

**HOG LAGOONS:
PITTING PORK WASTE AGAINST PUBLIC HEALTH AND
ENVIRONMENT**

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A Report by the
Environmental Defense Fund
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In this report, the Environmental Defense Fund highlights the severe threats to public health and the environment associated with hog waste lagoons and calls for the adoption of a solution package in 1999.

Contents

	Page
Summary and Recommendations	
3	
Threats: Public Health and Environmental Impacts	6
Solution Package Essential Now	
9	
References	
13	

About the Authors

The Environmental Defense Fund is a leading nonprofit organization and represents 300,000 members, including 8,000 in North Carolina. EDF links science, economics, and law to create innovative, equitable, and economically viable solutions to today's environmental problems. The North Carolina office of EDF has worked on environmental issues in the state and region since 1988.

For information on issues associated with factory hog production, see

www.hogwatch.org

SUMMARY AND RECOMMENDATIONS

North Carolina has more than 2,600 registered hog operations using at least one, and often more, open-air pits dug in the earth to process the waste from the state's 10 million hogs. The most recent number of active open-air pits totaled more than 3,800, with the number of abandoned pits at nearly 550. The vast majority of these pits (often referred to as "lagoons") are located along waterways and on lands that drain to the state's coastal waters, which have tremendous economic and ecological value for North Carolina. The coastal waters of the Albemarle and Pamlico Estuarine System are critical to some of the nation's premiere fisheries, providing some of the best spawning and nursery grounds on the Atlantic coast. These waters are home to recreational and commercial fishing, which are cornerstone industries of coastal economies. Coastal tourism also brings over \$2 billion to the state. All these outstanding resources and economic assets rely on a healthy environment, clean water, and clean air.

The state's hog waste lagoons, active and abandoned, threaten the environment of North Carolina and the public health of its citizens. The pork industry's current use of lagoons and sprayfields to handle huge volumes of hog waste is woefully inadequate to protect North Carolina's landscape. Cleaning up a few of these lagoons will not solve the problem-- rather, a complete phase-out of active and abandoned lagoons is urgently needed. The vast amount of animal waste generated by the high density of hog operations in eastern North Carolina must be treated using safer and more efficient waste-treatment systems. The cost to convert existing facilities to improved technologies is certainly a factor; however, it should not be the determining factor or an excuse to defer resolution of the problems. The pork industry must not be allowed to pass cleanup costs on to the people of North Carolina, many of whom are already paying the price of foul odors, contaminated groundwater, and a lower quality of life.

The thousands of active hog waste lagoons contain more than 19 million tons of manure annually. Ample evidence shows that these lagoons contribute significantly to the pollution of groundwater,

surface water, and air. All or most of them leak to some degree. Components in the leakage can concentrate for years in the soil just below the lagoons, presenting a threat to supplies of drinking water and to surface waters if the components are transported into the groundwater (Ham et al., 1998; Miller et al., 1976). The monitoring of wells down gradient of some North Carolina hog farms has shown levels of nitrate that could contaminate nearby water-supply wells (Rudo, 1998; Wynne, 1999). Cumulative emissions from the current method of treating hog waste account for nearly half of the atmospheric ammonia nitrogen emitted from all state livestock and industrial sources combined (Aneja et al., 1998). Offensive odors also rise off the lagoons and sprayfields and travel downwind, far too often resulting in a potential health threat and reduced quality of life for the neighbors of some of the hog operations (Schiffman, 1998; Thu et al., 1997; Wing and Wolf, 1999). The pathogens (disease-causing bacteria) in hog waste are not sufficiently eliminated by treatment in the lagoons to adequately protect public health (Hill and Sobsey, 1998).

Some modest progress has been made in dealing with the waste problems resulting from factory pork production. For example, in 1996 the North Carolina legislature strengthened setback distances from neighbors and streams for new operations and, in 1997, it placed a temporary moratorium on the construction of new or the expansion of existing hog farms, pending the development of a plan to phase out anaerobic lagoons and aerial sprayfields. But the problems are far from solved for North Carolina. Indeed, when the moratorium ends on September 1, 1999, North Carolina will still have--

- Inadequate environmental and public health performance standards for existing or new hog operations.
- No requirement for the timely cleanup of abandoned waste lagoons that pose threats to public health.
- No mandatory controls to reduce and prevent the offensive odors that emanate from hog factories (rather, only a cumbersome, complaint-driven process that promises to take years to provide relief from intense odors for the neighbors of hog operations).

- No requirement to monitor lagoons for the leakage of pollutants and the contamination of groundwater.
- No requirement to reduce, or even monitor, the release into the atmosphere of hundreds of millions of pounds of nitrogen coming from hog operations.

It is time to solve the serious problems associated with the hog industry, once and for all. To do so, North Carolina must pursue a solutions package with at least the following:

- Adopt meaningful, permanent environmental and health-based performance standards by December 1999 for new and existing hog operations, using the innovative technology performance goals defined in 1998 by the General Assembly in House Bill 1480.
- Maintain the moratorium on the construction of new or the expansion of existing hog operations until the conversion of existing farms is well under way. Require the conversion of existing operations to be completed by no later than 2006.
- Strengthen the closure standards for abandoned lagoons and require that all abandoned lagoons be cleaned and closed properly within two years. Reward companies that commit to early closure with priority for state cost-share funding.
- While new technologies are being developed and installed in existing operations, direct the state to take several inexpensive, short-term steps (used in some other states) to reduce the impacts of unacceptable odors and airborne emissions of ammonia from hog operations.
- Require that both growers that contract to raise hogs and corporate integrators (large companies that own the hogs) share responsibility and liability for complying with environmental laws.
- Accelerate research to identify alternative waste systems.

THREATS: PUBLIC HEALTH AND ENVIRONMENTAL IMPACTS

Lagoons: Function and Design

A lagoon is defined as *an impoundment made by excavation or earthfill for biological treatment of animal or other agricultural waste* (Natural Resources Conservation Service, 1996). The biological treatment for which lagoons are designed is the anaerobic (without oxygen) breakdown of complex organic compounds (e.g., proteins) in the manure into simpler compounds that can serve as plant fertilizers (e.g., ammonium, phosphate). This breakdown is not completed in the lagoon, however, and many intermediate products are formed—the hundreds of compounds contributing to odor being prime examples (Schiffman, 1998).

North Carolina requires that lagoons be constructed in compliance with standards set by the Natural Resources Conservation Service (NRCS).^{*} The standards do not call for any monitoring to ensure that the lagoons are not leaking, despite the potential for soil differences which could result in excessive leakage in lagoon bottoms or sides, for lagoon bottoms falling below the water table, or for lagoon bottoms or sides cracking or sloughing during the years of operation.

Public Health Impacts

New research indicates the severity of the public health impacts of pork operations. For example, studies conducted at the University of North Carolina and Iowa State University link hog factories to increased rates of asthma and other respiratory ailments in communities adjacent to the farms (Thu et al., 1997; Wing and Wolf, 1999) and to psychological problems, such as depression (Schiffman, 1998). The testing of groundwater wells down gradient of North Carolina hog farms indicated that more than 10% of them were contaminated with nitrate (a nitrogen compound)

^{*} Anaerobic lagoons are designed with a minimum treatment level (of 6 feet) and a temporary storage volume to hold the varying quantities of liquid waste and rainwater consistent with the planned pumping interval incorporated into the waste-utilization plan. The NRCS standards do not require the lagoons to be above the water table, but only that all temporary storage volume be above seasonally high water tables. Design criteria specify an on-site soils investigation before construction to determine if a liner is needed. Clay liners are recommended, if needed, with maximum hydraulic conductivity (leakage rate) of 0.003 foot a day.

(Rudo, 1998). In a study of groundwater immediately surrounding unlined hog lagoons in North Carolina, 38% of the sites studied had nitrogen levels at concentrations that could contaminate nearby wells (Wynne, 1999).

Using the current lagoon-sprayfield approach, hog waste being applied to land contains 100 to 10,000 times the number of pathogens in human waste that is treated and applied to land through municipal treatment systems. Although fecal coliforms and *E. coli* (common indicators of pathogenic or disease-causing bacteria) can be reduced by about 99% in lagoons operated and maintained by current best management practices, research shows that these pathogen indicators in hog lagoon effluent were still at levels well above state standards and federal guidelines for maximum allowable fecal coliform concentrations in municipal wastewater applied to land (Hill and Sobsey, 1998).

Lagoon Leakage and Groundwater Contamination

The Division of Water Quality, Groundwater Section, of the North Carolina Department of Environment and Natural Resources conducted a study to determine if the NRCS lagoon construction standards established in 1993 were adequate for the protection of groundwater quality. The draft report concluded that the standards (or the process of implementing them) are insufficient to prevent the contamination of groundwater (Department of Water Quality, 1998). The NRCS lagoon standards allow leakage from lagoon liners to 0.003 foot a day (Natural Resources Conservation Service, 1996).[†] While this does not seem like a lot, it adds up to more than 350,000 gallons an acre every year—or more than 1 million gallons a year for a 3-acre lagoon.

[†] NRCS revised some of its animal waste technical standards in 1996, but those revisions did not address the deficiencies identified in the Division of Water Quality's draft report.

It has been recognized since 1976 that the ammonium (a nitrogen compound) leaked from lagoons is likely to concentrate in the soil beneath them (Ham et al., 1998; Miller et al., 1976). Ammonium is quickly converted to nitrate in the presence of oxygen. However, since the soil directly beneath lagoons usually has a low level of oxygen, the ammonium does not convert to nitrate but accumulates in the soil. If the sides or bottom of a lagoon are allowed to dry out, as can happen after the lagoon is abandoned or when the water table is low, the sides or bottom can crack, allowing oxygen to seep into the ammonium-rich soils beneath the lagoon. The introduction of oxygen into the ammonium-rich zone stimulates the conversion of ammonium to nitrate. Since nitrate is very water soluble, it does not stick to soils but drains away into the groundwater. This is a concern because the public health standard for nitrate in drinking water is only 10 parts per million. In addition, groundwater supplies more than half the water in surface streams in eastern North Carolina (Gilliam et al., 1996).

Atmospheric Emissions

Hogs in North Carolina release over 167 million pounds of nitrogen into the air every year, or more than 458,000 pounds a day (based upon the hog population in 1997 and emission factors in Battye et al., 1994). Blown downwind, this ammonia nitrogen subsequently rains down on sensitive rivers, estuaries, and coastal waters in North Carolina, possibly affecting waters as far away as the Chesapeake Bay (Dennis, 1997). Studies in the North Carolina region where hog factories are clustered show that ammonia measured in rain has doubled in the past decade (Cornelius, 1997). Current methods of treating hog waste discharge into the air 48.8 percent of the total amount of ammonia nitrogen emitted from all state livestock and industrial sources combined (Aneja et al., 1998). Currently, neither North Carolina nor the U.S. Environmental Protection Agency regulates any air emissions from hog operations.

Threats from Abandoned Lagoons

A telephone survey conducted in May 1998 by the Division of Soil and Water, in the North Carolina Department of Environment and Natural Resources, identified 643 hog waste lagoons, 95 dairy waste lagoons, and 28 poultry waste lagoons that were abandoned or "inactive."

(Subsequent contact with the Division of Water Quality indicated that there are currently 548 inactive hog waste lagoons.) While inactive lagoons are still required to be maintained and inspected by the state, officials of the Department of Environment and Natural Resources admit that many are probably left unattended and unmanaged by their owners. Although standards for lagoon closure are included in animal operation permits, they do not specify *when* an inactive or abandoned lagoon is required to be closed. In addition, closure standards do not address the accumulation of ammonium beneath lagoons.

Waste lagoons contain sludge accumulated over the years since their last clean out which, for many of them, constitutes their entire active lifetime. Sludge can have nitrogen levels up to 13 times higher and phosphorus levels up to 45 times higher than those in lagoon liquid and may contain significant quantities of heavy metals, salts, and other trace elements (Natural Resources Conservation Service, 1996). The 548 known abandoned lagoons in North Carolina pose serious threats to public health and the environment from overspill and runoff of heavy metals, nitrogen, and phosphorus during rainstorms and from groundwater contaminated with nitrate. The standards must be revised to require lagoons to be properly closed in a timely fashion to protect the public and the environment.

SOLUTION PACKAGE ESSENTIAL NOW

To address the public health and environmental impacts associated with factory hog farms, North Carolina must pursue a meaningful solutions package with the following components.

Component 1: Adopt meaningful, permanent environmental and health-based performance standards by December 1999 for new and existing hog operations, using the innovative technology performance goals defined in 1998 by the General Assembly in House Bill 1480.

Component 2: Maintain the moratorium on the construction of new or the expansion of existing hog operations until the conversion of existing farms is well under way. Require the conversion of existing operations to be completed by no later than 2006.

Systems to manage and treat hog waste must meet specific criteria to protect public health and the environment. These criteria should be based on the performance goals set out in 1998 by the General Assembly in House Bill 1480, which address air emissions, groundwater and surface water contamination, odor, and pathogens.

The legislature should direct the Department of Environment and Natural Resources (DENR) or the Environmental Management Commission (EMC) to establish performance standards for hog waste technologies at existing and new operations by December 1, 1999. (Temporary rules should be adopted by December 1, 1999, while the permanent rule-making process is initiated.) DENR and the EMC should be directed to require that all existing hog operations comply with the new performance standards by no later than 2006.

The moratorium should not be lifted until at least 50% of the anaerobic lagoons are phased out, all aerial spraying is eliminated, and alternative technologies for new operations meet the new performance standards.

<p>Component 3: Strengthen the closure standards for abandoned lagoons and require that all abandoned lagoons be cleaned and closed properly within two years. Reward companies that commit to early closure with priority for state cost-share funding.</p>

The General Assembly should adopt legislation to direct DENR to identify and inventory the location of abandoned lagoons by September 1999 and to prioritize the abandoned lagoons according to their threat to public health and the environment by October 1999; to direct the EMC to revise and strengthen current regulatory standards for the closure of abandoned lagoons by December 1999; and to require that abandoned lagoons be cleaned up and closed within two years, using DENR's priority list to determine the sequence of closure and cost-share funding.

North Carolina should include incentives for hog owners who commit to the closure of abandoned lagoons early, by authorizing that they be rewarded with priority in receiving state cost-share funding for cleanup. As requested in Governor Jim Hunt's budget, an investment of \$1 million by the state should be applied for use in this cost-share program. Such action would ensure that the

state does its job of requiring that operators of hog farms clean up abandoned lagoons, in addition to providing financial incentives for the pork industry.

The state's standards for lagoon closure should be revised and strengthened by mandating a specific date for the closure of abandoned lagoons; by addressing the threat posed by the accumulation and subsequent release of ammonia beneath lagoons; and by requiring the measurement of the levels of heavy metals in the lagoon sludge on an annual basis while the lagoon is still in operation, to prevent the potential hazardous accumulations of contaminated sludge.

Component 4: While new technologies are being developed and installed in existing operations, direct the state to take several inexpensive, short-term steps (used in some other states) to reduce the impacts of unacceptable odors and airborne emissions of ammonia from hog operations.

Governor Hunt and the General Assembly should direct DENR and the EMC to require the implementation of short-term remedies to reduce odor and air pollution from factory hog farms—for example, the use of porous covers (floating material such as pumice or construction matting) over lagoons and the termination of high-pressure spraying of waste on nearby fields. While porous covers do not exclude rain from the lagoons, they are inexpensive, reduce the release of ammonia nitrogen into the air, provide some level of odor and insect control, and can be undertaken quickly. Eliminating high-pressure aerial spraying of waste results in similar benefits. These interim steps will result in a significant increase in the amount of nitrogen in the lagoon liquid. There will not be sufficient nearby cropland to utilize all the additional nitrogen. Consequently, in the short term, the number of hogs will have to be reduced, the manure will have to be transported to locations where the fertilizer resource of the manure can be used, or an alternative treatment or product will have to be developed. Put another way, alternative management strategies will be needed for the waste that exceeds crop needs on available land.

Component 5: Require that contract hog farmers and corporate integrators (large companies that own the hogs) share responsibility and liability for complying with environmental laws.

North Carolina should provide a degree of certainty and protection to smaller farmers who are under contract to raise hogs for large swine integrators. Currently, if there is an environmental problem or violation at the hog facility, the farmer alone is liable for the costs of compliance or cleanup, while the corporate integrator bears no responsibility. State law must establish fairness for farmers by requiring that farmers and integrators be co-permittees. This would help ensure that abandoned lagoons are cleaned up properly and that the integrator and the farmer share the obligation to comply with environmental regulations. Such action would not interfere with the integrator's rights or ability to make contract agreements with individual farmers.

Component 6: Accelerate research to identify alternative waste systems.
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Priority should be placed on accelerating research to identify systems that utilize the nitrogen in hog waste as a resource (i.e., commercially viable product). This is the most economically and environmentally sound approach. Alternative technologies to replace lagoons and sprayfields must eliminate the emissions into the air of pollutants that cause offensive odors and the substantial release of nitrogen as ammonia and its subsequent deposition on land and in water. To achieve this, an alternative use (to land application) for the nitrogen in the waste must be developed. This should be given highest priority in technology research.

The approval of any new animal waste systems should also be contingent on a demonstration of their reliability in preventing the contamination of groundwater.

Public funding of research and development should continue, but the burden of paying for additional research should not fall solely on the public. The pork industry, particularly those entities with multiple operations, should contribute significantly to research and development efforts at the Animal and Poultry Waste Management Center at North Carolina State University and elsewhere. Ultimately, pork producers will profit from the development and use of environmentally sustainable technologies.

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