FEMAville: Rocky Mount's Temporary Housing Facility
Are its residents at risk?

By

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Full disclosure is an important part of people's democratic right to know about the conditions of the places they live and work.

Saladin Muhammad
Black Worker's for Justice

Abstract

Background: Following Hurricane Floyd in September of 1999, residents from damaged communities in eastern North Carolina were placed in temporary housing facilities. One of these facilities, located outside Rocky Mount, North Carolina, was suspected by community members and facility residents to be located on land previously used as a landfill. These individuals were concerned about public health issues resulting from possible toxic exposures and continuing practices of discrimination related to environmental justice.

Materials/Methods: Questions aimed at determining reasons for such concerns, finding evidence to validate concerns, and elucidating facts to determine health risks should the temporary housing facility be found to be located on land previously used as a landfill were drawn up with the help of UNC School of Public Health faculty and concerned community members. Personal, telephone, and electronic mail interviews were performed and government-authorized studies were collected and analyzed in an attempt to answer these questions.

Findings: Information collected from interviews and government-authorized studies indicated that the temporary housing facility is located on land previously used as an industrial landfill. Contaminants on the facility from this activity include coal ash, wood fibers, cotton motes, and gypsum molds. Although the examined environmental review and site assessment of the facility site found no health risks to facility residents, its contents are incomplete. Constituents of some of the contaminants, particularly of coal ash, could present health risks to residents depending on the level of soil contamination.

Discussion/Conclusion: The temporary housing facility outside Rocky Mount, North Carolina is located within a site previously used as an industrial landfill. The resources necessary to determine both this and possible health risks to residents secondary to prior uses of the site required concerned citizens and residents to enlist the help of university faculty and graduate students. Further information regarding soil contents at the facility must be obtained in a timely manner to determine any health risks present to residents from toxic substances that might be present at the site.

Introduction

Hurricane Floyd hit eastern North Carolina on September 16, 1999, dropping fifteen inches of rain on communities already feeling the effects of being left behind in the "boom economy of the 1990s". While the enormous rains were not solely responsible for disaster-like situations that developed in this area, they acted as a powerful catalyst to already underlying pathological social conditions to transform the area into one of unmitigated catastrophe. Most of the crisis situations exacerbated by the flood already previously existed, such as lack of jobs, food, transportation, health care, appalling working conditions, environmental degradation, and particularly, deficient adequate housing.[1] All in all, numbers totaled 57,000 damaged homes, with 17, 000 judged to be uninhabitable and 7,000 more beyond repair.[2] To help residents of affected communities deal with this housing crisis, seven temporary housing sites, consisting of travel trailers and mobile homes, were constructed in eastern North Carolina. These sites, constructed in Edgecombe, Pitt, Lenoir, and Wayne counties, were founded with the objective "to provide safe, sanitary housing" for North Carolina residents displaced from their homes by the flood. To date, site requests for travel trailers and mobile homes have reached 2,900 with additional requests coming in each day.[2]

Background

Concerns possessed by residents of Edgecombe county's temporary housing facility first came to my attention in March of this year, when Saladin

Muhammad, a Rocky Mount resident and active force within the Edgecombe County African-American community currently struggling for labor, social, and racial justice, came to speak at the UNC School of Public Health about environmental justice issues existing in his part of the state. During this discussion, Mr. Muhammad indicated that concerns had been expressed to him, both by residents of Edgecombe county's temporary housing facility and Rocky Mount community members, that the temporary housing facility had been constructed on top of a landfill. The facility is located at the Fountain Industrial Park in Rocky Mount. Currently, it contains 207 travel trailers and 64 mobile homes, an average of two and a half to three people living in each trailer, placed on soil that has been covered with grass in undisturbed areas.[3] In particular, the facility contains a significant portion of residents from Princeville, the oldest incorporated African-American town in North Carolina, founded by emancipated slaves. In Mr. Muhammad's opinion, the residents of Princeville had already faced a large deal of discrimination in the disaster relief provided following the flood, such as being forced to stay in shelters, while their white counterparts were housed in hotels, and receiving the last opportunities for donations, as they were first distributed at establishments frequented by Caucasians, such as white churches in the neighboring town of Tarboro. If the housing facility was found to be located on top of a landfill, Mr. Muhammad felt that this would substantiate the perception of discrimination directed toward Princeville residents, as well as illuminate the possibility that residents might be facing daily exposure to substantial health hazards. Unlike neighboring Tarboro, Princeville had been

completely destroyed and although officials state that residents are expected to vacate the temporary housing facility eighteen months after its establishment, similar facilities with comparable requirements located in North Dakota following that area's recent floods lasted three years, as residents struggled to find alternative housing.[4]

Materials and Methods

After deciding to investigate these concerns raised by Mr. Muhammad, I met with Dr. Steve Wing, a professor at the UNC School of Public Health specializing in environmental justice issues, to draw up a set of questions to guide my investigation. Mr. Muhammad approved this list of questions as appropriately targeting the information desired by residents of the temporary housing facility and Rocky Mount community members. The list contained the following questions:

1. Why do people believe the temporary housing facility to be located on a landfill?
2. Can it be shown that the temporary housing facility is not located on a landfill?
3. If the temporary housing facility is located on a landfill,
   a. When was the landfill opened?
   b. When was the landfill closed?
   c. What materials were deposited in the landfill?
   d. What engineering methods were used?
   e. What parts of the facility are involved?
   f. Have any studies been done on the land?
   g. What documentation exists to substantiate information obtained in answering the above questions?
   h. Does the information obtained from the answers to these questions indicate that the residents of the housing facility might be at risk for any particular health problems?

Findings

Interviews

To attempt to answer the question of "Why do people believe the temporary housing facility to be located on a landfill?", I began by further questioning Mr. Muhammad. He indicated that longtime employees of the Fountain Correctional Facility, located next to the housing facility, were the first to come to him with concerns that the housing facility was located on top of a landfill. Several employees of the correctional facility, while on duty, had, for many years, noticed industrial-sized trucks using the land upon which the housing facility is located as a "dumping ground" for large quantities of unidentified materials. Also, according to Mr. Muhammad, both a local television report and community members raised concerns similar to those expressed by the workers at the correctional facility, that the land housing the facility had been formerly used as a landfill, and questioned whether such previous activities at the site might present health risks to the new residents.[4] Interviews with other community activists familiar with both the housing facility and Rocky Mount area confirmed that numerous individuals had observed the land housing the temporary facility being used to receive large deposits of unspecified matter for many years and that because of this many of these individuals were concerned about potential health risks that these deposits might pose to the facility's residents. These individuals included Ida Bodie (Black Workers for Justice), Joan Sharpe (Black Workers for Justice), Gini Webb (North Carolina Student Rural Health Coalition), Gary Grant (Concerned Citizens of Tillery), as well as residents of the housing facility.

These interviews were followed by a discussion with Jim Bayliss, the Edgecombe County health director. Mr. Bayliss indicated that the site at the Fountain Industrial Park had appeared ideal to state officials as a potential housing facility since it could provide water and sewage access for a large number of temporary households. He stated that anytime such a site was to be considered for human inhabitation, a Phase I Environmental Evaluation would be required to evaluate any health risks to future residents. While fairly certain that such an evaluation had been performed in the case of the Fountain Industrial Park, in his opinion, the site was seemingly constructed "overnight" and a lot of questions had been left unanswered, such as who was to govern the facility's residents and where residents would receive health care.[5]

After speaking with Mr. Bayliss, I sought to identify how I might obtain records as to the history of the land at the Fountain Industrial Park. In an effort to do so, I was referred to John Cooper, a city and regional planning student at the University of North Carolina at Chapel Hill. Mr. Cooper suggested that I look for an Office of Planning and Zoning within Edgecombe county, as well as local government officials to help me obtain this information. Mr. Cooper seemed excited about the project and offered to do some research on his own regarding the concerns posed to us by Mr. Muhammad as to prior activities on the Fountain Industrial Park land on which the temporary housing facility was built.[6]

After speaking with Mr. Cooper, I identified the chairman of the Edgecombe County Commissioners, Charlie Harrell, as a likely source of information regarding the history of land use at the Fountain Industrial Park. Mr.

Harrell stated that, to his knowledge, the property was originally part of the Fountain Correctional Facility, owned by the state. However, according to Mr. Harrell, 15 to 20 years ago, the property was given to the Edgecombe County Development Association for the purposes of development. During the 1990s, part of the land had been leased to ReUse Technology for storage of ash produced in a steam-making process that they performed for Abbott Labs, before being leased back to the state in the fall of 1999 for development of the temporary housing facility. Mr. Harrell suggested that I contact Oppie Jordan, the Edgecombe County Development Officer, to search for any documentation of this history.[7]

A phone interview with Ms. Jordan confirmed the history of the housing facility land as described by Mr. Harrell. Ms. Jordan stated that environmental studies of the land had been performed prior to construction of the temporary housing facility. According to Ms. Jordan, a private company, Appian Consulting Engineers, had performed one of these environmental studies at the request of the Edgecombe County Development Association. The other study, she indicated, had been a Phase I Environmental Evaluation performed by the state under the supervision of Doug Boyd, the North Carolina Temporary Housing Director. Although initially cooperative, when asked if she could provide me with a copy of the study performed on behalf of the Development Association, Ms. Jordan quickly became defensive, asking why I would need such a document if she could assure me that the land containing the housing facility was "perfectly safe". Despite my reassurances that such documentation is necessary in compiling a

report for the purpose of educating a group of individuals whose struggles have instilled in them a distrust in guarantees unsupported by factual data, she continued to deny my requests for documentation. Ms. Jordan ended our conversation stating that she would be in touch with me after speaking to the chairman of the county's Development Board to determine the acceptability of providing me with the requested documentation. To this date, despite repeated attempts, Ms. Jordan has failed to provide me with a copy of the study or provide me with any explanation as to why this is not possible.[8]

Following this discussion with Ms. Jordan, I contacted Doug Boyd at the North Carolina Office of Temporary Housing. Mr. Boyd confirmed that a Phase I Environmental Evaluation had been performed on the housing facility land. He stated that he possessed a copy of this evaluation and assured me that there is "no problem with the site." However, when asked if he could provide me with a copy of the evaluation, he denied my request, stating that he did not deem graduate work a suitable reason for the document's release.[9]

Aware that, under the North Carolina Public Records Statute, Mr. Boyd was required to provide a copy of the evaluation, I employed the help of Dr. Wing. After speaking with Mr. Boyd, Dr. Wing felt it reasonable to contact some of his colleagues within the state government. After these individuals spoke with either Mr. Boyd or his superiors, I was able to obtain a copy of the desired document from Tom Hegele, the Emergency Information Section Chief for the North Carolina Department of Emergency Management. Mr. Hegele provided me with a copy of the Environmental Review for the Fountain Industrial Park site,

including a Phase I Environmental Site Assessment. He also provided me with some further statistical data regarding the housing facility, included previously in this paper.

Documentation

The Environmental Review consists of two portions and is in the form of a checklist. The first portion asserts that the plan for the temporary housing facility is in compliance with all environmental laws, including the:

- National Preservation Act
- Clean Water Act
- Endangered Species Act
- Fish and Wildlife Coordination Act
- Wild and Scenic Rivers Act
- Coastal Zone Management Act
- Clean Air Act
- Hazardous and Toxic Waste Regulations (Comprehensive Environmental Response, Compensation and Liability Act, Resource Conservation and Recovery Act, Superfund Amendments and Reauthorization Act, and the Hazardous and Solid Waste Amendments)

While asserting that the plans for the site are in compliance with all of these laws, however, the review, in most cases, fails to cite evidence for these assertions. Even more importantly, however, in the section regarding compliance with Hazardous and Toxic Waste Regulations, despite the fact that evidence is cited in

the form of the entry "See ESA (Environmental Site Assessment)—11/1/99", this document was seemingly not attached to the report.

The second portion of the review asserts that the plans for the temporary housing facility are in compliance with executive orders, particularly those regarding flood plains, wetlands, and environmental justice. Under the section pertaining to environmental justice, the report states that "the principal population using the temporary housing is minority and low income. However, provision of this housing is beneficial to them and does not impact any populations in the vicinity of the site."[9] Although this is seemingly accurate, the document's ignorance of possible environmental justice issues surrounding the location of the housing facility are strikingly ironic, as it fails to acknowledge that the location of the facility could be viewed as an environmental justice issue by the very group of people it is meant to serve.

The Phase I Environmental Site Assessment was performed by Titan Atlantic Group, Inc. of Winterville, NC for Appian Consulting Engineers, Inc. of Rocky Mount, NC. Titan states the purpose and scope of its work as involving the following:

- Site reconnaissance to verify what is discovered by research of documents and to look for any evidence of waste-handling or storage activities
- Review of selected lists (e.g. of state and federal agencies) for records or comments pertaining to past or present environmental concerns
- Review of selected historical information, including aerial photographs and topographic maps
- Evaluation of site topographic, hydrologic, and hydrogeologic conditions based on readily available information[10]

Examination of the assessment provides several important observations. These include:

•The site visit for the assessment was not performed until after half of the temporary housing site was constructed and the other half was already being developed. While such a time frame might be considered reasonable given the urgency placed on construction secondary to the flood, the scope of the assessment and site reconnaissance were completed a month after Hurricane Floyd hit eastern North Carolina.

•The assessment confirms the history of the site as a "landfill" for ReUse Technologies. It is registered on the Solid and Hazardous Waste Management Division of the North Carolina Department of Environment, Health, and Natural Resources List of active and closed demolition landfills. According to the assessment, since the "1990's, the site has been used for composting and coal storage by ReUse Technology. The site grades have been raised using coal ash as fill. In addition, the site was used for composting of wood fiber and cotton motes. A portion of the site was used for storage of gypsum molds that were also recycled."[10]

•Soil samples analyzed from the site were taken "from several locations". No metals were found to be above threshold regulatory limits. However, the exact location from which the samples were taken from is not indicated. In particular, it is not evident whether or not samples were taken from the mounds of coal ash on the eastern end of the site.

Despite this, Titan's conclusions read

> Based on our site observations and evaluation of the data obtained...we did not observe evidence of potential environmental contamination of the subject property. Based on our findings, Titan does not recommend additional environmental assessment of the subject site.[10]

Repeated requests, in the form of telephone calls and written letters to the North Carolina Department of Emergency Management, were initially unsuccessful in allowing procurement of the document, "ESA 11/1/99", or further information regarding sampling methods used in the provided site assessment. However, after relating my difficulties in obtaining this information to government officials within the Office of

Minority Health, Barbara Pullen-Smith and Chris Hoke, a response from Mr. Hegele was finally provided. According to Mr. Hegele, the "ESA 11/1/99" is actually the Environmental Site Assessment that had already been provided to me as part of the Phase I assessment that had been performed on the site. Mr. Hegele explained that the reason for the discrepancy in the Environmental Review citation of the document appeared to stem from the faxed cover memo on the ESA when it was received on 11/1/99 by the individuals preparing the review. Also, Mr. Hegele informed me that the Department of Emergency Management had no further information on soil sampling at the site and suggested contacting Carl Bonner at the Titan Atlantic Group, Inc. to obtain further information regarding sampling methods.[11]

A discussion with Mr. Bonner revealed that the only information that the Titan Atlantic Group, Inc. possessed regarding soil sampling at the temporary housing facility site was contained in two pages of lab reports that the group had used during preparation of the Environmental Site Assessment. While he agreed to provide me with copies of these documents, he did not feel that they would provide me with any information regarding sampling methods and suggested that I call Bobby Joyner at Appian Consulting Engineers, Inc., who he believed to have been involved with the actual sampling.[12]

The documents given to me by Mr. Bonner provided no further information than what had been discussed in the Environmental Site

Assessment, except to reveal that the soil sampling described in the assessment had taken place in 1998, rather than in October of 1999, when the site assessment was carried out.[13] Further shortcomings of this testing were indicated to me during a telephone conversation with Mr. Joyner, who informed me that the soil sampling recorded in the Environmental Site Assessment had only involved areas of the site on which recent composting activities had taken place and had, purposely, not involved areas where coal ash was located. He explained that this was because the coal ash at the site had been tested prior to transport from the ReUse Technologies facility and suggested that I contact Bob Waldrop at ReUse Technologies, who had been involved with the coal ash testing.[14]

Mr. Waldrop informed me that ReUse Technologies had been using the temporary housing facility site to store coal ash from 1990 until the time of Hurricane Floyd. He indicated that, from his recollection, the majority of the testing performed on the coal ash was not designed to provide information that would allow a determination as to the amounts of hazardous metals in the coal ash to which residents of the temporary housing facility might be exposed to by routes of ingestion or inhalation. Rather, according to Mr. Waldrop, most of the testing performed on the coal ash was to determine what groundwater might pickup from the ash should it be exposed. However, Mr. Waldrop agreed to review the tests performed on the coal before it left ReUse Technologies to be stored at the

temporary housing facility site and provide me with any pertinent results.[15] I am currently waiting for these results from Mr. Waldrop.

Evaluation of health risks to facility residents

Without thorough soil sampling of the site, the health risks to facility residents cannot adequately be assessed. However, review of the toxicology literature and recent environmental health initiatives can identify possible health risks that facility residents might be exposed to secondary to contaminants that the Titan Site Assessment indicates are present on the site.

Coal Ash

Of the contaminants found on the site, the presence of coal ash is the most worrisome. As defined by the CCB (Coal Combustion By-Products) Information Network, coal ash refers to "any materials or residues produced from the combustion of coal" including specifically "fly ash, bottom ash, boiler slag, fluidized combustion ash, and flue gas desulfurization material."[16] Coal ash has recently been under scrutiny by the United States Environmental Protection Agency (EPA) for its possible adverse effects on human health and the environment. In the May 22, 2000 issue of the Federal Register, the EPA explains that while coal ash does not warrant regulation as hazardous waste under Subtitle C of the Resource Conservation and Recovery Act (RCRA), national non-

hazardous waste regulations under RCRA Subtitle D are needed for coal ash disposed in surface impoundments and landfills. The agency deems that some form of national regulation for coal ash disposal is necessary given their conclusion that "the composition of these wastes has the potential to present danger to human health...". Furthermore, eleven cases of proven injury to human health by improper management of the wastes when disposed of in landfills are identified.[17] Ironically, concerns presented by the EPA relate to the health of humans in areas located near disposal sites for coal ash, as affected by the consumption of contaminated drinking water or inhalation of tainted air.[18] The document ignores the possibility of habitation upon a site used for coal ash disposal, such as in the case of the Rocky Mount temporary housing facility, in which residents would be even more likely to be exposed to contaminants through inhalation or, as might be particularly likely with children, direct consumption.[18]

The constituents of coal ash that give rise to health concerns are hazardous metals, such as arsenic, chromium (VI), lead, mercury, cadmium, barium, and thallium.[17, 18] In particular, the EPA comments on the fact that leachates from wastes generated at coal combustion facilities have been found, on occasion, to exceed hazardous waste toxicity levels for the first five of these metals.[17] On examining just one of the constituents of coal ash, fly ash, Sanders writes

> Experiments with animals have shown that coal fly ash is cleared from the lungs as a double

> exponential...alveolar macrophages rapidly phagocytize inhaled ash particles, greatly increasing the elemental concentration of toxic metal in individual cells.

Sanders continues, citing increased lung concentrations of 80-fold with respect to arsenic, 25-fold with respect to lead, and 40-fold with respect to barium.[19] While few studies have been done to examine the long-term effects of chronic exposure to coal ash, sizable research elucidates the possible adverse health effects of coal ash constituents.

As described in Casarett and Doull's Toxicology: The Basic Science of Poisons, as well as other sources, chronic exposure to arsenic compounds can adversely affect humans in a number of ways. Peripheral and central nervous system toxicity can manifest beginning with sensory changes, paresthesia, and muscle tenderness, followed with weakness that progresses from proximal to distal muscle groups. Liver injury, particularly characteristic of chronic arsenic exposure, initially manifests as jaundice, often progressing to cirrhosis. Peripheral vascular disease, in the form of acrocyanosis, Raynaud's phenomenon, endarteritis obliterans, and gangrene, has been observed in chronic exposure to arsenic in drinking water in Taiwan and Chile. Arsenic carcinogenic effects can be seen in its association with various skin cancers, lung cancer, hemangiosarcomas of the liver, lympohomas, leukemia, nasopharyngeal cancer, and urinary tract malignancies.[20-25] Except for arsenic, in its report to Congress, the EPA noted no risks of cancer from the ingestion exposure route with respect to coal ash to be greater than 10^{-6} (or larger than a

hazard quotient of one) for levels and durations of exposure used in modeling exposure to coal ash constituents. For arsenic, however, the cancer risk was found to be substantially larger, up to 5×10^{-5}, or fifty times greater than the government-indicated acceptable level of 10^{-6}.[18] Arsenic exposure has also been shown to be a risk factor for diabetes mellitus, stillbirths, and cerebrovascular disease.[26-28]

Most studies linking arsenic exposure to human disease are based on exposure to arsenic-contaminated drinking water. Because of this, some authors criticize the elucidation of health risks from inhalation of airborne arsenic particles or ingestion of arsenic in soil, such as to residents living on a site previously used as a landfill for coal ash might be exposed, based on toxicity derived from such studies of arsenic in drinking water. In particular, Valberg et al. write that

> ...the toxicity of arsenic in drinking water cannot be directly extrapolated to toxicity of soil arsenic because of differences in chemical form, bioavailability, and excretion kinetics. Because of the differences between soil arsenic and water arsenic, we conclude that risks from arsenic in soil are lower than what would be calculated using default toxicity values for arsenic in drinking water.[29]

However, the association of lung cancer and stillbirths with arsenic has been shown to be through an airborne exposure route, indicating that although health risks to arsenic exposure via non-soluble routes might be less, they are hardly negligible.[25, 27] Furthermore, the relevance of such arguments can be questioned in view of studies such as that by Hwang et

al., that have shown elevated urinary arsenic levels in children to be statistically significantly related to soil arsenic levels in bare areas of their respective residential yards.[30] Lastly, it should be noted a number of diseases for which arsenic exposure places populations at risk are diseases that many of the residents of the temporary housing facility are already at risk for, including diabetes, peripheral vascular disease, cerebrovascular disease, and in particular for those who smoke, lung cancer. In fact, a synergism between arsenic exposure via inhalation and smoking in the induction of lung cancer has been shown in the literature.[31]

The other metal found commonly in coal ash that the EPA cites as exhibiting a carcinogenic risk in the [10^{-6} range] in their described models of exposure to coal ash is chromium (VI).[18] Unlike the model for arsenic used by the EPA, this value for chromium was established by modeling inhalation exposure. Accordingly, hexavalent chromium is currently classified as a Group A inhalation carcinogen by the EPA.[32] As the editors of Casarett and Doull's Toxicology: The Basic Science of Poisons write, "Chromium in ambient air originates from...combustion of fossil fuels...Exposure to chromium is associated with cancer of the respiratory tract."[20]

Although not singled out in the EPA's report to Congress as causing coal ash to exhibit significant health risks to humans, the other metal constituents of coal ash have been noted to cause health risks independently. The most widely described of these are lead, mercury, and

cadmium. The toxic effects of lead were noted as early as the 18th century in medical writings and the decline in the prevalence of childhood lead poisoning has been heralded as one of America's greatest public health success stories.[33] Chronic exposure to the substance can lead to encephalopathy, hearing deficiency, IQ deficiency, epilepsy, mental retardation, optic neuropathy, blindness, peripheral neuropathy, anemia, nephropathy, decreased vitamin D metabolism, elevated blood pressure, male sterility, cancer, particularly of the respiratory, digestive, and urinary systems, and even death.[20] Lead's principal route of exposure for humans is oral consumption, traditionally from exposure to lead-based indoor paint in old dwellings, lead in contaminated drinking water, lead in air from combustion of lead-containing industrial emissions, lead-glazed pottery, or as is most applicable in possible exposure of residents to any lead contained in coal ash waste contained on the housing facility's grounds, lead in dust from environmental sources, hand-to-mouth activities of children living in polluted environments, and lead dust brought home by industrial workers on their clothes and shoes.[20] Pica is the exposure route frequently responsible for pediatric cases of lead toxicity, particularly among children in lower socioeconomic classes.[34] Despite numerous epidemiologic studies demonstrating associations between lead exposure and a wide range of adverse health outcomes, including quantitative dose-response relationships, a review of the literature by Jin, Teschke, and Copes failed to identify any studies specifically examining established

human health effects in association with soil lead levels. However, the authors were able to identify a number of studies indicating

> that, compared to children exposed to soil lead levels of 100 ppm, those exposed to levels of 1000 ppm had mean blood lead concentrations 1.10-1.86 times higher and those exposed to soil lead levels of 2000 ppm had blood lead concentrations 1.13-2.25 times higher.[35]

Clinically-observed health effects have been noted at blood lead concentrations as low as 10 micograms/dL.[20]

Health effects from exposure to mercury differ to a degree, depending on the form to which a person is exposed. With respect to inhalation of mercury vapor, health effects are predominantly related to central nervous system pathology. Early symptoms are non-specific and form a complex referred to as asthenic-vegetative syndrome that includes findings such as tremor, thyroid enlargement, labile pulse, tachycardia, dermographism, gingivitis, and hematologic changes. Increasing exposure to inhaled mercury leads to more characteristic symptoms, such as intentional tremors of muscles that perform fine-motor functions progressing to generalized trembling of the entire body and violent chronic spasms of the extremities. This is often accompanied by personality and behavior changes, decreased memory function, increased excitability, depression, delirium, and hallucinations. Consumption of methyl mercury can lead to neurotoxic effects as well. However, these effects are manifested in findings such as paresthesias, ataxia, difficulty swallowing

and articulating words, neurasthenia, vision and hearing loss, spasticity, tremor, and eventually, should the exposure continue, coma and death.[20] Fetuses are particularly susceptible to the toxic effects of mercury, as the metal readily crosses the placenta and has been associated with psychomotor retardation and congenital anomalies in infants.[36, 37] Furthermore, evidence has suggested that breast milk contaminated with metals such as mercury, lead, and/or cadmium, secondary to maternal exposure, can serve as a potential health risk to recipient infants in certain populations.[38]

The principal long-term effects of low-level exposure to airborne cadmium are numerous. Studies have shown such exposure to result in chronic obstructive pulmonary disease leading to emphysema, as well as in chronic renal tubular disease.[20] Similarly, exposure to environmental cadmium, even at low-levels, has been associated with skeletal demineralization and changes, leading to bone pain, osteomalacia, and osteoperosis, increasing bone fragility and the risk of fractures.[39] Furthermore, epidemiological studies suggest cadmium to be a causative agent for essential hypertension.[40] Other studies have found increased risks of lung and prostate cancer with exposure to inhaled cadmium.[20] Hence, cadmium has recently been named by the International Agency for Research on Cancer as a Category 1 (human) carcinogen.

Although not typically considered as toxic as their fellow coal ash constituents, barium and thallium exposure can present health risks to

humans as well. Ingestion of soluble forms of barium can result in gastroenteritis, muscular paralysis, decreased pulse rate, ventricular fibrillation, and extra-systolic heart rhythms, while inhalation of barium sulfate or barium carbonate can cause a benign pneumoconiosis.[20, 34] Long-term thallium intake has been reported to result in liver necrosis, nephritis, gastroenteritis, pulmonary edema, degenerative adrenal changes, degeneration of the both the peripheral and central nervous systems, alopecia, cataracts, and, even, death.[20, 34]

Other site contaminants

Although arguably not as worrisome as some of the constituents typically found within coal ash, there may be adverse health risks related to other site contaminants. As described in William and Burson's book, Industrial Toxicology: Safety and Health Applications in the Workplace, exposure to wood dusts can produce asthma in various individuals. Symptoms are similar to commonly encountered extrinsic atopic asthma and, in the United States, are most often associated with exposure to western red cedar dust, widely used in the construction industry.[41] With respect to health risks secondary to cotton dust exposure, William and Burson discuss byssinosis, an occupational lung disease seen in textile workers exposed to cotton. Symptoms include chest tightness, wheezing, and shortness of breath that typically resolve with removal of the individual from the cotton dust-laden environment. However, cotton dust

concentrations in the general environment at the temporary housing facility are probably not high enough to warrant concern for byssinosis. A review of pertinent texts, journals, and internet sites revealed no studies or information related to exposure to gypsum molds.

Discussion

What types of conclusions can be drawn from this research? First, while concerns posed by residents of both the Rocky Mount community and temporary housing facility that the housing facility is constructed within a landfill have been confirmed, it is still not known if such a relationship poses any health concerns to the residents of the facility. Further evaluation of the site, in particular through more thorough soil sampling methods, will likely be critical to this effort. Once the exact nature and amounts of contaminants are determined, possible health risks to the housing facility community can begin to be assessed.

The urgency of the situation requires expediency in data collection. As indicated in the reviewed literature, a number of health risks exist with chronic exposure to such contaminants, however, data on short-term exposure to low or moderate levels of contaminants is lacking. The investigation has found no evidence of adequate testing for toxic agents at the site, and there is no evidence to show that there has been testing to determine if anyone has been exposed to toxins should they exist. If the residents at the housing facility are being subjected to any toxic exposures,

the longer they remain at site the more likely they are to be placed at risk for related diseases. Although the North Carolina Office of Emergency Management states that residents of the temporary housing facility will only be allowed to utilize the facility until the spring of 2001 (allowing for a maximum possible duration of exposure of 18 months), similar statements were made with regard to temporary housing facilities after flooding in the state of North Dakota before residents eventually utilized the facilities for three years.[4] Should a positive identification of significant levels of toxic contaminants in the land housing the facility be identified, the need for research examining the effects of short-term exposure to relevant levels of pertinent toxic constituents would be indicated.

Second, while concerns raised by any community as to the nature of the conditions in which they live are valid, such concerns can be viewed as particularly so in this case. Not only were the concerns of those in the Rocky Mount community and temporary housing facility dismissed by officials, they were dismissed even when residents had the most firm of grounds upon which to stand. Officials knew, before placing residents in the temporary housing facility, that the facility was contained within a landfill and did not provide residents with this information.

Lastly, as a graduate student, I have access to many resources not available to those living in a place such as Rocky Mount's temporary housing facility. Even with access to time, money, long-distance phone

service, the internet, e-mail service, transportation, and a host of administrative connections, it has taken me three months to only begin to discern answers for concerns that constitute the most basic of rights in a democratic society--the right to know about the conditions in which one works and lives. This causes one to ask, if I must put in such extravagant effort to answer the most basic of questions, how could anyone with less resources, particularly those actually living on the land in question, be expected to obtain such information?

Conclusion

The next step for this research is two-fold. First, the information I have collected will be distributed to residents of Fountain Industrial Park temporary housing facility and general community in the form of a presentation given at the facility. Influential groups within both the Rocky Mount area and housing facility community, such as the Workers and Community Aid and Relief Project, the Southeast Halifax Environmental Reawakening Project, and the North Carolina Student Rural Health Coalition, will sponsor this presentation. Second, the land upon which the temporary housing facility exists needs to be further evaluated, to determine what, if any, toxic substances are located on the site. After such information is obtained, the potential health risks to residents at the facility can begin to be determined.

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