

# **Evaluation of Health Concerns in Waterford Virginia and Their Possible Association with Biosolid Applications**

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## **I. Background**

### **A. Basis for Investigation**

In February 2002, a resident of Waterford Virginia contacted the Loudoun County Health Department (“Health Department”) alarmed about a perceived increase in disease in her community. Specifically, she believed that an unusually large number of Waterford residents were experiencing respiratory infections, allergies, nose bleeds, and other uncommon illnesses. This individual was concerned that these illnesses were potentially associated with the application of biosolids near the town of Waterford.

In response to this complaint, the Health Department initiated an investigation of illness in Waterford and any possible association with biosolids.

### **B. Waterford, Virginia**

Waterford, founded around the year 1733, lies 379 feet above sea level. It is a rural Virginia community located at latitude 39.11 degrees north and longitude 77.36 degrees west, approximately 8 miles northwest of Leesburg and 8 miles southeast of Lovettsville. The Catoctin Creek is just west of town, which empties into the Potomac River 10 miles to the north.

Zip code 20197, which encompasses Waterford, has a population of approximately 670 residents in 255 households. 95% of this population is Caucasian and 4.2% African-American, with a median age of 40.3 years and median household income of approximately \$54,000 (US Census).

### **C. Biosolids**

Biosolids, in use for the past several decades, are human sewage sludge that have undergone treatment to significantly reduce pathogens, such as bacteria, viruses, protozoa, and parasitic worms. Biosolids are typically transported by truck in a liquid or semi-liquid (filter cake) state to a land application site where they are applied as a natural, cost-effective fertilizer.

Class B biosolids undergo aerobic and anaerobic digestion, air drying, composting, and lime stabilization. This process reduces the levels of pathogens significantly, though sufficient quantities remain to justify restricted public access and the use of personal protective equipment during its application. Class A biosolids undergo further treatments, which results in a product that is virtually pathogen free and, consequently, do not warrant restricted access.

Application of biosolids is regulated by federal, state and local ordinances to protect the public’s health, including both ground and surface water. State Virginia Code 12 VAC 5-585 (available online at [www.biosolids.state.va.us/regulations.htm](http://www.biosolids.state.va.us/regulations.htm)) delineates the Commonwealth’s requirements for obtaining a permit for application of biosolids, including the quality and composition of sludge allowed and minimum sampling and testing required.

Loudoun County’s ordinances are viewed by many as the most progressive in Virginia. Chapter 1090 of the Loudoun County Ordinance further clarifies the Virginia Code to ensure the health

of its residents, including delineating buffer zones and loading rates, notification of neighbors, and specifying a role for the Loudoun County Health Department in protecting its residents.

There have been case studies of illnesses occurring to people in direct contact with biosolids during their application (article attached). Other than to applicators, there have also been anecdotal reports of illness in people exposed to biosolids, such as pneumonia, rashes, nose bleeds, allergies, and headaches.

As biosolids are a human waste product, most of the pathogens found in Class B biosolids are those that pass through the human intestinal tract, such as hepatitis A, Coxsackievirus, *Escherichia coli* (*E. coli*), *Salmonella*, *Shigella*, *Campylobacter*, *Cryptosporidium*, *Giardia*, roundworms, tapeworms, hookworms, and enteroviruses. If ingested in sufficient quantities, these pathogens may cause gastroenteritis (vomiting and diarrhea). Few pathogens found in biosolids are able to cause respiratory infections, though they may cause allergic responses in sensitive populations if inhaled. Additionally, biosolid components that are not pathogens may cause rashes, allergic reactions or other types of irritation if they come in contact with people.

Studies have consistently shown that once biosolids have been applied and been allowed to dry, pathogens contained in them are not transported by air.

Odor is the most common complaint associated with biosolids. Although odor is not considered a direct health hazard, it may indirectly impact human health in several ways, such as through changes in eating, sleeping and exercise patterns. Odor may also directly impact on quality of life.

## **II. Study Design**

### **A. Soil Testing**

In the area around Waterford, Class B biosolids were applied in July 2001, August 2001, and May 2000. In 2001, the sites closest to Waterford (Fields 15 and 30, among others) were by the intersection of Loyalty Road (Route 665) and Ball Hill Road (Route 673), approximately four miles north east of town. In 2000, the closest application was approximately one quarter mile west of Waterford (Field 8), by the intersection of Old Wheatland Road (Route 698) and Clover Hill Road (Route 662). Trucks transporting biosolids for these sites may have passed through Waterford. No Class A biosolids were known to be applied around Waterford.

Three soil samples were obtained by an employee of the Loudoun County Health Department in each of these three application sites (Fields 8, 15 and 30) on March 11, 2002. At each location, a sample was taken in an area where biosolids had been applied (A) and where runoff would be expected (R). An additional sample was taken along the border of each property (B) where we would expect no biosolids to have reached; these samples served as evidence of baseline (background) levels.

Although soil samples could not be tested for every possible pathogen, they were evaluated for bacteria, including total coliforms and *E. coli*. Each soil sample was also tested for heavy metals and minerals, since these tend to persist in soil and may indicate ongoing contamination due to pathogens not specifically tested.

## B. Disease Surveillance

The second component of this investigation looked at the pattern of disease in Waterford. The resident who initially brought her health concern to the attention of the Health Department volunteered to contact other town residents regarding their disease histories. Specifically, residents were asked whether they had experienced any respiratory infections, nose bleeds, recurring headaches, nausea, vomiting, or burning in the mouth, nose or throat within the previous year. Respondents were able to submit their feedback anonymously, though general location information was requested to assist in evaluating possible patterns of disease.

## III. Results

### A. Soil Sampling

#### 1. Bacteria

Field/Sample	Total Coliforms	E. coli	Bacillus	Gram-Negative Rods
8/A	Negative	Negative	Positive	Positive
8/R	Positive	Negative	Positive	Positive
8/B	Positive	Negative	Positive	Positive
15/A	Negative	Negative	Positive	Positive
15/R	Negative	Negative	Positive	Positive
15/B	Positive	Negative	Positive	Positive
30/A	Positive	Negative	Positive	Positive
30/R	Positive	Negative	Positive	Positive
30/B	Positive	Negative	Positive	Positive

A=Area Where Biosolids Applied, R=Runoff, B=Background

Results that are at least 50% higher than the lowest sample from that field are bolded.

#### 2. Heavy Metals

Sample	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Selenium
8/A	<b>4.19</b>	3.2	33	25	20	<0.01	<b>0.36</b>
8/R	1.85	3.3	28	35	16	<0.01	0.13
8/B	2.04	3.1	31	33	14	<0.01	0.24
15/A	1.41	4.3	<b>85</b>	57	< 5	<0.01	0.21
15/R	<b>2.74</b>	3.9	51	61	8	<0.01	0.30
15/B	<b>2.93</b>	4.2	<b>91</b>	62	<b>7</b>	<0.01	<b>0.43</b>
30/A	1.03	4.5	51	127	< 5	<0.01	0.21
30/R	<b>2.61</b>	4.7	47	119	5	<0.01	0.26
30/B	0.91	3.8	52	160	5	<0.01	0.19

### 3. Minerals

Sample	Organic Matter	Phosphorous	Potassium	Magnesium	Calcium
8/A	3.5	11	75	114	1300
8/R	2.9	14	67	121	1500
8/B	2.3	13	37	136	1100
15/A	2.9	19	55	311	2300
15/R	3.5	10	48	198	1300
15/B	4.6	23	83	213	1600
30/A	3.1	12	70	275	2100
30/R	3.1	6	65	399	2200
30/B	3.8	16	103	310	2000

Sample	Sulfur	Zinc	Manganese	Iron	Copper	Boron	Chloride
8/A	13	2.4	50	133	2.2	0.3	31
8/R	18	3.3	38	132	2.8	0.4	14
8/B	5	2.0	41	131	1.7	0.3	9
15/A	6	1.7	29	75	1.8	0.3	4
15/R	5	2.5	34	131	3.8	0.6	15
15/B	7	3.2	49	52	2.6	0.5	3
30/A	15	3.0	21	93	3.1	0.2	6
30/R	5	3.0	20	117	3.8	0.3	5
30/B	5	3.5	25	80	4.7	0.4	6

In no sample were levels found that could be considered violations of state or local ordinances.

### B. Health Surveys

A total of 33 households from the Waterford area reported illnesses within the previous year. More than one symptom may have been included for each respondent and same complaints reported from the same household were only counted once. The location of these households were:

<u>Location</u>	<u>Households</u>	<u>Location</u>	<u>Households</u>
Main Street	6	Britenbush Court	1
Second Street	5	Browns Lane	1
Loyalty Road	3	Factory Street	1
Bond Street	2	Harley Lane	1
Charles Town Pike	2	High Street	1
Clark's Gap Road	2	Highview Court	1
Trapshire Court	2	Janney Street	1
		Wrights Lane	1

Symptoms expressed by these respondents included:

<u>Respiratory</u>	<u>Households</u>	<u>Non-Respiratory</u>	<u>Households</u>
Runny nose or sore throat	12	Headaches	8
Pneumonia	6	Nose Bleeds	6
Flu-Like Symptoms	5	Allergies	5
Sinus Infections	3	Gastroenteritis	5
Asthma	1	Rashes	4
Other Respiratory Symptoms	7	Conjunctivitis	2
		Sores on Tongue	1

Eight respondents complained of fever, chills and/or general muscle aches. These were usually associated with respiratory complaints.

#### **IV. Discussion**

The mission of the Loudoun County Health Department is to ensure and enhance the health of all our residents. Consequently, when advised that there may be a higher incidence of specific diseases in Waterford Virginia, we agreed with the importance of working with town residents to investigate further.

In order to determine whether there was a causal relationship between the application of biosolids and subsequent disease in the town of Waterford Virginia the Health Department worked with town residents to document patterns of disease and to determine whether residents may have been exposed to pathogens from biosolids around the time their disease was diagnosed.

Based on the results of the laboratory testing and health surveys, there is no evidence that the application of biosolids is the cause of the bulk of infections or ailments noted. This conclusion is based on the following:

1. **Lack of a temporal relationship** between the application of biosolids and subsequent disease. That is, one would expect that if pathogens in biosolids were the cause of disease, there would be a greater number of complaints noted around the time of application than months or years later.
2. **Lack of biological plausibility.** The types of infections or complaints noted by the majority of respondents would not be caused by pathogens in Class B biosolids. Complaints such as gastroenteritis, allergies and rashes, though, could be consistent with exposure to biosolids.
3. **Lack of specificity of symptoms.** Almost all of the diseases or symptoms noted are common occurrences and have more likely etiologies than exposure to biosolids. Respiratory complaints are very common during winter months and allergic symptoms in rural areas are more likely due to such natural environmental factors as pollens or molds.
4. **Lack of consistency.** Biosolids have been applied for decades and aside from anecdotal reports of illness temporally associated with the application of biosolids, there is no evidence of an association between biosolids and the diseases described. Importantly, though,

biosolids are increasingly being applied in fields near population centers which increases the likelihood of contact with residents.

This study is subject to several limitations:

1. Health survey results were dependent on voluntary reporting from Waterford residents. Additional cases may have gone unreported.
2. There is no usual pattern of disease known for Waterford so it was not possible to determine whether these illnesses represented an increase from baseline.
3. Although the majority of health concerns were not consistent with pathogens found in biosolids, it does not rule out the possibility that an individual complaint may be related to biosolid application.
4. The study was conducted months after the most recent application of biosolids around Waterford. A similar study conducted shortly after its application may have picked up ailments more likely to be associated with biosolids.
5. Given the lack of any soil findings suggesting the persistence of pathogens, no air or water pathogen testing was conducted.
6. This study was not designed to pick up any indirect health effects due to biosolid odors.
7. This study did not examine alternative causes of the perceived increase in illness, such as environmental allergens or common exposure to a contagious resident.

The Loudoun County Health Department looks forward to continuing to work with the residents of Waterford Virginia to address their health concerns.

## Hazard ID

# Workers Exposed to Class B Biosolids During and After Field Application

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From the National Institute for Occupational Safety and Health

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### Key Points

- Workers may be exposed to disease-causing organisms while handling, applying, or disturbing Class B biosolids on agricultural lands or mine reclamation sites.
- Class B biosolids are sewage sludge that have undergone treatment by processes that significantly reduce pathogen concentrations. These processes include aerobic and anaerobic digestion, air drying, composting, and lime stabilization. According to the U.S. Environmental Protection Agency (EPA), Class B biosolids may contain pathogens in sufficient quantity to warrant restricted public access and special precautions for exposed workers.
- Class A biosolids are sewage sludge that have undergone treatment by processes that further reduce pathogen concentrations resulting in an end product that is virtually pathogen-free. These processes include irradiation, composting, heat drying, heat treatment, pasteurization, thermophilic aerobic digestion, and alkaline stabilization. Class A biosolids do *not* contain pathogens in sufficient quantity to warrant restricted access or special precautions and may be applied the same way as commercial fertilizer.
- The National Institute for Occupational Safety and Health

(NIOSH) collected air samples for bacteria and endotoxin (a component of some bacteria), and bulk sewage sludge samples for fecal coliform bacteria at a Class B biosolids land application processing facility. Potentially pathogenic bacteria were found in bulk samples and in some air samples. Employee gastrointestinal illnesses at that facility may have been caused by ingestion or inhalation of Class B biosolids.

- Whereas EPA rules restrict public access to treated lands in order to protect public health, these rules do not apply to workers involved with applying biosolids to land. The recommendations in this document are intended to provide guidance to employers and workers to minimize occupational risks from Class B biosolids through the use of engineering controls, personal protective equipment, and worker training. These recommendations are not intended to address nonoccupational exposure.

### About Biosolids

Sewage sludge is typically treated to Class B requirements at a sewage treatment plant. Class B biosolids, in a liquid or semiliquid state, can be transported by truck to a land application site where they are directly applied to the land using tractors, tank wagons, irrigation systems, or special application vehicles. Biosolids may undergo dewatering using polymers. Dewatered biosolids are often temporarily stored at a treatment plant or application site before being transported and applied to land

using front end loaders, trucks, tractors, or sludge-spreading equipment. Workers may come into direct or indirect contact with biosolids during any phase of the treatment, transport, or application process. The biosolids are applied as fertilizer to improve and maintain productive soils and stimulate plant growth. Biosolids have been applied on agricultural lands and surface mine reclamation sites.

### Description of Hazard

There are four major types of human pathogenic organisms found in biosolids: (1) bacteria, (2) viruses, (3) protozoa, and (4) helminths (parasitic worms). The concentration of organisms in biosolids depends on the type and concentration of pathogens present in the source sewage and the degree to which those organisms are removed or killed by the pre-treatment process.

The hazard associated with Class B biosolids is a function of the number and type of pathogens in the treated sludge relative to the minimum infective dose and the exposure level. Under the EPA biosolids rule (40 CFR 503), Class B biosolids must contain less than two million colony forming units (CFU) of fecal coliform per gram of total solids (dry weight). To protect public health, the EPA rule prescribes a *restricted period* of up to one year to limit public access to lands where Class B biosolids have been applied. These EPA restrictions do not apply to occupational access. The risk of worker exposure to infectious agents is likely greatest during and immediately after land application of the biosolids. Because the concentration of pathogens decays through natural processes, the potential for pathogen exposure decreases over time.

In other settings, the association between poor hygiene, raw sewage, and infectious disease is well established. Most of the pathogenic bacteria and viruses in Class B biosolids are enteric, which means they are present in the intestinal tracts of human and animals. Enteric organisms that may be found in Class B biosolids include, but are not limited to, *Escherichia coli*, *Salmonella*, *Shigella*, *Campylobacter*, *Cryptosporidium*, *Giardia*, and enteroviruses. Exposure may potentially result in disease (e.g., gastroenteritis) or in a carrier state (e.g., typhoid), where an infection does not clinically manifest itself in the individual but can be spread to others. These enteric organisms are usually associated with self-limited gastrointestinal illness but can develop into more serious diseases in sensitive populations such as immunocompromised individuals, infants, young children, and the elderly. Because data are sparse on what constitutes an infective dose, it is prudent public health practice to minimize workers' contact with soil or dusts containing Class B biosolids during the restricted periods.

During investigations at a Class B biosolids land application and at a Class B biosolids storage site:

- NIOSH interviewed five employees at a Class B biosolids land application operation. All five employees reported at least one episode of gastrointestinal illness after working with the biosolids, either at the treatment plant or during land application. The environmental sampling results indicated that the gastrointestinal illnesses were possibly of occupational origin.
- NIOSH collected bulk samples from different locations within the biosolids storage site. The mean fecal coliform concentration of the bulk samples was 220,000 CFU per gram of sample (wet weight). Fecal coliforms are used as an indicator for the presence of other enteric microorganisms. There

remains a significant exposure risk. This example illustrates the importance of minimizing exposure to Class B biosolids during the restricted period.

- NIOSH collected air samples at the Class B biosolids land application and storage site. Enteric bacteria were detected in the air. The presence of enteric bacteria in air samples is sufficient justification to implement engineering controls and work practices that minimize employee exposure to biosolid aerosols.

The detection of enteric bacteria in a limited number of air and bulk samples confirms the potential for workers to be exposed to organisms which have been associated with gastrointestinal symptoms and illness. Operations where employees are potentially exposed to Class B biosolids include transport, loading, unloading, and application activities. Other potentially exposed workers include compost workers, surface miners working around reclamation sites, and farmers.

### Recommendations for Prevention

The recommendations contained in this document apply to workers at Class B biosolids land application sites. These recommendations are different from those required for the general public which are regulated by Title 40, Code of Federal Regulations, Part 503 (40 CFR 503).

- Class B biosolids should be incorporated (thoroughly mixed) into the soil to prevent suspension into the air during periods of dryness. After application, mechanical disturbance and contact with Class B biosolids should be avoided for the restricted period.
- Hand-washing stations with clean water, mild soap, and paper (disposable) towels should be readily available whenever contact with Class B biosolids may occur. In the case of workers in the field, portable equip-

ment, including clean water and soap, should be provided.

- Since employees are at risk of soil-contaminated injuries, management should ensure that all employees are up-to-date on tetanus-diphtheria immunizations.
- Current CDC recommendations do not support hepatitis A vaccination for sewage workers. Data are sparse, thus, this recommendation may be modified as more data are developed.
- Periodic training regarding standard hygiene practices and the use of personal protective equipment should be conducted.

### Actions That Should Be Taken

As a rule, the most effective control for occupational safety and health hazards is to eliminate the hazard through substitution. In this case the use of Class A pathogen-free biosolids would eliminate the hazard. However, this report addresses reducing worker risk where Class B biosolids are used. When using Class B biosolids, engineering controls and work practices should be used to prevent exposures. Personal protective equipment, including respiratory protection, should be used when engineering controls are not feasible, before engineering controls are installed, or when installed engineering controls are being repaired or maintained.

### Engineering Controls

- The storage time for dewatered (filter cake) Class B biosolids should be minimized at both the water treatment facility and in the field to prevent the growth of pathogens.
- The Class B biosolids should be incorporated (thoroughly mixed) into the soil, where feasible. Where incorporation is not feasible, workers exposed to the land-applied biosolids should use personal protective

equipment during the restricted period.

- Mechanical disturbance of applied Class B biosolids should be avoided during the restricted period.
- Heavy equipment used at storage and application facilities for Class B biosolids should be equipped with sealed positive pressure, air-conditioned cabs that contain filtered air recirculation units to reduce the potential for exposure to airborne microorganisms and endotoxin.

#### *Personal Protective Equipment*

Appropriate personal protective equipment should be required for all job duties likely to result in exposure to Class B biosolids. The choices of personal protective equipment include goggles, splash-proof face shields, respirators, liquid-repellant coveralls, and gloves. Face shields (that fit over the employee's hard hat) should be made available for all jobs where there is a potential for exposure to spray, high-pressure sewage leaks, or aerosolized biosolids during land application. Gloves should be used when touching biosolids or surfaces exposed to biosolids. Management and employee representatives should work together to determine which job duties are likely to result in this type of exposure and which type of equipment is needed. A qualified health and safety professional should provide training or retraining in the appropriate use of personal protective equipment.

#### *Hygiene and Sanitation*

Hand-washing stations with clean water and mild soap should be readily

available whenever contact with class B biosolids may occur. In the case of workers in the field, portable sanitation equipment including clean water and soap should be provided. Biosolids should be removed from shoes prior to entering enclosed vehicles, and cabs should be wiped down and cleaned of residual mud (or settled dust) after each use to reduce potential exposure to contaminated material.

#### *Hazard Communication and Training*

Periodic training regarding standard hygiene practices for working with Class B biosolids should be conducted which covers issues such as:

- Frequent and routine hand washing (the most valuable safeguard in preventing infection by agents present in Class B biosolids), especially before eating or smoking, and after contact with Class B biosolids or surfaces exposed to biosolids;
- Using personal protective equipment, such as coveralls, boots, gloves, goggles, respirators, and face shields;
- Removing contaminated personal protective equipment and using available onsite showers, lockers, and laundry services;
- Properly storing, cleaning, or disposing of contaminated personal protective equipment;
- Using clean, dry bandages to cover cuts and wounds;

- Instructing workers that work clothes and boots should not be worn home or outside the immediate work environment; and
- Prohibiting of eating, drinking, or smoking while working in or around biosolids.

#### **For More Information**

Additional information about Class B biosolids and preventive measures can be obtained from the following:

National Institute of Environmental Health Sciences (NIEHS). The Beauty of Biosolids. Environmental Health Perspectives, Vol. 104, No. 1, January 1997.

On the Internet at: <http://ehpnet1.niehs.nih.gov/qa/105-1focus/focusbeauty.html>. Environmental Protection Agency (EPA): Title 40 Code of Federal Regulations Part 503.

Homepage on the Internet at: <http://www.epa.gov/owm/bio.htm>. National Center for Infectious Diseases (NCID). Viral Hepatitis Resource Center: <http://www.cdc.gov/ncidod/diseases/hepatitis>.

To obtain more free information about this hazard or other occupational safety and health issues: call NIOSH at 1-800-35-NIOSH (1-800-356-4674) or visit the NIOSH Web site at <http://www.cdc.gov/niosh.html>.

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