

The Dirty Work of Promoting “Recycling” of America’s Sewage Sludge

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Serious illnesses, including deaths, and adverse environmental impacts have been linked to land application of sewage sludge. EPA and the wastewater treatment industry have worked with Congress to fund wastewater trade associations to promote land application, supporting industry-friendly scientists and discouraging independent research, to prevent local governments from restricting land application and to thwart litigation against municipalities and the industry. *Key words:* sewage sludge; biosolids; EPA; conflicts of interest; industry influence; corporate control; suppression of research.

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The United States Federal Clean Water Act defines municipal sewage sludge as a pollutant. Typical sludges from industrialized urban centers contain tens of thousands of contaminants, from industry, institutions, businesses, landfills, and households, that discharge into sewers. Wastewater treatment plants are designed to remove these pathogens, metals, and chemical compounds—many of which are toxic and persistent—from wastewater. Almost all the removed material, by necessity, concentrates in the resulting sludge. Every month, every industry in the country is permitted to discharge up to 33 pounds of hazardous waste into sewers without reporting.¹

Despite the fact that sewage sludge is a contaminated waste product, it is being commonly treated and used as a fertilizer, without informing the recipients about the complete contents of the sludge. In 2002, a National Academy of Sciences (NAS) panel warned that treated sewage sludge is such a complex and unpredictable mix of biological and chemical wastes that its risks, when used for farming, can not be reliably assessed. Therefore, the panel concluded, standard strategies to manage the risks of land application do not protect public health.² pp 104,252–53

Even though the effects of treated sludge are unpredictable, complex, and potentially harmful, the United States Environmental Protection Agency (EPA) has failed to appropriately manage its disposal. Instead,

upper-level managers in the agency’s Office of Water (OW) and Office of Research and Development (ORD) abandoned their agency’s mission by yielding to industry pressure to promote and defend the risky practice of using a contaminated waste product as a fertilizer.

Reports of adverse health effects linked to the use of sludge as fertilizer have mounted, especially in the last ten years. Over the same time, EPA forged a powerful alliance with municipalities that needed an inexpensive method of sludge disposal and sludge-management companies that profit from this practice. The alliance’s primary purpose was to control the flow of scientific information, manipulate public opinion, and cover up problems, in order to convince an increasingly skeptical public that sludge farming is safe and beneficial. The alliance ignored or concealed reported health problems, threatened opponents with litigation, distributed misleading information to the media, legislators, and the public, and above all, attempted to silence critics.

Since 1996, EPA’s efforts to silence opponents have been the subject of Labor Department investigations³ congressional hearings,^{4,5} Inspector General audits,^{6,7} and lawsuits filed by farmers and residents.^{8–10} This article draws on these proceedings and other information by explaining how EPA uses industry-friendly scientists and corporate influence to defend an unprotective policy. It’s a carrot-and-stick approach. Supportive scientists receive federal grants,^{11,12} while economic threats are used to silence unsupportive scientists, private citizens, and local governments.^{3,4,12,13}

IN THE BEGINNING

Since its inception, EPA has been promoting sludge use for farming. In the late 1970s, the first land application regulations were formulated by managers and scientists in EPA’s Office of Water (OW): Henry Longest II, John Walker, and Alan Hais. As Deputy Assistant Administrator of OW, Longest was one of the people responsible for administering the funds for EPA’s multi-billion-dollar Construction Grants Program, the United States’ largest public works project ever. The purpose of the project was to build wastewater treatment plants, as mandated by the Clean Water Act.

The rapid proliferation of new wastewater treatment plants produced vast quantities of sludge. And because industrial wastes that used to be dumped into rivers were now discharged into sewage systems, the sludge became much more hazardous, often qualifying as haz-

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ardous waste. At the time, the Resource Conservation and Recovery Act (RCRA) was being developed to regulate hazardous waste. During this inflationary period, municipalities demanded an inexpensive way of disposing of their sludge. President Carter's appointee to OW, Thomas Jorling, insisted that sludge not be regulated under RCRA, and the Act was weakened. The watered-down Act allowed not only sludge but also industrial wastes to be legally used as fertilizer.¹⁴ A 1978 memorandum from Walker to Longest outlined the purpose of EPA's land application program¹⁵:

The goal of 405/4004 sludge regulations should be to promote low cost sludge management . . . [the proposed RCRA provisions] would essentially preclude [land application] as an option. The application of some low levels of toxic substances to land for food crop production should not be prohibited. . . .

A significant amount of the country's hazardous waste from industries and other institutions is in the form of wastewater. Under the domestic sewage exclusion, industries are permitted to discharge hazardous wastewater into sewer lines to mix with domestic sewage entering publicly owned treatment plants. The assumption that this wastewater has been adequately pretreated by the sources, so that sewage sludge contains only "low levels of toxic substances," has been widely questioned.^{2 p 69,16}

There were early warning voices within the agency that sludge and industrial waste used as fertilizer would lead to serious problems down the road. William Sanjour, chief of EPA's Office of Solid Waste Management Programs Technology Branch, warned repeatedly that Mr. Jorling's order to reduce the scope of RCRA so that sewage sludge and other industrial waste could be land applied "was illegal and inconsistent with the agency's congressional mandate to protect human health and the environment." Sanjour's warnings, however, went unheeded, and EPA removed him from his position.¹⁷

The campaign to promote "beneficial use" of sewage sludge continued in the 1980s. It was becoming "a murky tangle of corporate and government bureaucracies, conflicts of interest, and cover up of massive hazards to the environment and public health."¹⁸ In 1981, EPA published a document describing the various persuasion techniques that could be used to induce the public to accept land application.¹⁹ Preferred application sites were rural low-income neighborhoods where cash-strapped farmers were told municipal sewage sludge was superior to manure and commercial fertilizer, would dramatically increase yields, and, best of all, was free. EPA and wastewater treatment plants did not inform rural residents about the potential hazards that might occur from using this material.

The only thing missing at EPA was a body of scientific evidence that explained why chemical pollutants, considered toxic and regulated elsewhere, are somehow benefi-

cial when present at the same or higher levels in processed sewage sludge. In 1987 Congress reaffirmed its 1977 directive that EPA develop "a comprehensive framework to regulate the disposal and utilization of sludge."²⁰ The fact that EPA developed these regulations post hoc to justify an existing policy was problematic. Would the regulations be truly science-based and protective, or would they merely rationalize an existing policy?

The sludge-disposal problem became more urgent in 1988, especially in the Northeast. Sludge generated in coastal cities was being dumped into the ocean. This impacted marine organisms and damaged beaches. Outraged environmentalists succeeded in having Congress pass legislation prohibiting ocean dumping. Environmental groups unwisely agreed to sign a consent decree supporting land application if, in return, ocean dumping would stop.²¹

From 1989 to 1992, land application was governed by a stringent interim rule, the 1989 proposal. In the absence of good science, this first version of the 503 rule included strict precautionary metal standards as well as standards for 12 toxic organic chemicals.²⁰ The interim rule met with strong opposition from municipalities and sludge-management companies. Sludge generated in many large urban centers could not meet these strict standards. In addition, the extra testing requirements for toxic organics would be time-consuming and expensive. Cities that had depended on cheap ocean dumping insisted that disposal of sewage sludge should remain convenient and inexpensive. Also, hauling sludge from cities to nearby farms was becoming a growing and lucrative business. Robert O'Dette, representing the sewerage industry, warned in 1990 that if the interim rules were adopted, beneficial reuse of sludge would end.²²

Thus, pressure from municipalities and the sewerage industry ensured that the final rule, the 503 rule, would be so lenient that virtually all municipal sewage sludge could legally be land applied. Alan Rubin, an EPA scientist working in OW, led the effort to craft the final rule and have it peer-reviewed by research scientists in EPA's Office of Research & Development (ORD). Based on risk analyses and a national survey of priority pollutants found at approximately 180 wastewater treatment plants throughout the country, the final part 503 sludge rule exempted all organic priority pollutants and regulated only ten heavy metals: arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. Chromium was later de-listed and molybdenum was largely deregulated.^{2 p 30}

Potentially toxic organic and inorganic chemicals regulated under the Clean Water Act and RCRA were exempt from regulation based on a variety of scientifically unsupportable rationales.^{2 p 129; 23 p 21} For example, the national survey relied on insensitive analytical methods for many chemicals, and all chemicals detected at less than 5% or 10% frequency were automatically

exempted. The EPA exempted other chemicals based on risk analyses incorporating questionable assumptions about land application practices and exposure levels, which were made despite a paucity of data.² p 136; 23 p 20

Under the 503 rule pathogens were regulated based on numbers of indicator microorganisms (fecal coliforms or Salmonella, and enteric viruses) and parasites (helminth ova). Two classes of sewage sludge were established: Class A (no detectable indicator pathogens) and Class B (low levels of indicator pathogens, e.g., < 2 million CFU of fecal coliforms/g). Non-spore-forming bacteria, including fecal coliforms and Salmonella, are among the most easily disinfected pathogens found in sewage sludge. More resistant microorganisms likely to be present in sewage sludge (e.g., hepatitis A virus, rotavirus, norovirus) may survive even when the processed sewage sludge meets all federal and state requirements for pathogen testing.² p 60; 24

ORD's internal scientific peer review severely criticized the 503 rule.³ OW claimed that numerous studies demonstrated that heavy metals, organic chemicals, and pathogens in processed sewage sludge posed no significant risk to human health or the environment. Rubin, however, could provide only a few laboratory studies and no relevant field studies.³ ORD was unconvinced that any credible scientific evidence existed to support key parts of the proposed rule. On Sept 6, 2000, Robert Swank Jr., former research director at the ORD laboratory at Athens, Georgia, stated under oath "We did not think the rule passed scientific muster. If the sludge rule were put to the test today, it would miserably fail EPA's own scientific peer review process."²⁵ As the process concluded in 1992, the peer-review coordinator sent the following message to reviewers prior to a meeting with the Administrator²⁶:

The sludge rule discussions with OW are on hold waiting for Ryan and Chaney's rewrite. Committing to success raises the horizon of our discussion. Options facing the Agency . . . include boldly publishing admittedly weak science, using a factor of safety to compensate for any weakness, or scrapping the whole exercise, and promulgating the Feb 89 proposal as interim. Your advice is solicited. Are human health and the environment "pretty safe" with the application rates drafted, or does the Administrator need to hear that major work is necessary just to be pretty safe? Can we feel ok as long as the uncertainty is fully discussed, both in the preamble and guidance documents?

Despite these major concerns, 40 CFR Part 503 became the final and remains the current rule governing the land application of municipal sewage sludge. To deal with the unresolved safety questions, EPA committed to spend \$10 million for a five-year research program to address six major areas of concern. The overall objective of the research was to reduce uncertainties and provide a basis for revising the rule. As soon as the rule was

promulgated, however, EPA designated it low priority, and almost none of the work has ever been done. The 503 rule is, in fact, the least protective rule governing land application of all such rules in industrialized countries that regulate this material.² pp 45-55; 23 pp 7-10; 27 p 11

THE UNHOLY ALLIANCE

The Office of Water makes policy, which is then reviewed independently by ORD to see whether it is scientifically sound. Longest eventually left OW and became Deputy Assistant Administrator for Management at ORD, making him the highest-ranking career manager over EPA's research scientists at ORD.²⁸ Longest, therefore, was now in charge of policies that he had initiated and supported while at OW. This obvious conflict of interest virtually guaranteed that agency research scientists would not be able to publish findings critical of the 503 rule or argue for more protective land-application policies. Instead of working independently, OW and ORD managers became close allies, supporting the newly crafted land-application policies.

Problems with the 503 rule developed almost immediately after its promulgation. In 1994 and 1995 three deaths occurred that were linked to land-applied sludge. In response to mounting public concerns, those at EPA responsible for land-application policies allied themselves more closely with sludge management companies, which knew how to deal with public opposition. An April 1994 article in the industry trade journal *Bicycle* explained the strategies that "project managers" should use to silence opponents²⁹ p 34 :

Controlling the flow of information from the start is the most important aspect for managing the first impression the public receives about a project. To minimize vulnerability in the press, a preemptive strike is usually launched to catch the opposition off guard and get positive messages out about the project before the counter messages start.

When planning an acceptance campaign, "countering the opposition without letting them determine the approval process is the most important goal of a good campaign manager. In the political world, this is called "controlling the debate."²⁹ p 33 Eventually this alliance forged a smoothly running and well-funded infrastructure that controlled the debate and manipulated public opinion. The alliance formed by EPA and USDA managers who crafted the 503 rule primarily included trade and lobbying groups—e.g., the Water Environment Federation (WEF) and the Association of Metropolitan Sewerage Agencies (AMSA)—state environmental protection departments, university scientists funded to support "beneficial reuse" of sewage sludge, municipal sewerage agencies, and industries marketing sewage sludge.

For land application to continue, it was essential to change the public image of sewage sludge. Accordingly,

the alliance changed the name of this material to “biosolids” and defined the transfer of thousands of pollutants from industrialized urban centers to relatively pristine rural farmland as “recycling.” Most states appointed “biosolids” coordinators, who worked closely with state agencies and received direction, information, and advice from OW and sludge-management lobbying groups on how to promote land application and deal with public safety concerns.³ pp 604, 1205–1224;³⁰ The alliance EPA formed with the sludge industry focused its main efforts on assuring the public that the federal rule was protective and scientifically sound in order to discourage states and counties from promulgating stricter rules or bans.^{30–32}

In March 1997, the prestigious Cornell Waste Management Institute (CWMI) released a working paper “The Case for Caution,” which was revised in 1999 and published in a peer-reviewed journal under a different title.²³ This was the first comprehensive science-based critique of the 503 rule. In their opening sentence the authors boldly state: “Current US federal regulations governing the land application of sewage sludges do not appear adequately protective of human health, agricultural productivity, or ecological health.” Between April and December 1997, New York State regulators worked closely with Alan Rubin, John Walker, EPA’s Assistant Administrator, and Rufus Chaney, of USDA, on a response to the Cornell paper.^{33,34} Copies of their correspondence were sent to the President of Cornell University. On July 24, 1997, EPA’s Assistant Administrator wrote to the Deputy Secretary of USDA: “I am quite concerned about the Cornell paper. We believe the publication being proposed by Cornell . . . will have a negative impact on the use of biosolids.”³⁵ Subsequently the nation’s leading sludge-management company paid a group of sludge-friendly scientists to attack the paper.³⁶ Cornell scientists, however, have not wavered in their critique of the 503 sludge rule.³⁷

At the same time, David Lewis, one of EPA’s internationally known senior research scientists, began investigating reported cases of illnesses and deaths among sludge-exposed individuals and started to form a theory of why some of them were suffering serious health problems.³⁸ Lewis presented his findings at various scientific meetings³⁹ and began submitting the work to EPA managers for clearance as a series of research articles and commentaries in peer-reviewed scientific and technical journals. EPA managers in Washington, DC, and at Research Triangle Park, NC, responded by ending all of his research funding in 1998 and instructing his local supervisors in Georgia not to let him collaborate with other EPA scientists or let him have access to agency resources.^{40,41} pp 5,9,⁴⁰ He raised enough, including \$80,000 of his own personal funds, to continue his sludge research until 2004.⁴⁰

Simultaneously members of the alliance put incredible roadblocks in Lewis’ way to prevent the dissemina-

tion and publication of his groundbreaking research and to discredit his expertise. They attacked him at scientific conferences, at public hearings, on their Web sites, and in their promotional literature, claiming that his theories “are far outside the realm of accepted science and have been rebutted by leading researchers around the country.”³ p 602–11; ⁴¹ pp 6,27; 42,⁴³ Often his credibility and credentials were questioned by alliance scientists at public meetings he did not attend, eliminating any opportunity for Lewis to respond.^{31,44} In October 2001 at a public meeting in Franklin County, GA, an attorney for a sewage sludge management company held up a “white paper” written by another sewage-sludge-management company that attacked Lewis’ credentials and credibility and claimed that EPA had forbidden him to do sludge research. The attorney had received this document from EPA’s Biosolids Manager, John Walker. Audience members were not informed that this defamatory “white paper” had not been fully endorsed by the EPA.⁴¹ p 29;⁴⁵

In 2002, because of repeated attacks on his scientific credibility and his inability to do research in a hostile work environment, Lewis filed suit against the EPA.³ In 2004, Labor Department Administrative Law Judge Jeffrey Tureck defended EPA’s conflict of interest with the regulated industry, ruling that EPA could not be held liable for Walker’s misconduct and that whistleblowers should not expect EPA to jump to their defense when industry goes after them. The Labor Department’s Administrative Review Board has undertaken a de novo review of the case.⁴⁶

By 2001, Helene Shields had compiled a 382-page victims’ package composed of published newspaper articles and investigative reports that, for the most part, described the plight of rural residents who had experienced serious health problems after having been exposed to land-applied sewage sludge.⁴⁷ Apparently EPA was aware of “thousands of allegations of problems.”⁴⁸ But instead of investigating these reports and strengthening the sludge regulations accordingly, EPA strengthened its alliance with the industry it regulates. In 1997 EPA, WEF, and AMSA formed the National Biosolids Partnership (NBP). One of NBP’s primary goals was to control negative media reports and the public perception that “risks are high, biosolids qualities are poor, inspections and enforcement are small or nonexistent, and EPA does not know what is going on.”⁴⁹ For example, the agenda for the January 14, 1998, NBP Management Committee Meeting listed as its top priority projects “Communications Plan Update, Code of Good Practice, Public Information Survey, and Technical/Public Acceptance Support.”⁵⁰

THE CARROT-AND-STICK APPROACH

Tens of millions of dollars in research funding to NBP members have been earmarked by Congress for land-

application research. According to cooperative agreements between EPA and WEF, a considerable portion of congressional funding is used to overcome “misinformation spread by project opponents” who “politicize the decision-making process.”¹¹ Project opponents, as it turns out, are mainly residents living near land-application sites who complain of adverse health effects and scientists who document problems.¹¹ Other opponents include major environmental groups, such as the Sierra Club, which had protested selective funding of supporters and retaliations against scientists who question the practice.¹³ EPA/WEF gave generous grants to regional lobbying groups, such as the New England Biosolids and Residuals Association (NEBRA), to develop an EPA-funded Web site.^{3 pp 601–602,1106} The Web site touted the benefits of “biosolids recycling” and attacked researchers that questioned the 503 rule.⁴³

The alliance between EPA, sludge management industries, municipalities, and industry-friendly scientists was mutually beneficial: the scientists received grants; the sludge industries and municipalities could continue to profit from the least costly and most convenient method of sludge disposal. EPA, on the other hand, used the public relations expertise of sludge-trade organizations and the findings of EPA/WEF-funded scientists to defend its inadequate rule. This partnership spoke with one voice and was united by one purpose: to vigorously promote sludge farming by ignoring or denying health concerns.

ILLNESSES, DEATHS, AND DENIALS

Meanwhile, hundreds of rural neighbors living or working adjacent to sludged fields reported unbearable quality-of-life conditions as the stench from this chemical and biologically active waste material forced them to retreat inside their homes.^{47,51} Many reported serious adverse health effects after being exposed to sludge. These included nausea, vomiting, burning eyes, burning throats, congestion, various infections, and serious respiratory problems.^{24,38,47,51–53} Others, including infants, had to be rushed to hospitals because they had trouble breathing.⁵¹ The three deaths linked to land application were those of Shayne Connor, from Greenland, NH, Daniel Pennock, from Robeson, PA, and Tony Behun, from Osceola Mills, PA.^{8,24,38,47,52} While the parents of Shayne, Daniel, and Tony were mourning their sons’ deaths, WEF distributed EPA-funded “fact sheets” with EPA assurances that there were “no documented cases of illnesses” and “no public health concerns from the use of biosolids whatsoever.”⁵⁴

Tony Behun’s death intensified the public concern over sludge application in Pennsylvania. For land application to continue under the current policies, it was essential for the Pennsylvania Department of Environmental Protection (PA DEP) to deny that sludge might have caused the death of a Pennsylvania child. Len

Martin compiled a chronological and detailed account of how, for almost two years, the PA DEP went to extraordinary lengths to hide the circumstances of the child’s death.⁵⁵ In October 1994, 11-year old Tony had ridden his dirt bike through sludge that had been applied to a reclaimed mining site. The child developed headache, sore throat, furuncles on one leg and arm, difficulty breathing, and a high fever. On October 21, a week after he had been exposed to sludge, Tony died of staphylococcal septicemia.³⁸

In 1999, Tony’s mother, who had heard that sludge was causing health problems in other parts of the country, sought answers from the state about her son’s mysterious death. The PA DEP repeatedly and publicly denied that there was any connection between sludge exposure and her son’s death.^{55 pp 8,9,15,16} According to public statements made by the agency and the company that had spread the sludge, Tony’s death resulted from a bacterial infection caused by a bee sting, and sewage sludge had not been applied on the mining site.^{55 p 3} In May 2000, PA DEP secretary, James Seif, drafted a report claiming that both the National Institute of Occupational Safety and Health (NIOSH) and the state health department had investigated the case thoroughly and ruled out sludge as the cause or contributing factor of Tony’s death.⁵⁶ Every one of the above-cited claims proved to be false. The DEP was forced to retract the fabricated bee-sting story; truck weigh slips indicated that about 5,600 wet tons of sludge had been spread on the site next to the child’s home; and on August 7, 2000, the PA Department of Health sent a letter to State Representative Camille George confirming that the department “in fact, did not conduct an investigation into Tony Behun’s death.”⁵⁷ NIOSH also stated that it “had no involvement [in the case] because “our agency only investigates workers’ health complaints.”^{55 pp 21–22}

Subsequent public testimony by EPA’s Robert Bastian illustrates how EPA and the state agencies responsible for land-application policies work together to misrepresent facts to cover up incidents. On March 13, 2001, Bastian presented Seif’s report to the NAS panel that was investigating information about alleged health incidents linked to sludge and assured the panel that “the findings of [PA] state and local health officials have indicated that the Pennsylvania death was not attributable to biosolids.”⁵⁸

REACTION AT ORD

EPA’s handling of the biosolids issue disturbed many ORD scientists, who were concerned that EPA was developing other regulations based on weak or biased science. Also, managers working under Longest at OW had developed a reputation for retaliating against employees who questioned government policies.¹⁷ By 1996, the consensus was that ORD was truly in a state of

crisis and had reached a turning point. David Lewis and others believed that an attempt to work within ORD, bolstered by outside efforts to get congressional and public attention, stood the best chance of correcting the situation. After meeting with two members of Congress and explaining what they had in mind, Lewis was introduced to leading members of Congress who had EPA oversight responsibilities. Combining insights into the political process and examples of weak science identified by some of EPA's best scientists, Lewis wrote a commentary published in *Nature* in 1996, titled "EPA Science: Casualty of Election Politics."⁵⁹

The commentary was followed by a research article, published in *Nature* in 1999.⁶⁰ In this article Lewis specifically criticized the 503 sludge rule. Later, Lewis worked with researchers at the University of Georgia and physicians treating sludge-exposed patients to document illnesses in a series of research articles and commentaries.^{24,38,52} Over all, the research indicated that residents exposed to dusts blowing from treated fields experienced hypersensitivity reactions consistent with many occupational diseases involving endotoxin-contaminated organic dusts. Most patients were susceptible to recurring respiratory and skin infections, especially involving *Staphylococcus aureus*. Residents experiencing problems generally lived within 1 km of land-application sites, where lime-stabilized (Class A or B) sewage sludge was applied at a rate of several metric tons per hectare annually.³⁸

Up to this time, the debate about the safety of land application had primarily been among soil scientists, who focused on the fate and mobility of toxic metals and PCBs degrading soils and contaminating the food chain, as well as on children ingesting sludge. Rufus Chaney, of USDA, key author and defender of the 503 rule, views the inorganic fraction of sludge as a virtually permanent repository for strongly-bound heavy metals. Murray McBride, an independent soil scientist at Cornell University, believes the 503 rule is simplistic, grounded on a weak hypothesis, and that the organic matter in sludge is more important in binding several of the toxic metals; since the organic matter in the soil decomposes, there is always the potential for metal release into soluble and bioavailable forms over time.

The interactions of irritant chemicals and pathogens, which most likely are causing the immediate health problems of rural sludge-exposed residents and which Lewis was investigating, had not been addressed in the risk assessment for the 503 rule. Documentation and explanation of these incidents in the scientific literature would disprove the long-held and frequently quoted industry-EPA position that "there is no documented scientific evidence that the Part 503 rule has failed to protect public health."

Consequently, Longest and others began to retaliate in response to Lewis' *Nature* articles, prompting two hearings by the full Science Committee in the U.S.

House of Representatives: *EPA's Sludge Rule: Closed Minds or Open Debate?*,⁴ and *Intolerance at EPA: Harming People, Harming Science*.⁵ The first hearing focused on retaliations or threats by Alan Rubin against scientists and private citizens who questioned EPA policy.³ The second hearing dealt with the director of the Athens EPA laboratory, Lewis' second-line supervisor, who, on advice from Henry Longest, was notified that she would be transferred after she approved his second *Nature* article. Earlier the Labor Department had found that EPA's actions against her were retaliatory, and she kept her position at the Athens laboratory. Subsequently the Science Committee drafted the *No Fear Act* (H.R.169) to better protect federal employees against retaliation.⁶¹ The Act required agencies to inform employees of whistleblower protections and pay for judgments in favor of whistleblowers out of their own budgets. It passed with unanimous support in the House and little change in the Senate, and was signed into law by President George W. Bush. Before it passed the Senate, however, the Act was revised to protect managers like Henry Longest. "After months of work with Senate and House Staff, and members of the Government Affairs Committee in the Senate, much of the bad language has been deleted or substantially altered, and specific language has been inserted stating that managers would not be adversely affected by the bill."⁶²

Lewis was terminated by EPA in 2003 but continued his sludge research at the University of Georgia (UGA) until attacks on his work, which EPA directly coordinated with industry, forced him to finally abandon his research on adverse effects of sewage sludge and develop other areas of research.^{40,45,46,63,64} In his final (unpublished) sludge research, he and other UGA scientists, working with pulmonary and heart specialists in Tennessee, isolated and were in the process of identifying bacterial DNA from the lower lung of a teenaged boy who was hospitalized after inhaling sewage sludge dusts.⁶⁵ The patient's physicians concluded that the dusts, which he had inhaled while spreading sludge, had caused bacterial infections and severely damaged his heart and lungs.

Lewis' report states that the patient's medical records between 1996 and 1998 show that he "had normal heart and pulmonary function prior to spreading sewage sludge" and that after spreading sludge beginning in 1999 he had frequently been treated for "recurring sinus infections, allergies, and bronchitis."^{65 p 5} By 2001, the patient was being treated for "respiratory infections and the resulting reduction in lung capacity, which physicians found had also affected his heart." According to Lewis' report, pathologists identified the infectious organisms as *Nocardia*, *Enterococcus faecalis*, and *Moraxella catarrhalis*. After the UGA researchers identified bacterial DNA in a lower lung biopsy sample, Lewis pointed out that the microorganisms involved in the infections "have individual cell sizes within the range of

respirable particles (0.5–7 µm). Therefore, they would penetrate the lower lungs when inhaled. . . .” This was to be the first DNA tracking study ever proving that sludge dusts cause pulmonary hypersensitivity complicated with bacterial infections.^{65 p 4; 66}

POISONED CATTLE: EPA DEFENDS ADMITTEDLY INACCURATE DATA

In Georgia two large dairy farms receiving Augusta’s “Class B” sewage sludge experienced a precipitous drop in milk production and a high cattle mortality rate when dairy herds were fed forage crops grown on treated land. Experts, including bovine nutritionists and a veterinarian, found the cause to be silage grown on sludged fields after observing that affected cattle recovered when fed forage crops grown on fields that were not treated with the sludge. Also, liver and kidney samples of the cattle had toxic levels of copper and zinc, as well as high levels of cadmium, lead, and other pollutants found in the sewage sludge, which could account for the observed impacts.^{67,68}

In 1998, the dairy farmers filed lawsuits^{9,10} after experts hired by the farmers discovered that the sewage sludge that was put on these fields contained hazardous wastes, damaged the lands, and caused excess mortality in the dairy herds.^{69–72} Repeatedly, during the period when sludge was applied, the City of Augusta assured the farmers that “the sludge was safe, non-toxic, and being applied in compliance with appropriate regulations.”⁶⁸ One of the affected dairy farmers stated⁷⁴:

Every time I asked a question about problems occurring on the fields, the answer always came back, that there was nothing in the sludge that could cause problems. They never informed us that they were land applying sludge in violation of 40 CFR 257. Never did they tell us that large quantities of toxic hazardous industrial wastes that had little or no industrial pretreatment were being dumped into the sewers.

Chemical analyses of Augusta’s sewage sludge reported to the Georgia Environmental Protection Division (EPD) had indicated that the contaminants were within regulatory limits. However, a 1998 EPD audit of the wastewater-treatment facility, prompted by the lawsuits, found that these data were unreliable and perhaps manipulated.⁷⁴ The plant manager at the treatment facility later testified that reported data were approximately four orders of magnitude lower than actual concentrations.⁷¹ Indeed, handwritten laboratory records oftentimes did not match the contaminant concentrations reported⁷⁵ (see Table 1). The EPD audit also noted many compliance violations in procedure records and concluded that the plant was in total disarray. The lab “was very dirty and this . . . may possibly compromise data.” Much of the equipment “was not working properly or was out of service.” The over-

TABLE 1 Discrepancies in Cadmium Concentrations on Worksheets and in Official Reports at the Augusta Wastewater Treatment Plant*

Date	Worksheets†	Reported‡
Jan 90	926	181.21
Feb 90	1,200	378.05
Mar 90	516	458.38
May 90	219	521.5
Oct 90	54	54.3
Nov 90	32	32
Nov 93	29	29
Dec 93	19	19

*Concentrations (mg/kg) in processed sewage sludge (biosolids).^{69,75}

†Wastewater treatment plant laboratory notebook (handwritten entries).

‡Corresponding data reported to Georgia Environmental Protection Division.

Source: Dr. Lewis Goodroad. Reproduced by permission.

all condition of the plant was described as “horrible.” Also, there was only “marginal implementation and administration of the pretreatment program.” As a result, the EPD recommended that the land-application program be shut down immediately and that the city should landfill its sludge.⁷⁴

The head of EPA’s Biosolids Incident Response Team (BIRT), Robert Brobst, had participated in the EPD audit and was fully aware of these facts, including the reported data that were unreliable. To help defend EPA policy, Brobst worked closely with attorneys representing the City of Augusta in the lawsuits filed by the dairy farmers.⁷⁶ In 1999, EPA assigned Brobst the task of working with UGA’s Julia Gaskin on an EPA-funded project to conduct a field study of Augusta’s land-application program.

Brobst co-authored the UGA study, “Long-term biosolids application effects on metal concentrations in soil and Bermudagrass forage.”⁷⁷ To disprove any connection between toxic chemicals in sewage sludge and cattle deaths, Brobst and his UGA co-authors incorporated the unreliable analytical data that the Augusta wastewater-treatment plant had reported to the State of Georgia indicating that the city had complied with state and federal regulations. Authors of the EPA–UGA study intentionally ignored the fact that the historical data indicating the quality of Augusta’s sewage sludge and the rates at which it was applied to farmland had been falsified to appear in compliance with applicable laws.^{77,78}

Using the unreliable data, Gaskin et al. concluded that metal levels in Augusta sludge were mostly within regulatory limits and that forage samples they took indicated that “the quality of forage grown on these sludged fields should not pose a risk to animal health.”^{77 p 151} The authors knew the implications of testing samples during a severe drought, and thus these data would not accurately reflect metal levels in forage during normal growing conditions. In a handwritten

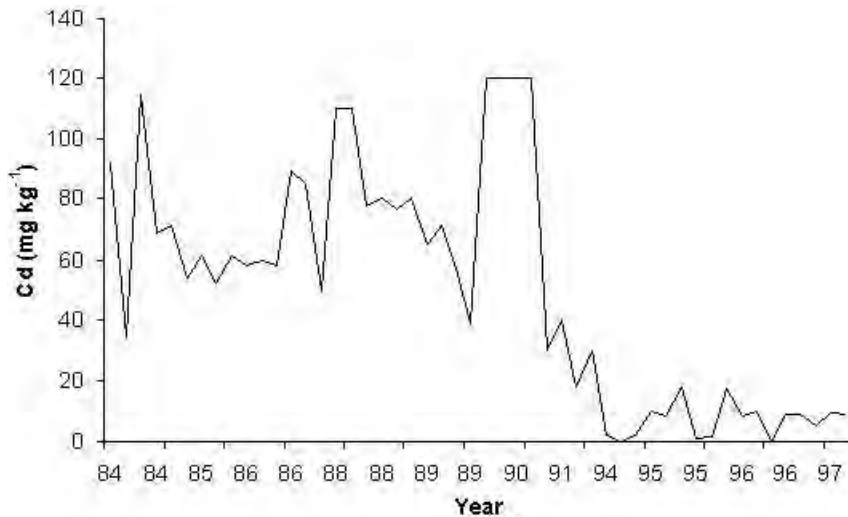


Figure 1. Cadmium levels in treated sewage sludge applied to two dairy farms, reported by Augusta, Georgia's waste treatment plant. Sludge was applied to either or both farms from February 1979 to March 1997. Dairy herds experienced a high mortality rate when fed forage grown on the treated fields.^{69,75} The ceiling concentration for Cd in the 503 Sludge Rule is 85 mg/kg. Data truncated at 120 mg/kg for display purposes were: 181.26, 378.05, 458.38, and 521.5 mg/kg (Table 1). Source: Dr. Lewis Goodroad. Reproduced by permission.

comment addressed to Gaskin on page 8 of her final draft, one of her co-authors wrote “we should fess up here that we DON'T know exact rates of application, or specific characteristics of sludges applied. . . .??” And on the cover page of the draft the co-author also recommended that Gaskin should “discuss overall sludge quality—pretty BAD in this case.”⁷⁹

Brobst's co-authorship ensured that the Gaskin et al. paper would easily pass through EPA's clearance process for policy-related scientific products. In 2003, the UGA-EPA paper was published in a peer-reviewed scientific journal. EPA and its alliance partners cite the Gaskin paper as conclusive scientific evidence that forage fertilized with Augusta sewage sludge did not cause the cattle deaths. Yet the paper was based entirely on forage samples taken during a severe drought and falsified analytical data regarding sludge quality and land-application rates.

EPA's grant to UGA was never meant to be used for a thorough and honest investigation of the poisoned-cattle cases. Instead, the agency funded and “commissioned” this paper expressly to protect EPA's position that its land-application policies are safe and to help the City of Augusta with the pending lawsuits. For example, during the Boyceland Dairy trial against the City of Augusta, Augusta attorneys cited the conclusion of the Gaskin paper in their opening and closing arguments. The jury was not persuaded and ruled in favor of the farmers that hazardous material in sludge had indeed caused the severe damage and deaths of their herds.

To begin with, EPA's misuse of university resources to promote the agency's land-application policies and defend municipalities against lawsuits raises serious questions about the agency's integrity. Beyond that, EPA also gave a pre-publication copy of the Gaskin study to members of the NAS panel, who stated in their 2002 report: “EPA investigated [allegations of animal deaths caused by land application of biosolids] but . . . found no substantiation for the allegations.”^{2 p 39} In

2003, after the Boyce family won a jury verdict,⁸⁰ 73 farm, health, and environmental organizations petitioned EPA for an emergency moratorium on land application. On December 24, 2003, EPA denied the petition, again citing the Gaskin et al. study as primary scientific evidence that land application is safe.⁸¹

Attorneys representing the dairy farmers have asked Gaskin and her co-authors to withdraw her paper.⁸² The authors, however, have steadfastly refused to do so. In an apparent move to defend the work of Gaskin and her co-authors in its College of Agricultural and Environmental Sciences, the University of Georgia recently announced the appointment of Jay Scott Angle as the new Dean of the School of Agriculture. Angle is a prominent sludge researcher from the University of Maryland who has worked closely with Rufus Chaney, USDA's main author and defender of the 503 sludge rule.⁸³

Figure 1 illustrates examples of high levels of regulated pollutants that the city of Augusta frequently reported to agencies and property owners prior to 1989, when the interim rule [which preceded the less restrictive 503 rule] went into effect. After 1990, the data leveled off below regulatory limits, even though procedures for treating, sampling, and analyzing sewage sludge had remained unchanged.

The metal levels reported by the Augusta treatment plant raise a serious issue. The implications of the Augusta data profiles represented in Table 1 and Figure 1 are enormous because they are similar to others that have been reported throughout the United States.^{2 p 125} Trends in data reported by waste-treatment plants are used to argue that large reductions in heavy metals and other contaminants in sewage sludge have resulted from federal and state regulations,^{23 p 13} and the National Academy of Science (NAS) recommended that EPA undertake a new national survey based on these databases.^{2 p 129-130} Most municipalities, however, have experienced severe budgetary shortfalls and could incur very large costs to upgrade their facilities if

they report that they are noncompliant with the 503 rule. "The virtual absence of any independent monitoring of sewage sludge quality by EPA and the states only encourages municipalities to manipulate data. The fact that most pollutant data profiles in the national data banks follow the trend reported by Augusta therefore may simply reflect massive fraud."⁸⁴

EPA DELAYS PUBLICATION OF LEWIS' GROUNDBREAKING RESEARCH WHICH IS NOT CITED IN THE 2002 NAS REPORT

Whereas EPA funded, expedited, and co-authored a fraudulent study that was meant to prove that land application was safe, the agency tried to prevent or, at least, delay the publication of the Lewis et al. research that criticized the 503 rule and documented adverse health effects from land application. To do so, EPA's John Walker solicited help from a vice president of the nation's leading sludge-management company, to prepare and distribute his internal EPA peer review of the Lewis et al. paper.^{3 pp 766-811} Walker, who has a PhD in soil science and used to work for the Department of Agriculture (USDA), admitted under oath that he was not competent in microbiology.^{41 p 20} He first sent Lewis' paper to an outside colleague in USDA for technical comments, submitted the comments verbatim as his own official EPA peer review, added negative comments, and then recommended against publication of the paper.^{41 pp 19-22}

The sludge-management company then shared the negative peer-review comments with the EPA Administrator and requested that the agency stop supporting Lewis' research.⁸⁵ WEF made the same request of the Administrator⁸⁶; and AMSA contacted Longest to discuss the matter.⁸⁷ To assist in their efforts, the sludge-management company provided Walker with an anonymous "white paper" outlining scientific arguments to be used against the Lewis et al. manuscript and its authors. It included allegations that conducting research on sewage sludge was outside the scope of Lewis' EPA appointment to UGA, a misuse of federal and state resources, and therefore potentially a violation of criminal law. Walker widely distributed this document both inside and outside EPA.^{41 p 27} The EPA, however, ultimately rejected the company's allegations and Walker's recommendations, and finally approved the Lewis et al. paper for publication.⁸⁸

Lewis provided the NAS panel investigating the scientific basis of the 503 rule with final and in-press versions of all of his sludge articles, and the 2002 NAS report incorporated many of his ideas and recommendations. One panel member testified under oath to the Department of Labor: "[Lewis'] ideas . . . were important to sort of framing the NAS panel's report. He gave legitimacy to the allegations that has made it impossible to ignore alleged health issues. [Without Lewis'

research] EPA's position would still be that nobody has gotten sick and biosolids are safe. He has been the most important player in all this."^{41 p 3} Yet, whereas earlier drafts of the NAS report had referenced some of Lewis' papers, the final report mentions neither his name nor his research. The decision to omit all references to Lewis' work apparently was prompted by members of the alliance. On the day the report was scheduled to be released, panel member Greg Kester, biosolids coordinator for Wisconsin and spokesperson for all of the states' biosolids coordinators, sent an e-mail to the panel chair objecting to "elevating David Lewis" and "criticizing the EPA."⁸⁹ Subsequently the panel chair removed the last remaining reference to Lewis' papers from the final version of the NAS report. By deleting all references to Lewis' peer-reviewed research, although once vaguely alluding to it as unsubstantiated "speculation,"^{2 p 209} EPA and its partners could assure the public that now the prestigious National Academy of Sciences agreed with the agency and its partners that "there is no documented scientific evidence that the Part 503 Rule has failed to protect public health."^{2 p 3}

Two months after the NAS report was released, the nation's leading residuals management company distributed a publication titled "Biosolids Recycling" that said that the NAS panel had dismissed Lewis' views.^{42 p 9} On four occasions the industry document cites the 2002 NAS conclusion that "there is no documented scientific evidence that the 503 rule fails to protect public health." The publication also cites EPA Deputy Administrator of OW, Benjamin Grumbles: "The NAS report confirms EPA's view that the existing sewage sludge regulations protect human health."^{42 p 10} The message to farmers, property owners, land appliers, legislators, the public, and the media couldn't be clearer: NAS agrees with EPA, the industry, and with those scientists who are funded to promote the current policies. Not only EPA, but also NAS "has divorced itself from Lewis' theories."^{42 p 12}

Alluding in 2002 to the combined efforts of EPA, industry, and their various trade associations to stop Lewis' sludge research at UGA, and to discredit his research that had already been published in the peer-reviewed literature, the vice president of the company commented⁹⁰:

What we don't need are more so-called scientists whose research findings are predetermined by scientific or personal bias. These people will find their work rightly discredited and their funding will disappear while credible researchers continue to have funding.

EPA THREATENS HONOLULU WITH FINES

In the third example of how EPA interfered with scientific research on sewage sludge, the agency provided the state of Hawaii with a letter supporting approval of

a sludge-management company's contract to build a sewage-sludge-processing plant on Sand Island.⁹¹ EPA claimed that this product is pathogen-free and environmentally safe. When Lewis' input was sought by local businesses and residents, Lewis presented the Council with a plan to test the efficacy of EPA's claims before approving the contract. EPA learned of the plan and threatened Honolulu with \$5.5 million in fines if the Council delayed the contract.⁹²

The Council, however, rebuffed the threat. Tests carried out at the University of Hawaii found the product met all EPA requirements for indicator pathogens; however, it contained "high levels" of unidentified heterotrophic bacteria.⁹³ Heterotrophic bacteria include all human, animal, and plant bacterial pathogens. EPA again informed Honolulu of the agency's concerns about delaying the contract, but the Council has extended the delay while considering additional pathogen testing.⁹⁴

BIOSOLIDS SCIENCE

Thirty years ago, Henry Longest committed the nation to the concept of land-applying sewage sludge and then set out to create the science necessary to support it. By funding a network of industry-friendly scientists and discouraging independent research, EPA succeeded in building a body of science around the notion that hazardous biological and chemical wastes in sewage sludge are rendered innocuous, even beneficial, simply by adding lime or passing the material through a digester. This accomplishment necessitated the creation of "biosolids science."

Biosolids scientists believe that heavy metals are immobilized in sludge forever, don't migrate into groundwater, never become bioavailable, and will not accumulate over time at sites where this material is applied.^{42 p 6,95,96} They also claim that the organic nature of sludge ensures that land-applied sewage sludge releases nitrogen only as plants need it, and only in the amounts needed.^{42 p 7} Even pathogens, they contend, are perfectly harmonized with nature: "The organic nature of biosolids means pathogens, if present, adhere to soil, effectively preventing them from entering groundwater; [then] naturally occurring enemy microbes destroy the remaining pathogens."^{42 p 15} According to Walker and others, heavy metals are permanently bound to organic matter such that even children ingesting biosolids are protected from lead poisoning.^{3 pp 1305-1311} Walker also considered illnesses reported by residents to be psychosomatic responses to odor and organized an EPA-funded workshop with Duke University psychologists and odor specialists to explore this theory.⁹⁷

Some EPA partners continue to disseminate absurd claims about the safety and benefits of sludge: that crops grown on sludged fields "are healthier" and that

sludge used on agricultural land "builds healthy soils"⁹⁸; that mixing sewage sludge with another industrial waste product and placing this mixture at 500 tons an acre on highly permeable soil a few feet above the water table will prevent contaminants from impacting ground water.⁹⁹ They also assure the public that regulations prohibit pollutants generated by industry from entering the municipal wastewater-collection system.^{31,54,98 p 21} A spokesperson for the New Hampshire Department of Environmental Services, defending unrestricted use of Class A sewage sludge, recently told a legislative subcommittee that this material [which can legally contain up to 32 mg/kg of arsenic, 14 mg/kg of cadmium, 10 mg/kg of mercury, 300 mg/kg of lead, as well as potentially harmful organic chemical compounds and viable disease-causing pathogens] is so safe "that you can eat it."¹⁰⁰ Such statements are liable to reduce these agencies' credibility in the eyes of the scientific community and the public. It is not surprising that surveys indicate that EPA's credibility among citizens concerned about the sludge issue is extremely low.²⁴

CONCLUSION

EPA promoted land application largely on the basis that processed sewage sludge possesses certain unusual properties, which prevent the material from polluting the environment. By taking this approach, rather than promulgating more restrictive regulations, EPA has shifted much of the burden of the nation's water-pollution problems, and their associated risks, to cash-strapped farmers and poor, minority neighborhoods.^{45,47,51} To deal with the backlash, EPA is attempting to manage negative press,¹⁰¹⁻¹⁰⁵ while working with the alliance to purge or frighten its critics into silence. Unfortunately, the problems poorly managed biosolids programs are creating will be far more challenging to solve than simply preventing surface-water contamination, which is the goal of our municipal waste-treatment system.

Despite EPA's well-coordinated public-acceptance campaign, many organizations involved with agriculture and the food industry do not support sludge use. H. J. Heinz Company, Del Monte, Western Growers, and other major food suppliers refuse to accept produce grown on land treated with sewage sludge. J. M. Dryer, General Manager of Heinz' Food & Technology Systems, wrote: "[The] risk of utilizing municipal sludge, which is known to be high in heavy metals, such as cadmium and lead, is not a health risk which we need to take. This is not a publicity statement since it is rigorously enforced and we have at times dropped suppliers who have used sludge on their crop land."¹⁰⁶ Del Monte recently confirmed its earlier position not to accept produce grown on sludged land, awaiting more convincing scientific evidence while holding to the

“more conservative and prudent” position of the National Food Processors Association and the American Frozen Food Institute.¹⁰⁷ In 2004, the National Farmers Union enacted a policy stating: “The current practice of . . . spreading hazardous wastes and Class B biosolids on land surfaces . . . should be discontinued [to] protect the soil and water of agricultural lands, from which the nation’s food is produced.”¹⁰⁸

EPA’s handling of the biosolids issue is an important lesson in political science. It illustrates what appears to be the complete corporate control of EPA’s land-application policy. Top managers at OW and ORD have failed to honestly address the flaws of a policy that protected neither human health nor the environment. Instead, they leverage corporate influence to their own advantage, expend vast amounts of taxpayer’ resources to protect their careers, and wield the awesome power of a federal agency against those who stand in their way. Lewis stood in their way for seven years in his battle to improve EPA’s regulatory science. The battle cost him two career jobs, and he is currently unemployed. In November 2004, he finally gave up the fight: “I have taken this effort as far as humanly possible,” he wrote to friends and colleagues.⁶⁴ In retrospect, Lewis’ critical comments in the 1996 *Nature* article about the role of science at EPA were vastly understated. Progress in science and environmental protection depends on open and honest debate. Silencing scientists who question an unwise government policy does not further such progress.

Meanwhile, the dirty work goes on. Health impacts reported by sludge-exposed rural families are countered with EPA’s 12-year-old refrain “there is no documented scientific evidence” that land application of sewage sludge is causing adverse health effects,^{2 p 3;3 p 610;42,44,54} and reported symptoms are blamed on “mass hysteria” and lack of education.¹⁰⁹ To “educate” the public, WERF earlier this year released another EPA-supported public-relations document, co-authored by NEBRA, entitled “Public Perception of Biosolids Recycling: Public Participation and Earning Trust.”¹¹⁰

EPA claims it no longer promotes land application of treated sewage sludge. Yet there is no indication that the agency has divorced itself from the industry it is supposed to regulate. Grants to deal with “public perception issues” and promote “better communication approaches”¹¹ continue to go to alliance researchers, with WERF controlling who gets the money.^{11,12 pp 17385–87,17392} Epidemiologic studies are not among the projects that EPA plans to fund.^{12 p 17390} To assure legislators, the media, and the concerned public that the current rules, when followed, are protective, the National Biosolids Partnership is touting a voluntary alliance-funded and alliance-run Environmental Management System (EMS). It will never be possible to identify, monitor, and regulate the thousands of industrial and commercial chemical compounds contained in land-applied sewage sludge and their fate and interactions.^{2 pp 252-53} Yet at public meetings, EPA and its

alliance partners continue to assure increasingly skeptical audiences that land-applied sludge is “an extremely safe material,”⁴⁴ while they pressure employers to withdraw support from independent scientists who investigate complaints.

Dr. David Lewis collaborated with the author in writing this paper until giving up his research on sewage sludge in November 2004. He is currently doing humanitarian work in AIDS-stricken areas of sub-Saharan Africa (<www.RoyalLaw.org>).

References*

1. 40 CFR Part 403.12 (P)2.
2. National Research Council of the National Academy of Sciences (NAS). *Biosolids Applied to Land: Advancing Standards and Practices*. Washington, DC: National Academy Press, 2002 [pre-publication copy].
3. *David L. Lewis, Ph.D. v. Environmental Protection Agency*. U.S. Department of Labor, Office of Administrative Law Judges, Washington, DC. 2003-CAA-00005, 2003-CAA-0006. 2004.
4. EPA’s Sludge Rule: Closed Minds or Open Debate? Hearing before the House Committee on Science, 106th Congress, 2nd Session (March 22, 2000); Serial No. 106-95. U.S. Government Printing Office.
5. Intolerance at EPA: Harming People, Harming Science: Hearing before the House Committee on Science, 106th Congress, 2nd Session (Oct 4, 2000); Serial No 106 -103. U.S. Government Printing Office.
6. U.S. Environmental Protection Agency. Land application of biosolids status report. Report 2002-S-000004. Washington, DC: Office of the Inspector General, 2002.
7. U.S. Environmental Protection Agency. Biosolids management and enforcement audit report; 2000 March 20. Report 2000-P-10. Washington, DC: Office of the Inspector General, 2000.
8. *Marshall et al. v. Synagro-WWT, Inc. et al.* No. 99-C-45 Rockingham County, New Hampshire Superior Court.
9. *McElmurray, et al. v. Augusta-Richmond County, et al.* United States District Court Southern District of Georgia, CV 198-216.
10. *Boycland Dairy v. City of Augusta.* No. 2001-RCCV-126 Richmond County Superior Court, Augusta, GA.
11. U.S. Environmental Protection Agency. Cooperative Agreement CR-820725-01-1 and renewals; 2001.
12. U.S. Environmental Protection Agency. Standards for the use or disposal of sewage sludge; agency response to the National Research Council report on biosolids applied to land and the results of EPA’s review of existing sewage sludge regulations. Fed Reg. 2003;68:17379-95.
13. Sierra Club. Comments on EPA response to NAS recommendations. Office of Water Docket ID OW-2003-0006. 2003 May 22.
14. Resource Conservation and Recovery Act. 261.4(a)(1) [45 FR 33120].
15. Walker JM, EPA Municipal Technology Branch, to Longest II HL, EPA Associate Deputy Assistant Administrator for Water Program Operations [memorandum] Sept 12, 1978.
16. U.S. Environmental Protection Agency. Inspector General Report. Sept 28, 2004. <<http://www.epa.gov/oig/reports/2004/20040928-2004-P-00030.pdf>>.
17. Sanjour W, Chief, EPA Waste Reduction Branch Resource Recovery Division, to Record [memorandum] March 5, 1979 <<http://pwp.lincs.net/sanjour/790305.htm>>.
18. Stauber JC, Rampton S. *Toxic Sludge is Good for You*. Monroe, ME: Common Courage Press, 1995: 99-122.
19. U.S. Environmental Protection Agency. Institutional constraints and public acceptance barriers to utilization of municipal wastewater utilization and sludge for land reclamation and biomass production. Washington, DC: EPA, 198. Cited in Stauber,¹⁸ p 111.

*Many of the cited documents are posted at <<http://www.sludgefacts.org>>.

20. Goldfarb W, Krogmann U, Hopkins C. Unsafe sewage sludge or beneficial biosolids. *Boston College Environmental Affairs Law Review*. 1999; 26(4): Tables 2 and 3, 767-8; 700.
21. Rockefeller AA. Civilization & sludge: notes on the history of the management of human excreta. *Current World Leaders*. 1996;39(6):99-112.
22. O'Dette RG. EPA's technical sludge regulations may end beneficial reuse. *Water Environment and Technology*. 1990; Nov. Cited in Goldfarb et al. 20: 703
23. Harrison EZ, McBride MB, Bouldin DR. Land application of sewage sludges: an appraisal of the US regulations. *Int J Environ Pollution*. 1999;11:1-36.
24. Gattie DK, Lewis DL. A high-level disinfection standard for land-applied sewage sludges (biosolids). *Environ Health Perspect*. 2004;112:126-31.
25. Swank R. September 6, 2000 Deposition. *David L. Lewis, Ph.D. v. Environmental Protection Agency*. U.S. Department of Labor, Office of Administrative Law Judges, Washington, DC. 2003-CAA-00005-2003-CAA-00006. 2004.
26. U.S. Environmental Protection Agency. *Burnell V to Barber C et al.* [e-mail], May 6, 1992.
27. Brinton W. Compost quality in America. Woods End Research Laboratory, Inc. PO Box 297, Mt. Vernon, ME 04352, 2000.
28. U.S. Environmental Protection Agency. 2004. <<http://www.epa.gov/ord/htm/daa.htm>>.
29. Saber K. How to strategize for successful project development. *Biocycle*. 1994;April:32-5.
30. New Hampshire Department of Environmental Services. Do Federal Biosolids Regulations Protect Public Health and the Environment? June 20, 1996.
31. Rubin A. Presentation on sludge and [the] 503 rule. Presentation before the NH Environment and Agriculture Committee, Nov 19, 1998.
32. Rubin A, EPA Biosolids Team, to Duff R, New Hampshire Division of Public Health Services [letter], March 8, 1996.
33. Rubin A, EPA Biosolids Team Coordinator, to Sterman D, Deputy Commissioner, New York State Department of Environmental Conservation [letter], May 9, 1997.
34. Walker J, EPA Office of Water, to Nosenschuck N, Director, Division of Solid & Hazardous Waste, New York State Department of Environmental Conservation [letter], Dec 15, 1997.
35. Perciasepe R, EPA Assistant Administrator, to Rominger R, Deputy Secretary, U.S. Department of Agriculture [letter], July 24, 1997.
36. Chrostowski PC, Foster S, Preziosi D. Scientific peer review of "The Case for Caution." CPF Associates Inc., 7708 Takoma Avenue, Takoma Park, MD 20912, 2002.
37. McBride MB. Toxic metals in sewage sludge-amended soils: has promotion of beneficial use discounted the risks? *Advances in Environmental Research*. 2003;8(1):5-19.
38. Lewis DL, Gattie DK, Novak ME, Sanchez S, Pumphrey C. Interactions of pathogens and irritant chemicals in land-applied sewage sludges (biosolids). *BMC Public Health*. 2002; 2:11. Reprinted in: *New Solutions*. 2002;12:409-23.
39. Lewis DL, Shepherd S, Gattie DK, Sanchez S, Novak M. Enhanced susceptibility to infection from exposure to gases emitted by sewage sludge: a case study. Proceedings of National Science Foundation Workshop, College Park, MD, April 10-11, 2000.
40. Lewis DL. EPA whistleblowing <<http://members.aol.com/LewisDavel>>.
41. *David L. Lewis v. Environmental Protection Agency*. U.S. Department of Labor, Office of Administrative Review Board. ARB Case No 04-117, Oct 15 2004 Brief-in-Chief.
42. Synagro—A Residuals Management Company. Biosolids recycling: background issues, legislation, regulation, concerns, and benefits. Sept 18, 2002.
43. Maine Wastewater Control Association and New England Biosolids and Residuals Association [NEBRA]. Response to the Toxics Action Center Report "Toxic Sludge in Our Communities," March 3, 2003, p 11. NEBRA, PO Box 422, Tamworth, NH 03886; <<http://www.nebiosolids.org>> [CD].
44. Land Application of Biosolids. Agriculture, Safety, and Health Issues. Public Information Meeting. Campbell County, VA. Greg Evanlyo, Virginia Tech, July 13, 2004 [video].
45. Harkinson J. Wretched excess: sludge spread across the land makes some people vomit and others very rich. Houston, TX: Houston Press, 2005: 17(3); March 31.
46. *David L. Lewis Ph.D. v. Environmental Protection Agency*. U.S. Department of Labor 2003-CAA-0005-6. Motion for Expedited Consideration and Partial Vacation of ALJ Decision. Aug 1, 2004.
47. Shields H. Sludge victims: 1996-2004. Available from <HShields@worldpath.net>.
48. Rubin A. Telephone call to Shields H, Oct 30 1997. Cited in: Dangers of sludge. Proceedings of Citizens for a Future New Hampshire Conference, Concord, NH, Feb 5, 1998.
49. Perciasepe R. EPA Assistant Administrator to Herman SA. EPA Assistant Administrator for Enforcement and Compliance Assurance [draft memorandum], 1998.
50. Agenda for the National Biosolids Partnership Management Committee Meeting, Jan 14, 1998. Metro Wastewater Reclamation District Office, 6450 York Street, Denver, CO.
51. Williams CW. Information Project II. 2004. Video-taped self-reported symptoms and experiences of Virginia rural residents exposed to land applied sewage sludge. DVD available from <Cwwms3@wmconnect.com>.
52. Lewis DL, Gattie DK. Pathogen risks from applying sewage sludge to land. *Environ Sci Technol*. 2002;36:286A-293A.
53. Harrison EZ, Oakes SR. Investigation of alleged health incidents associated with land application of sewage sludges. *New Solutions*. 2002;12:387-408.
54. Water Environment Federation. Biosolids Recycling and Beneficial Use. [No date].
55. Behun ML. UMWA, and Rush Township synopsis. Nov 26, 2001.
56. Seif JM. Pennsylvania Department of Environmental Protection. Report on the investigation into the application of biosolids at the Al Hamilton Mountain Top Site and the death of Tony Behun, May 5, 2000.
57. Zimmerman RS Jr. Pennsylvania Secretary of Health, to the Honorable George C [letter], Aug 7, 2000.
58. Bastian R. Investigations into allegations of health effects caused by exposure to biosolids. Testimony given to the NAS panel investigating the scientific basis of the 503 rule, March 13, 2001.
59. Lewis DL. EPA science: casualty of election politics. *Nature*. 1996;381:731-2.
60. Lewis DL, Garrison AW, Wommack KE, Whittemore A, Steudler P, Melillo J. Influence of environmental changes on degradation of chiral pollutants in soils. *Nature*. 1999; 401:898-901. [At the time, J. Melillo was Associate Director for the White House Office of Science and Technology Policy.]
61. Notification and Federal Employee Anti-discrimination and Retaliation Act of 2002. Pub. L.107-174 (2002).
62. Shaw GJ. SEA secures vital changes to "no fear" bill. Senior Executive. Legislative Update. May 2002, p 3.
63. Kuehn RR. The suppression of environmental science. *Am J Law Med*. 2004;30:333-69.
64. Russo E. The plight of the whistleblower. *The Scientist*. 2005; Jan 17.
65. Lewis DL. Expert Testimony Interim Report. June 9, 2004. *Michael Seth Jones v. Erwin Utilities et al.* Circuit Court of Unicoi County, Tennessee.
66. Cleavenger R. Farmhand sues Erwin Utilities for \$4.5 million. *Erwin Record*. Jan 14, 2003. <http://news.mywebpal.com/news_tool_v2.cfm?pnpid=592&show=archivedetails&ArchiveID=930047&om=1>.
67. *Boyceland Dairy v. City of Augusta*. No. 2001-RCCV-126, Richmond County Superior Court, Augusta, GA. Expert report of Chip Pritchard, DVM. Feb 3, 1999.
68. *Boyceland Dairy v. City of Augusta*. No.2001-RCCV-126, Richmond County Superior Court, Augusta, GA. Supplemental and rebuttal expert report of Chip Pritchard, DVM. Aug 12, 1999.
69. *Boyceland Dairy v. City of Augusta*. No. 2001-RCCV-126, Richmond County Superior Court, Augusta, GA. Dr. Lewis Goodroad, soil scientist, in affidavit and attachments dated April 30, 2002.
70. *McElmurray, et al. v. Augusta-Richmond County, et al.* U.S. District Court Southern District of Georgia, Civil Action File No. CV 198-216. William L. Hall, environmental engineer, in expert report affidavit and attachments dated May 30, 2002.

71. *Boycland Dairy v. City of Augusta*. No. 2001-RCCV-126, Richmond County Superior Court, Augusta, GA. Deposition testimony of Allen Saxon, representative of Augusta.
72. *Boycland Dairy v. City of Augusta*. No. 2001-RCCV-126, Richmond County Superior Court, Augusta, GA. Deposition testimony of Marion Harris, laboratory manager for the City of Augusta.
73. McElmurray A, to Snyder C. [e-mail], June 20, 2005.
74. Hallman AW. Compliance Evaluation Task Force, Georgia Department of Natural Resources, Georgia Environmental Protection Division, to Larson JH, Somerville, GA. [memorandum], Dec 16, 1998.
75. *Boycland Dairy v. City of Augusta*. No 2001-RCCV-126, Richmond County Superior Court, Augusta, GA. Expert report of New-Fields Resources, Inc., Atlanta, GA.
76. Brobst Bob, EPA Region 8 Biosolids Coordinator. Unpublished communication, May 11, 1999.
77. Gaskin JW, Brobst RB, Miller WP, Tollner EW. Long-term biosolids application effects on metal concentrations in soil and Bermudagrass forage. *J Environ Qual*. 2003;32:146-52.
78. Hallman EF, representing the GA dairy farmers. Personal communication, July 26, 2005.
79. Gaskin JW, et al. Long-term biosolids application effects on metal concentrations in soil and Bermudagrass forage, pp 1 and 8 of final draft. [UGA 00435 and UGA 00442]
80. Lee J. Sewer sludge spread on fields is fodder for lawsuits. *New York Times*. 2003; Jun 26, Sect. A.
81. Mehan III GT, Assistant Administrator for the Office of Water, U.S. EPA, to Mendelson III J, Legal Director, Center for Food Safety [letter]. Washington, DC, Dec 24, 2003.
82. Hallman EF, of Decker, Hallman, Barber & Briggs, to Gaskin JW [letter], July 22, 2004.
83. Dendy LB. University of Maryland administrator named dean of UGA College of Agricultural and Environmental Sciences [press release]. June 3, 2005. University of Georgia Public Affairs News Bureau.
84. Lewis D. Personal communication, November 2004.
85. Patton R, President, Synagro Technologies, Inc., to Whitman C., Administrator, U.S. EPA [letter], Feb 6, 2002.
86. Gray A, Deputy Executive Director, Water Environment Federation, to Whitman C, Administrator, U.S. EPA [letter], Feb 13, 2002.
87. Kirk K, Executive Director, Association of Metropolitan Sewerage Agencies (AMSA), to Longest II HL, Acting Assistant Administrator, Office of Research & Development, U.S. EPA [letter], Apr 2, 2002.
88. Russo RC. Director, Ecosystems Research Division, U.S. EPA National Exposure Research Laboratory at Athens, GA, to Holibaugh T, Acting Director, School of Marine Sciences, University of Georgia [letter], Sept 4, 2001.
89. Kester G, to Burke T, and members of the NAS panel [e-mail], July 2, 2002, <<http://www.sludgefacts.org>> document 13.
90. O'Dette RC, VP Government Relations, Compliance & Technical Services, Synagro Technologies, Inc., to Stavinoha TD, Commissioner, Precinct 1, Fort Bend, TX [letter], Nov 18, 2002.
91. Fondahl L, Biosolids Coordinator, Clean Water Act Compliance Office, U.S. EPA Region IX, San Francisco, to Kawahara K, Department of Environmental Services, Hawaii [letter], Sept 18, 2003.
92. Strauss A, Director, Water Division, EPA Region IX, San Francisco, to Doyle FJ, P. E. Director, Department of Environmental Services, Honolulu [letter], Dec 2, 2003.
93. Fujioka R, Vithanage G, Yoneyama B. Analysis of Synagro biosolids pellets applied to Hawaiian soil for detection and growth of Salmonella. Water Resources Research Center, University of Hawaii at Manoa, May 2004.
94. Moore K, Chief, Clean Water Act Compliance Office, EPA Region IX, San Francisco, to Doyle FJ, P. E. Director, Department of Environmental Services, Honolulu [letter], Jul 13, 2004.
95. Epstein E. Sludge allegations astound scientist [guest editorial]. Brunswick, ME: *Times Record*, June 2, 2005.
96. Peckenham J. Biosolids use and the environment [guest editorial]. Brunswick, ME: *Times Record*, May 27, 2005.
97. Schiffman SS, Walker JM, Dalton P, et al. Potential health effects of odor from animal operations, wastewater treatment, and recycling byproducts. *J Agromed*. 2000;7:1-81.
98. Beecher N, Ostermiller J, Brydges A, Kruger K, Woodhouse S. Saving soil: biosolids recycling in New England. Tamworth, NH, and EFI, Boston, MA: New England Biosolids and Residuals Association, Sept 2001.
99. Beecher N, New England Biosolids and Residuals Association Coordinator, to New Hampshire State Senator Clifton Below and New Hampshire State Representative Hal Melcher [letter]. Feb 2, 2000.
100. Hannon P, Residuals Management Director, New Hampshire Department of Environmental Services, to a Sub-Committee of the New Hampshire Environment and Agriculture Committee [oral testimony], May 31, 2005.
101. Mann A. Fight over sludge starts to get dirty. *Time*. 1999; Sep 27; Sect. Notebook.
102. Faced with faulty science, EPA muzzles critics [editorial]. *USA Today*. 2000; Oct 5.
103. Armbrister T. Weird science at the EPA. *Reader's Digest*. 1999; June.
104. Barnett M. Making a stink. *U.S. News & World Report*. 2002; Aug 5.
105. Heilprin J. Senators protest firing of EPA scientist. *AP*; 2003, May 22.
106. Dryer JM, General Manager, H. J. Heinz Company, Food Technology & Quality Division, Pittsburgh, PA, to Shumaker J, Mayport, PA [letter], Nov 19, 1992.
107. Meyers C, Del Monte, Consumer Affairs, San Francisco, to Gallagher C, Far Hills, NJ [letter], March 24, 1995.
108. National Farmer Union [homepage on the Internet]. National Farmers Union Policy Manual, 2004, p 64. <www.nfu.org>.
109. Sokolowski JL. Biosolids: education is the big key. *The Winchester Star*. 2002; Sept 28.
110. National Biosolids Partnership. Weekly Update. 2005; Jan 5.