MANAGING ARCHEOLOGICAL COLLECTIONS 8. COLLECTIONS MANAGEMENT

Cataloging

Cataloging glass sherds at Harpers Ferry National Historical Park. *Photo courtesy of Museum Management Program, National Park Service.*

A repository depends on collections management activities to ensure the long-term care, preservation, and protection of its accessioned collections. The material remains and associated records, including digital data, of an archeological collection must be cataloged, then labeled, to make them accessible for a variety of uses. There are some differences in the steps and issues involved in cataloging material remains as opposed to associated records, which are presented below.

Cataloging Objects

Cataloging is the process of recording all primary information about an object. With archeological collections, it also involves assigning a catalog number to an object that is specifically related to its archeological context or provenience and is often related to its accession number. While an accession number is usually applied to one collection or group of objects, the catalog number is specific to an object or a lot of like objects. The key purposes of cataloging are to record information that is useful for identification, organizing whole collections, and providing information to researchers and staff who want to use them.

While there are no absolute standards for cataloging archeological collections used by all repositories, there are some common categories used by many. Some federal (e.g., National Park Service, Army Corps of Engineers) and state agencies catalog standardized information. As well, many repositories provide guidance on cataloging information they require. Typical cataloging information for objects include:

Data Field	Example
Accession #	98-112
Catalog #	98-112-938
Object name	White paste earthenware
Object description	Body sherd; no decoration
Material of manufacture	Ceramic, earthenware
Form (object type)	Bowl
Quantity	3
Measurements (when needed, e.g., wgt., hgt., circumference)	12 gms.
Conservation & condition	No conservation, stable condition
Cataloger name & date	J. Doe, 8/10/98
Location in repository	TSA9.12 (tier rack 9, box 12)

Additional categories for archeological objects should include:

- site number
- state site number
- provenience/collection unit
- state and county
- UTM coordinates

The information collected during cataloging then goes into a catalog list or catalog file that includes information on all the objects in a collection. This information is valuable for grouping objects, and provides another link between objects, lots, associated records, and digital

data in a project collection. Some of this information is sensitive, especially UTM coordinates of a site and excavation unit, and should not be accessible to the public. Therefore, it may be kept in the original accession file and linked to the catalog file by the numbers assigned.

Now, many repositories use computerized catalog systems. This allows for easier, quicker, and more complex sorting, grouping, and identification of objects for a number of uses. It also facilitates updating the data.

Archival Processing and Cataloging Associated Records

Document appraisal activities at the Stabilization Laboratory of the U.S. Army Corps of Engineers, St. Louis District's Mandatory Center of Expertise for the Curation and Management of Archaeological Collections. *From the photograph collection of the U.S. Army Corps of Engineers, St. Louis District.*

The process of cataloging associated records involves some key steps and considerations before cataloging can begin. One is an initial assessment of the collection, which focuses on identifying the range of document types, condition, any legal issues involved, and further processing and preservation needs. It also involves providing basic care to individual items, particularly segregating those that require special treatments (e.g., folded oversized maps) and conducting minor conservation treatments. The latter may include dry cleaning, mending small tears with archival mending tissue tape, or humidification and flattening.

Another key step is archival processing of the records in a collection. During processing, the archivist researches and records the provenance of the collection, including information on its origin and history, and successive transfers of ownership and custody. Archival processing is based on the principle of original order, the arrangement of a collection of records as established by the creator. Within the original order, series and sub-series are identified, which function as natural sub-divisions rather like chapters in books, for long-term management. Common series and sub-series arrangements are chronological, topical, numerical, or alphabetical. During archival processing, archivists also weed out unnecessary duplicate records that have low value.

Following arrangement, archivists develop finding aids to the collection. This entails creating an archival records description and management system that is detailed enough to provide researchers and others with quick and easy access to the records they need. The level or detail of description for a record usually depends on its research value and anticipated use or needs -- the greater the value and anticipated use, the greater the detail. Finding aids are useful tools for organizing and finding description information. They generally include information on: creator or project; box, series, folder and/or item listings; volume of materials; type of record (paper, photographs, maps, etc.); intellectual contents and arrangement; condition; and any limitations on use or access. The archival profession has recently finalized a standard for archival finding aids in both paper and Web-encoded form called Encoded Archival Description (EAD.)

Archival cataloging itself follows a standard called Machine Readable Cataloging (MARC) and focuses on the collection, not the individual item. However, an archival collection may be composed of a number of components that were donated or acquired over a period of time in a series of accessions. In these cases, the components are still cataloged as one collection. Sometimes cataloged at a lower level than the collection, such as series, are individual items that are in an exhibit or on long-term loan, are at risk due to condition or value, or are restricted due to copyright, privacy constraints, donor restrictions, or federal statute, such as the Archaeological Resources Protection Act. Individually cataloged items with sensitive or restricted data usually are separated from the collection, replaced by a separation sheet on acid-free paper that provides the new location, and are placed in a restricted storage location.

The catalog record for each archival collection and occasional individual item should contain standardized information, at a minimum, on:

- collection title
- inclusive dates of the collection
- accession number
- catalog number
- location(s) of the collection
- medium of records (form/genre)
- creator(s) of the collection
- item count or quantity by linear foot
- collection arrangement (a listing of series and sub-series)

Labeling

Objects

Ceramic labeled in an inappropriate place on its broken edge. *Photo courtesy of Alexandria Archaeology, City of Alexandria, Virginia.*

Once a catalog number has been assigned to an object or lot of objects, that number must be attached to the object(s) for identification purposes. Every item should be labeled in the most permanent method applicable to its material and status in the collection, yet be reversible if the label must be removed or changed.

The method used to label an object depends on a variety of factors. These include: physical stability of its surface, its surface roughness, its porosity, its physical strength, and its flexibility. It is important to use methods and materials that are appropriate to the object and do not harm it in any way or, in other words, are chemically stable. The label number should be placed in an area that does not impact important diagnostic or aesthetic parts of the object, and minimizes the handling needed to view the number.

Directly marking an object is the preferred method because the identification number is less likely to be lost. The most common method for directly labeling objects involves a "sandwich" technique. Steps for this method are:

1. Clean (if necessary) the area to be labeled.
2. Place a thin coat of clear reversible lacquer (e.g., Acryloid B72 or B67) on the labeling area. If the artifact is dark in color, use white lacquer for the base coat. Multiple applications may be necessary on porous objects, such as unglazed ceramics. Let the base coat dry thoroughly.
3. Write the label information on top of the base coat using a permanent water- or pigment-based ink (e.g., India ink). Let ink dry completely.
4. Apply a topcoat of clear varnish (e.g., Acryloid B72).
5. Let the label dry thoroughly before placing the object in a container.
6. Record labeling methods and materials used in appropriate object information file.

It is possible to remove a label if it is incorrect or applied in the wrong location. If a base coat and inked label have been applied, the ink may be removed with a cotton swab slightly moistened with water. This will not affect the lacquer base coat for the application of a new number. If all three layers have been applied, the lacquer and ink may be removed with careful application of the solvent acetone.

Some objects cannot be labeled directly. They may be too small or have unstable surfaces. Most paper, basketry, leather, textiles, and wood should not be marked directly. Acid-free tags may be attached to these objects by tying or sewing. Or, they can be placed in the sealed container with the object or on the housing of the container. When attaching labels, use materials compatible with the object and its storage location. In general, string or thread should be softer than the artifact's surface, should not cut through or into the object, should not be attached too tightly, and should not be colored or dyed.

Associated Records

Proper labeling of associated records, including photographs, audiovisual materials, and digitized data, is also essential. It provides a means to relate one or more record to specific objects or collections in order to obtain key provenience information about particular material remains or other analytical information. Again, labeling techniques, as well as the amount of information on the label, depend on the media.

It is best to place paper records in acid-free folders and label the folders. The labels may be handwritten in carbon ink or pencil, typed, or computer generated on archival adhesive labels (though these may eventually fall off). If paper documents must be labeled directly, preferably in the same location on each sheet such as on a reverse edge. If using pencil, such as a #4 graphite (2H), apply very little pressure and write very small. Critical information on the label should include: collection name and/or number, box number, and file number. Accession number, unique file title, and date may also be included.

Labeling photographic materials begins with proper handling. It is always wise to wear gloves (cotton or natrile) since the acid on fingers may cause permanent damage. Each image (negative, slide or print) should be stored in its own envelope or sleeve made of inert plastic or unbuffered paper with a neutral pH, high alpha cellulose, and lignin free, since buffer can damage photographs. Each image must be labeled with a unique identifying number. Photographic prints, slides and negatives should be labeled on the file, sleeve, or on unbuffered paper with a neutral pH, high alpha cellulose, and lignin free inserted in the sleeve. Prints also may be labeled directly in the border area of the reverse side, using indelible or permanent ink. Care should be taken to minimize the pressure applied when writing since it can cause the emulsion to crack. Negatives should never be directly labeled. The most critical information on photograph labels is: collection name and/or number and unique identifying number.

Typed or computer generated archival adhesive labels should be used for audiovisual materials on tape or reel and for electronic diskettes. These labels should contain collection name and/or number, accession number, unique identifying number, and a brief description of the

contents. Diskette labels should also include the software, version, size and type of file(s), and date.

Labeling Materials

Below is a list of some materials that may be used for labeling and some that should be avoided. A conservator should be consulted on any questions about labeling. Whatever method is chosen, it is important to document all materials and methods used for both the objects and records.

Materials that can be used	Materials that should not be used
100% cotton string undyed	Typewriter correction fluid
Teflon monofilament	Nail polish
Nylon monofilament in polyethylene tubing	Rubber cement
	Pressure sensitive tape or labels
Acid-free 100% cotton rag paper	Paper labels moistened by water
Unbuffered paper with a neutral pH, high alpha cellulose, and lignin free	Ballpoint ink
	Metal fasteners or tags
Japanese paper	Edged tags
Tyvek®	Silicone products
Cotton twill tape	Chalks
India Ink	Fusible iron-on fabrics
Acryloid B72 or B67	Wire
Pencil	Elmer's® glue
Acid-free card stock	Nail polish remover
Reemay®	
Mylar®	
Alcohol and acetone solvents	

Packing

Not only are archeological collections sometimes stored in inappropriate facilities, but these materials may suffer further from compression damage, water damage, and pest infestation. *From the photograph collection of the U.S. Army Corps of Engineers, St. Louis District.*

Proper packing and storage of objects and associated records is essential for their long-term preservation. Poor storage, involving the containers, shelving, and storage environment, has probably been the biggest factor in the deterioration of many archeological collections over the last hundred years.

In the field, the principal investigator and archeological staff should try to use stable and long-lived materials for initial packing of objects. Often these "temporary" containers house objects and records for years. Consequently, they should also be labeled immediately. Using containers of stable materials, especially those of archival quality, at the start of a project can save time and money that otherwise will have to be spent later on rehousing the collection.

In general, until it is assessed, stabilized, and prepared for permanent storage, an object should be kept in a storage environment that closely resembles its *in situ* conditions. Records should be kept in a storage environment that minimizes deterioration from significant fluctuations in temperature and humidity, water leakage, and pest infestations.

Once initial analysis and processing of an object, object lot, or group of records is complete, the item, lot, or group should be placed in appropriate long-term housing. For artifacts, an artifact container, such as a bag, box, or sleeve made of acid-free paper or plastic, is the receptacle that holds one object. For associated records, such a container is usually a file folder. A storage container, such as larger boxes, drawers, and cabinets, holds numerous artifact containers or record file folders.

The type of artifact, records, or storage container used is based on a number of criteria. These include:

1. *Provenience.* The original location of material remains and the site where records were created is critical information to facilitate finding and returning objects to their correct storage locations, as well as using those items. Therefore, all containers must have good labeling systems to display information about their contents and provenience.

2. *Material Class.* Objects from one material class should be placed in an artifact or storage container. For example, lithic flakes, pottery sherds, and ground stone may be stored together in polypropylene bags. Heavy objects, such as brick or large stones, should be stored separately from lightweight objects. However, different types of records (e.g., paper documents, photographic prints, diskettes) may be placed in the same file folder or box based on their provenance (history of creation and ownership) and original order by creator.
3. *Human remains and sacred objects.* Human remains from an identified individual should be stored in an individual container to provide the respect they deserve. Sacred objects should be stored in a similarly respectful manner. A separate storage area in the repository should be designated for human remains and sacred objects to facilitate special access and use for consultation, ceremony, and research.
4. *Interaction between materials.* Be careful to understand how the object or record material(s) interacts with the material of which a storage container is made. This is particularly important for storing particular types of records, such as color slides, negatives, prints, or drawings.
5. *Anticipated use of the item.* What will be the frequency of access required for the artifact or record? More frequently used items should be packed and stored in a manner to facilitate access.
6. *Size of object/record and fragility.* Choose a container that fits an object or set of records. Do not bend or force an item into a smaller container. Do not store fragile objects or records in non-rigid containers. Whole pots, metal objects, fibers, and textiles should not touch one another. For bulky and heavy objects, make sure the container can hold the weight. For oversized materials, such as maps, make sure they are stored flat, preferably in acid-free files placed in baked enamel flat file cabinets. Do not overpack containers.
7. *Special packaging or support needs.* Some containers can be custom-designed to hold odd-shaped objects that need complete support. Use archival quality materials (such as Ethafoam® or acid-free cardboard) when constructing these mounts. Provide complete information on the container label to minimize handling of the object itself.

The type of storage and/or artifact container used may also depend on funding and space limitations. Unfortunately, few repositories have the space or funds for ideal packaging and storage of all the material remains and associated records they manage. At the very least, it is important for all objects to be fully supported and have readily visible, proper provenience data on the containers. In some cases, objects and/or records should not touch each other (see above). For example, never store colored papers, ink, photos, or maps directly next to buffered paper.

Once a storage container is selected to house a number of objects or records and the packing is completed, it may become necessary to remove an item to rehouse it in another sized container. If this is done, it is important to carefully document the removal from the original container and identify the new location.

Below is a table of materials that should and should not be used for packing and storing material remains. In general, containers should be self-closing. Rubber bands, twist ties, tape, string, staples, or heat sealing should not be used to close containers.

Recommended Packing Materials for Objects	**Packing Materials *Not* Recommended for Objects**
Acid-free boxes	Cigar boxes or regular cardboard boxes
Polypropylene containers	PVC or "plastic" containers
Acid-free poster board	Acidic cardboard
Polyethylene foam	Styrofoam
Polyethylene bags with zip closure (minimum 4mm thickness)	Sandwich baggies
Polyethylene sheeting and chips	Plastic wrap
Acid-free tissue paper	Polyurethane chips
Polyester batting	Toilet paper, facial tissue, or newspaper
Tyvek® for labels	Acidic paper
Aluminum foil (C14 samples only)	Brown paper bags
Metal containers (limited uses)	Cellophane tape
Glass containers (limited uses & insulated against breakage)	Cotton wool
Cotton or muslin fabric	Foam rubber, urethane foam
Cotton or polyester batting	Masking tape
Mylar®	
Ethafoam®	

Specific Notes on Associated Records

Inappropriate packaging of archeological associated records. *From the photograph collection of the U.S. Army Corps of Engineers, St. Louis District.*

The biggest challenges for associated records involve using the correct storage materials for particular types of records in association with a good storage environment (see also next sub-section).

Paper records should only be stored in archival quality housing, particularly paper, folders, and boxes with a neutral pH. Items should be unfolded and most paper records should be stored vertically in folders within storage boxes. Oversize items should be stored flat to avoid sagging.

Temperature and relative humidity (RH) should be kept within proper ranges in order to prevent mold or the embrittlement of paper. A good temperature range for paper records is between 60-75 °F and a good RH range is between 40-55%.

All metal fasteners (paper clips, staples), rubber bands, and adhesives (post-it notes, tape, adhesive labels) should be removed from individual records. Since the deterioration of such fasteners can leave residues on the records and cause further harm to the material, any damage and loss of information should be carefully recorded.

Different copying and printing processes also require special storage and conservation needs. Blueprints and newsprint should be stored separately from other paper because they are chemically unstable. Older copying processes, such as carbon copies or Photostats, deteriorate and fade rapidly. They should be copied onto archival quality materials. If a record is separated out for any reason, a separation sheet should be inserted that indicates the new storage location.

Packing and storing photographs, negatives, and slides differ somewhat from the methods and materials used for paper records. Photographs should be stored in individual sleeves that are non-buffered, have a neutral pH, and are made of archival quality paper or inert plastics, such as polyethylene. Vertical, supported storage containers should also be used.

Acceptable storage system for photographic slides -- appropriately cataloged, labeled, and stored in a baked-enamel specialty cabinet constructed for slide storage. *From the photograph collection of the U.S. Army Corps of Engineers, St. Louis District.*

Cold storage with a low RH are good for photographic materials that do not require frequent or regular access (no more than once a year) -- an RH between 20-50% and temperatures at 35-40°F. If photographs are placed in cold storage, the temperature and RH must be closely aligned in order to prevent condensation. Also, inert plastic sleeves should **not** be used to house individual photographs in cold storage.

More specific storage and conservation needs are dependent on the film processes used. Black and white pictures are much more stable than color. Older film, such as cellulose nitrate and cellulose ester films are highly unstable. Nitrate film can also be very combustible. Separate cold storage and copying of these materials is necessary. Badly deteriorated film should be disposed of since it poses health, safety, and fire risks.

The relatively recent widespread use of electronic and digital media, such as computer diskettes, magnetic tapes, and compact discs, have resulted in some interesting research concerning their preservation and storage. Guidelines for the life expectancy of these materials and how best to take care of them are now available. In general, electronic or digital media should be stored in a dust free environment and away from any magnetic fields. Storage in inert plastic containers and in a vertical position are usually the best. These materials are sensitive to temperature and RH fluctuation, especially excessive heat. (CDs are more prone to RH problems.) A range between 62-68 °F and 30-40% RH is acceptable. Tapes should be rewound and refreshed periodically to ensure viability. Magnetic media should be copied at least every five years. Digital media should be continuously migrated to newer file formats in order to be compatible with newer software and hardware.

As Eiteljorg (1998) emphasizes, however, archeological data in digital format may become relatively useless, despite migration and reformatting over time, **if the creator of the data does not provide complete and timely supporting documentation about the data and its structure**. This includes file names, relationships between files, data standards, the methods used to compile the data, and level of data accuracy. This supporting documentation, called metadata, must be stored with the digital data.

Rapid technological changes also affect digital records. Much electronic and digital archeological data created five-ten years ago are now in non-current formats that cannot be accessed by contemporary hardware and software. Time and funds now have to be spent on migrating data to new formats and purchasing or maintaining compatible hardware and software to read and use the data. When digital records and data are upgraded and transferred to new software or hardware specifications, they should be tested immediately for completeness of the transfer. For magnetic media, playback equipment must be kept in good condition. Because of their short use life and short conservation life

span, it is advisable to make copies of magnetic and digital records on other media, such as paper or microfilm. Any copies made should be placed onto longer-lived media than the original.

Here is a table of materials that should and should not be used for packing and storing associated records.

Recommended Packing Materials for Records	**Packing Materials *Not* Recommended for Records**
Acid-free boxes	Acidic cardboard boxes
Polypropylene containers	PVC or "plastic" containers
Acid-free poster board	Styrofoam
Polyethylene sheeting and chips	Plastic wrap
Acid-free tissue paper	Toilet paper or facial tissue
Tyvek® for labels	Newspaper
Cotton or muslin fabric	Acidic paper
Mylar®	Brown paper bags
Neutral pH, high alpha cellulose, lignin free paper	Cellophane tape
	Masking tape

Storage environment

High risk storage location (next to water valve). *Photo courtesy of the Art Conservation Center @ Univ. of Denver (formerly RMCC), Denver, CO.*

The overall storage environment is one of the most important variables in the long term preservation and conservation of objects and associated records. It encompasses both the physical area(s) where collections are kept, as well as the physical safety of the items. In general, the storage environment involves the spatial layout of the storage area(s), controls over the environment, and disaster planning.

Oversight of the storage environment is oriented towards mitigating the risks to collections, including: physical forces (e.g., flood, earthquake, tornado), fire, water, theft, pests, pollutants, light and radiation, incorrect temperature, incorrect relative humidity (RH), health of staff, and custodial neglect. Policies and procedures, such as a detailed risk management plan, should be in place to address controlling and minimizing these risks. Their negative effects can also be minimized through proper training, decreasing handling of objects and records, controlling access, and maintaining housekeeping procedures.

Layout and Equipment

The specific layout of a storage area depends on the types and number of materials in individual collections and in the repository overall. In general, the layout should minimize risks, while maximizing accessibility for repository staff.

The choice of what storage equipment to use is often complex. Some equipment that is safe for objects may also be very expensive. Closed storage cabinets are usually preferable because they keep out dust, minimize exposure to air and light, and can be locked. When open shelving is used to reduce costs, objects should be kept covered. For associated records, it is best to store them in neutral pH folders within archival flip-top boxes on open shelves to minimize costs while maximizing access and good storage practices.

Long-term storage should be separated from other activity space, such as exhibition, research, object preparation, conservation, and administration. Such physical separation enhances security and protection for objects and records. It also enables the use of storage environments that are beneficial to the collections, but may not be ideal for humans to work in on a day-to-day basis (e.g., lower temperature and humidity, low light levels, etc.). Some repositories use off-site storage facilities. There are advantages to these in terms of activity segregation and use of space, but there can be drawbacks when it comes to access, security, and monitoring.

Furthermore, environmental controls should be located in a repository to control the temperature, humidity, light levels, Ultraviolet (UV) rays, pests, and air pollution that may harm collections. Proper environmental controls are important for minimizing deterioration rates, extending object life, and decreasing conservation needs. While some controls need to be located amongst the collections, such as fire suppression systems and humidity monitoring, others need to be separated from the collections, such as the heating and cooling system, whenever possible.

Environmental monitoring at the Anasazi Heritage Center. *From the photograph collection of the Bureau of Land Management, Anasazi Heritage Center, Dolores, Colorado.*

Temperature and Humidity

Temperature and relative humidity (RH) are two of the most important aspects of the storage environment to control. Extreme levels and fluctuations of temperature and RH can be devastating to many materials, especially wood, leather, bone, paper, photographs, and electronic media. Temperature and humidity may be monitored through the use of a hygrothermograph or data logger. Acceptable ranges depend on the object or record material. In general, a good RH range is 40-60% (although this is too high for photographic materials) and a good temperature range is 68-72° F. It is always better to have a temperature and RH that are constant (within or slightly outside of the recommended range) than to have fluctuating levels.

Consistent levels can be accomplished in a number of ways. One is to create buffering zones and microclimates for the objects or records themselves. An artifact in a polyethylene bag, placed in a box, and stored in a cabinet is not as affected by outside environmental fluctuations. Another common method for buffering RH is the use of silica gel, an inert material that is usually used to absorb excess humidity. It may also be conditioned to maintain a constant RH.

Light and UV rays

Light and ultraviolet rays may be very damaging to many materials, especially textiles, paper, wood, and photographs. Light should be kept low in storage areas when work is taking place and off the rest of the time. Natural light should be avoided. Ultraviolet light (UV) should be filtered to block it out. Ideally, the storage area should contain no windows, lights should be turned off in areas not in use, and closed cabinets should be used when possible. Light levels may be monitored easily with a light meter. Levels should be kept between 50-300 lux, depending on the item, in exhibition spaces. The actual time an object or record spends in the light is also a factor in deterioration. A range of 96,000-576,000 total annual lux hours is the recommended range for most items (Read 1994).

Pests

Pests vary enormously from the smallest mite to the largest rodent. They can wreak major havoc on collections (as seen with our "mascot" -- a mouse that ate through a prehistoric basket in storage). Careful monitoring of pest activity in storage areas (and throughout the entire repository) is essential for the health of the collections. The most common approach to pest control in repositories today is called Integrated Pest Management (IPM). IPM is a systems approach that emphasizes prevention, use of the least toxic methods, and treatment of the building as one system.

Snake skin and dirt in the bottom of a collapsed artifact box. *Photo courtesy of Alexandria Archaeology, City of Alexandria, Virginia.*

Prevention entails consistent monitoring and inspection for pests and pest problems. Preventive measures can include locating and eliminating pest attractors, using sticky traps, and locating and eliminating pest entrances. When pest problems do arise they can be combated through the use of low or non-toxic procedures such as vacuuming, traps, freezing, and oxygen deprivation that pose little or no harm to humans and the collections. When these methods are not enough, experts should be consulted about applying more toxic methods, such as fumigants and pesticides.

Health Risks

There are a number of other materials that can put both the collections and the collections management staff at risk. Some of the principal ones are discussed here. All underscore the utility of an Integrated Pest Management program, as well as the need to perform periodic inventories, facilities inspections, and risk assessments in a repository.

Microorganisms, such as mold and mildew, may grow on the surface of organic matter (e.g., wood objects, paper) and may irritate human lungs or lead to disease, especially in the presence of dampness or decay. They produce irregular stains that may seriously damage museum items, including paper, leather, wood, and cloth. Low relative humidity (ideally between 45-55%, but below 65%) and lower temperatures help to reduce microorganism growth. Only extreme cold or heat destroys them.

A potentially more serious health risk to repository staff and others, as well as a contaminate of collections, is deteriorating asbestos. A popular building material used between 1940-1975, it can be found in the insulation, fireproofing and other components of a repository ceiling, walls, and floors, as well as in many other locations. Asbestos is activated when cut, crushed, scraped, or released from its binding materials in other ways. The tiny, abrasive fibers may then enter the human airways and lungs and lead to a variety of serious diseases. It is best not to work in pre-1975 areas with exposed insulation, damaged walls, ceilings, or floors, or where renovation or repair work is occurring. If work in asbestos contaminated areas cannot be avoided, protective clothing, gloves, and a respirator is essential.

Hantavirus is one of several serious respiratory diseases transmitted primarily as airborne particles. Hantavirus is caused by dried saliva or feces of deer mice. These and other rodents can get into museum collections. Therefore, in high risk areas of the American west, it is advisable to quickly process and rehouse newly received archeological collections, perform regular housekeeping procedures, and carefully assess and inventory collections in newly acquired, remote facilities.

Drawer storage system for archeological artifacts. Note system includes security bar to ensure drawers stay in place during seismic activity. *From the photograph collection of the U.S. Army Corps of Engineers, St. Louis District.*

Another health risk to repository staff, researchers, culturally affiliated groups, and other users of museum collections are the toxic residues from pesticides once used on old collections to kill insects. The residues from arsenic compounds, mercury salts, and various other toxic fumigants may lie on museum objects for years until stirred up by human activity. At that time, the toxins may penetrate a person and cause serious health problems. Conservators and scientists are researching ways to detect contaminated items, to identify the source and quantity of contamination, and to handle removal.

Security, Disaster, and Fire Protection

The archeological objects and associated records, including digital data, in a repository are irreplaceable. Security and protection from loss are therefore essential aspects of the storage environment. Big risks to the complete loss of individual items or whole collections are theft, natural disaster, and fire.

Security against theft can be achieved through practical methods or advanced security systems. Relatively inexpensive ways to increase security involve restricting access to collections in storage, as well as to different areas of the repository. Thus, all access to and use of collections should take place in a supervised research room with sign in and sign out procedures in place. There should also be a system of controls over who can use particular keys to specific rooms on what occasions. Regular and systematized inventory of the collections also helps to detect theft. More expensive and detailed procedures may include the use of locked storage or exhibition containers, security personnel, and electronic intruder or theft detection systems.

There are several possible natural disasters that could affect repository collections, especially flooding, earthquakes, and tornadoes. Repository managers need to evaluate the likelihood of any of these or other disasters in their geographical area. They should then create a disaster management plan that considers the site of the repository (e.g., it is in a flood plain), its physical layout and construction materials, and the nature of the collections it contains.

Protection from fire is also critical. Appropriate fire detection and suppression systems should be in place. Detection systems may monitor heat, smoke, or flames. Many repositories use sprinkler systems (wet or dry) for fire suppression. The use of fire-resistant storage and exhibit containers can also minimize risk to objects, especially for highly flammable items such as textiles, paper, and wood.

Fire protection for associated records involves a stable environment protected by a sprinkler system and a good smoke and fire alarm system. It may also include creating a safety copy, a record duplicate for access and use. Associated records are generally not housed in fire resistant file cabinets for several reasons. Due to their quantity, the weight could buckle most floors, the cost of the file cabinets would be prohibitive, and it would be very difficult to provide researcher access to records stored in cabinets as opposed to moveable boxes. Also, the fire-protective qualities of these cabinets may diminish over time.

Policies and procedures for the prevention of fire are also important. These may include identifying, monitoring, and eliminating fire hazards; the segregation of flammable materials; and training staff on emergency procedures.

Conservation and preservation

The preservation and conservation of archeological objects and associated records is a continuing process. The goal is to maintain an item in a stable condition. All items have a limited life span and are never immune to agents of deterioration, no matter what measures are taken. Archeological materials face even more conservation and preservation problems because they are already old and deteriorated. Active conservation measures can be costly and decisions on proper care need to be considered carefully. This is one reason why conservation and preservation should be a collaborative effort between conservators, archeologists, curators, archivists, and registrars. As well, such considerations need to begin before a field project starts (see Sections V and VI).

One of the best approaches to conservation is prevention. It may take less time, less money, and less effort to slow down or prevent deterioration than it takes to repair or replace material remains or records after they have deteriorated. Prevention involves proper housing using long-lived and durable containers, storage, and handling. It also involves constant monitoring and control of both the physical environment and the collections themselves, many of the measures previously outlined for packing and storage. Condition reports are another essential element of the monitoring process. These may be prepared by collections management staff or conservators and need to be readily accessible in an accessions file or similar location.

Conservator testing ethanol on a pot. *Photo courtesy of the Art Conservation Center @ Univ. of Denver (formerly RMCC), Denver, CO.*

A condition report is "an accurate and informative account of an object's state of preservation at a moment in time" (Demeroukas 1998:53). Archival materials also require a condition report, however. Condition reports may be used to:

- Establish the exact condition of an object or associated records.
- Benchmark the type and/or rate of deterioration taking place.
- Document the condition history and treatment of an object or group of associated records. This is especially important for archeologists who are sampling a collection for scientific analysis. They must know about any treatments in case those treatments could affect the analytical process and results.
- Set priorities for conservation care and treatment.
- Make future handlers aware of seen and unseen problems.

A condition report for **objects** should include:

- Item identification number(s)
- Object composition
- Types of damage (biological, physical, chemical, etc.)
- Extent of damage
- Location of damage
- Previous conservation work
- Dates and reason(s) for damage (if known)

A condition report for **associated records** should include:

- Collection identification number(s)
- Range and quantity of materials (e.g., process, media, genre)
- Types of damage (biological, physical, chemical, etc.)
- Extent of damage
- Location of damage in the collection, using series, box, or folder numbers
- Previous conservation work
- Dates and reason(s) for damage (if known)
- Recommendations for reformatting and/or stabilization

Buckskin jacket in humidification chamber. *Photo courtesy of the Art Conservation Center @ Univ. of Denver (formerly RMCC), Denver, CO.*

The documentation in a condition report may be textual notes, sketches, and/or photographs. It is important to maintain consistency in these reports. Items should be examined in a consistent manner and under consistent conditions. Consistent use of terms and qualifiers is also important (i.e., good, bad, scratched, abraded, etc.).

Establishing an item's or collection's condition may aid in the identification of further conservation needs. There are five basic types of conservation that may be applied (adapted from UKIC 1983 guidelines).

1. Full Conservation – Includes photography, x-radiography, examination, investigation, cleaning, active stabilization, and reconstruction. All of these procedures should be reversible. Appropriate analytical information provided where required.
2. Display Conservation – In addition to category 1, may include further cleaning, additional restoration, and cosmetic treatment.
3. Partial Conservation – Includes work in category 4 and a high degree of cleaning with or without active stabilization. May include reassembly of broken or detached fragments, but not reconstruction of missing areas.

4. Minimal Conservation – Includes "first-aid" measures, x-radiography, and photography, and a minimum amount of investigative cleaning. May include suitable packing or repacking for stable storage.
5. No Conservation – No work of any kind by the laboratory or repository except for handling and checking.

Specific conservation treatments vary for every item. Detailed conservation work should only be attempted by a trained conservator. An inferior conservation treatment often causes more harm than good.

Below is a chart of some basic cleaning and storage measures for common archeological materials, including associated records (Cronyn 1990; Sease 1994; Puglia 1999a). **These are only generalizations.** Specific courses of action depend on the item's archeological environment, state of deterioration, and expected use. Again, consult with a conservator before doing any active treatments. Regardless of the choice of conservation, every procedure and material used should be fully documented for future archeologists, conservators, archivists, and others.

	Common Deterioration	**Cleaning**	**Storage & Exhibition**
BONE, ANTLER, IVORY	Hardening with drying. Possible shrinking, warping, cracking, and delamination.	Dry brush. If wet, clean when still damp. Mechanical methods may be used.	45-60% RH, below 75° F. Controlling RH is essential. Human remains need special consideration.
CERAMIC	Hardening of dirt or salt encrustation. Crumbling possible. Breakage and abrasion. Crazing or crizzling of glaze.	Wash with water or dry brush. Dry completely. Do not clean specimens that will be used for scientific analysis!!	Stable RH, also for ceramics with soluble salts. Control humidity to prevent soluble salt crystallization. Support & careful handling essential.
DIGITAL MEDIA	Exposure to heat and magnetic fields.	Copy to a non-proprietary format. Recopy every 2 yrs thru data migration. Upgrade related software & hardware.	68° F, 30-40% RH. Store vertically in dust-free environment.
GLASS	Crizzling, weeping, iridescence, efflorescence, & devitrification.	Spot clean. Dry thoroughly if washed.	An RH below 42% for weeping glass. Keep away from heat in storage & exhibition areas.
LEATHER, SKIN, FUR	Drying can cause shrinking, curling, & cracking.	May use damp swabs or dry brushes. Wet leather may be cleaned with water & soft brushes.	Proper support essential. Cold storage best for furs.
MAGNETIC MEDIA (including magnetic tape for digital data)	Tape adhesion, tape cohesion (binder flakes off), high curl of tape, & high friction from tape stickiness.	Rewind tape at controlled tension every 3 years. Make copies for use. Recopy every 5 years.	Store originals at 40° F, 20% RH, no lower. Store usage copies at 60-74° F, 25-55% RH, Store vertically; Keep away from magnetic fields.
METAL	Tarnish and corrosion.	Do not wash!! Work with a conservator if corrosion products must be removed.	Actively corroding, dry metal should be stored in a dry microenvironment (below 35% RH).

PAPER	Mold, rips, tears, & buckling.	Fumigation. Gentle brushing.	60-75° F, 40-55% RH. Store in buffered folders and boxes, usually in vertical position.
PHOTOGRAPHIC MATERIALS	Curling or planar distortion; silver mirroring of image details; emulsion cracking, softening or flaking; mold; pest damage.	Contact a photo conservator. Handle with gloves.	Around 68° F, 20-40% RH. Store in the dark; 50-100 lux for exhibition. Use sleeves, folders, and boxes of neutral pH (unbuffered preferred) paper or inert plastics.
STONE	Powdering, crumbling, cracking, spalling, & delamination possible.	Wash in water with gentle brush or dry brush. Dry thoroughly. Do not clean specimens that will be used for scientific analysis!!	Store heavy objects appropriately.
TEXTILE	Crumbling and fragmentation. Light, mold, pests, & bacteria are problems.	Do nothing.	Low light essential, 50 lux max. Acid-free storage needed. Flat storage usually best. Minimize exhibition & handling.
WOOD, FIBER	Shrinking, swelling, cracking, and warping. Fungi, bacteria, & pests are major problems.	Do not clean unless necessary! Dry brush or low vacuum through a screen.	Low light. Keep dust free.

Inventory

Photographic processing and cataloging activities at the Stabilization Laboratory, U.S. Army Corps of Engineers, St. Louis District's Mandatory Center of Expertise for the Curation and Management of Archaeological Collections. *From the photograph collection of the U.S. Army Corps of Engineers, St. Louis District.*

Collections inventories are an important aspect of good collections management. They are useful for updating location information on objects, updating location information on associated records at the collection level, identifying conservation needs, aiding in security, and helping researchers access particular items. Inventories can also be used as a basis for planning, budgeting and accountability. Similarly, archival collection level surveys are used to plan archival processing activities (arrangement, rehousing, producing finding aids, and cataloging.)

Inventories may take some considerable time and funding to complete and maintain. As a result, inventorying often has been an overlooked aspect of collections care with the result that many repositories, as well as federal, state, tribal and local agencies, have had little idea about the exact contents of their collections. The passage of NAGPRA and 36 CFR 79 has helped change that. NAGPRA required repositories to complete inventories of all Native American human remains and associated funerary objects by 1995. 36 CFR 79 requires repositories to conduct "periodic" inventories and inspections of any federal collections that they care for and manage.

For objects, inventories function as periodic checks to account for items in a collection and to update their accession and catalog records. There are three basic types of inventory used by repositories. A complete inventory accounts for every object. A sectional inventory involves the inventory of only one section of the storage area, one collection, or one type of object. Sometimes, depending on funds and staff, a repository might devise and implement a continuing schedule of sectional inventories to make up a complete inventory over a particular period of time. A spot inventory is the third type. It is very limited in scope and only involves checking a small part of the collection, often using a random sampling procedure. Spot inventories are useful for quickly checking the accuracy of records and location information.

The type and amount of inventory done usually depends on the repository's collection size, funding, types of materials housed, and mission. Regardless of how it is completed, all objects and associated records in the collections should be inventoried periodically, the more

frequently the better. This includes not only items in storage but also those on exhibit, loan, or undergoing conservation. Archival collections, on the other hand, are usually inventoried upon acquisition by collection unit, not individual records. After archival processing (arrangement and description), the finding aids produced take the place of an inventory.

Planning and scheduling inventories is an important task due to the staff time and funds involved. Planning includes determining the minimum amount of critical information that needs to be recorded. Inventory information usually includes object number, name, location, and condition. Information collected during an inventory should then be reconciled with repository records to ensure that it is correct and up-to-date. Organization is the key to a smooth and fast inventory. If the storage containers, objects, and collections are well organized and labeled, the inventory process should not be difficult.

Time and energy spent on inventories also may be minimized with the use of computerized inventory and catalog systems. Computer programs manipulate, search, and retrieve data faster and more completely, thereby increasing the value and usefulness of inventory information. Computerized cataloging and labeling systems, such as barcodes and barcode scanners, are becoming more common in repositories and can noticeably facilitate the inventory process.

Records and data management

In general, a repository manages two types of records related to archeological projects -- the records generated by the repository during day-to-day operations and the associated records of an archeological project. The care and management of archeological associated records have been discussed in previous sections as an integral part of archeological collections management.

What has not been fully presented is the management of the repository records and the information they contain. Repository staff both create and manage numerous records, those that document day-to-day activities and those that record specific information about the objects, associated records, and collections themselves over time. Detailed and consistent management of these records is essential to ensure their long-term usefulness for repository staff, researchers, resource managers, and others. Records may be produced in a number of media, such as ink, toner, or pencil on paper; photographs and film; digital, audiovisual, and magnetic media; and microforms such as microfilm.

Common Types of Repository Records & Information
(may vary with type and size of repository)

Accession File	Central document file on an acquisition or incoming transaction. Should contain all associated paperwork, including legal documents, correspondence, deed of title, and copyrights, when applicable. It may also include photos, object history, condition report, and catalog information.
Source or Donor File	Information that identifies donors or source of individual items or collections of objects and/or associated records. Useful for identifying past provenance. May be part of an accession record.
Insurance Information	Information on what is covered by insurance and the value of objects or documents. Often in an accession record.
Catalog Record	Information on individual objects, lots of objects, or a collection of records (including a sub-collection, series, container, and file unit), often organized by accession number. Usually contains basic descriptive information and access points (e.g., names, subjects, genres). Instead of placing this information on cards, as in previous decades, these records are now often in a digital format, such as a database. May be cross-referenced to other types of records.
Location File	Details the location of all objects and collections of associated records. May be organized by object type or by location. May include location history. Often found on a catalog record or in a catalog database for easy search and retrieval.
Classification or Category File	Information on a system used to group together objects. Categories vary by type of collection and repository organization. Associated records are not arranged in a classified order, but by the record creator's original arrangement or filing plan. The repository creates finding aids to help locate and use specific records.
Photo or Image File	Information on photographs or images of objects, documents, collections, exhibits, etc. May contain captions, release forms, copyright information, and

	other data about the photo or image, or may contain actual photographs or images.
Loan File	Documents incoming and outgoing loans. File contains information on ownership, object use, loan conditions, and location.
Exhibition File	Detailed information on an exhibit, such as exhibition objects and/or documents, loans, receipts, correspondence, photos, layout and design, research, budgets, and insurance.
Correspondence	Incoming and outgoing letters, memoranda, minutes from meetings, briefing materials, decision documents, etc.
Access, Reference, and Use File	Information on users and collections use, including researcher registration forms, permissions to publish, duplication requests, rights and permissions granted, requests for research help, researcher correspondence, and Freedom of Information Act requests (see Section IX).

Given the broad range of records created and managed by a repository, it should have policies and procedures in place to handle the records management life cycle -- the phases of creation, maintenance and use, and disposition. Importantly, however, records management may be handled somewhat differently by the various types of repositories discussed in Section VII based on laws, regulations, directives by the Board of Directors, or other guidance for this activity. In particular, federal repositories must follow the requirements specified in the Federal Records Act, the Freedom of Information Act, and their accompanying regulations. Many states may have similar laws, including Sunshine laws, and policies that affect state repositories and archives. Private museums, academic repositories, tribal cultural centers, and historical society museums, however, may choose to follow standards set out by professional societies, such as the Society of American Archivists, the Academy of Certified Archivists, and the Association of Information Management Professionals.

In the life cycle of records management, the creation of records involves a number of considerations. These include:

- Knowing the action that generated the records.
- Identifying the need for particular kinds of information, such as those presented in the chart above.
- Distinguishing records from other documents (e.g., books and other library materials, exact duplicate copies, blank forms, personal materials not related to repository business).
- Selecting appropriate, long-lived media to produce and retain records.
- Determining appropriate communication methods to record information to ensure efficient and effective preservation, retrieval, and use (e.g., documents, database files, images, etc.).

The second phase of the records management life cycle is maintenance and use, which involves the organization, storage, access and retrieval of repository records and data. This is when filing systems (paper or digital) are used to separate repository records from other documentary materials, as well as to efficiently and effectively retrieve specific records. It also when security and backup measures are used to protect records from loss or damage by natural or human causes, unauthorized change or deletion, and leaking of confidential or sensitive material. Other considerations include:

- Identifying records with proprietary, confidential or sensitive information. Sensitive information may need to be placed in a password-protected electronic system or in restricted access cabinets or areas.
- Implementing a file plan or arrangement of the records during their active lifetime.
- Identifying copyrights to any of the materials, which are held by another, such as a contractor.
- Preparing a disposition schedule for the records.

The vast majority of the repository records discussed above remain in active use and should be stored and managed following standard archival procedures. Some records, on the other hand, may become candidates for disposition when the items they document are deaccessioned or transferred. At this third stage in the records management life cycle, the status of records change from active to inactive and, in some cases, to temporary. This is when the records schedule, a written guide for identifying how long to keep temporary records, how to dispose of them, and who should hold an organization's permanent records when they are inactive, comes into play.

Scheduling the disposition of records is complex. It may involve temporarily storing records for a specific period of time in an appropriate storage facility. For records of continuing value (e.g., they fit in the repository's scope of collections and mission), this may involve transferring their custody to a designated archive (the National Archives and Records Administration for federal records) where the records are arranged, rehoused, described in a finding aid, cataloged, and made accessible for use. The last means to dispose of records is to destroy them.

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