MOISTURE

Moisture is the enemy of good indoor air quality. Leaks, humidity, condensation, and even internally generated moisture from cooking and bathing, encourage bacterial and mold growth, pest infestations, and the release of chemicals from water damaged building materials all of which negatively impact the air in your living spaces. Controlling moisture is your best defense.



While it is impossible to completely eliminate all moisture sources from your home - whether from leaks, flooding, or condensation - you can take steps to minimize its impact and make your home more supportive of health. While each step by itself is important, none are sufficient by themselves for significant improvement. Completion of all steps for the appropriate situation in the order listed below, will provide maximum benefit.

1

Identify the source of the water. If the source cannot be identified, then the moisture cannot be stopped and damage will continue. Remember water comes in two forms liquid and vapor. High levels of humidity and frequent condensation can cause damage as easily as a leaky pipe or basement flood.

2

Identify the extent of the moisture intrusion by determining the boundaries of where all the moisture spread or soaked in. Failure to do this can result in incomplete restoration of the affected areas, unresolved health issues, and mold that continues to reappear.

3

Determine the type of contamination of the water in the home. Each type of contaminated water - whether originating from clean drinkable water or hazardous sewage - requires some different procedures, which if not followed can create additional and intensifying hazards to structures and people.

4

Remove water and dry the materials.

5

Remove mold.

6

Change moisture generating habits.

IMPLEMENTATION MANUAL





Moisture can be one of the most damaging conditions in your home. From small leaks and high indoor humidity to larger water intrusions like a flooded basement, water can cause structural damage, odors, and the growth of bacteria and mold on and in walls, ceilings, and floors. By quickly identifying and fixing issues, preventing leaks, and managing excess moisture (relative humidity) you can improve the air quality inside your home and increase your Hayward Score.

This manual is designed to help you address the issues stemming from moisture intrusions and manage moisture over time. Although most of these actions and their combinations are not new, the reasons for conducting them are new to many contractors. They have been trained to comply local building codes and general industry standards, not these higher standards which include the impact of the house on the people who live in them.

Our methodology encompasses building science and academic research in combination with extensive practical experience of what works and what doesn't work. It exceeds most industry standards, and dramatically reduces pollutants in the outdoor air from entering your living spaces. It is critically important that the steps be completed as specified and in the order listed!

STEP 1: SOURCE IDENTIFICATION AND FIXES

STEP 2: EXTENT DETERMINATION

STEP 3: DETERMINE TYPE OF CONTAMINATION

STEP 4: REMOVE "FREE" WATER, DRY "BOUND" WATER

STEP 5: REMOVE MOLD

STEP 6: CHANGE MOISTURE GENERATING HABITS

STEP 1: SOURCE IDENTIFICATION AND FIXES

Inspect the area where water is visible, and trace it back to where it came from. If water isn't stopped at the source, the damage will continue at the source and condensation and humidity aren't managed, the damage will continue and you will end up having to redo repairs and repeatedly clean up mold. If you don't see visible water or stains, but smell damp or musty odors - keep looking! You almost certainly have a moisture source that needs attention!

- Repairs are required for:
- ROOF LEAKS
- FOUNDATION LEAKS
- BROKEN OR LEAKY PIPES
- LEAKY WINDOWS AND DOORS
- Alterations are required for:
- LANDSCAPING WHERE RAIN WATER OR SNOW MELT ACCUMULATES AGAINST THE FOUNDATION SHOULD BE SMOOTHED AND SLOPED TO RUN WATER AWAY FROM FOUNDATION
- DOWNSPOUTS THAT DRAIN TOO CLOSE TO THE HOUSE/FOUNDATION SHOULD BE EXTENDED SO THEY DIRECT WATER AWAY FROM THE HOUSE
- SPRINKLER NOZZLES THAT ALLOW WATER TO HIT THE SIDE OF THE HOUSE SHOULD BE MOVED TO
- CRAWLSPACES WITH DIRT FLOORS SHOULD HAVE SEALED MOISTURE BARRIERS INSTALLED (SEE THE CRAWLSPACE ACTION PLAN FOR DETAILS).

- Behavior changes are required to:
- RUN KITCHEN EXHAUST FANS WHILE BOILING OR STEAMING FOOD
- RUN THE BATHROOM EXHAUST FAN DURING AND AFTER SHOWERING/BATHING
- Equipment changes may be required to:
- ENSURE KITCHEN EXHAUST FANS ARE LARGE ENOUGH TO COVER BURNERS AND ARE VENTING OUTSIDE THE HOUSE
- ENSURE BATH FANS ARE FUNCTIONING PROPERLY AND VENTING OUTSIDE THE HOUSE
- ENSURE DRYER VENTS ARE FREE FROM EXCESS LINT AND ARE VENTING OUTSIDE THE HOUSE
- Climate control is required to:
- PREVENT/MINIMIZE CONDENSATION FROM HIGH HUMIDITY OR ON COOL SURFACES

←→ STEP 2: EXTENT DETERMINATION

Water obeys the law of gravity and (initially) flows downhill. But when it stops at the bottom of a wall or onto a floor then it goes sideways across the floor. If it encounters a wall or other obstacle, then it can continue under the wall. At that point the water can also move upwards from a few inches to nearly two feet

as it soaks into the materials of the wall. Water that enters the interior of a wall becomes trapped, and as it slowly evaporates into the air space between the studs it can often condense at higher levels if the materials are cool enough. And where water goes, so can bacteria and mold grow.

- Because water moves, it is critical to discover where it all went. Identify the boundaries of the water by checking 360 degrees in all directions - horizontally, vertically, and through structures.
- If you don't find all the water, then damage and potential growth of bacteria and mold will continue.

HOW TO FIND BOUND WATER

Free water is visible, like puddles on the floor and can be easily mopped up. Bound water is usually not visible, like with damp drywall or carpet. If you aren't hiring a professional, use a moisture meter or infrared (IR) camera to find bound water.

There are affordable and highly useful IR camera that can be plugged into an iPhone or Android suitable for amateur use.

INFRARED TIPS AND TRICKS

The key is to practice, practice, practice with known conditions. IR doesnt detect moisture itself. It detects temperature differences, regardless of the cause of the temperature and it could be something other than water. It takes practice to tell the difference.

Moisture meters are available in most hardware stores. It is especially important to check wood for bound water. Even if water stains and mold aren't visible, wood may still have high moisture content (>20%) which can result in rotting, structural damage and mold. Your goal is not only to find the visible wet areas, but also to learn how to find the bound water, the hidden damp spots, and the boundaries.

MOISTURE METER TIPS AND TRICKS!

Moisture meters with pads are easier to use than those with pins, but both require practice. Practice on areas that you know are dry and areas you know are wet so you can compare the readings and the behavior of the meter. Practice placing the meter on metal objects to see how it responds to objects that are not water.

By becoming familiar with the straight lines of readings from electrical wiring in a wall or metal reinforcements on wall corners, you can learn to compare those patterns to the irregular outline of moisture patterns

(1) STEP 3:

DETERMINE TYPE OF CONTAMINATION

Water is never "just water." Water is as close to a universal solvent as possible. This means it will "pick up" quantities of whatever it flowed through, into, or over. The longer water sits before it is cleaned up, the more contaminants it will contain and the greater the risk that bacteria and mold have grown. It is important to know what kind of water is in your home so you can safely and correctly clean it up.

THERE ARE THREE CATEGORIES OF WATER CONTAMINATION:

Category 1. 1 – Liquid from a clean and sanitary source. Examples are water from:

- Faucets
- Drinking fountain
- · Ice Maker

Category 2. Liquid from a source that may be contaminated and may cause illness or discomfort if ingested. Can also be referred to as "grey water." Examples are water from:

- · Dishwasher or washing machine discharge
- · Flush from sink drain or garbage disposal
- Toilet overflow with urine only (no feces)
- A clean source that has come into contact with building materials, carpet, or any surface that may contain contaminants

Category 3. Liquid from a source that is grossly unsanitary and could cause severe illness or death if ingested. Can also be referred to as "black water." Examples are water from:

- Sewage backup
- Toilet overflow with feces
- Flooding from rivers or streams
- · Wind-driven rains, strong storms or hurricanevs that are likely to have come in contact with outdoor pollutants like chemicals, pesticides, fertilizers, gasoline or other fuel, ground water, and more

• Sources that have been standing of stagnant and has begun to support bacterial growth.

Water of any type should always be removed as soon as possible though effective restoration methods are different for each type of contamination. For Category 2 or 3 water especially, we strongly suggest consulting a professional who follows professional industry standards and ANSI standards.

- Water from a clean source, like straight from a water pipe, is potable until it contacts structure, materials, or surfaces.
- If the structure is relatively clean, then the water won't be "contaminated" but it will no longer be safe to drink. The longer the water remains, the more the various kinds of contamination will be dissolved into the water. This also increases the potential for germination and growth of the always present bacteria and mold.
- Water from dishwashers, washing machines, garbage disposals are not safe to drink because they contain organic pollutants such as food, dirt, human skin flakes, and other generic "filth." If this water is not removed quickly bacteria can begin reproducing within minutes.
- Water from sewage is obviously contaminated and potentially hazardous to human health. It must be removed, cleaned, and disinfected immediately.
- Water from floods, wind-driven rain, hurricanes, and other strong storms are also assumed to be contaminated - from chemicals, fertilizers, litter boxes, dirt, ground water, gasoline and other fuels, plus other unknown pollutants that may have been in its path.

Effective restoration methods are different for each type of contamination. Consult a professional for appropriate actions per prevailing industry guidelines and ANSI Standards.

STEP 4:

REMOVAL OF "FREE" WATER, DRYING OF "BOUND" WATER

As described earlier, "free water" is water that is flowing or puddling on a surface that can be soaked up with towels or sucked out with a shop vac. "Bound water" is water that has soaked into materials and is now below the surface which means it cannot be easily removed. It is important to stop the water source and remove water as quickly as possible for several reasons:

- The longer free water is left on a surface, the more of it will soak in and become bound water.
- WATER LEFT PUDDLING ON CONCRETE WILL BE QUICKLY
 ABSORBED BUT NOT EASILY REMOVED. OFTEN EXTENSIVE
 AND SOPHISTICATED TECHNIQUES ARE REQUIRED TO FORCE
 THE BOUND WATER BACK TO THE SURFACE. ONCE ON THE
 SURFACE IT CAN SLOWLY EVAPORTATE INTO THE AIR OR THE
 EVAPORATION CAN BE ACCELERATED WITH THE USE OF
 DEHUMIDIFIERS.
- OVER TIME, BOUND WATER CAUSES SOFTENING AND ROTTING OF WOOD AND CAN PUT STRUCTURES AT RISK.

- Germination of mold spores takes anywhere from a day or so to a couple of weeks, depending on the genus and species of mold.
 The longer free water and bound water is not removed the higher the likelihood of mold.
- "Clean" water can actually become "contaminated" water in as a little as 48 hours in some circumstances, as bacteria amplifies when water is left standing.

There are three fundamental methods for removing bound water, all based on the same scientific principle of wetness moves to dryness:

1 OPEN DRYING:

Like it sounds, this involves opening the building to the outside air. If the humidity outside is significantly lower than inside, then drying will take place. The greater the difference the better it works.

2 REFRIGERANT DEHUMIDIFYING:

Refrigerant dehumidifiers can reduce the humidity of the inside air, regardless of the outside humidity, to about 40% relative humidity (RH). This is often sufficient to accelerate the drying of materials before damage or growth can occur. This is especially true for rooms and small houses.

3 DESSICANT DEHUMIDIFYING:

Mechanical Desiccant dehumidifiers can reduce the RH even lower than the 40% minimum of refrigerant dehumidifiers. They can go as low as the teens. Desiccants are most cost effective in large homes and commercial buildings, or when rapid drying is critical.

Refrigerant dehumidifiers are readily available from retail and home improvement stores, with costs starting at about \$100. But not all dehumidifiers are created equal. The less expensive ones can only remove small amounts of water per day (30 pints), while the larger more expensive ones can remove as much as 9 gallons per day. If renting or purchasing a dehumidifier, make sure you choose one that is the appropriate size for your space.

STEP 5: REMOVAL OF VISIBLE MOLD

Visible mold can be very easy or very difficult to remove. The difference depends on how much mold there is, what kind of surface it is on, and how long it has been there. If the moisture is not completely stopped or all locations with moisture intrusion are not identified and sufficiently dried, it is likely that visible mold and/or mal-odors will return.

BE SAFE

Exposure to mold can cause a reaction, even if you never had one previously. For people who are particularly sensitive, even exposure to a small quantity of mold can cause symptoms.

Use caution whenever you might be around moldy areas. At the very least, use a good quality, use a snug-fitting mask lableled NIOSH N-95 or higher. Paper surgical masks or bandanas are ineffective.

A FEW NOTES ABOUT MOLD

Mold is a micro-organism, meaning it cannot be seen without a microscope. With sufficient moisture and food it can grow and eventually create seeds (spores) for reproduction. With continued dampness the spores can germinate and grow into new mold "plants," With continued dampness ranging from 2-3 days to 2-3 weeks, the mold growth will be large enough to be visible to the unaided eye.

As with the large visible plants we are more familiar with, mold "plants" have a similar structure of roots, trunk, and branches. Mold roots, however, don't need soil. They just need a surface with "dust" plus dampness.

REMOVING VISIBLE MOLD GROWTH

Mold, whether dormant or active, must be removed.
Non-porous surfaces can often be cleaned while
porous surfaces are difficult to clean sufficiently.
Remember, there may be mold that you can't see
hidden behind walls or under carpet or floors.

- IF THE SURFACE IS SMOOTH AND NON-POROUS THE ROOTS STAY ON TOP OF THE SURFACE. WHICH MEANS WIPING CLEAN THE SURFACE WITH A DAMP CLOTH AND A LITTLE DETERGENT WILL REMOVE THE MOLD PLANTS, ROOTS AND ALL.
- IF THE SURFACE IS ROUGH, LIKE UNFINISHED WOOD OR DRYWALL, THE MOLD PLANT CAN STILL REMAIN ON TOP OF THE SURFACE BUT THE HILLS AND VALLEYS PREVENT CLEANING BY WIPING TO REMOVE THE PORTIONS THAT ARE IN THE DEEP CREVASSES. FOR WOOD, ESPECIALLY, ABRADING THE SURFACE BY SANDING OR WIRE BRUSHING WILL REMOVE THE TOP LAYER OF PEAKS AND VALLEYS, AND THE MOLD ALONG WITH IT. DRYWALL MUST BE REMOVED.
- IF THE SURFACE IS POROUS, LIKE UPHOLSTERY OR CARPET,
 THEN THE ROOTS OF GROWING MOLD WILL BECOME
 ENTANGLED IN THE FABRIC AND CANNOT BE RELIABLY
 REMOVED. IF THERE IS MOLD GROWTH ON THOSE OBJECTS,
 WHETHER A CHILD'S SMALL TOY OR A THOUSAND SQUARE
 FEET OF CARPET, THEY WILL NEED TO BE REMOVED AND
 REPLACED.

REMOVING MOLD SPORES

If there is visible mold, then there will have been at some time spores which become airborne. Once in the air they will circulate with the air to where ever the air goes. Spores by themselves have very different characteristics than growing mold, but can still trigger reactions and need to be removed. Because spores are light and dry and without roots, they will be like dust. And in fact are a typical component of routine "house dust." This means spores can be removed just like dust:

- FOR HARD SURFACES, LIKE TILE OR WOOD FLOORS,
 VACUUMING WITH A HEPA FILTERED VACUUM OR A
 SWIFFER IS USUALLY SUFFICIENT.
- FOR FABRIC SURFACES, LIKE UPHOLSTERY OR CARPET,
 VACUUMING WITH A HEPA FILTERED VACUUM CAN HELP
 REMOVE SPORES, BUT BECAUSE THEY BECOME EMBEDDED
 FROM SITTING OR WALKING ON THE FABRIC, THEY ARE
 DIFFICULT TO REMOVE. SUFFICIENTLY DEEPLY EMBEDDED
 SPORES ARE LESS LIKELY TO BECOME AIRBORNE SO
 EXPOSURE RISK IS LOWER. HOWEVER, SPORES WHICH ARE
 EMBEDDED IN AN OBJECT THAT BECOMES DAMP OR WET
 FOR MORE THAN A FEW DAYS CAN GERMINATE AND BEGIN
 GROWING INTO A MOLD "GARDEN." LEFT LONGER AND THAT
 "GARDEN" CAN BECOME A "JUNGLE WHICH WILL NEED TO
 BE REMOVED, ALONG WITH ANYTHING IT IS GROWING ON,
 BECAUSE IT CAN'T BE SUFFICIENTLY CLEANED.

TRAP 1: MOLD KILLING PRODUCTS

Products claiming to "kill mold" are not only expensive but they aren't very effective. They can even make the situation worse by increasing exposure.

Dead mold can no longer take up moisture, so it dries. Like tree leaves in the Autumn that fall to the ground, they dry out and then naturally crumble into tiny fragments. The fragments of the spores and of the main body of the mold organism have been measured as much as 1000 times more plentiful than intact spores and of the mold organism. If the mold growth – and all else associated with it – cannot be removed, then the material it is growing on must be removed.

TRAP 2: MOLD TESTING

Mold testing is rarely needed. The type of mold does not change the need to remove and does not change how to remove. Air samples in crawlspaces are mostly irrelevant. Surface samples identify suspect visible mold growth, but are not needed if the suspect mold is visible. If the "suspect" mold growth isn't mold, it still needs to be removed. So, simply remove.



TRUSTWORTHY RESOURCES:

- www.epa.gov/mold for several free downloadable documents plus a video.
- New York City Department of Health Guidelines
- ANSI-IICRC \$500 Standard and Reference Guide for Professional Water Damage Restoration.
- ANSI-IICRC S520 Standard and Reference Guide for Professional Mold Remediation.

STEP 6: CHANGE MOISTURE GENERATING HABITS

8

There are a lot of things you can do to minimize moisture in your house and help to support good indoor air quality:

- Run the bath fan during and for up to 2 hours after bathing.
- Run the range hood fan (vented to the outside) while cooking to remove moisture as well as cooking gasses.
- Make sure sprinklers don't hit the side of the house.
- Keep indoor humidity levels at 50% or less.
- Make sure your dryer is properly vented outside.

MAINTENANCE MANUAL





Houses change over time and repairs you did one year, may not last indefinitely. Ongoing, routine maintenance is required to ensure that moisture issues do not recur. Our Maintenance Manual outlines the things you need to do to keep your home's air healthy!

INSPECT REPAIRED LEAKS:

- Roof leaks
- Foundation leaks
- Broken pipes
- Leaky windows and doors

MAINTENANCE ACTION: Make sure all repairs are still in good condition. If the repairs have failed and you are still noticing water intrusion, mold growth or off-odors, then you need to assess and repair

INSPECT LANDSCAPING:

Areas where rain water or snow melt accumulates against the foundation

MAINTENANCE ACTION: If water is still accumulating against the foundation, make the necessary alterations to slope and uniformity of the surface to direct water away from the foundation.

INSPECT THE STRUCTURE:

- Downspouts that drain too close to the house/foundation
- Sprinkler nozzles that allow water to hit the side of the house

MAINTENANCE ACTION: Add extensions to the downspouts and move (or not use) the sprinkler nozzles near the house

INSPECT THE CRAWLSPACE MOISTURE BARRIER:

It was installed to block the moisture in the dirt floor of a crawlspace. See the Crawlspace Action Plan for additional details and for other changes.

MAINTENANCE ACTION: If the barrier has holes, penetrations, or tears to assess why these occurred and make the necessary repairs. You may need to hire a professional to help with the assessment and repairs.

EVALUATE OCCUPANT BEHAVIOR:

- Always turn on kitchen exhaust fan, vented to the outside, while boiling, steaming or cooking to minimize moisture as well as cooking gasses.
- Always run bathroom exhaust fan during and for at least 20 minutes after showering/bathing

MAINTENANCE ACTION: Review behaviors and create inducements for compliance.

EVALUATE THE INTERIOR CLIMATE:

Check climate control procedures and system of the interior to ensure there is no longer condensation from high humidity or on cool surfaces

MAINTENANCE ACTION: If condensation continues, then hire a professional to assess why and make recommendations on how to stop the condensation.

CHECKLIST





Ready to get started? Great! Keep this checklist handy as you move through the process of getting moisture under control in your house.

STEP 1:

SOURCE IDENTIFICATION AND FIXES

Some moisture sources are obvious - like leaks or flooding, but some are less obvious, like excess condensation from cooking, laundry, or bathing. If you are seeing evidence of excess moisture and you don't see leak, keep looking!

If the source is not stopped then the damage will continue.

Stopping the moisture will require different techniques for each source type.

STEP 2:

EXTENT DETERMINATION

Moisture, whether as liquid water or water vapor, does not stay at its source, it moves, but not always where it is expected to move. Use visual cues as well as a moisture meter to determine how far in each direction moisture has spread.

Removal of all water, wherever it goes and however it got there, is critical to stop damage and amplification of bacterial and mold growth.

STEP 3:

DETERMINE TYPE OF CONTAMINATION

Determine if the original water source is potable (safe to drink), slightly contaminated (enough to cause illness but not threaten life, or contaminated (potentially life threatening).

Determine the final contamination of the water once you figure out what the water has come into contact with. As water is essentially a universal solvent, it will contain quantities of whatever it flowed over, through, or into.

Effective restoration methods are different for each type of contamination.

MOISTURE 101

THERE ARE THREE TYPES OF MOISTURE

SOLID (ICE)

LIQUID (RUNNING WATER, CONDENSATION)
VAPOR (HUMIDITY)

SOME INDOOR MOISTURE SOURCES

- cooking
- bathing
- leaks
- improperly vented dryer
- excess humidity
- human (and pet) respiration

SOME OUTDOOR MOISTURE SOURCES:

- rain and snow melt
- sprinklers hitting the side of the house
- storm flooding
- poor drainage
- sewage back up from street

REMEMBER: WATER IS ESSENTIALLY A
UNIVERSAL SOLVENT WHICH MEANS IT WILL
"PICK UP" QUANTITIES OF WHAT IT FLOWS
INTO, OVER, OR THROUGH.

STEP 4:

REMOVE "FREE" WATER AND DRY "BOUND" WATER

- Water must be removed within 48 hours to prevent structural damage and the growth of bacteria and mold. If you don't dry all affected areas completely, you'll just repeat Step 5 over and over.
 - Water flowing or in puddles on the floor is called "free water" and should be immediately mopped up.
 - Water that has soaked below the surface and into materials such as carpeting, flooring, or drywall is called "bound water." It is the water (dampness) that remains after the "loose" water has been removed. The material must be dried to the moisture content of similar, unaffected areas. If the materials cannot be sufficiently dried or are damaged, moldy, or rotten they must be removed and replaced.

STEP 5: REMOVE MOLD

- Mold must be removed by cleaning the the surface and/or removing the material the mold is growing on or behind (where you can't see it
- On hard, smooth, non-porous surfaces, such as tile, wiping the surface with warm water and a non- fragranced detergent or vinegar is sufficient even if the area of growth is extensive.
- Growth on soft, rough, or porous surfaces cannot be sufficiently removed. Small areas may not present enough exposure to warrant futher action. However, larger areas almost always need to be removed and replaced. The roots, trunks and other growth structures are in the low spots which cannot be simply wiped clean. Roots of the growth can become entangle in the fabric of porous materials preventing removal. These materials almost always shoud be be replaced.
- When multiple surfaces or rooms are affected, professional assessment is recommended, which should also include a scope of work, the industry guidance or professional standards most appropriate, and the criteria for determining successful completion of removal.

"Killing" mold with bleach or other agents is not effective and can actually make the situation worse. The structures of the dead mold growth will dry, crumble, and fragment into hundreds of ultra small particles. This increases exposure and allows the particles to penetrate deeper into the lungs. Simply killing mold does not stop the water source so new mold can quickly grow in the same location.

A Note about Mold Testing

Testing for mold before removal may satisfy curiosity and reduce fear, but the delay allows the growth to o continue increasing. Testing does not determine whether or not the mold should be removed - it should be removed regardless of what kind it is - or the methods for removal.

BE SAFE

Exposure to mold can cause a reaction, even if you never had one previously. For people who are particularly sensitive, even exposure to a small quantity of mold can cause symptoms.

Use caution whenever you might be around moldy areas. At the very least, use a snug-fitting mask lableled NIOSH N-95 or higher. Paper surgical masks or bandanas are ineffective.

STEP 6:

CHANGE MOISTURE GENERATING HABITS

There are a lot of things you can do to minimize moisture in your house and help to support good indoor air quality:

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