

CRS Report for Congress

Received through the CRS Web

Cleanup after Hurricane Katrina: Environmental Considerations

October 13, 2005

Robert Esworthy, Linda Jo Schierow,
Claudia Copeland, and Linda Luther
Resources, Science, and Industry Division

Cleanup after Hurricane Katrina: Environmental Considerations

Summary

Local, state, and federal responders face numerous cleanup challenges associated with Hurricane Katrina. In Mississippi and Alabama, the focus is on restoring infrastructure and managing debris and waste. In New Orleans, where most damage was due to floodwaters, the immediate tasks have been “unwatering,” monitoring, and evaluation of potential risks from contaminated water, sediment, and air. As floodwaters receded, and debris management and infrastructure repair began, monitoring and analysis has continued to inform decisions about whether neighborhoods would be safe for returning residents. Finally, local authorities worked to determine how and where disaster-related wastes would be gathered, separated, and disposed. This report provides an overview of the immediate and intermediate cleanup tasks and the federal role supporting these tasks.

State, county, and local municipalities have jurisdiction with regard to cleanup after any natural catastrophe. However, because, at the governors’ requests, the President issued a major disaster declaration under the Robert T. Stafford Disaster Relief and Emergency Assistance Act in response to Hurricane Katrina, federal agencies have been broadly authorized to provide assistance. Federal cleanup assistance efforts are being coordinated by the Army Corps of Engineers (the Corps), the U.S. Coast Guard, and the Environmental Protection Agency (EPA). The Corps is coordinating non-hazardous debris removal, assessment and repair of water and wastewater systems, and unwatering of New Orleans, in conjunction with other emergency response activities, such as filling levee breaches. EPA and the U.S. Coast Guard have primary responsibility for assessing and managing releases of oil and other hazardous substances. Many other federal agencies are also contributing various expertise and assistance to the cleanup effort.

In New Orleans, Katrina-generated waste was expected to be highly contaminated, making the potential for toxic chemical exposure of returning residents highly uncertain. Unwatering New Orleans was the critical first step in the public health response, because tests of the floodwaters showed high concentrations of fecal bacteria. Sampling results of residue sediments and air, whenever the floodwaters receded, have indicated some sediment contamination with bacteria and fuel oils, and possible health risks from contact with deposited sediment or with contaminants in dust as the sediments dry. Mold is also an issue of concern.

Throughout the Katrina-affected region, drinking water and sewage treatment plants were damaged and must be restored. Many are operating again now that electric power has been restored, but some drinking water facilities have issued notices advising that water be boiled prior to use. The status of many facilities is unclear (especially small systems). Disposal of debris and waste continues to be a major concern. The affected states have stated that they would prefer diverting disaster debris from the waste stream, but there also will be a need for landfilling and contained burning. The unique issues associated with the volume and diversity of debris and waste may lead to innovative/creative approaches for disposing of these materials. This report will be updated as events warrant.

Contents

Introduction	1
Federal Disaster Cleanup Response Authorities and Activities	3
General Disaster Management Authorities	4
Disaster Cleanup Response and Waste Management Tasks	6
Debris Management	6
Disposition and Diversion of Debris and Waste	9
Releases of Oil and Hazardous Substances	11
Previously Contaminated Sites (Superfund)	13
Contaminated Floodwaters in New Orleans	14
Assessing Floodwaters and Sediment	15
Contaminated Sediment and Structures	16
Water Discharged from New Orleans	18
Contamination of Drinking Water Sources	20
Water Infrastructure Facilities in the Affected Region	21
Potential Challenges and Next Steps	22
Appendix 1	24

List of Figures

Figure 1. U.S. Environmental Protection Agency Superfund National Priority List (NPL) Sites in Areas Affected by Hurricane Katrina: Alabama, Louisiana, and Mississippi	14
---	----

List of Tables

Table 1. Federal Department/Agency Cleanup Functions and Responsibilities as Indicated in the Emergency Support Functions of the National Response Plan (NRP)	24
---	----

Cleanup after Hurricane Katrina: Environmental Considerations

Introduction

Local, state, and federal responders face numerous cleanup challenges associated with the effects of Hurricane Katrina, many of them unique due to the magnitude of events and specific features of communities affected. The immediate need has been to clear debris and control releases of hazardous substances that may pose a health and safety threat or may hamper emergency response activities. Subsequently, authorities initiated efforts to determine how and where the huge quantities of Hurricane Katrina-related waste and debris (hazardous and non-hazardous), will ultimately be gathered, separated, and disposed.

Congress is working to address the devastation wrought by Hurricane Katrina in the Gulf States, which is on a scale larger than any experienced by the United States in a single natural disaster incident. A number of legislative proposals for supplemental funding, waivers from normal procedures and legal requirements, and other forms of assistance in response to Hurricane Katrina are being debated and considered. This report aims to provide an overview of the immediate and intermediate cleanup tasks across the diverse communities in the affected region, and federal legal authorities and plans for tackling them. The report also discusses coordinated roles and activities among local, state, and federal agencies and officials. Finally, the report serves to reference other, more detailed CRS reports and other sources on particular Katrina cleanup activities. Public health and environmental concerns associated with Hurricane Katrina span a wide variety of issues, including air and water quality, and hazardous chemical releases. Katrina's impacts also have environmental implications for other major issue areas such as energy, transportation and defense. While this report addresses selected cleanup concerns receiving post-Katrina attention, it is not intended to provide comprehensive coverage of all public health and environmental issues associated with Hurricane Katrina, nor is it within the scope of this report to analyze ongoing legislative considerations related to the hurricane disaster response efforts.

There are many elements and phases of cleanup in response to natural disasters. Elements of cleanup often undertaken during the initial and intermediate phases following a disaster include the following:

- activation of state, local, and federal disaster response plans and delegation of authorities;
- debris (non-hazardous and hazardous) assessment and management, including initial removal, volume reduction, designating staging areas for separation, temporary storage, and transport;

- oil (and oil by-products) and hazardous materials assessment, containment, and management, as well as mitigation of public health effects;
- assessment and containment of existing Superfund sites;
- un-watering of non-receding floodwaters (primarily in New Orleans) and managing potentially contaminated soil and sediment;
- cleanup and repair of water and other infrastructure systems;
- reduction (e.g., shredding, chipping), diversion (e.g., salvaging, recycling, reusing), and disposal (e.g., landfilling, incinerating) of debris and hazardous materials;
- monitoring, sampling, and analysis to identify and reduce potential public health and environmental risks.

These tasks and the federal government's role are the primary focus of this report.

In response to the impacts of Hurricane Katrina, a joint task force of the Environmental Protection Agency (EPA) and the Centers for Disease Control and Prevention (CDC) issued an initial assessment of the environmental health and supporting infrastructure challenges facing one part of the affected region, New Orleans. The EPA/CDC report sets a tone for the broader scope of response actions required in that city and throughout the region affected by Hurricane Katrina by observing, "The most striking feature of the disaster is the array of key environmental health and infrastructure factors affected all at once."¹

¹ The joint task force identified several specific environmental health issues and supporting infrastructure concerns to address, categorizing them according time (short-term and long-term) and complexity. Joint Taskforce Centers for Disease Control and Prevention and U.S. Environmental Protection Agency, "*Environmental Health Needs and Habitability Assessment.*" Sept. 17, 2005. Online at [<http://www.bt.cdc.gov/disasters/hurricanes/katrina/envassessment.asp>]

Federal Disaster Cleanup Response Authorities and Activities

States, counties, and local municipalities have primary jurisdiction with regard to natural catastrophe cleanup. To the extent they are capable, these entities initiate cleanup activities operating under their own statutes² and their various emergency operation and/or incident response plans, often in coordination with various federal agencies, as needed.³ However, in the event that state and local governments are overwhelmed by a natural hazard, the President may issue a major disaster declaration under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the Stafford Act) and invoke federal authorities,⁴ as occurred in response to Hurricane Katrina. A major disaster declaration usually is in response to a governor's request and generally specifies, among other things, the type of incident covered, the time periods covered for specific activities,⁵ the types of disaster assistance available, and the counties affected by the declaration. The Stafford Act broadly authorizes the President to direct federal agencies to provide "essential assistance" as needed, including cleanup and disposal of waste and debris.⁶ Although this declaration heightens the federal response coordination and support activities, state and local governments maintain primary jurisdiction, particularly with regard to cleanup.

The following section briefly describes the Stafford Act, the December 2004 National Response Plan,⁷ and presidential directives that provide general authority

² For an overview of emergency management and homeland security statutes in the 50 states and the District of Columbia see CRS Report RL32287, *Emergency Management and Homeland Security Statutory Authorities in the States, District of Columbia, and Insular Areas: A Summary*. That summary report is supported by companion reports on each state, the District of Columbia, and the insular areas. See profiles for Louisiana (CRS Report RL32678); Mississippi (CRS Report RL32316); and Alabama (CRS Report RS21777).

³ For example see "State of Louisiana, Office of Homeland Security and Emergency Preparedness Emergency Operation Plan," April 2005, at [<http://www.ohsep.louisiana.gov/plans/eopindex.htm>].

⁴ 42 U.S.C. 5121 et seq. See CRS Report RL33090, *Robert T. Stafford Disaster Relief and Emergency Assistance Act: Legal Requirements for Federal and State Roles in Declarations of an Emergency or a Major Disaster*, and CRS Report RL33053, *Federal Stafford Act Disaster Assistance: Presidential Declarations, Eligible Activities, and Funding*.

⁵ FEMA, 2005 Federal Disaster Declarations, [<http://www.fema.gov/news/disasters.fema>].

⁶ Section 403 (a) of the Stafford Act (42 U.S.C. §5170(b)(a)) authorizes "assistance essential to meeting immediate threats to life and property resulting from a major disaster." This is defined to include "any work or services essential to saving lives and protecting and preserving property or public health and safety," including debris removal; search and rescue, emergency medical care; emergency shelter and transport; provision of food, water, medicine, and other essential needs; clearance of roads and construction of temporary bridges; provision of temporary facilities for schools; demolition of unsafe structures; warning of further risks and hazards; dissemination of public information; provision of technical advice to state and local governments; and reduction of immediate threats.

⁷ Section 502(6) of the Homeland Security Act of 2002 authorized the Secretary of
(continued...)

and direction to federal agencies responding to incidents of national significance. For a complete listing of statutory, Homeland Security Presidential Directives (HSPDs), and other authorities for agency actions in response to an incident of national significance, see Appendix 3 of the National Response Plan.

General Disaster Management Authorities

The Stafford Act authorizes the President “to establish a program of disaster preparedness that utilizes services of all appropriate agencies,”... “direct any Federal agency, with or without reimbursement, to utilize its authorities and the resources granted to it under Federal law (including personnel, equipment, supplies, facilities, and managerial, technical, and advisory services) in support of State and local assistance efforts;” coordinate provision of “technical and advisory assistance” to states and communities; and assist in distributing supplies and emergency assistance.⁸ Congress appropriates money to the Disaster Relief Fund (DRF) to ensure that such federal assistance is available to help individuals and communities stricken by severe disasters.⁹ Through executive orders, the President has delegated responsibility for administering the major provisions of the Stafford Act to the Federal Emergency Management Agency (FEMA).¹⁰

The Homeland Security Act created the Department of Homeland Security (DHS) and incorporated FEMA within the new department. Section 502(6) of the Homeland Security Act authorizes the Secretary of Homeland Security to consolidate federal emergency response plans into “a single, coordinated national response plan.” FEMA coordinates disaster assistance provided by 27 federal agencies by implementing the National Response Plan (NRP). The NRP establishes a comprehensive all-hazards approach to federal interventions, and a framework to coordinate activities of the federal government with those of state, local, and tribal governments and the private sector. The plan establishes the coordinating structures, processes, and protocols required to integrate the specific statutory and policy authorities of various federal departments and agencies. While the NRP is the core plan for managing domestic incidents and coordinating federal actions, other supplemental agency and interagency plans provide details on authorities, response protocols, and technical guidance for responding to and managing specific contingency situations (such as hazardous materials spills, wild fires, etc.).¹¹

⁷ (...continued)

Homeland Security to consolidate federal government emergency response plans into a single, coordinated National Response Plan (NRP). The current NRP was finalized in Dec. 2004, and may be viewed or downloaded from [http://www.dhs.gov/interweb/assetlibrary/NRP_FullText.pdf], visited Sept. 13, 2005.

⁸ 42 U.S.C. §§ 5131, 5170(a)

⁹ Funds appropriated to the DRF remain available until expended. Supplemental appropriations acts generally are required to meet the urgent needs of particularly catastrophic disasters.

¹⁰ Primarily Executive Order 12148, “Federal Emergency Management,” as amended.

¹¹ NRP, 2004, p. 16, [http://www.dhs.gov/interweb/assetlibrary/NRP_FullText.pdf].

The NRP is organized functionally by 15 Emergency Support Functions (ESFs). Under these ESFs, federal departments and agencies (and the American Red Cross) are grouped according to their capabilities and assigned various tasks. Each ESF has a designated coordinator, primary agency(ies), and a number of support agencies, which together are responsible for planning, supporting, providing resources, implementing programs, and providing emergency services related to their respective tasks to state, local, and tribal governments. When the President declares a major disaster or emergency, DHS/FEMA “activates” and assigns missions to relevant ESFs as deemed necessary.

The ESFs primarily addressing cleanup activities are ESF #3-*Public Works and Engineering*, and ESF #10-*Oil and Hazardous Materials Response*.¹² The primary focus of ESF #3 is infrastructure protection and emergency repair, infrastructure restoration, engineering services, construction management, and critical infrastructure liaison. The U.S. Army Corps of Engineers (the Corps) is designated the coordinator of ESF #3 missions and shares with FEMA the responsibilities of being a primary agency. The primary focus of ESF #10 is oil and hazardous materials (chemical, biological, radiological, etc.) response, and environmental safety, and short- and long-term cleanup. EPA is the designated coordinator, as well as a designated primary agency for ESF #10. The U.S. Coast Guard (the Coast Guard) is the other primary agency responsible for ESF #10 missions. ESF #8- *Public Health and Medical Services Annex*, also includes certain activities related to cleanup in coordination with ESF #3 and ESF #10.¹³ ESF #8 is coordinated by the Secretary of the Department of Health and Human Services (HHS) principally through the Assistant Secretary for Public Health and Emergency Preparedness (ASPHEP).

Multi-agency task forces of environmental response experts, including representatives from virtually all federal agencies, have been deployed throughout the Gulf region. In addition to those agencies with primary or coordination responsibilities, such as the Corps, the Coast Guard, and EPA, key agencies represented include the U.S. Department of Agriculture, U.S. Fish and Wildlife Service (Department of the Interior), Centers for Disease Control and Prevention (CDC) (Department of Health and human Services), and National Oceanic and Atmospheric Administration (Department of Commerce). These and other federal agencies are working in cooperation with Louisiana, Alabama, Mississippi and Florida municipalities and state agencies, to address countless cleanup issues. **Table 1** in Appendix A briefly outlines roles and activities that federal agencies often undertake related to disaster cleanup under the NRP.

¹² See the Emergency Support Function (ESF) Annexes to the National Response Plan at [http://www.dhs.gov/interweb/assetlibrary/NRP_FullText.pdf], visited Sept. 13, 2005.

¹³ “HHS, in coordination with ESF #3 and ESF #10 as appropriate, may task its components, and request assistance from other ESF #8 organizations as appropriate, to assist in assessing potable water, wastewater, solid waste disposal issues, and other environmental health issues; conducting field investigations, including collection and laboratory analysis of relevant samples; providing water purification and wastewater/solid waste disposal equipment and supplies; and providing technical assistance and consultation on potable water and wastewater/solid waste disposal issues,” December 2004 NRP, Annex, p. ESF #8-6. [http://www.dhs.gov/interweb/assetlibrary/NRP_FullText.pdf]

Several Homeland Security Presidential Directives (HSPDs) also shape the federal cleanup after natural catastrophes such as Hurricane Katrina, including HSPD-5 (Management of Domestic Incidents) and HSPD-8 (National Preparedness).¹⁴ Generally, these directives have been issued to clarify responsibilities of various governmental agencies when a catastrophe occurs. Executive orders and presidential directives do not alter statutory authority.

Activities undertaken by federal agencies, and state and local governments or contractors under their jurisdiction, must generally comply with federal laws, including environmental laws, as well as state and local statutes and ordinances that implement federal laws. Individual statutes offer varying flexibility by authorizing enforcement discretion. Temporary or emergency exemptions or waivers under certain statutes allow limited relief from certain requirements. For a more detailed discussion see CRS Report RL33107, *Emergency Waiver of EPA Regulations: Authorities and Legislative Proposals in the Aftermath of Hurricane Katrina*, and CRS Report RL33104, *NEPA and Hurricane Response, Recovery, and Rebuilding Efforts*.

The remainder of this report provides an overview of some of the elements of immediate and intermediate disaster cleanup, including roles of primary federal agencies and references to relevant statutes and other authorities.

Disaster Cleanup Response and Waste Management Tasks

Debris Management

As noted in a FEMA planning document, disaster debris is a “highly visible reminder” of the scope of a disaster, and accounts for as much as 40% of all disaster-related costs.¹⁵ States generally plan ahead for debris management in response to natural disasters, and EPA assists states in this task.¹⁶ However, the level of destruction to homes, businesses, industries (e.g., oil refining and chemical manufacturing), public utilities and structures, and vegetation after Hurricane Katrina is unprecedented in the United States. Proper management of this disaster debris is an important initial step in protecting public health and safety and the environment, as well as recovery and rebuilding efforts in these affected areas.

¹⁴ The Department of Homeland Security has these directives on its website at [<http://www.dhs.gov/dhspublic/display?content=4331>] and [<http://www.whitehouse.gov/news/releases/2003/12/text/20031217-6.html>].

¹⁵ “Disaster Debris Planning,” materials presented by FEMA at EPA’s August 2003 “RCRA National Meeting,” see [<http://www.epa.gov/epaoswer/osw/meeting/pdf02/ward.pdf>].

¹⁶ See, for example, *Planning for Disaster Debris*, a 1995 EPA publication, available online at [<http://www.epa.gov/epaoswer/non-hw/muncpl/disaster/disaster.txt>], visited Sept. 29, 2005.

Flooding, wind, and storm surge across vast areas of Louisiana, Mississippi, and portions of Alabama have resulted in the generation of two broad, overlapping categories of waste: “disaster debris” and wastes consisting largely of, or heavily contaminated by, oil or other hazardous substances. The waste that ultimately will be generated in New Orleans as a result of Katrina is unusual not only for its volume, but also because of the degree to which the waste may potentially be hazardous to health and the environment: structures submerged in flood waters soaked in raw sewage, oil, and an assortment of hazardous chemicals, sometimes for weeks.

Disaster debris from hurricanes and floods includes, but is not limited to, construction materials, damaged or destroyed buildings, sediments, “green” wastes (e.g., trees, limbs, leaves, and shrubs), “white goods” (appliances such as refrigerators), personal property, and vehicles. The geographic area over which Hurricane Katrina caused destruction along the Gulf Coast has generated a volume of disaster debris that, although not accurately known as of this writing, has been estimated to be much greater than any previous natural or man-made disaster in the United States. The Louisiana DEQ debris estimate for New Orleans alone as of October 3, 2005, was 55 million cubic yards,¹⁷ while debris in Mississippi has been estimated to be more than 20 million cubic yards¹⁸ (compared to 43 million cubic yards of disaster debris in Florida’s Metro-Dade County from Hurricane Andrew in 1992¹⁹). The Corps has estimated that it will take eight months to consolidate the material in Mississippi, and a year and a half to dispose of it.²⁰ The total amount of debris and time for removal and disposal will not be known for some time, and will depend largely on the extent of demolition in areas with flood damage.

State and local governments are primarily responsible for waste management, and the states affected by Katrina have significant experience in managing hurricane-related debris. The Solid Waste Association of North America (SWANA) has provided state and local waste managers with access to various resources on best debris management practices, including one recent publication that was prepared at the request of the state of Louisiana addressing Hurricane Katrina specifically.²¹

¹⁷ Louisiana DEQ. Estimated amounts of debris in cubic yards parish/community, and summary of household hazardous waste collections for St. Tammany, Jefferson and Lafourche Parishes, as of Oct. 3, 2005. Available online at [<http://www.deq.state.la.us/news/pdf/DEBRISMISSIONOct3.pdf>], visited Oct. 4 26, 2005].

¹⁸ U.S. Army Corps of Engineers. Hurricane Katrina. News Bits. Sept. 20, 2005. [http://www.mvd.usace.army.mil/hurricane/mvk/news/rita_not_stopping_recovery.pdf], visited Sept. 23, 2005.

¹⁹ U.S. Environmental Protection Agency. Municipal Solid Waste. Planning for disaster debris. [<http://www.epa.gov/epaoswer/non-hw/muncpl/disaster/disaster.htm>], visited Sept. 22, 2005.

²⁰ USACE, Sept. 20, 2005.

²¹ SWANA Applied Research Foundation. 2005. *Hurricane Katrina Disaster Debris Management: Lessons Learned from State and Local Governments*, Briefing Report. SWANA. [http://swana.org/pdf/swana_pdf_358.pdf], visited Sept. 28, 2005.

The Stafford Act authorizes debris removal by federal agencies from publicly and privately owned lands and water when state and local governments are overwhelmed and request assistance, as was the case following Katrina. Debris management falls under ESF #3, Public Works and Engineering, which is coordinated under the NRP by the Corps. The Corps is tasked with managing, monitoring, and providing technical assistance in the clearance, removal, and disposal of debris and the clearing of ground and water routes into the affected areas. The physical work generally is done by contractors, to the extent that it cannot be accomplished by local government sanitation workers. FEMA plans to reimburse local governments for debris removal on public and private property in counties that are eligible for assistance.²²

Debris management entails collection, followed by separation of the various types of materials, including nonhazardous from hazardous debris. Hazardous debris often includes household containers of pesticides, drain cleaners, cleaning supplies, and paint; asbestos-coated pipes; and surfaces coated with lead-based paint. Separation of hazardous from nonhazardous materials is necessary to prevent improper disposal, which can release hazardous substances to the environment. However, hazardous and nonhazardous materials often are commingled, making separation difficult or impossible. For example, many building materials contain asbestos and lead-based paint. For this reason, the Corps manages contaminated debris in coordination with EPA.²³ EPA has advised states to make efforts to segregate asbestos, as well as certain other types of waste.²⁴ The states, including those in the Hurricane Katrina-affected region, have primary authority for their asbestos programs and disposal of asbestos-containing debris. EPA has reviewed the Hurricane Katrina debris management plans developed by Mississippi²⁵ and Louisiana²⁶, where most debris has been found, and is working closely with state and local agencies providing debris management guidance. EPA is also assisting with asbestos sampling as necessary.

There are many physical risks for workers in the recovery and rebuilding efforts in disaster areas, particularly in flood conditions. These include electrocution; exposure to toxic materials, infectious agents, and mold; structural instability; falls; and the dangers of using equipment in unfamiliar situations or with inadequate

²² FEMA. FEMA streamlines debris removal process for private property. Sept. 19, 2005. Release number HQ-05-274.

²³ For additional information about debris management, see [<http://www.usace.army.mil/inet/functions/cw/cecwo/readness.htm>], visited Sept. 23, 2005.

²⁴ U.S. EPA. Hurricane Katrina Response, Frequent questions, "Asbestos." Available online at [<http://www.epa.gov/katrina/faqs.htm>], visited Sept. 29, 2005.

²⁵ State of Mississippi DEQ, Katrina Debris Management Response, on the their website at [http://www.deq.state.ms.us/MDEQ.nsf/page/Main_Home?OpenDocument].

²⁶ State of Louisiana, "Hurricane Katrina Debris Management Plan," Louisiana Department of Environmental Quality, September 28, 2005 (Revised September 30, 2005); online at [<http://www.deq.state.la.us/news/pdf/AttachmentstoDebrisPlanupdatedSept29.pdf>], visited Oct. 4, 2005.

training, including heavy equipment, chain saws and generators.²⁷ EPA, CDC and OSHA are advising state and local governments and cleanup workers on proper health and safety measures when entering structures and handling commingled debris.

Disposition and Diversion of Debris and Waste. Diversion and disposal of debris and waste has been a major concern following many natural disasters. However, as outlined earlier, the magnitude of destruction from Hurricane Katrina is unprecedented in the United States. The type and volume of debris and waste materials generated, and the existing management options available generally determine the endpoint of disaster debris and waste. To the extent possible many communities prefer diverting disaster debris — salvage, reuse, and recycle — rather than disposal. If they are not contaminated or extensively commingled with hazardous wastes, vegetation, soil, certain metals, bricks, wood, and some other building materials can be recycled or reused. Examples listed by EPA on its website²⁸ include the following:

- Green waste can be composted or chipped into mulch.
- Concrete and asphalt can be crushed and used as sub-base in road building.
- Metal can be recycled as scrap metal.
- Brick can be reused or ground for use in landscaping applications.
- Uncontaminated dirt and sediment can be used for landfill cover or as soil amendments.

The waste and debris that cannot be diverted is generally disposed of in compliance with environmental statutory requirements, in sanitary landfills or in combustors equipped with devices to control pollutants.

The federal Resource Conservation and Recovery Act (RCRA) specifies the criteria for managing municipal and industrial solid and hazardous waste.²⁹ Solid waste is defined broadly under the law as “any garbage, refuse ... and other discarded material.” Hazardous waste, a subset of solid waste, is defined as a solid waste that is either specifically listed in the regulations or meets specific criteria that make it toxic, ignitable (i.e., burns readily), corrosive, or reactive (e.g., explosive). Solid wastes that are not reused or recycled are generally sent to municipal landfills; hazardous wastes are required to be sent to specially constructed hazardous waste landfills. Under RCRA, EPA can authorize states to implement their own RCRA programs. Each state affected by Katrina is authorized and has implemented its own waste management program under RCRA. Initially, the localities have been relying

²⁷ Detailed information on these hazards and protective measures are posted on several government websites: Occupational Safety and Health Administration (OSHA) at [<http://www.osha.gov/OshDoc/hurricaneRecovery/.html>]; National Institute on Occupational Safety and Health (NIOSH) at [<http://www.cdc.gov/niosh/topics/flood/>]; and Centers for Disease Control at [<http://www.bt.cdc.gov/disasters/hurricanes/index.asp>]

²⁸ EPA, Office of Solid Waste and Emergency Response, Disaster Debris [<http://www.epa.gov/epaoswer/non-hw/munclpl/debris.htm>], visited Sept. 29, 2005.

²⁹ 42 U.S.C. §§ 6901-6991k

on existing landfills but are working with state and federal experts considering options for locating additional capacity, including possibly siting new landfills.

In the past, debris from major disasters was most often buried or burned in the community (much of the Katrina-generated debris that was handled in the immediate aftermath of the hurricane was burned). However, considering the volume and potential toxicity of the disaster debris and waste materials that will be generated as a result of Hurricane Katrina, it may not be feasible to bury or burn significant amounts of the waste.

Burning is a limited option, since only “clean” (i.e., uncontaminated) debris can be burned. Also, citizens do not want to inhale the smoke from open burning. Further, even if the smoke from burning operations is controlled, it is not an option for waste containing hazardous constituents (e.g., contaminated structures and their contents in New Orleans or asbestos-containing wastes). Most states, including Alabama, Mississippi, and Louisiana, prohibit open burning as a means of waste disposal. However, that prohibition does not apply to disposal of debris from emergency clean-up operations.

To respond to the huge volumes of debris and waste generated in the wake of Hurricane Katrina, both Mississippi and Louisiana have issued disaster debris management plans.³⁰ Among other criteria, those plans delineate the types of disaster debris that will be handled under the specified emergency conditions. The plans also specify requirements regarding the selection of debris storage and staging sites and waste handling methods (e.g., chipping/grinding, burning, or landfilling) for certain types of waste. The Alabama Department of Environmental Management has not posted a disaster debris management plan, but does have existing guidance regarding open burning of natural disaster debris.³¹ Diversion from the waste stream appears to be the preference within the areas affected by Hurricane Katrina, when possible. As a first step, local municipalities have been reducing the volume of debris and waste through chipping/shredding and grinding, prior to final diversion or disposal.

The unique issues associated with the volume and diversity of debris and waste may lead to innovative/creative approaches for disposing of these materials. State agencies are facilitating communication among private parties’ offerings to assist with the disposition of the materials. There are also various federally administered programs that provide a forum for introducing and evaluating potential cleanup and remediation technologies. Examples of federal programs for evaluating technologies include EPA’s Technology Innovation Program (TIP), and Superfund Innovative

³⁰ Mississippi Department of Environmental Quality, Emergency Order 5062 05, see sections regarding Solid Waste Management, Hazardous Waste Management, and Asbestos, September 13, 2005, available online at [http://www.deq.state.ms.us/MDEQ.nsf/page/Main_Home?OpenDocument] and Louisiana Department of Environmental Quality, Hurricane Katrina Debris Management Plan, revised September 30, 2005, available online at [<http://www.deq.state.la.us/>].

³¹ Alabama Department of Environmental Management, “Guidelines for Open Burning of Natural Disaster Debris,” issued September 28, 2004, available online at [<http://www.adem.state.al.us/>].

Technology Evaluation (SITE) and Environmental Technology Verification (ETV) programs.³² Through these programs, the federal government and its partners generally provide and exchange information which may give assurance that those technologies which were evaluated will, in fact, clean and remediate under specific conditions. The extent to which these federally administered programs may provide assistance to the ongoing Katrina cleanup efforts is not fully known.

Releases of Oil and Hazardous Substances

Like the volume of waste generated, the level of contamination of Katrina-generated waste was anticipated to be unprecedented, particularly in and around New Orleans. While some contamination, such as that caused by contact with sewage, may be managed through burning or sanitary landfills, other contamination has come from releases of oil and hazardous substances, which require special handling to reduce risks to public health and the environment.

Federal responsibilities under the National Response Plan (NRP) for coordinating cleanup of environmental releases of hazardous substances and oil build on long-term experience in monitoring and cleanup efforts of contaminated areas. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (“Superfund”; CERCLA),³³ and Section 311(f)(5) of the Federal Water Pollution Control Act, as amended (Clean Water Act),³⁴ provide EPA and the Coast Guard broad statutory authority to support state and local response to releases of hazardous materials, contaminants, or pollutants, regardless of cause, as long as the release “constitutes a public health or environmental emergency, and no other person with the authority and capability to respond to the emergency will do so in a timely manner.”

Generally, EPA leads response to spills on land and in inland waters, while the Coast Guard leads response to spills into coastal waters of the United States. CERCLA also authorizes EPA’s long-term, remedial work at contaminated sites where release into the environment of a pollutant or contaminant may present an imminent and substantial danger to the public health or welfare. CERCLA mandated the establishment of a National Response Team (NRT), chaired by EPA, made up of 16 federal agencies, and includes state and local government representatives. CERCLA further required development of the National Contingency Plan (NCP) to coordinate responses to environmental releases of hazardous substances, pollutants, and contaminants.

³² United States Environmental Protection Agency. Information about EPA’s TIP can be found at the EPA website [<http://www.epa.gov/tio/about.htm>]; information about EPA’s SITE program can be found at [<http://www.epa.gov/ORD/SITE>]; information about EPA’s ETV program can be found at [<http://www.epa.gov/etv>].

³³ 42 U.S.C. § 9601 et seq.

³⁴ Section 311(f)(5) of the Federal Water Pollution Control Act, as amended (Clean Water Act), 33 U.S.C. §1321.

The NCP continues to operate, although it is subsumed within the broader NRP structure when the President declares a major disaster or emergency and FEMA activates ESF #10 under the NRP. Under the NCP, the On-Scene Coordinator (OSC) is the pre-designated federal official who is the exclusive manager of releases of oil and hazardous substances, and has the responsibility for ensuring an immediate and effective response to a discharge or release. The OSC makes early (and subsequent) judgments about the extent of the incident and what resources will be required, and which scientific advisory teams will be needed. A major duty of the OSC is to coordinate with state and local organizations at the site, who may have been the first responders. In response to Hurricane Katrina, approximately 50 of EPA's 250 OSCs nationwide were sent to the affected region.

As of October 9, 2005, the Coast Guard reported that it had responded to 9 major and medium oil spills in southern Louisiana alone, where a total of 8.0 million gallons of oil were released from above-ground storage tank facilities. Most of this oil has been contained, recovered, or naturally dispersed.³⁵ This total does not take into account gasoline from gas stations and the more than 300,000 flooded cars in the New Orleans area, which may add another 1 million to 2 million gallons of oil. A joint CDC/EPA taskforce report issued September 17, 2005, on issues associated with the repopulation of New Orleans, noted that underground storage tanks of gasoline pose a potential threat of unknown proportions, pending "unwatering."³⁶

Other contamination has resulted from numerous releases, both large and small, of hazardous substances. EPA Region IV reported that emergency response personnel had conducted more than 2,600 incident responses as of October 12, 2005, in Mississippi and Alabama (Louisiana is located EPA Region VI).³⁷ An incident response can involve investigation of reports from the National Response Center (NRC),³⁸ contacting facilities, and reporting hazardous material debris while conducting land or water assessment in the affected areas. All oil and hazardous substance releases throughout the Hurricane Katrina area have not been determined or assessed. The CDC/EPA joint taskforce report stated that the potential for toxic chemical exposure of returning residents is highly uncertain.³⁹ For instance, the

³⁵ U.S. Coast Guard, Department of Homeland Security. Press release. "Update — Southeast Louisiana Post-Hurricane Pollution Recovery Continues." Oct 9, 2005. Updates available at [<http://www.uscgstormwatch.com/go/site/1008/>], visited Oct. 12, 2005.

³⁶ EPA/CDC Joint Taskforce. p. 7 and 24 of the assessment, which can be downloaded at [http://www.epa.gov/katrina/reports/envneeds_hab_assessment.pdf], visited Sept. 26, 2005.

³⁷ U.S. EPA, Region IV. Hurricane Katrina Response. Oct. 12, 2005. Available online at [http://www.epa.gov/region4/Katrina/response_20050922.htm], visited Oct. 12, 2005. EPA Region IV Cleanup activities are updated often on this website.

³⁸ The NRC is the federal communications center staffed by the Coast Guard, which receives all reports of releases involving hazardous substances and oil that trigger the federal notification requirements under several laws. Reports to the NRC activate the National Contingency Plan and the federal government's response capabilities, available online at [<http://www.nrc.uscg.mil/nrcback.html>], visited Sept. 30, 2005.

³⁹ Joint Taskforce. p. 38. Available from the EPA website at [<http://www.epa.gov/katrina/>]
(continued...)

amounts of household hazardous substances in homes and businesses that have been seriously damaged or destroyed in the Gulf Coast region, are unknown. In the New Orleans area, there is the added element that household hazardous materials have been soaking in contaminated waters. EPA has collected more than 65,000 household hazardous waste or “orphan” containers throughout the affected region.⁴⁰ Numerous containers and drums, and 718,216 gallons of fuel have been collected by EPA Region IV in Mississippi and Alabama.⁴¹ Many of these containers were empty, and others contained hazardous substances that otherwise might have been commingled with nonhazardous wastes.

In addition, a large concentration of industrial operations — bulk oil storage and refinery operations, chemical plants (both processing and storage facilities), and shipbuilding operations — in the Gulf Coast region hardest hit by Katrina may pose a release threat. So that EPA Regions and states might more quickly assess the impact of the Hurricane Katrina at those facilities, EPA provided information about the location of registered businesses that generate hazardous wastes, as well as facilities that treat, store, and/or dispose of hazardous wastes.⁴² There are 774 registered treatment, storage, and disposal facilities for hazardous wastes in the Katrina-affected area: 397 in Louisiana, 235 in Alabama, and 142 in Mississippi, according to EPA. Each of the three states has its own programs for managing hazardous wastes.

Previously Contaminated Sites (Superfund)

In addition to releases from households and businesses, another threat of releases exists at sites that were heavily contaminated by earlier known releases of hazardous substances. Existing contaminated sites include those on the Superfund National Priorities List (NPL), EPA’s list of the most contaminated sites in the United States. There are 15 NPL sites in the Katrina-affected area of Louisiana (including 5 in New Orleans), 6 in Alabama, and 3 in Mississippi.⁴³

³⁹ (...continued)
reports/envneeds_hab_assessment.html], visited Sept. 27, 2005.

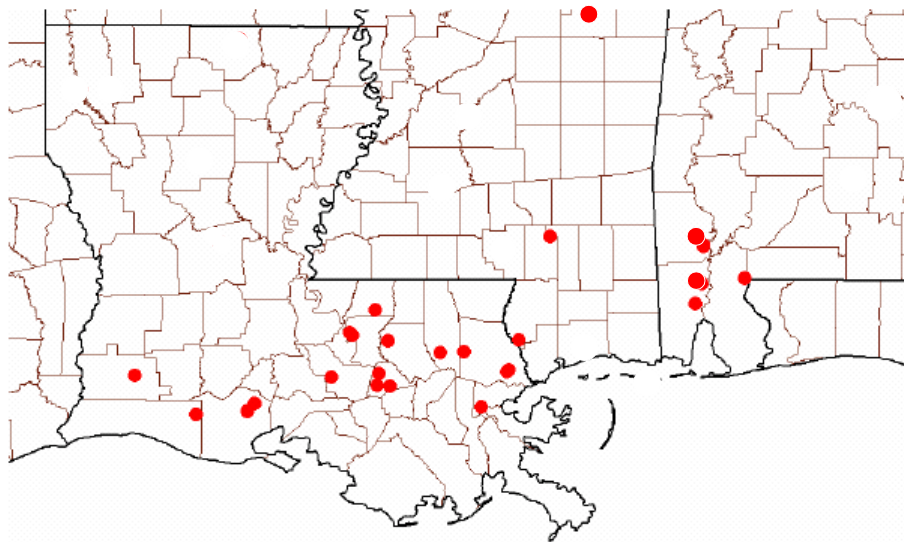
⁴⁰ U.S. EPA. Hurricane Katrina Response. Current activities EPA response activity - posted October 4. [<http://www.epa.gov/katrina/activities.html>], visited Oct. 11, 2005. Activities are updated often on this website.

⁴¹ U.S. EPA, Region 4. Hurricane Katrina Response. Sept. 26, 2005. Available online at [http://www.epa.gov/region4/Katrina/response_20050922.htm], visited Sept 27, 2005.

⁴² U.S. EPA. Hurricane Katrina Response, Frequent questions. Available online from EPA at [<http://www.epa.gov/katrina/faqs.htm>], visited Sept. 23, 2005.

⁴³ U.S. EPA. Hurricane Response: Katrina/Rita, “Superfund Issues.” Available online from EPA at [<http://www.epa.gov/katrina/superfund.html>], visited Oct. 12, 2005.

Figure 1. U.S. Environmental Protection Agency Superfund National Priority List (NPL) Sites in Areas Affected by Hurricane Katrina: Alabama, Louisiana, and Mississippi



Source: U.S. Environmental Protection Agency, Sept. 27, 2005.

EPA reported that all NPL sites have had initial assessments, and more detailed assessments and monitoring are continuing. The Agriculture Street Landfill Superfund site in New Orleans, which was submerged in three feet of water and is located in an area that was extensively damaged, has been of particular concern to authorities. An initial visit by EPA and the Louisiana Department of Environmental Quality to that site and a second inspection September 20 determined that the cap was not compromised. The soil was sampled on September 25, 2005, and again on October 2 and 3, 2005.⁴⁴

Contaminated Floodwaters in New Orleans

Outside of Louisiana, large highly urbanized or industrialized areas did not remain flooded for an extended period after Hurricane Katrina passed. In Mississippi and Alabama, the primary damage from that Katrina resulted from the storm surge, high winds, and rainfall accompanying the hurricane.

In New Orleans, however, floodwaters breached the city's existing system of levees and floodwalls that is designed to provide a certain level of protection from storms and intense precipitation. Because flooded portions of the city are below sea level and have little natural drainage, the first task there has been to remove the trapped water, estimated by the Corps to have been 114 billion gallons at the maximum,⁴⁵ through intentional levee breaks and the existing complementary system of pumps and canals. (For additional information, see CRS Report RS22238, *New*

⁴⁴ *Ibid.*

⁴⁵ Stacey Brown, U.S. Army Corps of Engineers. Personal communication, Sept. 14, 2005.

Orleans Levees and Floodwalls: Hurricane Damage Protection, by Nicole Carter.) While the surge of storm water from Hurricane Katrina that engulfed the city was not contaminated initially, it became so when the trapped water mixed with human and animal sewage, decaying bodies, oil and gas from ruptured tanks and pipes, and myriad chemicals that leached from damaged properties and vehicles. Managing the floodwaters raised several issues — how to control immediate public health and environmental impacts due to direct exposure to the water, how to identify and manage releases of toxic chemicals into the water and deposition into the muck and sediment that remain after the water recedes, and how to assess and manage the impacts of discharging the floodwaters into Lake Pontchartrain.

As mentioned above, the National Contingency Plan, prescribed under both the Clean Water Act (33 U.S.C. §§1251-1387) and CERCLA (Superfund; 42 U.S.C. §§9601-9675), gives EPA specific responsibility to respond directly to releases or threats of releases of hazardous substances and pollutants or contaminants that may present an imminent and substantial danger to public health or welfare and to discharges of oil, all of which have been contaminating waters that flooded New Orleans. In addition, under the Stafford Act (42 U.S.C. §§5121-5206) and the National Response Plan, EPA generally has the lead federal role in addressing hazardous materials and oil, and in ensuring environmental safety and short- and long-term cleanup. The Coast Guard often acts as co-lead, with responsibility for coastal incidents.

Assessing Floodwaters and Sediment. “Unwatering” New Orleans has been critical to the public health response to the Hurricane Katrina in order to remove water that poses a direct risk to public health and the environment, and also may provide a breeding area for vectors of illnesses such as West Nile Virus. Biological and chemical tests of the floodwaters conducted by EPA and the Louisiana Department of Environmental Quality beginning immediately after the Hurricane Katrina showed concentrations of fecal bacteria at least 10 times in excess of EPA’s recommended levels for human contact. The initial sampling in flooded neighborhoods identified total coliforms and *E. coli* (bacteria found in high numbers in the feces of humans and other warm-blooded animals) that are indicators of the potential presence of disease-causing microbes. Because of the risk of intestinal and other illness from exposure to the contaminated water, EPA and CDC issued an advisory on September 6, 2005, cautioning the public and all responders about the possible hazards of contact with flood waters.⁴⁶ Further testing continued to show greatly elevated *E. coli* levels higher than EPA’s recommended levels for contact, even several weeks after Hurricane Katrina. The level of contamination is not unusual in urban runoff, however.⁴⁷

⁴⁶ U.S. Environmental Protection Agency. Hurricane Response: Katrina/Rita, “Test Results: Water.” [<http://www.epa.gov/katrina/testresults/water/index.html>], visited Oct 12, 2005.

⁴⁷ J.H. Pardue et al, “*Chemical and Microbiological Parameters in New Orleans Floodwater Following Hurricane Katrina*,” Environmental Science & Technology Online News. Oct 11, 2005. Available online at [http://pubs.acs.org/subscribe/journals/esthag-w/2005/oct/science/pt_neworleans.html]

In addition, EPA has analyzed floodwaters for over 100 priority pollutants, including a number of volatile organic compounds (VOCs), metals, pesticides, and polychlorinated biphenyls (PCBs). In preliminary results, lead, hexavalent chromium, and arsenic were detected at levels that would exceed health levels established by EPA and the Agency for Toxic Substances and Disease Registry (ATSDR, an agency of the Department of Health and Human Services)⁴⁸ to protect people who are exposed to those levels over a period of time longer than flood waters will persist in New Orleans. That initial testing detected another 20 chemicals, either at levels that did not exceed EPA standards (for example, copper, mercury, and toluene) or chemicals for which no health standards exist (e.g, zinc, calcium, and iron).

Concentrations of toxic substances found in the floodwaters were not high enough to produce overt, immediate illness, unless a great deal of floodwater were swallowed. According to EPA's website, "These compounds would pose a risk to children only if a child were to drink a liter of flood water a day. Long-term exposure (a year or longer) to arsenic would be required before health effects would be expected to occur."⁴⁹ Nevertheless, EPA and CDC advised the public and emergency responders to avoid contact with the water, when possible.

Overall, EPA and most other officials appear to believe that the floodwaters were less hazardous than some had originally feared — at least in terms of toxic chemicals whose risks are more long-term than immediate — but that high levels of bacteria did pose a significant short-term risk to public health. However, they acknowledged that the levels of contamination found are typical of urban floodwaters.

Contaminated Sediment and Structures. As of October 11, 2005, the Corps⁵⁰ reported that the unwatering of the New Orleans metropolitan area was completed, although some areas require additional pumping of flood water.⁵¹ The unwatering effort for Hurricane Katrina was temporarily delayed by additional floodwaters from Hurricane Rita and reoccurrences of breaches to sections of the canal levees. As the floodwaters receded, some pollutants settled in a layer of sediment, complicating the cleanup. On September 10, 2005, EPA began sampling residue sediments from locations in Orleans and St. Bernard Parishes, testing for about 140 priority pollutants. According to EPA, "sediment, for the purposes of the hurricane response sampling effort, is being defined as residuals deposited by

⁴⁸ ATSDR was created by Congress in 1980 to implement the health-related sections of laws that protect the public from hazardous wastes and environmental spills of hazardous substances. [<http://www.atsdr.cdc.gov/congress.html>]

⁴⁹ U.S. Environmental Protection Agency. "EPA Response Activity — September 14." [<http://www.epa.gov/katrina/activities.html>]

⁵⁰ The Corps of Engineers' authority to unwater New Orleans derives from the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. §5170b) and P.L. 84-99, Flood Control and Coastal Emergencies, Section 216 (33 U.S.C. §701n).

⁵¹ U.S. Department of the Army, Corps of Engineers, Public Affairs Office, Press Release, Oct. 11, 2005. [http://www.mvd.usace.army.mil/hurricane/news/news_release_1011.pdf]

receding flood waters which may include historical sediment from nearby water bodies, soil from yards, road and construction debris, and other material.”⁵²

Preliminary results indicated that some sediment may be contaminated with bacteria and fuel oils, and human health risks may exist from contact with deposited sediment, EPA said. However, because no standards exist for determining human health risks from bacteria in soils or sediment, EPA officials can only generally recommend that contact or exposure to sediment be limited if possible. In the preliminary tests, a number of chemicals and metals were detected (including arsenic and lead), but were reported to be below levels that would be expected to produce adverse health effects. Samples taken October 1, 2005, indicated the continued presence of petroleum, as well as volatile and semi-volatile organic compounds, pesticides, and heavy metals. All of these were reported to be at levels not expected to cause adverse effects to cleanup workers and other responders, who wear appropriate protective gear.⁵³

At EPA’s request, the Science Advisory Board (SAB) reviewed the Agency’s sediment sampling testing protocol and strategy, which initially focused on a one-square-mile area of the city. The SAB was asked to examine the scope of the sampling area and substances to be scrutinized to ensure that results, when available, will be scientifically adequate to support any conclusions about risks and exposure. The SAB convened a workgroup on October 5, 2005, to provide consultative advice to EPA. EPA is considering the SAB comments which are summarized on the EPA’s website.⁵⁴ EPA and the state will continue sampling on a daily basis, and appropriate sediment removal options will be determined once the sampling results have been reviewed.

Related Air Quality and Vector Concerns. EPA scientists are concerned that air pollution may result not only from chemical spills and releases at industrial plants, but also may emanate from contaminated sediments. As contaminated sediments dry, they may release pollutants that can be re-suspended as dust. In addition, some scientists are concerned that, as flooded areas dry out, some of the pathogens in the contaminated water will become airborne.

EPA has begun an extensive air quality sampling effort throughout New Orleans, using an EPA helicopter, buses, and an Air Force plane with air monitoring technology, examining many possible sources, including sediments. Early screening results indicated that chemical concentrations are below ATSDR health standards and that long term exposure (a year or more) at the levels detected would be required for health effects to be of concern. The sampling identified particle pollution at levels considered moderate (meaning that unusually sensitive people should consider avoiding vigorous exercise). However, samples were not collected with standard

⁵² U.S. Environmental Protection Agency. Hurricane Response: Katrina/Rita, “Test Results: Sediment.” [<http://www.epa.gov/katrina/testresults/sediments/index.html>], visited Oct. 11, 2005.

⁵³ *Ibid.*

⁵⁴ U.S. Environmental Protection Agency. SAB Public Meeting October 5, 2005, Draft Minutes. [<http://www.epa.gov/sab/hurricane>]

monitors, meaning that the mix of particles in the screening samples cannot easily be compared to EPA standards. EPA cautions that initial sampling does not represent air quality conditions throughout the region, and should not be used to make general characterizations. Air sampling continues in the Katrina-affected area and EPA posts updated test results regularly on its website.⁵⁵

A significant concern associated with the cleanup is the potential for health hazards due to the presence of molds, mildew, and fungi in soggy, damaged structures. The excess moisture and standing water resulting from Katrina contributed to the growth of molds in homes and other buildings, particularly in the New Orleans area. All persons are being cautioned about the effects of mold, especially those with weakened immune systems and those with respiratory illnesses/allergies.⁵⁶ Although guidance is available to private parties for cleaning up mold indoors, for larger surface areas affected (generally ten square feet or more) EPA recommends cleanup be conducted by professionals experienced with addressing mold.

A related issue is an increase of rodents and insects that might carry diseases such as West Nile Virus. Hurricane Katrina compounded Louisiana's insect problem on several levels, including forcing the evacuation of standard vector control personnel, the destruction of vector disease control equipment, and a dramatic increase in the number of stagnant bodies of water throughout New Orleans and surrounding parishes, which serve as ideal breeding grounds for insects like mosquitoes. Medical personnel from the U.S. Navy are working with the CDC and Louisiana Department of Public Health to eliminate vector-borne disease and other insect-related problems associated with mosquitoes. However, because spraying for mosquito control can affect workers in the region, spraying is being used conservatively, according to the Navy. EPA has been working with state agencies, FEMA, and others to expedite any requests that may be needed for pesticide use and also is working with pesticide manufacturers to make sure that adequate supplies are available.

Water Discharged from New Orleans. While necessary to the overall cleanup from the Hurricane Katrina, the water removal from New Orleans has raised a number of concerns. Removal involves pumping the floodwater into Lake Pontchartrain, an option that is necessarily expedient, but not necessarily ideal, because contamination in the lake may harm aquatic plants and animals. As noted above, because of geography, the city lacks sufficient natural drainage for the water to remove itself. Pumping it into the Mississippi River was not a viable option, as

⁵⁵ U.S. Environmental Protection Agency. Hurricane Response: Katrina/Rita, "Air Quality Data." [<http://www.epa.gov/katrina/testresults/air/index.html>]

⁵⁶ For more information about molds and mildew related to Katrina see, "Update on Health Issues Related to Mold, Mildew and Mud in Hurricane and Flood Affected Areas," September 28, 2005, at the DHHS/CDC website: [<http://www.cdc.gov/od/oc/media/transcripts/t050928.htm>]. For general information regarding mold and mold cleanup guidance, see the EPA website [<http://www.epa.gov/iaq/molds/moldresources.html>] and the DHHS/CDC website at [<http://www.bt.cdc.gov/disasters/mold/protect.asp>]. All site visited Sept. 30, 2005.

the floodwater could contaminate river water which is the source of the city's drinking water supply. Treatment of the contaminated floodwaters prior to discharge was not possible because of the need to unwater the city rapidly, and the unavailability of full treatment technology. Nor was it possible to hold the pumped water somewhere to filter out pollution. The Corps has taken some steps to remove wastes prior to discharge into the lake, such as putting booms and skimmers in place at outfalls to trap floating material and debris, and installing aeration units in canals. The contaminated floodwaters are low in dissolved oxygen, because of the presence of oxygen-consuming matter in sewage and decaying plant material, and these aeration units are intended to restore oxygen levels before the water enters the lake. Otherwise, the oxygen-deprived floodwaters would likely harm fish and other organisms in the lake which need oxygen to survive.

The lake is a 630-square mile waterbody that already is impaired by a number of known sources of water pollution, including stormwater runoff (the largest contributor to pollution of the lake), agricultural discharges from animal operations and chemical use, discharges from wastewater treatment plants and individual septic systems, oil and gas production, and saltwater intrusion from the Mississippi River Gulf Outlet (a navigation channel that links the Gulf of Mexico to the Port of New Orleans as an aid to shipping).⁵⁷ The lake is partly rimmed by cypress and tupelo swamps, which could be damaged by saltwater that the Hurricane Katrina introduced. But restoration activities have been underway for some time, and there is aquatic life in the lake — manatees, an endangered species, have been observed in recent months; sportfishing occurs in the lake; and certain species of clams are harvested from the lake.

The Corps's prevention efforts (e.g., booms, skimmers, aerators) likely had little effect on limiting any toxic chemicals, metals, or pesticides in the discharged water. Consequently, the lake has received the equivalent of several years of urban runoff in only a few weeks. Sudden loads of toxic chemicals and low dissolved oxygen levels might cause considerable harm to sensitive species of aquatic life over the short term, but long-term effects are more difficult to predict. Whether toxic chemicals will be diluted, degraded by bacteria, and flushed out of the lake by tides, as some scientists believe, or will remain in the lake and accumulate in its sediments, as others believe, will not be known for some time, perhaps years. Early reports indicate only that levels of zinc and copper are high enough to adversely affect some fish.⁵⁸

The Louisiana Department of Environmental Quality (Louisiana DEQ) has begun implementing a plan to test Lake Pontchartrain to assess short-term and long-term effects of discharging pumped water into the lake, as well as outlets into and out of the lake. Federal partners, including the U.S. Geological Survey, are assisting the

⁵⁷ U.S. Geological Survey. "Environmental Atlas of the Lake Pontchartrain Basin, Water Quality." [<http://www.pubs.usgs.gov/of/2002/of02-206/env-overview/water-quality.html>]; Lake Pontchartrain Basin Foundation. "Wetlands." Online at [<http://www.saveourlake.org/wetlands.htm>].

⁵⁸ J.H. Pardue et al. [http://pubs.acs.org/subscribe/journals/esthag-w/2005/oct/science/pt_neworleans.html]

state. Results will be used to determine if pollutants exceed expected levels (as compared to historical site data) and if water quality standards are being exceeded. Louisiana DEQ test results reported October 4, 2005, showed that all fish and 10 of 12 invertebrate test animals were able to survive in 100 percent pump-down floodwaters.⁵⁹

In addition, an EPA water testing vessel is surveying waters of the Mississippi Sound, each major bay system feeding the Sound, and the Gulf of Mexico for water-quality effects from the hurricanes. The main objective is to provide a snapshot of current water quality and flow data and compare the results to historic conditions. The survey is expected to take until mid-October to complete, and Mississippi hopes to design more targeted studies based on preliminary results.

Contamination of Drinking Water Sources

Another area of interest is possible effects of Hurricane Katrina on waters that are sources of drinking water supplies throughout the area. Outside of New Orleans, public and private drinking water supplies are drawn from groundwater sources. During the week of September 19, 2005, the U.S. Geological Survey and the State of Louisiana began a small groundwater reconnaissance effort to look for impacts from the storm surge, such as saltwater mixing or elevated bacteria levels. Also, EPA is distributing drinking water test kits in the New Orleans area so that private well owners can test for possible contamination by floodwaters and overflowing sewers. Privately owned wells that provide drinking water are regulated by states, not EPA, and the number of such wells in the affected Gulf Coast area is unknown. In most states, owners of private wells are responsible for testing for contamination.

The source of public drinking water supply for New Orleans is the Mississippi River. Assessments by the state and federal partners are underway to determine possible impacts to the river such as saltwater and sediment dumped during the Katrina's storm surge and chemical and bacteria contamination released from damaged facilities, structures, and sewers. The state is working to re-establish its Early Warning Organic Chemicals Detection System (EWOCDS) to help evaluate the quality of the River as the city's drinking water supply. This system consists of sampling sites at six locations at various points on the river, primarily at chemical facilities and the New Orleans Sewerage and Water Board.⁶⁰

⁵⁹ Louisiana DEQ. "Tests show animals survive in New Orleans floodwaters," Oct. 4, 2005. [<http://www.deq.state.la.us/news/pdf/aquatictoxicitytesting.pdf>], visited Oct. 11, 2005.

⁶⁰ Louisiana Department of Environmental Quality. "Plan for Monitoring Surface Water Quality Conditions in Waters Impacted by Hurricane Katrina." Sept. 10, 2005.

Water Infrastructure Facilities in the Affected Region⁶¹

Throughout the Katrina-affected region, high winds and water damaged a wide range of public service facilities, including drinking water supply and treatment and sewage treatment plants, and restoring those facilities is part of the overall cleanup and restoration process. Damages caused by the storm at many facilities included loss of electric power to pump, process, and treat raw water supply and wastewater. Under authority of the National Response Plan, especially Emergency Support Function #10, EPA and Corps of Engineers staff are conducting assessments, providing assistance to state and local government personnel to evaluate damages.

As electric power continued to be restored, many of the affected systems were able to restore needed services, although some drinking water facilities are still operating under boil-water notices pending test results to ensure that the water has been restored to standards safe for public consumption. The number of sites that are off-line changes daily.⁶² By October 10, 2005, EPA reported that more than 85% of drinking water and 95% of wastewater treatment facilities in the affected region were operational.⁶³ However, EPA estimated that facilities not operating or with unknown status normally served about 200,000 drinking water customers and more than half a million wastewater customers. Efforts to assess facilities continue throughout the region to determine their operating status, including needs to repair or rebuild. Staff of EPA's Water Program are assessing all drinking water and wastewater plants in the region.

EPA cautions that evaluations are on-going, and the status of many facilities is unclear (especially small systems). Facilities determined to be operational may still require repair or reconstruction. Facility restorations, full or partial, may take many months, and costs of needed repairs are unknown. On September 23, the American Water Works Association issued a very preliminary estimate that \$2.25 billion will be needed to repair or replace drinking water infrastructure at perhaps 1,000 systems that were damaged by Hurricane Katrina.⁶⁴

Impacts on New Orleans's water systems were particularly severe. In the central portion of the city, in addition to electric power impairments, extensive damage occurred from flooding of treatment plants, drinking water distribution lines, and collector and interceptor sewers, and the water system's power plant. The largest of the city's two drinking water plants, located where the worst flooding took place, was completely underwater for nearly two weeks. It was repaired sufficiently to provide flow (i.e., for fire fighting), but may not be providing potable water for weeks. Steps

⁶¹ For additional information, see CRS Report RS22285, *Hurricane-Damaged Drinking Water and Wastewater Facilities: Impacts, Needs, and Response*.

⁶² Detailed information, updated often, is available online from EPA's website at [<http://www.epa.gov/katrina/activities.html>].

⁶³ Detailed information on drinking water and wastewater facilities, updated often, is available on EPA's website at [<http://www.epa.gov/katrina/activities.html>].

⁶⁴ American Water Works Association. "Restoring Public Water Supply Systems in the Aftermath of Hurricane Katrina: A Preliminary Cost Estimate." Sept. 23, 2005.

involved in restoring service include drying out and cleaning engines; testing and repairing waterlogged electrical systems; testing for toxic chemicals that may have infiltrated pipes and plants; restoring pressure (drinking water distribution lines); activating disinfection units; restoring bacteria needed to treat wastes (wastewater plants); and cleaning, repairing, and flushing distribution and sewer lines.

For flooded areas, sewage treatment tends to be the last thing back on line, because plants are at the lowest point of the city and thus under the deepest water. New Orleans's two wastewater treatment plants were damaged by flooding and extensive wind damage. The city's public works officials reportedly believe that much of the sewer system has probably been damaged, and cracks will need to be fixed by tearing up roads (although road repairs already may be required, as part of the overall cleanup effort).

Potential Challenges and Next Steps

The enormity of the tasks associated with cleaning up from a natural disaster on the scale of Hurricane Katrina is probably unprecedented, and likely to exceed others in this country's history in terms of scope, duration, and cost. The range of tasks described in this report will occur over varying periods of time, from the immediate responses of reducing threats to public health and safety; to assessing the Hurricane Katrina's impacts; to removing, repairing, and rebuilding; and to long-term monitoring of the impacts of actions that are taken to mitigate the storm's damages. Each of these phases of cleanup — which reflect more a continuum than discrete steps — presents challenges and issues. Some of these issues are listed below.

- The scale of the cleanup (e.g, geographic, in terms of volume) represents a huge management challenge for all levels of government and the private sector. Potential concerns include adequacy of landfill capacity; health and safety of cleanup workers; capability of, or resistance to, applying “best practices” for waste management.
- Potential ecological risks, if any, that may result from the short- and mid-term recovery measures, such as discharging contaminated floodwaters from New Orleans into Lake Pontchartrain. Environmental officials will have to plan for and implement monitoring programs to assess any longer term impacts, after cleanup and removal are done.
- The volume of storm-related waste containing hazardous materials, and whether the capacity exists in the region to handle and dispose of it.
- Public involvement in cleanup decisions. The public — especially residents of the affected region — has a strong interest in the cleanup, since they will experience impacts of those actions.

Keeping the public well informed may be critical, but also may be difficult, especially in the early aftermath of the storm events.

- The need to balance public health protection with allowing access to homes and businesses.
- Availability and applicability of new remediation technologies or processes to aid in the recovery, to handle solid debris materials (hazardous and non-hazardous), or to clean contaminated materials, surfaces, or structures. In the necessary haste to begin cleaning up, will there be opportunities to identify and utilize better technologies?
- Whether existing federal cleanup authorities are adequate to address the damage caused by Hurricane Katrina.
- Assessing the effectiveness of current federal roles.

Appendix 1

Table 1. Federal Department/Agency Cleanup Functions and Responsibilities as Indicated in the Emergency Support Functions of the National Response Plan (NRP)

Agency	National Response Plan (NRP) Responsibilities and Functions (text <i>italicized</i> to emphasize cleanup elements; page # indicates where function is located in the NRP)
Department of Agriculture	Provides engineering and contracting/procurement personnel and equipment to assist in emergency removal of <i>debris</i> , demolition, repair of roads and bridges, temporary repair of essential public facilities, and water supply. (p. ESF3 - 5)
	Provides support for <i>public health</i> matters for radiological incidents as a member of the Advisory Team for Environment, Food, and Health. (p. ESF8 - 8)
	Support coordination of animal issues such as <i>disposal of animal carcasses</i> . (p. ESF8 - 8)
	Food Safety Inspection Service: includes proper <i>disposal</i> of contaminated products in order to protect public health and the environment in affected area. (p. ESF11 - 8)
	Provides for the inspection, fumigation, <i>disinfection</i> , <i>sanitation</i> , <i>pest extermination</i> , and destruction of animals or articles found to be so infected or <i>contaminated</i> as to be sources of dangerous infection to human beings and takes such other measures as necessary. (p. ESF11 - 6)
	Assists with the prevention, control, and eradication of any highly <i>contagious/zoonotic disease</i> involving wildlife; and <i>carcass disposal facilities</i> , as appropriate. (p. ESF11 - 11)
Department of Homeland Security / U.S. Coast Guard	The Coast Guard is designated the primary agency with EPA for interagency incident management under ESF#10 supporting assessment, mitigation, <i>cleanup</i> , <i>containment</i> , and <i>disposal of oil and hazardous materials</i> ; the Coast Guard is the primary agency for coastal incidents; EPA is primary agency for inland areas and incidents affecting both. (pp. ESF10 - 1-3)
	Coordinates the marking and <i>removal of obstructions</i> declared to be <i>hazards to navigation</i> . (p. ESF3 - 6)
	Assists in debris and contaminated <i>debris</i> management activities when debris or runoff impacts navigable waters. This includes coordinating and/or providing resources, assessments, data, expertise, technical assistance, monitoring, and other appropriate support. (p. ESF3 - 6)
Department of Commerce/ National Oceanic and Atmospheric Administration	Provides expertise on natural resources and coastal habitat, the environmental effects of <i>oil and hazardous materials</i> , and appropriate <i>cleanup</i> and restoration activities. (p. ESF10 - 10)
	Conducts emergency hydrographic surveys, search and recovery, and <i>obstruction</i> location to assist safe vessel movement. (p. ESF10 - 10)

Agency	National Response Plan (NRP) Responsibilities and Functions (text <i>italicized</i> to emphasize cleanup elements; page # indicates where function is located in the NRP)
Department of Defense /U.S. Army Corps of Engineers	The U.S. Army Corps of Engineers (the Corps) is designated as the coordinator for ESF#3 dealing with infrastructure protection and emergency repair, <i>infrastructure restoration</i> , engineering services, construction management, and critical infrastructure liaison. (p. ESF3 - 5)
	Provides contracting services through ESF#3 to urban and rural firefighting forces to obtain heavy equipment and/or <i>demolition services</i> as needed to suppress incident related fires. (p. ESF4 - 4)
	Provides available military medical personnel to assist HHS in the protection of public health (such as food, water, wastewater, <i>solid waste</i> disposal vectors, hygiene, and other environmental conditions). (p. ESF8 - 9)
	The Department of Defense (not the Corps) provides On-Scene-Coordinators and directs response actions for releases of <i>hazardous materials</i> from its vessels, facilities, vehicles, munitions and weapons. (p. ESF10 - 10)
	Provides expertise and resources to assist in the removal and disposal of <i>contaminated and non-contaminated debris</i> , to include animal carcasses and <i>debris</i> affecting NCH resources. (p. ESF11 - 10)
	Supports the development of national strategies and plans related to housing and permanent housing, <i>debris</i> management and the restoration of <i>public facilities and infrastructure</i> . (p. ESF14 - 5)
Department of Energy	Enables <i>radiologically contaminated debris</i> management activities by coordinating and/or providing resources, assessments, data, expertise, technical assistance, monitoring, and other appropriate support. (p. ESF3 - 6)
	Provides regional resources to evaluate, <i>control and mitigate radiological hazards</i> to workers and the public. (p. ESF8 - 10)
	Provides an On-Scene-Cordinator and directs response actions for releases of <i>hazardous materials</i> from its vessels, facilities, and vehicles. (p. ESF10 - 10)
	Provides advice in identifying the sources and extent of <i>radioactive releases</i> relevant to the National Contingency Plan, and in <i>removal and disposal</i> of radioactive contamination. (p. ESF10 - 10)
	Provides technical advice in <i>radioactive debris</i> management. (p. ESF14 - 5)
General Services Administration	Provides personnel and contractors to assist in damage assessment, structural inspections, <i>debris</i> clearance monitoring and restoration of facilities in general, construction inspection, and environmental and archeological assessments. (p. ESF3 - 8)

Agency	National Response Plan (NRP) Responsibilities and Functions (text <i>italicized</i> to emphasize cleanup elements; page # indicates where function is located in the NRP)
U.S. Environmental Protection Agency	EPA is designated as the coordinator and primary agency (with the Coast Guard) for interagency incident management under ESF#10 supporting assessment, mitigation, <i>cleanup, containment, and disposal of oil and hazardous materials</i> . EPA is primary agency for inland and incidents affecting both inland and coastal zones; the Coast Guard is the primary agency for coastal incidents. (pp. ESF10 - 1-3)
	Supplies sanitary engineers to assess wastewater and <i>solid waste</i> facilities. (p. ESF3 - 8)
	Assists in locating <i>disposal sites for debris</i> clearance activities. (p. ESF3 - 8)
	Assists contaminated <i>debris</i> management activities by coordinating and/or providing resources, assessments, data, expertise, technical assistance, monitoring and other appropriate support. (p. ESF3 - 8)
	Identifies location and provides safety guidance for areas affected by <i>hazardous materials</i> . Ensures the protection and <i>cleanup</i> of these areas. (p. ESF 3 - 8)
	Provides technical assistance and environmental information for the assessment of the health/medical aspects of situations involving <i>hazardous materials</i> . (p. ESF8 - 13)
	Provides technical assistance, subject-matter expertise and support for biological, chemical, and other <i>hazardous agents</i> on contaminated facility remediation, environmental monitoring and <i>contaminated agriculture (animal/crops) and food product decontamination and disposal</i> . (pp. ESF11 - 12)
	Provides technical assistance for planning for <i>contaminated debris</i> management and environmental remediation. (p. ESF14 - 5)
Department of Health and Human Services	Enables <i>contaminated debris</i> management activities by coordinating and/or providing resources, assessments, data, expertise, technical assistance, <i>monitoring</i> and other appropriate support. (p. ESF3 - 6)
	Supplies engineering and environmental health personnel to assist in assessing the status of wastewater and <i>solid waste</i> facilities. (p. ESF3 - 6)
	Provides technical assistance for shelter operations related to food, vectors, water supply and <i>waste disposal</i> . (p. ESF6 - 6)
	Works in cooperation with EPA and USDA to ensure the <i>proper disposal</i> of contaminated food or animal feed. (p. ESF10-11)
Department of Homeland Security/FEMA	DHS/FEMA is the primary agency for providing ESF#3 recovery resources and support; provides supplemental Federal disaster grant assistance for <i>debris removal and disposal</i> . (p. ESF3 - 3)
Department of the Interior	Provides personnel to assist in damage assessment, structural inspections, <i>debris</i> clearance monitoring, and restoration of facilities in general. (p. ESF3 - 7)

Agency	National Response Plan (NRP) Responsibilities and Functions (text <i>italicized</i> to emphasize cleanup elements; page # indicates where function is located in the NRP)
Department of Labor/OSHA	Provides <i>worker safety</i> advice, assistance, and policy support for <i>debris removal</i> , building demolition, and other ESF#3 activities. (p. ESF3 - 7)
Nuclear Regulatory Commission	Assist radiological <i>contaminated debris</i> management activities by coordinating and/or providing resources, assessments, data, expertise, technical assistance, <i>monitoring</i> , and other appropriate support. (p. ESF3 - 8)
	The NRC and EPA coordinate their responses to an emergency involving both <i>radiological and chemical release</i> in accordance with joint NRC/EPA implementing procedures. (p. ESF10 - 13)
Department of State	Facilitate an integrated response between nations when a <i>discharge or release</i> crosses international boundaries or involves foreign flag vessels. (p. ESF10 - 2)
Department of Transportation	Provides engineering personnel and support to assist in <i>damage assessment, debris clearing</i> , and restoration of the Nation's transportation infrastructure. (p. ESF3 - 7)

Source: Prepared by the Congressional Research Service using data from the National Response Plan, December 2004, downloaded from [<http://www.dhs.gov/interweb/assetlibrary/NRPbaseplan.pdf>], visited Sept. 13, 2005.