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Survey Methodology for the Preservation of Historic Burial Grounds and Cemeteries

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An integrated program of digital surveying and mapping can provide a powerful database for the analysis, conservation, and management of historic burial grounds and cemeteries.

There are few places which we visit with more interest than old burial grounds, so frequent in our early settlements, and in which the dust of our ancestors is laid. We observe in their appearance a charming simplicity, that attracts the attention of all visitors, enlists their sympathies with the dead, and excites a tender veneration for their memory.¹

As man is the only animal that buries the dead,² then cemeteries and burial grounds, as final repositories, represent the largest material correlate associated

with the rituals and commemorations relating to death. The layout and design of monuments, tombs, and grave markers, motifs and inscriptions, and plantings and immortelles reveal our collective and personal responses to death, as well as much about our attitudes toward life.

Cemeteries and burial grounds and their mortuary structures, monuments, and associated features are rich and complex cultural landscapes. Although their formal aspects have long been

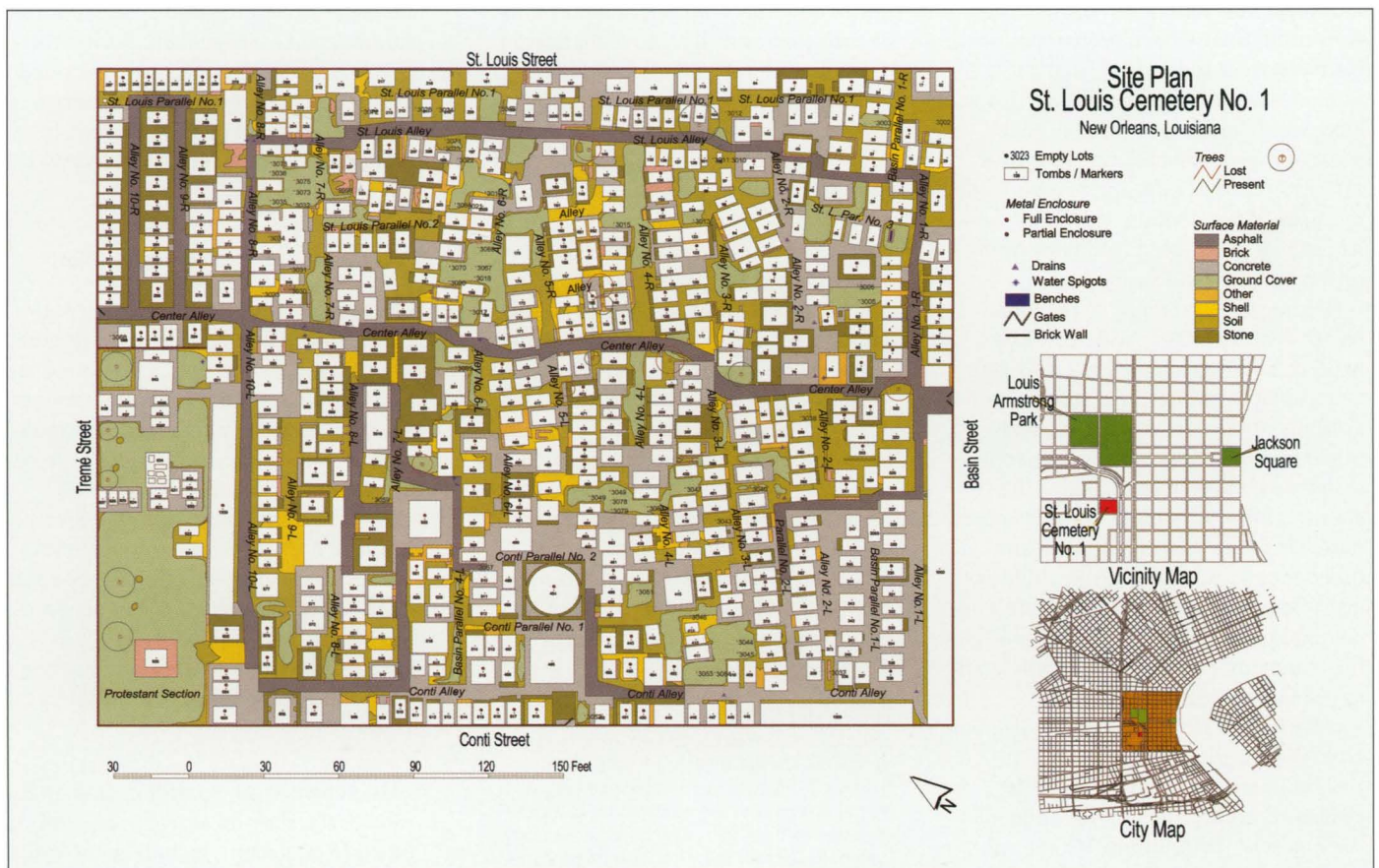


Fig. 1. The digital site map for St. Louis Cemetery No. 1 showing all tombs, markers, metal enclosures, and primary defining features, such as paths, ground surface, and vegetation. Final map layout by John Hinchman. Courtesy of the Architectural Conservation Laboratory, University of Pennsylvania.

studied, these landscapes beg renewed consideration, as J. B. Jackson has observed, as “social constructs formed over time” rather than only as designed entities.³

Critical to the problems of the preservation of these sites is an understanding of their past and current meanings and acquired associations beyond the primary physical and spiritual necessities of burial. For many older cemeteries and burial grounds, their transformation into heritage tourist sites has brought new problems, including commercialization, looting, vandalism, and overzealous or inappropriate restoration. Underlying these problems is the more fundamental question of the continued relevancy and practicality of these sites as sacred burial places. Shifting and declining populations, redevelopment of surrounding land, space limitations, and changes in burial practice and religious observance have all diminished their ability to function as places for the interment and veneration of the dead. As a result, many have been abandoned. Conversely, at some sites, such as St. Louis Cemetery No. 1 in New Orleans, increasing numbers of tourists have presented problems relating to visitor safety, owner liability, and access, while the rising market value of cemetery art has escalated the need for better protection from theft and vandalism.

During the latter half of the nineteenth century, many American Colonial-era burial grounds, long discontinued as places of interment, became symbols in the construction of a national identity memorializing persons associated with the founding of the country. Interest in these burial grounds paralleled that shown in houses and other sites associated with Revolutionary War personages and the nation’s colonial past, and they played a role in the commemoration of these individuals as public ancestors.

As early as 1851 Thomas Bridgeman crusaded for the preservation of Boston’s early burial grounds.⁴ His published arguments provide some of the first scholarly support for the cultural and historical value of American burial grounds and their protection. Further recognition of the importance of

cemeteries beyond their obvious function was generated by nineteenth-century scientific interest in the weathering of stone, as observed and measured in many ancient burial grounds;⁵ by antiquarian interest in tombs and grave markers as stylistic and epigraphic artifacts; and by the rural-cemetery movement, which established cemeteries as places for contemplation and recreation.

Defining Necrogeography

Necrogeography is a term believed to have been first used by Fred Kniffen in 1967 to describe the spatial and cultural dimensions of mortuary landscapes.⁶ Necrogeographies can range from a simple burial or tombstone to the complex, landscaped cemetery sites of the nineteenth and twentieth centuries. Determining what constitutes proper preservation and management of this unique class of cultural property requires an understanding of the origins of each site, as well as how changes in customs and attitudes over time have affected a site’s use, form, meaning, and preservation.

Beyond their practical purpose and cultural meaning, necrogeographies provide important information. Inscriptions can record birth and death dates, ethnicity, sex, life span, migration, occupation, social status, religion, and other demographic information. Tombs and markers can function as outdoor laboratories for scientists, conservators, architects, and sculptors studying the performance of many common materials, especially stone and metal, that have been subjected to harsh environmental conditions and to different methods of treatment. This use was recognized as early as 1883 by Dr. Alexis Julian in a lecture read before the New York Academy of Sciences:

There could hardly be devised a superior method for thoroughly testing, by material means, the durability of stone, than by its erection in this way [as a grave marker], with a partial insertion in the moist earth, complete exposure to the winds, rain and sun on every side, polished and sharply incised with dates, inscriptions, and carvings, by which to detect and to measure the character and extent of its decay.⁷

Yet despite their importance as cultural, historical, scientific, and scenic resources, necrogeographies and their monuments are endangered. Much of this problem can be attributed to the logistical complexity inherent in these sites: they contain markers of varied materials, design, and age; and they are subject to damaging environmental effects, both natural and human. Also, many seventeenth- and eighteenth-century urban burial grounds were destroyed or significantly altered in the nineteenth century in the belief that they were a source of disease and the cause of epidemics.

In order to ensure their preservation, various survey methods have been developed and utilized to record site, tomb, and marker information and to manipulate the data for historical and anthropological research. Fewer attempts have been made to expand the survey process to study site evolution over time or to conduct analyses of physical conditions and use for comprehensive conservation planning and management. Such efforts have formed the basis for an integrated program of documentation, conservation, training, and public outreach in recent work at St. Louis Cemetery No. 1 in New Orleans.⁸

Developing the Conservation Plan

A review of preservation and cultural-resource literature revealed that despite a plethora of public and private projects involving documentation and treatment of historic cemetery sites, little information has been published, except in cemetery-specific or regional guidelines.⁹

As with all heritage sites, the preservation of historic burial grounds and cemeteries requires a methodology based on principles, practices, and procedures. The following components define a basic, sequential conservation program for any historic cemetery or burial ground:

1. Documentation, recording, and analysis of the site and surrounding context (e.g., urban), including individual monuments, tombs, and landscape features through archival and field

research, as well as ethnographic recording of past and present uses.

2. Survey of site condition, including investigations of deterioration and characterization of biotic and abiotic features.
3. Development of an emergency program that includes fragment collection, inventory and storage, and temporary protection and stabilization of tombs and monuments.
4. Development of a phased treatment program for individual resources based on historical and cultural values, significance, condition, and integrity.
5. Testing and execution of model treatments and the development of standards and guidelines for conservation.
6. Preparation of a site conservation plan, including strategies for intervention and maintenance, as well as social and economic development and public outreach.

These six steps inform all preservation work. Additionally, the implementation of standards for documentation and treatment enhances opportunities for comparative analyses, dialogue, and planning across individual historic cemetery sites and projects.

Documentation and Recording

Documentation and recording of qualitative and quantitative information are the foundation for any conservation program.¹⁰ Past and present information on type, style, materials, design, environment, conditions, and use informs the analyses, diagnoses, and treatments required to ensure the long-term viability of any historic resource. Documentation provides the baseline that is essential to assess a site, prioritize the necessary work, and manage the resources.

Information should be compiled from archival images and other documentary sources, interviews, and physical evidence. The sources and methods chosen depend on the scope and objectives of the project. Historic cemeteries and burial grounds are usually well repre-

sented in both image and primary source materials in local archives. With sites that are still used or have only recently closed, interviews can provide valuable insights into the physical and social history of the site and individual monuments.

Inferred data, or educated guesses, based on physical evidence or observations of the surrounding monuments and landscape, can cautiously be used to bridge information gaps when no written data or images are available. The recording of site-wide observations is also a critical step in the documentation phase. What patterns of site evolution and tomb and marker typology can be constructed? How do material, design, orientation, environment, and past maintenance affect performance? Observed patterns help refine hypotheses for analyses.

An important product of the recording process is the development of a site map that identifies all individual monuments and site-defining features, such as paths, topography, water systems, walls, vegetation, and all other built or natural features. New technologies now make it possible to produce more accurate and comprehensive documentation by combining digital-imaging applications with tabular information stored in relational databases. A relational database stores information in multiple files or separate tables linked together (or related) by data elements that the files or tables have in common. Layered digital site maps allow visualization and analysis of the site through time, by individual features, by conditions, or by any combination of data collected. The database-connected map enables information on future treatment and maintenance information to be added, making it a valuable tool for ongoing site management (Fig. 1).

A field-survey form coordinated with the database should be used. All terms used and the methods of data collection should be documented in an illustrated survey manual. Basic information should include:

- Site specifics (address, locator information, contacts)
- Survey information (date, weather, surveyor)

- Tomb or marker identification (reference number, location, orientation, dimensions, precinct/enclosure, sketch)
- Monument or marker type and style
- Construction, alteration, and restoration dates
- Builder, architect, stone carver
- Materials and construction
- Inscriptions and iconography
- Other features (such as plaques, planters, furniture, metalwork)
- Status (relocated, altered, replica/replacement, fragmented)
- Treatment history
- Condition, form integrity, and material integrity¹¹
- Proposed treatments

Condition Survey and Assessment

The development of a comprehensive conservation program requires a thorough understanding of existing conditions. A condition-assessment survey must outline clearly what information is required and why. Consistent terminology should be specified for use and explained in a survey manual. The information should be presented to reveal broader patterns and trends of physical transformations over time.

Condition has many determinants. These include, in general order of occurrence:

- Original design, materials, and construction
- Subsequent changes through use, natural causes, and human interaction
- Micro- and macro-environments
- Disuse and/or abandonment
- Repair, reuse, and maintenance

As deterioration most often occurs over a considerable period of time, its study poses an enormous challenge. The most comprehensive method of study is continuous long-term monitoring, which is costly, time consuming, and not possible for many sites. The most feasible alternative is a periodic, systematic

methodology of descriptive recording and reevaluation of symptomatic conditions data, with information recorded under reproducible conditions at specific intervals over time. In this way, the variables of condition — including type, location, extent, and severity of damage — can be assessed alone, together, and in combination with other factors such as materials, design, construction, environment, use, modification, maintenance, and treatments.

By considering performance, deterioration, and treatment in a holistic and integrated manner, linking design, environment, and human agency, conservators can develop and apply documentation and recording methods focused on etiological concerns.¹²

Undertaking a tomb and marker condition-assessment survey can be a daunting task, given the sheer number and variety of types, materials, and conditions. All condition-assessment surveys depend on complementary levels of qualitative and quantitative recording that describe the type, location (micro or macro), status (active or inactive), and extent or degree of severity for each condition. Historical or otherwise previously recorded information, where it exists, should be included. The medium or format by which new information is gathered depends on what is being described, the size and scale of the work, the degree of accuracy required, and the equipment, skill, and time available.

Terminology should often be accompanied by photographic and schematic illustrations, the latter identifying differ-

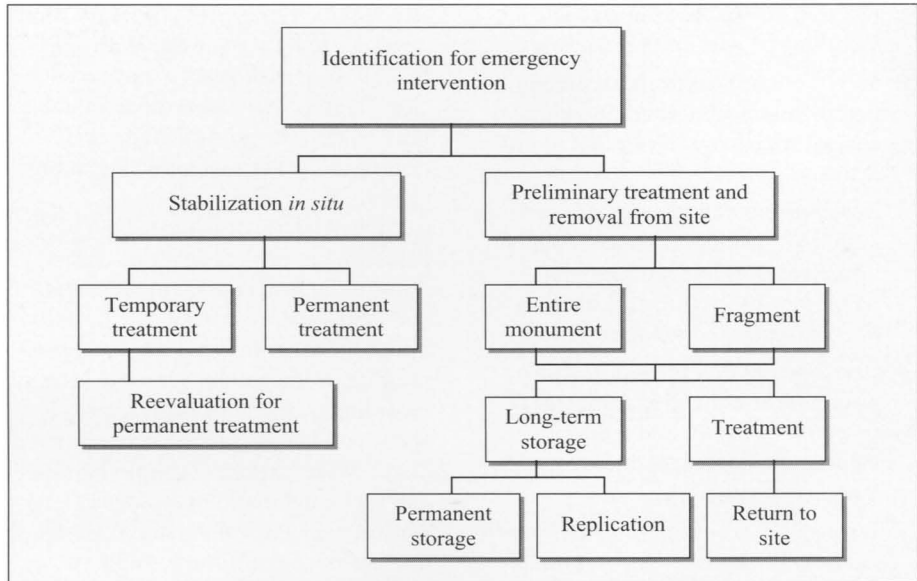


Fig. 6. An intervention decision-tree for historic tombs and markers. Diagram by Frank Matero.

ent conditions and materials, all of which can be incorporated into the project database and digital maps. Classification schemes are usually designed to serve a specific end, such as preparation for treatment or monitoring deterioration. They represent an artificial hierarchical typology of the variables observed.

Once a database and its accompanying survey have been developed and tested, data collection and management can begin. The database and graphic software available today allows for flexible and detailed analysis and visual display of information, facilitating the interpretation of data for diagnostic purposes and for developing manage-

ment strategies, including preventive conservation. Today's state-of-the-art condition surveys far exceed earlier methods of recording the physical details of before-and-after treatments.

Emergency Treatment Program

Because of the large numbers of monuments in most historic cemeteries and burial grounds and the unlikelihood of immediate and continuous conservation treatments, emergency measures are often required before a full assessment can be made or before the condition survey can be completed (Figs. 2–5).



Fig. 2. Emergency stabilization by means of temporary reburial with sand and geofabric "pillows." Photograph by Frank Matero.



Fig. 3. Emergency stabilization using temporary gauze facing. Photograph Frank Matero.



Fig. 4. Emergency stabilization by using an open-roofed shelter. Photograph by Frank Matero.



Fig. 5. Emergency stabilization using a closed, ventilated box around the structure. Photograph by Frank Matero.



Fig. 7. Bergamini Tomb, St. Louis Cemetery No. 1, New Orleans, before. Photograph by D. Krotzer.



Fig. 8. Bergamini Tomb, after. Preservation of existing form and materials through repair and maintenance. Photograph by D. Krotzer.



Fig. 9. Perrault Tomb, St. Louis Cemetery No. 1, New Orleans, before. Photograph by D. Krotzer.



Fig. 10. Perrault Tomb, after. Partial restoration through repair of roof and missing stucco. Photograph by F. Matero.

Any or all of the following usually constitute emergency conditions: structural instability, public-safety issues, large-scale material losses due to accelerated decay, instability of significant details such as carving or inscriptions, and imminent danger of theft or vandalism.

Although usually not feasible, the emergency “treatment” of choice is temporary removal and storage until the full site assessment and conservation plan can be completed. In situ stabilization of stonework with seriously flaking, scaling, delaminating, or sugaring surfaces or with loose, small fragments can be achieved with temporary facings of wet-strength tissue paper or gauze and a reversible synthetic adhesive. Where greater in situ protection from wind and water is required, temporary protective shelters made of wood; a breathable, water-repellent fabric; or a geotextile are recommended. Ground slabs may be protected temporarily by partial reburial under geotextile sand bags. These shelters can be left in place until time and funds allow for more permanent treatment.

Because fragments and other loose elements are very vulnerable to theft, vandalism, and collapse, a program of fragment collection, inventory, and safe storage should be initiated as soon as possible. This effort is invaluable for the future matching of fragments to parent monuments.

Phased Treatment Program

A separate numerical rating system for each tomb material’s condition, form integrity, and material integrity and for the significance of each marker, tomb, or component should be utilized. The data can then be analyzed based on the values of individual or combined attributes. In this way, a complete and integrated assessment of each marker is possible, leading to priority lists for phased stabilization, treatment, management, and maintenance programs. Overall site priorities based on condition, integrity, interment status, and significance of the individual monuments and of the individuals interred can then be developed. This approach is necessary to prioritize large numbers of monuments requiring immediate attention when time and resources are limited. These value-weighted ratings help decision makers follow the paths in an intervention decision tree (Fig. 6).

Model Treatments and Guidelines

After a survey has been completed and the information synthesized, standards and guidelines for the work and proposed treatments can be developed through laboratory and field testing and then executed in model projects on site in order to illustrate the range of materials, techniques, and recommended approaches. Projects should provide performance data over an accepted period

of time, usually not less than one year. This data can also provide a reasonably accurate prediction of conservation costs and skill and time requirements, information that can be used for scheduling work and for fundraising (Figs. 7–10).

Ultimately the aim of the preservation of outdoor monuments and sites is to augment the stability of the materials in situ by halting or retarding detrimental processes or by removing situations that threaten the continued existence of these works. In the case of historic burial grounds and cemeteries, this often translates into preferential respect for historic design and intent, the retention of as much historic fabric as possible, and the use of compatible but discernible replacement materials where needed. Recarving historic material generally is to be avoided, and relocation of monuments off site is not desirable since most cemeteries are public places. The materials and techniques selected, whether traditional crafts or specialized conservation, must address not only the structural requirements of the monument but also levels of exposure and issues of access and public safety. This process often requires a modification of the principle of reversibility of treatment to one of re-treatability. In general, every effort should be made to restore the visual syntax of the entire site through the structural and visual reintegration of the individual markers, the tombs, and their landscape.

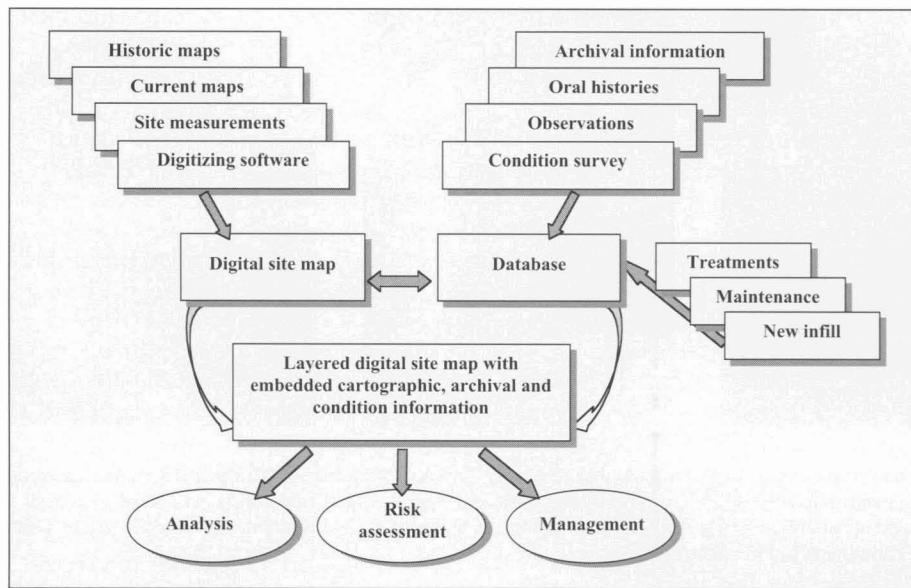


Fig. 11. Linking digital tools for enhanced information management. This diagram shows how the many categories of data (archival, verbal, field surveys, test data), as well as the later generation of treatment, maintenance, and new-construction data, can be linked to a digital map to be used for problem solving, preservation planning, and site management. Diagram by Judy Peters.

Tested conservation techniques should be appropriately incorporated into standards and guidelines to reflect site-specific materials, monuments, decay mechanisms, and environmental issues. The project team for St. Louis Cemetery No. 1 prepared a manual of illustrated guidelines that included extensive recommendations specific to above-ground tombs. The product was targeted to tomb owners and cemetery managers.¹³

Digital Documentation and Analyses

Historic burial grounds and cemeteries generally contain numerous site-defining features, and a large quantity of information will be generated during the course of a well-documented project. Efforts to maximize the information can benefit greatly from the creative use of digital tools for recording, analyses, information management, and presentation. The development of a relational database that is linked to a geographic information system (GIS) and that allows the mapping and analysis of spatial data, should be part of the planning process from its inception. This combination of digital tools with archival research and field recording can improve

the efficiency of historical research, the speed and accuracy of surveys, and the quantity and quality of archival information directly hyper-linked to site features. This combined approach can also become the tool for future documentation of treatments, maintenance, and changing conditions. Digital tools provide powerful analytical capabilities and can enhance the generation of creative presentations for project discussions, funding proposals, and public outreach (Fig. 11).

Although CAD, GIS, and relational databases are well understood individually and are in common use at preservation firms, most historic cemeteries and burial grounds do not have a GIS base map and have not developed a relational database to facilitate site-wide preservation planning. Commercial cemetery-management software is available to map plots and facilitate burial record keeping, and some of these packages incorporate GIS. However, these systems have been developed for modern cemetery management and generally do not address monument conservation needs or long-range site preservation planning.

Acquiring the commercial software for computer-aided design (CAD) and developing a GIS relational database can

cost \$5,000 to \$10,000, depending on the options or enhancements selected. However, once this investment is made, the programs can be used to link data, maps, and images from multiple projects of all sizes, and in-house use can eliminate the need for expensive, outsourced project-specific software development, which is generally unnecessary and difficult to maintain over time.

Establishing a digitized site map.

Layers of historic and current site information can be captured and digitized through the use of widely available CAD (e.g., Autodesk, AutoCAD) and geographical information system (e.g., ESRI ArcView) software. Geographic information systems are designed for the efficient acquisition, analysis, synthesis, and presentation of cartographic data and also allow the mapping of any collectible information that can be expressed as cartographic symbols such as polygons, dots, or lines. Fine-level survey data captured through Total Survey Stations (TSS) or coarse measurements taken with hand-held global positioning systems (GPS) can be loaded directly into CAD, GIS, spreadsheet, and database software. Data from traditional hand-measurement and digital-survey techniques can also be incorporated into the data tables to define existing boundaries, markers, tombs, and landscape features for mapping. Historic maps, USGS maps, and local planning maps can be “rubber-sheeted” within the GIS software to assist in the development of the base map or to create informative historic layers. Rubber-sheeting allows the historic map image to be incorporated as a layer in the GIS and manipulated so that the land features and boundaries line up with the current digital map data. There is a wealth of high-resolution aerial photography available, both commercially and within local governing bodies, that can also be incorporated.

Currently, most site layers are initially developed in a CAD program and then transferred to GIS software as closed polygons, points, and lines. Improvements to the newer versions of GIS allow facade features, new layers for treatments, or new site developments to be prepared directly through GIS. With

either tool, maps can be digitized for multiacre cemetery sites or for very small areas, such as a tomb-facade condition assessment. The development of the digital map for St. Louis Cemetery No. 1 can be seen in Figure 12.

Documentation requirements and survey forms. Different types of documentation can be collected at all stages of the project and incorporated into the project database. Research from primary and secondary sources, historic and current photographs and maps, past alterations or treatments, architectural elements, materials, current conditions, treatments, results of physical tests, and maintenance events can all become entries linked to the features of the digital site map. Data can be captured as searchable text in the form of a short comment, dates, numbers, calculations, charts, and images. The type and quantity requirements for documentation will dictate the design needs of the database.

The power of the digital-database-to-map connection is most obvious with large amounts of survey data, such as in a condition survey or architectural-significance survey. Working with the database design, the survey content and format must be optimized to ensure ease of use, accuracy, and the most meaningful collection of data for later mapping and analyses.

Relational database, data entry forms, and reports. After documentation requirements and survey questions are confirmed, then data fields, forms, and reports are developed, and the primary linking field of the database can be established using the survey coding system and vocabulary. Data fields that force surveyors to select from a list of materials produce more meaningful maps than data fields permitting the use of any text, any spelling, or numerous yes/no answers. The assignment of value-weighted numerical ratings to defined terms enables qualitative assessment terms to be used quantitatively, leading to more meaningful maps, comparisons, and summarization of data.

Complete and accurate recording of all pertinent data is the goal, so data entry forms should be user-friendly, and all team members should participate in

training sessions early in the process. The training often provides valuable feedback for the database developers, highlighting areas of confusion. For the St. Louis Cemetery No. 1 documentation and survey data, Microsoft Access worked well as the database program because of its recognizable interface, its ability to pull data to and from spreadsheets and GIS, and its ease of use. Computerized forms and reports were created to match the paper field-survey forms closely. For large cemetery surveys, field data collection with handheld computers is a cost-effective method for reducing error and ensuring rapid data entry.

Linking site map and database. The database is linked directly to the GIS mapping program through an ODBC (Open Data Base Connectivity) translator, available through the basic Windows operating system. This allows a direct SQL (Structured Query Language) connection from within the GIS program. The links can be set up before any data are collected so that each time the GIS program loads, it links to the current version of live database tables and established queries, or it questions how the data sets relate. Once the link has been established, additional tables and queries of interest can be brought into the GIS as new layers or combined with existing layers to answer future queries (Fig. 13).

Analysis, interpretation, and communication of information. Both the relational database and the GIS software contain extensive analytical and presentation capabilities. Depending on the question or desired output result, either tool can be used. Additionally, the data from the tables of both programs can be exported to spreadsheets for further charting and graphing capabilities. Layers of historical development and typology or condition can best be related in a visual format created through the GIS software. Complicated queries, reports, and calculated summaries can best be processed through the database and then charted through the GIS or spreadsheet-charting tool. Summaries and comparisons often are more clearly conveyed by means of charts and

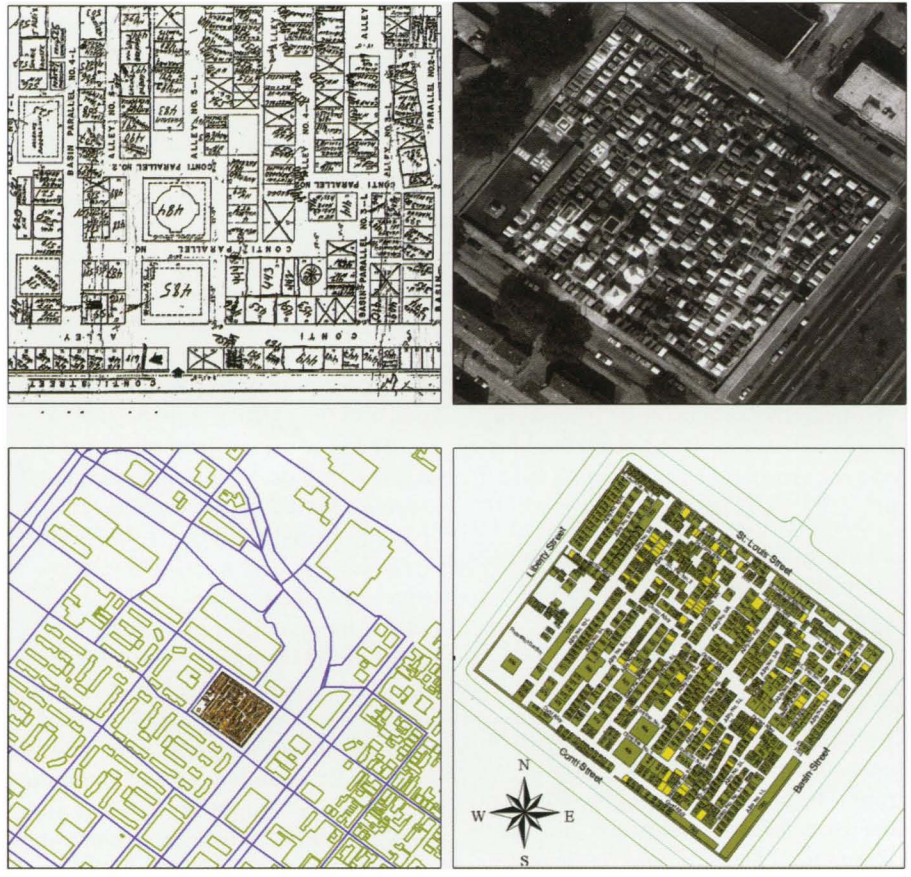
graphs. If the original map digitization was prepared in sufficient detail, complete material and condition mapping of tomb or marker surfaces can be achieved, with mathematical calculations possible for each deterioration condition, as suggested in earlier work by B. Fitzner.¹⁴ Each of these data displays, used in the right context, ensures that the final conservation plan is based on solid fact. This leads to informed decision making for the appropriate conservation treatments, funding priorities, and long-term site management.

By following a consistent digital approach to data collection, additional avenues for analysis and presentation become available. In the St. Louis Cemetery No. 1 project, participants developed three-dimensional models of the site by use of color, height, and roof-form data. Historical research resulted in timelines and scaled urban-context maps reflecting changes through time. Historical travel accounts were analyzed and used to map tour routes, significant events, and people as they related to specific tombs. Data collected on tomb changes over time allowed a progressive display of the morphological evolution of individual tombs, as well as of the entire site (Fig. 14).

The maps, analyzed data, and recommendations from the St. Louis Cemetery No. 1 project are presented on an educational Web site, which was developed using Web-design and animation-software tools. Dynamic pages allow users to query the project database directly, and GIS maps with “clickable hot spots” show summary data and a thumbnail image for each tomb. This versatile means of public outreach was chosen to meet the needs of local students and supporters, interested visitors, cemetery managers, and future researchers.¹⁵

Conclusion

Assessing and planning for the conservation needs of historic cemeteries and burial grounds can be a difficult task due to the sheer volume of tombs, markers, and other built memorial structures, as well as the many important landscape features. The conservation methodology discussed above was greatly enhanced



through the use of a conservation-focused database linked to a digital site map. This rich geographical information system enabled visualization of the site through time, provided decision making capabilities to assess significance and urgency for treatments, and will continue to serve as a tool for site-management and public outreach.

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Acknowledgments

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Fig. 12. The development of a site map. Top left: An earlier (c. 1940) hand-drawn survey map identifies tomb plots and numbering. Top right: A 1972 aerial photograph showing exact placement of tombs and features. Bottom left: A city-commission data layer positioning the site within the neighborhood. Bottom right: The new site base map georeferenced and projected within the World Coordinate System. Sequence by Judy Peters.

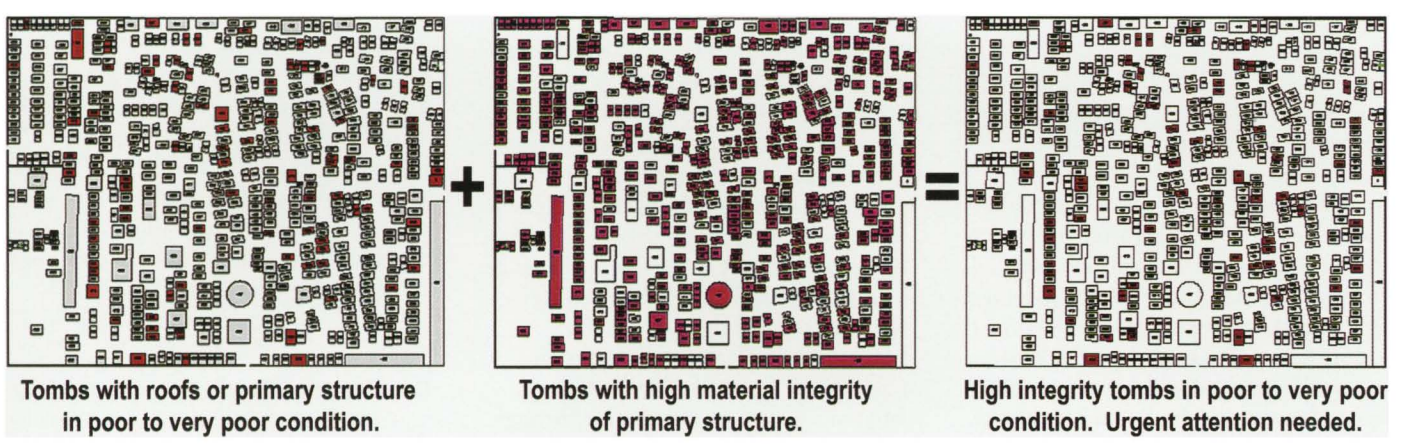


Fig. 13. Site maps with condition and integrity data mapped. The GIS maps provide enhanced visual references for site and resource issues, and the embedded information becomes available for extensive analyses, comparisons, and calculations. The combination of tombs in poor to very poor condition with tombs displaying high material integrity, allows the identification of a select group of tombs requiring the most urgent attention. Sequence by Judy Peters.

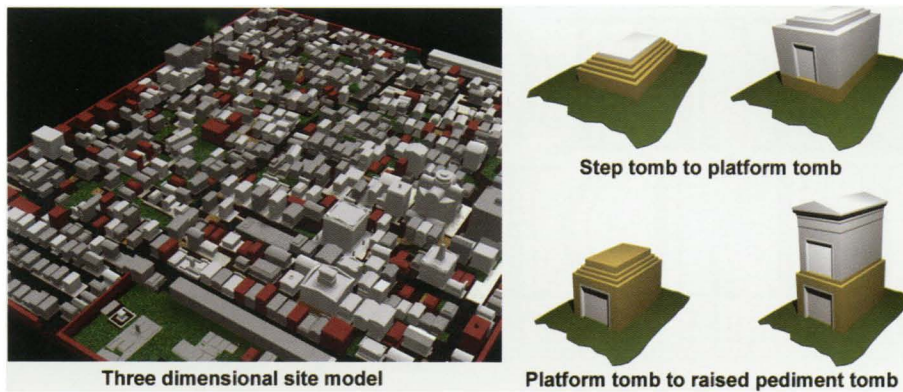


Fig. 14. A three-dimensional site model and two representative tomb-modification sequences. Digital visualization of site evolution over time and tomb type can be created easily using the survey data. Model by S-Y. Lu and sequence by John Hinchman.

Notes

1. Wilson Flagg, *Mount Auburn: Its Scenes, Its Beauties, and Its Lessons* (Boston and Cambridge, 1861), 114.
2. Louis Vincent Thomas, *Anthropologie de la mort* (Paris: Payot, 1975). Quoted in Michel Ragon, *The Space of Death: A Study of Funerary Architecture, Decoration, and Urbanism*, trans. Alan Sheridan (Charlottesville: University Press of Virginia, 1983), 4.
3. John B. Jackson as quoted by Paul Groth, "Frameworks for Cultural Landscape Study," *Understanding Ordinary Landscapes*, ed. Paul Groth and Todd W. Bressi (New Haven: Yale Univ. Press, 1997), 21.
4. Thomas Bridgeman, *Memorials of the Dead in Boston* (Boston: B. B. Mussey & Co., 1853).
5. See, for example, Thomas Egleston's, "The Cause and Prevention of the Decay of Building Stone," *American Society of Civil Engineers Transactions* 15 (October 1886): 647–715. Egleston discusses the condition and deterioration of markers in Trinity and St. Paul's burial grounds. See also Archibald Geikie, "Effect of Weather on Tomb-Stones," *The American Architect and Building News* (July 10, 1880): 21. Geikie discusses his research on the deterioration of dated tombstones as a method to evaluate the effect of time and weather on various types of stone.
6. Fred B. Kniffen, "Necrogeography in the United States," *Geographical Review* 57 (1967): 426–427.
7. Alexis Julian, "The Decay of Building Stones in New York City: Papers Read Before New York Academy of Sciences January 29, and April 30, 1883," *American Architect and Building News* 13, no. 373 (1883): 76–78. The papers featured his research on stone in buildings and graveyards in and around New York City.
8. This project was developed by the Department of Historic Preservation and Landscape Architecture at the University of Pennsylvania, under the direction of Frank Matero and Dana

Tomlin and in collaboration with the Preservation Studies Program of the School of Architecture of Tulane University. Funding was provided by the Louisiana Division of Historic Preservation, Office of Cultural Development, and the Samuel H. Kress Foundation in collaboration with Save Our Cemeteries, Inc., and the Archdiocesan Cemeteries of New Orleans. Field survey data were collected by the graduate students in a 2001 collaborative studio at the University of Pennsylvania and subsequently analyzed by a research team consisting of Stephen Curtis, John Hinchman, Sophie Middlebrook, Al Parker, Judy Peters, and Kyu-Bong Song.

9. Most of the available literature is incorporated in guidelines published by the National Trust, the National Register, or various state or local preservation offices. See Elizabeth Potter and Beth M. Boland, "Guidelines for Evaluating and Registering Cemeteries and Burial Places," *National Register Bulletin 41* (Washington, D.C.: National Park Service, 1992). Lynette Strangstad, *Preservation of Historic Burial Grounds* (Washington, D.C.: National Trust for Historic Preservation, 1993). Sharyn Thompson and Lynette Strangstad, *Florida's Historic Cemeteries: A Preservation Handbook* (Tallahassee: Historic Tallahassee Preservation Board, 1989). Frank G. Matero, et al., *A Conservation Program for Louisiana's Above Ground Cemeteries* (New York: Center for Preservation Research, 1987). Tamara Anson-Cartwright, ed., *Landscape of Memories: A Guide for Conserving Historic Cemeteries* (Toronto: Ministry of Citizenship, Culture and Recreation, 1997). English Heritage, "Paradise Preserved," at <http://www.englishheritage.org.uk>, March 2003. National Trust for Australia (NSW), *Guidelines for Cemetery Conservation*, <http://www.nsw.nationaltrust.org.au/cemscontents.html>, May 2003.

10. "The conservation professional has an obligation to produce and maintain accurate, complete, and permanent records of examination, sampling, scientific investigation, and treatment" (American Institute for Conservation of Historic and Artistic Works, "Code of Ethics of the American Institute for Conservation of Historic and Artistic Works"

and "Guidelines for the Practice of the American Institute for Conservation of Historic and Artistic Works," *AIC Directory* [Washington, D.C.: American Institute for Conservation of Historic and Artistic Works, 2003], or online at <http://aic.stanford.edu/pubs/ethics.html>).

Recording and documentation are separately defined by ICOMOS in Robin Letellier, "Recording, Documentation and Information Management Guidelines for World Cultural Heritage (draft)" (paper presented at the 11th ICOMOS General Assembly, Sofia, Bulgaria, October 5–9, 1996), Annex 1.

11. When evaluating the integrity of tombs and markers, integrity of both form and material should be rated. Definitions developed during the St. Louis Cemetery No. 1 project included "Form integrity: The extent of existing original form and details,..." and "Material integrity: The extent of existing original material,..." The full survey manual and form can be accessed at <http://www.noladeadspace.org>.

12. At the Trinity Church Burial Ground, New York City, unusual discoloration and deterioration of many of the sandstone monuments was finally identified from church records to be the result of a hot paraffin wax treatment (the Caffall process) applied in 1924. Once identified and dated, this information was verified using analytical techniques, and appropriate cleaning measures were prescribed based on the knowledge of these past treatments.

13. Frank Matero, S. Curtis, John Hinchman and Judy Peters, *St. Louis Cemetery No. 1: Guidelines for Preservation and Restoration* (Philadelphia: Univ. of Pennsylvania, 2002). Can be accessed at <http://www.noladeadspace.org>.

14. Bernd Fitzner, "Weathering Forms at Natural Stone Monuments: Classification, Mapping and Evaluation," *International Journal for the Restoration of Buildings and Monuments* 3, no. 2 (1997): 105–124. Fitzner refers to a proprietary software program for analyzing the data collected using the categories he suggests. Geographical systems now available can easily handle large quantities of data to show spatial correlations or to make mathematical calculations of areas of deterioration. Measured drawings (by hand or AutoCAD) or rectified photography images can be used as the base. Published literature on the use of GIS for historic preservation primarily features mapping of historic districts or large cultural landscapes. Small-scale surface mapping of conditions, treatments, or sample locations is an area of research that holds considerable promise.

15. More examples of GIS mapping and analysis of the survey data can be found at <http://www.noladeadspace.org>.