



# Protecting Worker & Occupant Health from Sewage in Floodwaters

Catastrophic flooding, like that caused by Hurricane Sandy, can introduce sewage from external sources into the indoor environment. This sewage can pose serious health threats to building occupants and to cleanup and restoration workers.

Sewage is untreated water that contains raw animal or human body fluids, fecal matter or other organic contaminants. During and after Hurricane Sandy, untreated sewage mixed with storm water overwhelmed sewers, sewage treatment plants, and septic systems. It then saturated soil and entered flooded buildings and vehicles.

Sewage-contaminated floodwater may remain in a building for hours or days. During this time, it can penetrate and contaminate wood, gypsum, concrete, and other building materials. Whenever sewage is present, pathogens are present. Pathogens are disease-causing agents, which can be in the form of bacteria (such as e. coli), viruses, mold spores, or protozoans. These are normally present in large numbers in sewage wastes. Exposure can cause illnesses ranging from gastritis to dysentery, infectious hepatitis, and severe gastroenteritis. In any flood cleanup, assume that pathogens are present and take appropriate precautions.

## RISK

Sewage cleanup can be a high-risk task since dangerous contaminants are an inherent part of sewage. Risk is the likelihood that harm will occur. The risk of sewage-related health harm to occupants and workers depends on:

- the volume of contaminated floodwater that enters an indoor space
- the chemical and biological nature of the sewage
- the concentration (percentage) of sewage in the floodwater
- whether flooding is isolated to the basement or involves other floors as well

- the amount of time the sewage remains, and
- how deeply the sewage penetrates into building materials.

Risk also depends on contact time - how often an occupant or worker is exposed, how long each exposure is, and the period of time over which exposures continue to occur. Individuals whose immune systems are compromised or who are otherwise susceptible due to age, medication, or underlying illness are at greater risk of contracting potentially fatal infections than are healthy individuals.

## BASIC PRINCIPLES OF CLEANUP

The fundamental goals of sewage remediation are:

- Do no additional harm!
- Protect worker and occupant health and safety.
- Protect the indoor and outdoor environments from further contamination during the cleanup process.
- Remove water and residual moisture.
- Neutralize contamination and remove contaminated materials.

Rapid evacuation of water and rapid drying of impacted materials are essential. Cleanup should begin as soon as floodwaters have receded. The longer sewage remains in an indoor space, the greater the potential for illness and for damage to building materials. Wet extraction systems (pumps, wet vacs) should be used to remove sewage and water used for cleaning. Where possible, dehumidifiers and mechanical ventilation should also be used. The rate of evaporation may be increased by introducing air from the outside. Remaining sewage sludge may have to be shoveled out.

Removal of affected contents and structural materials may be necessary. Assume anything touched by sewage is contaminated. The following items should

always be discarded - food, cosmetics, medicines and medical supplies, stuffed animals, toys, mattresses and pillows, upholstered furniture, large carpets, carpet padding, cardboard, and impacted sheet rock, ceiling tiles, and similar porous materials. Foam rubber and books and paper products should usually be discarded. These and other non-restorable contaminated materials should be disposed of in sealed impermeable plastic bags.

## **CHEMICAL DISINFECTION**

Sewage-affected areas should be washed with a detergent solution, then disinfected and allowed to dry. Cleaning and disinfection are two different processes. Cleaning removes dirt. Disinfection eliminates the pathogens and organisms that were in the sewage or that grew during the period of contamination. Even concrete can be colonized and broken down by microorganisms if it is allowed to remain wet and contaminated by organic matter. If a commercial disinfectant is used, directions must be strictly followed so as to not endanger workers, occupants, or the indoor environment.

A household bleach solution, made by combining 1/4 to 1/2 cup of chlorine bleach to one gallon of water, can be an effective disinfection agent. Bleach should never be used in concentrated form because it can cause severe skin and respiratory harm. Never use bleach with any product that contains ammonia.

## **PERSONAL PROTECTIVE EQUIPMENT (PPE)**

Assume anything touched by sewage is contaminated. Avoid direct skin contact with floodwaters to minimize the chance for infection. Be especially careful of the face and eyes. Protect all cuts, scrapes, and sores. Immediately wash and disinfect any wound that comes in contact with sewage. Cleanup workers should be trained

and equipped with appropriate personal protective equipment, including rubber boots or equivalent, rubber gloves, splash-proof goggles, full-body protective clothing, and, if conditions warrant, respirators. An N95 respirator may be adequate. A half face air purifying respirator with hybrid organic vapor/HEPA cartridges may be more appropriate in some circumstances.

Use heavy gloves to protect the hands when handling debris to protect against cuts and scrapes.

Gloves designed to protect the skin from chemical exposure are usually not strong enough to protect from debris. Double gloving with a waterproof glove under a heavy work glove is the best way to protect against both cuts and scrapes and floodwater exposure.

Wearing wet gloves or PPE can cause dermal irritation. Repeated use of impermeable gloves, especially in hot and humid conditions, can aggravate skin rashes. Cotton liners can be used under protective gloves to improve comfort and to prevent dermatitis. Latex gloves should be avoided because of the risk of developing skin sensitivity or allergy. If skin contact with floodwaters does occur, use soap and water to clean exposed areas. Waterless alcohol-based hand rubs can be used when soap or clean water is not available. Hands should be washed after removal of gloves. Gloves that will be reused should be cleaned with soap and water and dried between uses.

## **HEALTH-BASED RECOMMENDATIONS FOR RESTORATION**

The goal is to restore the contaminated area to a condition where there is no additional risk of pathogen-caused disease, while protecting the health of cleanup workers and occupants.

1. Remediation should begin as soon as possible. The longer the contamination is allowed to persist, the greater the potential for microbial growth.

2. Unprotected occupants and workers should be evacuated from the affected areas during the initial stages of decontamination, cleaning, and disinfection (until sewage has been removed and disinfectants applied).

3. During the initial stages of sewage decontamination, cleaning, and disinfection, cleanup

workers should be equipped with at least a half face air purifying respirator with hybrid organic vapor/HEPA cartridges, rubber gloves, splash-proof goggles, rubber boots, protective suits, and hard hats as appropriate.

4. Rapid evacuation of water and rapid drying of impacted materials is essential. Wet extraction systems should be used to remove sewage and water. Dampness and humidity should be reduced as much as possible by using the existing mechanical ventilation system, auxiliary fans, and dehumidifiers. If possible, evaporation of indoor water should be sped up by introducing outside air. Where flooding is extensive, the drying process may require several days. Using a respirator, even the right respirator, probably will not provide proper protection unless you have been fit-tested, trained, and qualified to use a respirator. If you are an employee and are required to use a respirator, your employer must provide you with a respirator at no cost, along with annual training, fit-testing, and medical clearance. Days or longer to be effective. Drying should be evaluated with a moisture meter and a humidity meter.

5. Affected materials should be cleaned with detergent and decontaminated by spraying with a disinfectant solution. More than one round of cleaning and/or disinfection may be necessary.

6. Highly porous low value materials should be removed and discarded as soon as possible. Highly porous high value materials, such as some rugs and textiles, should be removed and restored off site.

7. Semi-porous materials such as linoleum, hardboard furniture, and construction materials such as wood and plaster, should be replaced or cleaned and disinfected. If these materials are not removed or properly disinfected, they can become reservoirs for microbial growth.

8. Heavy organic matter such as raw sewage and silt must be physically removed in a manner that protects both workers and the indoor environment. This may involve the use of shovels, squeegees, septic pump trucks, wet vacuums, and moisture-extraction machines. All tools and machines, especially recovery tanks, wands, and hoses, must be cleaned and disinfected after use.

9. Septic systems should be professionally inspected.

10. Environmental monitoring should consist of moisture measurements, rather than surface or air sampling for microorganisms. After the restoration process, surveillance of occupants for illness, allergy, and sensitivity may also be used to assess cleanup adequacy.

11. Outdoor areas might need cleanup. Most biological contaminants from sewage on grass will degrade naturally from exposure to UV radiation from sunlight. Bacterial levels on turf will reduce significantly in 3 weeks to 3 months. A disinfectant can be used on paved areas. Depending on the type and amount of chemical contamination present in sewage, soil removal may be warranted in some circumstances.

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**Adapted from:**

PUniversity of Michigan. Suggested Guidelines for Remediation of Damage from Sewage Backflow into Buildings.

<http://www.oseh.umich.edu/pdf/guideline/fdrappe.pdf>

PMassachusetts Dept. Of Environmental Protection. Flooding and Sewage Back-ups: Home Care Guide.

<http://www.mass.gov/dep/water/laws/flooding.htm>

PNational institute for Occupational Safety and Health. Hazard Based Guidelines: Protective Equipment for Workers in Hurricane Flood Response. <http://www.cdc.gov/niosh/topics/emres/pre-workers.html>