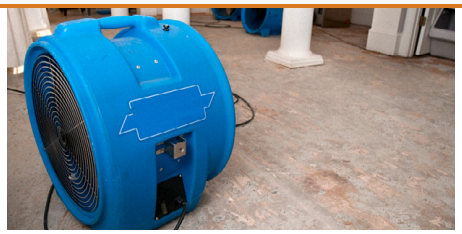
Remediation of Mold and Bacteria from Water Contamination

Risk Control from Liberty Mutual Insurance



Flooding inside of buildings can occur due to plumbing pipes bursting or being damaged during maintenance or construction activities; the sewage system backing up into the plumbing systems; rainwater intrusion; or overflow from rising rivers, lakes, or ocean water due to storms and hurricanes.

Highlights:

- Provides guidelines for remediating clean water and more stringent guides for gray and black water intrusion
- General Safety Considerations
- Categories of Water Entering a Structure

General Safety Considerations

Before entering a flooded building, isolate and shut off all electrical service until it is established that there is no danger of electric shock. Do not connect generators to a building's electrical circuits without the approved, automatic-interrupt devices. If a generator is online when electrical service is restored to a building, it can become a major fire hazard and may endanger hot-line contractors helping to restore power in the area.

Ensure that gas is not flowing through the regulators of natural gas appliances such as building heaters, water heaters, or clothes driers.

Provide an adequate supply of fresh outdoor air to buildings through natural or mechanical ventilation. This is the most effective engineering control for preventing indoor air quality problems, and includes the use of natural dilution, local exhaust, or increased ventilation efficiency. Provide ventilation levels according to the design criteria set forth in ASHRAE 62.1-2016.

Categories of Water Entering a Structure

In considering what kind of remediation is required, evaluate the type and source of the water that entered the building. Water causing a flooding situation is divided into three categories that require different remediation (clean-up) measures. These categories are clean, gray, and black water.

1. Clean water originates from a source that does not contain significant microbial content and does not pose substantial harm to humans. Examples are rainwater or melting snow from openings in the roof with no contamination, broken water supply lines, or tub or sink overflows with no contaminants.
2. Gray water contains a significant level of contamination and has the potential to cause discomfort or sickness if consumed by or exposed to humans. Gray water carries microorganisms and nutrients for microorganisms. Examples may include water from sump pump failures, seepage due to hydrostatic pressure or floodwater, broken aquariums, or overflows from washing machines and dishwashers.
3. Black water contains pathogenic agents and is grossly unsanitary. Black water contains sewage and other contaminated water sources entering or afflicting the indoor environment. Such water sources carry silt and organic matter into structures and create black water conditions. Toilet backflows that originate from beyond the toilet trap and contaminated floodwaters are often considered black water contamination, regardless of the physical content or color of the water.

The following remediation guidelines are grouped into two parts. Part one for clean water intrusions, and part two for additional procedures for gray and black water remediation.

Liberty Mutual INSURANCE

Part 1: Clean Water Intrusion

Identify the Source(s) of Water Intrusion

Identify the source(s) of the water intrusion and correct them to prevent additional water intrusion and further damage to building materials.

Inventory all water damaged areas, building materials, and furnishings. Give special attention to wet carpet under cabinets and beneath furnishings (e.g., file cabinets, lateral files, desks). A visual inspection of the affected area is the most important initial step in identifying a possible contamination problem.

Use a moisture meter to identify the extent of water damage to drywall and carpeting. Dry from both sides any drywall with moisture content above 14 percent. Replace drywall where mold growth is present.

Dry Affected Areas as Soon as Possible

Drying will help stop the spread of mold. It may be done before or during remediation. Note the following four general principles of drying water-damaged buildings:

1. **Remove excess water:** Remove excess water prior to restoration procedures. Typical equipment used for this water removal are pumps and wet/dry shop vacuums.
2. **Evaporation using moving air:** After removing excess water, the remaining water must be evaporated using air-moving equipment to move air over all the surfaces that had been wetted. Air-moving equipment should not be used if the clean-up response was delayed and mold is actively growing on surfaces.
3. **Dehumidify:** Use dehumidifiers in addition to fans to avoid secondary condensation. High capacity dehumidifiers are frequently required. In cold, dry winter conditions, introducing and heating outside air can be equally effective.
4. **Control temperature:** Both evaporation and dehumidification are enhanced by using building's Heating Ventilation and Air Conditioning (HVAC) system or auxiliary heaters.

   The following precautions must be taken:

   – Follow proper safety practices if auxiliary heaters are used, including those associated with electrical power supplies and venting.

   – Do not use unvented heaters indoors that are fired by fossil fuels (e.g., gasoline, LP-gas, Diesel) because this could result in carbon monoxide gas release in the building.

   – Do not increase temperatures above 80°F without controlling relative humidity (RH) below 60 percent, as this may accelerate mold growth.

Remove and Clean the Contents of the Building

Prior to beginning any of the remediation work, remove contents (furnishings, draperies, etc.) from the remediation area. Clean, wrap in plastic, and store the contents that can be salvaged in a humidity-controlled storage area (less than 60 percent RH) to prevent mold growth.

If cleaned contents are stored on-site, provide a clean enclosure maintained at a slight positive pressure in relation to the remediation area so that no contamination from other areas of the building can enter these decontaminated areas. Use a separate storage facility if a suitable storage space is not available on site.

Furniture: Air dry, HEPA vacuum, and/or steam clean, promptly dry, and monitor. If damaged by other water types, discard.

Hardwood furniture or laminate furniture whose laminate is intact should be air dried and cleaned with a wood floor cleaner.

Particleboard, pressed wafer board, or Medium Density Fiberboard (MDF) can be air dried and monitored if the water source was clean water. These manufactured wood products may allow rapid growth of mold if a response and water clean-up is delayed so the material should be inspected for mold growth before drying.

Swollen laminate, particleboard, pressed wafer boar, or MDF material should be discarded.

Files and Papers: Remove and dispose of non-essential wet files and paperwork. Essential (e.g., legal documents, tax returns) wet paper should be moved to a location where it can be dried, photocopied, and then discarded. However, if no mold growth is present, essential papers can be dried.

Use Containment Enclosures to Prevent Spreading Mold

Perform cleaning within containment enclosures to prevent mold spreading to previously cleaned areas. The containment areas should be consistent with Level III NYC DOH guidelines.

Use Plastic Curtains and Other Appropriate Structures to Isolate the Mold Contaminated Area

A vacuum or air mover having HEPA filters should be used to keep this containment area under negative pressure with respect to the rest of the building or floor. Exhaust air to the outside of the building.

Place HEPA filtration unit(s) close to where demolition and cleaning procedures are being done. This negative pressure system should run when removing contaminated material and when cleaning and treating all contaminated structural and building material components.

The following should be conducted inside the containment area:

- Allow only remediation workers inside the containment.
- Place all movable objects outside the containment area(s).
- Cover all non-movable objects with polyethylene sheeting.
- Place ample dehumidification equipment throughout the containment area to maintain a RH level below 60 percent.
- Block off and cover all HVAC supply and return vents inside the containment area.
- Remove all water-damaged and mold-damaged from the walls and ceiling. This removal should continue 16” to 24” (depending on wall framing spacing) past the perimeter of the damage.
- Use airless sprayers for dust control and sanitation.
- Remove any water damaged and/or mold contaminated carpet and padding.

Clean Moderately Contaminated Structural Material

Once the drywall and flooring are removed, assess the potential contamination of wall studs and floor joists.

Visible mold on wooden studs must be removed by HEPA vacuum followed by sanding with a hand sander that has a HEPA dust collection device attached. After sanding, HEPA vacuum again and wipe the surfaces with an appropriate detergent or biocide, and allow to dry. Other non-mold contaminated structural wood should be HEPA vacuumed and damp wiped with a detergent solution.

Scrub affected hard surfaces such as block walls with a mild detergent solution.

After work is competed dry the materials through the use of air movement (e.g., fans blowing air across the surface) coupled with dehumidification to keep room air below 60 percent RH.

The NYC Remediation Guidelines cautions against using gaseous, vapor-phase, or aerosolized biocides for remedial purposes.

Clean Moderately Contaminated Household Articles

Wipe down all household semi-porous (e.g., wood, concrete) and non-porous (e.g., metals, glass, hard plastics) articles with a damp cloth or mop using a detergent solution or EPA-approved biocide solution diluted to the manufacturer's dilution specifications.

Clean Air Conditioning/Heating Unit and Ductwork

Shut off and then clean the inside of the air conditioning/heating unit and ductwork. A variety of biocides are recommended by HVAC manufacturers for use with HVAC components. Seal adjacent duct openings (supply and return openings) in all affected rooms during the remediation work. Use a licensed HVAC contractor to complete the repairs and to reconstruct the system. Insulated ductwork may require special consideration and may need to be replaced depending on the degree of contamination.

Replace Severely Water-Damaged Wood

Replace rotted structural boards and trim. Other boards should be appropriately cleaned with a disinfectant or EPA-approved biocide. All areas should be left dry and free from mold contamination and debris.

Remove Water-Damaged Porous Material

Remove all visible, mold-contaminated, porous material including, but not limited to, all of the drywall, pressboard, paneling, insulation, cabinets, carpet, carpet padding, and furring strips. Double bag materials and seal for disposal. These wastes are not biohazards and can be disposed of as construction wastes.

- **Ceiling tiles:** Remove and dispose of all wet ceiling tiles within 24-48 hours of water damage. Visible mold growth should not be covered with sealants or coatings, such as Fosters or Kilz®.
- **Sheet rock:** If water incursion is detected within 24 hours and no previous water damage has occurred:
  - Carefully make small openings at top and bottom of wall cavity.
  - If confident that there was no prior history of water incursion, blow air through the wall cavity with a fan. Monitor relative humidity and moisture levels to determine when wall cavity is dry. RH should be 60 percent or below.
  - If drying does not start for 48 hours after the water incursion or if there was previous water damage that was not dried using these guidelines, removal or abatement of the affected area must be done under controlled conditions. Do not use fans or other air current generators to induce airflow into wall cavities that may have mold growth, as this process will spread the mold spores. An assessment should be performed to determine if careful removal is possible or if mold abatement protocols should be followed.
- **Wall interiors:**
  - Dry wall interiors when moisture content (as measured by a moisture meter) exceeds 14 percent.
  - Vinyl wall coverings and enamel paint may trap water and prevent prompt, unaided drying, and increase the need for mechanical drying.
  - Moisture may come from above or wicking from below. In either case, moisture content above 14 percent requires drying. The actual location of the wet area may influence the actual drying process used, but not the need for drying.
- **Sheet rock (decide within 24-48 hours):**
  - When there is visible mold growth (may be pre-existing mold contamination), this requires that remediation protocols be followed to prevent the spread of mold spores.
  - When the sheetrock is sewage contaminated (IICRC S500-2015 Standard), this requires that remediation protocols be followed.

  - When the drywall is swollen, especially around seams and nail heads, careful removal without following full remediation protocols can be used if removal takes place within two weeks of the incursion and there is no history of a prior incursion.
  - Rusty nails are an indication of the need to remove sheetrock.
- Carpet wet less than 48 hours: Remove all materials (furniture, file cabinets, etc.) from the carpet. Extract as much water as possible from carpet using wet vacuums. Dry the carpet within 24 hours. After work is completed, increase the room temperature and use commercial dehumidifiers, floor fans, or exhaust fans to aid in drying.
- Carpet wet more than 48 hours: Disposal of water-damaged carpets is recommended. Sub-flooring beneath the carpet should be dried with air movers and dehumidifiers using one air mover per room, or one air mover for every 200 square feet, whichever is greater. Place the appropriate number of dehumidifiers, according to the manufacturer's rating for cubic feet, for buildings with highly saturated porous materials such as wood sub-floors.
- Moderately-Contaminated clothing: Launder clothing and blankets with moderate to heavy soap in a typical household washing machine. HEPA vacuum any other porous materials that cannot be laundered (e.g., upholstered furniture, beds, etc.).

Post-Remediation Assessment Sampling

Conduct verification sampling within the building after the remediation has been completed, but prior to reconstruction, to ensure the remediation has been successful and no significant residual mold contamination is present in the structure. An air scrubber (HEPA-filtered) should be operated and exhausted inside (recirculation mode) the containment area for one to three days after the remediation and shut off 24-hours prior to the post-remediation test. The containment enclosure system (i.e. plastic sheeting and supports) should not be removed until successful post-remediation assessment is achieved.

Part 2: Additional Procedures for Gray- or Black-Water Remediation

Where gray or black water intrusions have occurred in buildings, additional measures are needed to protect against pathogens.

Gray water or black water from flooding may contain pathogenic agents, including human or animal waste, and is grossly unsanitary. This water may also include contamination with chemicals such as pesticides, heavy metals, gasoline, and other petroleum products. All floodwater from lakes, rivers, or other bodies of water are considered black water and should be treated as follows:

1. Remove standing water immediately. Excess water may be mopped or mechanically extracted by a pump or wet vacuum system. Black water that is extracted from a building should be disposed of in a sanitary sewer system or removed from the site by a septic waste transporter.
2. Wash materials in a commercial washing system. Non-contaminated items should not be mixed with items contaminated with floodwater or black water.
3. Clean hard, non-porous surfaces, such as metal wall studs, that are structurally sound with an EPA approved biocide rated for elimination of both pathogenic and non-pathogenic organisms. There are numerous quaternary ammonium chloride products that are rated for black water remediation. Use a pump sprayer or approved fogger to apply biocides.
4. Remove and discard upholstered office partitions, chairs, and other large permeable objects that cannot be thoroughly cleaned and disinfected. Remove all porous items that have been wet for more than 48 hours and that cannot be thoroughly cleaned and dried.

5. Remove and discard carpeting and/or padding that has been contaminated with black water. The concrete floor or sub-floor beneath carpeting or other floor covering systems should be thoroughly cleaned and dried before the floor covering is replaced.
6. Remove and replace plaster, gypsum board (dry wall), and insulation that has been saturated at least 12 inches above the water line.
7. Consult a qualified HVAC contractor to determine if black water contamination has been introduced into the HVAC system. If lined duct has been contaminated with floodwaters, this insulated duct should be removed and replaced.
8. Disinfect mops, brooms, and brushes with a quaternary ammonium solution after flushing thoroughly with water. Contact time should be 10 minutes. Flushing with water should be followed with wring out and thorough drying outside in the open air.
9. Although skin contact with floodwater does not pose a serious health risk, there is risk of disease from eating or drinking anything contaminated with floodwater.
10. Establish methods to verify that the building is safe to re-occupy by employees. Odors or visible contamination are signs that the building should undergo further remediation before it is reoccupied. Moisture readings in gypsum board should not exceed 14 percent. Relative humidity should not exceed 60 percent in the interior of the building. If these environmental conditions exist after remediation, it may be necessary to have an industrial hygienist evaluate conditions at the site.
11. Porous material that has become wet from floodwater can contain mold and bacteria that can be harmful to health. Responders who are cleaning up mold or black water contaminated material should wear impermeable rubber gloves and a suitable respirator (at least an N-95 disposable dust mask) to avoid breathing in spores and other contaminated particulate. Wear protective eyewear while handling contaminated material.
12. Handle black water flooding as though it contains infectious organisms. Those who perform remediation work after floods should wear skin, respiratory, and eye protection to prevent infection. Wash hands with soap and water after handling contaminated material and before eating, smoking, drinking or performing other hand to mouth actions.
13. Those who remediate in areas flooded with black water should avoid taking potentially contaminated clothes and shoes into clean areas (non-affected areas) of a building or structure, and should clean their hands thoroughly before entering any clean area.

Additional Resources

Several state and federal agencies have websites that provide additional information on the potential health hazards of floodwater. Links to websites that provide hurricane clean up and worker safety information are listed below:

- Centers for Disease Control and Prevention, *Protect Yourself from Mold*. https://emergency.cdc.gov
- Environmental Protection Agency, *Flood Cleanup*. https://www.epa.gov
- Federal Emergency Management Agency, *Flood*. http://www.fema.gov
- Institute of Inspection Cleaning and Restoration Certification S500, *Water Damage Restoration Standard and Reference Guide for Professional Water Damage Restoration*. http://www.iicrc.org
- National Safety Council, *Air Quality Problems Caused by Floods*. http://www.nsc.org

Liberty Mutual INSURANCE