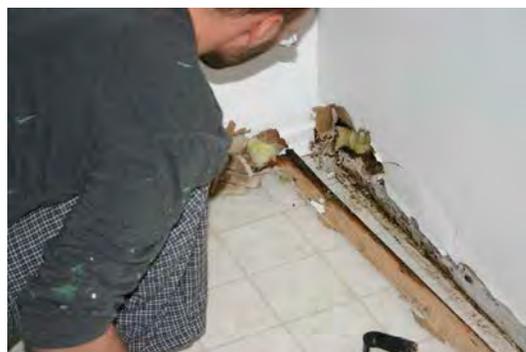




# Mould Remediation Recommendations

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## Summary

- Excessive dampness and mould growth on building material surfaces and contents can pose health risks and should not be tolerated in indoor environments.
- The main goal of remediation is to reduce the risk of exposure to mould and to prevent structural damage; the underlying cause of dampness must be identified and eliminated or mould will reappear.
- Effective mould remediation requires the physical removal of mould growth and spores; even dead mould can cause negative health effects.
- Strategies must be employed to reduce risk to workers and occupants during remediation.
- Ongoing prevention is the most important concept in mould intervention; keep all surfaces in the home as clean and dry as possible to prevent mould from growing.

## Introduction

This report provides Public Health Inspectors (PHIs) and Environmental Health Officers (EHOs) with a summary of current knowledge about mould remediation in homes. The information is based on Mould Remediation in Indoor Environments – Review of Guidelines & Evidence, a more comprehensive review of available evidence from current research papers and mould assessment guidelines commissioned by the National Collaborating Centre for Environmental Health (NCCEH). Lack of evidence in this area emphasizes the need for ongoing research in all aspects of mould remediation.

Recommendations provided in this report are intended for home remediation. While general mould remediation principles apply to schools, workplaces, public and commercial buildings affected by indoor dampness and mould, remediation of larger buildings needs to consider the activities and safety of a larger number of people.<sup>1-4</sup> This report addresses only the situations where mould remediation is technically and economically feasible. Flooding, hidden mould, and marijuana grow operations are situations that present special challenges and risks and are not covered in this report.

evidence.  
review

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## The Purpose of Mould Remediation

Mould remediation involves the cleanup of both moisture and mould. The goal of mould remediation is not to create a sterile, fungi-free environment but to return the space and contents as closely to the pre-damaged condition as possible. The scope of remediation activities depends on the extent of water damage and mould contamination, from surface mould removal by an occupant to an extensive structural renovation requiring a team of skilled professionals. Numerical limits for acceptable levels of mould in the air or on surfaces do not yet exist; the relationship between indoor dampness, the levels of mould exposure, and health effects is not easily quantifiable.<sup>1,4,5</sup>

Evidence shows that while not all remediation efforts are successful, remediation can potentially reduce visible mould and spore counts in a building<sup>6-13</sup> and can also reduce health symptoms in occupants<sup>6,7,9,14,15</sup>. While it is difficult to determine how extensive remediation activities need to be, AIHA indicates that surface and bulk sampling methods in combination with moisture measurements can be utilized to determine how far

mould growth (which may not be readily visible) extends during removal of impacted materials.<sup>16</sup> Studies also indicate that even minor changes to housekeeping activities and building maintenance can significantly improve indoor air quality.<sup>17</sup>

## When Remediation is Necessary

In the absence of health-based limits for mould, there are several accepted ways to determine the required scope of mould remediation. Basing remediation decisions on the amount of visible mould contamination is an approach based on practical considerations that has been accepted in the field and adopted by almost all guidelines (Table 1). With different guidelines, there is some variation in size classification of visible mould. While there has been little scientific evidence to prove that this method is appropriate or effective, a recent study has shown that the area of visible mould does correlate to the number of mould spores present.

Other mould remediation decision methods, supported by guidelines, include decisions based on the condition of the area (IICRC)<sup>25</sup> and amount of water damage (AIHA).<sup>1</sup>

**Table 1: Generalized guidelines for areas of visible mould**

Classification	Description	Necessary Precautions
<b>Small / Area I</b>	Total area: 1 m <sup>2</sup> of visible mould growth or less.	Most guidelines recommend that occupants can clean up areas less than 1 m <sup>2</sup> . No special training is required.  Recommended Personal Protective Equipment (PPE): N-95 mask and rubber gloves.  Guidelines disagree about whether containment is required for this size of growth. <sup>21,22</sup>
<b>Moderate / Area II</b>	Total area: between 1–4 m <sup>2</sup> of visible mould.	Most guidelines recommend that occupants can clean up moderate areas if they have received some training and are using proper procedures.  Recommended PPE: N-95 mask, goggles and rubber gloves.  Minimal containment is required, including air filtration and barriers.
<b>Large / Area III</b>	Total area: 4–10 m <sup>2</sup> of visible mould.	Professional remediation only.*  Full PPE, air filtration, and full containment required.
<b>Extensive contamination / Area IV</b>	Contiguous visible mould growth larger than 10 m <sup>2</sup> in an area.	Professional remediation only.*  Full PPE, air filtration, and full containment required.  Note: Only guidelines from the New York City Department of Health and Mental Hygiene, <sup>18</sup> the US Department of Labor, <sup>21</sup> and Canadian Construction Association <sup>26</sup> include extensive areas of mould growth.

**Notes:** \*Remediation qualifications, licensing requirements, training, and certification for remediation professionals is described elsewhere.<sup>1,23</sup>

For a more thorough explanation of the different classifications, the reader should consult the references.

## Protecting occupants and workers during remediation

During remediation, several strategies need to be implemented to prevent contamination of mould-free areas and reduce risks to both occupants and remediation workers. These strategies include:

- (1) proper planning prior to remediation<sup>1,25</sup>;
- (2) removing vulnerable persons from the work area, including infants under 12 months, pregnant woman, those recovering from surgery, immune suppressed persons, and those with chronic respiratory ailments<sup>5</sup>;
- (3) use of Personal Protective Equipment (PPE) appropriate to the situation<sup>2,18,21,23,25</sup>;
- (4) containment, during remediation, to minimize the distribution of mould and particulates to surrounding areas<sup>1-4,22,25</sup>;
- (5) implementing appropriate quality assurance/quality control measures to monitor activities during and after a remediation project to ensure that the source of moisture is eliminated, mould is removed using correct dust-suppression techniques, and appropriate containment procedures and PPE are used.

## Remediation strategies and procedures

Differences in building characteristics, climate, and occupancy mean there is no single standard or strategy for mould remediation; the following provides a summary of generally accepted principles and processes:

### (1) Identify and eliminate the moisture source

This is the first and most important step of mould remediation. It may involve major repairs or structural modifications, such as adding insulation or increasing ventilation with fans, as well as changing behaviours and habits of occupants. Once the source of moisture is addressed, all materials and contents need to be dried immediately and completely; mould has been shown to grow on materials that are wet for 48-72 hours.<sup>27</sup>

### (2) Remediate heating, ventilation, and air conditioning (HVAC) systems

During structural remediation, heating, ventilation, and air conditioning (HVAC) systems may need to be

deactivated or sealed off to prevent contamination and to limit the dispersal of mould spores and dust throughout the building. Mould-contaminated HVAC systems need to be professionally remediated.<sup>23</sup>

### (3) Removal and remediation of contaminated contents

Before structural remediation, both contaminated and non-contaminated contents need to be removed from affected areas. Contaminated contents should be discarded or thoroughly cleaned, using suitable methods, to prevent the introduction of significant mould spore reservoirs back into the remediated space. The methods for cleaning generally follow the same guidelines as those for structural remediation, as outlined below.

### (4) Removal of mould from structure

The physical removal of mould from the building is essential. Both live and dead mould and mould fragments contribute mycotoxins and other mould products which have been shown to retain their antigenic and/or toxic properties over extended periods of time.<sup>4,5</sup> Cleaning strategies are based on types of materials present and are classified as follows:

- **Porous materials with mould growth**, such as ceiling tiles, wallpaper, drywall, and carpets should be removed and discarded; they cannot be effectively cleaned.
- **Porous materials that are surface-contaminated with dust or mould spores only**, but do not contain mould growth, can be decontaminated by HEPA vacuuming, if dry. If wet, materials should be professionally cleaned. Items that have been wet for extended periods of time are best discarded to prevent further spread of mould.<sup>3,20</sup>
- **Semi-porous materials with mould growth**, such as wood, can be surface cleaned by a combination of scraping, scrubbing, and HEPA vacuuming. The integrity of structural components should be carefully examined to decide on replacement, if it is established that they have been physically compromised.
- **Non-porous materials**, such as tile or glass, can be scrubbed and cleaned.

Many guidelines recommend the use of soap or detergent and water to physically remove mould.<sup>21,23</sup> Other guidelines recommend using diluted bleach, if professional judgment determines it would be beneficial.<sup>28</sup> The use of fungicides and antimicrobials is controversial, due to concerns about the toxicity of the

compounds, the questionable effectiveness in killing and preventing mould growth, and the concern that dead mould and fragments are still toxic/antigenic.<sup>1,29,30</sup> Biocides/ disinfectants are required in cases where contaminated water is present (e.g., sewage, soil, floodwater).<sup>1,3,18,25</sup>

Although encapsulation is sometimes used to cover mouldy material with impenetrable paint or other sealants to prevent the escape of mould particles, there is little evidence to support this approach. Encapsulation is not recommended by any guideline, as it presents an ongoing risk to occupants if the paint/sealant is disturbed and the mould is released back into the indoor environment.

### **(5) Disposal of contaminated material**

Contaminated materials removed from the building should be sealed in 6 mL polyethylene bags to prevent spore dispersal. No additional special disposal requirements are recommended for mould-contaminated materials.

### **(6) Final cleaning, rebuilding, and clearance**

Once the building interior and contents have been dried and mould-contaminated materials removed, dust and visible traces of debris from the remediation process should be removed using damp wiping and a HEPA vacuum cleaner. Prior to containment teardown, clearance procedures should confirm that all water and moisture problems have been identified and addressed and that mould removal is complete; no visible mould, mould damaged material, dust, debris, or mouldy odours are present. Clearance procedures can include visual inspection, olfactory evaluation, moisture measurements, black/white glove tests to ensure that any dust has been removed, as well as airborne mould sampling to determine if levels of indoor and outdoor airborne mould spores are comparable.

For larger projects, post-remediation verification needs to be done by an independent indoor environmental professional. After completion of work, including containment/barrier teardown, a final professional cleaning of the entire interior is recommended, including any areas outside the remediation area, as well as soft and hard furniture, draperies, blinds, and all hard surfaces.

Rebuilding involves reconstructing any part of the structure that was disassembled or removed during remediation. This needs to be done in a manner that prevents future mould growth. The sequence of mould remediation and water repair can be complex, as

sometimes water or moisture repair work cannot proceed until mould sources have been removed. Once cleaning and rebuilding is complete, non-contaminated contents can be returned to the home.

## **Follow up and prevention**

Once a home has been remediated for moisture and mould, surfaces in the home need to be kept as clean and dry as possible to prevent mould from returning. Continuous maintenance and visual monitoring is required to prevent future moisture damage.<sup>2-5,22,25,31</sup> Preventative strategies include:

### **(1) Reduction of moisture through humidity and condensation control**

Excess humidity can be reduced by increasing ventilation and encouraging air circulation using kitchen and bathroom fans or opening windows. Condensation can be reduced by maintaining ventilation air below, or above, the dew point when it is being cooled or heated, respectively and by insulating cold surfaces, such as indoor walls, attics, and cold water pipes.<sup>2,3,22,32-35</sup>

### **(2) Preventative maintenance of building structures and HVAC systems**

Leaks and other water damage can be prevented by ensuring adequate preventative maintenance is conducted and repairs are done in a timely manner. HVAC systems should be inspected and maintained on a regular basis. Professional cleaning of air ducts has not been shown to improve health and is only necessary if visible mould growth is observed in the air duct or heavy contaminated dust is identified in air ducts,<sup>36</sup> in which case, fibrous duct liners may need to be removed, as vacuuming has not been shown to be effective.<sup>37</sup>

### **(3) Awareness and implementation of other practices to reduce moisture and mould**

Occupants should be made aware of how residential activities, such as cooking, bathing, or improper use of appliances, e.g., clothes dryers vented to the indoors, can generate moisture. Modest environmental or behavioural interventions can lower indoor mould concentrations as well as other allergens, including: changes to cleaning and housekeeping habits, increasing ventilation, reducing the number of plants, eliminating clutter, installing air filtration systems or air filters, and using entry mats.<sup>17,33,34,38,39</sup>

## Recommended Mould and Remediation Resources for Homeowners

Canadian Mortgage and Housing Corporation

<http://www.cmhc-schl.gc.ca/en/co/maho/yohoyohe/momo/index.cfm>

Health Canada guidelines for Mould, Dampness and Humidity

<http://www.hc-sc.gc.ca/ewh-semt/air/in/poll/mould-moisissure/rid-debarrasser-eng.php>

<http://www.hc-sc.gc.ca/fniah-spnia/promotion/public-publique/home-maison/mould-moisissure-eng.php>

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National Institute of Environmental Health Sciences (NIEHS)

<http://www.niehs.nih.gov/health/topics/agents/mold/index.cfm>

US Centre for Disease Control <http://www.cdc.gov/mold/>

US Environmental Protection Agency

<http://www.epa.gov/mold/moldguide.html>

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