THE NATIONAL PARK SERVICE AND THE USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) FOR CULTURAL RESOURCE MANAGEMENT

by

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(Under the direction of Wayde Brown)

ABSTRACT

The National Park Service plays a central role in managing cultural resources in the United States and has served as a leader in the the use of geographic information systems (GIS) for this task both inside and outside its official jurisdiction. Review and analysis of park service literature facilitates an examination of how the park service has expanded and altered its cultural resource management objectives as it has become more comfortable with and reliant upon GIS.

INDEX WORDS: Historic Preservation, Geographic Information Systems, GIS, Cultural Resource Management, National Park Service

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INTRODUCTION

The National Park Service plays a central role in managing cultural resources in the United States. From Chaco Culture National Historic Park to Petersburg National Battlefield, the park service sets high standards for a variety of cultural resource management programs. The park service has also served as a leader in the the use of geographic information systems (GIS) for this task. The purpose of this project is to examine how the park service has expanded and altered its cultural resource management objectives – if at all – as it has become more comfortable with and reliant upon GIS. Has GIS changed the practice of cultural resource management at the National Park Service? If it has, how has it changed? More importantly, has the use of GIS altered the theoretical and philosophical frameworks around which cultural resource management has been built historically, and if so, in what way? If not, why not?

These questions are addressed using the following structure. Chapter one serves as an introduction to GIS where the basic structure and history of this technology is explained. Chapter two explores the limits of the definition of the term cultural resource, and examines how the National Park Service has contributed to an understanding of cultural resources. In chapter three, a brief history of the National Park Service role in cultural resource management is provided. This history includes one of the first uses of GIS in this field. Chapter four and chapter five are the key chapters of the thesis. The park service's expanded role in developing cultural resource GIS is investigated in chapter four with a specific emphasis on how GIS has influenced the American Battlefield Protection Program. Chapter five examines ways in which the use of GIS for cultural resource management has extended beyond national park boundaries and into

lands owned by private individuals, states, and companies. Chapter five also discusses how the park service has facilitated this phenomenon, and explores the ways states and private organizations have contributed. Finally, a brief conclusion directly addresses the questions initially posed.

Chapter 1
What is GIS?

What is GIS? Ten people might answer this question ten different ways. There are, however, some definitions of GIS that most GIS experts and professionals would accept. An introductory GIS text book gives perhaps the most general and simplest definition: "GIS is a set of computer based systems for managing geographic data and using these data to solve spatial problems."[1] The problem with this definition is that it does not explain what "geographic data" are. The United States Geological Survey gives a more precise definition, calling GIS a "computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e., data identified according to their locations."[2] This definition captures the essence of GIS at three points. First, GIS is a computer system; second, GIS can perform the functions of a database; and third, all of the data in the database are assigned a real spatial dimension.

This third point is worth examining more closely, as it is this quality that makes GIS unique among databases and spatial information systems. It is easy to understand how GIS differs from a traditional database, such as Microsoft Access; a traditional database does not have a spatial component. The difference between GIS and a non-GIS spatial information system, such as computer-assisted drafting (CAD), is more subtle. While programs like CAD may contain database-like information, and while CAD displays images meant to be understood spatially, CAD does not tie these images and this information to real geographical locations. It is only GIS that contains data that are

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[1] CP Lo and Albert Yeung, *Concepts and Techniques of Geographic Information Systems* (Prentice Hall: New Jersey, 2002) 2.

[2] USGS, "Geographic Information Systems," an informational brochure published by the United States Geological Survey, 1997. In Lo and Yeung.

geographically referenced to a coordinate system that corresponds data to a specific location on the surface of the earth.[3]

There are two main types of GIS: raster based and vector based (figure 1). Raster GIS was the first type developed and is easier to understand than vector GIS. In raster GIS, space is divided into a grid of pixels, and each pixel can be identified precisely by a set of two coordinates: its row number and its column number. This set of coordinates corresponds to a specific value in a data table. Each layer of raster data describes one attribute, and each cell contains one value that represents its relationship to this attribute. For example, a layer in a raster GIS might represent elevation above sea level. Each pixel within this layer contains a number indicating the specific elevation of that particular pixel. The size of each pixel is called the resolution.

Vector-based GIS is less intuitive than its raster-based counterpart. In vector GIS, entities are not represented by a continuous carpet of pixels but as discreet objects. These objects are constructed of points, lines, polygons, or a combination of these features. Unlike raster GIS, where a pixel in a particular layer is assigned one value, a object in vector GIS can be associated with a table of values, called an attribute table, in a single layer.[4] For example, a vector-based GIS of historic structures in a downtown area might contain several discrete objects in single layer, where each object is a polygon representing a specific building. Each building might have its own attribute table which lists the date the building was constructed, the current occupant of the building, whether or not the building is listed in the National Register of Historic Places, and other information. Perhaps the most significant advantage of vector GIS is its incorporation of

[3] Lo and Yeung, 5.
[4]See, for example, Lo and Yeung, 90.

topology. Topology "describes space and spatial properties such as connectivity which are unaffected by continuous distortions"[5] such as twisting, stretching, and shrinking.[6] Topology affects cultural resource management primarily with respect to road and pathway network analysis. Without topology, for instance, two roads that cross in a GIS display might be assumed to form an intersection when one road in reality bridges another. Topology enables a more accurate approximation of relationships among entities in a vector GIS.

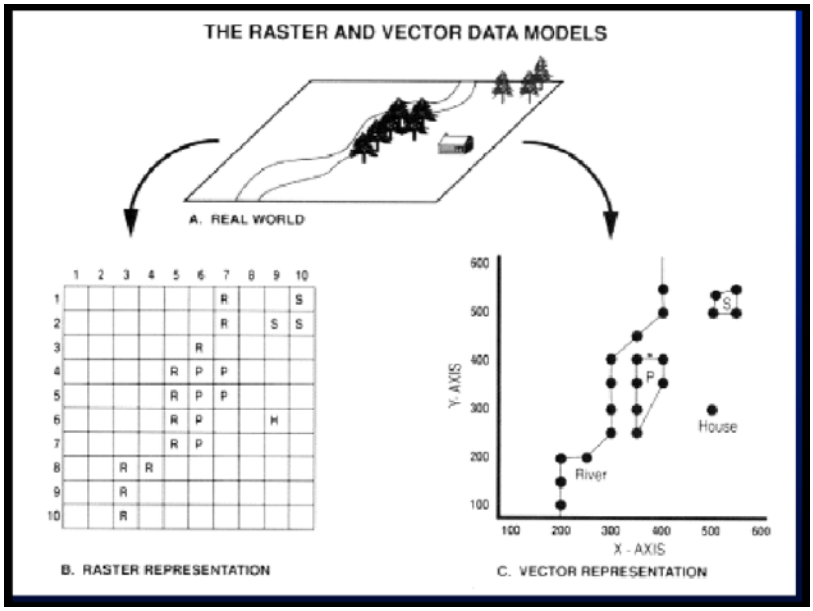

Figure 1: Raster and Vector Representation.[7]

The decision whether to use raster- or vector-based GIS depends on the type of data which the GIS will capture and analyze. Vector data is most appropriate for what GIS users call object-based view; that is, data are best represented as discrete entities with clear delineations. Raster GIS is usually used to store and study data that are best

[5]Burrough and McDonnell, 12. Peter Burrough and Rachel McDonnell, *Principles of Geographic Information Systems* (Oxford University Press: Oxford, 1998) 12.
[6]Lo and Yeung, 86.
[7] Accessed online at http://pasture.ecn.purdue.edu/~aggrass/GROUNDWATER/power/rast.gif.

represented in a field-based view where the geographical phenomena under examination are continuous and have fuzzy boundaries. Most GIS employed in cultural resource management is vector based. Historic buildings, archaeological sites, and battlefield trail networks all represent discreet objects or collections of discreet objects with clear boundaries. However, there is important work being done in cultural resource management using raster-based GIS. Many visualization techniques used for viewshed analysis or to promote a management plan, for example, rely on raster-based GIS.

This brief introduction explaining the basic properties of GIS may lead the reader to ask, "Now what?" Once a format is chosen and data are captured, how does analysis begin? What can GIS do that a database and a map cannot? A short history of the development of GIS will reveal much about the current ways GIS is used for cultural resource management as well as the potential for incorporating this technology into preserving cultural heritage. This history will describe what GIS can be and also explain the reasoning behind its design and development. The science, methodology, and implementation of geographic information systems are always evolving. Advances in remote sensing, computer programming, and cartography inform new ways of understanding spatial phenomena, and software companies and academies race to incorporate these new ideas in new GIS packages meeting the demands of industry and research.

Though people have used maps since before antiquity, the science of systematic cartography arose as a tool of colonialist European states during the eighteenth century.[8] New surveying and cartographic technologies, recovered from antiquity in the

[8] Burrough and McDonnell, 2.

Renaissance and improved upon during the Enlightenment, expanded the effectiveness of this tool. Economics played a role in the development of scientific cartography as well; mercantilism and nascent capitalism created a demand for a precise way to represent three dimensional space in two dimensions. Better maps, then as today, meant bigger profits. Perhaps just as importantly, better maps meant easier and more decisive military victories for imperial powers. Improved technology, economic demand, and military necessity all contributed to an improved cartography that has been practiced by the Western world for the past 200 years.[9]

These same pressures created not only a need for more precise cartography but also a need for more specialized maps. The nineteenth century witnessed an unprecedented number of scientific advances in macroscopic biology, geology, and other natural sciences. As the industrial revolution swept Europe, capitalists desired to exploit these advances for profit. Specialized maps depicting one or a limited number of attributes were a natural response to this demand.[10] For example, a burgeoning coal magnate might want a map showing the different qualities of coal deposits across his mines but not showing tenement apartments above his mines. A map such as this containing a specific attribute or group of attributes is called a thematic map. Thematic maps tie specific physical attributes to their locations. The logic behind a thematic map is similar to the logic behind a particular layer of a GIS, though the thematic map is on a smaller scale and much simplified.

As humanity uncovered and created ever increasing amounts of data about the world, new ways of storing and analyzing this data were needed. Thematic maps allowed

[9] Burrough and McDonnell, 2.
[10] Burrough and McDonnell, 3.

for an increased amount of data to be stored on one map. However, they did not necessarily increase the ease with which a map user could glean information about a variety of geographic phenomena. Take, for example, the coal mine owner in the paragraph above. If he wished to know the quality of his coal deposits, the depth of the deposits below the earth's surface, and the location of underground aquifers, he might have to cross reference three separate thematic maps that depict these three attributes. Such a process would be laborious and might result in a high degree of inaccuracy.

A method called overlay analysis helped map users analyze attributes from several thematic maps through an easier and more accurate process. Though the first documented use of overlay analysis dates from the eleventh century when Cambodians used stones as maps, sophisticated overlay analysis evolved during the modern period. One of the more significant uses of overlay maps in American history was during the siege of Yorktown in the American Revolution. Noted French cartographer Louis Alexandre Berthier's hinged overlays helped ensure victory for Rochambeau and Washington over Benedict Arnold in this decisive battle.[11] Despite the efficacy of overlay, it took over 100 years for overlay analysis to be used by civilians in a significant way. In 1912, city planners in Billerica, Massachusetts and Dusseldorf, Germany both developed overlay maps to help them visualize and analyze geographic attributes contained on different thematic maps.[12]

Perhaps the most familiar use of overlay maps – at least to landscape architects and environmental planners – is found in Ian McHarg's seminal 1969 work *Design with*

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[11] Timothy Foresman, "GIS Early Years and the Threads of Evolution," in Thomas Foresman, ed, *The History of Geographic Information Systems: Perspectives from the Pioneers* (Prentice Hall: New Jersey, 1998) 3.

[12] Foresman, 3.

Nature. This book is important to both the history of GIS and the way cultural resource management is understood in the context of natural resource management. In this book McHarg's aim is to add a volume to the "small shelf of books that deals with man's relation to his environment as a whole"[13] McHarg wants humanity to accept and relish its dependence on the natural world and take more seriously its responsibility to use resources wisely. "If one accepts the simple proposition that nature is the arena of life and that a modicum of knowledges of her processes is indispensable for survival... it is amazing how many apparently difficult problems present ready resolution."[14] For McHarg, the best way to solve these difficult problems was by creating thematic maps of these processes that could then be analyzed to make land use decisions (see figure 2).

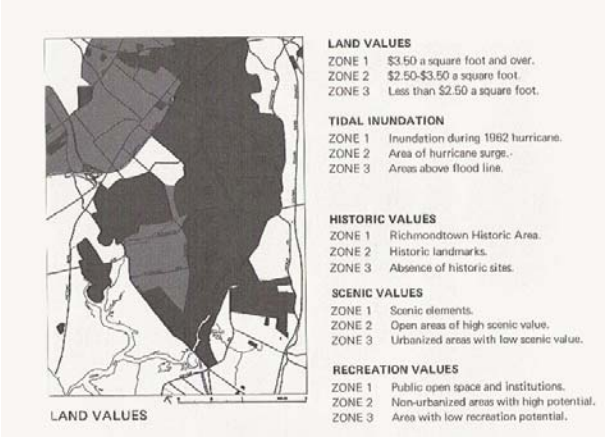

Figure 2: McHarg Values Overlay[15]

Assigned to study the "least-social-cost/maximum-social-benefit" method of developing a five mile stretch of Richmond Parkway in New York, McHarg created transparent thematic maps representing natural processes like slope, soil drainage, and susceptibility to erosion along with transparent thematic maps representing cultural

[13]Ian L. McHarg, *Design with Nature* (New York: Doubleday/Natural History Press, 1969) vi.
[14]McHarg, 7.
[15] McHarg, 39.

qualities, like scenic values, recreation values, and historic values.[16] He overlaid all of these transparent maps to examine the intersections of social natural values. The result, reproduced in *Design with Nature*, looks like a dark gray blob (figure 3). Though McHarg's reasoning and methodology were groundbreaking, the tools at his disposal hampered his ability to convey his message. Using GIS, the ideas behind McHarg's overlay analysis of thematic maps point the way to a much more elegant presentation. Moreover, as later chapters will address in depth, GIS enables a much wider array of analytical tools than simple overlay.

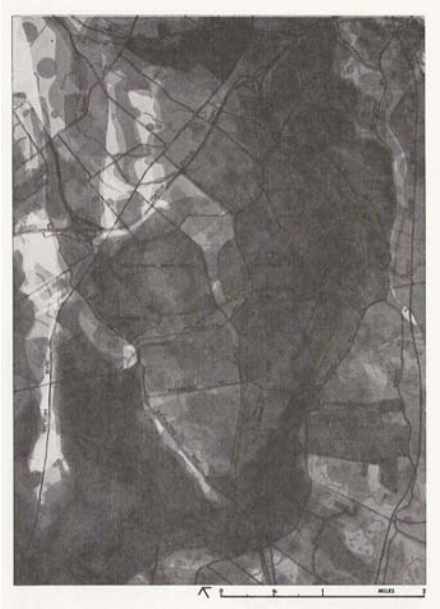

Figure 3: McHarg Dense Overlay.[17]

In 1969 – the year *Design with Nature* was published – GIS was still in its infancy. Two separate institutions, Harvard University and the Canadian federal government in conjunction with private companies, were working to develop in-house GIS packages for specific tasks. The work at Harvard was housed in the Graduate School

[16]McHarg, 36-39.
[17] McHarg, 41.

of Design with aims of improving urban planning methods, while the work in Canada was conducted with the purpose of enabling a better way to manage natural resources. This early example of two entities developing GIS for very different tasks foreshadows the broad applicability of GIS as it is currently used.

Though GIS relies on a variety of concepts that evolved from different strands of cartographic, geographic, and planning-related thought, GIS is wholly reliant upon electronic data processing programs developed in the 1940s and 1950s.[18] The dependency of GIS upon computers and the digital revolution cannot be overstated. "Fundamentally," writes Timothy Foresman, the Environmental Protection Agency's first specialist in GIS, "...modern GIS owes its phenomenal success to the advent of and dependence upon computer automation."[19] Ultimately, the science of GIS is a computer science, with all the familiar advantages and disadvantages inherent in this field.

This brief examination of the history and structure of GIS reveals the direct applicability of this powerful technology to cultural resource management. Though the power of GIS resides in the fact that it is computerized, computerization should not be understood as a reason to consider GIS infallible. The following may be obvious, but it is still worth stating: as with other computer applications, GIS is only as effective as its designers and it users. Cultural resource managers who use this powerful technology still bear the ultimate responsibility for shaping cultural resource management policies that reflect their understanding of these resources.

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[18] Lo and Albert, 7.
[19] Foresman, 4.

Chapter 2
What is Cultural Resource Management?

The recognition of cultural resources as such is largely a modern phenomenon. It is true that Classical, Medieval, and Early Modern cultures made true efforts to protect and manage what people today call cultural resources. However, the motivation behind these early efforts was very different and often narrower than the motivation of many current cultural resource managers. Whereas managers of cultural resources today wish to preserve resources for the sake of maintaining an artifact that recalls the context in which it was constructed, earlier efforts to preserve resources were either conducted out of pre-industrial necessity or as part of a larger movement directed at resurrecting past achievements. The last of these situations recalls the Italian Renaissance, a time characterized by a revival of Classical motifs if not preservation.[20]

Modernization and industrialization seem historical prerequisites for cultural resource management. "Indeed," writes preservationist James Fitch, "an appreciation of the material culture of pre-industrial societies has grown in the Western word in almost exact proportion to the ever-intensifying industrialization of the West itself."[21] Before people were able to place real value on cultural resources for their own sake, these resources had to be threatened with unprecedented destructive powers and an end of a reliance on hand-craftsmanship. It is a harsh irony that technology used to protect and managing cultural resources has historically lagged behind technology used to destroy them.

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[20] James Marston Fitch, *Historic Preservation: Curatorial Management of the Built World* (New York: McGraw-Hill Book Company, 1982) 13.
[21] Fitch, 13.

Before a discussion of the way the National Park Service and other entities manage cultural resources can proceed, some terms need to be more precisely defined. What exactly is cultural resource management? This question is central to this thesis both in terms of laying semantic foundation as well as investigating the ways geographic information systems can facilitate cultural resource management. That said, a clear definition of cultural resource management is nebulous.

One recent publication defines cultural resource management as "a stewardship and conservation effort that is linked to use and enjoyment" and the "interpretation of cultural and historic sites and structures."[22] These relatively simple definitions belie the complex questions each of them beg. The most obvious of these questions: what is a cultural resource? Indeed, what is culture?

The explicit study of culture, as understood today, is a relatively recent enterprise in social science. Anthropologists Leslie White and Alfred Kroeber led the charge into serious inquiry of culture in the middle of the twentieth century.[23] The lateness of cultural studies may be explained in part by the complexity of the subject, though this hypothesis fails to explain why other fields, such as sociology, engaged topics equally complex almost a century prior. Eminent cultural geographer Wilbur Zilensky explains the situation best: "The idea that traditional ways of thinking and acting of one's group is not absolute… required a bold leap of the anthropological imagination."[24]

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[22] Francis P. McManamon and Alf Hatton, "Introduction," in McManamon and Hatton, eds, *Cultural Resource Management in Modern Society* (London and New York: Routledge Press, 2000) 4.
[23] William Norton, *Cultural Geography* (Ontario: Oxford University Press, 2000) 11.
[24] Wilbur Zilensky, *The Cultural Geography of the United States* (Englewood Cliffs, NJ: Prentice Hall, Inc., 1973) 68.

A search for a definition or collection of definitions of culture begins at the beginning: an introductory cultural geography text book. "There is considerable debate," reads one Canadian text, "about precisely what the word 'culture' means."[25] The text continues, "One review stated that culture 'is one of the two or three most complicated words in the English language.'"[26] It is so complicated, in fact, that author William Norton declines even to make an attempt at explaining the term at its introduction, instead satisfying curious young minds by noting that debate over the definition of culture "while important, is not a central one as it is essentially diversionary… multiple meanings of culture are legitimate, indeed valuable."[27] Norton seems to be telling his audience that a lack of definition for culture should in no way stand in the way of researching the subject. When finally forced to produce a definition in the glossary, Norton concedes that culture "generally refers to the way of life of the members of a society as evident in their values, norms, and material goods" but hedges "there are numerous specific interpretations of this word."[28] These interpretations are explored in the body of the textbook, but the fact that the term culture cannot be defined in any detailed and precise way in the glossary of a cultural geography text speaks to its complexity. Though the definition of the phrase "cultural resource" differs depending on context, a cultural resource may be thought of as one of the "material goods" in this definition of culture. A more specific definition might be defined generally as a human-

[25] Norton, *Cultural Geography,* 4.
[26] Raymond Williams, *Keywords: A Vocabulary of Culture and Society* (New York: Oxford University Press, 1976) in Norton, 4.
[27] Norton, *Cultural Geography*, 4.
[28] Norton, *Cultural Geography*, 325.

made resource that encompasses to some degree an important aspect of the culture of the people by whom it was created.[29]

Famed cultural geographer Carl O. Sauer developed definitions of culture in the early part of the twentieth century that are applicable to this project's treatment of cultural resource management for two main reason. As suggested by the title of his seminal 1925 article "The Morphology of Landscape," Sauer seeks to scientize the study of culture in the field of geography. Suaer founded the landscape school of cultural geography, a body of theory that argues that culture carves itself into the physical landscape. "There is a strictly geographic way of thinking of culture," writes Sauer, "namely, as the impress of the works of man upon an area."[30] Culture, to Sauer, shapes the physical geography of landscape. The fact that society makes no appearance in Sauer's definition implies that culture shares equal footing with nature in the sense that both forces exist as objective entities outside of the human imagination.[31] This literal model of culture has direct ties to the way cultural resource managers today use GIS in their profession: cultural resources can be cataloged, analyzed, and interpreted as entities reducible to a series of attributes.

The second reason Sauer's understanding of culture is relevant to this thesis is the fact that the National Park Service adopted Sauer's concept of culture and therefore of cultural resources. In the United States, cultural resource management has direct relationships with natural resource management; the two practices are united on the

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[29] The term historic preservation is often used interchangeably with cultural resource management. Historic preservation, however, is actually a specific type of cultural resource management devoted to the protection and interpretation of buildings, structures, sites, and objects at least fifty years old. As one might expect, cultural resources are generally historic resources. A resource can be appreciated in the context that created it after the passing of a half century.

[30] Karl Sauer, *The Morphology of Landscape* (Berkeley: University of California Press, 1925) 327.

[31] Norton, 13.

federal level (not exclusively, of course) within the National Park Service. The National Park Service exercises a particular type of natural resource management – the maintenance of pristine wilderness to the utmost extent politically feasible, in contrast to the utilitarian Forest Service. This practice represents a 125-year-old quality of American culture that ascribes intrinsic value to "natural" areas and encourages many Americans to ensure these areas stay as wild as fully as possible. These natural areas, our national parks, are Sauerian cultural landscapes of the first order. They are nature shaped and reshaped by successive and often conflicting manifestations of American culture. Because the National Park Service is invested in the protection, management, and interpretation of both cultural and natural resources, it serves as a touchstone for examining the attitudes of Americans to nature, to culture, and to the nebulous intersect of the two entities. National parks, especially the older and more famous ones, are at least as much cultural resource as natural resource. Yosemite National Park is an example of such a place.

At Yosemite early last century, John Muir and Frederick Law Olmsted, Jr. (son of the father of landscape architecture) led the fight against Gifford Pinchot's efforts to dam the Hetch-Hetchy Valley to create a reservoir for San Francisco. "Some things," Olmsted argued, "are of a value wholly or primarily for their beauty, and if they have any direct utilitarian value it is utterly secondary and incidental."[32] The Hetch-Hetchy Valley is submerged today, but winning this battle cost Pinchot his war: over the forester's objections, Congress designated the National Park Service in 1916. The loss of Hetch-

[32] Ethan Carr, *Wilderness by Design: Landscape Architecture and the National Park Service* (Lincoln: University of Nebraska Press, 1998) 70.

Hetchy Valley was crucial in galvanizing support this entity.[33] Yosemite is protected and managed to the extent that it is today as a direct result of the creation of the Hetch-Hetchy Reservoir. Both the reservoir and the physical creations of the National Park Service stand today as reminders of an early twentieth century culture, now part of the landscape and a rich cultural resource.

The palimpsest of Yosemite continues to be altered and built upon. At about the same time as the Olmsted and Muir versus Pinchot conflict, Department of Interior administrators began a lengthy marketing and infrastructure-building campaign designed to capture American tourist dollars being squandered in Europe. The campaign worked too well, and today many environmentalists argue that Yosemite Valley is overcrowded. Some environmentalists even argue for the removal of the Hetch-Hetchy Reservoir[34] in order to restore, in Olmsted's words, "this commodity called Yosemite scenery."[35] Yosemite's El Capitan, Tuolumne Meadows, and the Merced River may appear pristine, but they are seared by layers of culture. As suggested by Olmsted's words, Yosemite offers a prime example of a Sauerian cultural resource.

The idea of scenery as a commodity, found also in the discussion of McHarg's overlay analysis and especially in Sauer's work, lends itself to quantification and objectification. For these reasons, the National Park Service's systematic protection, research, and interpretation of cultural resources provides a well-suited practical ideology for incorporation into GIS.

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[33] Carr, 67.
[34] Restore Hetch-Hetchy, http://www.hetchhetchy.org/index.html, accessed 15 December 2003.
[35] Carr, 70.

Chapter 3
The National Park Service, Cultural Resource Management, and Early GIS

Whatever the reasons for the development of interest in cultural resource management and historic preservation, it is undeniable that the National Park Service has played a major role in cultural resource management in the U.S. Since its founding in 1916, the park service has operated as both the impetus behind, and the vessel for, the management of physical manifestations of America's cultural heritage.

Federal cultural resource management in the U.S. was born in the late nineteenth century when Congress appropriated $2,000 for the protection of pre-Columbian ruins known as Casa Grande in Arizona and declared the area a National Monument.[36] Mesa Verde, a more extensive collection of ruins in Colorado, was granted National Park status in the early twentieth century. The primary goal behind these early conservation efforts was protection, the first of the cultural resource management strategies outlined above. The prevention of looting and vandalism, activities that grew more common as the settlers populated the West, was really prerequisite to the other strategies of documentation, research, and interpretation. These problems became so severe that in 1906 Congress passed The Antiquities Act, the nation's first national preservation law, which forbade defiling and stealing from sites owned by the U.S. government.[37] Thus the federal government's first forays into cultural resource management, though conducted even before the creation of the National Park Service, foretold the creation of this entity.

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[36] Norman Tyler, *Historic Preservation: An Introduction to its History, Principles, and Practice* (New York and London: WW Norton and Co., 2000) 35.
[37] Tyler, 35.

As the twentieth century progressed, the federal government expanded its interests to collecting and managing information pertaining to buildings, sites, and structures largely located in and around current settlements. (However, cultural resource management under the National Park Service still devotes much time and resources to the management of ruins. As discussed in the following chapter, GIS is used widely in this effort.) As part of an effort to combat Depression-era unemployment, the U.S. government created the Historic American Building Survey (HABS) under the National Park Service. This program, which was later expanded to include landscapes and engineering projects, involves the survey and documentation of thousands of historic sites. "This survey," read the HABS mission statement, "shall cover…buildings of every description… so that a complete picture of the culture of the times as reflected in the buildings of the period may be put on record."[38] This systematically acquired nation-wide inventory would serve as a model for local agencies interested in documenting and protecting cultural resources in the 1960s and beyond.[39] In a more subtle but equally important way, the HABS program established the importance of historic resource documentation and research on a national level and reinforced cultural resource management as an emphasis of the National Park Service.

Perhaps the most important year in the history of cultural resource management in the U.S. was 1966, the year the National Historic Preservation Act passed Congress. The Act provided for the National Register of Historic places, a listing of historic resources that offered a small degree of protection for designated cultural resources. More

[38] HABS website, www.cr.nps.gov/habshaer/habs/habshist.htm, accessed 4/23/04 in Tyler, 41.
[39] See for example, the foreword by Lady Bird Johnson in *With Heritage So Rich* (New York: Random House Publishers, 1966) vii.

importantly, the act laid the legal groundwork that would eventually enable serious local protection for cultural resources. However, while the National Historic Preservation Act of 1966 owed much to the documentation and research efforts of HABS,[40] the National Park Service did not play an active role in either the passage or the development of the Act. The National Park Service was instead relegated to implementing the Act administratively, marking a shift from its earlier position as the leading entity behind cultural resource management in the U.S. The discussion of state-level cultural resource management in chapter five examines how the National Historic Preservation Act has fueled interest in GIS.

The fourth and final aspect of cultural resource management, interpretation, is perhaps the fuzziest. Interpretation is the point of most preservation and cultural resource management, and it is so broad a subject that its success is difficult to assess. It is therefore difficult to say that the National Park Service, or indeed any entity, has ever been at the forefront of interpretation in a general sense. However, it should be noted that even relatively early in its existence, the National Park Service demonstrated a dedication to preserving the cultural heritage of not only the wealthy and powerful but also of the commonplace. The most obvious example of this policy was seen in the construction of the Blue Ridge Parkway. There, engineers and landscape architects went to pains to preserve and showcase pioneer buildings and sites as early as the 1930s.[41]

Just as the National Park Service served as the premier entity behind the birth and early development of cultural resource management in the United States, the organization

[40] Ibid.
[41] See for example, Ethan Carr *Wilderness by Design: Landscape Architecture and the National Park Service* (Lincoln: University of Nebraska Press, 1998).

continues to make efforts to fulfill its mission today. A significant part of these efforts in recent years has been the creation of a clearing house of information related to the use of almost all aspects of cultural resource management and historic preservation. Since 1975, the National Park Service has formally offered what it calls heritage preservation services to both protected and non-protected entities in the form of advice ranging from technical preservation practices to preservation planning to a guide to obtaining grants.

The Heritage Preservation Services department of the National Park Service has made it part of their mission to provide for the use of GIS in cultural resource management as detailed below. This use of GIS parallels the National Park' Service's four-part approach to cultural resource management in general, encompassing protection, information management, research and analysis, and interpretation. All of these approaches are treated in *Cultural Resources Management*, the magazine that the National Park Service publishes regarding the subject.

The first article in *Cultural Resources Management* that addressed the possibility of using GIS for cultural resource management was an article titled "Computer Maps for Cultural Resources Planning." The fact that the authors of the article, which was published in 1988, did not use the words "geographic information systems" in the title is an illustration of the radical novelty of using GIS for cultural resource management at the time. The simplistic reference to GIS as a "computer map" underscores the limited understanding of GIS even among the small number of people in the field who knew of its existence, and, indeed, who were using it.[42]

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[42] John J. Knoerl and Sandy Weber, "Computer Maps for Cultural Resource Planning," in *Cultural*

The primary objective of "Computer Maps for Cultural Resource Planning" is to give the reader a general understanding of information management and analysis using GIS for cultural resource management. GIS technology, the authors argue, can provide a welcome solution to problems the park service faced with disorganized data and information. "It is important to realize that to manage cultural resources," the authors explain, "we must first learn to manage information about them."[43] In 1988, there were over 15,000 structures and almost 37,000 sites described as cultural resources under the National Park Service in addition to some 1.2 million cultural resources listed by states.[44] Cultural resource managers had taken pains to describe what these resources were but had not adequately pinpointed their locations, making what information was available practically impotent. The authors explain that cultural resource managers could use GIS to locate cultural resources more effectively.

This 1988 article also makes it clear that the National Park Service understood that GIS could greatly facilitate the cataloging process by providing an interoperable georeferenced database. To a lesser degree, site analysis of cultural resources could be made more efficient and effective using GIS. Not surprisingly, given the National Park Service's initial emphasis on GIS for natural resource management, early analysis of development pressures on cultural resources were conducted in conjunction with similar analysis of natural resources. For example, parts of Santa Monica Mountains National Recreation Area and Mount Rainier National Park proposed GIS overlay operations

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Resources Management: A Technical Bulletin for Parks, Federal Agencies, States, Local Governments, and the Private Sector (August 1988), 1.

[43] Knoerl and Weber, 1.

[44] Knoerl and Weber, 1.

"with natural and cultural thematic maps to assess the impact of these projects."[45] Though this sort of analysis was more or less just a faster way to perform manual overlay operations using transparencies, it still represents a foundation for later efforts of spatial analysis. Later uses of GIS for cultural resource management within the park service demonstrate a deeper and more sophisticated understanding of the technology.

[45] Knoerl and Weber, 4.

Chapter 4
Expansion of GIS within the National Park Service

Just as the National Park Service's role in cultural resource management expanded and evolved over the twentieth century into more sophisticated forms, so did its role as a leader in cultural resource management for GIS – and at a much faster pace. In 1990, the park service created the Cultural Resources Geographic Information Systems Center (CRGIS) "to enable Federal, state and local agencies, tribal governments, and community organizations to access, exchange, and distribute accurate information on the location, status, and condition of cultural resources."[46] More specifically, CRGIS performs several functions to fulfill this mission: aside from creating and maintaining georeferenced inventories of cultural resources for public and private entities dedicated to cultural resource management, it also plays an active role in promoting GIS among local governments and in training cultural resource managers in GIS technology. Moreover, claims the National Park Service, "the CRGIS facility is the only one in the nation devoted to developing GIS applications to cultural resource and historic preservation management."[47] Though this statement may no longer be true, CRGIS certainly is the largest agency of its kind in the U.S.

The American Battlefield Protection Program (ABPP), founded two years before CRGIS, works closely with this entity on a variety of projects. From the onset, ABPP has been a well-funded program relative to sister cultural resource management programs; it is no secret that the American people and their elected officials prioritize the protection of

[46] National Park Service CRGIS Website at http://www2.cr.nps.gov/gis/gis_p.htm accessed 4/23/04.
[47] National Park Service Website at http://www.cr.nps.gov/hps/gis/gis_p.htm accessed 3/4/05.

historic battlefields over most other resources. The story of the birth of ABPP illustrates this point. The ABPP began after private land adjacent to the Manassas National Battlefield Park in Virginia was narrowly saved from becoming a shopping mall when Congress purchased the tract of land for over $100 million. The cost per acre fell just under $200,000.[48] This expensive emergency preservation measure alerted the federal government to the general threat posed to historic battlefields located near the great population centers of the eastern seaboard. As a result, the Department of the Interior established the ABPP.

Given the national importance placed on historic battlefields and the feverish interest provoked by the Manassas crisis, it is not surprising that the National Park Service wished to use one its strongest tools, GIS, to further the mission of the ABPP. The relationship between ABPP and CRGIS illustrates several methods for using GIS to manage cultural resources within the specific context of battlefield management while also providing more general insights into the use of this technology. The ABPP/CRGIS relationship also demonstrates how the use of GIS has expanded within National Park Service properties over the past ten to fifteen years. By examining the broad range of GIS applications within the ABPP, the promises and potential pitfalls of this technology can be more accurately understood.

The American Civil War battlefield at Brandy Station, Virginia was one of the first projects enabled by CRGIS.[49] The purpose of this project was to catalog data

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[48]"Guidance for Developing a Battlefield Preservation Plan," National Park Service American Battlefield Protection Program Promotional Materials, October 2001.

[49] Betsy Chittendon, "GIS Technology Used in American Battlefield Protection Program" in *Cultural Resources Management* (Vol. 13 No. 5, 1990) 1.

involving "terrain, hydrogeography, roads, historic land use, proposed land use, cultural resources, battle action areas, troop movement and position areas, contemporary interpretive viewsheds and historic viewsheds" and then using this data to create overlays.[50] GIS specialists then used these overlays to create "resource zones" with specific management plans.

The Brandy Station project is an example of the same type of simple overlay analysis made famous by Ian McHarg before GIS became widely used, and explained in the 1988 article about "computer maps" detailed above. A major difference between these two articles, however, is a shift from using GIS as a database created and used by professional managers to a tool used primarily in the process of planning. "At the local level," the Brandy Station article states, "... reaction to the project has been positive, with all parties to the debate pleased to have the various issues involved clearly portrayed in a map format."[51] Here GIS serves as a visualization tool and as a clarifier for a public coalition; ABPP and CRGIS have broadened their reach from federally owned land to locally- and privately owned land. Along with this expanded influence, however, appears to have evolved a potentially dangerous belief: "the neutral analytical GIS approach provides all parties with straightforward and accurate information about the resource, from which effective protection strategies can be devised and negotiated."[52] Geographic Information Systems – or any software or technology – is only as "neutral" and "accurate" as the data it contains and the people who use it. The visual and conceptual

[50] Chittendon, 1.
[51] Chittendon, 1.
[52] Chittendon, 1.

clarity that can make GIS a democratizing tool cannot be conflated with faith in an objective perspective enabled by technology.

Despite this apparently simplistic understanding of GIS, the Brandy Station project shows significant advances compared to the hypothetical projects of the National Park Service at Santa Monica Mountains National Recreation Area and Mount Rainier National Park described in the previous chapter for two reasons: first and most fundamentally, the Brandy Station project was actually completed; second, the project was designed primarily to protect cultural resources rather than just including cultural resource sites as part of a broader plan to assess and protect natural resources.

A particularly strong example of this relationship involved the use of GIS to catalog, map, and plan for the future of Petersburg National Battlefield outside Petersburg, Virginia in 1999. Unlike at Brandy Station nine years earlier when the task at hand involved locating events and phenomena on a current map, the goal of the Petersburg project was the creation of an interactive historic base map in GIS.[53] The process of creating the map involved digitally scanning historic maps of the battlefield, piecing together and georeferencing these maps according to 200 points of congruence identified using GPS, and then correcting any significant errors to an accuracy of +/- 40 meters on a scale of 1:792.[54] After the base map was finished, park researchers created layers of information, such as troop movements, park boundaries, National Register of Historic Places listings, and trench positions. The end result is a powerfully equipped GIS that may be used for planning both inside and outside park boundaries, that

[53] David W. Lowe and Bonnie A. Burns, "Using GPS and GIS to Create a Historic Base Map," in *Cultural Resources Management* (Vol. 18 No. 5, 1998) 38.
[54] Lowe and Burns, 38.

accommodates archaeological inventories, and that commands visualization capabilities both interpretive and expressive (figure 4).

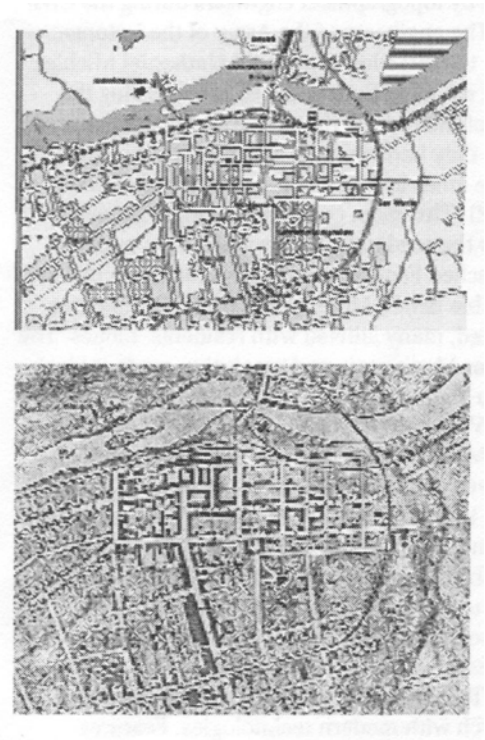

Figure 4: Petersburg National Battlefield GIS Screen.[55]

The Chickamauga Battlefield Park near Chattanooga, Tennessee is unique among battlefield parks due to the great number of monuments, markers, and especially desktop-sized cast iron tablets scattered throughout the landscape (figure 5). The cast iron tablets, painted white, describe to visitors in blue (if the tablet represents soldiers of the United States Army) or red (if the tablet represents soldiers of the Army of the Confederate States of America) what took place at that particular location during the battle in September 1863. The tablets, erected beginning in 1895 when the War Department

[55] Lowe and Burns, 38.

purchased the land where the battle took place, have created a cultural landscape that is both a part of the original landscape of the battlefield and a reflection of the technology and priorities of late nineteenth century America. This layered cultural landscape is perhaps as literal a representation of the kind of landscape described by Sauer as is possible. As a person walks among the tablets, it is easy to imagine that he has stepped into a vector-based GIS layer with attribute tables displayed across the terrain.

Figure 5: Chickamauga National Battlefield Park.[56]

It is appropriate, then, that the initial focus of CRGIS's work within Chickamauga involved creating a database of the monuments, markers, and tablets. This decision contrasts with the work done at Petersburg National Battlefield where the initial goal was a birds-eye reconstruction of the battle. The first step in creating the Chickamauga GIS,

[56] Photograph by author.

writes GIS specialist Bonnie Burns, was figuring out "which data layers were needed by park staff on a daily basis."[57] The most common questions encountered by staff - "'Where did my great-grandfather fight, where are the monuments to his regiment, and how do I get there?'" - require a vector-based GIS equipped with locational data for the tablets and monuments. This data, along with data capturing specifics about roads, trails, and houses in the park, was collected in a week using a handheld GPS unit.[58]

Workers at Chickamauga used the points recorded by these GPS units to georeference historic maps of the battlefield using ArcInfo, a primarily vector-based GIS software package with topological capabilities. The operation was similar to the one used at Petersburg.[59] By georeferencing maps of all the tablets, markers, and monuments created in 1895 and 1935, CRGIS specialists and park workers were able to locate the remains of objects that had been since damaged or removed. One such object, a tablet removed during World War II that the park had previously been unable to find (to the dissatisfaction of relatives of the deceased), has since been replaced.[60]

Though CRGIS workers and staff at Petersburg and Chickamauga approached the development of GIS layers in different ways, the resulting GIS of the parks is similar. Both use georeferenced historic maps; both contain archaeological inventories; both are used to develop more efficient park managing strategies. These similarities are to be expected given that CRGIS played the main role in both projects, and that the projects

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[57]Bonnie Burns, "GPS Solutions for the Chickamauga Battlefield," presented at the Trimble Conference 14-16 October 1998.
[58]Burns, 6.
[59]The 1895 map of Chickamauga proved to be accurate within 30 meters, as opposed to 40 meters using the 1864 map of Petersburg.
[60] Burns, 4.

were both conducted in 1998. Moreover, the same GIS specialist, Bonnie Burns, played a role in both projects.[61] One important similarity, however, evolved outside of CRGIS's intentions of data cataloging and historic map referencing; at both battlefields, GIS has been used to better understand the history of the battles. At Chickamauga, historic roads were compared to present trails to determine which roads were turned into trails.[62] The historic analysis at Petersburg was more profound. By overlaying georeferenced historic maps, researchers discovered that the U.S. and C.S.A. armies combined cleared a total of 4,400 acres (22% of the wooded area) of the battle site prior to fighting![63]

There are significant differences between the ways Petersburg and Chickamauga systems are presented, and the way Brandy Station system is presented. These differences reveal much about the increasing sophistication of GIS within the cultural resource management efforts of the National Park System in the 1990s. The treatment of the discussion of the technical aspects of GIS, while not thorough, is much more in depth in the later articles. Perhaps more importantly, the faith in GIS as a "neutral" tool found in the Brandy Station article is absent from the Petersburg and Chickamauga articles.

The Cultural Resources Geographic Information Systems Center has, of course, a much broader focus than just battlefield protection. A GIS at Shenandoah National Park, for example, encompasses a much larger land area than the battlefield projects described above. A more significant difference between the work at the battlefields and the work at Shenandoah lies the type of data the GIS contains and the way in which this data is used to manage the park. The Shenandoah GIS "maintains an extensive database of

[61]Burns also authored papers detailing both projects.
[62]Burns, 6.
[63] Lowe and Burns, 29.

information supporting all management disciplines, including natural and cultural resource management, fire management, visitor protection, backcountry management, pest management, and facilities management."[64] These data are combined with georeferenced historical maps in order to create a powerful planning tool. This integrated GIS demonstrates the applicability of creating and manipulating a cultural resource GIS encompassing a large area as well as the success CRGIS has met in such large scale projects.

Perhaps an even more ambitious project completed by CRGIS involves the creation of a GIS with data related to historic roads and markers taken in part from studies conducted under the Historic American Engineering Record (HAER). Workers at CRGIS incorporated the HAER data into a GIS profiling the Colonial Parkway, a road that connects the colonial towns of Jamestown and Yorktown Virginia.[65] Using this GIS (figure 6), a planner interested in avoiding NRHP properties and archaeological sites in a development project can use the GIS to search for such sites within a buffer of the parkway – even if these sites are not on federally owned land.

This large-scale incorporation of cultural resources beyond the boundaries of National Park Service land represents an effective effort by the park service to extend their cultural resource management objectives. It is perhaps inevitable that the park service, so successful using GIS for preservation and interpretation of battlefields and other cultural resources within this agency's jurisdiction, would use this technology to

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[64] Dan Hurlbert, "GIS as a Preservation Tool at Shenandoah," in *Cultural Resources Management* (Vol. 18 No. 1, 1998) 28.

[65] Diedre McCarthy, "Using Geographic Information Systems with Historic Roads," presented at the *Preserving the Historic Road in America Conference* 5-8 Mar 1998.

further cultural resource management goals elsewhere. In the cases of Petersburg and the Colonial Parkway, where GIS was used to aid decisions regarding land adjacent to park service land, these efforts have proved fruitful. As the park service attempted to use its command of GIS to influence cultural resource management further afield, however, the agency found less success.

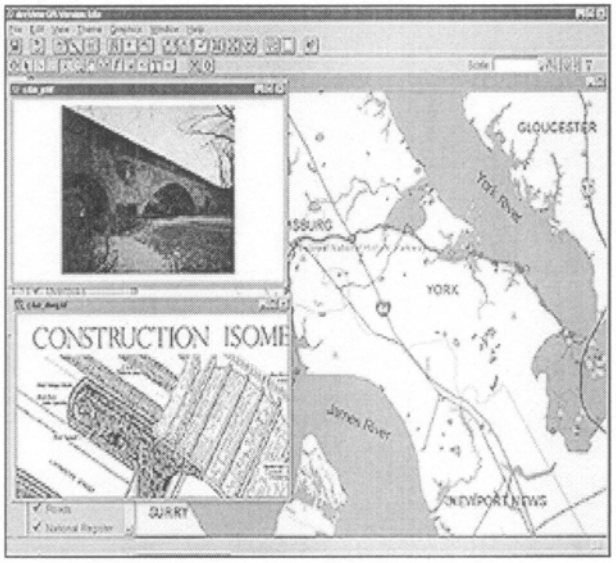

Figure 6: Colonial Parkway GIS Screen.[66]

[66] McCarthy, 1998.

Chapter 5
Outside the Park

The National Park Service's leadership role in GIS for cultural resource management, as might be expected, tapers the further one gets from the boundaries of a national park. Though the partner ship between CRGIS and ABPP did contribute to the information available to cultural resource planners in communities adjacent to the battlefield sites in a significant way, in general National Park Service assistance to non-park areas with respect to GIS is extremely limited. Despite the good intentions behind the creation of CRGIS, whose list of lofty objectives include providing GIS services "both within and outside the National Park Service," the vast majority of the entity's focus has been on the parks themselves.[67] However, the National Park Service has been involved with projects facilitating cultural resource management outside of federally owned and protected areas.

The main thrust of the National Park Service's efforts to expand the use of GIS for cultural resource management outside its borders lays in the creation of a GIS software package developed specifically for cultural resource management. The program, Mapping and Preservation Industry Tool (MAPIT) was created in the late 1990s in order to facilitate the jobs of State Historic Preservation Officers (SHPOs) by providing a user-friendly, task-specific interface for GIS. The software is a vector-based ArcView extension seriously handicapped by its inability to incorporate topological relationships.[68] "MAPIT," explains National Park Service GIS Specialist Deidre McCarthy, "links to

[67]National Park Service Website at http://www.cr.nps.gov/hps/gis/gis_p.htm accessed 3/4/05.
[68]Liz Kramer, interview by author, 3 March 2005.

databases, images, documents, and historic records, as well as extensive geographical data… users can view and query cultural resources on a large scale to identify trends or distribution patterns."[69] The ambitious goals of MAPIT, while well intended, have not been realized.

The MAPIT software in practice proved a disappointment. Pratt Cassity, director of the College of Environment and Design's Office of Public Service and Outreach (PSO) at the University of Georgia, speaks bluntly about the program. "It is a cantankerous, clunky program," Cassity asserts, "that the park service invested a lot of money in trying to teach all the fifty states to use." This investment in Cassity's eyes was not worthwhile because "GIS has moved much better than MAPIT. It's too difficult to use at the state level because it doesn't do enough from what I hear."[70] Cassity, one of the top cultural resource managers in the state, and whose office maintains close ties to the State Historic Preservation Office, has never used the program.

In fact, Cassity rarely uses GIS at all, except on an as-needed contractual basis with Liz Kramer, an eight and a half year veteran of the College of Environment and Design's Office of Public Service and Outreach. "I do a lot of work with land use planning and I've worked with them on some charrettes, base plans… I provide resources to their programs," explains Kramer. "Most of what is done is identify... environmentally sensitive areas. I've gone on charrettes and I worked with a group of students down in Brunswick looking at potential areas for marsh restoration... we've produced maps for

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[69] Deidre McCarthy, "Applying GIS Technologies to Cultural Resource Management" in *Cultural Resources Management* (Vol. 18 No. 5, 1998) 34.
[70] Interview by author, 4 Apr 2004.

projects... at this point not a whole lot of analysis."[71] Cassity notes that the Historic Preservation Division (HPD) of the Department of Natural Resources in Georgia (DNR) – the entity that oversees a large part of the cultural resource management in the state – uses GIS, "but in the same limited way that we [at PSO] do. Just for maps. Which is not the right way to use it."[72] MAPIT has not been the boon it was intended to be for state and local entities interested in using GIS for cultural resource management.

The most telling condemnation of MAPIT is that the National Park Service itself declines to use it. When implementing the extensive Integrated Cultural Resources Databank at least a year after MAPIT was being used by Delaware,[73] GIS specialists at the park service chose "industry-standard, off-the-shelf database, and imaging software" to conduct the project.[74] The reluctance of the National Park Service to use its own specially designed GIS program likely indicates the poor quality of the MAPIT package.

The void in cultural resource management GIS outside of the National Park Service which MAPIT proved unable to fill, however, is in the process of being satisfied at the state level. Thanks to relatively recent state- and privately-funded initiatives, many states are developing GIS packages that not only accomplish the goals of MAPIT but also extend beyond the original objectives of this package. In Georgia and elsewhere, the objective of cultural resource managers, universities, departments of transportation and

[71] Kramer, interview by author, 3 Mar 2005.
[72] Interview by author, 4/26/04.
[73] McCarthy, 35.
[74] Baumann, 33.

other entities is to create a space on the World Wide Web where a fully searchable GIS of cultural resources is accessible to the general public.[75]

In Georgia, this searchable GIS is known as the Natural Archaeological and Historic Resources Geographic Information Systems (NAHRGIS). This GIS is currently being created by the Carl Vinson Institute of Government's Information Technology Outreach Services (ITOS) at the University of Georgia.[76] The NAHRGIS project began in1996 as a way to facilitate Georgia Department of Transportation (DOT) searches for archaeological sites that might be in the path of proposed highway development. "Identifying these sites early in the planning process can save significant amounts of time and money," says ITOS faculty member Betty Brewer, who also touts the broad applicability of the NAHRGIS project: "[It] will assist in the research and review of Georgia's archaeological and historic resources for a variety of statewide planning activities."[77] Georgia DOT entered into contract with the HPD of the Georgia DNR, which is working in conjunction with ITOS and the College of Environment and Design's Offices of Public Service and Outreach.

A current database of historic properties is in the process of being integrated into NAHRGIS through the FindIt! historic resources survey program. Melissa Roberts is the director of the FindIt! program at the Center for Community Design, Planning, and Preservation (CCDPP) in the Office of Public Service and Outreach in the School of

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[75]See for example Thomas Green, Lela Donat, Jerry Hilliard, and Jami Lockhart, "A GIS Enhanced Cultural resource management System," Arkansas Archaeological Survey and University of Arkansas, 9 January 1995.

[76]"Check Before You Dig: New System to Map Historic Treasures," Carl Vinson Institute of Government at the University of Georgia, online at http://www.cviog.uga.edu/newsworthy/vol2no3/historictreasures.html. Accessed 28 Feb 2005.

[77]Ibid.

Environmental Design. FindIt! has worked in conjunction with HPD for three and a half years, funded by a $725,000 five-year grant from the Georgia Transmission Corporation (GTC). Similar to the Georgia DOT's funding of NAHRGIS, the GTC's funding of FindIt! is predicated upon the need to comply with state and federal laws regulating cultural resources (see below). The close relationship between NAHRGIS and FindIt! grew out of GTC's dissatisfaction with the way HPD handled data. "GTC basically pushed HPD – and said if we're going to continue this partnership, if we're going to continue to get information from you, we need to have you up to date technologically," says Roberts. "HPD [was] so far behind in terms of their computer applications and the knowledge of a lot of their staff... they [were] still running these DOS-based, very archaic programs."[78] The updated database of historic properties currently in process under FindIt! will become part of the NAHRGIS data structure when NAHRGIS goes online. "It's actually made it easier as a field surveyor. A lot of the mapping we've done – there's no purpose for it." With the site of each cultural resource georeferenced in NAHRGIS using geographic coordinates obtained from a hand held GPS, Roberts asks, "Why are we going to waste two minutes to draw a detailed map?" Roberts anticipates other time-saving advantages to collecting data for NAHRGIS. "Ultimately we want to get it to a point where it's sustainable. It would be so great if we could just have this functioning database, and have our surveyors enter all the stuff straight into the internet, have HPD

[78]Melissa Roberts, interview by author, 3 Mar 2005.

look over it, review it, give us feedback, we fix it, they clear it, it goes right it [to the GIS]."[79]

Once the data are collected, NAHRGIS offers several advantages over HPD's current system of data management, say Roberts and Kramer. "The biggest positive factor with the NAHRGIS project is that it's going to be internet accessible, says Roberts. "If you want to see where a cultural resource might be – if you're a DOT official, if you're a preservation planner – you can see exactly what the resources are." Roberts offers a specific example: "If you want to find all the cemeteries in a certain county, well, all of a sudden here's all this information, right on the internet... [NAHRGIS] is clearly going to be one of the best planning tools that we have." [80] Moreover, submits Kramer, NAHRGIS allows HPD "to see where surveys have existed, where we need additional surveys." This convenient evaluation will serve HPD much more efficiently than the current system that uses "four or five or six databases that are all separate... [NAHRGIS] is integrating them into a single source and then creating an easier interface.... it's one point for finding all this information."[81] Finally, those who work outside of HPD and the cultural resource management profession can also benefit from NAHRGIS. "There's a real interest now in some of the real estate community," explains Kramer, who says there are home buyers who are specifically interested in historic properties. "Realtors are probably going to use this data to find historic properties. The cultural resource side is going to be publicly

[79]Roberts, interview by author, 3 Mar 2005.
[80]Roberts, interview by author, 3 Mar 2005.
[81]Kramer, interview by author, 3 Mar 2005.

available, so anybody can go in once this website's up... you can't hide cultural resources, so the cultural resources side is going to be publicly available."[82]

Though NAHRGIS was originally conceived as incorporating natural as well as cultural resources (the "n" in NAHRGIS stands for "natural"), the funding plan places priority on historic and archaeological resources. "The way the dollars were set up," says Kramer, "it was really for the archaeological and cultural side of things." However, ITOS and the College of Environment and Design have made plans to include natural resources into the GIS. "We've been talking about putting [in] things like wetlands information... and there's a lot of information for a heritage program in wildlife resource division keeps, so there's the possibility of incorporating where endangered species are, things like that... so those kinds of things can all fit into NAHRGIS eventually." When all of this data is placed in NAHRGIS online, within minutes interested parties with proper training can perform advanced analysis similar in concept to McHarg's work with transparent overlays. The difference is NAHRGIS will speed the process exponentially.

A major difference between tasks related to cultural resource management conducted by an agency like CRGIS and multi-agency projects like the NAHRGIS/FindIt! program is the apparent efficiency with which CRGIS works. Part of this discrepancy can be explained by the nature of the work; as demonstrated in the previous chapter, CRGIS has developed a data-collection method that works with little alteration from site to site whereas NAHRGIS is an original vector-based GIS program (albeit based heavily on ArcInfo software). However, it should be noted that entities like

[82]Archaeological resources, however, will not be available to the general public in compliance with the National Historic Preservation Act of 1966. Kramer, interview by author, 3 Mar 2005.

departments of transportation and transmission corporations do not fund projects like NAHRGIS and FindIt! for altruistic reasons. They are required to perform environmental assessments under Section 106 of the National Historic Preservation Act of 1966 and other applicable laws that vary from state to state.[83] Unlike the work the CRGIS does in and around national parks, where cultural resource management is the focus of the job, the environmental reviews conducted by the DOT and other agencies may be seen as secondary to the main task at hand, or even as impediments. It is reasonable to assume that most DOT workers are not passionate about cultural resources in the same way that workers at CRGIS likely are. This situation may lead to a lack of accountability on the part of the funded parties, especially when these parties are not technologically savvy. As discussed below, therein lies a potential problem of externally-funded, multi-agency projects like the NAHRGIS/FindIt! programs.

Though Roberts recognizes present and future advantages to collecting and managing data using NAHRGIS, she expresses frustration at the slow pace of the project and the lack of communication among the agencies involved. “I never got any feedback as far as whether or not our data fit into the parameters of their new database, whether or not they could link it with the metadata to our digital images – I'm just not really sure where all that stands,” says Roberts of her relationship with HPD and ITOS. “It's a matter, unfortunately, of patience, and a lot of times... when you don't have feedback, when you don't have comments, it gets a little, 'so what am I doing?'” Equally frustrating is the fact that Roberts has no information regarding how the implementation of the GIS

[83]See for example “New York State Preservation Web Office GIS Access Web Page Introduction,” New York State Preservation Office, online at http://nysparks.state.ny.us/shpo/disclaimers/disclaimer_gis.htm, accessed 28 Feb 2005.

is progressing. “We, at this point, have surveyed six counties, and we're about to start our seventh county, and all the information and all the data that we have is still in our databases... and we still haven't gotten feedback as far as where those counties stand or how that information looks... I gave all of my data to [ITOS] and I'm just waiting to hear back.”[84] Based on the articles detailing CRGIS work at Civil War Battlefields in the previous chapter, it is hard to imagine similar complaints directed at CRGIS from cultural resource managers at national parks.

Though there are delays and other problems with NAHRGIS in Georgia, other states, including New Jersey, Colorado, Texas, and New York, have successful programs that integrate cultural resource data into a GIS.[85] The Colorado GIS is unique in that it has been constructed with assistance from the National Park Service’s bureaucratic rivals, the U.S. Forest Service and the Bureau of Land Management. The New York GIS (see a sample map in figure 7) provides “generalized boundary information” for almost 4500 historic properties and districts in the state along with “Archaeological Sensitivity Maps” that “define areas within the state where the discovery of archaeological sites is predicted.”[86] Though this GIS is powerful and efficient, the website of the New York State Historic Preservation Office offers a word of caution not addressed in the NAHRGIS publications and interviews: conducting research using this publicly accessible GIS “cannot serve as a substitute for consultation with the SHPO for projects

[84] Roberts, interview by author, 3 Mar 2005.
[85] New York State Preservation Web Office GIS Access Web Page Introduction, New York State Preservation Office, online at http://nysparks.state.ny.us/shpo/disclaimers/disclaimer_gis.htm, accessed 28 Feb 2005; and Roberts, interview by author, 3 Mar 2005.
[86] Ibid.

reviewed under... the National Historic Preservation Act of 1966."[87] The GIS, in other words, is fallible.

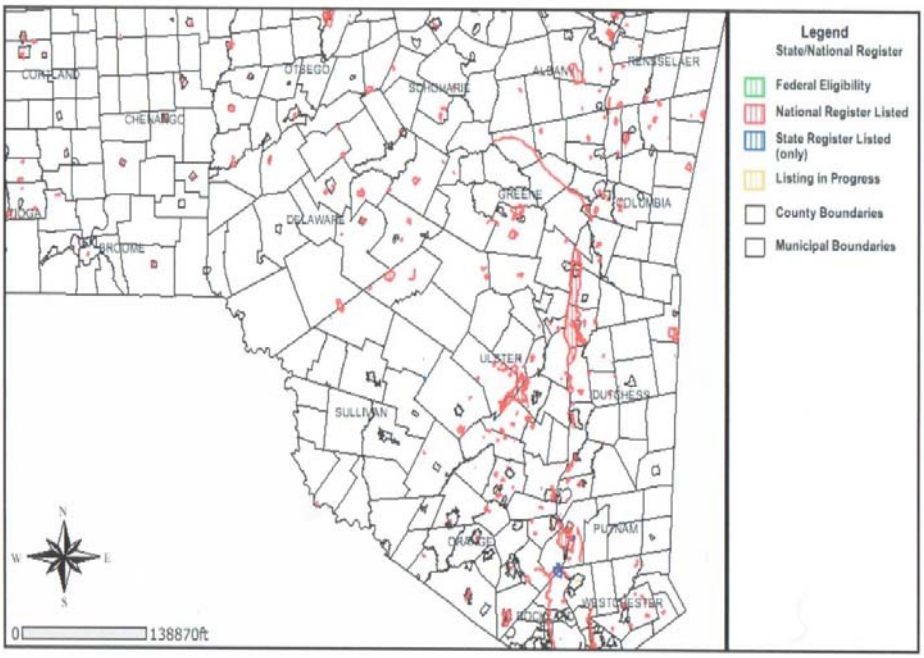

Figure 7: New York State Historic Preservation Office GIS Screen.[88]

State and local governmental agencies also use advanced visualization techniques for research and interpretation of cultural resources. At Pueblo Bonito in New Mexico, GIS experts are creating models of pre-Columbian ruins using a vector-based terrain simulator known as triangulated irregular networks (TIN). These models are extensively manipulated by users to store and extract data and information. The Pueblo Bonito TIN project materialized at the behest of researchers at the Navajo Nation Historic Preservation Project who wished to create an educational and promotional three-dimensional model of ancient Anasazi ruins in Chaco Canyon of McKinley County, New

[87] Ibid.
[88] New York State Preservation Web Office GIS. Map created online by author.

Mexico. Two central problems hampered their efforts to achieve this goal. First, rockslides and archaeological work had greatly damaged the 700-year-old Pueblo Bonito, once a 350-room, four-storey complex.[89] It was difficult for researchers to ascertain what was original to the site and what represented an alteration or intrusion. Second, the creation of a conventional model proved labor intensive and slow, and the model was unable to adequately portray the complexities of the ruin's evolution.

The solution to both of these problems lay in GIS visualization. The first task before the McKinley County GIS team involved creating TINs of the landscape based on early maps and aerial photographs. This process gave the team a basic landscape model of the site devoid of any human-constructed objects. The ruins and other structures of human origin were then added in chronologically ordered layers on top of the basemap as vector-based GIS files, allowing the researchers to effectively "remove" layers of artifacts from the virtual site and thereby visualize Pueblo Bonito at various stages of its evolution. Tables behind the file provided important information such as the age and height of the structures as well as a complete database of all the archaeological findings arranged according to location.

The result of the GIS team's research and implementation is a useful and educational three-dimensional model of Pueblo Bonito. Curators and visitors are now better able to imagine what the site probably looked like when it was inhabited hundreds of years ago. Perhaps more importantly, the project currently serves as the basis for an extensive database of artifacts discovered within and around the ruins. This database

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[89] Rich Friedman and John R. Stein, "Native American Ruins in 3D" in *Geospatial Solutions* (May 2002) 28.

represents the realization of goals expressed in the 1988 article initiating the use of GIS for cultural resource management.

Despite the effective use of GIS's visualization capabilities at Pueblo Bonito, the National Park Service is in general not a pioneer in advanced visualization techniques for cultural resource management. Visualization techniques made possible by GIS, however, have far-reaching implications in cultural resource management. One of the most striking examples of interpretive visualization employed by cultural resource managers today is the draping of historical maps over digital elevation models (DEMs) (figure 8). Historical map collector and president and founder of Cartography Associates David Rumsey is at the forefront of the development and implementation of this technique. Rumsey's collection, which includes some 150,000 historic maps from around the world, affords him great range in this endeavor. The process is simple: Rumsey scans historic maps at 600 pixels per inch or higher resolution. He then rectifies the maps by "selecting a series of ground control points, computing a transformation matrix, and resampling the pixels of the grid source to extrapolate values for the pixels on a new grid."[90] The rectified maps are then draped over USGS or vendor-supplied DEMs to create a three dimensional perspective. The maps show changes in the physical landscape over time as well as evolving human geographies. Most importantly, historical maps draped over DEMs powerfully convey the way past cartographers viewed their surroundings. In doing so, these images make a significant contribution to cultural resource management in addition to many types of historical research.

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[90] David Rumsey, "From Parchment to Ether: Fusing Historical Maps with Web GIS" in *Geospatial Solutions* (April 2002) 37.

Figure 8: San Francisco.[91]

Rumsey has expanded the interpretive powers of draped historical maps by posting them on the web for the public to experience.[92] More significantly, he has facilitated the expressive visualization qualities of his work by making his data and information available to the National Park Service. GIS specialist Stephen Skartvedt at the Golden Gate National Recreation Area outside San Francisco uses the maps to demonstrate patterns of intense urban development around the park over time. Skartvedt also uses the maps for park planning. "We can ask questions about our cultural and natural resource history and determine what our standards are for restoration," he explains.[93] This situation represents something of a reversal of the National Park Service's role as the leader in GIS for cultural resource management. However, this sort

[91] David Rumsey and Meredith Williams, "Historical Maps in GIS," in Anne Kelly Knowles, ed., *Past Time, Past Place: GIS for History* (ESRI Press: Redlands, California. 2002) 13.
[92] The website can be accessed at www.davidrumsey.com.
[93] Rumsey, 38.

of give-and-take between private individuals and the park service is a model that the park service has worked diligently to attain.

It is clear that despite state- and privately-funded efforts, cultural resources on non-park lands are currently not being protected, managed, researched, and interpreted to nearly the same degree as their counterparts within national parks. This is to be expected; it is unfair to evaluate the National Park Service too harshly due to the high-profile failure of MAPIT. It is only reasonable that protected areas under the aegis of the National Park System will receive substantially more attention from this entity than non-protected state- and locally-managed resources. Furthermore, the GIS for cultural resource management initiatives implemented by the National Park Service have been successful as a whole. In the grand scheme of cultural resource management in the United States, and more specifically in GIS for cultural resource management, the National Park Service continues to lead and lead well. The question posed at the introduction, however, remains: how has GIS changed cultural resource management within the park service?

Chapter 6
Conclusion

This thesis arrives at multiple conclusions to questions presented at its outset. Clearly the National Park Service has historically exerted a strong influence on cultural resource management in the United States, and the use of GIS for cultural resource management is no exception to this rule. The original National Park Service goal of using GIS as georeferenced database for cultural resources has been implemented on the national level. The park service, in conjunction with Western Archaeological and Conservation Center, created the Integrated Cultural Resource Databank (ICRD).[94] The ICRD links all the descriptive and graphic data available about all documented cultural resources. The databases from which this data is drawn is extensive: "[National Park Service] standard archaeological databases including the ASMIS, List of Classified Structures, National Register of Historic Places, and Automate National Catalog System" are all included in the databases and then "integrated with state-level and archaeological project data."[95] The result is a highly manageable set of information that cultural resource managers can exploit for the protection of resources.

The ICRD is one of the many goals that the National Park Service has realized; besides having an extensive inventory of cultural resources presently at its disposal, the park service has also directly and indirectly served as a model for effective ways to manage publicly-owned cultural resources with the help of GIS. The CRGIS facility's teaming with the American National Battlefield Parks Protection Plan is a prime example

[94] Steven R. Bauman, "Integrating GIS and Cultural Resources Databases for Archaeological Site Modeling" in *Cultural Resources Management* (Vol. 19 No. 9) 33.
[95] Baumann, 33.

of such success. The National Park Service generally has not met with large-scale success implementing cultural resource management GIS databases outside of park boundaries. There are exceptions, especially regarding lands adjacent to park boundaries. However, the National Park Service's main effort to expand outside of the parks, MAPIT, was a failure.

Beyond the success and failure of specific projects, however, lies the central question of this thesis: has GIS changed the way the National Park Service manages cultural resources? In one sense, GIS has enabled enormous advances in data storage, manipulation, and dissemination. The technology has made it possible to catalog and visualize information in new ways, like at Chaco Culture National Historic Park and Chickamauga National Battlefield Park, for example. GIS has enabled broader and deeper interpretation of cultural resources; the analysis of the trenches at Petersburg National Battlefield Park is probably the most obvious example of this development. The park service has also used GIS to expand their influence outside park boundaries, most notably with MAPIT but also in the case of Petersburg, Shenandoah, and others.

It is obvious that GIS has changed the efficiency and capability of the park service to an unprecedented degree. But has this change in capability accompanied a change in the fundamental impetus for, and philosophy behind, cultural resource management? As a whole, the literature reviewed in this thesis does not reveal such a change. To be sure, in the park service's early articles about GIS, there were suggestions that cultural resource managers were relieved of some of their decision-making duties by virtue of an

“objective” and “neutral” software package. If this line of thought had been allowed to develop, this would have certainly changed the way cultural resources are managed.

Today, the park service acknowledges that GIS is merely a tool. It is true that the use of GIS in cultural resource management by the National Park Service has allowed the agency to realize its original purpose to a degree otherwise impossible, and that perhaps in the future this increased capability will lead to fundamental changes in cultural resource management. It is easy to see how this phenomenon could come to pass outside the park service as databases like NAHRGIS make the commercial value of historic properties more readily exploitable. The park service is probably not immune to similar changes, though they have yet to take shape.

More interesting than discovering that GIS has changed the way the National Park Service conducts cultural resource management is discovering how the National Park Service's use of GIS for cultural resource management – while groundbreaking in its technical efficiency – relies upon the same theories and practices that have shaped cultural resource management in the U.S. for 100 years. Perhaps this is because GIS and the National Park Service are built upon the same literal understanding of cultural resources - that they are, in Sauer's words, "the impress of the works of man upon an area."

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