MOVING FORWARD AFTER HURRICANES KATRINA AND RITA

WASTE MANAGEMENT OF HURRICANE DEBRIS

Senate Committee on Environment and Public Works

February 26, 2007
New Orleans, LA

by Wilma Subra
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Testimony of Wilma Subra

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Before the Senate Committee on Environment and Public Works
on
Moving Forward After Hurricanes Katrina and Rita

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INTRODUCTION

My name is Wilma Subra and I am testifying on behalf of Subra Company, Louisiana Environmental Action Network (LEAN), and the Delta chapter of the Sierra Club. The organizations listed above want to give a special thanks to Joel Waltzer and Robert Wiygul of Waltzer and Associates for their assistance in preparing this testimony.

Thank you for the opportunity to testify on the issues associated with the waste management of hurricane debris resulting from Hurricanes Katrina and Rita. I have been involved with solid and hazardous waste issues for more that 30 years and serve as a technical advisor to community groups on the issues of solid and hazardous waste, oilfield waste and superfund. I have served as Chair of the Louisiana Department of Environmental Quality (LADEQ) Solid Waste Advisors Subcommittee, Chair of the LADEQ Rules and Regulations Committee on Solid Waste Reduction and Recycling, Chair of the LADEQ Review Committee on Proposed Solid Waste Regulations, a member of the LADEQ Recycling and Solid Waste Reduction Committee, member of the EPA RCRA Remedial Waste Policy Advisory Committee, member of the EPA Permit Reform Committee, Vice-Chair of the State Review of Oil and Natural Gas Environmental Regulations, Technical Advisor to the National Committee on Superfund, Vice-Chair of the EPA National Advisory Council for Environmental Policy and Technology (NACEPT) and a member of the NACEPT Superfund Subcommittee, member of the EPA National Environmental Justice Advisory Council (NEJAC) and Chair of the NEJAC Gulf Coast Hurricanes Work Group.

HURRICANE DEBRIS WASTE FROM HURRICANES KATRINA AND RITA

The hurricane debris generated by the gutting of flooded homes throughout the impact zone contained sheetrock and insulation, furniture, treated and untreated lumber, municipal solid waste, household hazardous waste, electronic waste, asbestos and many other components. Louisiana Department of Environmental Quality allowed the waste to be disposed of in Type III Construction and Demolition Landfills. Type III landfills, unlike more protective Type II municipal waste landfills, do not have synthetic liners, collection systems for contaminated leachate, and systems for the collection of landfill gas (methane and hydrogen sulfide). Allowing disposal of C & D waste in unlined landfills has been based on the theory that this waste would not produce toxic leachate or gas emissions. This theory, as explained later in this testimony, has proven to be incorrect even with respect to ordinary C & D waste. It is certainly not true with respect to mixed hurricane waste.

LAC 33:VII.721(C) provides the operational requirements and limitations for a Type III, or construction and demolition, landfill. LAC 33:VII.115 defines construction/demolition debris as, "nonhazardous waste generally considered not water-soluble, including but not limited to metal, concrete, brick, asphalt, roofing materials (shingles, sheet rock, plaster), or lumber from a construction or demolition project, but excluding asbestos-contaminated waste, white goods, furniture, trash, or treated lumber. The admixture of construction and demolition debris with more than five percent by volume of paper associated with such debris or any other type of solid waste... will cause it to be classified as other than construction/demolition debris."

In the wake of Hurricane Katrina, the Louisiana Department of Environmental Quality used its authority to allow this banned materials to be placed in Type III landfills. The Declaration provided in section 2.c. that, "Construction and demolition emergency debris that is mixed with other Hurricane-generated debris need not be segregated from other solid waste prior to disposal in a permitted landfill." An accompanying, "Hurricane Katrina Debris Management Plan," states that, "[m]aterials approved for receipt at [Type III] sites include roof shingles, roofing materials, carpet, insulation, wallboard, treated and painted lumber, etc." These definitions allow virtually any kind of hurricane debris to be placed at Type III landfills such as the Gentilly or Chef Menteur landfills, as long as they are mixed with C & D waste.

A Second Amended Declaration of Emergency and Administrative Order issued by LADEQ on November 2, 2005, further changed the definition of the waste that could be deposited in a type III landfill such as Gentilly or Chef Menteur. Section 2.d. of this Declaration - which has been carried forward in each of the Amended Declaration of Emergency that have followed - provides that, "[u]ncontaminated construction and demolition debris may be disposed of in a permitted type III landfill or a site that has been authorized by the Department for such disposal. For purposes of this Order, construction and demolition debris shall be the materials indicated in Appendix D of this Declaration." Appendix D to the November 2, 2005 - which again has been carried forward in each subsequent Declaration of Emergency - provides as follows:

The following hurricane generated materials shall be allowed for disposal at a permitted construction and demolition debris (C&D) landfill or a Department authorized site:

- Nonhazardous waste generally considered not water-soluble, including but not limited to metal, concrete, brick, asphalt, roofing materials, sheet rock, plaster, lumber from a construction or demolition project, and other building or structural materials;

- Furniture, carpet, and painted or stained lumber contained in the demolished buildings;

- The incidental admixture of construction and demolition debris with asbestos-contaminated waste. (i.e., incidental asbestos-contaminated debris that cannot be extracted from the demolition debris); and

- Yard waste and other vegetative matter.

The following materials shall not be disposed in a construction and demolition debris landfill, but segregated and transported to a Department approved staging area for eventual management, recycling and/or disposal at a permitted Type II Landfill, unless segregation is not practicable:

- White goods
- Putrescible Waste

(Emphasis supplied)

Hurricane Debris Charachteristics

As noted above, even materials ordinarily classified as C & D waste can result in substantial environmental impacts. A study contracted by the US EPA Office of Solid Waste, conducted a review of the characteristics of leachate generated by construction and demolition (C & D) waste landfills (ICF, Inc., 1994). This report found that C & D landfill leachate contained potentially significant concentrations, compared to drinking water maximum contaminant levels (MCLs) of 1,2-dichloroethane, methylene chloride, cadmium, iron, lead, manganese and total dissolved solids (TDS).

Studies performed in the hurricane Katrina and Rita impacted areas have confirmed the findings of the ICF study as well as expanded the areas of concern and toxic treats. In the study performed by Dr. John Pardue, *Anticipating Environmental Problems Facing Hurricane Debris Landfills in New Orleans East* (October 24, 2006-attached), the disposal of hurricane debris in the Gentilly and Chef Menteur landfills will cause three significant environmental impacts: toxic landfill leachate from the presence of household hazardous waste in the hurricane debris stream, the potential for emissions of toxic reduced sulfur gases from the degradation of sheetrock and wall board, and the potential for leaching of arsenic from treated wood disposed of in the landfills. The disposal of house hold hazardous waste in unlined C & D landfills creates leachate that enters the groundwater and threatens the health and safety of the environment and those who live in the area. Household hazardous waste has been documented as being present in the hurricane debris disposed of in the Gentilly and Chef Menteur landfills. The degradation of sheetrock and wall board disposed of in C & D landfills will degrade and release hydrogen sulfide which will generate odors and cause toxic human health impacts. Large quantities of sheetrock and wall board have been disposed of as hurricane debris in the Gentilly and Chef Menteur landfills. Treated lumber has been documented as a significant component of the hurricane debris and that debris disposed of at the Gentilly and Chef Menteur landfills. The stormwater and landfill waters leach the arsenic from the treated wood and the contaminated waters create leachate that enters the groundwater.

A recent study of hurricane debris in New Orleans performed by the University of Florida and published in Science News, Feb. 3, 2007, *Quantities of Arsenic-Treated Wood in Demolition Debris Generated by Hurricane Katrina* (copy attached) confirmed the threat from arsenic treated wood waste. The study calculated that the chromate copper arsenate (CCA) treated wood disposed of as hurricane debris in Louisiana and Mississippi contained 1,740 metric tons of arsenic. The Environmental Protection Agency in 2004 banned the use of CCA as a treatment chemical in residential projects due to its toxicity. The disposal of CCA treated wood as hurricane debris in unlined landfills allows the arsenic to be leached from the treated wood and impact the landfill leachate and contaminate groundwater resources.

Federal Regulatory Authority Over Disposal Of Hurricane Debris Streams

The hurricane debris waste streams with all of the non-C & D components were and continue to be disposed of in unlined Type III C & D landfills (permitted and non-permitted) as authorized by the Louisiana Department of Environmental Quality. A substantial quantity of hurricane debris containing unknown amounts of hazardous materials are also being disposed of in illegal disposal (dump) areas along the Almonaster corridor in New Orleans East.

The inappropriate disposal of toxic and hazardous chemicals in the Hurricane debris pose a threat to surface water and groundwater resources, air quality, and human health in the areas of disposal and ignores and is contrary to federal regulations. Such inappropriate disposal can also result in sites that fall under Federal authority such as Superfund, CERCLA, and RCRA and will need to be addressed in the future with Federal funds.

Solid waste collection, storage, treatment and disposal activities are regulated by state environmental agencies. The water quality and air pollution issues associated with solid waste storage, treatment, and disposal fall under the jurisdiction of the Federal Environmental Protection Agency. That authority is frequently delegated to the state environmental agencies with the EPA retaining oversight. In the case of the management of hurricane debris, a number of federal agencies were responsible for making decisions that directly impacted the methods of debris collection, handling, and disposal locations that were used to dispose of the Hurricane debris. These Federal Agencies are FEMA, Army Corps of Engineers (404 Wetland Permits, Collection Contractors and designated disposal locations), and the Environmental Protection Agency (incident commander directing response activities and monitoring hurricane debris issues).

State agency activities that do not comply with federally approved state regulations sidestep federal regulatory authority, and results in a lack of consideration of human health and environmental impacts. The lack of monitoring and enforcement activities, and lack of consideration of long term impacts will lead to substantial detrimental impacts and establish inappropriate precedence for debris management in future natural and man made disasters. In order to prevent the continuation of such activities by federal agencies that are not in compliance with their regulatory authority and not protective of human health and the environment, a number of changes must be immediately implemented.

RECOMMENDATIONS FOR CHANGES AT THE FEDERAL LEVEL

Waste Stream Characterization and Proper Disposal

Based on the experiences gained in disaster debris collection and disposal post-Katrina and academic studies concerning the hurricane debris characteristics, the Senate Committee on Environment and Public Works should use its authority over RCRA and Superfund to work to require waste stream characterization to enable proper management and disposal of disaster debris based on waste characteristics. Based on debris characteristics, require the debris to be disposed of in fully protective RCRA Subtitle D Municipal Solid Waste Landfills and Subtitle C Hazardous Waste facilities in order to be protective of human health and the environment and prevent the generation of additional contaminated sites that will require the commitment of federal resources in the future.

Debris Management and Disposal Facility Siting Requirements

Require the Environmental Protection Agency to promulgate regulations with more stringent siting requirements for debris management and disposal facilities that take into account floodplains, impacts on flood protection systems, protection of water and air resources, protection of human health and the environment and environmental justice concerns.

Regional Based Integrated Waste Management Plans with Sufficient Disposal Options

Require the establishment of regional based integrated waste management plans that protect the environment and vulnerable communities in advance of natural disasters. The plans must provide for sufficient disposal options and appropriate disposal capacity on a regional basis that will prevent inappropriate disposal of debris in inadequate disposal facilities and in flood prone and vulnerable areas. The disposal options must comply with all regulatory requirements and not default to waivers.

Planning requirements on a regional basis must also include the establishment and implementation of an integrated waste management approach which includes the utilization of the waste management hierarchy methods of reduction, recycling, and reuse prior to disposal in facilities that meet all regulatory requirements. Require all disposal facilities accepting disaster debris to be lined with impermeable liners and have appropriate monitoring systems to insure isolation of the waste from the environment. State environmental agencies must be prohibited from using emergency authorities that allow waste to be inappropriately handled and disposed of in violation of federal statutes during and following disaster situations.

Current Hurricane Debris Management and Disposal Recommendations

For the remainder of the hurricane recovery and rebuilding activities, require increased monitoring of the hurricane debris for toxic and hazardous waste constituents and require disposal of the debris in appropriate locations consistent with the chemical characteristics. Require the agencies to work towards the elimination of disposal of hurricane debris in Type III landfills. Use only RCRA compliant Type ii municipal solid waste landfills that contain synthetic liners, leachate collection systems and landfill gas collection systems. Require the LADEQ to remove the authority to blend the hazardous waste and toxic waste streams with the construction and demolition debris prior to disposal.

For the reconstruction, deconstruction and new construction debris, require separation of waste constituents with proper disposal of toxic waste streams, re-use and recycling of uncontaminated construction debris, and proper disposal in an appropriately permitted and constructed landfill, not a landfill with an exemption or emergency authority. All of the waste streams not included under the C & D authority should be required to be disposed of separately in permitted landfills authorized and permitted to accept such waste streams.

EPA NEJAC Recommendations

The U. S. Environmental Protection Agency, National Environmental Justice Advisory Council (NEJAC) issued a report on The 2005 Gulf Coast Hurricanes and Vulnerable Populations: Recommendations for Future Disaster Preparedness/Response in August 2006. The report recommended the establishment of guidelines on handling and disposing of contaminated sediments and associated hazardous materials. In addition, the report recommended a process to insure that appropriate planning is in place to identify disposal facilities that can handle waste debris and sediment in an environmentally acceptable manner. These recommendations support the recommendations that have been made herein.

Specific Disposal Sites

In the greater New Orleans area a number of disposal locations have been used for hurricane debris dumping and disposal and have resulted in environmental and human health impacts to vulnerable and environmental justice communities. These locations and their associated inappropriate debris disposal activities have created environmental impacts that deserve individual specific recommendations in order to protect the surrounding environment and reduce the impacts on human health.

Gentilly Landfill -New Orleans East

The Gentilly Landfill was opened in approximately 1960 in the wetlands of eastern New Orleans, off Almonaster Boulevard. It lies directly adjacent to the levees of the Intracoastal Waterway (the same levees that were overtopped during Hurricane Katrina) and except for the area that has been filled with waste, the landfill site is still largely surrounded by wetlands and standing water. The water table, "is at or near the elevation of the natural ground surface." Although the Gentilly dump was ordered closed in 1982, the site continued to accept waste until 1986, by which time it covered approximately 230 acres.

Although the Gentilly Landfill remained in part unclosed and therefore in violation of federal law, in 2002 the City of New Orleans sought to have a permit issued which would allow the Gentilly Landfill to be used as a site to receive construction and demolition debris and wood waste. The facility never met all the requirements for a Type III landfill, and therefore never opened.

On September 29, 2005, following Hurricane Katrina, LADEQ issued a final decision entitled, "Order Authorizing Commencement of Operations," (the, "September 29 Order"), which authorized Gentilly Landfill to allow disposal of hurricane debris. Millions of cubic yards of debris was disposed there post Katrina. As much as 100,000 cubic yards (one hundred million pounds) was disposed in one day, well past the amount the LADEQ now states is the maximum amount that can be safely disposed.

The Louisiana Environmental Action Network sued to require LADEQ to safely dispose of this waste. The case settled with LADEQ agreeing to limit the amount of daily debris entering the facility and to implement more monitoring and safety precautions. In March 2006 FEMA instructed the USACE and Corps contractors to limit the amount of debris they deliver to the Gentilly Landfill for disposal to 5,000 cubic yards per day, primarily out of concern for the integrity of the adjacent levee (experts suggest a one in three probability that the placement of this much debris about one hundred feet from the toe of the levee will undermine the levee itself. See attached report by Dr. Robert Bea of the University of California, Berkeley, October 2006).

Gentilly Landfill Recommendation

The waste contained in the Gentilly Landfill must be isolated from the surrounding wetlands environment to prevent further migration of chemicals and contaminants from the landfill into the surface waters, wetlands and shallow groundwater surrounding the landfill. The isolation system must not negatively impact the integrity of the flood protection levee adjacent to the Gentilly Landfill. The integrity of the isolation system must be monitored and effectiveness demonstrated on an ongoing bases over the long term. A cap must be required to be constructed over the landfill and keyed into the isolation system to prevent surface water and storm water from entering the landfill and contaminated waste water and landfill gases from leaving the landfill and entering the environment. A prohibition on construction on top of the Gentilly Landfill cap any time in the future must be included as institutional controls.

Chef Menteur Landfill - New Orleans East

The Chef Menteur site consists of approximately 100 acres of land that, immediately prior to construction of the landfill, housed, "a complex of open-water impounds created as a result of previous borrow-excavation activities on the Maxent Ridge." In 1991 the city rejected a zoning request to site a landfill across the highway from the site. In 1997 the city rejected another zoning request to place a construction and demolition landfill at the site.

In a particularly compelling letter dated May 19, 2006, the U.S. Department of The Interior, Fish and Wildlife Service (FWS), described the significance of the ecosystem surrounding Chef Menteur: "[T]the coastal wetlands... adjacent to the proposed Chef Menteur Landfill" as "key remaining marsh areas," that provide important habitat for numerous fishes, shellfishes, birds and other species. According to FWS, "[a]pproximately 340 species of birds (including many migratory species) use the [Bayou Sauvage Refuge] throughout the year. The refuge supports at least one wading bird rookery, and roughly 30,000 to 50,000 waterfowl inhabit the refuge's wetlands during the fall, winter, and early spring months." FWS Letter at 1-2. FWS also explained its concerns about the Chef Menteur landfill:

> "Given the scope and nature of the flooding events and the age of many of the buildings to be demolished and deposited in the proposed landfill, we believe that the delivery of materials containing numerous environmental contaminants, such as: lead based paint, asbestos, creosote, arsenic-based wood treatment chemicals, various petroleum products, and a variety of pesticides and household cleaning chemicals would be unavoidable. Placement of such materials in an un-lined landfill, particularly within coastal wetlands, could potentially result in leaching and resultant persistent contamination of ground water, surface water, and adjacent wetland habitats."

Following Hurricane Katrina, Waste Management again began efforts to have the site permitted as an emergency landfill. On February 9, 2006, concurrent with Waste Management's efforts to gain LADEQ's emergency approval of the Chef Menteur site, New Orleans Mayor Ray Nagin signed an Executive Order suspending the Orleans Parish zoning ordinance for the site. See Executive Order CRN-0603.

LADEQ granted Waste Management's request for an emergency authorization on Thursday, April 13, 2006. Aside from the emergency authorization, LADEQ had not taken any action to initiate proceedings to issue a permit for operation of the Chef Menteur landfill. Thus, the emergency approval embodied the only authority under state environmental regulations for the facility to operate. The Chef Menteur landfill operated under this emergency authority until July 13, 2006, when Mayor Nagin announced that he would not extend the emergency suspension of the comprehensive zoning ordinance for Chef Menteur beyond its original six month period of effectiveness, thus allowing the temporary land use approval for the landfill to lapse on August 14, 2006.

The Chef Menteur landfill is hydraulically connected to the ground water and surface water resources in the area of the landfill. The potential for impacting the environment and human health due to Hurricane waste disposal activities in the unlined cell is sufficient basis for requiring removal and off site disposal of all Hurricane debris disposed of in the landfill.

Chef Menteur Landfill Recommendation

The Chef Menteur Landfill disposal cell must be clean closed. The hurricane debris disposed of in the Chef Menteur Landfill cell must be removed and properly disposed of according to its chemical characteristics. After waste removal, the contaminated soils remaining in the disposal cell must be excavated and properly disposed of. The disposal cell must be certified as clean. Monitoring wells must be installed and sampled to evaluate the current and future status of groundwater impacts due to the disposal of hurricane debris waste during 2006. The surface water and water bottom sediments in the area potentially impacted by the disposal of hurricane debris at the Chef Menteur Landfill must be sampled and appropriate actions taken to remediate contamination.

Industrial Pipe Landfill - Oakville, Plaquemines Parish

The Industrial Pipe Construction and Demolition Debris landfill is located off Highway 23 immediately adjacent to the historic African American community of Oakville in Plaquemines Parish. A forested fresh water swamp and the Hero Canal surround the remainder of the site. The C & D landfill began operating before there were promulgated regulations for C & D landfills. The Industrial Pipe facility was granted permission to accept hurricane related construction/demolition debris for disposal in the C & D Landfill and white goods for recycling. The operation of the Industrial Pipe facility has caused negative impacts to the adjacent environmental justice community of Oakville over the operating life of the facility. When the facility began accepting hurricane debris the negative impacts experienced by the adjacent community became extremely severe. The facility has experienced two fires since accepting hurricane debris. One of the fires occurred on March 9, 2006 and burned the wood waste pile and part of the C & D landfill. The fire burned for several weeks and resulted in noxious odors and smoke and the unpermitted discharge of runoff from the fire. The unpermitted discharge caused a fish kill near the Hero Canal. Hurricane debris was dumped in and adjacent to the Oakville community and wind blown debris was dispersed through out the Oakville community.

The debris waste streams disposed of in the Industrial Pipe landfill consist of demolition debris, municipal solid waste, toxic and industrial waste as well as hazardous components. The lack of separation of waste components prior to disposal have resulted in an added toxic burden to the environment and the health of the adjacent community.

Industrial Pipe Landfill - Recommendation

The toxic and hazardous hurricane debris waste disposed of in the Industrial Pipe Landfill must be isolated from the surrounding residential area and wetlands environment to prevent further impacts to public health and to prevent further migration of chemicals and contaminants from the landfill into the surface waters, wetlands and shallow groundwater. The effectiveness of the isolation system must be monitored on an ongoing basis and over the long term. The surface water resources and bottom sediments in the water bodies adjacent to the landfill must be sampled and remediated to address the contaminants originating from the hurricane debris.

The soils in the residential area must be sampled to identify the extend of hurricane debris impacts on the residential area. The residential areas impacted must be remediated.

The C & D landfill must be prohibited from expanding and work to phase out and close the existing landfill. The landfill location in close proximity to the residential area, has and continues to severely impact the health and quality of life of the community members and negatively impact the aquatic and terrestrial environment surrounding the landfill.

Indiscriminate Disposal of Hurricane Debris in the Wetlands along the Almonaster Corridor in New Orleans East.

An area of more than 7,000 acres of wetlands along the Almonaster corridor in New Orleans East have been used to illegally dump hazardous, commercial, and industrial waste, municipal solid waste and construction and demolition debris from hurricanes Katrina and Rita. The Gentilly landfill is also located in this corridor area and is surrounded on three sides by these illegal dumps. The waste dumped at the illegal dump sites have the potential to severely impact the surrounding environment and associated aquatic environments.

Federal agencies (EPA and Corps) have authority over these illegal dumps due to their locations in wetlands and disposal of hazardous waste. Minimal enforcement efforts have resulted in little to no reduction in dumping activities. A number of operators of the illegal dump sites have been referred by Louisiana Department of Environmental Quality to the US Army Corps of Engineers for wetlands violations. The Corps has issued a few cease and desist orders to the operators of the dumps. Dumping continues.

Illegal Dumps in New Orleans - Recommendation

The Corps must take appropriate action to stop disposal in the wetland areas and require restoration to pre project conditions. The EPA must perform site assessment evaluations under CERCLA and require site remediation activities funded by the dump operators, waste haulers and waste generators. The EPA should also determine if the sites qualify for designation as Superfund and address under the agencies Superfund authority.

Supporting Organizations

These comments and recommendations are supported by the following local, regional and national organizations that have been involved in hurricane debris issues since the land fall of Hurricane Katrina in August 2005.

Louisiana Environmental Action Network (LEAN)
Mary Queen of Vietnam Church
Citizens for a Strong New Orleans East (CSNOE)
National Alliance of Vietnamese American Service Agencies
Delta Chapter of the Sierra Club
All Congregations Together
Catholic Charities
Asian Law Caucus
Asian American Justice Center
Korean American Resource and Cultural Center
National CAPACD
Vietnamese American Young Leaders Association of New Orleans

FIGURES

Figure 1: Photo showing Gentilly Landfill, New Orleans East. Almonaster Blvd. to the left and Intracoastal Waterway and levee to the right. The Gentilly Landfill is located adjacent to the Intracoastal Waterway levee system. The waste disposal area to the left, adjacent to Almonaster is one of many illegal dump site in the Almonaster corridor area.

Figure 2: Photo showing hurricane debris being disposed of at the Gentilly Landfill in New Orleans East.

Figure 3: Photo showing close up of hurricane debris being disposed of at the Gentilly Landfill in New Orleans East.

Figure 4: Photo showing Chef Menteur Construction and Demolition Debris Landfill and previously operated municipal solid waste transfer station in New Orleans East. Landfill site surrounded on three sides by open water and wetlands. Chef Menteur Highway in the foreground and railroad in background. Chef Menteur Landfill received hurricane debris from April 2006 to August 2006.

Figure 5: Chef Menteur Construction and Demolition Debris Landfill and previously operated municipal solid waste transfer station in New Orleans East. Hurricane debris can be seen being disposed of in the unlined disposal cell.

Figure 6: Photo showing Industrial Pipe Construction and Demolition Debris Landfill, Oakville, Plaquemines Parish. Industrial Pipe C & D Landfill disposes of hurricane debris in the unlined excavation and recycles white goods. The community of Oakville can be seen to the left, immediately adjacent to the Industrial Pipe Landfill to the right. A playground can be seen in the upper left corner with the graveyard just below the playground. Standing water can be seen (upper right corner) in the unlined pit that is being used to dispose of hurricane debris.

Figure 7: Photo showing Industrial Pipe Construction and Demolition Debris Landfill, Oakville, Plaquemines Parish. Hurricane debris disposal activities as seen from across the fenceline of the community of Oakville.

Figure 8: Photo showing illegal dumps along the Almonaster Corridor of New Orleans East. 7,000 acres of wetlands have been and are being used to illegally dump hazardous, commercial and industrial waste, municipal solid waste and construction and demolition debris. Gentilly Landfill is located in the center of the picture. Almonaster Blvd. is to the left and the Intracoastal Waterway and levee is to the right. The illegal dumps are located to the left, above and below the Gentilly Landfill. The illegal dumps extend along the Almonaster Corridor from the Industrial Canal eastward to Interstate 510. The I-510 bridge is visible in the background.

Figure 9: Photo showing an illegal dump along the Almonaster Corridor of New Orleans East. The Illegal dump site is situated near Gentilly Landfill and the Industrial Canal. Hurricane debris and waste is being dumped into standing water.

Figure 10: Photo showing an illegal dump site just off Almonaster Blvd. in New Orleans East. Hurricane debris and waste is being dumped into a marsh and wetland area. The site is situated between Gentilly Landfill and the I-510 Bridge

Figure 11: Photo showing illegal dump site along the Almonaster Corridor in New Orleans East. Hurricane debris and waste is being dumped into standing water.

Figure 12: Photo showing an illegal dump site along the Almonaster Corridor in New Orleans East. The site is situated near the Old Gentilly Landfill. Hurricane debris and waste is being dumped into standing water. Tires and debris are spread throughout the standing area.

ATTACHMENTS

Attachment 1:

Gentilly Landfill Potential Influences On Reliability Of Adjacent ICWW/ MRGO Flood Protection Levee

by Professor Robert. Bea, Ph.D.

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October 25, 2006

Subject: Gentilly Landfill Potential Influences on Reliability of Adjacent ICWW/MRGO Flood Protection Levee

The Louisiana Department of Environmental Quality, Office of Environmental Services (LDEQ), has prepared a decisional document that provides justification for the continued operation and utilization of the Gentilly Landfill. LDEQ's justification document includes a slope stability study conducted by Soil Testing Engineering, Inc. (STE), which examines the potential impact of the completed landfill upon the performance of the adjacent Inter Coastal Water Way (ICWW) – Mississippi River Gulf Outlet (MRGO) flood protection levee, in place to protect New Orleans East. This review examines the slope stability study and provides preliminary conclusions regarding both the reliability of its conclusions and the risk implications of the proposed landfill on the adjacent ICWW - MRGO flood protection levee.

In addition to the STE report, entitled "Geotechnical Investigation, Gentilly Landfill, Slope Stability Analyses" (STE, 25 July 2006), and this author's knowledge and experience gained from examining the failure of the New Orleans flood protection system in the aftermath of Katrina, this review is based on information previously provided by LDEQ. It is also based on information contained in the NISTAC report prepared for the Federal Emergency Management Agency, entitled "Potential Impact by the Old Gentilly Landfill on the Environment Due to the Placement of the New Type IIII C&D Landfill" (NISTAC, a joint venture of Dewberry & Davis and URS Group, Inc, 14 February 2006).

STE's slope stability analyses focuses on the final projected condition of the proposed landfill and addresses the likelihood that the proposed landfill will significantly degrade the ability of the adjacent ICWW/MRGO flood protection levee to perform its intended functions. STE concludes that the landfill, completed to its permitted height, shows minimum factors of safety (FS) in the range of 1.2 to 1.35. Factor of safety analyses are based on engineering assessments of the expected weight of the fill, the expected strengths of the underlying soils, and the expected failure mode (slope stability).

Two important ideas are inherent in the slope stability study. First, the term "factors of safety" refers to levels of acceptable risk. The nearer to 1 the factors of safety are, the more likely a failure is to occur. If a system has a factor of safety below one, the capacity of the system is already overwhelmed by the demand being placed upon it. At this point, it is said to be in a state of failure. When the capacity of the system exceeds the demand placed upon it, the factors of safety rise, and the probability of failure diminishes.

The New Orleans flood protection system was previously designed to a factor of safety of 1.3 (referred to as, but in reality not quite, Category Three protection), slightly higher than the 1.2 found here. That provided a one in fifty chance per year of failure. As noted in the Independent Levee Investigation Team's report to Congress, of which your writer was a member, that level of acceptable risk was developed in the 1950's to defend sparsely developed agricultural lands. Factors of 2 to 3 or greater are appropriate for important facilities and densely populated areas. Of note, offshore structures and the Dutch flood protection system are built to a much higher factor of safety, a one in ten thousand chance of failure, known as Category Five protection. In any event, permitting the construction of this landfill is inconsistent with the stated goal of a Category Five flood protection system for the City of New Orleans, which includes New Orleans East.

The second important concept is the reliability of the underlying assumptions imbedded in the Gentilly slope stability model. The more assumptions that are contained in a safety analysis, the more likely some assumptions are incorrect, and the more probable a consequent failure becomes. Again, New Orleans has just recently experienced the devastating effect of erroneous assumptions and natural variability in the soil properties and other properties in the failure of the flood protection system. A reliability analysis attempts to quantify the risk inherent in uncertain assumptions that constitute part of the model.

In this case, the reliability analyses would explicitly address the uncertainties that are associated with the engineering assessments and the effects of these uncertainties on the reliability of this important flood protection levee. Based on the information contained in the referenced reports, there have been no analyses performed to determine the potential effects of these uncertainties on the justification for continued operation and utilization of the Gentilly Landfill.

Based on the available information, this author has performed preliminary analyses to characterize and quantify the primary uncertainties (natural, model) associated with the projected landfill 'demands' (loads, stresses imposed on the supporting soils), and the 'capacities' of the underlying soil layers to support the projected demands without excessive displacements, and with the associated analytical models. These analyses have not addressed uncertainties associated with human, organizational, and information developments (Bea, 2006).

Given the range of factors of safety cited, the preliminary analyses indicate total uncertainties (expressed as the logarithm of the standard deviation of the slope stability demand and capacity) of 60% to 70%. These values are based on demand uncertainties (primarily dependent on the long-term effective compacted unit weight of landfill) in the range of 40% to 50%, capacity uncertainties (primarily dependent on effective shear strengths of the affected soils) in the range of 30% to 40%, and analytical model (circular arc slope stability) in the range of 20% to 30%. The analyses have assumed that the analyses that have been performed have been based on 'best estimate' values and that there are no systematic 'biases' that have been introduced into the computed factors of safety.

The resulting probabilities of failure (likelihood that the slopes are 'unstable', deform excessively) are in the range of 25% to 37% (Figure 1). These results can be interpreted as about one chance in three (1/3) that the adjacent flood protection levee will be seriously impaired (slope stability failure) when the proposed landfill is completed (2012).

As noted, these results have been based on the premise that the analyses have been based on 'best estimates'. A primary concern identified in these analyses is that of the effective compacted long-term unit weight of landfill (65 pounds per cubic foot, pcf) and the shear strength attributed to the landfill. Consultation with a landfill stability analysis expert (Dr. Raymond Seed, University of California Berkeley) indicated a value of 90 pcf could be more appropriate; such values have been used previously for similar landfills in California. Additional concerns were expressed for the effects of severe rainfall and moisture accumulation in the landfill in further increases in the unit weight. If such an effective unit weight was appropriate for these analyses, this would indicate a significant reduction in the previously cited factors of safety.

Another major element for concern is that of the condition of the adjacent flood protection levee when subjected to the effects developed by intense hurricane surge and waves. The ICWW flood protection levee at this very location overtopped and was subject to severe pressure during Katrina. The lateral force of another hurricane surge, pushing against the levee above ground, coupled with the lateral force associated with the weight of the landfill, pushing in the opposite direction below ground, raise very serious concerns about a shearing effect upon the levee itself. A sheer plane could develop could concentrate in the low strength soil layers that underlie the landfill and the levee (e.g. the very soft clay layer found approximately 20 ft. below the surface). These effects have not been included in the analyses performed to date nor in these results.

Given the potential ramifications of significant degradation in the ability of the adjacent flood control levees to withstand storm surges without breaching combined with the potential damaging and life-threatening effects of significant flooding from such breaches in such conditions, it is clear that probabilities of failure in the range of 25% to 37% are excessive and should not be accepted. We at least should give the people of New Orleans the same level of safety we give our oil infrastructure.

This review of the analyses that have been performed indicates that there are additional conditions (e.g. water saturated fill, storm surge conditions acting on flood protection levee), parameters (e.g. soil displacements), and states (e.g. soils affected by fill leachate) that should be further analyzed using the best available proven technology.

Initial considerations and estimates indicate that such analyses will provide additional information that will indicate the probabilities of failure cited above have been underestimated and that these probabilities of failure are even more unacceptable than indicated above.

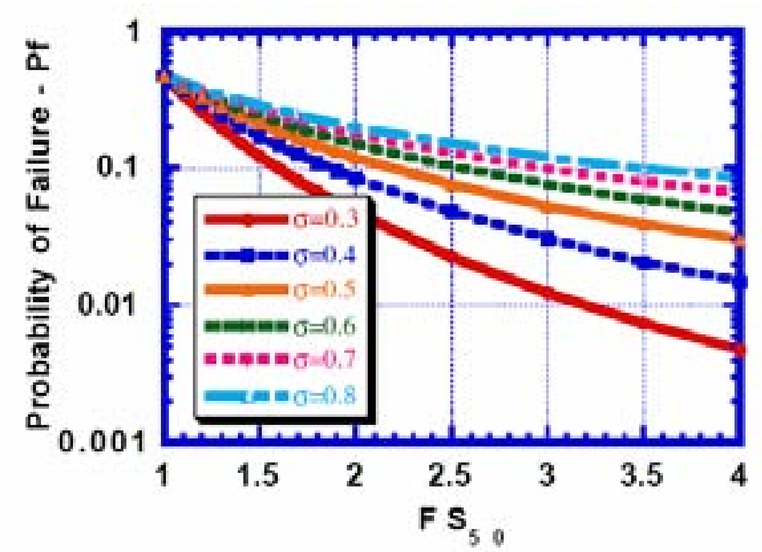

Figure 1: Probabilities of failure as functions of the Factor of Safety (FS50) and total uncertainties (σ)

Explanation of Figure 1. The probability of failure (Pf) is the probability or likelihood that the demand (loads, stresses) imposed by the proposed landfill (final condition) will equal or exceed the capacity of the landfill, underlying and adjacent soils to resist the demand without failing (excessive displacements). Failure is determined as the condition when the imposed demand exceeds the available capacity. The distributions of the slope stability demand and capacity have been evaluated to be well characterized with Lognormal distributions. The factor of safety (FS50) is expressed as the ratio of the median (50-th percentile) demand to the median capacity (this presumes that there are no systematic 'biases' present in the referenced analyses. The factor of safety has been determined from the geotechnical stability analyses. The total uncertainty in demand and capacity (σ) is determined from the standard deviations of the logarithms of the demand (σD) and capacity (σC, σ2 = σD 2+σC 2). The uncertainties in demand and capacity have been determined from the available data on soil strengths, unit weights of the fill, and accuracy of the analytical model employed to determine the factor of safety.

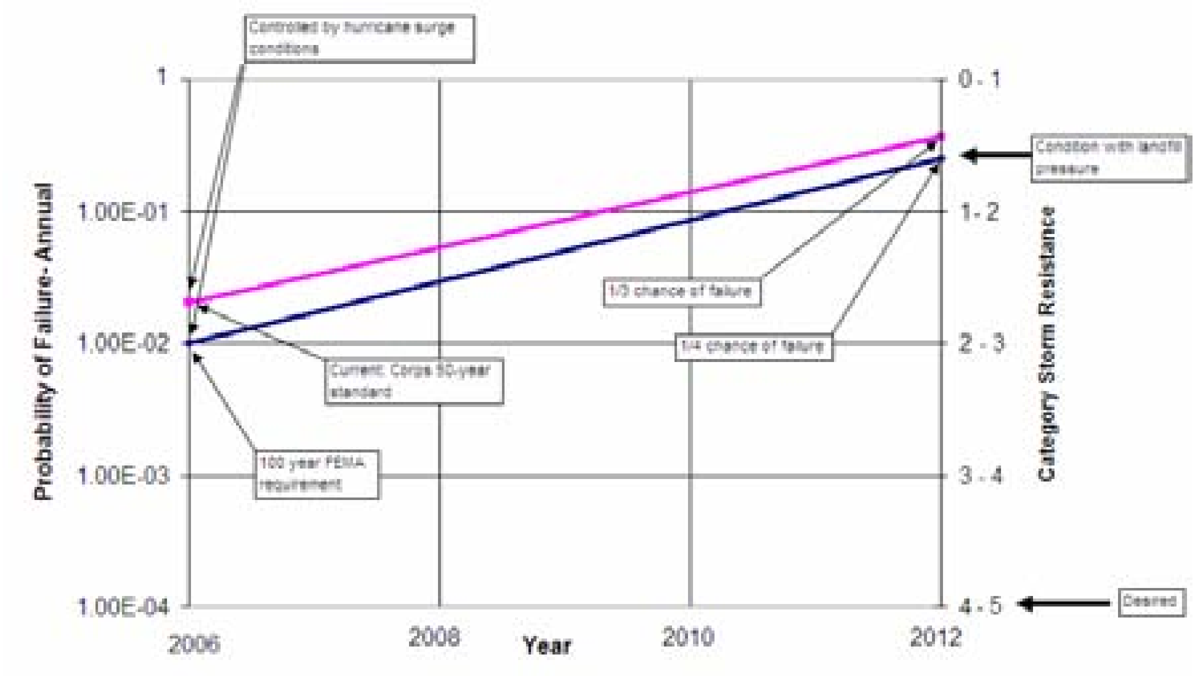

Figure 2: Probabilities of failure and Category Storm Resistance as functions of time

Reference (copy attached)

Bea, R. G. (2006). "Reliability and Human Factors in Geotechnical Engineering," Journal of Geotechnical and Geoenviromental Engineering, American Society of Civil Engineers, Vol. 32, No. 5, pp 631-643.

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Attachment 2:

Anticipating Environmental Problems Facing Hurricane Debris Landfills In New Orleans East

By John H. Pardue, Ph.D., P.E.

Anticipating environmental problems facing hurricane debris landfills in New Orleans East

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1.0 Introduction

The large debris field created by Hurricanes Katrina and Rita has led to a series of decisions by regulatory agencies regarding disposal of hurricane debris. Two of these debris landfills have been sited in eastern New Orleans, the Old Gentilly landfill and the Chef Menteur landfill which has been closed after several months of operation. Central to the debate over the disposal of hurricane debris is the decision to treat hurricane debris within the same regulatory framework as construction and demolition (C&D) wastes, allowing disposal in unlined landfills. An analysis of current debris disposal practices and current research on C&D landfill issues strongly suggests that environmental impacts will result from these landfills in New Orleans East. Three potential environmental problems will be discussed here. the presence of household hazardous waste in the hurricane debris stream, the potential for emission of toxic reduced sulfur gases from these facilities and the potential for leaching of arsenic from treated wood in these landfills. This white paper will discuss the rationale behind these emerging problems and propose recommendations to help mitigate the expected effects.

2.0 Household Hazardous Waste

2.1. **Emerging problem:** The presence of household hazardous waste (HHW) in the hurricane debris stream is widely acknowledged by all parties. As residents and business owners dispose of building contents, a significant amount of hazardous waste is brought to the curb. Diversion of the HHW stream is attempted by the Louisiana Department of Environmental Quality (LDEQ), the U.S. Environmental Protection Agency (EPA) and U.S Army Corps of Engineers (USCOE). As we have observed it, the process consists of these elements. First, the surface of debris piles is visually inspected curbside and the HHW removed. During these inspections, HHW within piles is not recovered unless it is visible, for safety reasons. Once loaded onto trucks, an additional inspection occurs of the top surface of the load from the towers at the landfill site. Again, only the "visible" HHW on top of the trucks has the ability to be seen from the towers. Finally, spotters are used, under some circumstances, to remove HHW from the face at the landfill, itself The efficiency of the diversion process is unknown but evidence from the field demonstrates the difficulty in diverting wastes using these procedures.

First, we wanted to understand the extent of HHW in the debris piles prior to pickup. Observations of HHW in debris piles in St. Bernard Parish were made on May 22, 2006 For these observations, the piles were disturbed and sources of HHW noted (Table 1). Only when the piles were considerably disturbed did the majority of these HHW sources become apparent. Materials included a variety of liquids, aerosol cans, paints, and batteries. All of these were expected from knowledge of HHW sources in typical residences and businesses.

These observations simply confirm that these HHW sources exist at the beginning of the process of debris disposal.

The end of the debris collection process is deposition of the material in the landfill, itself. In an inspection of the surface at Chef Menteur on May 15, 2006 a variety of HHW-containing materials were also observed including batteries (AA, C and D cells), electronic waste, and numerous unlabelled 1 to 5 gallon containers which we were not allowed to inspect or sample. Most significant was an apparent full can (8 oz.) of photographic developing fluid containing solvents (Figure 1). These observations confirm the inefficiency of the HHW process even though they were performed over only a very short visit to the Chef Menteur facility with great restrictions to movement and activity.

At Old Gentilly, LDEQ inspectors, themselves, documented the presence of electronic waste, tires, batteries, paint cans and other HHW in their inspections in the months following Katrina. Photographic evidence at Old Gentilly clearly shows "visible" HHW but like the inspections of the debris loads themselves, visible inspection reveals only a small fraction of what is present in the landfill.

Based on these observations, it is apparent that HHW has entered both the Chef Menteur and Old Gentilly landfills. Observations also suggest routes of exposure of the HHW sources to humans and the environment. Water was seeping beneath the face of the landfill during our visit to Chef Menteur. This liquid, either from rainfall or materials disposed in the landfill, is by definition "leachate", or "water that has come in contact with waste". As the HHW sources described earlier come under the load of the landfill, containers will break, become degraded and leach into this water. This leachate has the potential to be in direct contact with surface water since both landfills are directly adjacent to wetlands. Surface water features at the Old Gentilly landfill likely facilitate the contact of leachate with surface water. During its period of operation, leachate at Chef Menteur was managed by pumping to a lagoon, followed by discharge to the adjacent wetland. Management of leachate at Old Gentilly is unknown.

A secondary route of exposure will be through groundwater. Both landfills are unlined and are not equipped with leachate collection technologies found in Class I landfills. Leachate will migrate through more permeable soil materials beneath the landfills and come in contact with groundwater. The Old Gentilly site is complicated by the presence of municipal waste leachate from previous disposal activities. The history of unlined landfills in the U.S. is clear and does not bear repeating here.

Table 1. **Observation in debris piles stationed along streets May 22, 2006**

- Alkaline and zinc batteries (AA, AAA, C, D, 9V)
- Insulation (possibly containing asbestos)
- E waste (televisions, computers, microwaves, stereos, scanners, monitors and copiers)
- Numerous unidentifiable containers (with residues)
- Explosives (shotgun shells)
- Fire extinguishers
- Possible medical waste (unlabeled pills, sharps)
- Numerous 20 pound propane tanks
- Extensive carpet and carpet foam
- Extensive drywall
- Extensive lumber (treated and untreated)
- WD-40 and other aerosol cans
- Soaps and surfactants, lye and acid cleaners
- Paints and thinners, varnish, turpentine, and furniture stripper
- Automobile products (gasoline cans, brake fluid, transmission fluid, antifreeze, and motor oil)
- Yard equipment (weed eaters, lawnmowers and unlabeled garden sprayers)
- Herbicides, pesticides, and insecticides
- Fiberglass patching equipment
- Glues and epoxies
- Grease tubes
- Drain cleaners, oven cleaners, glass cleaners, and furniture polish
- Moth balls
- Flea and tick products
- Bug repellent
- Fertilizers
- Pool chemicals
- Bleach, ammonia, and laundry detergent
- Tires
- Fluorescent light bulbs

Figure 1. Example observations from the Chef Menteur landfill. A. Septic stormwater/leachate seeping beneath the landfill face, B. Batteries on the landfill surface, and C. Can of spray developing fluid

Unfortunately, these observations do not allow calculations of the potential for effects of HHW on the quality of surface or groundwater impacted by these releases. "Scale-up" calculations require more formal, statistically valid, waste characterization studies. These studies do not exist from either the USCOE or LDEQ despite the relative ease in performing them. They would inform both the facility operator and regulatory agencies what type of HHW is making it through the screening process, allowing for scale-up of potential impacts. At a minimum, they would inform regulators on what types of analytical methods and technologies should be applied to leachate management.

2.2 Recommendations: Because of the potential for HHW contamination of surface and groundwater, a monitoring and mitigation program should be established. This would include:

- Regulatory officials should immediately establish the efficiency of their HHW collection processes by performing formal, statistically valid, waste characterization studies. These studies should characterize the types and amount of HHW entering debris landfills in enough detail to understand specifically what categories, mass and characteristics of material are making it through the screening process.

- An important element of that study should include the direct analysis of leachate from both landfills. Only by direct analysis of leachate can the community assess what HHW sources have entered the landfill and have the potential to contaminate the surrounding groundwater and surface water.

- Once data are obtained, refinements to the HHW diversion process, groundwater monitoring plan or discharge monitoring permit can be performed if needed, to protect the community. Waiting blindly for environmental impacts years into the future is a lesson of the past that should not be repeated here.

- Volatile organic compounds, semivolatile organic compounds and heavy metals should be monitored in contaminated stormwater leaving these facilities and in the groundwater beneath these facilities. At present, these are not routinely measured, even though it is clear that HHW sources containing these priority pollutants are entering the landfill.

- Landfills should meet all applicable standards for volatile and semivolatile organics and metals discharge applied to other facilities. This may require treatment of contaminated stormwater onsite or offsite.

- Dilution or flow augmentation should not be used as a "treatment" approach for leachate or stormwater. Chef Menteur discharges contaminated storm water in a lagoon filled with rainwater. This clearly provides dilution of the contaminated stormwater or leachate with a huge volume of cleaner water.

3.0 Wallboard and potential for H_2S generation

3.1 **Emerging problem:** One of the characteristic wastes of the Katrina debris stream is flood-damaged "sheetrock" or wallboard. Large volumes of wallboard were observed on the landfill face at Chef Menteur on 5/22/2006. This is not surprising due to the large percentage of wallboard in C&D waste and the widespread gutting of homes in the region. Normally, wallboard represents between 5 and 15% of the total C&D waste stream in the US, a total of 14 million tons per year (Sandler, 2003). A larger percentage of wallboard may be present in hurricane debris since interior gutting of homes represents a larger proportion of debris, particularly in the early phases of recovery. To that end, the Hurricane Katrina and Rita events may represent one of the largest volumes of gypsum wallboard being disposed of in landfills in the shortest period of time. Because the Old Gentilly landfill has handled such a large proportion of the house gutting debris, most of the wallboard has been disposed here.

This component of the waste stream poses a particular concern. Wallboard is composed of a gypsum core ($CaSO_4 \cdot 2H_2O$) covered with paper. Within C&D landfills, the wallboard comes into contact with rainwater which solubilizes the sulfate present in the gypsum core. Bacteria, in the presence of a carbon source (i.e., paper, glue, etc.) will generate reduced sulfur gases such as hydrogen sulfide (H_2S) via an anaerobic conversion process. These gases not only cause odors but, at higher concentrations, are toxic and linked with serious health issues from chronic and acute exposure (Table 2). The potential for hydrogen sulfide production is a known problem in the C&D landfill industry (O'Connell, 2005; Lee et al., 2006) and is driving an array of changes in the management of C&D waste. The presence of these gases is not only significant as a "nuisance" for nearby residents. In 2003, the ATSDR released a urgent health advisory for the area around one C&D landfill in Warren Township, Ohio (http://atsdr1.atsdr.cdc.gov:8080/NEWS/warrenoh120803.html). At this location, concentrations of H_2S were high enough to cause immediate human health concerns. Ambient air concentrations explained a number of health problems the residences were

Table 2. Current hydrogen sulfide standards

Concentration, ppb	Exposure period	Standard	Agency
2	Lifetime	USEPA RfC[1]	USEPA
20	14-365 days	ATSDR Intermediate MRL[2]	ATSDR
100	1 hour	AIHA ERPG-1[3]	AIHA
200	14 days	ATSDR Acute MRL[4]	ATSDR
10,000	10 minutes	NIOSH 10 minute ceiling[5]	NIOSH
30,000	1 hour	AIHA ERPG-2[6]	AIHA

[1] US Environmental Protection Agency Reference Concentration

[2] Agency for Toxic Substances and Disease Registry (ATSDR) Intermediate minimal risk level (protective of public health, even sensitive populations)

[3] American Industrial Hygiene Association Emergency Response Planning Guideline (Level that all individuals could be exposed for up to 1 hour without experiencing or developing effects other than mild transient health effects or without perceiving a clearly defined objectionable odor)

[4] Agency for Toxic Substances and Disease Registry (ATSDR) acute minimal risk level (protective of public health, even sensitive populations)

[5] National institute for Occupational Safety ad Health (NIOSH) recommended exposure limit

[6] American Industrial Hygiene Association Emergency Response Planning Guideline (Level that all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action)

experiencing. This landfill was closed and remedial costs of 3-4 millions dollars were incurred to make the area safe again around the facility (details on EPA's removal response can be found at http://www.epaosc.net/site_profile.asp?site_id=1622). Odors exist at a number of C&D landfills from reduced sulfur gases and numerous states are considering rule making that would divert wallboard from these sites.

At the both the Old Gentilly and Chef Menteur site, conditions are ideal for generation of these gases. High volumes of gypsum wallboard are present and rainfall in the area exceeds 60 inches per year. Much of the wallboard has been broken into smaller pieces through transport and demolition activities. This "dusting" of the wallboard increases its surface area and, therefore, its vulnerability to microbial attack. A wide variety of carbon sources are in the landfill including the paper facing of the wallboard itself and other components of the Katrina debris stream (cardboard, paper, vegetation, etc.). Sulfate-reducing bacteria are ubiquitous and high temperatures in the region will also encourage more rapid bacterial growth and gas generation. It is hard to imagine more ideal conditions for H_2S generation than the hurricane debris landfills in New Orleans East.

Over time, both the Chef Menteur and Old Gentilly have a strong potential to become significant H_2S sources in the community. The time frame of the problem is difficult to predict but it may present itself quicker than other landfills due to the rapid disposal rate at these locations. At Old Gentilly, H_2S is already present at high concentrations (maximum of 200 ppm[1]) in landfill gas from the prior disposal of municipal waste at this location. Siting these landfills in the same area of town of course can exacerbate the problem depending on wind speed and direction. Installing and operating H_2S recovery systems is extremely costly and may not be technically feasible at these landfills after they have been filled.

3.2 **Recommendations**: Because of the great potential for H_2S generation from hurricane debris, a monitoring and mitigation program should be initiated. A program should have the following elements:

- Immediately explore methods and procedures to divert wallboard from the current debris landfills. This should include reexamining segregation opportunities and diversion of large wallboard loads to landfills with gas collection systems.
- Monitoring of H_2S and other reduced sulfur gases in the communities adjacent to landfills in New Orleans East

[1] H_2S concentration at VP-3, maximum concentration at site, EE&G Restoration, 2005

- Educating residents and landfill workers about the health effects of H_2S
- Investigate the effectiveness of organic cover materials (i.e., compost) on H_2S emissions from hurricane debris landfills. Organic cover has the potential to oxidize reduced sulfur gases, much like a "biofilter"
- During the rebuilding phase, establish a significant recycling program for wallboard scrap, diverting further gypsum based materials from C&D landfills

3.0 CCA treated lumber

3.1 **Emerging problem:** An emerging issue within the landfill C&D industry is the leaching of arsenic and chromate from wood treated with chromated copper arsenate (CCA) as a preservative (Solo-Gabrielle et al., 2005; Khan et al., 2006a, 2006b). Recent studies have identified potential leaching rates of arsenic from treated lumber in C&D landfills that are very worrisome (Khan et al., 2006b) and a number of C&D landfills in Florida have come out of compliance with respect to arsenic in groundwater beneath these unlined facilities. This has led to significant efforts to divert CCA wood from C&D facilities in Florida. Many facilities refuse large loads of treated wood and instead send them to Class 1 municipal landfills for disposal. Despite the impending residential ban on CCA-treated lumber, there is significant concern that arsenic may be a legacy issue for C&D landfills and the environment around them. The average leachate concentration for arsenic in Ohio C&D landfills, for example, is 206 µg/L,well above applicable standards (Harris, D., 2005).

Treated lumber appears to be a significant component of Hurricane Karina debris headed to landfills in New Orleans East. Decks, fences and other exterior wooden structures would be primarily treated lumber. Post-Katrina, the definition of C&D debris was changed to include treated and painted lumber, so no regulatory restriction exists currently. As these materials are placed within the landfill, rainfall events will leach arsenic from the treated lumber which can enter surface water via the contaminated stormwater discharge permit or enter groundwater through the base of the landfill. To my knowledge, no attempts are being made to divert treated lumber from C&D type landfills for hurricane debris. Therefore, the leaching issue for arsenic is now an issue facing New Orleans East, requiring a monitoring, and, if necessary, mitigation strategy for the area.

3.2 **Recommendations**: Because of the potential for arsenic concentrations in hurricane debris leachate, a monitoring and mitigation program should be initiated:

- During the ongoing rebuilding stage, treated lumber should be identified in a sorting/staging facility and diverted to a municipal landfill
- Arsenic should be monitored in contaminated stormwater and groundwater at C&D facilities handling hurricane debris. At present, it is not listed among the analytes on the standard C&D permit issued to the facilities
- Landfills should meet all applicable standards for arsenic discharge applied to other facilities. This may require treatment of contaminated stormwater offsite.
- Dilution or flow augmentation should not be used as a "treatment" approach for leachate or stormwater

4.0 Summary and Overall Recommendations:

This paper has identified three important environmental issues facing the landfills (and communities) of New Orleans East: the deposition of household hazardous waste in unlined landfills, the hydrogen sulfide gas problem from deposition of gypsum wallboard and the leaching of arsenic from treated lumber. All of these issues have the potential to create legacy sites for the city of New Orleans, State of Louisiana, and the nation much like the Agriculture Street Landfill, a CERCLA ("Superfund") site that resulted, at least partially, from depositing hurricane debris from Hurricane Betsy, a storm which impacted New Orleans in 1965 The potential environmental problems described in this white paper are not new and have been widely discussed and debated within the C&D industry and scientific community over the past 20 years.

Summary recommendations for these landfills are given below:

i. ***Continually evaluate opportunities to stage, sort, divert and recycle.*** The argument that staging, sorting and recycling would delay reconstruction has never been supported with an engineering analysis that has been released to the public. A major opportunity to recycle and divert materials is being missed. The appropriate agencies should continue to examine efforts to reduce the flow of debris to landfills such as those described here.

ii. ***DEQ, EPA and the US Army Corps of Engineers should perform waste characterization studies that inform both current and future debris disposal plans.*** An important opportunity to quantify the components of hurricane debris is being missed. Waste characterization studies are relatively easy to perform and require diverting, classifying, identifying and weighing a statistically derived subsample of materials in the debris stream at various stages of recovery. From the hazardous material perspective, it would allow regulators and stakeholders to understand, from a quantitative perspective, what is making its way into the landfill and the neighborhood. Clearly, studies would identify opportunities for better efficiencies in diverting hazardous materials, markets for recyclables and if nothing else, how to do this better, cheaper and more protective the next time around.

iii. ***Sample, sample, sample.*** Analysis to understand the exposure pathways for residents and the environment from landfill toxics should be conducted regularly with input from the community and their experts. The initial attempt at this at Chef Menteur (discussed at http://www.deq.louisiana.gov/portal/) was not a serious effort to answer the questions posed in this report. For example, water was sampled at the detention pond only, not the leachate, itself. At this point leachate would have been seriously diluted with rainwater. Air samples for H_2S had a detection limit over 400 ppb, well above many of the health standards cited above. A more serious effort is needed to answer these questions than the one attempted previously.

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Attachment 3:

Quantities Of Arsenic-Treated Wood In Demolition Debris Generated By Hurricane Katrina

by Brajesh Dubey, Helena M. Solo-Gabriele and Timothy G. Townsend

Quantities of Arsenic-Treated Wood in Demolition Debris Generated by Hurricane Katrina

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The disaster debris from Hurricane Katrina is one of the largest in terms of volume and economic loss in American history. One of the major components of the demolition debris is wood waste of which a significant proportion is treated with preservatives, including preservatives containing arsenic. As a result of the large scale destruction of treated wood structures such as electrical poles, fences, decks, and homes a considerable amount of treated wood and consequently arsenic will be disposed as disaster debris. In this study an effort was made to estimate the quantity of arsenic disposed through demolition debris generated in the Louisiana and Mississippi area through Hurricane Katrina. Of the 72 million cubic meters of disaster debris generated, roughly 12 million cubic meters were in the form of construction and demolition wood resulting in an estimated 1740 metric tons of arsenic disposed. Management of disaster debris should consider the relatively large quantities of arsenic associated with pressure-treated wood.

Introduction

The total disaster debris produced from Hurricane Katrina in the two hardest hit states, Mississippi and Louisiana, was estimated at 72 million cubic meters (*1*, *2*). Disaster debris is composed primarily of construction and demolition (C&D) debris (50%) and vegetative wood waste (30%) (*3*). C&D debris consists of materials used in construction including concrete, roofing materials, drywall, and wood. Vegetative wood waste consists primarily of shrubs, tree branches, and tree trunks. Because of its nature, vegetative waste does not contain wood preservatives. However, wood used for construction is frequently treated to protect the wood from fungi and termite attack. The most common wood treatment preservative manufactured in the United States through 2003 is chromated copper arsenate (CCA) (*4*). Since 2003, non-arsenical copper-based wood preservatives, such as alkaline copper quat (ACQ) and copper boron azole (CBA), have been primarily used for the residential market. The typical concentrations of arsenic, chromium, and copper in CCA-treated wood used for residential applications are 1800−2800 mg/kg, 1900−3100 mg/kg, and 1200−1800 mg/kg, respectively (*5*). Typical concentrations of copper in ACQ and CBA treated wood are 3500−4500 mg/kg and 2500−3500 mg/kg, respectively (*5*). As a result of these high levels of metals, the C&D portion of disaster debris can be potentially contaminated with metals. Among the metals contained in wood preservatives, arsenic is of primary concern because of its high human toxicity (*6*).

CCA-treated wood has been commonly observed in C&D waste, as documented through studies conducted in Florida (*7*−*9*). Within the wood waste component of C&D, the fraction of CCA-treated wood has been observed to vary from 8 to 22%. Research evaluating technologies for separating treated wood (particularly CCA) from other wood products has been conducted in an effort to remove arsenic contamination due to inadvertent inclusion of CCA-treated wood within mixed C&D debris at recycling facilities. Technologies available for rapid identification and quantification include near-infrared (NIR) spectroscopy, laser-induced breakdown spectroscopy (LIBS), and X-ray fluorescence spectroscopy (XRF) (*8*, *10*, *11*). Recently, handheld XRF units have been used for research to document their utility to further augment sorting and quantification of metals within treated wood (*9*). Such technology, because of portability and provision of rapid results, is ideal for evaluating the potential contamination of disaster debris with wood based preservatives.

The objectives of the present study were to evaluate wood waste generated by hurricane debris for the presence of arsenical-based preservatives (i.e., CCA) and to use these results to estimate the potential extent of arsenic associated with disaster debris. Handheld XRF units were used for this evaluation. Results from the study are useful for establishing policy concerning the management of wood waste after major disasters.

Methods and Materials

Site Selection for Study. Measurements were taken during March 2006 within disaster debris from the New Orleans area. The wood waste portion of the disaster debris was evaluated at seven different sites (Figure 1). Sites included areas with extreme damage characterized by complete collapses of homes and areas where the damage was primarily due to flooding. Among the area with major damage, four sites were selected: two each at Upper Ninth Ward (Sites W1 and W2) and Lower Ninth Ward (Sites W3 and W4). The other three sites (Sites W5 through W7) were located in the inner area of the city where damage was mostly due to flooding.

Measurement of Chemical Treatment within Wood Waste. A total of 225 dimensional lumbers were evaluated using an XRF-analyzer (Innov-X model α-2000S) with at least 24 dimensional lumbers evaluated at each site. The number of lumbers included in the study from a particular site was based upon the apparent volume of wood pile at that particular location, with larger piles resulting in a greater number of analyses. The selection of dimensional lumber for analysis was conducted in a uniform manner with wood pieces tested from different parts of the wood waste pile. Conversion of the XRF readings to As concentrations was based upon a calibration curve between the XRF results and As measurements using traditional atomic absorption analysis for the particular instrument used in this study (*12*; see Supporting Information for more details.)

Calculation of Amount of Arsenic Associated with Treated Wood Waste. The quantity of arsenic associated with demolition debris was computed as the product of the total amount of wood waste (33% of demolition debris (*3*)), the

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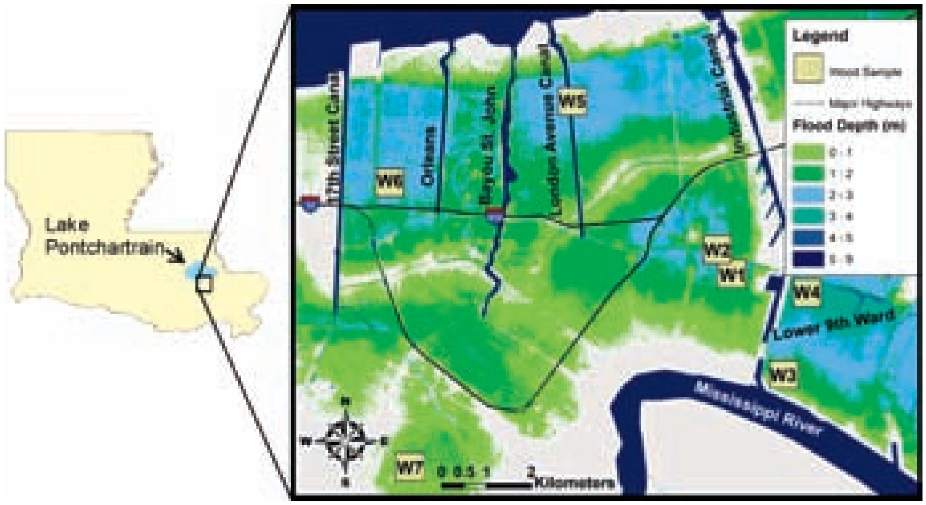

FIGURE 1. Sampling locations W1 through W7 where treated wood samples were evaluated using the XRF unit. The image was developed using the GPS coordinate recorded during the sampling event. Background image showing inundation depths was provided by Dean Whitman of Florida International University and Tim Dixon of the University of Miami.

TABLE 1. Statistics for Treated Wood Samples from Each Site (From a Total of 7 Sites) Including Range of Arsenic Concentrations Observed

sampling sites	number of lumbers tested	number positive for arsenic treatment	% CCA by number of lumbers tested positive for arsenic	range of arsenic concentrations (mg/kg)	number positive for copper only treatments	% other Cu treated wood by numbers of lumbers tested positive for copper only	number negative for arsenic and copper treatment
1	24	4	17	778–2170	5	21	15
2	28	10	36	199–3370	4	14	14
3	26	6	23	118–1430	0	0	20
4	54	10	18	890–4900	3	6	41
5	40	14	35	75–3500	10	25	16
6	27	1	4	248	1	4	25
7	26	7	27	284–2560	0	0	19
total	225	52	23.1	75–4900	23	10.2	150

fraction of wood samples that tested positive for arsenic treatment, and the geometric mean arsenic concentration. The geometric mean of the arsenic concentration was used because the data were found to be log-normal distributed (see Figure 3).

Results and Discussion

Statistics of Treated Wood Sample from Each Site. Overall, 52 dimensional lumbers were determined to have been treated with an arsenical preservative among the 225 samples evaluated at the seven sites (Table 1) or roughly 23% on a piece-by-piece basis. For individual sites the fraction that was treated with CCA varied from 4% for Site 6 to 36% for Site 2. This observation correlated with previous research conducted in Florida (8–22% CCA in C&D waste; *7–9*). The As concentration in the samples testing positive for arsenic ranged from 75 to 4900 mg/kg. The large range of variation of the As concentration from different treated wood lumber could be attributed to several factors including the initial degree of treatment for that particular piece, impregnation, fixation procedure, the extent of weathering, and the natural properties of the wood which impact chemical retention. Furthermore, the average concentration from each site was variable (Figure 2) ranging from 248 mg/kg for Site 6 to 2690 mg/kg for Site 4. Of note was that a significant proportion of the wood evaluated contained non-arsenical copper-based preservatives (10.2%) and this was noted in the waste piles characterized by newer construction.

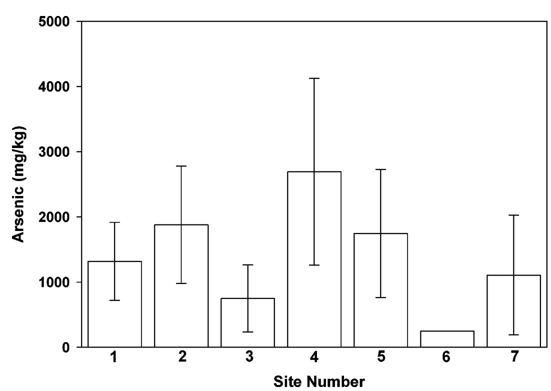

FIGURE 2. Average arsenic concentrations from the samples tested as CCA at seven sites (The error bar represents the standard deviation for the sample set for that particular site. For site-6, only one sample tested positive for CCA, hence no error bar is shown for this site).

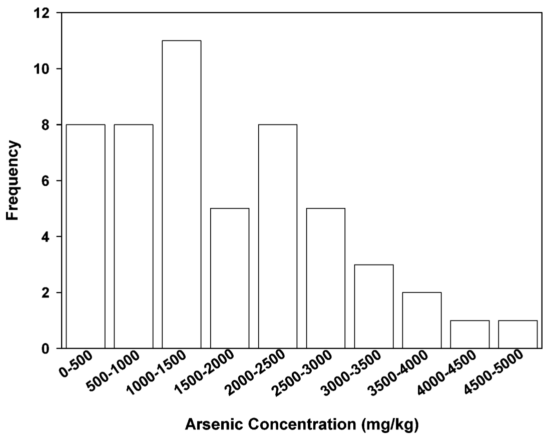

FIGURE 3. Frequency plot for arsenic concentration ranges in lumbers testing positive for arsenic treatment at the seven sites evaluated.

Amount of Arsenic in Disaster Debris. The frequency distribution of As concentrations from the sample set was found to be log-normally distributed (Figure 3). The geometric mean of the arsenic concentration in the treated wood samples was found to be 1240 mg/kg. With 50% of the disaster debris as construction and demolition waste of which 33% is wood waste and 23% of the wood waste being CCA-treated wood as per the field data, the total amount of As disposed in the environment in the form of disaster debris in the two states of Louisiana and Mississippi is estimated to be 1740 metric tons. In order to better visualize the magnitude, this quantity was scaled against soil and water relative to the surface area of the Mississippi and Louisiana states and the volume of water of Lake Pontchartrain, respectively. Using these scaling computations, the 1740 metric tons of arsenic was computed to be capable of increasing the concentration of a soil volume equivalent to the upper 1 in. of these two states' land by almost 0.17 mg/kg; it is capable of increasing the concentration of a volume of water equivalent to Lake Pontchartrain by 280 μg/L (28 times the drinking water limit of 10 μg/L).

Implication for Wood Waste Management after Disaster. Construction and demolition waste from the Hurricane Katrina disaster is currently being disposed in unlined C&D landfills. This disposal practice should be re-evaluated with respect to the potential for leaching of arsenic from pressure-treated wood (*13−16*) and in light of studies which suggest that such leaching can potentially impact groundwater quality (*17−18*). The need to consider the potential for arsenic leaching from disposed treated wood is further emphasized by the recent reduction of the drinking water limit from 50 μg/L to 10 μg/L (*19*). Although the focus of the current study was on quantifying arsenic, of note is that copper and chromium contained in pressure-treated wood can also be of concern due to the toxicity of copper to aquatic organisms (*20−22*) and the potential for chromium conversion to a more toxic form as Cr (VI) under certain environmental conditions (*23*). Future studies should focus on quantifying the Cr and Cu contributions in addition to As.

Given the large quantities of treated wood disposed during natural disasters, such as in the aftermath of Hurricane Katrina, disaster debris management plans should encourage communities to segregate treated wood for better management of wood waste as a whole. Although measuring every piece of wood is not practical in large scale disasters such as those which occurred in 2005 in the New Orleans area and Gulf Coast Region, those responsible for disaster debris management should consider the potential for arsenic contamination from treated wood as they make decisions concerning ultimate disposal.

Acknowledgments

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Supporting Information Available

Calculation details and debris photographs. This material is available free of charge via the Internet at http://pubs.acs.org.

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