.S. EPA's federal Land Disposal Restrictions, which are applied to zinc fertilizers[11] that contain toxic waste, are intended to ensure that toxic substances are properly treated before the waste is disposed of in heavily regulated, lined landfills. Land Disposal Restriction standards are technology-based standards, which means that they are designed to predict the ability of a hazardous waste to leach from these landfills.

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[6] Wilson, D., "Fear in the Fields," The Seattle Times, July 3, 1997, citing Agency for Toxic Substances Disease Registry, EPA.
[7] www.pirg.org /enviro/index.htm
[8] National Water Quality Inventory: 1998 Report to Congress (EPA841-R-00-001)
[9] 40 CFR 266.20 and 40 CFR 268.40 (i)
[10] The exception is K061 (the waste code for electric arc furnace dust produced by steel mills) which are not sunject to regulation.
[11] Non-zinc fertilizers are subject to Universal Treatment Standards, 40 CFR 268.48

These standards are not risk- or health-based standards. Using these standards for fertilizers can result in unacceptable health risks because of unanticipated uptake by plants, migration of toxic substances to groundwater more easily than would occur from a lined landfill, generation of airborne dusts, or exposure to humans, including children and farmworkers. Land Disposal Restrictions are inadequate for regulating the application of hazardous wastes, via fertilizers, to farms, lawns and gardens or for use as animal feed.

As hazardous wastes continue to burden regulatory agencies, municipalities, and the industries that generate them, regulators are under increasing pressure to find ways to treat, handle, and dispose of wastes. U.S. EPA encourages the reuse and recycling of industrial wastes, including hazardous wastes, as a way of handling increasing waste quantities, when such wastes can be used as substitutes for virgin, raw materials.[12]

Unfortunately, the recycling of hazardous wastes into fertilizer products does not always include the process of treatment or cleaning of hazardous waste, but rather dilution of the waste. Dilution involves adding substances to a waste to reduce the concentration of toxic substances that are present in the waste. Dilution does not reduce the toxicity of the hazardous constituents.[13] Federal law specifically prohibits dilution as a form of treatment.[14]

RECOMMENDATIONS

No uniform law for regulating the toxicity or labeling of the nation's fertilizers exists. Rather, myriad hazardous waste laws and regulatory bodies are responsible for various aspects of the practice of recycling industrial waste into fertilizers, often with little enforcement or oversight. As a result, the fertilizers we use on our farms and gardens contain high levels of toxic metals that are also not listed on the label. We encourage state and federal agencies to:

1) **Ban the use of hazardous wastes for manufacturing fertilizers.** The presence and quantity of toxic substances in fertilizers vary widely but occur at high levels. These substances are not essential to crop and plant growth and can negatively affect soil and food quality and human health. Current regulatory strategies have been inadequate for protecting farmers and growers, home-use consumers and specialty users from the accumulation of toxic substances from fertilizers in our farms, lawns and gardens.

2) **Adopt expanded right-to-know provisions for all hazardous wastes going into fertilizer.** Consumers should be made aware of the presence and quantity of all ingredients in fertilizers at the point-of-purchase on the product label. Such information is necessary to allow consumers to make informed choices about protecting soil, crop and plant quality and their own health.

3) **Stop exempting hazardous wastes being made into fertilizers from important treatment, storage and disposal tracking requirements.** The generation, treatment, storage, transport, disposal and receipt of hazardous wastes is tracked, or manifested by authorized state agencies. As soon as the waste becomes a recycled product, like a fertilizer, the tracking requirements end. The tracking of industrial wastes from "cradle to grave" and maintaining stringent handling requirements are significant components to ensuring protection of public and environmental health. Any exemptions in these areas put the public at risk.

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[12] http://www.epa.gov/epaoswer/hazwaste/recycle/fertiliz/index.htm
[13] Environmental Protection Agency, EPA530-F-99-043, December 1999.
[14] 40 CCR §268.3,: "Dilution prohibited as a substitute for treatment." In addition, 40 CFR 268.2 (k) states, "Any deliberate mixing of prohibited hazardous waste with soil that changes its treatment classification (i.e., from waste to contaminated soil) is not allowed under the dilution prohibition in section 268.3"

Chapter 1 THE THREAT OF TOXIC FERTILIZER

INTRODUCTION

★ **Fertilizers can contain harmful toxic metals that make the nation's farms, lawns and gardens dumping grounds for toxic waste.** Fertilizers intended for enriching the soil often contain numerous toxic metals that have no benefit for crop and plant growth. For more than thirty years, industries have generated hazardous wastes destined for highly regulated landfills which are instead reclassified as recycled wastes. These wastes, often without cleaning or treatment, are sold or given to farms and fertilizer manufacturers as primary sources or feedstocks for making the nation's fertilizers.

★ **Fertilizer labels lack critical consumer information.** This largely unknown practice is made worse by the fact that farmers, growers and other fertilizer users are not warned about the presence of toxic substances in their fertilizers through labeling, much less about any potential health impacts of exposure to the toxic substances. Fertilizer labeling laws in most states only require beneficial ingredients to be listed on the label. As a result, lead, cadmium, arsenic, and the more than two dozen other toxic metals and chemicals[15] often found in fertilizers are not listed on the labels of the nation's fertilizer products. Due to this inadequate labeling, farmers and consumers do not know which fertilizers contain toxic substances or at what levels they are present without testing.

★ **Regulations are inadequate.** Although all fertilizers must meet federal land disposal standards, which are intended to regulate wasted destined for lined landfills, only Washington state sets limits specifically for toxic metals in fertilizer products. Unfortunately, those standards only apply to the application of the fertilizers to Washington's soils, not to the levels of toxic metals allowed in the fertilizer products. The California Department of Food and Agriculture (CDFA) and the U.S. Environmental Protection Agency (U.S. EPA) have recently proposed metals limits for the fertilizer products, but both would still allow fertilizers to contain toxic waste. The practice is so under-regulated that, the U.S. EPA, in its 1999 *Background Report on Fertilizer Use, Contaminants and Regulations*,[16] acknowledges that they do not know from what sources the majority of toxic fertilizers are derived.

Lack of information is a crucial part of the problem. The generation, treatment, storage, transport, disposal and receipt of hazardous wastes is tracked, or manifested, by authorized state agencies. As soon as the waste becomes a recycled product, like a fertilizer, the tracking requirements end. Nonetheless, tracking is inadequate for:

1) the generators and industrial waste sources of fertilizers;
2) the kinds and levels of toxic substances that these waste sources introduce to our soils; and
3) uptake into plants; the impacts these substances have on soil quality, water quality, and air quality; and exposure to humans and other species.

As a result of this lack of information, regulators make assumptions about the fate of these toxic metals once they are introduced to the environment and our food supply through fertilizers, rather than choosing a precautionary approach to protecting agricultural sustainability and public health.

[15] In addition to the metals tested we know that chlorine, phosphorous, fluoride, dioxins, furans and PCBs can be present in fertilizers.
[16] "Background Report on Fertilizer Use, Contaminants and Regulations," National Program Chemicals Division, Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency, January 1999.

Chapter 2

Agricultural Land Disposal of Hazardous Waste a Growing Problem

Although the land disposal of hazardous waste has received some scrutiny from federal and state agencies, public interest organizations, environmental groups, municipalities, and farmers, not nearly enough has been done to assess all the impacts of using the nation's farms, gardens and lawns as dumping grounds for toxic substances. Agricultural applications of fertilizers made from hazardous waste increase our exposures to toxic substances through food uptake, irrigation runoff, airborne dusts and soil accumulation. Toxic substances found in fertilizers used in our backyards, gardens, parks and playgrounds have potential impacts on our health and the safety of vegetables grown in our gardens. However, no adequate documentation or regulation has been developed for the effects of land disposal of hazardous waste on soil, aquatic and aerial environments, species, drinking water or human health.

The generation of industrial hazardous waste in the United States is of increasing concern and farmlands[17] are a common destination for disposal. In their recent proposed rules for zinc fertilizers made from hazardous secondary materials, the U.S. EPA speaks often of encouraging "legitimate recycling of hazardous wastes" and that the manufacture of fertilizers from hazardous wastes can be "a safe and beneficial practice."[18] Unfortunately, the U.S. EPA does not make clear that current practices reflect legitimate recycling of hazardous wastes, and the results of the testing in this report point to the inadequacies of the technologies currently being used to manufacture toxic fertilizers. Currently the practice has been proven neither safe nor beneficial to crop growth.

Industrial Wastes become Fertilizers.

Some fertilizers are manufactured using or are solely comprised of industrial toxic waste[19]. The waste is first obtained from industrial facilities, such as steel works, blast furnaces, cement kilns, pulp and paper mills, and electronics plants, and then used as a cheap source of certain nutrients, such as zinc. Unfortunately, the resulting waste-derived fertilizers (particularly micronutrient fertilizers) typically contain high levels of toxic materials, such as dioxin and heavy metals, including arsenic, cadmium, and lead.

As new proposals to allow toxic substances to come in direct contact with humans and the environment are considered, concerns for future impacts of toxic substances on human health and the environment are often neglected in favor of keeping current practices in operation. Industrial waste generators pursue cost- and time-saving methods, rather than methods that would benefit agricultural sustainability and public and environmental health.

Natural Sources are of Concern

Naturally mined rock phosphate fertilizers may also be contaminated with cadmium and uranium. As natural sources for fertilizers can also contain harmful toxic substances, standards are necessary for limiting the total concentration of toxic metals in the fertilizers available to the public and farmers.

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[17] All businesses identified in the Toxic Releases Inventory as farms, ranches, grasslands, dairy operations, entities engaged in other forms of agricultural production and any individual who received toxic materials for "other" land disposal, "other" recycling, or land application. Consistent with Environmental Working Group classification from "Factory Farming: Toxic Waste and Fertilizer in the United States, 1990-1995."

[18] Environmental Protection Agency, "Requirements for Zinc Fertilizers Made From Recycled Hazardous Secondary Materials; Proposed Rule," November 28, 2000.

[19] "Background Report," U.S. EPA.

FERTILIZERS ARE USED AS ANIMAL FEED

Also of concern is the common use of fertilizers, including waste-derived fertilizers, as animal feed. Animals are often more susceptible to the hazards of the toxic substances found in fertilizers, such as lead, cadmium and dioxin. For example, cadmium has been linked to brain lesions in cattle.[20] In addition, at high doses, boron is a developmental and reproductive toxin in animals.[21]

WASHINGTON STATE TAKES THE FIRST STEP IN ADDRESSING TOXIC FERTILIZERS

A Seattle Times investigative report in 1997, "Fear in the Fields,"[22] documented the effects of toxic fertilizers on farms and cattle in Washington and a lack of regulations for the practice. The article reported that for decades, the fertilizer industry disposed of hundreds of billions of pounds of potentially harmful materials on farmland across the country. Industry officials initially denied the practice.

Since then, Washington state passed legislation setting the first statewide standards for toxic metals in fertilizers that regulate only the application of fertilizers to soils, but do not regulate limits on toxic metals in fertilizer products. Regulations have been proposed twice in California and both proposals have been met with public opposition, because fertilizers would sill be able to contain toxic substances.[23] The U.S. EPA proposed a rule in 2000 that may set the strongest standards in the nation. Unfortunately, this rule asked more questions than it answered and again several hundred citizens submitted comments opposing the proposal because it would continue to allow fertilizers to contain toxic substances. The U.S. EPA rule is the latest attempt to regulate an inherently dangerous practice rather than ban the disposing of hazardous wastes onto the nation's farms, lawns and gardens.

Meanwhile, the practice continues and untold amounts of toxic metals end up in our backyards.

A PRECAUTIONARY APPROACH

Lead, a persistent bioaccumulative toxic substance, is commonly found in waste-derived fertilizers. Rather than prohibit fertilizers from containing lead, regulators still allow lead to be distributed to the nation's soil through the application of fertilizers.

When lead was introduced into the gasoline supply in the 1920's, scientists expressed concerns that reflect current criticism of manufacturing waste-derived fertilizers. Lead at high doses was believed to be toxic to the brain. Also, once lead was dug up from underground and spread across the earth and water, it could not be recalled.[24] It was fifty years later before negative effects on children were demonstrated and lead poisoning was considered prevalent and insidious. Had decision-makers acted on the reasonable evidence researchers provided in objecting to the use of lead in the 1920's, the toxic legacy of lead may have been averted.

Now, opposition to the practice of recycling hazardous waste into fertilizers stems from the knowledge of toxic substances present in fertilizers, their persistence in soils, water, and food, and their risk to the health of animal species and humans. It would be irresponsible to repeat the mistake of allowing lead in gasoline and wait for the impacts on children's health and the environment to be realized before acting to prevent the health threats of toxic substances in fertilizers.

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[20] "Heavy Metal Fertilizer," Greg Horstmeier, Farm Journal, 1998.
[21] Pahl MV, Culver BD, Strong PL, Murray FJ, Vaziri ND. "The effect of pregnancy on renal clearance of boron in humans: a study based on normal dietary intake of boron." Toxicol Sci 2001 Apr;60(2):252-6.
[22] "Fear in the fields: Part 1 and 2, How Hazardous Wastes Become Fertilizer", Seattle Times, Duff Wilson, Thursday, July 3, 1997.
[23] As of publication of this report, no rule has been finalized in California.
[24] Gina Solomon, "Taking Back Our Food, Farms and Playgrounds", Plenary II: Environmental Health, October 2000.

CHAPTER 3

FERTILIZERS CONTAIN TOXIC METALS

To address a lack of information and growing evidence that our farms, lawns and gardens are being contaminated, California Public Interest Research Group (CALPIRG) Charitable Trust and Washington Safe Food and Fertilizer tested 29 fertilizers from 12 states for 22 toxic metals. The tested fertilizers represent a wide range of fertilizer blends available to agricultural, home-use and specialty consumers.

All twenty-nine tested fertilizers contained all twenty-two toxic heavy metals. Most noticeable is the wide number of toxic metals that exist in fertilizers.

Table 3-1: Twenty-nine Fertilizers Tested Contained Toxic Heavy Metals.

Metal Tested	Number of Fertilizers Containing the Metal	Metal Tested	Number of Fertilizers Containing the Metal
Aluminum (Al)	29	***Lead*** (Pb)	29
Antimony (Sb)	29	Manganese (Mn)	29
Arsenic (As)	29	***Mercury*** (Hg)	29
Barium (Ba)	29	Molybdenum (Mo)	29
Berylium (Be)	29	Nickel (Ni)	29
Boron (B)	29	Selenium (Se)	29
Cadmium (Cd)	29	Silver (Ag)	29
Chromium (Cr)	29	Thallium (Tl)	29
Cobalt (Co)	29	Vanadium (V)	29
Copper (Cu)	29	Uranium (U)	29
Iron (Fe)	29	Zinc (Zn)	29

Of the metals we tested, only boron, cobalt, copper, iron, manganese, molybdenum and zinc are recognized as beneficial to the growth of plants and crops or to the quality of soils. Many beneficial nutrients are also regulated as toxic substances under other conditions. The other metals listed above have no benefits to crop growth and are also regulated as wastes at certain levels.

LAND DISPOSAL RESTRICTIONS

The federal government has established land disposal restriction standards that limit the amount of toxic metals that can be disposed in landfills for thirteen of the twenty-two metals for which we tested (see table 3-2, below). All commercial fertilizers made from recycled materials such as hazardous wastes, and produced for the general public's use are subject to the federal Land Disposal Restrictions (LDRs).[25] Eleven of these standards apply to zinc fertilizers.[26] If the concentration of a metal meets or exceeds a level of concern, defined as twenty times the Land Disposal Restriction standard, the fertilizer must be tested to determine whether it must be further treated to meet the standard.

Twenty fertilizers tested higher than levels of concern. When such levels are exceeded, fertilizers are subject to further regulatory analysis and testing to determine whether they fail federal land disposal restrictions. One fertilizer, The Andersons 0-0-0, 36% Zinc [Michigan] exceeded six levels of concern. It also contained the highest levels of antimony, cadmium, chromium, nickel, silver and

[25] 40 CFR 266.20, 40 CFR 268.40 (i)

[26] Zinc fertilizers are subject to less stringent Phase III Land Disposal Restrictions. Zinc fertilizers made from electric arc furnace d (K061) are not subject to standards. 40 CFR Part 268, [FRL-6153-2], RIN 2050-AE05, EPA, 1998.

lead of any fertilizer we tested and the second highest levels of beryllium, selenium and mercury. In all, the twenty fertilizers exceed levels of concern for nine toxic heavy metals. The most frequently exceeded levels of concern were for cadmium, chromium and vanadium.

Table 3-2: Fertilizers Often Exceed Federal Levels of Concern[27]

Fertilizer [State]	Exceedences	Sb	As	Ba	Be	Cd	Cr	Pb	Hg	Ni	Se	Ag	Tl	V
The Andersons (0-0-0-36 Zn) [MI]	6					x	x	x		x		x		x
Cenex 11-52-0 [ID]	4					x	x			x				x
Monterey Micronized Neutral Zn [CA]	4			x		x		x	x					
Liquid Iron [MN]	3					x	x			x				
BCA Products [MN]	3					x	x							x
Cenex 18-46-0 [ID]	3					x	x							x
Cenex 18-46-0 [MT]	3					x	x							x
Scotts Winterizer [VA]	3			x			x							x
Scotts Step 1 [VA]	3					x	x							x
The Andersons (6-24-24) [MI]	3					x	x							x
Howard Johnson's [VA]	3					x	x							x
Agway 10-20-20-6S [PA]	3					x	x							x
Scotts TurfBuilder [VA]	2						x							x
The Andersons (6-24-24) [IN]	2					x	x							
Farmer's Favorite [GA]	2					x	x							
UAP Northwest 36% Zinc [WA]	2					x		x						
Agway 10-220-20 [PA]	2						x							x
Lesco Turf Builder [GA]	1							x						
American Plant Food [TX]	1		x											
UAP Northwest 10% Boron [WA]	1		x											

Fertilizers in ***Italics*** above are known to be Home and Garden fertilizers. (Full Fertilizer Information in Appendix F)

The results illustrate that fertilizers being used in agriculture and on our lawns and gardens can contain toxic levels of metals that exceed standards for disposal in a hazardous waste landfill.

TOXIC FERTILIZERS THREATEN HUMAN HEALTH

The toxic substances found in these fertilizers have been linked to adverse human health impacts. Nine metals are known or suspected to cause cancer and ten metals are linked to developmental effects.

Each of the metals we tested for is suspected or known to be toxic to humans and the environment by the U.S. EPA. Three of the tested metals, lead, cadmium and mercury, are persistent bioaccumulative toxins (PBTs). PBTs persist for long periods of time in the environment – some indefinitely – and they can accumulate in the tissues of humans and wildlife, increasing the

[27] The 20X Rule: When destined for an authorized, lined hazardous waste landfill, industrial wastes must meet Federal Land Disposal Restrictions (LDRs), 40 CFR 268.40 in order to ensure that the toxic substances in the waste will not leach from the landfill. To determine whether a waste must be tested and treated, a total metals analysis is performed, and if total metals are not more than or equal to 20 X the LDRs, then a treatment does not have to occur. With our sampling data expressed in parts per million (total metals) and LDRs expressed in milligrams per liter (aqueous volume), comparison is not straightforward (except with liquid fertilizers such as Liquid Iron [Minnesota]). However, the U.S. EPA presents this method of reflecting current waste toxicity standards to the proposed fertilizer constituent limits in its recent proposed rule. (www.epa.gov/epaoswer/hazwaste/recycle/fertiliz/index.htm) Also, Washington State makes the same distinction in their "Screening Survey for Metals and Dioxins in Fertilizer Products and Soils in Washington State", April 1999 Pub. 99-309. This method is also applicable to determining whether or not a fertilizer should be treated to meet LDRs. Using this method, we found that most fertilizers fail LDRs, often by extraordinarily wide margins. (Also included are Universal Treatment Standards (40 CFR 268.48) for vanadium and beryllium, as fertilizers other than zinc fertilizers are shown here to exceed Universal Treatment Standards for vanadium. See also Appendix E: Fertilizers Exhibit the Potential to Exceed Federal Toxicity Criteria)

long-term health risks at even low levels of exposure. These three metals cause cancer, birth defects, or reproductive problems.[28]

Table3-3: Fertilizers Contain Toxic Metals with Known and Suspected Health Effects

Metal	Causes Cancer	Developmental Effects	Other toxicity
Aluminum[a]	Unknown	High levels-birth defects	High levels - asthma, Alzheimer's, bone diseases
Antimony[a]	Unknown	Fertility in animals	High levels - lung and stomach problems
Arsenic[a]	Known	Suspected endocrine disruptor	60ppm - fatal; Low levels – nausea, decreased blood cells, blood vessel damage
Barium[a]	Unknown	Unknown	Breathing difficulty, increased blood pressure, stomach irritation, damage to brain, liver, heart, kidney and spleen
Beryllium[a]	Reasonable Evidence	Unknown	High levels - lung damage; Low levels - allergies, inflammation, rashes
Boron[a]	Unknown	Low sperm count	Nose, throat and eye irritation
Cadmium[a]	Reasonable Evidence	Unknown	High levels - stomach irritation; Low levels - kidney disease, lung damage, fragile bones
Chromium[a]	Known	Unknown	Hexavalent Chromium – nose, lung, stomach, liver and kidney damage; skin ulcers
Cobalt[a]	Possible	Unknown	High levels – lung damage
Copper	Unknown	Unknown	Suspected respiratory[bc], reproductive[bd], gastrointestinal or liver[ce], developmental[d] and cardiovascular toxicant[c]
Lead[h]	Reasonable Evidence	Developmental and neurological toxicity, growth retardant, cognitive delays	Kidney, nervous and immune systems damage
Mercury[a]	Possible	High levels – Retardation; brain, nervous, digestive system, kidney damage. Low Levels –learning ability and developmental dela s	High levels - brain, kidney, fetus damage; Low levels - lung damage, nausea, increased blood pressure, skin irritation
Manganese	Unknown	Unknown	Suspected respiratory[ac], reproductive[bd], gastrointestinal or liver[ce] and neurotoxicant[bcd]
Molybdenum	Unknown	Unknown	Suspected neurotoxicant[f]
Nickel[a]	Possible	Unknown	Allergies, asthma
Selenium[a]	Reasonable	Animals-high doses	Bronchitis; Contact - rashes, swelling
Silver	Unknown	Unknown	Suspected skin or sense organ toxicant[g]
Thallium[a]	Unknown	Animals	High levels - nervous system damage; Short term ingestion - lungs, kidneys, liver and heart effects and death.
Uranium[a]	Unknown	Animals	Kidney disease - Animals
Vanadium[a]	Unknown	Animals-high doses	Irritation – lungs, throat and eyes

[28] "Visualizing Zero: Eliminating Persistent Pollution in Washington State." Washington Toxics Coalition, 2000.
[a] http://www.atsdr.cdc.gov/toxfaq.html
[b] US Environmental Protection Agency. Health Effects Notebook for Hazardous Air Pollutants. Review Draft. December 1994.
[c] Klaassen, C., M. Amdur and J. Doull (eds.). Casarett and Doull's Toxicology. The Basic Science of Poisons, 5th Ed. Pergamon Press, NY. 1996.
[d] Roadmaps to Sources of Information on Chemicals Listed in the Emergency Planning Community and Community Right-to-Know Act (Also Known as SARA Title 3), Section 313 Toxic Release Inventory. (Report Number EPADFDK92040). 1991.
[e] Malachowsky, M.J. Health Effects of Toxic Substances. Government Institutes. Rockville, MD, 1995.
[f] Nordic Council of Ministers and Danish National Institute of Occupational Health. Neurotoxic Substances in the Working Environment (Danish ad hoc list). List originally published in Neurotoxic Substances in the Work Environment, Danish Working Environment Service, At-report Nr. 13/1990.
[g] OEHHA, Draft Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels. October 1997.
[h] "Generations at Risk," PSR and CALPIRG Charitable Trust, 1998.

DIOXIN

Additionally, dioxins were detected at a level of concern in one sample, The Andersons (36% Zinc) [Michigan].[29] All forms of dioxin are toxic and were present in this fertilizer sample. Dioxin is among the most toxic chemicals known to humans, can accumulate in soils over time and is highly persistent in the environment. It is known to cause cancer, birth defects and developmental defects in children. A recent U.S. EPA draft assessment revealed that dioxin is 10 times more dangerous than previously thought.[30]

LABELING IS INADEQUATE

Because fertilizer labeling laws only require beneficial nutrients like zinc or phosphate to be listed, fertilizers are sold to the public and farmers without warnings or information that inform consumers about the presence and quantity of toxic metals.

Inadequate labeling requirements mean consumers do not have the necessary information to make informed decisions about the products that they purchase to best protect the health of their families. Children are most susceptible to the toxic effects of most metals, especially lead, which has been the subject of intense government efforts to reduce lead exposure to children. Products like fertilizer are of great concern given that children spend more time on or near the ground and are often exposed to ground level substances through hand-to-mouth behavior.

TOXIC FERTILIZERS THREATEN AGRICULTURAL SOILS, FOOD SAFETY AND WATERWAYS

Over fifty-four million tons of fertilizers were applied to agricultural lands in 1996.[31] An additional 2.6 million tons of fertilizers were used for non-farm consumption, including use around residences, golf courses, other recreational fields, school yards, cemeteries, and public property. Without adequate tracking of wastes or labeling of fertilizer products, testing fertilizers is the only way to know at what levels fertilizers contain toxic substances.

Primary nutrient fertilizers contain nitrogen, phosphorus, and potassium, often designated N-P-K. Secondary (including calcium, magnesium and sulfur) and micronutrient (including boron, chlorine, cobalt, copper, iron, manganese, molybdenum, sodium and zinc) fertilizers[32] are most likely to be waste-derived. California consumers alone applied over 1.5 million tons of secondary and micronutrient fertilizers in 1996[33], the most of any state. As demonstrated in this report, these fertilizers are likely to contain toxic substances at high levels. These substances can accumulate in agricultural soils, be available for plant uptake, and run off into waterways.

Agricultural soil quality is at risk. Farming, especially single-crop farming, requires consistent and dependable soil conditions. The introduction to farm soils of toxic substances, like lead and cadmium, can adversely affect growing conditions and result in increased toxic accumulation as these metals are highly persistent in soils. This can negatively affect critical growing requirements, such as soil acidity or the solubility of beneficial metals like boron in the soils. One study shows that the effectiveness or impairment of boron (a constituent of toxic fly ash waste) in soils is affected by existing soil acidity and the presence of metals like aluminum.[34] Also, toxic substances such as lead, mercury, arsenic and cadmium are highly persistent in soils. The accumulation of these metals can adversely affect growing conditions.

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[29] See Appendix D for dioxin testing data.
[30] U.S. EPA, "Information Sheet 1, Dioxin: Summary of the Dioxin Reassessment Science," July 12, 2000.
[31] "Background Report," U.S. Environmental Protection Agency, January 1999.
[32] The Association of American Plant Food Control Officials defines secondary and micronutrients as "those other than the primary nutrients that are essential for the normal growth of plants and that may need to be added to the growth medium. Secondary plant nutrients shall include calcium, magnesium and sulfur; micro plant nutrients shall include boron, chlorine, cobalt,•copper, iron, manganese, molybdenum, sodium and zinc."
[33] "Background Report," EPA.
[34] U. Kukier, Sumner and Miller, "Boron Release from Fly Ash and its Uptake by Corn." JEQ, 23, May-June, p596-603, 1994.

The reliability of zinc fertilizers made from hazardous waste has also been questioned. Studies indicate that zinc fertilizers are not effective for crop growth when the zinc has a water solubility of less than 40%.[35] [36] Yet more than half of a group of zinc-based fertilizer products surveyed by Cozinco, a fertilizer manufacturer, failed to meet the 40% solubility level.[37] Two thirds of these products also contained very high levels of lead (greater than 1%), suggesting that they were derived from industrial waste. These findings indicate that some waste-derived zinc-based fertilizers may not even benefit plants and crops.

Plants are known to absorb toxic metals from soils. Crops and plants pull nutrients from the earth to grow and may absorb toxic metals present in the soil. Some crops are more likely than others to uptake non-nutrient toxic substances from soils:

Table 3-4: Some Toxic Metals in Fertilizers are Absorbed by Crops

Metal	Crops available for uptake
Arsenic[38]	Carrots, onions, potatoes and other root crops
Boron[39]	Corn
Cadmium[40]	Lettuce, corn, wheat
Lead[41]	Fruits and grains
Dioxin[42] [43]	Zucchini, pumpkin, cucumber, carrots, lettuce and peas

The introduction of toxic substances such as these to either high-volume agricultural production operations or to our vegetable gardens puts our food supply at risk for contamination by toxic substances to which humans would ultimately be exposed.

Water quality is impacted by toxic fertilizers. The overall health of the nation's waterways has declined dramatically over the last quarter-century. Forty percent of our rivers, lakes, and estuaries are still too polluted for safe fishing or swimming[44].

The U.S. EPA has set water quality standards for eleven of the toxic substances found in the tested fertilizers (antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, and thallium). The introduction of these substances to agricultural environments will only serve to add to their concentrations in waterways that state and federal agencies are working to make safe for fishing and swimming. A 1998 U.S. EPA report found that metals are the second most common pollutants in lakes, ponds, reservoirs, and estuaries. Agriculture is the industry most responsible for lake pollution.[45]

Agricultural runoff is a common cause of waterway pollution. The introduction of toxic substances from fertilizers to agricultural environments will only add to their concentrations in waterways that state and federal agencies are working to make safe for fishing and swimming.

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[35] J.J. Mortvedt. Study done at National Fertilizers and Environmental Research Center, Tennessee Valley Authority, Muscle Shoals, Alabama, 35660, USA.
[36] "Zinc plant availability as influenced by zinc fertilizer sources and zinc water solubility." Colorado Agricultural Experiment Station Technical Bulletin TB 97--4, Prepublication Draft, August 1997. http://www.cozinco.com/comparison.htm
[37] Sampled by Cozinco, a Colorado based fertilizer manufacturer. 45 of 73 (61%) had < 40% zinc solubility. See http://www.cozinco.com/comparison.htm
[38] Wilson, D., "Fear in the Fields," The Seattle Times, July 3, 1997, citing Agency for Toxic Substances Disease Registry, EPA.
[39] Kukier, et.al.
[40] Wilson, D., "Fear in the Fields."
[41] Ibid.
[42] Hulster, A., et al, "Soil-Plant Transfer of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans to Vegetables of the Cucumber Family," Environ. Sci. Technol., 1994, vol. 28, pp. 1110-1115.
[43] Muller JF, Hulster AA, Papke OC, Ball MC, Marschner H. Related Articles Transfer of PCDD/PCDF from contaminated soils into carrots, lettuce and peas. Chemosphere. 1994 Nov-Dec;29(9-11):2175-81.
[44] www.pirg.org /enviro/index.htm
[45] National Water Quality Inventory: 1998 Report to Congress (EPA841-R-00-001)

Chapter 4

AGENCIES FAIL TO PROTECT PUBLIC HEALTH AND THE ENVIRONMENT

Existing standards for regulating the content of non-beneficial toxic substances such as lead, mercury and dioxin in fertilizers are improper for protecting environmental or human health. Worse, consumers have been kept in the dark about the presence and quantity of toxic substances in their fertilizers. Labeling laws only require that the beneficial ingredients, such as zinc and phosphate be listed on the label, regardless of the amount of non-beneficial substances. Some state regulations require nutrient composition labeling of fertilizers.

MISGUIDED POLICIES AND TOXIC LOOPHOLES

All commercial fertilizers made from recycled materials such as hazardous wastes, and produced for the general public's use are subject to the federal Land Disposal Restrictions.[46] [47] The U.S. EPA's federal Land Disposal Restrictions, which are applied to zinc fertilizers[48] that contain toxic waste, are intended to ensure that toxic substances are properly treated before the waste is disposed of in heavily regulated, lined landfills. Land Disposal Restriction standards are technology-based standards, which means that they are designed to predict the ability of a hazardous waste to leach from these landfills. These standards are not risk- or health-based standards. Land Disposal Restrictions are inadequate for regulating the application of hazardous wastes, via fertilizers, to farms, lawns and gardens or for use as animal feed. Inadequate regulation can result in unacceptable health risks because of unanticipated uptake by plants, migration of toxic substances to groundwater, generation of airborne dusts, or exposure to humans.

Loopholes in the law encourage the recycling of hazardous waste into consumer products that can have direct impacts on human and environmental health. For example, the hazardous wastes used to manufacture fertilizers are subject to tracking requirements for generation, storage, disposal, transport and receipt of the wastes.[49] However, tracking ends when the wastes become fertilizer products. Without tracking at the stage the waste becomes a product, fertilizer manufacturers have additional incentive to use wastes to produce fertilizers.

Still other wastes slip through entirely without regulation. For example, fertilizers made from a steel mill waste (electric arc furnace dust) are exempted from meeting Land Disposal Restriction Standards.[50]

Mining wastes are also exempt from regulation as hazardous wastes under federal law[51]. This loophole allows very high levels of arsenic and lead to be incorporated into fertilizers. Mining waste is used to make at least one home and garden fertilizer, Ironite. An analysis by the Arizona Department of Health Services showed mean arsenic concentrations for Ironite of 4400 parts per million and mean lead concentrations of 2850 parts per million.[52]

As hazardous wastes continue to burden regulatory agencies, municipalities, and the industries that generate them, regulators are under increasing pressure to find ways to treat, handle, and dispose of

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[46] 40 CFR 266.20 and 40 CFR 268.40 (i)
[47] The exception is K061 (the waste code for electric arc furnace dust produced by steel mills) which are not sunject to regulation.
[48] [48] Non-zinc fertilizers are subject to Universal Treatment Standards, 40 CFR 268.48
[49] Tracking requirements for generator, transporter, treatment, storage, disposal facility (40 CFR 266.2) and receiver 40 CFR 268.7 (b)(6), but does not include tracking of the final product itself.
[50] 40 CFR 266.20
[51] The Bevill Exemption, 40 CFR 261.4(b)(7), The U.S. EPA is considering removing the exemption.
[52] EPA F-2000-RZFP-FFFFF

wastes. U.S. EPA encourages the reuse and recycling of industrial wastes, including hazardous wastes, as a way of handling increasing waste quantities, when such wastes can be used as substitutes for virgin, raw materials.[53]

Unfortunately, the recycling of hazardous wastes into fertilizer products does not always include the process of treatment or cleaning of hazardous waste, but rather dilution of the waste. Dilution involves adding substances to a waste to reduce the concentration of toxic substances that are present in the waste. Dilution does not reduce the toxicity of the hazardous constituents.[54] Federal law specifically prohibits dilution as a form of treatment.[55]

THE REGULATION OF TOXIC FERTILIZERS IS INADEQUATE

Although fertilizers must meet Land Disposal Restrictions which are limits to keep hazardous wastes from leaching from a lined landfill, the U.S. EPA has not set standards for the total amount of toxic substances permitted in waste-derived fertilizer products. Recent proposals for limiting heavy metals in our fertilizers will do little to address the fate of metals once they accumulate in our soils. For example, in California, the Department of Food and Agriculture has proposed standards for heavy metals in fertilizers that would allow fertilizers to be more toxic than hazardous waste for lead and cadmium:

Table 4-1: Proposed California Rules Allow Fertilizers to be More Toxic than Hazardous Waste

Hazardous Constituent	Maximum contaminant concentrations in fertilizers allowed under CDFA's proposal[56] (mg/kg)			Levels which define state hazardous waste[57] (mg/kg)
	N-P-K Fertilizers	Phosphate Fertilizers	Micronutrient Fertilizers	
Arsenic	80.6	136	416	500
Cadmium	161	**272**	**384**	100
Lead	806	**1360**	**4480**	1,000

The strongest proposed standards in the United States are the recent U.S. EPA proposed rule standards (see Table 4-2). These standards, however, are loosely based on the levels of six toxic metals currently found in some common fertilizers. These standards are not based on studies that demonstrate protection of the environment or human health.

Table 4-2: U.S. EPA Proposed Toxic Fertilizer Standards

Metal Constituent	**Maximum allowable total concentration in fertilizer, per unit (1%) of Zinc (ppm)[58]**
Lead	2.8
Cadmium	1.4
Arsenic	0.6
Mercury	0.3
Nickel	1.4
Chromium	0.6

[53] http://www.epa.gov/epaoswer/hazwaste/recycle/fertiliz/index.htm
[54] Environmental Protection Agency, EPA530-F-99-043, December 1999.
[55] 40 CCR §268.3,: "Dilution prohibited as a substitute for treatment." In addition, 40 CFR 268.2 (k) states, "Any deliberate mixing of prohibited hazardous waste with soil that changes its treatment classification (i.e., from waste to contaminated soil) is not allowed under the dilution prohibition in section 268.3"
[56] Shull, L., "Non-technical Summary: Development of Risk-Based Concentrations for Arsenic, Cadmium, and Lead in Inorganic Commercial Fertilizers," Newfields, Inc., p.17, Table 3.
[57] 22 CCR 66261.24
[58] A zinc unit in this context represents one percent (by weight) of zinc in the fertilizer product that is applied to the land. Thus, for example, an excluded fertilizer containing 10% zinc could contain no more than 28 ppm of lead. See EPA F–2000–RZFP–FFFFF.

Nonetheless, even as compared to the proposed U.S. EPA standards six of the fertilizers we tested would **fail:**

Table 4-3: Six Zinc Fertilizers Would Fail U.S. EPA Proposed Standards for Heavy Metals

Metal	**Fertilizer [Concentration of Zinc, State]**					
	Green Velvet Fall/Winter Lawn Food	The Andersons (6-24-24)	The Andersons (0-0-0)	Monterey Micronized Neutral	UAP Northwest	Pursell Turf Builder
	0.5% Zinc	0.5% Zinc	36% Zinc	52% Zinc,	36% Zinc	.05% Zinc
	Indiana	Michigan	Michigan	California	Washington	Georgia
	Actual Metal Level, (Maximum Metal Level Allowed Under U.S. EPA Rule)					
Lead	**<3 ppm** (1.4)	**5 ppm** (1.4)	**1,480 ppm** (100.8)	81 ppm (145.6)	**106 ppm** (100.8)	**4 ppm** (1.4)
Cadmium	**1.67 ppm** (0.7)	**4.19 ppm** (0.7)	**201.4 ppm** (50.4)	**87 ppm** (72.8)	**121.9 ppm** (50.4)	**1.14 ppm** (0.7)
Arsenic	**65 ppm** (0.3)	**10 ppm** (0.3)	**52 ppm** (21.6)	12 ppm (31.2)	<4 ppm (21.6)	**51 ppm** (0.3)
Mercury	<0.001 ppm (0.15)	0.008 ppm (0.15)	0.337 ppm (1.08)	2.910 ppm (15.6)	0.0019 ppm (1.08)	0.002 ppm (0.15)
Nickel	**2.0 ppm** (0.7)	**11.6 ppm** (0.7)	**517.3 ppm** (50.4)	2.5 ppm (72.8)	17.4 ppm (50.4)	**2.6 ppm** (0.7)
Chromium	**18 ppm** (0.3)	**62 ppm** (0.3)	**840 ppm** (21.6)	<1 ppm (31.2)	3 ppm (21.6)	**10 ppm** (0.3)
Exceedences	**5/6**	**5/6**	**5/6**	**1/6**	**2/6**	**5/6**

In its proposal, the U.S. EPA chose to set toxic metal standards comparable to levels of hazardous waste substances that are found in common zinc fertilizers. Such an approach runs counter to ensuring fertilizers are clean. The proposed standards are based on what already exists in the market, not based on what would prevent environmental or human health problems.

Also, these standards are only proposed for zinc fertilizers. This report demonstrates that fertilizers not included in the scope of the U.S. EPA proposal contain high levels of toxic metals. Non-zinc fertilizers available for home and garden use, like Scotts brand (Winterizer, Turfbuilder and Step 1) fertilizers contain barium, cadmium, chromium and vanadium in concentrations that exceed levels of concern. However, they would not be subject to the U.S. EPA's proposed regulation. This is a glaring flaw in the proposed regulation.

For thirty or more years, fertilizer consumers have shared the burden of toxic waste disposal, on our farms and in our gardens. With inadequate hazardous waste laws being applied to products that we use to grow our crops and purchase at grocery stores and nurseries, we are inherently at risk. Not only have the nation's regulators not set standards for toxic fertilizers that protect public health and the environment, but they also have not adequately enforced the standards that exist. All the while, fertilizers contain high levels of harmful toxic substances, which are not even listed on the label.

Chapter 5 RECOMMENDATIONS

No uniform law for regulating the toxicity or labeling of the nation's fertilizers exists. Also, myriad hazardous waste laws and responsible regulatory bodies are applied to the practice of recycling industrial waste into fertilizers, often with little enforcement or oversight. While both the federal U.S. EPA and the Association of American Plant Food Control Officials would prefer a uniform policy, no comprehensive strategy has been attained. Worse, attempts to develop a nationwide standard often lead to a protection of this dangerous practice, assuming that toxic fertilizers are innocent until proven guilty of damaging our agro-economic resources and our food supply and exposing millions of Americans to harmful toxic metals without their knowledge.

We encourage state and federal agencies to:

1. **Ban the use of hazardous wastes for manufacturing fertilizers.** As is made clear from this report and the findings of several other studies of toxic fertilizers, the presence and quantity of toxic substances in fertilizers vary widely but occur at high levels. These substances are not essential to crop and plant growth and can negatively affect soil and food quality and human health. Current regulatory strategies have been inadequate for protecting farmers and growers, home-use consumers and specialty users from the accumulation of toxic substances from fertilizers in our farms, lawns and gardens.

2. **Adopt expanded right-to-know provisions for all hazardous wastes going into fertilizer.** Consumers should be made aware of the presence and quantity of all ingredients in fertilizers at the point-of-purchase on the product label. Websites and 800-numbers are only sufficient in addition to full labeling. Such information is necessary to allow consumers to make informed choices about protecting soil, crop and plant quality and their own health.

3. **Stop exempting hazardous wastes being made into fertilizers from important treatment, storage and disposal tracking requirements.** Tracking for the generation, treatment, storage, transport, disposal and receipt of hazardous wastes is tracked, or manifested. As soon as the waste becomes a recycled product, like a fertilizer, the tracking ends. The tracking of industrial wastes from "cradle to grave" and maintaining stringent handling requirements are significant components to ensuring protection of public and environmental health. Any exemptions in these areas puts the public at risk.

APPENDIX A: METHODOLOGY

Fertilizers were chosen for analysis based on listed ingredients or Material Safety Data Sheets, and recommended maximum application rate. This data was matched to information in the Washington State Department of Ecology database (http://www.ecy.wa.gov/programs/hwtr/fertilizer/index.html) and a U.S. Environmental Protection Agency background report, "Background Report on Fertilizer Use, Contaminants and Regulations," EPA 747-R-98-003, National Program Chemicals Division, Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency, Washington, D.C. 20460, January, 1999.

Accompanying the purchase of each sample was a chain of custody forms provided by Axys Analytical Services, Ltd.

The laboratories that tested fertilizers were Axys Analytical Services Ltd. and Frontier Geosciences Inc. Axys was responsible for testing a fertilizer sample for dioxin, furans and dioxin and furan compounds. Frontier Geosciences was responsible for testing for metal content, including aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, uranium and zinc.

Samples were taken with 40 ml pharmacy-quality glass vials.

Data were received in Excel and are included in Appendix E (Frontier Geosciences metals data) and Appendix D (Axys Analytical dioxin data for The Andersons 36% Zinc).

Total metals were matched with federal Land Disposal Restriction Standards, Universal Treatment Standards and Toxicity Characteristic Leaching Procedure standards, using the 20 X rule.

The 20X Rule: When destined for an authorized, lined hazardous waste landfill, industrial wastes must meet federal Land Disposal Restrictions (LDRs), 40 CFR 268.40 in order to ensure that the toxic substances in the waste will not leach from the landfill. To determine whether a waste must be tested and treated, a total metals analysis is performed, and if total metals are not more than or equal to 20 X the LDRs, then a treatment does not have to occur. With our sampling data expressed in parts per million (total metals) and LDRs expressed in milligrams per liter (aqueous volume), comparison is not straightforward (except with liquid fertilizers such as Liquid Iron [Minnesota]). However, the U.S. EPA presents this method of reflecting current waste toxicity standards to the proposed fertilizer constituent limits in its recent proposed rule. (www.epa.gov/epaoswer/hazwaste/recycle/fertiliz/index.htm) Also, Washington state makes the same distinction in their "Screening Survey for Metals and Dioxins in Fertilizer Products and Soils in Washington State", April 1999 Pub. 99-309. This method is also applicable to determining whether or not a fertilizer should be treated to meet LDRs. Using this method, we found that most fertilizers fail LDRs, often by extraordinarily wide margins. (Also included are Universal Treatment Standards (40 CFR 268.48) for vanadium and beryllium, as fertilizers other than zinc fertilizers are shown here to exceed Universal Treatment Standards for vanadium. See also Appendix E: Fertilizers Exhibit the Potential to Exceed Federal Toxicity Criteria).

APPENDIX B: FERTILIZER SAMPLES

State	Fertilizer
CA	Monterey Maxi (10-52-8)
CA	Monterey Micronized Neutral Zinc - 52% zinc
GA	Farmer's Favorite (5-10-15) 7% Ca; 8.5% S; 15% Cl
GA	Lesco Turf Builder (16-4-8) 3% Fe; .20% Mn; 11.3% Cl
GA	Pursell Turf Builder (29-3-4) .05% Cu; .05% Zn; .05% Mn; .005% Mo, .1% Fe; 3.2% Cl
ID	18-46-0
ID	11-52-0
IN	Cargill Urea 46%
IN	The Andersons (6-24-24)
IN	Countrymark/Growmark Green Velvet (18-10-18) N-18% (3.9% ammoniacal nitrogen and 14.1% urea) Phosphoric acid-10%; Potash-18%; S-1%; Ca-3.41%; Mg-1.81%; Fe-0.15; Mn-0.05%; Zn-.05%; B-.02%
MI	The Andersons (6-24-24)
MI	The Andersons (0-0-0-36 Zinc)
MI	The Andersons (0-0-0)
MN	Voluntary Purchasing Groups Hi-Yield Liquid Iron – S 2%; Cu 0.125%; Fe 2.5%;Mn 0.25%; Zn 0.25%
MN	BCA Products - Total nitrogen 10%; Phosphoric Acid 21%; S-21%; Contains sulfur-coated urea, nitroform nitrogen, ammonium phosphate, potash muriate, sulfur of potash, iron sulfate
MT	18-46-0 (Florida)
MT	90% Sulphur (Alberta, Canada)
NC	Dragon's Iron Sulfate – 20% Iron
NC	Southern State's Carpet Maker (16-4-8) N (2.8% water insoluble; 13.2% water soluble urea form); Phosphate 4%; Potash 8%; S—10%; Mg-1% water soluble;
PA	Agway 10-20-20-6S
PA	Agway 10-220-20
TX	American Plant Food
TX	Deco Lawn Lime
VA	Scotts Winterizer w/Plus 2 Weed Control 22-4-11 w/ 97.98% inert
VA	Scotts TurfBuilder w/HALTS Crabgrass Preventer, 28-3-4, 98.97% inert, <4% chlorine
VA	Scotts Step 1 For seedlings, 16-21-4, 96.9% inert
VA	Howard Johnson's 12-22-14, 1% iron, <14% chlorine
WA	UAP Northwest 10% Boron
WA	UAP Northwest 36% Zinc

APPENDIX C: FERTILIZERS MAY EXCEED TOXICITY CRITERIA

Much like Land Disposal Restrictions, the Toxicity Characteristic Leaching Procedure (TCLP)[59], is used to determine whether or not a waste is a toxic waste. As we see here, twelve fertilizers exceed toxicity criteria of concern. Such results require the fertilizers to have a TCLP test run to determine if the waste is indeed a toxic waste that exhibits leachability. Should any fertilizer fail the TCLP, the product can be considered more toxic than hazardous waste.

FERTILIZERS EXHIBIT THE POTENTIAL TO EXCEED FEDERAL TOXICITY CRITERIA

Fertilizer	St.	Exceedences	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
The Andersons (0-0-0-36)	MI	4			x	x	x		x	
Monterey Micronized Neutral Zn	CA	3		x	x				x	
UAP Northwest 36% Zinc	WA	3			x		x		x	
Cenex 11-52-0	ID	2			x	x				
Cenex 18-46-0	ID	2			x	x				
Cenex 18-46-0	MT	2			x	x				
Scotts Winterizer	VA	2		x		x				
Liquid Iron	MN	1				x				
Scotts TurfBuilder	VA	1				x				
Scotts Step 1	VA	1				x				
American Plant Food	TX	1	x							
UAP Northwest 10% Boron	WA	1	x							

See Appendix G for actual numbers

There is no law for labeling fertilizers with the presence of these metals or any exceedence of toxicity standards. Here, again consumers are kept in the dark about the potential dangers of the fertilizers they purchase.

[59] 40 CFR 261.24, "A solid waste exhibits the characteristic of toxicity…"

APPENDIX D: DIOXIN TESTING FOR THE ANDERSONS 36% ZN

AXYS METHOD DX-S-1613/Ver.4043 1613_DAT5							
Form 1A: PCDD/PCDF ANALYSIS DATA SHEET						SAMPLE NO.: MBD-2	
Lab Name: AXYS ANALYTICAL SERVICES							
Contract No.: 4043				**Lab Sample ID:** L3126-2			
Matrix: SOLID				**Sample Size:** 9.37 g (dry)			
Sample Receipt Date: 22-Jan-2001				**Initial Calibration Date:**12-Feb-2001			
Extraction Date:	06-Feb-2001	**Shift:** 0700		**Instrument ID:** AUTOSPEC ULTIMA			
Analysis Date:	12-Feb-2001	**Time:** 22:07:13		**GC Column ID:** DB-5 0548712			
Extract Volume (µL): 20				**Sample Datafile: DX13_011 S:11**			
Injection Volume (µL): 1.0				**Blank Data Filename:** DX13_011 S:9			
Dilution Factor:	N/A			**Cal. Ver. Data Filename:**			
Concentration Units:	pg/g (dry weight basis)			**% Moisture:**	7.0		

ANALYTE	LAB FLAG[3,4]	CONCENTRATION FOUND		DETECTION LIMIT		ION ABUND. RATIO[1]	RRT[1]
2,3,7,8-TCDD		0.199		0.100		0.68	1.002
1,2,3,7,8-PeCDD		0.538		0.110		0.60	1.001
1,2,3,4,7,8-HxCDD		0.448		0.150		1.27	1.001
1,2,3,6,7,8-HxCDD		1.44		0.150		1.18	1.000
1,2,3,7,8,9-HxCDD		1.67		0.150		1.35	1.014
1,2,3,4,6,7,8-HpCDD		10.4		0.160		1.07	1.000
OCDD		48.9		0.410		0.86	1.000
2,3,7,8-TCDF		9.56		0.190		0.79	1.002
1,2,3,7,8-PeCDF		2.46		0.120		1.54	1.002
2,3,4,7,8-PeCDF		3.35		0.120		1.43	1.000
1,2,3,4,7,8-HxCDF		8.28		0.210		1.25	1.000
1,2,3,6,7,8-HxCDF		3.24		0.210		1.20	1.001
1,2,3,7,8,9-HxCDF		0.469		0.210		1.16	1.000
2,3,4,6,7,8-HxCDF		3.24		0.210		1.23	1.000
1,2,3,4,6,7,8-HpCDF		13.5		0.110		1.04	1.000
1,2,3,4,7,8,9-HpCDF		2.82		0.110		1.06	1.000
OCDF		17.9		0.190		0.89	1.002
Total Tetra-Dioxins		11.4		0.100			
Total Penta-Dioxins		12.2		0.110			
Total Hexa-Dioxins		16.5		0.150	**2,3,7,8-TCDD TEQs (NATO I-TEFs)**		
Total Hepta-Dioxins		20.8		0.160			
Total Tetra-Furans		52.4		0.190	ND=1/2 DL	5.43	pg/g
Total Penta-Furans		42.7		0.120			
Total Hexa-Furans		33.8		0.210	ND=0	5.43	pg/g
Total Hepta-Furans		23.8		0.110			

(1) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.

(2) Alternate ions used for native and labelled P5CDD for confirmation and quantitation.

(3) ND = Not detected.

(4) NDR = Peak detected, but did not meet quantification criteria. NDR concentrations are not included in the homologue totals or TEQ calculations.

APPENDIX D, CONT.:THE ANDERSONS 36% ZINC (DIOXIN)

AXYS METHOD DX-S-1613/Ver.4043, 1613_DAT5

Form 2, PCDD/PCDF ANALYSIS DATA SHEET | **SAMPLE NO., MBD-2**

LAB NAME: AXYS ANALYTICAL SERVICES

Contract No.: 4043			**Lab Sample ID:** L3126-2
Matrix: SOLID			**Sample Size:** 9.37 g (dry)
Sample Receipt Date: 22-Jan-2001			**Initial Calibration Date:** 12-Feb-2001
Extraction Date: 06-Feb-2001	**Shift:** 0700		**Instrument ID:** AUTOSPEC ULTIMA
Analysis Date: 12-Feb-2001	**Time:** 22:07:13		**GC Column ID:** DB-5 0548712
Extract Volume (µL): 20			Sample Datafile: **DX13_011 S:11**
Injection Volume (µL): 1.0			**Blank Data Filename:** DX13_011 S:9
Dilution Factor: N/A			**Cal. Ver. Data Filename:**
Concentration Units: pg absolute			**% Moisture:** 7.0

LABELLED COMPOUNDS	SPIKE CONC.	CONC. FOUND	R(%)[1]	ION ABUND. RATIO[2]	RRT[2]
13C-2,3,7,8-TCDD	2000	1490	74.7	0.78	1.012
13C-1,2,3,7,8-PeCDD	2000	1450	72.3	0.66	1.378
13C-1,2,3,4,7,8-HxCDD	2000	1700	85.0	1.26	0.986
13C-1,2,3,6,7,8-HxCDD	2000	1530	76.3	1.26	0.990
13C-1,2,3,4,6,7,8-HpCDD	2000	1220	61.1	1.06	1.096
13C-OCDD	4000	1660	41.6	0.89	1.181
13C-2,3,7,8-TCDF	2000	1380	69.1	0.79	0.967
13C-1,2,3,7,8-PeCDF	2000	1420	71.2	1.58	1.278
13C-2,3,4,7,8-PeCDF	2000	1380	68.8	1.61	1.347
13C-1,2,3,4,7,8-HxCDF	2000	1610	80.3	0.53	0.953
13C-1,2,3,6,7,8-HxCDF	2000	1590	79.5	0.53	0.957
13C-1,2,3,7,8,9-HxCDF	2000	1410	70.4	0.53	1.005
13C-2,3,4,6,7,8-HxCDF	2000	1480	73.9	0.54	0.980
13C-1,2,3,4,6,7,8-HpCDF	2000	1170	58.7	0.44	1.063
13C-1,2,3,4,7,8,9-HpCDF	2000	1230	61.3	0.43	1.106
CLEANUP STANDARD					
37Cl-2,3,7,8-TCDD	200	146	73.0		1.013

(1) Contract-required limits for percent recovery (R) are specified in Section 9.3.3, Method 1613.

(2) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613. NOTE: There is no ion abundance ratio for 37Cl4-2378-TCDD (cleanup standard).

(3) Alternate ions used for native and labelled P5CDD for confirmation and quantitation.

For more information on dioxin/furan testing, please contact Matthew Shaffer, CALPIRG Charitable Trust, 415-206-9338, mattshaffer@calpirg.org

APPENDIX E

APPENDIX E: Trace Metals Content of Fertilizers

analyzed in January, 2001 on a pro bono basis by

Frontier Geosciences Inc. 414 Pontius North, Suite B, Seattle, WA 98109
phone: 206-622-6960 fax: 206-622-6870 e-mail: nicolasb@frontier.wa.com

		Trace Metals Concentrations, ug/g (ppm)										
Fertilizer	St.	Be	B	Al	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Dragon's Iron Sulfate	NC	<0.11	51	746	<2	2	356	74,729	24.6	31.6	<3	276
Southern State's Carpet Maker	NC	<0.11	30	183	2	<1	7	330	0.5	0.7	<3	<10
American Plant Food	TX	0.08	839	88	4	<1	115	3,410	4	<0.3	<3	<10
Deco Lawn Lime	TX	3.23	659	1731	34	21	55	3,045	4	4	<3	22
Cenex 18-46-0	MT	2.67	178	8,681	307	163	292	14,014	6.5	64.2	15	355
Cenex 18-46-0	ID	4.66	635	8,669	895	567	95	5,599	1.8	113.0	26	2,074
Cenex 90% Sulphur	MT	0.33	32	711	<2	<1	15	804	<0.5	0.6	<3	<10
Cenex 11-52-0	ID	1.65	154	8,748	949	571	146	6,181	3.2	255.5	55	1,697
Cargill Urea 46%	IN	<0.11	<30	<20	<2	<1	<5	<125	<0.5	<0.3	<3	<10
The Andersons (6-24-24)	IN	1.15	<30	2,615	30	24	75	3,103	0.7	3.3	<3	35
Countrymark Green Velvet	IN	0.47	83	1,668	29	18	385	2,243	2.8	2.0	3	133
BCA Products	MN	0.74	149	7,756	80	42	177	7,177	0.9	7.3	16	65
Liquid Iron	MN	<0.11	<30	<20	<2	13	3,426	27,565	3.1	39.8	1,836	3,605
The Andersons (6-24-24)	MI	3.30	370	8,133	103	62	229	9,911	2.1	11.6	3	45
The Andersons (0-0-0-36)	MI	4.18	762	2,615	41	840	9,641	44,033	61.9	517.3	3,620	403,423
Monterey Maxi	CA	0.11	126	<20	<2	<1	332	426	<0.5	<0.3	317	300
Monterey Micronized Neutral Zn	CA	0.12	<30	1,514	<2	<1	47	1,401	<0.5	2.5	11	460,564
The Andersons (0-0-0)	MI	<0.11	<30	239	<2	<1	67	812	<0.5	0.4	<3	<10
UAP Northwest 10% Boron	WA	<0.11	123,644	446	9	<1	18	567	<0.5	0.4	7	46
UAP Northwest 36% Zinc	WA	<0.11	<30	254	<2	3	445	3,902	<0.5	17.4	5	279,889
Farmer's Favorite	GA	0.85	169	3,821	34	26	1,214	3,612	1.8	5.5	32	367
Lesco Turf Builder	GA	0.15	<30	942	14	4	317	12,684	<0.5	2.5	<3	16
Pursell Turf Builder	GA	0.52	88	1,071	16	10	333	1,466	1.3	2.6	58	447
Agway 10-20-20-6S	PA	1.57	165	6,370	127	60	246	12,296	4.3	11.9	3	31
Agway 10-220-20	PA	0.89	60	3,306	50	28	117	4,854	0.7	5.6	<3	16
Scotts Winterizer	VA	0.90	<30	28,734	90	460	384	27,183	30.8	156.9	49	85
Scotts TurfBuilder	VA	0.37	<30	17,331	63	288	200	19,169	19.4	115.8	43	44
Scotts Step 1	VA	0.74	<30	13,996	87	145	215	15,994	9.8	58.8	20	39
Howard Johnson's	VA	1.44	96	3,449	43	31	187	6,888	1.6	8.9	38	634

APPENDIX E, cont., Trace Metals Concentrations, ug/g (ppm)											
Sample	Be	B	Al	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
NIST 1643-d rep 1	12.38	135.8	133.3	22.75	18.10	37.69	109.8	24.09	55.47	20.85	96.76
NIST 1643-d rep 2	12.25	135.9	131.5	23.08	17.72	37.93	112.2	23.52	55.47	21.09	94.98
mean	12.32	135.8	132.4	22.92	17.91	37.81	111.0	23.81	55.47	20.97	95.87
RPD (%)	1.0	0.0	1.4	1.4	2.1	0.6	2.2	2.4	0.0	1.1	1.9
certified value	12.53	145	127.6	35.10	18.53	37.66	91.2	25.00	58.10	20.50	72.48
% recovery	98.3	93.8	103.8	65.3	96.7	100.4	121.7	95.2	95.5	102.3	132.3
NIST 2781	0.25	<30	8,265	80.6	139	867	25,833	4.7	71.6	640	1,431
NIST-2781	0.24	<30	8,456	91.1	162	919	28,886	5.9	84.9	684	1,286
mean	0.24	<30	8,360	85.8	150	893	27,360	5.3	78.3	662	1,359
RPD (%)	4.3		2.3	12.2	14.9	5.8	11.2	21.8	17.0	6.7	11
certified value	*nc*	*nc*	16,000	*nc*	202	*nc*	28,000	*nc*	80.2	627	1,273
% recovery	*nc*	*nc*	52.3	*nc*	74.5	*nc*	97.7	*nc*	97.6	105.5	106.7
Blank-1	-0.06	55	20	3.3	4.9	1	182	-6.6	0.07	-1.9	11
Blank-2	-0.03	35	32	3.6	5.6	4	257	-6.4	0.13	-0.3	7
Blank-3	-0.10	48	19	2.6	4.9	1	189	-6.7	-0.04	-1.8	5
average	-0.06	46	24	3.2	5.1	2	209	-6.6	0.05	-1.3	7
SD	0.04	10	7	0.5	0.4	2	42	0.2	0.08	0.9	3
estimated detection limit	0.11	30	20	1.6	1.1	5	125	0.5	0.25	2.6	10
ID-8 rep 1	1.62	158.7	8,205	896	536	139	5,743	2.7	233.8	53.0	1,668
ID-8 rep 2	1.65	154.0	8,748	949	571	146	6,181	3.2	255.5	55.4	1,697
mean	1.63	156.3	8,477	922	554	143	5,962	3.0	244.6	54.2	1,682
RPD (%)	1.7	3.0	6.4	5.7	6.3	4.5	7.3	17.3	8.9	4.3	1.7
spike level	500	500	500	500	500	500	500	500	500	500	500
ID-8 + 500 ug/g MS	446.1	468.5	*too low*	1,873	1,405	899.6	*too low*	708.4	1,019	740.6	*too low*
% recovery	88.9	62.4	*too low*	190.2	170.3	151.4	*too low*	141.1	154.8	137.3	*too low*
ID-8 + 500 ug/g MSD	325.7	336.8	*too low*	1,378	1,028	648.9	*too low*	518.2	734	529.6	*too low*
% recovery	64.8	36.1	*too low*	91.1	94.9	101.3	*too low*	103.0	97.9	95.1	*too low*
mean	385.9	402.7	*too low*	1625	1217	774.2	*too low*	613.3	876.3	635.1	*too low*
RPD (%)	31.2	32.7	*too low*	30.5	31.0	32.4	*too low*	31.0	32.5	33.2	*too low*

APPENDIX E, cont., Trace Metals Concentrations, ug/g (ppm)												
Fertilizer	St.	As	Se	Mo	Ag	Cd	Sb	Ba	Tl	Pb	Hg	U
Dragon's Iron Sulfate	NC	<4	<2	1.9	0.09	0.23	0.2	<4	<0.3	<3	0.003	0.15
Southern State's Carpet Maker	NC	<4	<2	<0.8	0.10	0.30	<0.2	<4	<0.3	<3	0.001	8.21
American Plant Food	TX	154	<2	<0.8	<0.02	<0.04	<0.02	<4	<0.3	<3	0.001	0.15
Deco Lawn Lime	TX	47	4	<0.8	<0.02	2	0.6	5	0.4	<3	0.010	59.70
Cenex 18-46-0	MT	71	<2	12.9	0.05	28.1	3.8	<4	0.5	<3	0.015	153.5
Cenex 18-46-0	ID	<4	<2	19.4	<0.02	145.6	5.0	4	3.9	<3	0.001	175.2
Cenex 90% Sulphur	MT	<4	<2	<0.8	0.06	0.15	<0.2	36	<0.3	<3	0.002	0.40
Cenex 11-52-0	ID	24	<2	12.7	0.29	146.3	4.3	6	2.5	<3	0.007	198.3
Cargill Urea 46%	IN	<4	<2	<0.8	<0.02	0.16	<0.2	<4	<0.3	<3	<0.001	1.61
The Andersons (6-24-24)	IN	<4	4	2.4	0.34	2.62	0.5	7	0.4	3	0.013	37.9
Countrymark Green Velvet	IN	65	<2	3.5	<0.02	1.67	0.5	<4	<0.3	<3	<0.001	12.0
BCA Products	MN	<4	<2	5.1	<0.02	3.41	1.1	6	<0.3	4	0.003	79.5
Liquid Iron	MN	<4	<2	2.5	0.05	0.27	<0.2	<4	<0.3	<3	<0.001	0.09
The Andersons (6-24-24)	MI	10	<2	8.8	0.15	4.19	2.1	17	0.4	5	0.008	156.1
The Andersons (0-0-0-36)	MI	52	37	39.3	6.32	201.4	12.2	75	<0.3	1,480	0.337	0.90
Monterey Maxi	CA	<4	<2	6.1	<0.02	0.08	1.9	<4	<0.3	<3	0.002	2.93
Monterey Micronized Neutral Zn	CA	12	44	1.1	0.18	87.0	0.5	593	<0.3	81	2.910	0.16
The Andersons (0-0-0)	MI	<4	2	<0.8	<0.02	0.06	<0.2	18	<0.3	<3	<0.001	0.12
UAP Northwest 10% Boron	WA	723	<2	1.3	<0.02	<0.04	3.6	41	<0.3	<3	0.015	0.79
UAP Northwest 36% Zinc	WA	<4	25	<0.8	0.02	121.9	1.0	<4	3.4	106	0.019	0.59
Farmer's Favorite	GA	17	3	7.2	0.51	2.82	1.0	49	<0.3	5	0.034	25.2
Lesco Turf Builder	GA	<4	<2	1.6	<0.02	0.64	0.2	5	<0.3	25	0.000	5.82
Pursell Turf Builder	GA	51	<2	1.4	0.10	1.14	0.2	<4	<0.3	4	0.002	5.77
Agway 10-20-20-6S	PA	20	<2	7.7	<0.02	2.60	2.5	<4	<0.3	<3	<0.001	116.2
Agway 10-220-20	PA	6	<2	3.5	0.02	1.63	0.9	<4	<0.3	<3	<0.001	52.5
Scotts Winterizer	VA	<4	<2	1.1	<0.02	1.29	<0.2	704	<0.3	<3	<0.001	26.1
Scotts TurfBuilder	VA	21	<2	<0.8	0.02	0.76	<0.2	370	<0.3	<3	0.015	12.6
Scotts Step 1	VA	<4	<2	3.9	0.03	2.65	0.6	219	<0.3	<3	0.006	55.0
Howard Johnson's	VA	<4	<2	4.4	0.07	2.66	1.1	<4	<0.3	8	0.041	13.2

APPENDIX E, cont., Trace metals concentrations, ug/g (ppm)												
Sample		As	Se	Mo	Ag	Cd	Sb	Ba	Tl	Pb	Hg	U
NIST 1643-d rep 1		62.95	8.32	119.5	1.32	6.75	55.19	536.5	7.27	18.61	7.89	0.023
NIST 1643-d rep 2		60.83	8.01	118.1	1.35	6.67	55.41	534.3	7.32	18.59	7.44	0.022
mean		61.89	8.16	118.8	1.33	6.71	55.30	535.4	7.30	18.60	7.67	0.022
RPD (%)		3.4	3.7	1.2	1.8	1.2	0.4	0.4	0.7	0.1	5.9	6.4
certified value		56.02	11.43	112.9	1.27	6.47	54.10	506.5	7.28	18.15	7.95	*nc*
% recovery		110.5	71.4	105.2	105.1	103.7	102.2	105.7	100.2	102.5	96.4	*nc*
NIST 2781		2.6	12.2	37.8	85.2	13.8	2.3	612	0.2	212		41.0
NIST-2781		5.9	16.7	36.6	95.5	13.3	2.1	624	-0.1	209	3.29	34.2
mean		4.3	14.4	37.2	90.3	13.6	2.2	618	0.0	210	3.29	37.6
RPD (%)		75.8	30.9	3.3	11.3	3.9	9.4	2.0		1.4		17.9
certified value		7.8	16.0	46.7	98.0	12.8	*nc*	*nc*	*nc*	202	3.64	*nc*
% recovery		54.4	90.3	79.6	92.2	106.2	*nc*	*nc*	*nc*	104.1	90.4	*nc*
Blank-1		34.9	0.9	-0.07	0.044	-0.208	0.01	0.0	0.24	0.6	0.0003	0.004
Blank-2		32.2	-0.3	0.42	0.055	-0.228	0.13	2.3	0.37	1.9	0.0010	0.002
Blank-3		34.0	-0.3	-0.05	0.043	-0.200	0.01	0.0	0.40	0.6	0.0006	0.000
average		33.7	0.1	0.10	0.047	-0.212	0.05	0.8	0.34	1.0	0.0006	0.002
SD		1.4	0.7	0.28	0.006	0.014	0.07	1.3	0.09	0.8	0.0004	0.002
estimated detection limit		4.1	2.0	0.83	0.019	0.043	0.21	3.9	0.26	2.4	0.0012	0.005
ID-8 rep 1		12.1	<2	12.2	0.22	138.1	4.4	4.9	2.4	<3	0.0102	195.0
ID-8 rep 2		24.5	<2	12.7	0.29	146.3	4.3	6.0	2.5	<3	0.0073	198.3
mean		18.3	<2	12.4	0.25	142.2	4.4	5.4	2.5	<3	0.01	196.7
RPD (%)		68.0		3.7	28.2	5.8	2.0	19.6	7.6		33.1	1.7
spike level		500	500	500	*ns*	500	500	*ns*	500	500	500	500
ID-8 + 500 ug/g MS		743.5	762.2	675.8	*ns*	867.5	655.8	*ns*	683.9	670.5	468.3	826.1
% recovery		145.0	152.0	132.7	*ns*	145.1	130.3	*ns*	136.3	133.5	93.7	125.9
ID-8 + 500 ug/g MSD		525.8	533.4	490.1	*ns*	622.8	471.2	*ns*	506.9	496.5	471.1	618.3
% recovery		101.5	106.3	95.5	*ns*	96.1	93.4	*ns*	100.9	98.7	94.2	84.3
mean		634.7	647.8	583.0	*ns*	745.2	563.5	*ns*	595.4	583.5	469.7	722.2
RPD (%)		34.3	35.3	31.9	*ns*	32.8	32.8	*ns*	29.7	29.8	0.6	28.8

APPENDIX E, CONTINUED:

NOTES:
#1 *nd* means *not determined*--these were inadvertently left out of the main analytical run, and so run later with a different set-up.
#2 samples were digested in hot concentrated nitric acid prior to analysis. This releases all or most of the metals, but a few of the samples did not fully dissolve, which means that elements such as Al, Fe, and Cr might be somewhat low. However, if they don't dissolve in concentrated nitric acid, they sure won't be bioavailable to the environment.
#3 mercury was analyzed using cold vapour atomic fluorescence spectrometry (CVAFS)
#4 all other metals were analyzed using ICP/MS
#5 low recoveries for some metals on NIST-2781 (sewage sludge) are due to incomplete dissolution of soil particles by the concentrated nitric acid--however, since almost all of the fertilizer samples fully dissolved, this should not be suggestive of a generalized low bias.
#6 NIST-2781 is a certified reference material for sewage sludge (no reference material for metals in fertilizers is available)
#7 NIST-1643d is a certified reference material for metals dissolved in nitric acid
#8 the designation *too low* means that the spike was lower than the native concentration, making assessment of spike recovery unreliable in that case.
#9 the designation *ns* means not spiked
#10 the designation *nc* means not certified
#11 These analyses were donated by FRONTIER GEOSCIENCES INC., and represent a retail value of $14,848.

APPENDIX F: LDR[60] RESULTS AND 20 X RULE

Fertilizer	St.	As	Se	Ag	Cd	Sb	Ba	Tl	Pb	Hg	Be	Cr	Ni	V
Dragon's Iron Sulfate	NC	<4	<2	0.09	0.23	0.2	<4	<0.3	<3	0.003	<0.11	2	31.6	<2
Southern State's Carpet Maker	NC	<4	<2	0.10	0.30	<0.2	<4	<0.3	<3	0.001	<0.11	<1	0.7	2
American Plant Food	TX	154	<2	<0.02	<0.04	<0.02	<4	<0.3	<3	0.001	0.08	<1	<0.3	4
Deco Lawn Lime	TX	47	4	<0.02	2	0.6	5	0.4	<3	0.010	3.23	21	4	34
Cenex 18-46-0	MT	71	<2	0.05	28.1	3.8	<4	0.5	<3	0.015	2.67	163	64.2	307
Cenex 18-46-0	ID	<4	<2	<0.02	145.6	5.0	4	3.9	<3	0.001	4.66	567	113.0	895
Cenex 90% Sulphur	MT	<4	<2	0.06	0.15	<0.2	36	<0.3	<3	0.002	0.33	<1	0.6	<2
Cenex 11-52-0	ID	24	<2	0.29	146.3	4.3	6	2.5	<3	0.007	1.65	571	255.5	949
Cargill Urea 46%	IN	<4	<2	<0.02	0.16	<0.2	<4	<0.3	<3	<0.001	<0.11	<1	<0.3	<2
The Andersons (6-24-24)	IN	<4	4	0.34	2.62	0.5	7	0.4	3	0.013	1.15	24	3.3	30
Countrymark Green Velvet	IN	65	<2	<0.02	1.67	0.5	<4	<0.3	<3	<0.001	0.47	18	2.0	29
BCA Products	MN	<4	<2	<0.02	3.41	1.1	6	<0.3	4	0.003	0.74	42	7.3	80
Liquid Iron	MN	<4	<2	0.05	0.27	<0.2	<4	<0.3	<3	<0.001	<0.11	13	39.8	<2
The Andersons (6-24-24)	MI	10	<2	0.15	4.19	2.1	17	0.4	5	0.008	3.30	62	11.6	103
The Andersons (0-0-0-36)	MI	52	37	6.32	201.4	12.2	75	<0.3	1480	0.337	4.18	840	517.3	41
Monterey Maxi	CA	<4	<2	<0.02	0.08	1.9	<4	<0.3	<3	0.002	0.11	<1	<0.3	<2
Monterey Micronized Neutral	CA	12	44	0.18	87.0	0.5	593	<0.3	81	2.910	0.12	<1	2.5	<2
The Andersons (0-0-0)	MI	<4	2	<0.02	0.06	<0.2	18	<0.3	<3	<0.001	<0.11	<1	0.4	<2
UAP Northwest 10% Boron	WA	723	<2	<0.02	<0.04	3.6	41	<0.3	<3	0.015	<0.11	<1	0.4	9
UAP Northwest 36% Zinc	WA	<4	25	0.02	121.9	1.0	<4	3.4	106	0.019	<0.11	3	17.4	<2
Farmer's Favorite	GA	17	3	0.51	2.82	1.0	49	<0.3	5	0.034	0.85	26	5.5	34
Lesco Turf Builder	GA	<4	<2	<0.02	0.64	0.2	5	<0.3	25	0.000	0.15	4	2.5	14
Pursell Turf Builder	GA	51	<2	0.10	1.14	0.2	<4	<0.3	4	0.002	0.52	10	2.6	16
Agway 10-20-20-6S	PA	20	<2	<0.02	2.60	2.5	<4	<0.3	<3	<0.001	1.57	60	11.9	127
Agway 10-220-20	PA	6	<2	0.02	1.63	0.9	<4	<0.3	<3	<0.001	0.89	28	5.6	50
Scotts Winterizer	VA	<4	<2	<0.02	1.29	<0.2	704	<0.3	<3	<0.001	0.90	460	156.9	90
Scotts TurfBuilder	VA	21	<2	0.02	0.76	<0.2	370	<0.3	<3	0.015	0.37	288	115.8	63
Scotts Step 1	VA	<4	<2	0.03	2.65	0.6	219	<0.3	<3	0.006	0.74	145	58.8	87
Howard Johnson's	VA	<4	<2	0.07	2.66	1.1	<4	<0.3	8	0.041	1.44	31	8.9	43
LDR Limit:		**5**	**6**	**0.14**	**0.11**	**1.2**	**21**	**0.2**	**1**	**0.025**	**1.22**	**1**	**11**	**2**
20 X LDR:		**100**	**120**	**2.8**	**2.2**	**24**	**420**	**4**	**20**	**0.5**	**24.4**	**20**	**220**	**40**

Numbers in Gray indicate exceedencs of 20 X LDR.

[60] 40 CFR 268.40 and 40 CFR 268.48 for beryllium and vanadium.

APPENDIX G: TCLP[61] RESULTS AND 20 X RULE

Fertilizer	St.	As	Se	Ag	Cd	Ba	Pb	Hg	Cr
Dragon's Iron Sulfate	NC	<4	<2	0.09	0.23	<4	<3	0.003	2
Southern State's Carpet Maker	NC	<4	<2	0.10	0.30	<4	<3	0.001	<1
American Plant Food	TX	154	<2	<0.02	<0.04	<4	<3	0.001	<1
Deco Lawn Lime	TX	47	4	<0.02	2	5	<3	0.010	21
Cenex 18-46-0	MT	71	<2	0.05	28.1	<4	<3	0.015	163
Cenex 18-46-0	ID	<4	<2	<0.02	145.6	4	<3	0.001	567
Cenex 90% Sulphur	MT	<4	<2	0.06	0.15	36	<3	0.002	<1
Cenex 11-52-0	ID	24	<2	0.29	146.3	6	<3	0.007	571
Cargill Urea 46%	IN	<4	<2	<0.02	0.16	<4	<3	<0.001	<1
The Andersons (6-24-24)	IN	<4	4	0.34	2.62	7	3	0.013	24
Countrymark Green Velvet	IN	65	<2	<0.02	1.67	<4	<3	<0.001	18
BCA Products	MN	<4	<2	<0.02	3.41	6	4	0.003	42
Liquid Iron (no 20 X rule)	MN	<4	<2	0.05	0.27	<4	<3	<0.001	13
The Andersons (6-24-24)	MI	10	<2	0.15	4.19	17	5	0.008	62
The Andersons (0-0-0-36)	MI	52	37	6.32	201.4	75	1480	0.337	840
Monterey Maxi	CA	<4	<2	<0.02	0.08	<4	<3	0.002	<1
Monterey Micronized Neutral	CA	12	44	0.18	87.0	593	81	2.910	<1
The Andersons (0-0-0)	MI	<4	2	<0.02	0.06	18	<3	<0.001	<1
UAP Northwest 10% Boron	WA	723	<2	<0.02	<0.04	41	<3	0.015	<1
UAP Northwest 36% Zinc	WA	<4	25	0.02	121.9	<4	106	0.019	3
Farmer's Favorite	GA	17	3	0.51	2.82	49	5	0.034	26
Lesco Turf Builder	GA	<4	<2	<0.02	0.64	5	25	0.000	4
Pursell Turf Builder	GA	51	<2	0.10	1.14	<4	4	0.002	10
Agway 10-20-20-6S	PA	20	<2	<0.02	2.60	<4	<3	<0.001	60
Agway 10-220-20	PA	6	<2	0.02	1.63	<4	<3	<0.001	28
Scotts Winterizer	VA	<4	<2	<0.02	1.29	704	<3	<0.001	460
Scotts TurfBuilder	VA	21	<2	0.02	0.76	370	<3	0.015	288
Scotts Step 1	VA	<4	<2	0.03	2.65	219	<3	0.006	145
Howard Johnson's	VA	<4	<2	0.07	2.66	<4	8	0.041	31
TCLP Limit:		**5**	**1**	**5**	**1**	**100**	**5**	**10**	**5**
20 X TCLP:		**100**	**20**	**100**	**20**	**400**	**100**	**40**	**100**

Numbers in Gray indicate exceedences of 20 X TCLP.

Note: This is a conservative analysis. EPA 540-R-94-005a, "Use of Total Waste Analysis in Toxicity Characteristic Determinations," 01/01/94, details the evaluation of the regulatory status of a 100% solid: "simply divide each total constituent concentration by 20 and then compare the resulting…concentration to the appropriate regulatory limit." Using this "Divide by 20" rule, twenty fertilizers would exceed TCLP values 38 times (vs. 11 fertilizers exceeding 22 TCLP values, above). The same may very well hold true for the LDR values in Appendix F.

[61] 40 CFR 261.24