February 28, 2007

Water Event Task (WET) Force Identified Hazards and Recommendations

Section 1 Facilities Management

Facilities Management (FM) Description of Water Event Related Responsibilities:

FM has the responsibility to prevent or mitigate losses from flooding in U of M buildings. Because losses are particularly likely when outside temperatures fall below freezing and after heavy rainfall FM should be particularly vigilant at those times. Losses have also occurred after a fire sprinkler system is activated. When one of these events occur FM staff should watch for water events and then promptly respond to a release of water. Prompt flood response allows the area affected to be rapidly characterized and cleaned. Prompt cleaning of water minimizes property loss and reduces the possibility of occupant health effects from mold growth on wet building material.

Facility Maintenance and Operations Physical Hazards and Loss Prevention Measures

A. Increase vigilance during freezing temperatures.

1. Frozen water in stairwell stand pipes can cause leaks

Fire system standpipes are located in stairwells. In some buildings, the stairwell is also pressurized to keep smoke out of the stair way during a building evacuation. A fire alarm or fire system malfunction or an open door to the outside can bring freezing outside air into the stairway as air supplied by a fire system stairwell pressurization fan is not heated. Also an open stairwell door can cause freezing temperatures in a stairwell. As water freezes, it expands and can crack pipes at elbows.

Recommendations to reduce risk of loss:

1. Insulate sprinkler pipe elbows in stairwells that have fire pressurization fans.
2. Post the location of sprinkler valves at the building fire department entrance and with BSAC.
3. Place exit alarms on stairwell doors with stand pipes to prevent outside doors from being propped open.
4. On days when the temperature falls below 0 deg. F, institute building walk through inspections on each shift.
5. Initiate a 24-hour watch for floods if stairwell temperatures go below freezing.
6. Notify building departmental facilities staff contacts after the temperature in a stairwell has dropped below freezing so that they can watch for leaks.
7. When frozen pipes are suspected, consult with Building Codes and close valves to the sprinkler system and institute building fire watch.

Example incidents:
12/96 WBOB Stairwell pressurization fan turned on and pipes froze. Est. cost $202,675. 12/19/04 BSBE – frozen sprinkler riser. Est. cost $94,000. Two similar events occurred in the PWB women's clinic (December, 1998- $300,000) (photos attached). A flood due a frozen pipe on a drinking fountain near a stairwell caused a weekend flood in PWB (February, 2007).

2. Pipes in rooms with operable windows can freeze and break

Pipes can break due to freezing in rooms with operable windows. People open windows when a room is too warm and may forget to close them. Windows in areas that have poor temperature control may routinely be left open by staff. Frozen pipes occur with greater frequency when outdoor temperatures fall below 0 degrees Fahrenheit because room heating systems cannot keep up with heat loss. Frozen pipes are also more common on weekends or holidays following a period of warm weather.

Recommendations to reduce risk of loss:
1. Custodial staff must check that operable windows are shut on Friday afternoons and before holidays.
2. Report broken or improperly closing windows to FM customer service immediately.
3. Each November, remind staff about the need to shut the windows.
4. Respond promptly to high temperature calls and correct temperature controls.
5. The Department of Emergency Management may send a campus email or voice mail that asks staff to close windows when cold temperatures are anticipated.

Example incidents: 1/19/02 Women's basketball arena flooded due to a frozen sprinkler pipe. A window was left open. Est. cost $241,571

3. Pipes in or adjacent to outside air intakes can freeze and break

Pipes located in the flow of unheated outside air can freeze during the winter and break.

Recommendations to reduce risk of loss:
1. Inspect mechanical rooms for pipes in areas that might fall below freezing.
2. Protect the pipes by moving, insulating or heat tracing them.

Example incident:
This has occurred on Mayo 14th floor (2006).

B. Inspect buildings during and after heavy rainfall events

When there is heavy rainfall, especially rainfall exceeding 3 inches in 24 hours, roof drainage and waterproofing systems are severely stressed. Roof drains can become clogged causing roof water levels to bypass the waterproofing system.

Recommendations to reduce risk of loss:
1. Weekly inspect and clean as necessary drainage grates for underground buildings such as Williamson Hall and CME (Civil and Mineral Engineering). DEHS will work with FM to identify areas at risk.

2. Weekly inspect and clean as necessary drainage grates in buildings with below grade entrances such as Pattee Hall and Wesbrook Hall. DEHS will work with FM to identify areas at risk.
3. Inspect and document the condition of roof drainage pipes with age greater than 20 years. Of particular concern are pipes in Moos Tower, PWB and the Mayo building. Some pipe replacement or repair may be needed.

Example incidents:
Interior rain leaders have failed at UMD in 2006, Mayo Building 2006 and WBOB (West Bank Office Building) in 2005

C. Inspect cooling systems for potential overflow and breakage

Because of blockage, changes to valves, or inadequate design, chilled water drains might not have the capacity to handle the volume of water drained from a cooling tower or chilled water system. This can happen when a drain is impaired or because a drain cannot handle the flow from the cooling system. Modifications to valves or piping systems can cause increased flow or the original design might be in error. Pipes can break because of defective pipe hangers or corrosion. UMD maintenance staff has noticed higher failure rates when PVC piping is used for cooling tower condensate lines.

Recommendations to reduce risk of loss:
1. Staff must visually observe cooling water as it goes down the drain. Where drainage capacity is inadequate the flow must be regulated.
2. Inspect chilled water pipes and hangers that are older than 20 years for corrosion.
3. Publish the location of water shut off valves for FM staff at the building fire department entrance or in mechanical rooms and at BSAC.
4. Orient evening shift custodial and housing staff to the location of these valves.
5. Investigate water line failures to determine if PVC or the construction technique was the cause of the problem.

Example incidents:
Smith Hall ($1.3 million) and Nils Hasselmo Hall ($94,000). A flood was prevented in CSOM just prior to opening because employees knew the location of the shut off valve. This was also part of the problem with the EECS (Electrical Engineering and Computer Sciences) flood of 2005 and the smaller EECS flood of 2006 and repeated floods on 4th floor of the Donhowe Building. Dollar losses for a flood starting on upper floors of these buildings would be very high.

D. Examine piping systems for corrosion and material failure

Incompatible materials and poor quality materials can fail and cause substantial losses. Galvanic action between different metals, water hammer and pipe movement can cause fittings to fail and leak water.

Recommendations to reduce risk of loss:
1. Inspect connections between dissimilar metals.
2. Replace incompatible fittings with compatible plumbing materials.

Example incidents.
In 2005, a galvanized connection costing less than $1 was used between two copper pipes in the Transportation Safety Building (TSB). The connection disintegrated and a $15,000 flood resulted. On 10/23/04 EECS Pipe on chilled water line broke due to cheap material used as connectors. Est. cost $205,874.

E. Ensure that procedures are promptly followed by staff

When standard procedures are not followed water damage can occur. Standard procedures ensure that conditions that support mold growth are minimized and that water events are mitigated.

Recommendations to reduce risk of loss:

1. Educate custodians on the proper method for wet carpet extraction.
    a. Wet extracted carpets must be dried quickly.
    b. Furniture and other materials must be moved from the floor to allow thorough drying.
    c. Thoroughly extract water from the carpet.
    d. Use fans to accelerate drying.
2. Maintain operation of the ventilation system in the building to facilitate drying or, when appropriate, open windows.
3. Report water events immediately to DEHS via the FM call center (612- 624-2900)
4. Periodically inspect space below raised floors and inspect the spaces after a water event.
    a. Inspect under floor spaces at least annually.
    b. Wet vacuum and mop dry under floor areas after an event
    c. Inspect the space below the raised floor 48 hours after a flood clean up to ensure that it is dry and that no mold growth has occurred.
    d. Create a list of buildings with raised floors for FM custodial services. For example: Jones Hall has a raised floor for displacement ventilation.

Example Incidents.
Inadequate water extraction led to heavy mold growth on carpets at the U of MN Childcare 2004-2005. In 2005 and 2006, the 14th floor of Mayo flooded three separate times in the same area. A similar delayed response led to mold growth after the December 2005 flood in WBOB ($200,000). DEHS was informed 2+ weeks after the event. Occupants were relocated due to health problems because the abatement was not adequate. See photos of Walter Library (2005) damage under raised floors.

Facility Maintenance and Operations Measures to Mitigate Water Event Losses

A. Immediately respond to sudden release of water

1. Promptly report flood events that affect more than one room to DEHS via the FM call center within 24 hours.
    a. Messages can be left at 612-626-6002 during business hours.
    b. A web message can be left using the DEHS FOCUS system at http://www.dehs.umn.edu/forms/ - Air Quality Concern.

c. Dial 911 to activate DEHS the "After Hours Emergency Response Paging System" when a flood impacts a large area or more than one floor.

Note: DEHS has purchased an infrared camera for flood response. DEHS has recently tested the effectiveness of a hand held infrared camera in flood response. The IR camera has been an effective tool in rapidly identifying the cooler water damaged materials within the first 72 hours after a flood. It reduces the possibility for missing a water damaged area during a moisture survey. It also allows for excellent photo documentation of insurance claims. The device can also be used during fire investigations to assure that no hot spots remain. (Photos attached)

2. Consider coordinating with an outside disaster recovery vendor who can provide a rapid and substantial after-hour major flood response if FM has insufficient resources.
    a. The vendor will work under direction of Facilities Management Supervisors.
3. Compile and post information about the location and operation of water shut off valves. Each zone must compile this information.
    a. Make information available electronically to BSAC operators and zone staff.
    b. Display valve location information near the fire departments entrance to a building.
    c. Update valve locations when remodeling occurs.

B. Repair water damage promptly

1. When there is visible mold growth or the material has been wet more than 48 hours follow mold abatement procedures that are found at www.dehs.umn.edu/iaq
    a. FMHMP staff has been training to contain and abate moldy material.
    b. DEHS consults about project scope and safety.
    c. Hire an outside mold abatement contractor when the project scope is large.
2. Remove wet sheet rock.
    a. DEHS staff will use a moisture meter and or IR camera and mark wet areas.
    b. Note that insurance will cover water damaged materials; however, it will not cover mold growth.
    c. Cleaning and application of antifungal coating may be done on an exceptional basis where removal of sheetrock is very difficult.
    d. Do not attempt to dry sheetrock. Usually, attempts to dry sheetrock after a flood have been a waste of time and effort because it is labor intensive to dry interior walls and it is not possible to dry interior walls with insulation or multiple layered sheetrock.
    e. In some locations sheetrock can only be removed from on side. The other side is rapidly dried or cleaned and painted with an antifungal paint as part of a mold remediation project.
    f. Remove sheetrock in increments of 2 feet ½ inch, 4 feet ½ inch or 8 feet ½ inch. This will facilitate installation of the new sheetrock with a gap at the base and reduce future flood losses.
    g. Mold resistant sheetrock may be specified when installing replacement sheetrock.
3. Thoroughly extract water from the carpet and quickly dry the carpet.
    a. Use portable fans to accelerate drying.
    b. Keep the ventilation system on in the building to facilitate drying. Wet extraction is not effective when the ventilation system for the building is shut off.
    c. Do not place materials or furniture on top of wet carpet until it is completely dry.
    d. Remove and replace wet carpet if it can't be cleaned and dried within 48 hours.
4. When water damaged carpet cannot be feasibly be removed, carpet must be watched for mold growth.

a. Heavy mold growth on carpet will typically start approximately one to two weeks after a flood.
b. Request that DEHS test the carpet 1.5 – 3 weeks after a flood.
c. Remove all items from the carpet to allow for thorough cleaning and drying.
d. A DEHS approved antifungal compound may be applied to the carpet if removal can not take place immediately.

Example incidents: Carlson School of Management – (February, 2007) Rapid sheetrock and insulation removal was completed within 48 hours and reduced abatement costs.

Section 2 Capital Planning and Project Management

CPPM Description of Water Event Related Responsibilities

CPPM is responsible for the conceptualization, planning, design, and construction of capital improvement projects for the University of Minnesota. CPPM negotiates and prepares construction agreements, oversees architectural design and coordinates specification reviews.

Loss Prevention Measures

A. Specify heightened contractor responsibility for building site security.

Losses have occurred when contractors have not adequately attended to security of construction sites.

Recommendations to reduce risk of loss:

1. Shut off water and power, when possible, to construction sites over weekends and holidays.
2. Develop a site security plan (See attached TRF plan)
    a. Specify procedures for handling construction keys and door cores.
    b. Review the level of security monitoring after an initial incident of vandalism.
    c. Use video monitoring of entrances or security guards.

Example incidents: Swenson Building - 2005 ($5.6 Million) and Genomics Building. TRF building had no security issues.

B. Increase performance standards for roofing contractors.

Current specifications for buttoning up roof at end of day appear to be adequate but greater use of less experienced workers in the roofing industry is putting the University at risk.

Recommendations to reduce risk of loss:

1. Require roofing contractors to cover the cost of the University's deductible (currently $200,000).
2. Require a flood watch when a 2" rainfall event is forecasted by the weather service.
3. Continue the use of the Performance Information Procurement System (PIPS) for roofing projects. Web site: http://www.pbsrg.com/pipsNEW/current/unofminn/index.html

Example incidents: 10/26/00 Walter DTC Failure to correctly encapsulate roof during construction. Est. cost $80,724. Spring 2004 Jackson Hall Roof leaks post construction. Est. total cost $57,000. Fraser Hall water leak (2005) (FM $2,301– Contractor $51,307 – Department ~$4,000) (photos attached)

C. Weatherproof buildings before installing sheet rock and other porous interior finishes

During large construction projects the roofing is often not completed prior to the installation of sheetrock. If porous building materials are water damaged after a rainstorm, they must be replaced thus causing the project to fall behind schedule and cost to increase.

Recommendations to reduce risk of loss:

1. Require that contractors properly schedule installation of sheetrock. Install sheet rock after securing the building envelope.
2. When materials are water damaged during construction, wet materials must be replaced immediately.
    a. Notify DEHS immediately to allow accurate characterization of wet materials.
    b. Use controlled abatement procedures when visible mold growth has occurred.

Example incidents: Kiehl Hall in Crookston, Molecular and Cellular Biology Building, Cancer Center. (Photos attached)

D. Require designers to demonstrate the feasibility of underground structures

Mechanical spaces and occupied spaces below the water table require an effective system to protect interior from water damage.

Recommendations to reduce risk of loss:

1. Require review of pertinent hydrological data by a competent engineer
2. Incorporate hydrological data into design of structures
3. Require an extended warranty on design and technical features

Example incidents. Elmer L. Anderson Library (Minnesota Library Access Building) and the Riverbend Parking Garage. Williamson Hall mechanical space repair- AHU and mechanical space have chronic water problems (10+ years). A project is underway in 2006 to address Williamson Hall. (Photos attached)

E. Carefully select designs when "green roof" technology is considered

In an effort to reduce storm water run off and reduce the roof temperature, plants have been placed on roofs. "Green roof technology" is being widely promoted. However, "green roofs" can lead to water infiltration, shorten roof membrane life, add to maintenance costs, and be unsightly if they are not properly designed, installed, and maintained.

Recommendations to reduce risk of loss:

1. Containers must be used for plantings. Do not allow plants to have direct contact with the roof.
2. When planters are placed on the roof the building must be designed to handle the additional load.
3. Hire designers and vendors who have substantial experience with green roof technology. Factors that must be considered in design include the size and slope of the roof, plant selection, depth of soil, care of plants, repair and replacement of the roof waterproofing system, roof drainage, and safe access to roof top planters and building equipment.

Example incidents: 7/8/00 Humphrey Building Roof planters leaked. Est. cost $763,241. Law Library re-roofing (1990's)

F. Upgrade University of Minnesota Construction Standards to minimize risk of water loss

There are many details used in construction and planning that can be implemented at no cost or minimal cost to the project that will reduce the risk of water event loss.

Recommendations to reduce risk of loss:

1. Install all sheetrock walls with a minimum of a ½ inch gap above the base floor. If the space is provided, the edge of the sheet rock will not be wetted in the event of a common small flood event or during housekeeping activities. Studies in environmental chambers at DEHS laboratories (2005) demonstrate that sheetrock with an edge in water will absorb up to 45% of its weight in water causing mold growth to start in less than 60 hours. Sheetrock in 100% humidity, but without an edge in water, will absorb no more than 1% of its weight in water. When sheet rock is only exposed to high humidity it takes more than a week for mold to grow.
2. Use wall materials that are moisture and mold resistant in areas of high water use. These include bathrooms, custodial closet slop sinks, and walls adjacent to ice makers, autoclaves, and dish rooms. Green board is not considered moisture resistant. Do not install carpet in these areas.
3. Do not install vinyl coverings on exterior walls or in areas of high water use. The vinyl cover often acts as a vapor barrier and will allow for fungal growth beneath the surface.
4. Use tile or other flooring that is resistant to mold growth when floor surfaces are below grade. Installation of carpet on grade or below grade is often problematic due to cold floor surfaces or moisture wicking up through the floor or infiltrating through foundation structures. Consider creating a slight raised floor system so that carpet could be installed without being in contact with the concrete floor.
5. Install impermeable membranes to protect building slab electric heating systems or foundation water capillary breaks to protect occupied spaces that are below grade.
6. Roof drainage must effectively move away from buildings. Install downspouts with an open face. The area around the discharge for the downspout should not require mowing; this can be assured by landscaping around the discharge with shrubbery, rocks or by using concrete tile extensions. Downspouts have been crushed or removed and not put back in areas where they are in the path of a lawn mower.
7. Landscape areas to provide surface water drainage away from buildings. The landscape improvement for the St. Paul Vocational Technical Education building is a good example. More landscape improvements needs to be done immediately for student housing in Como and Commonwealth Terrace. Mold remediation has occurred twice in some apartments due to flooding from improper landscaping.
8. Require designers to ensure that sanitary sewer systems are able to handle chilled water line drainage. Sewer lines that receive chilled water must have capacity to handle the expected volume of water.
9. Specify continuous range temperature sensors rather than binary sensors for cold rooms and other rooms with temperature sensor alarms. This reduces the high cost of responding on weekends to rooms that are only one or two degrees off of the set point and reduces the risk of water damage from condensate or thawed ice.

10. Avoid installing water or sprinkler pipes adjacent to or inside of return air or outside air ducts. These pipes are at risk of freezing.
11. Install above grade ventilation ductwork; do not install duct systems under ground. The interior duct surfaces can foster fungal growth because of condensed moisture or leaks. Ground water might flood the room served by the duct if it leaks.

Example incidents: Photos of sheet rock damage are attached. Mold growth has occurred under vinyl wall paper at WBOB and 2221 University (Photos attached.) U of M Landcare has made recent improvements at several locations in 2006 where roof drainage systems required work to prevent water from entering foundation areas (Photos attached.) Buildings such as Donhowe, EECS and Molecular and Cellular Biology Building have experienced repeated floods due to the failure of sewer lines to receive the flow from chilled water lines when they are drained. The Mayo building has experienced repeated floods because temperature controls on freezers have failed and resulted in the release of thawed water from cold rooms. The Childcare Center and the Natatorium have had water in the underground ducts and flooding. A portion of the ventilation system in childcare was abandoned in 2005. Another part of the ventilation system was flooded in 2006 due to a blocked storm water roof drain (Photos are attached.)