Chapter Three: Agents of Deterioration and Preservation Planning

Managing Risks

It is wiser and less expensive to prevent damage and maintain the integrity of each item in your collection, than to rely on conservation treatment. The goal of preventive conservation is reducing unnecessary damage and keeping collections in good shape. This approach conserves resources and improves collection-management decisions. By following policies and procedures, preventive conservation involves the entire staff in collection preservation.

Preservation, or preventive conservation, is defined by the American Institute for Conservation (AIC) as:
"The mitigation of deterioration and damage to cultural property through the formulation and implementation of policies and procedures for the following: appropriate environmental conditions; handling and maintenance procedures for storage, exhibition, packing, transport, and use; integrated pest management; emergency preparedness and response; and reformatting/duplication." http://aic.stanford.edu/geninfo/defin.html

Preventive conservation requires an understanding of what causes damage and the ability to determine the probability of damage occurring in your museum.
The most comprehensive assessment tool is the Canadian Conservation Institute's chart, "Framework for Preservation." (http://www.cci-icc.gc.ca/framework/index_e.shtml)

Use the chart to determine what threatens your collection and how to counter that threat. Risks have been codified by the Canadian Conservation Institute into nine agents of deterioration. These are listed and described on the vertical axis of the chart. The horizontal axis lists three mitigation levels:

1. Building features such as storage and display,
2. Portable features such as cabinets and exhibit cases, and
3. Staff procedures.

To use the chart, look at the vertical axis and determine what threatens your collection. Then use the horizontal axis to determine the best way, or combination of ways, to lessen damage.

Each of the three mitigation levels is further divided into five actions: avoid, block, detect, respond and recover/treat. These are discussed in more detail later. The philosophy, based on experience, is that preservation of the entire collection is better than treating individual objects only to return them to the museum environs that already damaged them.

Agents of Deterioration

You must have a basic understanding of the agents of deterioration. Common sense, combined with this knowledge, will help you develop innovative and cost-effective solutions for preserving your collection. Agents of deterioration cause damage – what we call aging. Damage caused by each agent can be either cumulative or catastrophic, with catastrophic being most easily and immediately evident. Many of the nine agents do not cause damage in isolation. The other environmental factors may increase and aggravate the damage. The nine agents are described below.

1. Direct Physical Forces

Explosives were used to excavate footings for a new museum addition. An extremely fine dinosaur, a triceratops, inside the building's entrance, had parts of the specimen breaking off during each explosion. Excavation had to be halted until the specimen was slung to eliminate the effect of vibration.

Direct physical forces include shock, vibration, abrasion and gravity. Long-term, gradual, cumulative damage is caused by improper handling, improper supports in storage or on exhibition, and overcrowded storage conditions. Damage includes scratching, flattening or distortion from stacking or an improper mount, tears or breaks, worn areas and cuts from tight ties. Sudden and catastrophic damage includes dropping an object, earthquakes, tornadoes, shelving collapse, roof collapse, war and construction vibration. Examples of damage include breaks and destruction of artifacts.

Vibrations can cause artifacts to "walk" off shelves or across exhibits. Sources of vibration include nearby trucking routes, subways, trains, airports, small earthquakes, construction activities, environmental equipment such as air conditioning, running children and large groups of people.

Summary

- Sudden and catastrophic forces include handling or moving shocks, collapse of shelving or supports, earthquakes, tornadoes, war.
- Long-term and gradual forces include inadequate support in display or storage, stacking, continual minor vibration.

Deterioration from physical forces can be reduced in storage areas by

- ❑ Padding between objects;
- ❑ Stabilizing shelves and cases;
- ❑ Making sure storage drawers open smoothly and cannot crash closed;
- ❑ Having adequate shelf space and enough space for each object;
- ❑ Using fully supporting storage mounts to immobilize and secure artifacts;
- ❑ Removing movement impediments such as level changes, difficult doors, uneven floors and rough lifts.

Deterioration from physical forces can be reduced during artifact movement within the museum by

- Requiring annual staff training in handling artifacts;
- Training staff in artifact packing and support;
- Building handling trays for moving artifacts;
- Padding examination tables;
- Padding carts, baskets and other transportation supports.

2. Thieves, Vandals and Displacers

A large, heavy copper nugget on open display but cabled to its mount, was removed when the museum was full of visitors. At least two people, and a large cable cutter, were needed to remove the nugget. Within 30 minutes, the staff was alerted of its disappearance. Fortunately, in the spring the nugget reappeared in front of the museum, where it had been buried in a snow bank most of the winter.

Criminal behavior including vandalism and theft are intentional property destruction. Unintentional damage is caused by neglect or carelessness and includes lost, displaced or misplaced artifacts and records. This action is known as curatorial neglect. Intentional damage or loss is combated with tight security. Unintentional damage and loss is reduced with written policies and regular staff training. Well-managed collection records that include clear photographs and detailed condition reports raise the chances that stolen property can be recovered. The J. Paul Getty Museum has worked with the FBI and the international police agency Interpol to develop a list of the basic information needed to successfully recover stolen cultural material. The list, known as Object ID is found at http://www.object-id.com/. More information can be found at http://www.getty.edu/conservation/publications/newsletters/13_1/news1_1.html.

Summary

- Thieves target high value items.
- Vandals attack high profile items and inflict severe damage.
- Displaced items are inadvertently misplaced within the museum, usually by staff, and cannot be found. This has the same effect as theft.

Reduce the risk of theft in storage areas by

- Locking and alarming doors and windows (if present) to storage areas. Also consider electronically controlled access;
- Motion detectors and security cameras with tape backups;
- Having clear sight lines and appropriate lighting in all areas;
- Keeping research areas outside storage (only staff need access);
- Locking cabinets and shelves;
- Controlling/limiting keys;
- Maintaining a staff and visitor log/guest book of people who enter storage.

Staff should always accompany guests;

- Building a strong roof and strong exterior and interior walls. Ideally the storage room should not have any exterior walls. The building should have an open perimeter with no hidden entrances;
- Connecting electronic detectors to a central panel;
- Providing independent communication equipment (walkie-talkies, personal alarms) for security personnel;
- Maintaining access and perimeter security systems;
- Implementing an integrated security program with local police. Police should be familiar with the storage area and special considerations for collections;
- Installing doors with hinge pins inside the storage area; and
- Training staff in appropriate response to intruders.

Reduce the risk of displacement in storage areas by:

- Maintaining a catalog to identify losses;
- Holding an annual inventory or partial inventory;
- Completing twice daily (morning and evening) security checks/collection inspection;
- Signing collection items in and out;
- Maintaining a location file;
- Placing cards in storage spots when items are removed;
- Keeping clear accession records and putting numbers on all objects in a secure, non-damaging fashion; and
- Maintaining your collection catalog to identify losses.

More publications about reducing theft are found at http://www.object-id.com/publications.html. More specifics on theft control and security are discussed in Chapter 4: Facilities.

3. Fire

A passing policeman noticed smoke from a museum building that contained offices and storage for the collection and records as well as rental apartments. The policeman evacuated the building, but the fire could not be stopped and it destroyed the building. The remains were bulldozed into piles. File cabinet contents were smoking and charred two days later and saturated with water. Luckily, backup copies of electronic records were stored off site, as were many paper records. By following its written disaster plan, the museum was able to slowly recover. However, no one could enter the site for over a month while insurance companies finished their investigations and the remains were stabilized.

Fire is usually catastrophic. It destroys organic material and, even when contained, scorches items and deposits soot and ash. Burned plastic, including insulation and wire coatings, may release toxic fumes and residues. Plastic fires leave characteristic black spider webs. Entry afterwards may be restricted. Water is required to put out fires (see the next deterioration factor).

Summary

- Fire threatens all objects.
- Organic items are most vulnerable.
- Smoke problems, especially to porous items.
- Fires occur infrequently, but result in massive loss and extensive damage.

Reduce the risk of a fire in storage areas by

- Putting fire monitors and suppression systems in every storage area. Install a sprinkler system with automatic shut-off and with protective cages around heads (preferably a pre-action system). Connect monitors to a central panel;
- Minimizing the use of extension cords (none should be plugged in overnight);
- Purchasing fire resistant storage cabinets and shelves;
- Leaving adequate spaces to stop fire;
- Posting exit routes, extinguisher locations and the phone tree;
- Limiting chaos, debris and path obstructions in storage areas;
- Removing all non-collections material from storage, especially paint and other inflammable liquids;
- Building fire-resistant structural elements, compartments and fire separations. Storage walls should have at least one hour of fire retarding capability. Use intumescent paint on walls, metal studs in walls and fire blocks in ductwork.
- Providing a separate HVAC for storage so smoke doesn't circulate into storage areas from another part of the building;
- Storing items in fire-resistant cabinets and using fire-resistant bulkheads for shelving. Leave 1.5 meters (about 5 feet) between walls and shelving to block spread of fire;
- Placing enough portable ABC fire extinguishers of adequate size and capacity near exits;
- Training staff annually in use of fire extinguishers and fire prevention and response protocol;
- Having fire department annually tour museum and understand importance of specific collection items;
- Implementing a fire safety program in consultation with local authorities;
- Establishing a call list;
- Testing fire detection systems regularly (ideally daily); and
- Maintaining fire barriers and fire separations. Keep doors closed. Limit chaos and debris.

4. Water

One afternoon, staff entered a rarely visited fine art storage area. To their horror, water was pooled on the floor. A small water leak had gone unnoticed for at least a week. It *had dripped on a flat file, collecting in each drawer. Once full, the file drawers overflowed onto the floor and collections left stacked there. Chipboard storage shelves absorbed the water, expanded and partially collapsed. It took 12 hours before a conservation team could assemble recovery supplies and get to the museum. By that time, some of the collection had dried and buckled. Other areas showed a healthy mold bloom. The collection was wrapped in plastic and frozen. Recovery was expensive and took years, using a local conservation laboratory.*

Water contact with the collection is a disaster. Depending on the amount of water, some damage can be repaired, some can't. Water sources include floods, broken water mains, leaking pipes, leaking roofs, defective sprinkler heads, clogged drains, wet basements, or fire fighting. Fire and water often go together creating a major headache. Mold outbreaks occur when items are wet longer than 48 hours at normal room temperature; cooler temperatures may slow outbreaks.

Extensive damage caused by uncontrolled exposure to water includes: a powdery crust (efflorescence), tide marks, swelling organic materials, metal corrosion, dissolving of some materials, weakened glue joints and veneer, shrinking and hardening hides, stains, color transfer of running dyes and paints. Water also can leave mineral deposits on objects and cause staining. It is devastating to archaeological metals. In extreme situations, accession numbers may float or run off, making it difficult to complete a post-disaster inventory.

Summary

- Structural failure results in water damage: leaking roofs, skylights and pipes.
- Water can be a catastrophic event: flooding, fire suppression, sewers.
- Water affects porous organic materials, metals and layered or joined composite materials.
- Many items have a soluble portion.

Reduce the risk of water damage to the collection in storage areas by

- ❑ Placing water alarms on the floor by drains, under pipes and near old leaks;
- ❑ Purchasing water resistant cabinets that will not collapse when wet;
- ❑ Keeping collections between 3 inches and 6 inches (10 centimeters) above floors, 6 inches from walls, far from water sources such as air conditioners, sinks, skylights and overhead pipes;
- ❑ Using temporary waterproof covers over shelves, cabinets and artifacts if leaks are anticipated (watch for mold under the plastic);
- ❑ Inspecting storage areas immediately after a heavy rain or thaw;
- ❑ Constructing to avoid problems: do not build in flood plains, keep storage above ground level, provide a reliable, pitched roof, route plumbing through a services corridor, provide dams around mechanical rooms, place drains on every floor, make sure floors are watertight;

- Installing water-resistant cabinets with a watershed above the top shelf and a drain channel from the watershed;
- Inspecting and maintaining water barriers and run-off systems, the sprinkler system, roof and plumbing.
- Training contract and staff cleaners about water risks to the collection;

5. Pests

On opening day at a new museum, a small problem appeared, scurried across the floor, and ran into an exhibit – something nasty was in the woodlands diorama. There were feathers everywhere. The diorama contained small, freeze-dried birds on the forest floor. Mice had left only a scattering of feathers and four small bird skeletons in the leaf litter. At the grand opening, the first view many visitors had of the museum was the rear end of a conservation department staff member crawling around, removing carcasses and hunting rodents.

Pests include insects, vermin, mold and microbes. An unchecked infestation can destroy organic objects. Inorganic objects may be permanently stained or physically altered. If caught early, infestations can be contained and stopped with minimal damage. Use integrated pest management (described in detail later in this chapter) to monitor and manage pests.

Summary

- Insects.
- Vermin.
- Mold (related to relative humidity).
- Mainly organic materials threatened.
- Damage can be extensive.

Reduce the risk of pest damage to the collection in storage areas by:

- Regularly inspecting and monitoring storage areas;
- Keeping storage clean and free of clutter, food, plants or old cardboard boxes;
- Caulking and sealing cracks and crevices in storage areas;
- Maintaining all building seals, especially at ground level;
- Quarantining incoming organic items in a room separate from the main storage areas;
- Applying an exterior perimeter spray of an environmentally safe pesticide, if necessary;
- Using elevated, insect resistant, non-infested, easy to clean (ideally moveable) cabinets;
- Providing easy access for regular complete inspection and cleaning of storage areas; and
- Writing and implementing an Integrated Pest Management Plan (IPM) as discussed in Chapter 4.

6. Contaminants

The museum staff proudly showed off the recycled wood storage cabinets and re-used oak exhibit cases. They were unaware of the hidden enemy within until a conservator placed acid-detection strips in the cabinets and cases and found they were producing acidic fumes. Looking closer, staff noticed white powder covering lead bullets, a geological specimen that had turned to dust, and stones and shells with white crystals growing on them. Staff obtained grant funds to buy replacement powder-coated metal storage cabinets. The old oak exhibit cases were aired out and the wood was sealed with aluminum foil. Carbon filters were placed on the floor of the cases, underneath decorative fabric, to absorb any residual gases. Acid-detection strips showed that the acidic fumes were no longer present in noticeable quantities.

Contaminants include a broad range of pollutants that cause chemical damage. Pollution sources include:

- Indoor and outdoor gases such as smog, oxygen and acidic fumes from wood drawers, acidic mats or other artifacts.
- Liquids such as chemicals from degrading plastics and grease.
- Particulates or solids such as dust, concrete and salt.

The collection itself may also be the source of pollutants. As materials deteriorate, fumes may build up inside storage and exhibit cases. Some collections have an "inherent vice." In other words, they are made of materials that are not compatible or have poor longevity. They self-destruct under certain environmental conditions. Examples:

- A Native American tanned hide shirt with glass and metal beads: byproducts of the hide can cause chemical deterioration to the glass and metal beads.
- A late 19th century dress made of silk or wool will deteriorate when its dye

mordant breaks down protein fibers, causing weakening or shattering.

- ❖ Metal artifacts in an old oak cabinet will tarnish and corrode.
- ❖ Green streaks on outdoor bronzes are corrosion caused by sulfuric acid and other common air pollutants.

Other environmental factors increase and aggravate contaminant damage. Damage comes in many forms and includes disintegration, discoloration and corrosion.

There are ways to control or minimize the effects of pollutants. You can reduce the effects by choosing the proper storage and exhibit materials, using a heating, ventilation and air conditioning system with dust and chemical filters, putting dust covers on open shelves, and creating microclimates.

Summary

- Gases: pollutants, external or internal.
- Liquids: plasticizers, grease, oil.
- Solids: dust, salt, incompatible materials.
- Damage from contaminants is usually disfiguring and can be destructive.

Reduce the risk of contaminants damaging the stored collection by:

- ❑ Providing separate ventilation units for each storage area and/or providing filtered air to each cabinet;
- ❑ Avoiding contamination from materials and finishes. Test materials before use. Create lists of suitable storage materials;
- ❑ Using barrier coatings and films to block vapors and/or absorbents and/or dilution in cabinets to reduce fumes. Use activated charcoal filters to absorb pollutant fumes building up in cases;
- ❑ Using dust covers. Cover items on shelves or tables when not in use;
- ❑ Improving furnace and fresh air filters to 95 percent to 99 percent efficiency;
- ❑ Including filters for chemical fumes such as potassium permanganate beds (expensive) and/or activated charcoal filters (inexpensive);
- ❑ Cleaning storage areas with a HEPA or ULPA filtered vacuum cleaner;
- ❑ Banning smoking in the building;
- ❑ Using airtight cabinets and barrier materials to block external contaminants. Using absorbers and dilution to reduce internally generated contaminants;
- ❑ Monitoring for contaminants using dosimeters, metal coupons, and A-D strips;
- ❑ Training cleaning staff or contractors to note frequent problems (quick dust buildup, rapid silver tarnishing, changes in patinas, fingerprints);

- Training staff to use gloves;
- Maintaining cleanliness;
- Segregating collection materials (rubber, plastics, oils, wood) that may pollute a case interior;
- When planning new storage: avoid locations with high pollution or dust (roadways), avoid building materials and finishes that create damaging fumes, locate loading dock far from the HVAC intake, filter fresh and recirculated air, have separate ventilation for smoking areas (if allowed) and parking facilities.
- Maintaining filters and seals;
- Identifying susceptible artifacts and monitoring them closely if a problem is suspected.

7. Radiation

A prized doll in its original costume was displayed in an interior-lit wall case. One day, staff opened the case to clean and noticed the inside felt warm. When the doll's dress was moved, bands of darker color showed where folds had protected the material from fading. Now the dress was distractingly two-toned: dark and pale blue in uneven streaks. Additionally, the hat, which was near the light, had a darkened orange-brown area, suspiciously similar to a scorch mark. Features on the doll's wax face looked blurred and the nose drooped. All of this damage caused by high light and heat is irreversible. Staff applied for a grant to change exhibit case lights and levels were lowered. Cases were ventilated to reduce heat.

Radiation, including light, is energy and most of it damages museum collections. Light fades colors, it makes fabrics fragile and brittle, it discolors plastic. The amount of damage depends on how strong the radiation is and how long exposure lasts. Light damage is always cumulative and irreversible. Its effects cannot be reversed, for instance, by subsequent storage in darkness.

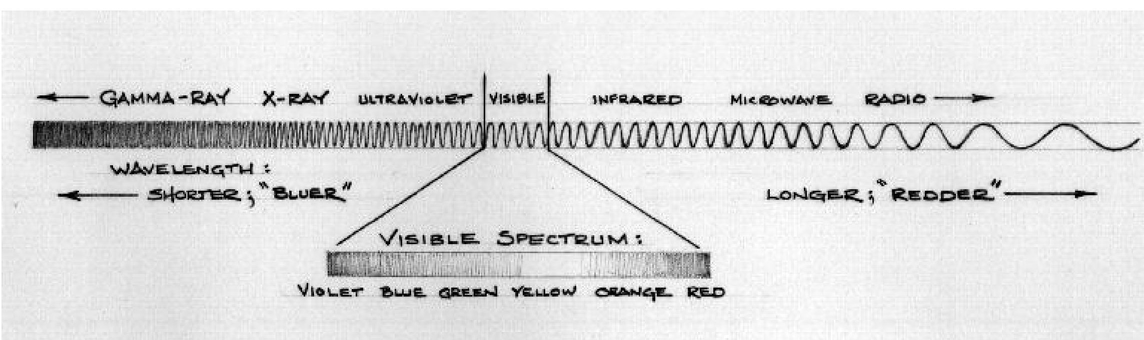
There are three major energy wavelength ranges that affect collections: ultraviolet (UV), visible and infrared (IR). Control methods are simple in theory, but harder to put into practice. Radiation, particularly ultraviolet light, can be blocked. Radiation levels can be reduced. Display times can be shortened to reduce exposure and artifacts can be covered when stored.

The UV range is considered the most damaging. Because ultraviolet is not necessary for human sight, it should be eliminated as completely as possible by any means available. Ultraviolet sources include sunlight, fluorescent bulbs and some halogen lamps. UV filters are available as window films, pull-down shades and light covers. Polycarbonate, a hard plastic, is a natural UV absorber and many fluorescent light covers such as Lexan brand are made from this material. Many textiles block ultraviolet as well as visible radiation. Muslin stretched over a window might eliminate UV and reduce visible radiation.

Visible radiation, or light, is needed to see, but can be controlled. Remember that if an item is light sensitive, eliminating UV is not enough. Damage will occur if light is strong enough for a long enough period of time. The intensity of light is measured in lux or footcandles. (See chart later in this document for exhibit light level recommendations). Not only must the intensity be considered, but also the duration. The total time that sensitive materials are exposed to light directly relates to the amount of damage incurred. Several months of exposure at low levels can have the same effect as a few days exposure in bright sunlight. Filters include thin cotton curtains or stretched shims, darkened window films, thicker curtains or pull-down shades. Boxes, cabinets and drapes over open shelving reduce light damage in storage areas.

Use light and UV meters and the Canadian Conservation Institute's Light Slide Rule to determine proper light levels when installing or retrofitting exhibits. Monitor light with data-loggers and/or blue wool fade cards. For more on Lights and Exhibits see the section later in this chapter.

The infrared range is sensed as heat. It comes from sunlight, incandescent bulbs and fluorescent light ballasts. Filters include window films and theater light covers known as dichroic films. Some bulbs have dichroic filters so heat is sent to the back of the bulb. Ventilate cases, install fiberoptic lights, and reduce numbers of bulbs to minimize heat in exhibit cases. An exhibit hall with track lighting will be 10 or more degrees hotter when the lights are on than when they are off. See the next section, Incorrect Temperature, for more information.



Electromagnetic Spectrum

Summary

- Ultraviolet radiation (UV) is invisible, not required for viewing, and causes disintegration and discoloration.
- Visible radiation (light) causes fading.
- Infrared radiation (IR) causes damage through heat (incorrect temperatures).
- Radiation damage can affect the relevance of, or the interest in, an object.

- Damage caused by radiation cannot be repaired or reversed and can reduce the value of an object.

Reduce the risk of radiation damage to the collection in storage areas by:

- Eliminating daylight by blocking or shading windows, including the edges. Ideally there should be no windows in storage areas;
- Limiting artificial light to task lighting and area lighting with separate, zoned switches;
- Eliminating ultraviolet radiation by adding UV filters to windows and lights using polycarbonate covers, Solarscreen or similar film and/or shades;
- Monitoring with blue wool fade cards, pink "canary" test strips, UV and visible light meters, dataloggers to ensure radiation levels are maintained (in storage these should be close to 0);
- Storing light sensitive collections in windowless cabinets and drawers;
- Covering shelving with blackout fabric.

8. Incorrect Temperature

A dramatic black, polished disc, over 10 feet high, representing the new moon, sits in a public park. Recently cracks have opened along the edge. At first, investigators thought the foundation was shifting or there was a flaw in the stone. However, investigation, including thermal imaging, eventually discovered the reason for the cracks. One side of the sculpture faced south, the other side faced north. The black stone absorbs the sun's heat and expands slightly on the south side while the north side stays cool. This differential expansion was causing the material to crack. Shading the sunny side would reduce the problem.

We measure temperature, cold or hot, by touch. It causes metals and other materials (primarily inorganic) to expand and contract. Temperature is recorded using mercury, a liquid metal, in a glass tube. As it warms, it expands, rising in the tube. As it cools, it contracts and lowers in the tube. Most materials in our collections can be damaged by exposure to incorrect temperature. Like the mercury in the thermometer, materials expand and contract at different rates, causing fractures to appear if dissimilar materials are joined, and surface abrasion if they are touching. Temperature determines the rate of many chemical reactions, a major cause of deterioration. Higher temperatures increase the reaction rate while lower temperatures decrease it.

Incorrect temperatures are defined as:

Too high: causing increased chemical deterioration, embrittlement, dehydration, softening of adhesives when their glass transition temperature is reached, discoloration and melting of plastics, wax, rubber, butter, etc.

Too low: making plastic, wax and rubber brittle, causing cracks and dehydration (freeze-drying).

Fluctuating: causing materials to crack, tear or delaminate.

Museum temperature is usually dictated by human comfort. Moderate temperatures, if stable, are less likely to cause problems than extreme temperatures (high or low). Human comfort level, about 70 degrees Fahrenheit, should be adequate for most artifacts. Reducing the storage area to 65 degrees will help longevity. Do not use energy setbacks to save money. Energy setbacks mean temperature fluctuates daily, from warm when the building is occupied to cool when it is not. This is appropriate for offices, but not for museums. Large windows can also cause diurnal shifts – daily temperature fluctuations as daylight warms the interior.

Temperature and relative humidity are closely related. Most small museums have some temperature controls (heating and maybe cooling), but can't control relative humidity. Controlling both requires an environmental system most commonly known by the acronym HVAC, which stands for heating, ventilating and air conditioning. (See the next section, Incorrect Relative Humidity, for more information). Filtering infrared radiation from windows, equipment and lights reduces heat, too. Keep artifacts away from heat registers, radiators and air conditioning vents.

Summary

- Temperatures that are *too high* accelerate chemical deterioration.
- Temperatures that are *too low* make some materials brittle.
- *Fluctuating* temperatures cause fractures and delamination.
- Expansion and contraction due to fluctuating temperatures affects inorganic materials more than organic materials.

Reduce the risk of temperature damage to the collection in storage areas by:

- ❑ Avoiding areas with temperature fluctuations due to solar exposure (e.g., attics, skylights, windows).
- ❑ Avoiding other areas with temperature fluctuations, such as radiators, heaters, HVAC vents, and tungsten lights. Cabinets and collections should be located far enough that there is no temperature difference noted on a monitor;
- ❑ Building vapor-barriered, well-insulated walls, floors and ceiling/roof for storage areas. This is critical for areas with special climate considerations, such as cold rooms;
- ❑ Installing a reliable HVAC system designed for easy maintenance;
- ❑ Ideally, having no external walls in a storage area. If present, leave adequate space (1.5 m or 5 feet) between shelving/cabinets and exterior walls. Insulated cabinets may provide protection from the external wall temperature variations, but this should be monitored;
- ❑ Monitoring storage areas and cabinets with thermohygrographs,

thermometers, data loggers, temperature monitors, and alarms.

- Manually correcting problems with portable heaters or air conditioners, probably with portable fans to circulate the air;
- Using freezers for cold storage;
- Defining the correct temperatures for various artifacts. Identify artifacts that require cold storage;
- Maintaining insulation and seals;
- Storing temperature sensitive artifacts in insulated storage cabinets to slow variations if the temperature control systems fail.

9. Incorrect Relative Humidity

A bronze Etruscan bowl kept growing blue-green powdery corrosion in normal storage conditions. It was placed in a microclimate made from an inexpensive polyethylene plastic box purchased from a discount department store. The bowl was placed above a bed of properly conditioned (in this case completely dried out) silica gel and the lid was snapped on and taped shut. The box has maintained a relative humidity of less than 20 percent for two years. No more corrosion product has appeared. This solution was both economical and practical.

Relative humidity (RH) is the percentage of water in the air relative to the amount of water the air can hold at a given temperature. The higher the temperature the more water air can hold. The lower the temperature, the less water air can hold. If the amount of water in the air remains the same, such as indoors, then relative humidity rises as temperature decreases and lowers as temperature rises. Relative humidity is always written as a percentage. In practical terms, the warmer the air is the more moisture it will hold, the colder the air the less moisture it holds. That is why in winter, when the temperature is at 0 Fahrenheit, the weather report may quote 90 percent relative humidity, but when we bring the air into our houses and warm it up it is dry. At 0, it will not take much moisture to saturate the air, but at room temperature the same air holds significantly more water, so the actual water in the air is a smaller percentage of the amount of water that the air can hold. Similarly, that dry air, when cooled near a cold exterior wall, has a much higher relative humidity next to the wall than in the center of the heated room. Because warm or cool walls create humid or dry microclimates, collections stored on or next to them can be damaged. Framed artwork may rapidly buckle or mold and pianos quickly go out of tune. For this reason, the best storage areas have no exterior walls.

There are several critical areas to look at when relating RH to museum collections:

> *Too high (above 65 percent):* Damp causes mold growth and increased insect activity.
> *Above or below critical for the material in question:* causes various types of deterioration. For example, poorly made glass, such as Venetian Cristallo, is only stable at exactly 42 percent RH. Be glad most materials

aren't this sensitive.

Above 0: Archaeological metal and some minerals will begin deteriorating in the presence of any moisture.

Fluctuations: Fluctuating RH causes the most damage. Organic materials swell and shrink as the RH fluctuates, which will eventually weaken the material. Damage includes cracks in wood and adhesive joint failure in furniture.

It is important to keep a stable level of relative humidity. Steady relative humidity within an acceptable range – generally between 40 percent RH and 60 percent RH – is preferable to fluctuations. Humidity fluctuations strain objects since they expand and contract with the amount of moisture in the air. This is especially troublesome for objects made from multiple materials that expand and contract at different rates. The result often is warping and cracking. For example, veneered furniture often shows cracks due to RH fluctuation. High or low humidity causes problems as well. Mold grows above 65 percent RH. Pest activity often increases with high humidity; powder post beetles prefer 55 percent relative humidity and higher. Below 20 percent, materials crack, flake, cross-link and lose flexibility.

Central Canada and the Upper Midwest of the United States have some of the most variable temperatures and relative humidity levels. This makes it extremely difficult to maintain constant relative humidity and temperature year-round. Museums in these climates often have to gradually raise and lower relative humidity and temperature from summer to winter levels because of inadequate equipment and buildings.

Solutions for controlling temperature and relative humidity within museum standards vary. The Science Museum of Minnesota maintains a temperature of 65 degrees Fahrenheit and relative humidity between 40 percent and 50 percent in collection storage by using an HVAC system. These levels can be maintained because the storage facility is a contained system tightly sealed against air leaks. Most modern buildings have an HVAC that controls the temperature, relative humidity and perhaps particulate and gaseous pollution. A system is usually divided into different zones, or areas that require different levels of control. Offices with people in them may be warmer; large open spaces with doors and windows tend to have less control than smaller, closed spaces. However, be warned – HVAC systems are pricey and expensive to run. In some cases, if not designed or run properly, they can damage the building structure. This is particularly true for older buildings retrofitted with HVAC.

There are other solutions to protect museum objects from fluctuating relative humidity. Well-sealed storage cabinets and exhibit cases provide excellent buffering against humidity fluctuations. At the Science Museum of Minnesota (prior to moving into a new building in 1999) the conservator placed a hygrothermograph inside a storage cabinet and one on top of the same cabinet. A hygrothermograph records temperature and relative humidity fluctuations on a paper graph. The storage area had seasonal RH shifts from 10 percent in the winter to 85 percent in the summer. During a storm, the fluctuation was extreme, showing a 40 percent drop in RH over six hours. However, the hygrothermograph showed that the cabinet's interior was more stable, with slow, seasonal shifts between 30 percent and 65 percent. There were no dramatic peaks and valleys due to daily weather fluctuations. In smaller rooms, dehumidifiers and humidifiers can be used.

Summary

- Damp conditions (over 65 percent RH) promote mold growth.
- Relative humidity above or below a critical value can cause metal corrosion, mineral deterioration and glass damage.
- Low RH levels (0-30 percent RH) can benefit some materials, such as archaeological metals and desiccated organic materials.
- Fluctuating RH levels cause organic materials to swell or shrink resulting in tears, cracks, crushing, or delamination.

Reduce the risk of relative humidity damage to the collection in storage areas by:

- ❑ Keeping sensitive items in airtight cabinets (buffer change – see next item);
- ❑ Using humidity buffers in enclosed spaces, such as silica gel or organic materials such as wood, cotton and paper. This is critical in an enclosed space if the temperature is uncontrolled. Do not use LiCl dessicant systems.
- ❑ Insulating cabinets, room or building;
- ❑ Keeping cabinets away from heat sources (furnace vents and interior case lights), and 6 inches (10 cm) from exterior walls and cold floors;
- ❑ Keeping storage out of basements, attics, areas with windows or exterior walls, all of which have solar exposure and/or environmental extremes;
- ❑ Putting humidity sensitive objects in the best conditions;
- ❑ Defining the correct temperature and relative humidity for the collection (what requires cold storage? what not?);
- ❑ Allowing packing cases to reach room temperature and RH before opening (Depending on the climate differences this can be as long as a month.)
- ❑ Installing and maintaining continuous vapor barriers in the walls, floor and ceiling for each storage area;
- ❑ Installing a reliable HVAC system with zoned relative humidity control. Include back-up humidification and dehumidification equipment;
- ❑ Monitoring the environment with thermohygrographs, psychrometers, coloured indicators, data loggers, and alarms. Make sure these monitors are calibrated monthly;

Avoid, Block, Detect, Respond, Recover/Treat

The five strategies that slow all nine agents of deterioration are avoid, block, detect, respond, recover or treat. The five strategies are interrelated. Often they occur in combination. For example, monitoring **detects** a problem. Your response is to **block** it or **avoid** it altogether. If damage has occurred you need to **respond** by considering **recovery** efforts, often known as conservation **treatment**. When used in combination, theses five strategies become guidelines for where to put your resources.

Avoid: Can this agent of deterioration be avoided? If the object is heat or humidity sensitive, move it away from heat and place it in a case to buffer environmental fluctuations. If the object is light sensitive, change its position so it is exposed to no more radiation than absolutely necessary. When constructing a new facility, avoid adding causes of damage such as daylight or water leaks.

Block: Can the agent of deterioration be blocked? Trinity College in Dublin houses two fine 7th century Celtic illuminated manuscripts. In 1979, the manuscripts were displayed in simple wood and glass cases with a black cloth attached to the top. Instructions read: "Please replace the cloth when you are done looking at the book, light will damage the pages." This was a simple, cost effective method of blocking light.

Respond: When you are dealing with a known problem, which may have been detected by monitoring, the CCI chart can help you determine the appropriate level of response. If the problem is excessive light from windows, you may need to install muslin blinds or light blocking film or move light sensitive objects to a room without windows.

Detect/Monitor: Which agents are potential problems? Detect them so you can deal with them. Monitoring helps determine the severity of the agent's effect on the object. For example, if you have detected an infestation and have treated it, you should continue monitoring to make sure that the infestation does not return. If you are dealing with light- or humidity-sensitive objects, monitor them with blue wool fade cards or relative humidity (RH) monitors to ensure that damage is not occurring.

Recovery/Treat: If damage has occurred to the object because you had not identified the problem in time to avoid or block it, then you will have to treat the object. You may need to stabilize or restore the object. It is not cost effective or efficient to treat an object for damage caused by humidity or pests only to put it back in the same environment to have the same damage recur.

RISK ASSESSMENT

How do you assess risks to the collection? How do you care for a collection given the sheer magnitude of its needs? The threats, or agents of deterioration, can seem overwhelming, but the CCI chart combined with a good assessment will help you put the situation in perspective. As with any large task, you need to develop priorities.

Determine the biggest threats to the collection and identify ways to deal with those threats.

Robert Waller of the Canadian Museum of Nature devised a system for evaluating risks and developing strategic mitigation priorities that provide the best cost/benefit ratio to the overall risk. With his system, you can identify the greatest risks to your collection and determine the best – and most efficient and cost effective – way to eliminate or reduce that risk.

Mr. Waller explains the technique in his article "Risk Management Applied in Preventive Conservation" in *Storage of Natural History Collections: A Preventive Approach*. Risk assessment sounds complicated at first, but after working through the system a few times, you will see the benefits.

Risk assessment is based on standard insurance company practices and terminology. By stepping through the system you will develop hard data that can be presented to private and public funding sources, your governing board and your insurance agency. All of this helps strengthen your case for collection care. It provides an analytical tool that can demonstrate to administrators and financing sources the reasons for long-term preservation despite the cost: It is cheaper to be proactive than recover from a disaster.

A risk assessment predicts what damage will occur to your collection. A collection condition survey, on the other hand, reports the damage that has already occurred. The results of a risk assessment can be used to predict the amount of loss to your collection over time. By changing the effect of various agents of deterioration, you can bring your loss rate down to an acceptable level. We must accept that there will be loss. A risk assessment gives you information to answer the following questions for your specific museum environment:

- How long do collections last?
- How well are you preserving collections?

Waller regularly performs risk assessments at the Canadian Museum of Nature and has determined that about 5 percent of the value of the museum's collection is lost every century. Every museum will have its own loss ratio.

The benefits of risk analysis:

1. Documents the real risks to the collection.
2. Organizes the risks into a manageable form.
3. Helps you set priorities.
4. Provides mitigation strategies.
5. Provides documentation and data for funding priorities.

Magnitude of Risk

Waller takes the nine agents of deterioration (he has begun adding a 10th, "curatorial neglect") and separates each into three levels of risk.

Type 1 risks are rare and catastrophic. They are the kinds of disasters likely to happen less than once every century, such as a tornado wiping out a section of a town. To determine the likelihood of these risks occurring, you will need to talk to regional and national agencies. An example from physical forces would be an earthquake in the region. For your museum, situated in Minnesota, the likelihood of occurrence is extremely low. For a museum located in California, the likelihood is significantly higher.

Type 2 risks are sporadic and severe such as, for instance, a forklift accident that damages a painting. To determine the rate of occurrence in your institution, look at condition and accident reports and other records or tap other sources of institutional memory such as veteran staffers and volunteers.

Type 3 risks are constant and mild or gradual, such as a poor storage support distorting an object over time. Often the probability of this occurring in your institution is based on personal experience.

Some agents of deterioration do not pose Type 1 risks, particularly pests, radiation, temperature, relative humidity and curatorial neglect. So Waller has identified a total of 22 generic risks. Each must be examined to properly assess the overall risk to your collection.

Begin by dividing the collection into units, perhaps by storage drawers, or collection types, even cabinets. Keep the size manageable.

Here is the calculation at the heart of Waller's approach: The magnitude of risk per century equals likelihood of occurrence multiplied by the expected severity. That sounds tough, but it's really not.

The first part of the equation is magnitude of risk per century. In the equation that's MR. Next, determine the fraction of the collection that is susceptible to risk. This is FS. Third is the loss in value that would occur if the collection is damaged, LV. Fourth is the probability of damage, or P. Finally, there is the extent or severity of damage, E. Here's how it looks: MR = FS x LV x P x E.

Fraction Susceptible
What is the risk of corrosion to 10 Native American spearheads stored in one drawer? Three are stone; seven are iron. Thus seven are highly susceptible, while three are not at all vulnerable. In this instance, the fraction susceptible is 0.7. If four of the iron spearheads contained salt, the susceptibility level would reflect that, dividing the 10 items into three sections: iron with salt, iron without salt, stone.

Loss in Value

There are many types of value: legal, emotional or sentimental, historical, artistic, reference, cultural, religious, market. Consider the value that is most appropriate for the collection at the time of the risk assessment. What amount of value would be lost if damage occurred? Do not use the absolute value. For most damage, the item is devalued by a percentage. To determine this, you need to talk to the people who use the collection to know what any particular damage means in terms of a loss in value. For this estimate, the finest delineation is one part per 10,000. For example, soil that can be removed would be considered one part per 1,000 – it is a nuisance and only slightly devalues the item.

Loss in value is subjective. Document your decisions and choices, without worrying if you might be a little off. Your subjectivity is mitigated when the entire collection is reviewed. For example, what is the value of your art collection, consisting of watercolor paintings and drawings? Which is more important: artistic, historic, market or sentimental values? Generally we would choose artistic. When the collection is exposed to light, what percentage would be devalued? The watercolors would be drastically affected, with almost all of their artistic integrity compromised, leading us to suggest a 90 percent loss in value (0.9) since colors would no longer exist in their original juxtaposition. However, the drawings might not fade at all, if they are pencil drawings, though the paper might yellow some. This would lead to approximately a 20 percent or 30 percent loss in value (0.2-0.3) for the drawings. If the drawings are ink, they may fade significantly, bringing their LV close to that of the watercolors.

Probability

Waller defines this as the "chance of an event causing damage taking place over a 100-year period." He further explains, "Probability information comes from statistics on the likelihood of events, generally stated as expected frequency. For Type 2 and Type 3 risks, the probability will be 1, since these events are certain to occur over an extended period of time." For Type 1 risks, the probability is based on regional data. Minnesota has few earthquakes and is unlikely to have a damage-causing temblor in the next 100 years. Seattle is quite likely to have one.

Extent

Waller defines this as the "measure to which a specific risk will result in loss in value to the fraction susceptible of a collection over a 100-year period. It reflects the amount of the fraction susceptible that is affected, or the degree to which a potential loss in value is realized, or both." For Type 1 risks E = 1. For Type 2 and Type 3 risks, E is a ratio based on the degree to which the loss in value is realized for the susceptible fraction of the collection or what part of the fraction susceptible is expected to be lost. Extent is determined from your own experience with your collection. Waller provides three examples:

1: Related to the fraction susceptible:

- Only the displayed collection is susceptible to breakage. Half the collection is displayed. (FS = 0.5)
- The loss in value is estimated at 0.75.
- The collection contains 15,000 objects.
- The collection manager estimates 3 specimens are damaged per year from improper handling.
- Thus, E = 0.02 (3 specimens/year x 100 years)/1500 total specimens

2: Related to the loss in value

- The collection is subject to abrasion from handling (FS = 1)
- Ultimately, this could destroy the objects (LV = 1)
- Staff knows from experience, because of present care and handling procedures, that only a 5 percent (0.05) loss in value is expected for the next 100 years.
- Thus, E = 0.05.

EXAMPLE 3: Related to both fraction susceptible and loss in value

- Half the collection is light sensitive (FS = 0.5)
- The potential loss in value for fully faded objects is estimated at 0.4 (LV = 0.4)
- Over 100 years, 20 percent of the collection will be exhibited.
- Exhibit conditions and duration will result in 30 percent of potential light damage being realized.
- Hence, E= 0.2 x 0.3 = 0.06

What is acceptable risk?

As you calculate risk, remember that the higher the MR number, the higher amount of risk. If MR = .01, then 1 percent of the collection is lost every 100 years to that particular risk. Look at the magnitude of risk for each collection unit, for each type of risk. Adding all of the MRs together and dividing by the number of MRs completed will give you the overall percentage of the entire collection damaged in 100 years. From this you can give your oversight organization (board or governmental body) a loss number. For example, if your MR for the entire collection is 0.01 (1 percent) and you have 1,000,000 objects in your collection, then you lose 10,000 objects every century or 100 objects per year.

Within museums we must weigh risk versus other resource spending. Generally, the rate of collection development is much higher than its losses, often ten to one hundred times higher. If your collection is quite large, losing 100 objects per year may be acceptable. Of course, the number of 100 is actually an accumulation of tiny losses affecting a significantly larger number of objects. However, you have a dramatic number, to impress the importance of preservation upon financiers, directors and others.

The risk assessment will point out areas with significant risk exposure. Improving preservation activities in these areas could lower your magnitude of risk. Waller recommends completing a risk analysis every five years. We would suggest completing one after every significant change to preservation activities.

Finally, you should be aware that Waller's work was developed for large natural history collections. Libraries and archives have other risk assessment methodologies. Some of these compare impact with frequency, providing an order of risk severity, but not providing quantitative measures of potential damage to the collection. This general risk analysis is a popular management tool. CALIPR, available for free over the Internet, is semi-quantitative. It evaluates risk, use and value for library and archival collections.

Preservation Planning

Planning helps you prioritize your problems and solutions clearly. In the long run, this benefits more of your collection and saves you money. A preservation plan is a vital part of any funding request.

Step 1: Information Gathering
A preservation plan is based on the needs of an institution and the actions required to meet them. This information is provided in needs assessment survey reports and in-house risk assessments. Since surveys are the foundation of preservation planning, having a survey that meets the institution's planning needs is critical. Gather information in five ways:

1. Gather and examine earlier survey reports.
2. Assemble a risk assessment.
3. Complete a statistical sampling of specific collection items.
4. Monitor the environment.
5. Have an outside consultant interview staff and examine current facilities to determine preservation needs. General conservation assessment or CAP reports often provide this information.

Step 2: Prioritizing Recommendations
Because institutional resources are limited, it is important to rank all of the recommendations in a manner that ensures your actions will have the most significant impact on the overall preservation of the collection. Prioritizing is the process of deciding which actions will have the most significant impact, which are the most important, and which are the most feasible. Use risk assessment tools to help you prioritize your response capabilities.

Rank recommendations using three criteria:

1. Impact: the extent to which an action will improve the preservation of the collections.
2. Feasibility: the ease with which an action can be implemented. This

includes the availability of human and financial resources as well as less tangible factors such as internal and community politics.

3. Urgency: an action is urgent if waiting to implement it would cause further problems or would mean bypassing an opportunity.

Consider the use, storage, condition and value of the materials in the collection when setting priorities. There are self-assessment tools to help you (see the bibliography). Hire a conservator to help you assess specific objects.

Step 3: Writing the Plan
Once the research is completed and the action items are prioritized, the final step is writing the plan. It should include a summary of the institution, its preservation history and its future commitment to preservation. Follow broad goals with a list of the prioritized action items. A good way to develop these is during a staff retreat. The final draft should be sent to the museum's board for review and approval.

The final preservation plan will address the needs, priorities and future actions regarding preservation activities at your museum. Since preservation improvements directly affect the length of time your collections are in existence, this in turn will assist to improve access by the public. Preservation plans make your work proactive rather than reactive. They help you avoid future catastrophes. With the development of a preservation plan your museum will be in a better position to articulate its needs and influence decisions.

Developing an Emergency Preparedness Plan

There are four steps to developing an emergency preparedness plan. Start with research, then analyze your risks, gather detailed information and stay prepared with regular training and evaluations.

I. RESEARCH
Begin planning by a thorough review of available published literature. Supplement the literature with sample emergency plans acquired from other museums and libraries. Finally, contact the fire department to obtain a copy of the city, regional and statewide emergency preparedness plans. Make sure the museum is part of local emergency planning documents.

II. ANALYZE RISKS
Do a thorough risk analysis. Locate the weaknesses in your physical plant, procedures and personnel. What could go wrong and affect the longevity of the museum's collection? Think of everything, small and large. List major disasters that could occur to the area (floods, city fires, chemical plant explosions, trucking and rail routes, high winds, snow load, hail). List minor disasters that could occur to the building (leaks, small fires, pest infestation, electrical failure, chemical spills). Use the Canadian Conservation

Institute chart or hire a conservator for a facilities walk-through to help you identify risks.

Has the following equipment been regularly inspected?

- door and building weather stripping
- security alarms
- fire suppression systems
- air filters in HVAC system
- drains/gutters
- gas lines
- electrical lines

Are the following procedures in place?

- regular inspection programs for pests
- regular building inspections of physical condition
- possible security requirements

People are your most important emergency response resource. Are you well staffed during opening hours? Do you have a pool of trained volunteers available in the event of a disaster? Have you developed a relationship with trained professionals in your region? Get to know the resource people in your area.

III. GATHER DETAILED INFORMATION
Details are important in your plan. During a disaster, you will need to call people and suppliers. Gather phone numbers now. Organize an emergency call list of staff personnel and a telephone tree of trained volunteers. Then write a list of the supply sources and service providers that are (a) on hand within the museum, (b) locally available, (c) available within the state and (d) nationally available. On a museum floor plan show the location of emergency supplies and equipment. Post this throughout the building. Copies should be given to the local police and fire departments.

Can a mutual aid plan be established with suppliers and service providers as well as other local or regional institutions? If you are not part of a mutual assistance agreement, consider joining.

Now is the time to prioritize retrieval of records, museum collections and building equipment. You won't be able to think when disaster strikes.

Who should be called and in what order if a disaster occurred? Who should be in charge during the disaster or as soon as the disaster response team can enter the area? Write down a line of succession, with phone numbers. All the people should be familiar and practiced in their roles. The person in charge is not necessarily the top administrator. Who are the REAL leaders? A useful tool is the *A.R.K.: A Recovery Kit*, developed by Northern States Conservation Center and the Alliance to organize small museum staff during the first 48 hours of a disaster. The kit is available from Northern States Conservation Center, P.O. Box 8081, St. Paul, MN 55108, 651-659-9420 and can be ordered from www.collectioncare.org.

IV. STAYING PREPARED

Preparation keeps an emergency from becoming a disaster. Use a master calendar to schedule regular building inspections (see later in this chapter) and staff/volunteer training. Training should include annual care and handling sessions and emergency preparedness sessions. Organize lectures by the local fire and police departments on potential hazards. Hold quarterly drills with staff and volunteers that cover all contingencies. Make sure everyone operates a fire extinguisher annually. Make sure staff and volunteers can remove the extinguisher easily from the wall. Finally, hold an annual staff tour of the building. Familiarize everyone with the location of all emergency supplies and equipment.

Schedule regular inspections of emergency supplies and equipment, refilling as necessary. Update the numbers and contacts for suppliers and services annually. At the same time, update the volunteer telephone tree.

When Disaster Strikes

When the worst happens, you have 48 hours to stabilize your site. You will need to get people, supplies and services. The first person to enter the scene is the INCIDENT COMMANDER. He or she retains that position until relieved by someone that can do the job better or has been designated ahead of time.

Within the first hour the following must occur:

- Make sure all staff and visitors are out of the building and safe.
- Call 911.
- Call five people on your museum call list to act as operations officer, security officer, media officer, finance officer and logistics officer.

If local phones are inoperable, call an out-of-state contact person. If you cannot call out, have a designated out-of-state person who will call you. Often outside lines work when local lines do not.

- Shut off electricity, gas and water if possible and safe.
- Start taking photographs and making notes immediately.
- Set up a command center (where five officers will meet or call in and let the team know what they have accomplished).

Together, the six officers develop an action plan immediately. The plan is revised as information is obtained. The six officers communicate frequently and meet regularly. In a major disaster, it may take at least five days to complete the initial response. It may take many years to complete full recovery. Remember that no one should talk to the press except the media officer. Nothing should be moved or cleaned until well photographed or videotaped. Good communication is vital throughout the recovery. Make sure each officer has the financial, staff and physical support they need.

Position Descriptions

The first person on the scene is the INCIDENT COMMANDER and retains that position unless relieved. The incident commander is responsible for developing and implementing strategic decisions and approving the ordering and release of resources. He or she delegates authority for different aspects of the recovery to five individuals.

The OPERATIONS OFFICER is responsible for all actions directly applicable to the primary mission of stabilizing the museum building(s) and collection. He or she supervises activities and people in accordance with the action plan and direct execution of the plan. He or she will need assistance from staff or volunteers and must remain in close communication with the incident commander and the other officers.

The SECURITY AND REGISTRATION OFFICER is responsible for monitoring and assessing potential hazards and developing safety measures to protect recovery personnel and the collection. He or she is responsible for the safety and security of workers and the collection and corrects unsafe acts or conditions through the regular line of authority, although he or she may exercise emergency authority to stop or prevent unsafe acts when immediate action is required. The security and registration officer is responsible for monitoring and supervising activities to secure the site and collection from further damage or theft. The person in this position will need assistance from contractors, staff or volunteers to implement security. He or she will need to remain in close communication with the incident commander and the other officers. The museum may need to arrange for a nurse or doctor to be available for emergencies.

The MEDIA OFFICER is the contact person for all press and outside agency representatives. He or she is responsible for putting together and releasing information about the incident to the board of directors, the media and appropriate agencies. The media officer will need to remain in close communication with the incident commander and the other officers. No one talks to the press or outsiders except the media officer – ever.

The FINANCE OFFICER is responsible for recording personnel and volunteer time, tracking purchases and ongoing costs, administering costs of contracts, equipment and supplies, collecting cost data, performing cost analyses, providing cost estimates and recommending ways to save money, establishing and operating compensation for injury and claims function. He or she will coordinate with the safety and registration officer when necessary and must remain in close communication with the incident commander and the other officers.

The LOGISTICS OFFICER is responsible for providing facilities, services and material to support the recovery and stabilization operations. This person will provide services that aid communications; arrange housing, food, toilet and other needs for recovery workers; order necessary supplies, personnel and equipment; maintain an inventory of supplies; and service non-expendable supplies and equipment. He or she will need assistance from contractors, staff or volunteers. As with all officers, he or she will need to remain in close communication with the incident commander and the others, especially the operations and finance officers.

FOLLOWING DAYS: Follow the process set up on the first day. Have regular information exchange sessions with all workers. At the end of each day, the officers should meet and revisit the action plan. As items are stabilized, they will need long-term storage and perhaps conservation treatment. The action plan will change as the recovery progresses and you learn what works and what doesn't. Make sure workers take breaks and debrief. A mental health professional should be available during debriefings to assist with the emotions and stress of emergency work. Where collections were wet, they should be completely dried or otherwise stabilized by the end of the third day.