UNGER
CONSTRUCTION CO.

Proof of Training

Print name: _____Signature: _____ Date: _____

Water Intrusion - Category 1 and 2 Policy

Category 1 is water from a clean and sanitary source. Category 2 is water that has a level of contaminates that may cause illness or discomfort if ingested. Unger Constructions water intrusion program is based on American National Standard Institute (ANSI) and Institute of Inspection Cleaning and Restoration Certification (IICRC) Standard S500-2015 "Standard for Professional Water Damage Restoration".

Purpose

This policy describes the procedures to be followed and the precautions to be taken when performing Category 1 and 2 remediation. The purpose of this policy is to provide information about: the potential health effects associated with exposure, engineering controls, administrative controls, work practices that prevent exposure and protect the health of employees, subcontractors, building occupants during Category 1 and 2 remediation. This policy is closely linked to our Infection Control Policy and our Mold Remediation Policy. This policy is a living document that is subject to change as more information becomes available and as development occurs and advancements are made.

Scope

This policy will apply to all work performed by employees and subcontractors including, but not limited to the following activities: construction, installation, demolition, remodeling, relocation, refurbishment, testing, and at other times when Category 1 and 2 water intrusion events could be encountered.

Deviations

It is impractical to prescribe procedures for every Category 1 and 2 remediation situation since every water remediation project is unique. In certain circumstances experience and professional risk management judgement may justify deviation. Deviations shall be documented and approved in writing by senior management (one of the owners of Unger Construction).

Responsibilities

Management (Board of Directors and Project Managers)

Management is responsible for ensuring that the materials (e.g., tools, equipment, personal protective equipment) and other resources (i.e., worker training materials) required to fully implement and maintain this program are readily available where and when they are required. Additionally, management will monitor the effectiveness of the program, provide technical assistance as needed, and review the program bi-annually.

Program Manager

Dave Simpson is responsible for the development, documentation, training and administration of the program. This position carries the responsibility of insuring this program is adhered to and that proper reporting is executed.

Supervisors (Superintendents and Foreman)

Supervisors are responsible for ensuring that a task specific job hazard analysis (JHA), also known as a safe work plan, is developed. The JHA will select, implement and document the appropriate site-specific control measures as defined within this policy. Supervisors will direct the work in a manner that ensures the risk to workers is minimized, adequately controlled and that practices defined by this policy will be followed. Supervisors are responsible for ensuring Unger Construction employees and subcontractors are following expectations. Supervisors will be held accountable for enforcing the requirements of this program. Undesirable behavior will not resolve itself, therefore supervisors must be directly involved with modifying behaviors inconsistent with program expectations. Supervisors will be held accountable for enforcing Unger Construction's disciplinary program.

Workers (Employees and Subcontractors)

Unger Construction has high expectations and requires safety excellence for each employee, crew, project and for our entire company. Workers are required to follow the minimum procedures outlined in this program. Workers are responsible for knowing the hazards and the control measures established in the JHA. Workers are responsible for using the assigned PPE in an effective and safe manner. Workers are responsible for stopping unsafe acts and correcting unsafe conditions on the spot as soon as they are discovered. Any deviations from this program must be immediately brought to the attention of your supervisor. Workers that choose to conduct themselves in a manner that is inconsistent with these expectations will be held accountable for those decisions and may incur disciplinary actions.

Hazardous Material Survey

Unger Construction requires hazardous materials surveys before demolition or renovation work begins. The survey shall include all of the following: A visual inspection of a facility or a portion thereof for suspect materials, sampling and laboratory analysis of any suspect materials found for the presence of asbestos. The hazardous materials survey will also furnish a written report that includes: a description of the area(s) visually inspected, a detailed description of any suspect material sampled, the results of any laboratory analysis of suspect materials, the method of analysis, and the total amount of asbestos containing material. Typically a floor or roof plan is included with the report to reference the written information visually.

The person conducting the survey must be certified pursuant to OSHA and/or EPA regulations. The survey may be performed by a certified Site Surveillance Technician (SST) under the supervision of a licensed consultant. Note: The survey needs to be kept in a project file so that it can be accessed when working on future projects.

If lead or asbestos have been confirmed to be present employees and subcontractors must follow Unger Constructions Lead and/or Asbestos program. If hazards such as asbestos or lead will be disturbed during remediation, a properly licensed professional must perform the work and follow appropriate regulations.

Job Hazard Assessment (Safe Work Plan)

Unger Construction utilizes JHA's as our means of hazard assessment and establishing a safe work plan. JHA's are performed by supervisors and/or workers. Our library of hazard assessments is maintained on the "S" drive. Before beginning a new task refer to the JHA library, generally speaking all scopes of our work are covered. For situations that have not yet been covered select one that is substantially similar and use it as a baseline. JHA's on the "S" drive are organized by work area and job description. JHA's include strategies for elimination, substitution, engineering and administrative controls. After applying all appropriate reduction and elimination technique, the remaining hazards will be analyzed and the proper PPE to reduce the hazards will be selected. PPE will be identified for hazards that are in the process of being reduced or eliminated and/or when hazard-reduction efforts are not 100% effective in eliminating the hazards.

For complex or moderate to high hazard tasks, tasks where an additional level of safety planning is needed, the safety director will perform the JHA with the supervisor and workers.

Training

Before any employee or subcontractor is allowed to perform work in areas that are known to contain or are suspected of containing Category 1 and 2 water they must be trained. Training shall include the following information: Health effects associated with water intrusion, methods of recognizing/identifying Category 1 and 2 water, engineering controls, administrative controls, personal protective equipment and safe work practices. Each employee or subcontractor must demonstrate an understanding of the required training before being allowed to perform work. For Unger Construction, employee's proof of training is available on the "S" drive. Prior to starting work all subcontractors shall provide evidence of Category 1 and 2 water intrusion awareness training.

Retraining

The need for retraining will be indicated when: An employee or subcontractors work habits or knowledge indicates a lack of necessary understanding, motivation or skills required to properly work within or around Category 1 and 2 water remediation.

Immunization

Be sure that your tetanus shots are current. If the skin is broken, particularly with a puncture wound or a wound in contact with potentially contaminated Category 2 material, a tetanus vaccination may be needed.

Risk Management and Insurance

Category 1 and 2 water intrusion and mold remediation warrants prudent risk management to ensure our liability exposure is balanced with our business management practices. Depending on the circumstances Unger Construction may choose to hire specialized experts that can carry appropriate business and environmental liability insurance. Unger Construction will decline work that is outside of our own expertise.

Client insurance policies covering structures subject to water damage or mold remediation are complex. The evaluation of insurance coverage for water damage or mold remediation has become much more uncertain and problematic. Payment for water damage and mold remediation services generally comes directly from the client rather than through an insurance company. General, liability policies and most commercial liability policies could exclude some or all of the claims for injury or damage resulting from mold or pollutants including the cost of the cleanup.

Environmental insurance is the only insurance available to cover mold remediation. This specialized insurance coupled with proper planning can maximize the value of the insurance purchased while minimizing the premiums paid and the potential professional liability exposure. The market place includes only a small number of insurers capable of writing a full range of environmental coverage.

Exclusions

Hazardous or Regulated Materials

The presence of hazardous or regulated materials such as lead or asbestos will present a limitation and complications. Lead and asbestos require specific training, licensing, permits, specific mitigation or remediation protocols. The presence of these hazardous or regulated materials takes precedence over the Category 1 and 2 remediation and will necessitate engaging a qualified/specialized hazardous or regulated materials expert.

Heating Ventilation and Air Conditioning (HVAC) Systems

Category 1 and 2 water intrusion remediation of HVAC systems shall be excluded from Unger Constructions scope of work and shall be performed by a HVAC subcontractor. Ductwork with a non-porous surface responds well to cleaning and remediation. Sections of internally lined duct work, duckboard or flexible ductwork that are exposed to water cannot be successfully cleaned and therefore shall be replaced. When HVAC systems undergo remediation they should be inspected and retuned to Condition 1 per the National Air Duct Cleaners Association (NADCA) Standard "Assessment Cleaning and Restoration of HVAC Systems"

Health Effects

Microbial contamination associated with water damage is a health concern presenting risks to both the remediators and the building occupants. Generally speaking the illnesses are of a respiratory inflammation/sensitivity, allergic or infectious nature. To reduce the risk of exposure Unger Construction utilizes engineering controls, administrative controls and personal protective equipment.

Water Intrusion Basics

A water intrusion event is defined as an unintentional release of water, either in liquid or vapor form, into a building, including the building's envelope and mechanical systems. Such events would include, but not be limited to, leaks from plumbing or mechanical systems, flooding from surface runoff, water leaks from roofs and other building structure (windows, walls, etc), and sewage backflows. Water is the single most long-term destructive substance in the indoor environment. It dissolves or weakens many materials and supports the growth of microorganisms on others. When water intrusion occurs, quick reaction to seepage, spillage, flooding, or backups has many benefits.

Quick reaction often saves valuable property from direct water damage as well as destruction from microbial growth. The longer water damage goes untreated, the greater the damage. Immediate response to water intrusion saves time and money, and protects property and health.

During a water intrusion remediation project the primary objectives are to protect public health, immediately remove harmful substances, restore the environment to a dry state, and salvage valuable property. The severity of the health threat depends on chemical content of the water and the degree and extent of penetration into the building environment. The degree of penetration is dependent on the porosity of contaminated materials, the quantity of water, and the amount of time the water remains in contact with materials.

Time is of the essence, if materials are thoroughly dried out within 48 hours and the source of the moisture corrected, the area is thoroughly cleaned further problems are unlikely. If the impacted area cannot be dried before 48 hours conditions will be downgraded 1 classification (Category 1 becomes Category 2, Category 2 becomes Category 3). Category 3 presents serious health concerns. Refer to our Category 3 water intrusion policy for detailed information. Mold presents serious health concerns. If mold is discovered during the remediation effort refer to our mold remediation policy.

Determining the Appropriate Response

In determining the appropriate response for a water intrusion event an initial determination must be made regarding the water source and category of water as defined under Institute of Inspection, Cleaning and Restoration (IICRC), "Standard for Professional Water Damage Restoration" (S500-2015). The water source should be located and eliminated, repaired or contained to full extent possible. Properly categorizing the type of the water is critical as is classifying the extent of the damage.

The Categories of Water are defined as follows:

Category 1 This is water from a clean and sanitary source, such as faucets, toilet tanks, drinking fountains, rainwater, broken water supply lines, tub or sink overflows etc. In essence clean water that originates from a source that does not contain significant microbial content and does not pose substantial harm to humans.
Category 1 progresses to Category 2 after 48 hours.

Category 2 This category of water, formerly identified as grey water, is described as having a level of contaminates that may cause illness or discomfort if ingested. Category 2 carries microorganisms and nutrients for microorganisms. Sources include dishwasher or washing machine overflows, flush from sink drains, and toilet overflow with some urine but not feces.
Category 2 progresses to Category 3 after 48 hours.

Category 3 This is the worst classification and is grossly unsanitary. It could cause severe illness or death if ingested. This category of water was formerly identified as black water, sources include sewer backup, flooding from rivers or streams, toilet overflow with feces, and stagnant liquid that has begun to support bacterial growth. This water may also be contaminated with chemicals such as pesticides, heavy metals, gasoline or other petroleum products. 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.

Persons conducting evaluation or restoration activities for Category 2 or 3 water events shall wear the appropriate personal protective equipment (PPE). A determination of specific PPE to be used will be made by Unger Constructions Superintendent with support from the Safety Director.

Water Intrusion Events Response

Generally speaking the client's staff will be the initial responders. Unger Construction will be notified after some remediation effort has taken place. When Unger Construction arrives a joint evaluation shall be conducted to understand the progress and steps taken to date. Unger Construction will conduct a detailed inspection to determination the potential exposure risks, the extent of damage, and the resources needed to adequately respond to the event. (See the Investigation section beginning on page 8 and the Remediation Plan beginning on page 13.)

General Safety Precautions

Before entering the water intrusion area be sure you have the appropriate PPE, the building is structurally safe, no sagging or falling materials, there is no danger of electric shock. Before allowing workers into the flooded area make certain no live electrical circuits or outlets are in contact with water. Consider all wet wiring and electrical components to be shock hazards until proven differently. Floor outlets and extension cords are the primary concern. Investigate the potential for electrical hazards, de-energize circuits as needed.

Do not touch your nose, mouth, eyes with your hands or forearms unless you have just washed. Eating, drinking, and using tobacco products and cosmetics where remediation is taking place should be avoided.

Avoid breathing dust/vapors without the protection of a respirator.

Remediators should take care to avoid "cross-contamination" from affected to unaffected areas by foot traffic or material handling.
Personal Protective Equipment (PPE)

After determining the scope of contamination, determine what personal protective equipment is required for performing remediation. If the remediation job disturbs mold and particulate become airborne, then the risk of respiratory exposure increases. Actions that are likely to stir up mold include: breakup of moldy porous materials such as wallboard; invasive procedures used to examine or remediate mold growth in a wall cavity; actively stripping or peeling wallpaper to remove it; and using fans to dry items.

PPE is used to reduce the risk of exposure to chemical, physical or biological hazards. Biological hazards can be encountered when performing remediation including but not limited to: allergenic, toxigenic and or pathogenic organisms. The following are the potential routes of exposure inhalation (respiratory), contact with mucous membranes (eyes, nose, and mouth), ingestion and dermal (contact with skin). Unger Construction shall provide appropriate PPE to our employees at no cost. Subcontractors shall provide PPE for their employees.

Information provided in this section generally assumes the contamination is severe. The PPE may be scaled back as appropriate for less severely contaminated environments. However, this will require written authorization of the superintendent and project manager. The selection depends on the anticipated exposure, types of microbial contamination, activities to be completed, physical hazards, potential chemical hazards that may be used in the remediation process. PPE can include but is not limited to: respirators, eye protection (goggles, face shield), hearing protection (inserts or muffs), disposable coveralls (hoods and booties) hand protection (laceration and or chemical), head protection (hard hat), and chemical aprons.

During the initial stages of investigation, demolition, decontamination and cleaning remediators should be equipped with, rubber gloves over cut resistant gloves, safety glasses, hard hats and boots. In the case of overhead contamination, Remediators should also be equipped with goggles and protective suits.

Respirators shall be worn whenever engineering and work practice controls are not adequate to prevent atmospheric contamination. Respirator cartridges and filters most frequently used in Category 3 remediation are Magenta (P100 HEPA filter for particulate), Black (organic vapor), Yellow (organic vapor/acid gases, Green (ammonia) and White (organic vapor, acid gases, formaldehyde).

The following sections discuss the different types of PPE that can be used during remediation activities. The selection of PPE depends on the anticipated exposure and activities to be completed.

Rubber boots

Protect against contamination and offer electrical protection as well.

Gloves

Chemical resistant gloves are required to protect the skin from contact with contaminants. Cut resistant gloves will be required for much of the remediation activity therefore workers will often times be wearing dual glove protection. Inner gloves, such as Kevlar to protect against cuts or abrasions and outer chemical resistant gloves to protect against skin contact with contaminants. Chemical gloves that extend to the middle of the forearm (well past the wrist) are recommended. The glove material should be selected based on the safety data sheet (SDS) for known or suspected chemicals.

Eyes

Safety glasses alone do not provide adequate protection from drips or splashes. To protect your eyes, use non-vented goggles. Goggles must be designed to prevent the entry of dust and small particles. Wearing dual protection such as safety glasses under a face shield is acceptable for moderate remediation projects. Full face respirators and powered air purifiers have built in eye protection therefore don't require safety glasses be worn underneath them.

Skin (*Protective Clothing)*

Protective clothing is used to minimize cross-contamination between work areas and clean areas, to prevent the transfer and spread of contaminants to street clothing, and to eliminate skin contact with contaminants. For minimal-moderate remediation projects protective clothing is not required. For major remediation projects disposable paper overalls head and foot coverings should be used. Disposable PPE should be discarded after it is used. Used items should be placed into impermeable bags, and be discarded as ordinary construction waste.

Respiratory Protection

For minimal-moderate remediation projects respiratory protection is not required. For major remediation projects respirators should be worn. Respirators protect remediators from inhaling airborne contaminated dust, and other particulates that are released during the remediation process. Respirators could be 2 strap N95, ½ face P100 (with organic vapor and acid cartridges) or full face P100 (with organic vapor and acid cartridges), air purified respirators (APR's), powered air purifiers (PAPR's). A full face piece respirator provides both respiratory and eye protection.

Respirators used must be certified by the National Institute for Occupational Safety and Health (NIOSH). Respirators will be determined by the known or suspected chemicals product manufacturer's warnings and recommendations. Individuals using respirators, must be trained, must have medical clearance, and must be fit-tested by a trained professional. In addition, the use of respirators must follow Unger Constructions respiratory protection policy. Before purchasing or wearing a respirator Unger Construction employees and subcontractors must demonstrate proof of training, have a current annual medical evaluation and fit test.

Suggested PPE for Category 1 and 2 Remediation

Minimal	Moderate	Major
Gloves (Chemical and cut resistant) Safety glasses.	Gloves (Chemical and cut resistant) Safety glasses under a face shield when working directly overhead or in the drip zone or non-vented goggles. 2 strap -N95 filtering face piece respirator.	Gloves (Chemical and cut resistant). Safety glasses under a face shield when working directly overhead or in the drip zone or non-vented goggles. ½ Face-P100 respirator with organic vapor and acid gas filter media or full face respirator P100 with organic vapor and acid gas filter media. Paper coveralls, head and foot coverings. Rubber boots.

Communication

It is important to communicate with building occupants when water intrusion problems are identified. Communication is key to helping maintain control of the situation. Open communication can foster cooperation and successful resolution. Without it, problems can be made worse and solutions delayed by frustration, anxiety, and distrust. To manage expectations and prevent unnecessary anxiety, it is essential to effectively deliver complete and accurate information to affected stakeholders about the nature of the problem.

Communication methods include meetings (include question and answer opportunities), memoranda, postings, and flyers. The frequency of messages, methods of communication, and degree of formality should be based on the scope of the project and the audiences' needs and interests (if in doubt, over-communicate). To ensure that information is consistent and accurate, project team members should identify a single point person to whom all requests for information about the remediation project are referred.

When remediation will disrupt normal operations, the project team should develop a communication strategy and make sure it is followed. In all such cases it is critical to be open, honest, and direct. All findings regarding the problem should

be fully and promptly shared. It is best to create an opportunity for discussion of these findings. Once remediation has begun the project team should continue to provide updates, progress and target completion dates. The frequency, methods of communication, and degree of formality should be based on the scope of the project and the audiences' needs and interests (if in doubt, over-communicate).

The following are communication priorities:

1. Demonstrate that occupants' health and safety is of utmost concern and how potential risks are minimized;
2. Supply appropriate details of project goals, findings, and activities;
3. Provide a mechanism for open, ongoing two-way dialogue between the project team members and the affected groups or individuals.

When water intrusion problems are small and will likely be corrected through routine custodial practices, extensive communication efforts are often not necessary. However, due to the widespread attention given to water intrusion some means of communication should occur. By acknowledging the existence of even simple problems and explaining how they will be handled, project team members can demonstrate their commitment to protecting building occupants. Early, proactive communication can avert rumors and the perception that information has been concealed.

Investigation Tools

Unger Construction and our 3rd party consultants will utilize a combination of moisture meters, borescopes and infrared cameras to determine the extent of moisture migration. Moisture meters and infrared cameras are noninvasive, borescopes are minimally invasive.

Moisture meters may be helpful for measuring the moisture content in a variety of building materials following water damage. They can also be used to monitor the process of drying damaged materials. These direct reading devices have a thin probe which can be inserted into the material to be tested or can be pressed directly against the surface of the material. Moisture meters can be used on materials such as carpet, wallboard, wood, brick, and concrete. Moisture readings can be used to identify wet materials, dry materials and to track drying times. Moisture meters should be properly calibrated in accordance with manufacturers' specifications. Unger Construction utilizes the Delmhorst model DB-2100 moisture meter as our standard inspection tool. This tool is self-calibrating and is considered an industry standard, the use of other moisture meters is discouraged.

A borescope is a hand-held tool that allows users to see potential moisture problems inside walls, ceiling plenums, crawl spaces, and other tight areas. It consists of a video camera on the end of a flexible probe. Minor drilling or cutting of dry wall is required. Borescopes can reduce the amount of "hidden moisture" by enabling viewing into spaces that are normally enclosed, reducing the surprises once the remediation effort is underway. Borescopes can be rented or purchased Unger Construction typically uses Extech, Milwaukee and or Dewalt borescopes.

Infrared (IR) cameras and thermometers are used to detect surface temperature differences which are indicative of moisture intrusion. Infrared cameras are useful in providing images that confirm or exclude potential moisture areas. They can be used to measure roughly 10 foot by 10 foot sections quickly. Infrared cameras can save time by inspecting areas that are difficult to access, from a safe remote distance. They can quickly rule an area in or out for further inspection. Suspect areas should be verified by using a moisture meter. Infrared cameras are expensive delicate instruments that require specialized training to efficiently operate them. Unger Construction does not own an infrared camera; these cameras are typically owned by the 3rd party consultant.

Investigation Techniques

Investigation techniques can be used to both determine the extent of a moisture problem as well as determine if the remediation efforts have been successful, in essence before and after testing. Investigation techniques include sensory approach, moisture testing, and sampling.

Sensory Approach

The sensory approach should be used to evaluate all moisture remediation efforts, from the most routine "Minimal" problems to "Major" problems. The sensory approach involves using senses of sight and smell to determine the presence or absence of conditions that support mold growth. One very important indicator of moisture removal effectiveness is the overall cleanliness of the work site after job completion. The presence of any remaining visible moisture indicates that cleaning and restoration was not adequate. Moreover, the presence of dirt, moisture, debris, and dust should not be tolerated in remediated areas after project completion. Methods to document a sensory evaluation include, photographs, white glove/black glove inspection for dust, and confirmation by an independent third party. A white glove/black glove inspection involves allowing suspended matter time to settle, then wiping a finger over all or representative (previously determined) surfaces to demonstrate general cleanliness.

Combined with evidence that effective methods for removing moisture were used and moisture problems were addressed, the sensory approach offers a practical and common sense option for evaluating whether remediation goals have been met. Sensory criteria should include, at a minimum, that there is no visible mold growth, negligible dust, no moldy odors, and no apparent dampness.

Moisture Testing

Moisture meters and infrared cameras are used in combination to determine the extent of the initial moisture, the current moisture content of materials and to track drying times. Moisture meters are used to verify that adequate drying has occurred before the replacement of damaged materials, refinishing, installation of surface coverings, or other re-construction efforts. Additionally, they can be used during post corrective actions and subsequent water testing before "close up" that the corrective measures have truly resolved and are controlling the original moisture issue.

When verifying acceptable moisture levels it is preferable to compare moisture measurements to published acceptable moisture content values for a particular material. The data sheet from the Delmhorst DB-2100 moisture meter will be used as reference and to make dry – not dry decisions. To calibrate the DB-2100 simultaneously press the watermark and the checkmark buttons. The display should read 12. If any other number appears replace the batteries and repeat the calibration test. Any number other than 12 indicates the instrument is not calibrated. Once calibrated use the star button to select the material being tested 1 (wood), 3 (gypsum). This instrument has 3 LEDs green = dry, yellow = likely to dry within 48 hours, red = won't dry in 48 hours.

Investigate floor to ceiling on each floor of the building. Start at the lowest level, determine the width of the exposure by measuring horizontally at approximately 1 foot intervals. Continue measuring until you have 5 consecutive "dry" readings. Return to the last non-dry reading place tape on the wall 18-24 inches past the non-dry reading to indicate the horizontal boundary. Take photographs of known dry as well as known wet areas to clearly delineate the boundary. In addition to taping the floors, walls, ceiling make sketches or update a floor plan. To determine the height of the exposure use the same technique, making vertical measurements in approximately 1 foot intervals.

It is crucial to remember if the moisture problem has impacted closed spaces and cavities; the extent of moisture intrusion might be greater than what is visible from within occupied spaces. In such cases, destructive techniques may be used carefully to access and inspect inside surfaces of floor, wall, and ceiling cavities. Whenever there is information

suggesting that additional contamination may be uncovered during remediation or investigation, increased contaminant control and personal protective measures should be used. Plans should be made flexible to allow for any necessary revision of the project's scope, such as adjusting work practices and procedures if unforeseen contamination or other complications are encountered.

Hidden Moisture

In some cases, moisture may not be obvious. It is possible that moisture could be hidden surfaces, such as the backside of dry wall, wallpaper, or paneling, the top of ceiling tiles, the underside of carpets and pads, etc. Possible locations of hidden moisture can include pipe chases and utility tunnels (with leaking or condensing pipes), walls behind furniture (where condensation forms), condensate drain pans inside air handling units, porous thermal or acoustic liners inside ductwork, or roof materials above ceiling tiles (due to roof leaks or insufficient insulation). To locate potentially concealed moisture, identify the pathways of water intrusion. Some building materials, such as dry wall with vinyl wallpaper over it or wood paneling, may act as vapor barriers, trapping moisture underneath their surfaces

Sampling or Testing

Microspores (Mold)

In most cases, if visible mold growth is present, sampling is unnecessary. Because mold contamination is not always visible, mold testing can serve an important and necessary role in evaluating remediation when it is done is scientific manner. However, before making the decision to use mold testing the project team should familiarize themselves with the limitations, uncertainties and nuances of sampling to determine if testing will add value. It is important to remember that the results of sampling may have limited use or application. For someone without experience, sampling results will be difficult to interpret, experience in interpretation of results is essential most clients will lack that expertise (this is not an indictment of the client, but a simple reality). Sample results can vary dramatically depending on the time and location of the samples, often times many samples are needed to account for this variability. Since a large number of samples are necessary, the cost of mold testing can be considerable. Sampling can also be used to assess the possible spread of contaminants from a containment zone to adjacent areas during or after remediation. In cases involving major contamination, sampling has been used for post-remediation clearance.

Currently, there are no widely accepted testing protocols for mold, although a wide number of sampling methods exist. Sampling can include surface wipes, bulk samples and or several types of airborne techniques. Sampling should be done only after developing a sampling plan that includes a confirmable theory regarding suspected mold sources, routes of exposure, how the data will be utilized or interpreted. Since no EPA, State, Federal or other threshold limits have been set for mold, sampling cannot be used to check a building's compliance. There are a number of limitations to mold testing after a remediation project mold testing cannot answer questions such as "is there a safe level of mold" or "is the kind of mold present more harmful than others."

Unger Construction recommends that mold testing only be done if the results can adequately answer a question with acceptable certainty. Generally speaking Unger Construction will utilize airborne (total mold – viable and non-viable) sampling to determine Pre- and Post-remediation conditions in essence have remediation efforts have been effective. After remediation, the types and concentrations of mold in indoor air samples should be similar to what is found in the local outdoor air. Surface sampling may also be useful in order to determine if an area has been adequately cleaned or remediated. Surface samples will use the comparison method, remediation areas compared to unaffected areas.

When the decision has been made to sample the sampling for mold should be conducted by professionals with specific experience in designing mold sampling protocols, sampling methods, and interpretation of results. Sample analysis should follow analytical methods recommended by the American Industrial Hygiene Association (AIHA), the American Conference of Governmental Industrial Hygienists (ACGIH). When utilizing airborne sampling a sample shall be taken outdoors before indoor sampling and once indoor sampling is complete another outdoor sample shall be taken.

Microbial

In most cases of water intrusion microbial sampling is not required. When it is required microbial sampling will be taken from suspect surfaces (focusing on coliform bacteria (E. coli) fecal sterol and endotoxin) and compared to areas that were not in any way impacted by the water intrusion event. When performed in a medical care environment the data collection methodology and interpretation shall be supported by the Infection Control staff for the client. In environments that are not within a medical care environment the data collection methodology and interpretation shall be supported a registered Industrial Hygienist.

Data Interpretation

As discussed before, there are no widely agreed upon standards for acceptable levels of mold. Data is compared to the concentrations and diversity of molds present in the remediated area to the outdoor and unaffected indoor area air levels. The following general principles should be used when interpreting comparison sampling results: Comparison is only valid between samples taken at similar times on the same day and using the same sampling method (e.g. flow rate, duration, culture medium, etc.). Some variation in the total mold levels and the presence or absence of a few types from one sample to the next is expected. Air sampling for mold provides information only for the moment in time in which the sampling occurred, much like a snapshot. Where relevant, indoor areas should be sampled and compared when building operations are similar, such as ventilation, open windows, cleaning and occupant activity level prior to and during sampling, and weather conditions.

The following suggests acceptable mold levels:

1) Total concentrations of mold (number of colony forming units and/or total spores detected per unit volume of air) in indoor samples should be similar to, or lower than outdoor and unaffected indoor area samples,

2) Indoor samples consistently contain types of mold present in the outdoor and unaffected indoor area samples,

3) Indoor samples are not dominated by types of mold (as a percentage of the total amount) unless the same types also dominate the comparable outdoor and unaffected indoor area samples.

The basis for determining that an area is free from microbial contamination will be the comparison of coliform bacteria (E. coli) fecal sterol and endotoxin counts from like surfaces (carpet compared to carpet, counter tops to counter tops, etc.) in areas that were not in any way impacted by the water intrusion event.

Documentation

Documentation and recordkeeping are important when investigating actual or potential water intrusion, in developing a remediation plan, executing the plan and completing the remediation project. Remediation plans will include the following: scope of work, containment, pressure differentials, hazardous or regulated materials (lead or asbestos), safety and health provisions, cleaning details, disposal, post remediation evaluation, post remediation verification, containment removal, and returning the remediation area to like new condition.

Determining the Extent of the Problem

Unprotected occupants and workers should be evacuated from the affected areas during the initial stages. The factors that determine the extent of contamination within the building include the volume and the chemical composition of the backflow, whether flooding is isolated or involves other levels as well, and how long the contamination has been in place. The factors to be considered in remediation include the types of materials affected, assessment of the degree of damage, the extent of contaminated absorbent material, and the total contact time.

In addition to a rating system based on the type of water (Category 1, Category 2, Category 3) water intrusion events have a classification ranking based on the amount of destruction. The classification is based on the approximate amount of wet surface area, permeability and porosity of the affected materials that remain in the environment to be dried. Additionally, the class determination may be dependent upon the restorability of wet materials and access to wet substrates.

The Classes of Damage are defined as follows:

Class 1 The lowest and easiest to deal with, this has a slow evaporation rate. Only part of a room or area was affected, there is little or no wet carpet, and the moisture has only affected materials with a low permeance rate, such as plywood or concrete.
Class 1 (least amount of water absorption and evaporation load) Wet porous materials (carpet, drywall, insulation, textiles CMU block) represents less than 5% of the combined floor, wall and ceiling surface in the space. And where low evaporation materials (plaster, wood, concrete, masonry, multi-layer wallboard, multi-layer floorboard have absorbed minimal moisture.

Class 2 With a fast evaporation rate, this level affects an entire room, carpeting, or cushioning, the wetness has wicked up the walls at least 12", and there is moisture remaining in structural materials.
Class 2 (significant amount of water absorption and evaporation load) Wet porous materials (carpet, drywall, insulation, textiles CMU block) represents between 5-40% of the combined floor, wall and ceiling surface in the space. And where low evaporation materials (plaster, wood, concrete, masonry, multi-layer wallboard, multi-layer floorboard have absorbed minimal moisture.

Class 3 This class has the fastest evaporation rate, and ceilings, walls, insulation, carpet and sub-floors are all saturated. The liquid may have come from overhead.
Class 3 (greatest amount of water absorption and evaporation load) Wet porous materials (carpet, drywall, insulation, textiles CMU block) represents more than 40% of the combined floor, wall and ceiling surface in the space. And where low evaporation materials (plaster, wood, concrete, masonry, multi-layer wallboard, multi-layer floorboard have absorbed minimal moisture.

Class 4 This class is labeled as specialty drying situations, which means there has been enough liquid and time to saturate materials with very low permeance, such as hardwood, brick, or stone.
Class 4 (deeply held or bound water) Water intrusions that involve a significant amount of water absorption into low evaporative materials.

The table below presents subjective criteria to help characterize the scale of Category 1 and 2 contaminations. Three categories minimal, moderate and major are used throughout this document to characterize the complexity of the contamination problem and the potential for exposure of building occupants. Persons responsible for planning the remediation should review and discuss the three criteria below (amount of water, degree of contamination, and potential for releasing contaminants) to determine which ranking best describes the problem.

Degree of contamination takes into account the amount of water and the type of materials (porous, non-porous, semi-porous). The potential for hidden moisture should also be considered. Potential for releasing contaminants refers to the amount of disturbance necessary to clean or remove the contaminated material. Large amounts of disturbance or force can lead to the release of large numbers of particulate.

Suggested Criteria for Determining Extent of Problem

	Class 1	Class 2	Class 3	Class 4
Category 1	Minimal	Minimal	Moderate	Major
Category 2	Minimal	Moderate	Major	Major
Category 3	Minimal	Major	Major	Major

*In all cases, workers must be provided with appropriate personal protective equipment such as respirators, boots, gloves, splash goggles, and coveralls, and with equipment with which to remove contamination.

All affected materials should be evaluated for porosity (permeance). From this inspection, materials should be rated as highly porous (saturated), semi porous, and nonporous. Some materials may exhibit varying degrees of porosity, depending on the exposed surfaces. For example, the surface of painted drywall has very low porosity, yet the base of the wall may be unpainted or have exposed gypsum paper that is highly porous.

Highly porous (permeance factor >10) materials that have been exposed to sewage backflow and have a value that exceeds the cost of restoration such as high-value rugs and carpet, upholstery, and other textiles should be removed and restored off site. Highly porous materials with low cost or replacement value, such as carpet cushion, carpet, cardboard, tackless strip, wicker, and straw, should be removed and discarded as soon as possible. Other materials, such as saturated mattresses and cloth upholstery, regardless of value, cannot be restored and should be discarded. If disposal is necessary, these materials should be bagged in plastic for removal to a proper disposal site.

Semi porous (permeance factor of >1 to 10) materials, including items such as linoleum, vinyl wall covering and upholstery, and hardboard furniture, along with construction materials such as wood, painted drywall, and plaster, should be cleaned, disinfected, or replaced as part of the initial restoration process. If these materials are not removed or properly disinfected, they can become reservoirs for growth of microorganisms.

Nonporous materials (permeance factor ≤1) such as Formica, linoleum, vinyl, and tile finishing materials can be inspected for subsurface contamination with a non-penetration moisture meter. Although these materials may be rated as nonporous, they must be evaluated carefully because contamination can migrate from the perimeter and become trapped below the surface. If migration of contamination below the surface has not occurred, these materials may be fully restored.

Refer to Table 1 on page 24 and Table 2 on page 25 for more details.

Remediation Goals

Clear and achievable goals should be set during remediation planning. All parties involved in the remediation project should understand and agree upon the goals. The following specific guidelines are presented with a goal of restoring the contaminated area such that the health of occupants is protected from any risk of pathogen-caused disease. Remediation should begin as soon as possible. The longer the contamination is allowed to persist, the greater the potential for microbial growth and resultant damage.

Remediation Plan

Unger Construction highest priority is to protect the health and safety of the building occupants and remediators. The remediation plan should cover the use of appropriate personal protective equipment (PPE). It also should include steps to carefully contain and remove building materials in a manner that will prevent further contamination. The remediation plan may vary greatly depending on the size and complexity of the job, and may require revision if circumstances change or new facts are discovered (such as hidden mold or an additional moisture source). It is a best practice to develop

detailed remediation plan prior to starting any remediation project, especially when the problem is considered "major" or subcontractors are involved. The remediation plan should clearly define the responsibilities of all parties involved in the project and state the requirements for removal, salvage, cleaning and abatement of hazards.

After gaining a reasonable understanding about the extent of contamination and the source(s) of moisture, and the type of damaged materials project team members should determine the scope of remediation best suited to the problem. Remediation efforts will depend upon the ability of the material to absorb or adsorb moisture, whether or not the materials are porous, semi-porous or nonporous. In some cases, especially those involving large areas of contamination, the remediation plan may include temporary relocation of some or all of the building occupants.

The process for determining the scope of work involves a number of parties which may include but is not limited to: Unger Constructions project manager and superintendent, the client's project management team and other materially interested parties, insurance representatives, specialized experts (Industrial Hygiene, Restoration Firms). The areas addressed by the remediation plan include but are not limited to:

a) Identification of possible hazardous materials (such as lead and asbestos) in abatement areas;
b) Job hazard analysis to determine safe work practices, equipment, tools and appropriate PPE.
c) Engineering controls (containments and managed airflow)
d) Contamination control
e) Floor covering materials (carpet, hardwood, resilient, ceramic) and underlays (pad)
f) Structural components (ceiling, walls, insulation, framing, vapor barriers, subfloor and underlay materials.
g) Affected contents and furnishings (fabrics, furniture, appliances, electronics)
h) Basement, crawl spaces, attics, chases, structural voids, unfinished storage areas.
i) Heating Ventilating Air Conditioning ductwork, insulation and mechanical components.
j) Electrical, fixtures, outlets, switches, lights, sensors, controllers, wiring, cabling.

Example Remediation Plan for Minimal Intrusion

1) Identification of possible hazardous materials (such as lead and asbestos) in remediation areas;
2) Health and safety precautions;
3) Remediation of excess moisture; (steps to permanently correct the water or moisture problem)
4) Category 1 and 2 remedeation practices and procedures; (administrative and engineering controls)
5) Repair and re-construction;
6) Evaluation/determination of project completion;
7) Returning the area to the client

Example Remediation Plan for Moderate and Major Intrusion

1) Identification of Hazardous Materials (Asbestos or Lead)
    a. Removal of regulated materials (Asbestos or Lead)
2) Investigation Techniques
    a. Sensory approach
    b. Moisture testing (Moisture probes, IR Cameras, Borescopes)
    c. Testing/sampling (Surface, air [viable or non-viable])
3) Data Interpretation
4) Determining the extent of the problem
5) Hidden Moisture
6) Cross Contamination Control
    a. Administrative controls (relocating occupants and scheduling work during evening, or weekend hours.

   b. Containment
      i. (Source, Limited, Full)
7) HVAC systems
8) Removal of contaminated materials (waste disposal)
9) Remediation Goals
10) Communication Protocol (communication strategy within the project team and to building occupants)
11) Documentation
   a. (3rd party reports, investigation reports, pictures, floor plans, remediation plan, acceptance criteria)
12) Third Party participation (IH Consultant)
13) Remediation Tools, Techniques and Equipment
14) Post Remediation Verification (indicators considered evidence of an acceptable outcome or clearance)
15) Returning the Area to Condition 1
16) Relocation back into the remediated space
17) Budget
18) Staffing
19) Schedule
20) Contract terms

Remediation Tools, Techniques and Equipment

The steps and procedures used in responding to water intrusion events shall follow those outlined in IICRC's Standard for "Standard for Professional Water Damage Restoration" (S5OO-2015). A list of key steps, procedures, and tasks are highlighted as follows.

Administrative Controls

For both health and practical reasons, administrative controls should be considered for any remediation project. Administrative controls are actions to protect building occupants by adjusting tasks and activities in ways that minimize exposure. Signage, barricades and communication will be used to secure the area against unauthorized entry. Common examples include removing or relocating occupants and scheduling work during evening, or weekend hours. Practical and logistical considerations may also make it necessary to temporarily prohibit occupants from entering the work zone and possibly adjacent areas depending upon the nature and duration of the anticipated remediation project. For example, it is prudent to relocate occupants from areas adjacent to the remediation work area until it is verified that the work area is under appropriate containment (such as following measurements and visual observation of negative pressure relationships between the work area and adjacent occupied areas). It is important to clarify this is not necessarily the evacuation of an entire building. Concerns can be remediated while utilizing engineering controls of the affected areas, while maintaining normal operations in the rest of the building.

HVAC Systems and Components

A qualified HVAC contractor should determine if the contamination has been introduced into the HVAC system. If the lined duct has been contaminated, the insulated duct should be removed and replaced. Where water has directly entered HVAC systems, especially when insulation is present, it probably will not be possible or practical to disassemble, clean and decontaminate duct work. In these situations the HVAC system should be contained then disassembled and removed.

Use a licensed HVAC contractor to complete the repairs and to reconstruct the system. A variety of antimicrobials are recommended by HVAC manufacturers for use with HVAC components.

During remediation work, inside the affected areas, shut off/seal duct openings (supply and return openings).

Cross Contamination Control

Contamination control (not allowing it to spread) by isolating contaminated areas, erecting containments, isolating HVAC systems, using supplemental air movers exhausted outside and employing safe work practices. Solid and liquid contaminants can be tracked on feet, spread on wheels or bases of equipment, carried on contents (bulk materials or debris) during manipulation or removal.

Airborne contaminants (volatile organic compounds, aerosolized liquid, particulates) can be spread by natural circulation, HVAC systems or by using air moving equipment (air movers, scrubbers, negative air systems).The most effective way to ensure that gaseous and aerosolized contaminants do not spread is to isolate work areas by establishing critical barriers or by erecting containment systems.

Cross contamination control is achieved by engineering and administrative controls that ensure contaminated materials do not spread to non-contaminated areas via foot traffic, the movement of contaminated materials or equipment and through air movement.

Contaminated materials will be handled in a manner that minimizes the disturbance of particulates and vapors. Perform controlled demolition, minimize dust generation and aerosolization by using appropriate practices (source controls, vacuum attachments on saws, bagging wet materials immediately.) To prevent the dispersion of particulates and vapors beyond the remediation area, containment and special cleaning practices will be utilized.

Containment includes physical barriers (rolled plastic or plastic sheeting), pressure isolation (depressurization techniques via negative air pressure machines to maintain a pressure differential of 0.01- 0.03 inches water column, separation and protection of HVAC systems (separating the HVAC system from remediation areas and non-contaminated spaces), dust suppression methods (Kett saws, damp wiping and HEPA vacuum cleaning), decontamination procedures (ante rooms) and waste disposal (materials will be enclosed in plastic and removed from the building using the shortest direct route leading to the outside of the building).

Source Control

Contamination should be controlled as close to the source as practical. Use techniques that limit particulate and vapors. Work areas should be maintained free from dust as practical. Debris should be bagged immediately. (Touch it once protocol). Use razor knifes or Kett saws rather than tearing materials or using hammers and saws that don't have dust control. Set the cutting depth so that blades do not penetrate all the way through and damage hidden materials or utilities. Contaminated materials should be physically removed during remediation. Source control can be achieved by covering surfaces with self-adhering plastic, plastic bags, encapsulates, sealants or physical barriers such as containment systems.

Containment Systems

The primary object of containment should be to prevent occupant and remediator exposure. Containment systems are generally separated in 3 basic types. Source, limited, and full scale containment. For all containment systems fire retardant materials with a minimum flame spread rating of 25 shall be used. The purpose of containment systems during remediation activities is to limit release of contaminants into the air and surroundings. In general, the size of the area helps determine the level of containment. Choice of containment should be based on the results of the investigation and the remediation goals.

Pressure Isolation

Airflow should be from the non-contaminated areas (clean area) to the contaminated area. When using limited or full scale containment HEPA filtered negative air machines are required to create pressure differential in relation to surrounding areas. Generally speaking the pressure in the remediation area will be between 0.01-0.03 inches of water less than the surrounding areas. Pressure differential can be measured or monitored by analog or digital manometers,

smoke tubes or pencils, or visual inspection (plastic sheeting, billows inwards into the remediation area) Based on the scope of work the airflow exchange rate will need to be modified. For low dust producing tasks the airflow exchange rate should be 6 times per hour, for moderate dust producing the exchange rate is 8 times and for high dust producing the exchange rate is 12 times per hour.

Source Containment

Source containment is generally recommended for areas that are less than 25 square feet. The enclosure around the contaminated area should consist of a single layer of 6-mil, fire-retardant polyethylene film (visqueen). The containment should have a slit entry and covering flap on the outside of the containment area. The polyethylene film can be affixed to floors, walls and ceilings with tape.

Limited Containment

Limited containment is generally recommended for areas that are less than 100 square feet. The enclosure around the remediation area should consist of a single layer of 6-mil, fire-retardant polyethylene film (visqueen). The containment should have a slit entry and covering flap on the outside of the containment area. Zip poles or metal stud frame can be erected and polyethylene film attached to it. All supply and air vents, doors, chases, and risers within the containment area must be sealed to minimize the migration of contaminants to other parts of the building. Removal of ceiling materials (tiles or drywall) may impact HVAC systems and the effectiveness of the containment system if the space above the ceiling is used as a return air plenum. In this case, containment should be installed from the floor to the ceiling deck. The containment area must be maintained under negative pressure relative to surrounding areas. This will ensure that contaminated air does not flow into adjacent areas. This can be done with a HEPA-filtered fan unit exhausted outside of the building. Prevent the remediation area from becoming positively pressurized. Cease all work if negative pressure has been lost, don't restart until appropriate pressure differential is re-established.

Full Containment

Full containment is recommended for the cleanup of contaminated surface areas greater than 100 square feet or in any major contamination situation. The enclosure around the remediation area should consist of a single layer of 6-mil, fire-retardant polyethylene film (visqueen) or flame rated corrugated plastic (Polygal). A decontamination chamber or ante room should be constructed for entry into and exit from the remediation area. The entryways to the ante room from the outside and from the ante room to the main remediation area should consist of a slit entry with covering flaps on the outside surface of each slit entry. Removal of ceiling materials (tiles or drywall) may impact HVAC systems and the effectiveness of the containment system if the space above the ceiling is used as a return air plenum. In this case, containment should be installed from the floor to the ceiling deck. The containment area must be maintained under negative pressure relative to surrounding areas. This will ensure that contaminated air does not flow into adjacent areas. This can be done with a HEPA-filtered fan unit exhausted outside of the building. Prevent the remediation area from becoming positively pressurized. Cease all work if negative pressure has been lost, don't restart until appropriate pressure differential is re-established.

Ante Room/Decontamination Chamber

Ante rooms or decontamination chambers are designed to prevent cross contamination by acting as a transition space between the remediation area and the surrounding clean areas. Ante rooms should be large enough to move materials into the remediation area without requiring both doors to be open at the same time. Opening both doors at the same time defeats the purpose of pressure isolation and will lead to cross contamination. The ante room shall have a waste container(s) and HEPA a vacuum to clean tools, materials and personnel as they exit the remediation space. Waste containers shall be large enough to place all contaminated PPE and protective clothing. Ante rooms shall be under negative pressure. The ante room shall be configured such that protective clothing (coverall, hoods, booties) shall be donned and doffed in this space. Contaminated materials (demolition debris) shall be bagged, wrapped or sealed before entering the ante room, from the remediation space. Before contaminated materials (demolition debris) are moved from the ante room to the non-contaminated space all outer surfaces shall be HEPA vacuumed and damp wiped. Respirators should be worn until remediators are prepared to step outside the decontamination chamber and into the

non-affected area. Respirators should be doffed and placed in a sealed bag while in the ante room. Tack mats shall be used to prevent tracking.

Water Extraction or Vacuuming

Water removal is critical to effective drying. Water should be absorbed, drained, pumped or vacuum extracted. Water that is not physically removed will need to be removed by evaporation which is much slower and costlier. Repeated extraction may be required as water seeps out of inaccessible areas, especially in multi-story projects. When extracting contaminated water or vacuuming contaminated material HEPA vacuum systems shall be used to prevent the contaminants from becoming aerosolized. Water shall be disposed of in sanitary sewer drains, not storm drains, or removed from the site by a septic waste transporter (temporary/portable toilets). Following bulk removal of contaminants (solid waste, silt, debris) and water extraction the "waste material" shall be handled, transported and disposed of in accordance with state and federal regulations.

Contain the spill to the maximum extent possible by utilizing spill containment devices, redirect the water to a sanity sewer line or other means of containment (totes/barrels/drums). 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. Excess water may be mopped or mechanically extracted by a pump or wet vacuum system. Dry the area out as quickly as possible.

Drying

Upon the completion of the initial moisture extraction and cleaning, steps shall be taken to increase the rate of drying. This can be accomplished by the use of dehumidifiers and air movers. In order to speed the drying process, both mechanical and natural dehumidification should be employed as the gross contamination is removed and during restoration. An indoor humidity target of 40% relative humidity (RH) or less should be attained as quickly as possible. Where flooding has been extensive, the drying process may require several days or longer to be effective.

Removing wet materials significantly improves the drying time. Generally speaking Unger Construction will remove the bottom 12-18 inches of the drywall to expose the interior wall surface and bottom track to the drying systems. Drying systems, air movers and axial fans are the primary means to dry out a moisture intrusion event. When used in the initial response to an intrusion event they can be used to dry the area. If mold is already present care must be taken to prevent the spread of contamination. Air should be routed and vented to the exterior of the building. Infection control barriers and negative pressure systems should be used to minimize potential contamination. Air movers should not be used in situations where mold growth or other contaminants have occurred. Water damaged building materials and furnishings, if not handled appropriately, will become significant sources of microbial contamination.

As it relates to specific materials they need to be dried to the point that they: will not support microbial growth (mold & bacteria) regain structural integrity and be restored for their intended purpose. Monitoring shall be conducted throughout the restoration and drying process. This monitoring shall be conducted per the use of visual inspections, temperature and humidity measurements, and moisture meter readings. A written record of the monitoring shall be kept for each moisture event.

Water can be held in materials as "bound water" (moisture held within or absorbed into the material or "free water" (moisture on the surface of the material). Free water can become bound water through capillary action or absorption. The water absorption time of all materials is significantly shorter than desorption (drying) time. The difference is exponential (non-linear). Which is why it is so important to remove "free water" as fast as it is practical (working double triple shifts without stopping).

Surface evaporation occurs as energy transfers from the surrounding environment to the material. The rate of evaporation depends on the airflow at the surface and the exposure of the wetted surfaces to the environment.

Internal moisture movement is the process of changing from liquid to vapor within the bulk of the material towards the surface which is a function of the porosity, permeability and composition (layering) of the material.

Air movers are the most common equipment used they use a squirrel cage fan directed through a snout. Air movers create laminar air flow to promote evaporation. For porous materials at least one air mover should be utilized for every 300 square feet. For non-porous and semi-porous materials at least one air mover should be utilized for every 500 square feet. When multiple air movers are used they outlet of each air mover should be oriented in roughly the same direction to achieve circulatory flow. For best results aim the outlet at the wall in a 15-45 degree angle. The materials will dry based on the evaporation rate moisture is removed from the surface and from within the material at a fixed rate adding more or faster fans do not necessarily yield faster drying times. Generally speaking the fans rated between 400-600 feet per minute are acceptable. Adjustments of the fans should be made throughout the dry process. Dehumidifiers can be used in conjunction with drying systems or separate, depending on the size of the area.

Drywall, carpet and insulation are difficult if not impossible to dry within 48 hours therefore Unger Construction chooses to replace these materials. Our experience has found that this is the most expeditious method and the least costly to return the area to like new condition. An additional benefit is complete confidence that mold will not surface at a later date. Saturated wood laminates (plywood, pressboard, and paneling) tend to delaminate after they have been dried. The project team should evaluate the decision to remove or dry these materials. Once dry they should be evaluated to ensure they meet their intended function.

Dry Times

Drying water damaged materials within 48 hours (of original exposure) can help avoid the need for remediation of mold growth because the moisture is removed before mold growth can start. Drying can be accelerated by using fans and dehumidifiers and heaters. Note: if mold growth is discovered accelerated drying process must be stopped until containment and isolation systems can be installed.

Moisture Levels

Material	Green (Dry)	Yellow (Likely to dry in 48 hours)	Red (Unlikely to dry in 48 hours)
Wood	6-15%	15-17%	>17%
Drywall	0-.5%	0.5-1%	>1%
Concrete/masonry Using the 0-100 reference scale, not percentage of moisture.	0-85	85-95	>95

Refer to Table 1 on page 24 and Table 2 on page 25 for more details.

Dehumidification

The indoor humidity in affected areas should be reduced to 40% RH as quickly as possible. Dehumidifiers remove moisture from air by the process of condensation. Dehumidification involves the cooling of air below its dew point which causes the moisture to condense. Most dehumidifiers are rated for water removal in pints per day. The size and number of dehumidifiers will depend on the size of the affected area. When combined with extraction and air movers dehumidifiers can significantly decrease humidity, thereby speeding up the drying time. Air movers significantly increase the rate of evaporation from wet surfaces adding to the areas humidity. When using dehumidifiers ensure they have sufficient performance and capacity for each area in which they are used. Reservoirs of dehumidifiers shall be emptied at the end of each shift to ensure they do not overflow and re-contribute to the water load. Extracted water shall be disposed of in accordance with applicable laws and regulations.

Removal of Contaminated Materials

Category 1 and 2 contaminated materials are not classified as hazardous waste and can be disposed in a sanitary landfill. Category 1 and 2 contaminated materials can be disposed of in normal landfills as construction waste, no special disposal provisions are required. Bag or wrap contaminated materials in heavy gauge plastic, preferably 6 mil thickness. It is important to package contaminated materials in this fashion to minimize the dispersion of mold spores. Large items with heavy mold growth should be covered with polyethylene sheeting and sealed with duct tape before being removed from the remediation area. Sharp items capable of puncturing the wrap or plastic bags should be packaged in such a way to prevent them from penetrating the plastic bag or wrap. Contaminated waste that is not immediately disposed of should be stored securely (e.g., in a covered and properly labeled waste container) located away from high traffic areas, entrances, and fresh air intakes. Any hazardous materials removed must be kept separate from the non-hazardous waste, labeled appropriately, and disposed of according to applicable rules and regulations. Some jobs may require the use of dust-tight chutes to move large quantities of debris to a dumpster strategically placed outside a window in the remediation area.

Heavy organic matter and silt, must be physically removed by any safe means available. This may include the use of shovels, squeegees, wet vacuums, and moisture-extraction machines. Water must also be extracted from floor covering fabrics such as carpets and rugs. All tools and machines, especially recovery tanks, wands, and hoses, must be cleaned and disinfected after use.

Residual organic matter in cracks and crevices can be removed by pressure washing with a disinfectant solution. The solution then must be recovered with an extraction unit, immediately after application, to prevent further migration or saturation of contaminants into other porous materials.

Remediation Methods

A variety of cleanup methods are available for remediating damage to building materials and furnishings. Some methods that may be used include the following:

Wet Vacuum

Wet vacuums are vacuum cleaners designed to collect water. They can be used to remove water from floors, carpets, and hard surfaces where water has accumulated. They should not be used to vacuum porous materials, such as gypsum board. Wet vacuums should be used only on wet materials. The tanks, hoses, and attachments of these vacuums should be thoroughly cleaned and dried after use since contamination may adhere to equipment surfaces.

Damp Wipe

Contamination can generally be removed from nonporous surfaces by wiping or scrubbing with water and detergent. It is important to dry these surfaces quickly and thoroughly to discourage further mold growth. Instructions for cleaning surfaces, as listed on product labels, should always be read and followed. Wipe down all semi-porous (e.g., wood, concrete) and non-porous (e.g., metals, glass, and hard plastics) articles with EPA-approved biocide solution diluted to the manufacturer's dilution specifications. As mentioned above, be aware of the biocide's irritant affects.

High-Efficiency Particulate Air (HEPA) Vacuum

HEPA vacuums are recommended for final cleanup of remediation areas after materials have been thoroughly dried and contaminated materials removed. HEPA vacuums also are recommended for cleanup of dust that may have settled on surfaces. Care must be taken to assure that the filter is properly seated in the vacuum so that all the air passes through the filter. When changing the vacuum filter, remediators should wear respirators, appropriate personal protective clothing, gloves, and eye protection to prevent exposure to other contaminants. The filter and contents of the HEPA vacuum must be disposed of in impermeable bags or containers in such a way as to prevent release of the debris.

Porous Materials

Porous materials that are wet with contamination may have to be discarded. Porous materials such as drywall, insulation and ceiling tiles should be removed and discarded. Drywall shall be cut back a minimum of 1 foot past the outermost moisture line. Semi-porous materials such as wood can be dried, cleaned and reused dependent upon their structural integrity.

Antimicrobial Cleaning, Sterilizers etc.

There are three distinct and separate levels of cleaning when contaminated water enters an area, initial bulk cleaning, detailed cleaning and final cleaning.

- Initial bulk cleaning is the removal of debris, unsalvageable or contaminated materials which can include the removal of materials to gain access or to expedite drying.

- Detailed cleaning is the process of thoroughly removing soils and contaminates by damp wiping, mopping, using a cleaning solution containing detergent, disinfectant or sanitizer. Cleaning products and processes play an important role in limiting the spread of bio-contamination and disease. Many are deactivated by organic matter (chlorine based formulations, alcohol, peroxide, ammonium compounds) therefore pre-cleaning is an essential step. In addition many require physical contact with affected surfaces for substantial periods of time (10-30 minutes) to be effective. Depending on the label requirements rinsing with clear water may be required. Hot water extraction, steam cleaning is a method of removing soils and contaminates. Immediately after hot water extraction or stem cleaning the residual water left behind needs to be physically extracted and HEPA vacuumed.

- Final cleaning is to improve the appearance in preparation for re-occupancy. Chemical strippers, rub out products for finishes, finishing waxing and polishing products.

Cleaning products encompass a wide range of physical and performance characteristics. Some are; highly flammable, irritants, toxic and or corrosive. In determining their use evaluate and compare the benefits against the associated risk of their use. Often times it is best to conduct a test, with the client's approval and participation, before choosing which cleaning product to use. In all cases cleaning products shall be applied following label instructions. Classes of cleaning products include sanitizers, disinfectants and sterilizers.

- Sanitizers are used to reduce but not necessarily eliminate microorganisms to levels considered safe.
- Disinfectants kill or inactivate at least 99% of disease-producing (pathogenic) microorganisms. They are used to destroy or irreversibly inactivate infectious bacteria.
- Sterilizers destroy or eliminate all forms of microbial life (fungi, viruses and all forms of bacteria). Other commonly used terms include: Bacteriastats - which is a compound that suppresses bacterial growth. Biocides - which kill living organisms or controls organism amplification. Fungicides - that kill vegetative fungi.

Source removal of contamination should always be the primary means of remediation. Cleaning products should not be used as an alternative to physical removal and conventional cleaning procedures. Some cleaning products are labeled for both low odor and low volatile organic compounds (VOC's).

Standard household bleach is often used to clean and disinfect materials. Bleach has chlorine in it which can cause corrosion or discoloration. Bleach should not be used on materials that will corrode (metal surfaces). Bleach can also stain or cause color loss, test it in a small area first. Bleach solutions is typically ¾ cup per gallon of water but will vary based on the strength of the bleach. Follow labels instructions.

Bleach and many cleaning agents are rendered ineffective after reacting with microbial contamination or other organic soiling, they should be applied only to previously cleaned surfaces using clean applicators (buckets, mops, sponges, etc.) or dedicated equipment. Apply the solution with a damp cloth and leave it on for a period of time according to the manufacturer's direction (some disinfectants should be left on for 10 minutes or less, while bleach is usually left on for 30 minutes).

After disinfecting, the remaining chemical residue should be damp wiped from the treated surface with clean water, and the material should be dried quickly. Working with bleach requires safety precautions. Never heat or combine bleach with ammonia- containing products, both will produce a toxic chlorine gas. Bleach should only be mixed with other chemicals if this is permitted on the label. Since bleach, most disinfectants and antimicrobials are volatile chemicals, they should only be applied when adequate ventilation and appropriate respiratory protection are used. When using bleach, or antimicrobials PPE recommendations from the SDS shall be followed to the letter.

Chemicals classified as disinfectants are appropriate for use in areas exposed to sewage backflow. These chemicals are defined as being capable of inactivating potential pathogenic microorganisms on inert substrates. Fully evaluate all factors that affect the success of decontamination. These include the organic matter present, extent of prior cleaning, type and level of microbial contamination, concentration and time of exposure to the disinfectant, and the nature of the material to be decontaminated.

When using cleaning products a Hudson sprayer (low pressure-hand pumped) is recommended for application of antimicrobials. They produce large droplets which reduce suspension time (drift) and the potential for inhalation. High pressure sprayers and fogging sprayers are not recommended.

Cleaning of Remediation Equipment

Equipment used during remediation, such as respirators and protective clothing, may need careful cleaning depending on how much contamination was released during cleaning. In the case of a "Minimal" and "Moderate" contamination, tools and personal protective equipment can usually be adequately cleaned by damp wiping or washing with soap and water. With "Major" contamination, all equipment should be HEPA vacuumed, damp wiped, bagged or wrapped before they are removed from the work area. This includes cleaning tools, negative air machines, bags containing waste, outer clothing, respirators, gloves, and goggles. Workers should wear at least an N-95 respirator when cleaning or replacing HEPA filtered equipment components. At the end of the removal effort, all materials used for containment should be bagged and the area decontaminated as part of the final job site cleaning.

If hazardous materials such as lead or asbestos are also handled as part of the removal work, applicable regulatory work practices and procedures must be followed to clean remediation equipment.

Disinfect mops, brooms and brushes with a quaternary ammonium solution after flushing thoroughly with water. Contact time should be ten minutes. Flushing with water should be followed with wring out and a thorough drying outside in the open air.

Post Remediation

Post remediation shall be conducted and formally documented to determine whether or not the remediation has been complete. It can include visual inspection, olfactory evaluation for malodors, tools and equipment such as infrared cameras, moisture meters and particle counters. These inspection shall be performed with client representatives and when appropriate 3rd party consultants. Once successful remediation has been confirmed in writing the space can be brought back to like new. If significant inadequacies are revealed, proper remediation should be resumed before remediation activities continue. An incomplete or inadequate job of cleaning and disinfection may leave residue that can be a substrate for disease-causing microorganisms.

Post Remediation Verification

1. The cause of the original problem (source of the water) has been resolved.
2. No visible contamination on any construction materials.
3. Impacted materials have been removed and properly discarded.
4. All construction materials are dry to industry standards.
5. Indoor air quality is within acceptable levels.
6. Microbial sampling of suspect surfaces focusing on coliform bacteria (E. coli) fecal sterol and endotoxin.
7. Verification is when the structure, systems, and contents have been returned to like new condition.

Returning the Space

Whenever occupants have been moved, anticipate questions about re- occupancy and safety after job completion. Post-remediation evaluation findings are necessary for making re-occupancy decisions. Communicating these findings is essential to provide peace of mind to the occupants. Implicit is the need to determine (in the planning phase) specific clearance indicators or criteria that will be used to evaluate the effectiveness of the remediation. It may be useful to include stakeholders in high profile or “Major” contamination problems, since this can help anticipate questions and concerns that may need to be addressed and to manage their expectations. After re-occupation, occupants should be informed about the process for reporting any future concerns

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Example Remediation Plan for Moderate and Major Intrusion

1) Identification of Hazardous Materials (Asbestos or Lead)
    a. Removal of regulated materials (Asbestos or Lead)

2) Investigation Techniques
    a. Sensory approach
    b. Moisture testing (Moisture probes, IR Cameras, Borescopes)
    c. Testing/sampling (Surface, air [viable or non-viable])

3) Data Interpretation

4) Determining the extent of the problem

5) Hidden Moisture

6) Cross Contamination Control
    a. Administrative controls (relocating occupants and scheduling work during evening, or weekend hours.
    b. Containment
        i. (Source, Limited, Full)

7) HVAC systems

8) Removal of contaminated materials (waste disposal)

9) Remediation Goals

10) Communication Protocol (communication strategy within the project team and to building occupants)

11) Documentation
    a. (3rd party reports, investigation reports, pictures, floor plans, remediation plan, acceptance criteria)

12) Third Party participation (IH Consultant)

13) Remediation Tools, Techniques and Equipment

14) Post Remediation Verification (indicators considered evidence of an acceptable outcome or clearance)

15) Returning the Area to Condition 1

16) Relocation back into the remediated space

17) Budget

18) Staffing

19) Schedule

20) Contract terms

Table 1 presents strategies to respond to water damage within 24-48 hours. These guidelines are designed to help avoid the need for remediation of mold growth by taking quick action before growth starts. If mold growth is found on the materials listed in refer to Table 2 for guidance on remediation.

Table 1: Water Damage – Cleanup and Mold Prevention	
Guidelines for Response to Clean Water Damage Within 48 Hours to Prevent Mold Growth* Note that mold growth will not always occur after 48 hours; this is only a guideline.	
Water Damaged Material[+]	Actions
Books and Papers	For non-valuable items, discard books and papers. Photocopy valuable/important items, discard originals Freeze (in frost-free freezer or meat locker) or freeze-dry until they can be properly reviewed and determinations made.
Carpet and backing – dry within 24-48 hours[δ]	Remove water with water extraction vacuum Reduce ambient humidity levels with humidifier Accelerate drying process with fans, dehumidifiers or heaters.
Ceiling tiles	Discard and replace
Cellulose insulation	Discard and replace
Concrete or cinder block surfaces	Remove water with water extraction vacuum Accelerate drying process with dehumidifiers, fans or heaters
Fiberglass insulation	Discard and replace
Hard surface, porous flooring[δ] (linoleum, ceramic tile, vinyl)	Vacuum or damp wipe with water and mild detergent and allow drying: scrub if necessary. Check to make sure under flooring is dry. Dry if needed.
Non-porous, hard surfaces (Plastics, metals)	Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.
Upholstered furniture	Remove water with extraction vacuum Accelerate drying process with dehumidifiers, fans or heaters. May be difficult to completely dry within 48 hrs. If the piece is valuable, you may wish to consult a restoration/water damage professional
Wallboard (drywall and gypsum board)	May be dried in place if there is no obvious swelling and the seams are intact. If not, remove, discard and replace
Window drapes	Follow laundering or cleaning instructions recommended by manufacturer
Wood surfaces	Remove moisture immediately and use dehumidifiers, gentle heat and fans for drying (Use caution when applying heat to hardwood floors). Treated or finished wood surfaces may be cleaned with a mild detergent and clean water and allowed to dry. Wet paneling should be pried away from wall for drying.
*If mold growth has occurred or materials have been wet for more than 48 hours, consult Table 2.	

Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water*			
Material or Furnishing Affected	Cleanup Methods[+]	Personal Protective Equipment	Containment
Minor – Total surface area affected less than 25 square feet.			
Books and Papers Carpet and Backing Concrete or Cinder block Hard Surface, porous Flooring (linoleum, ceramic tile, vinyl) Non-porous, hard surfaces (plastics, metals) Upholstered furniture and drapes Wallboard Wood surfaces	3 1,3 1,3 1,2,3 1,2,3 1,3 3 1,2,3	Minimum: N-95 two strap respirator and nitrile gloves .	Source
Moderate – Total surface area affected less than 100 square feet.			
Books and Papers Carpet and Backing Concrete or Cinder block Hard Surface, porous Flooring (linoleum, ceramic tile, vinyl) Non-porous, hard surfaces (plastics, metals) Upholstered furniture and drapes Wallboard Wood surfaces	3 1,3,4 1,3 1,2,3 1,2,3 1,3,4 3,4 1,2,3	Limited or Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Limited Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area
Major– Total surface area affected greater than 100 square feet or remediator exposure during remediation estimated to be significant			
Books and Papers Carpet and Backing Concrete or Cinder block Hard Surface, porous flooring(linoleum, ceramic tile, vinyl) Non-porous, hard surfaces (plastics, metals) Upholstered furniture and drapes Wallboard Wood surfaces	3 1,3,4 1,3 1,2,3,4 1,2,3 1,3,4 3,4 1,2,3,4	Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Full Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area

See the recommend clean up methods on the next page

Cleanup Methods for Table 2

A variety of mold cleanup methods are available for remediating damage to building materials and furnishings caused by moisture control problems and mold growth. The specific method or group of methods used will depend on the type of material affected, as presented in Table 2.

Method 1: Wet Vacuum
Wet vacuums are vacuum cleaners designed to collect water. They can be used to remove water from floors, carpets, and hard surfaces where water has accumulated. They should not be used to vacuum porous materials, such as gypsum board. They should be used only when materials are still wet—wet vacuums may spread spores if sufficient liquid is not present. The tanks, hoses, and attachments of these vacuums should be thoroughly cleaned and dried after use since mold and mold spores may stick to the surfaces.

Method 2: Damp Wipe
Whether dead or alive, mold is allergenic, and some molds may be toxic. Mold can generally be removed from nonporous (hard) surfaces by wiping or scrubbing with water, or water and detergent. It is important to dry these surfaces quickly and thoroughly to discourage further mold growth. Instructions for cleaning surfaces, as listed on product labels, should always be read and followed. Porous materials that are wet and have mold growing on them may have to be discarded. Since molds will infiltrate porous substances and grow on or fill in empty spaces or crevices, the mold can be difficult or impossible to remove completely.

Method 3: HEPA Vacuum
HEPA (High-Efficiency Particulate Air) vacuums are recommended for final cleanup of remediation areas after materials have been thoroughly dried and contaminated materials removed. HEPA vacuums are also recommended for cleanup of dust that may have settled on surfaces outside the remediation area. Care must be taken to assure that the filter is properly seated in the vacuum so that all the air must pass through the filter. When changing the vacuum filter, remediators should wear PPE to prevent exposure to the mold that has been captured. The filter and contents of the HEPA vacuum must be disposed of in well-sealed plastic bags.

Method 4: Discard — Remove Damaged Materials and Seal in Plastic Bags
Building materials and furnishings that are contaminated with mold growth and are not salvageable should be double-bagged using 6-mil polyethylene sheeting. These materials can then usually be discarded as ordinary construction waste. It is important to package mold contaminated materials in sealed bags before removal from the containment area to minimize the dispersion of mold spores throughout the building. Large items that have heavy mold growth should be covered with polyethylene sheeting and sealed with duct tape before they are removed from the containment area.