# Perspectives in Knowledge Management

## Integrating GIS and GPS Technologies into Cultural Resource Management Strategies

DoD Cultural Resources Workshop
Cultural Resource GIS Facility
National Park Service
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## Applying Knowledge Management Principles to Cultural Resource Management

► Knowledge management touches on all subject matters

► In cultural resources, we collect a variety of data in all manner of formats

► Primarily we collect data by observing, surveying or documenting

► Through this data, we hope to gain better understanding of the context within which our resources exist
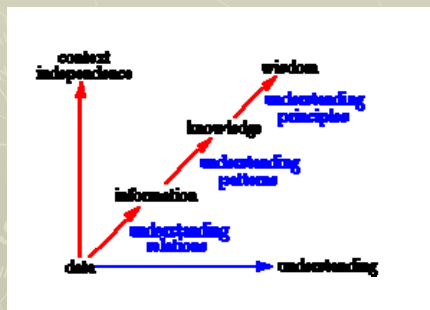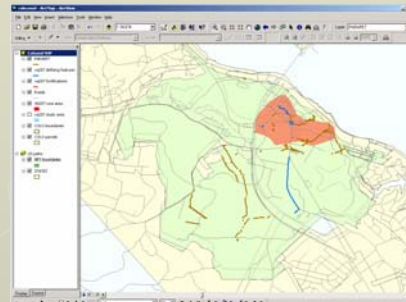


► Management of our data helps us as preservationists identify patterns, examine landscapes, find connections and understand different cultures

► Technological tools like GIS and GPS provide the flexibility and power to integrate all the data that we collect

► These tools give us new perspective in our scholarship, our understanding and our management of resources

## The Cultural Resource GIS Facility
## National Park Service

- ► Geographic Information Systems (GIS)
- ► Global Positioning Systems (GPS) Survey
- ► GIS Analysis
- ► Cartography and Output
- ► GIS Programming
- ► GIS and GPS Training
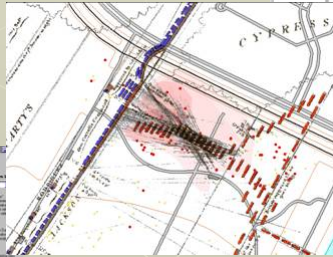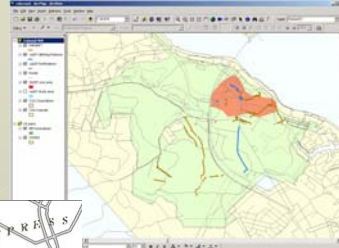
CRGIS frequently works with the American Battlefield Protection Program, and other NPS programs or divisions.
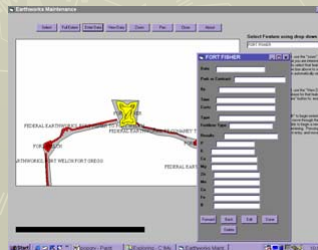
Our primary mission is to assist State Historic Preservation Offices and National Park Units in automating data, collecting data, and exploring the use of technology with cultural resource management.

## Geographic Information Systems (GIS)

- ► Combination of elements: hardware, software, data, and people
- ► The software provides the tools used to manage, analyze and display information
- ► All GIS contain: database management system, query tools, analysis tools, display tools, and graphical user interface
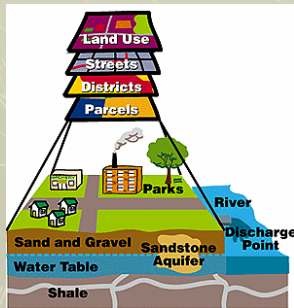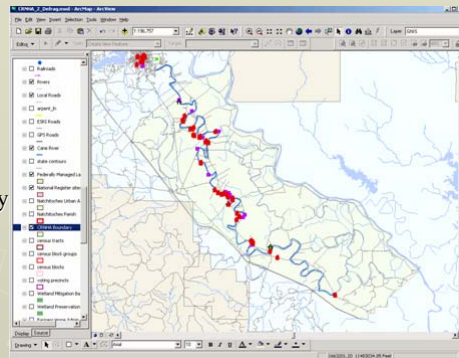
- ► Real world features are represented as individual map layers or "themes" according to feature type
- ► themes are stacked on top of each other, allowing users to see all the data sets in relationship to each other, geographically
- ► each map feature is attached to database or "attribute" information that describes it
- ► GPS data is downloaded into a GIS and becomes a map layer or theme

## Global Positioning Systems (GPS)

- ► GPS is a satellite-based navigational system
- ► provides navigational aides by locating single points and moving between points
- ► data collected becomes the basis for mapping
- ► coordinates are collected for each feature, along with information describing those features
- ► levels of accuracy range from approximately 20 meters to sub-centimeter
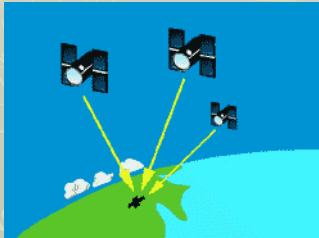
- ► GPS works by triangulating your position on earth, based on satellite signals
- ► GPS satellites are controlled and operated by the Dept. of Defense, but the system is open
- ► there are 28 satellites transmitting data now
- ► using velocity of the signal and time, GPS receivers calculate your distance to each satellite

## The Current Status of Cultural Resource GIS

- ► Today there are over 5 million cultural resources listed on state inventories of historic structures, archaeological sites, landscapes and objects
- ► Many State Historic Preservation Offices (SHPOs) manage their resources and data through GIS, and some require data collected with GPS
- ► At the National level, each Federal land holding agency keeps similar inventories of resources, and most use GIS to manage this data
- ► Additionally, all Federal agencies that undertake a project that may adversely affect a historic property must track those resources, and any mitigation to comply with Section 106 of the NHPA

- ► Taken by themselves, each of these efforts functions effectively within separate states and agencies
- ► Data produced should be shared among all parties for truly productive cultural resource management and knowledge management to take place
- ► Further, data must be shared within cultural resource disciplines, particularly at the Federal level

## Knowledge Management and Spatial Data
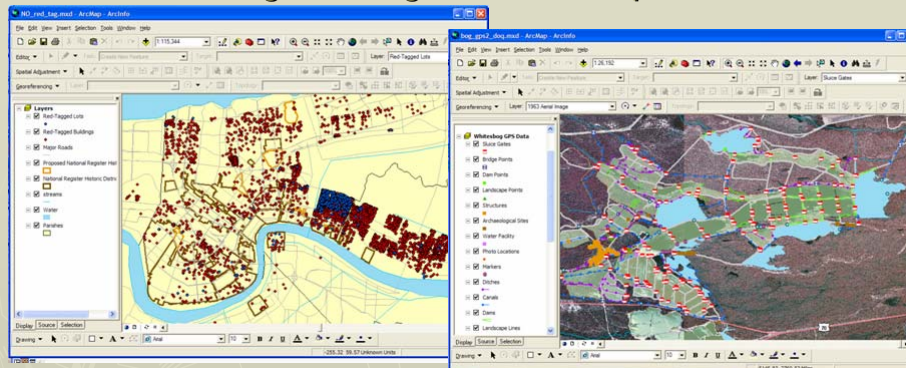


► If cultural resource specialists can agree that locational information is a key factor in understanding resources and their management, GIS becomes the ultimate tool to bring all the data and disciplines together

► These tools allow us to pursue the process that follows the flow knowledge management principles lay out: from the data itself, to integration of information, and finally to a better understanding of the resources

► In order to take advantage of GIS in this way, the cultural resource community must develop standards to define the spatial data that forms the keystone of the system

## The National Park Service and Cultural Resource Spatial Data Standards

► OMB Circular A-16 defines a set of requirements for Federal agencies to follow when they create, manage, or distribute spatial data

► A-16 also identifies the National Park Service as the lead agency for developing the cultural resources national data frame

► Within the National Park Service the Cultural Resources Geographic Information Services (CRGIS) office has assumed this responsibility

► The task of developing the cultural resources national data theme includes:

• setting data content standards and metadata standards

• monitoring the progress towards converting paper historic inventories into digital files

• coordinating the development of cultural resources databases that have spatial data

• eliminating duplication of spatial information

• identifying best practices and disseminating this information to other Federal, state, local agencies, historic preservationists, and universities.

► CRGIS is working toward the development of standards that will be both A-16 compliant and user friendly through meetings and workshops

## Accomplishing our Goals

► Standards for both legacy and future data are needed in a number of key areas:



► We need standards for collecting cultural resource spatial data: geometry, accuracy, datum, coordinate systems, sub-entities etc.
► We need standards that relate cultural resource spatial data to cultural resource attribute data
► We need standards that address how to safeguard sensitive spatial data
► We need standards to create metadata standards at the data set and feature levels

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## Guiding Principles We Can All Agreed Upon



► Based on the input of subject matter experts from all of the cultural resource disciplines within the NPS, the NPS developed a set of guiding principles that preservationists and GIS specialists can agree on, to help direct the standard process

► Spatial representation of cultural resources is important for their protection and management
► Each cultural resource database needs to remain autonomous
► A unique ID needs to be created for each cultural resource entity to enable linking between databases and use in a GIS
► Each unique feature will have a unique spatial representation
► Discipline experts for the predominant characterization of a feature should be responsible for the spatial boundary determination
► Standards should be defined for how each resource type will be represented, and at what level of accuracy, scale and resolution
► Standards may need to be different for legacy data and new data
► Questions we are asking of these datasets should drive the resolution and accuracy of spatial data layers

## Implementing the Draft Standards
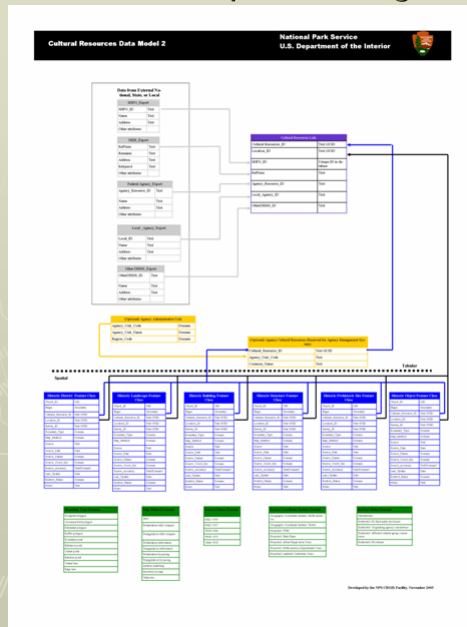


- From this process, CRGIS developed a draft set of standards describing how to create data, how to link data, how to safeguard data and what to include in metadata
- In 2005, CRGIS began presenting these draft standards to other Federal agencies, and began soliciting existing standards from those agencies
- In 2005, CRGIS created a draft data model to describe how these draft standards could be implemented within the NPS
- The model creates cultural resource feature classes within specific feature type data sets
- Each cultural resource is assigned a globally unique ID
- Each unique representation of the location of that resource is assigned a globally unique ID
- A link table associates the cultural resource ID with each of its locational IDs, and allows users to link each resource to outside databases

## Building Consensus to Reach our Common Goals

- CRGIS would like to hold a Federal agency-wide workshop to review the draft standards and explore various ways to implement those standards
- This workshop will include the State and Tribal Preservation Officers
- Our goal is to develop consensus and revise/update the draft standards accordingly
- Following this, CRGIS proposes field testing and further data model development to accommodate changes



- With consensus among Federal, state and local entities on the creation, development and management of cultural resource spatial data, we can take advantage of the power of GIS to integrate our data
- Without such standards and consensus, we will continue to use these technological tools to meet our individual needs, but the larger goal of data sharing across boundaries to establish better understanding of our resources can not be reached

## Using GIS for Data Integration: The Cane River

► CRGIS works with the Cane River National Heritage Area to provide a GIS tool for preservation planning, resource management and education

► Linking historical documentation to the complex multicultural landscape, visualized through GIS
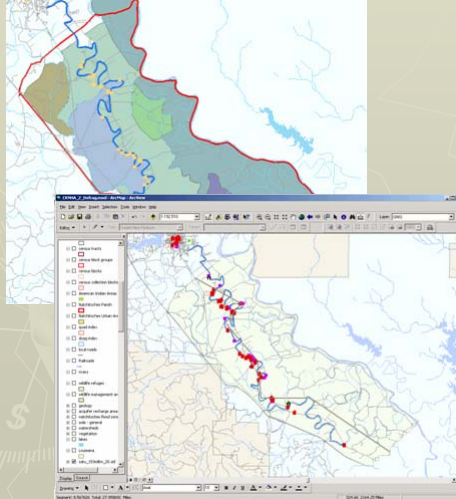
► Heavily documented through measured drawings, photographs, historic maps and GPS/GIS data, users can click their way through the landscape, and watch it change over time

► At the Cane River, a diverse collection of paper documentation combines with the GIS to create a powerful tool

► The true flow of knowledge management is illustrated, moving from individual data elements, to analysis, to products based on information, leading to new understandings of the region and its cultural interactions

► The heritage area is now able to interpret its complex history as it relates to the entire region, for its own use, and for public interpretation

## Using GIS to Manage Cultural Data: Katrina Response

► Other examples illustrate how the lack of knowledge management can be mitigated by the introduction of technologies such as GIS and GPS

► The Katrina/Rita disaster is the single largest disaster for cultural resources that the US has witnessed since the creation of the National Historic Preservation Act in 1966

► For FEMA, the Katrina/Rita event is the largest Section 106 project ever

## Section 106 Requirements

► In order to be compliant with Section 106, FEMA must survey and evaluate all of the potential demolitions (funded by FEMA) for their historic significance, consult with the State Historic Preservation Office to develop concurrence, and determine what will mitigate any adverse affects to historic resources

► To do this, FEMA needs accurate locational information for potential undertakings to understand the extent of the problem

► FEMA needs an accurate evaluation of the historic significance and nature of the resources, including current photographs

► In order to place any potentially eligible resources into context, FEMA must also have an understanding of the historic significance of the area to understand the interaction of various cultural resources and their relative significance



Scope of the problem in New Orleans:

5000 red-tagged structures (eminent threat)

86,000 yellow-tagged structures (major damage)

40,000 green-tagged structures (habitable)

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## Opportunity to Field Test the Draft Standards

► CRGIS was asked to help FEMA in its hurricane Katrina/Rita recovery efforts

► FEMA's goal was to create a strategy to survey all of the historic resources affected by the hurricanes and develop a way to fulfill its Section 106 requirements through the most efficient methodology

► CRGIS developed a strategy to document the locations of structures tagged for demolition in New Orleans and the surrounding Parishes with GPS, and to incorporate that geographic data into our draft data model to act as a field test for the standards

## Assessing the Strategy

► The survey of structures scheduled for demolition in Orleans, and therefore requiring assessment by FEMA for Section 106, is now complete

► The successful survey strategy and GeoDatabase implementation of the draft standards has allowed the Federal and state partners to quickly and digitally form concurrence on National Register eligible properties, through GIS

► The GPS documentation of cultural resources, GIS data produced, and the method of reviewing each site for Section 106 purposes is digital for the first time, and now serves as a mitigation or treatment measure for the first time
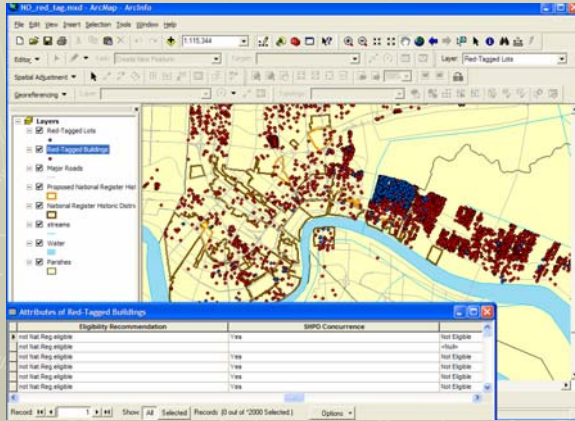


## Barriers to Making GIS Work for Cultural Resource Management

► Like any other technology, there are barriers which hinder full implementation of GIS/GPS capabilities for cultural resources

► Software changes occur, data formats change, storage media adapt

► Few solutions exist for these problems, other than to insure that the cultural resource community is aware of the trends in technology


Federal Geographic Data Committee

► Establishing cultural resource spatial data standards that focus on data creation and documentation of that data, outside a particular platform will help to insure that any data produced will transfer in the future

► Establishing these standards to guide the creation of our spatial data remains the critical element in moving forward however

► Without standards to define the basic building block of the GIS, no data sharing can take place

► Losing that tool and opportunity eliminates the possibility of creating a knowledge management system that will add to our overall productivity

## The Future of GIS with Cultural Resources

► As documentation and data gathering tools, GIS and GPS provide additional perspective and context for cultural resource specialists looking at landscapes of all kinds

► As a communication tool however, GIS provides a critical method of making powerful, visual and quantifiable statements to the public and to organizations responsible for protecting resources

► These tools can be extremely powerful, but the must rely on the underlying data, which truly shows the detail, significance and context of the resources themselves
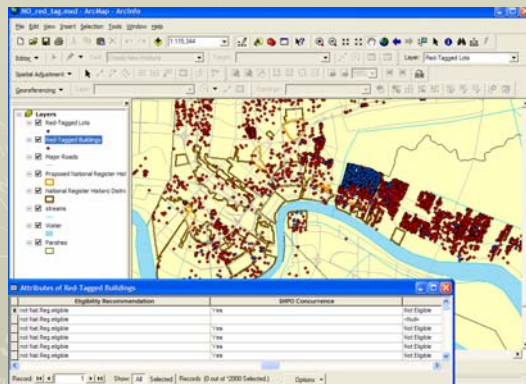


## The Future of GIS with Cultural Resources
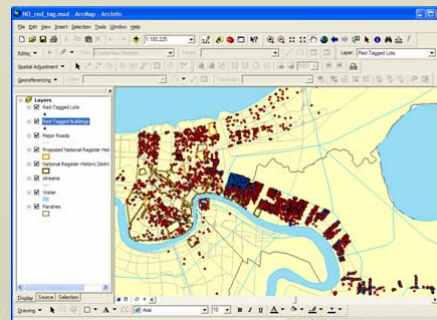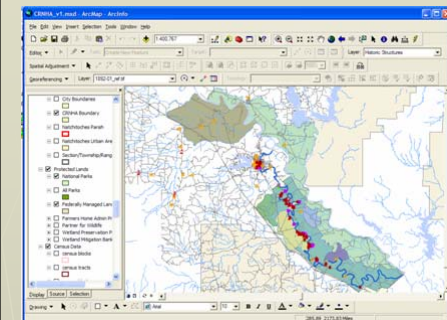


► Currently, technologies such as GIS and GPS are optional tools for cultural resource managers

► As the number of resources on state, local and Federal inventories grows however, GIS and GPS tools will be a required part of our daily cultural resource management strategy

► Cultural resource specialists have proven many times that GIS is the best way to integrate data types and datasets to better understand and evaluate our heritage

► Without standards to guide how we produce the data that contributes to the GIS however, we can not break down the inevitable barriers which technology brings to the cultural resource management world

► This strong framework of standards produces a truly efficient knowledge management system that will contribute meaningful new insight into our understanding of cultural resources

# Author Information

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