Chaco Culture

National Historical Park
National Park Service
U.S. Department of the Interior

Geographic Information System (GIS) Plan

EXPERIENCE YOUR AMERICA

Signators

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Executive Summary

Chaco Culture National Historical Park provides for the preservation public enjoyment, study and interpretation of the internationally significant cultural landscape and natural ecosystem within the park and of the associated cultural features within the surrounding San Juan Basin Region.

Chaco Culture National Historical Park became a UNESCO World Heritage Site in 1987. Chaco's national and international significance is based on its approximately 4,000 prehistoric and historic archaeological sites, representing more than 10,000 years of human cultural history in Chaco Canyon. These sites document:

- Evidence of a civilization which flourished between the 9th and 13th centuries and attained remarkable achievements in architecture, agriculture, social complexity, engineering, astronomy, and economic organization.
- Chaco "great houses" – the largest, best preserved, and most complex prehistoric architectural structures in North America. Sixteen great houses are interpreted within the park.
- A regional system of communities, centered in Chaco Canyon and linked by pre- historic road and trade networks throughout the San Juan Basin.
- 120 years of archaeological and anthropological research in the park that has yielded a systematic record of the lifeways and environment of the region's former inhabitants, and resulted in the accumulation of more than 1.5 million artifacts and archival documents that are curated for purposes of furthering scientific inquiry and public education.
- In addition to its archaeological legacy, Chaco Culture NHP preserves other links to the past and to the natural landscape through contemporary American Indian descendants of Chaco Canyon, whose traditional oral histories tell of their time in Chaco Canyon and who value it today for its spiritual connection to their past.
- A remote location that offers outstanding opportunities to enjoy solitude, natural quiet, clear air, starlit night time skies, and panoramic vistas of scenic sandstone outcrops into which Chaco Canyon is carved.
- The largest long- term protected natural area in northwestern New Mexico, which encompasses relatively undisturbed examples of floral and faunal communities within the Colorado Plateau ecosystem, and offers unparalleled opportunities to conserve the region's biodiversity and monitor its environmental quality.

Park Purpose and Significance

Park purpose statements are based on national park legislative history and NPS policies. They reaffirm the reasons for which a national park was set aside as a

unit of the national park system and provide the foundation for national park management and use. The purpose of Chaco Culture National Historical Park is:

- Recognize and preserve the archeological resources associated with the prehistoric Chacoan culture in the San Juan Basin, and surrounding area
- Preserve and interpret these resources unimpaired for the enjoyment of present and future generations
- Facilitate research activities associated with these resources
- Facilitate and cooperate in the protection, preservation, maintenance, and administration of the Chaco Culture Archeological Protection Sites to further preserve, interpret, and research Chacoan culture.

GIS Plan Purpose

The GIS Program must have a comprehensive automated information system that will integrate spatial (geographic) and tabular data from a variety of sources to enable modeling of real and theoretical situations for management of all park resources. GIS helps document park resources and perform analysis using spatial data, all of which support the park's stated purpose.

Park management is organized into 7 divisions: Cultural Resources, Natural Resources, Interpretation, Maintenance, Protection, Administration and Management. Administratively, the Natural Resources division directs the GIS operations and applications. The purpose of the GIS program is to: document park facilities and resources spatially and serve as a tool for the presentation and analysis of data to facilitate management decisions. GIS is considered a resource for park management and will be available to all park divisions to meet these objectives and more as they are developed. All park divisions are committed to developing a strong GIS program; those commitments are detailed in this plan.

Applications and products generated from the GIS will enhance the work done by all of the divisions. Specifically examples are:

- Natural Resources: Monitoring of vegetation species, paleo- resource location and condition, geology mapping, wash monitoring, viewshed analysis;
- Cultural Resources: site location databases, condition assessments;
- Maintenance: Utility mapping (both current and legacy), project planning, facility location;
- Interpretation: Visitor site maps, directions, interpretive materials;
- Protection: Crime mapping, archaeological site monitoring, search and rescue assistance, site steward and site locales; and
- Management: Property boundaries and ownership issues, as well as all of the above.

The division chiefs of the park, the NPS Intermountain Region Support Office, and CHCU and Park Service management directives all support creating and operating a functional GIS. It provides long- term guidelines for GIS operations and aids in refining short- term strategies that are outlined in the appendices and standard operating procedures. The GIS Implementation Strategy section and the appendices may require annual updates due to the evolving nature of GIS and changing issues facing the park. This will provide flexibility to meet these needs without the necessity of continuously rewriting this plan. Note that sections of this GIS Plan are to be used directly with the Project Management Information System (PMIS) and for various grant proposals submission processes.

Purpose and Need

Geographic information systems (GIS) have rapidly become one of the most efficient tools for land management within the National Park Service (NPS). They provide some of the most effective methods for quickly displaying and quantifying spatial data as well as linking spatial data with other types of data (such as images and databases). Many parks have transitioned entirely from paper- based maps to digital spatial information.

NPS GIS personnel attempt to acquire, manage, analyze, and distribute such data related to their park units. These efforts benefit parks and their visitors by:

- Informing park decisions with accurate maps
- Improving park planning through more efficient maps
- Providing expertise on Global Positioning Systems (GPS), legal land descriptions, spatial modeling, cartography, and data management
- Sharing park information with visitors, researchers, other NPS personnel
- Providing maps and descriptions to the public and other agencies
- Preserving a long- term digital spatial archive on park assets, resources and events.

As technology grows, the role of GIS personnel will continue to expand. GIS will eventually reach all park employees, allowing them to make their own simple maps and do basic spatial analysis using the park's spatial database.

The GIS program at Chaco Culture National Historical Park (CHCU) has benefitted all of the parks divisions but is not formally integrated into the overall park operations or management. GIS at Chaco remains a small program, but has the potential to expand to reach to more divisions without an increase in personnel. A more formal integration of the GIS program would benefit all park divisions. The GIS program has been operating without a documented, long-term plan. This plan seeks to provide a GIS program vision. Where possible, overarching goals have been included in the plan's main body, and more specific information, standards, etc. have been compiled in appendices that are intended

to be periodically updated. A series of Standard Operating Procedures (SOPs) will also be developed to provide specific, step- by- step instructions for common tasks. SOPs help develop standard collection, documentation, storage, security, archiving and dissemination (data life cycle) of spatial data to ensure continuity in the GIS program even in the event of personnel changes. This plan outlines specific objectives and goals in the implementation strategy section.

Existing GIS policy

In the 2003 Resource Management Plan, GIS is listed as a park priority for both Cultural and Natural Resources. There is no outlined GIS policy, just a stated desire to begin a program. GIS is considered an important form of spatial information by all park managers, but in order for a more complete integration into park activities, it is essential for more formal guidelines to be created and followed.

GIS Mandates

CHCU Resource Management Plan

In the 2003 Chaco resource management plan "Developing the GIS program" is listed as a priority for both the Cultural and Natural Resource Divisions. This plan outlines the desire for a full time GIS technician GS- 1371- 5/7 split between the two divisions. It also details comprehensive archaeological GIS data collection and processing planned for the park (RMP Project No. CHCU- C-001.005). As of 2008, few of these objectives have been accomplished. They serve as an example of the park's recognition and commitment to a fully automated GIS.

CHCU General Management Plan 1984

The 1984 General Management Plan predates GIS and omits discussion of any comprehensive data management plan.

NPS Management Policies 2006

Section 1.9.2 of the Policies discusses the importance of information management to an effective, accountable organization. It specifically commits the NPS to enhancing geographic information systems, making data available to the widest possible audience, and withholding information when its release would endanger resources.

NPS Inventory and Monitoring Program Data Management Plan

The NPS Inventory and Monitoring (I&M) program focuses on improving the scientific validity, data management, and public outreach of natural resource work in national parks. The 32 I&M Networks serving the national parks created a comprehensive data management plan (titled "Objectives, Policies, and Guidance for Inventory and Monitoring Network Data Management") which includes a wealth of data management information that GIS employees can

benefit from. The plan outlines the comprehensive processes for managing collected data by the networks, network parks and network cooperators. The plan provides citations for specific policies and procedures suggested for implementation within the GIS program.

Southern Colorado Plateau Network Data Management Plan
Chaco's I&M network, the Southern Colorado Plateau, established its own more detailed data management plan in which it outlined the desired data structure and standard operating procedures (SOPs). The plan calls for the GIS coordinator to take an active role in the management of spatial data. It also outlines a uniform data structure so all data collected in the network can be easily related. GIS at CHCU will take collaborate with the Network and follow the guidelines in the plan for data collection, particularly when data is intended for the network.

Unit Management Organization
Park management is currently organized into six divisions:

- Cultural Resources
- Protection
- Maintenance
- Natural Resources (currently natural resources is part of maintenance)
- Interpretation
- Management

These divisions routinely exchange information to achieve the parks management objectives, but that data sharing process could be streamlined. Currently access to spatial data is limited to direct contact with the GIS computer and downloadable data from the NPS data store. Each division has accumulated vast quantities of data over the years, some of which would benefit from being included in a large scale unified spatial database. The GIS technician performed a needs assessment survey (June 2008) with each of the division chiefs in order to assess the needs and long term goals of each division. For detailed results of this survey see appendix I. During this assessment management expressed the desire to create several new datasets which are outlined in appendix VII.

Program History
The Chaco GIS program is relatively young and undeveloped to date. GIS was listed as a key need in the 1997 resource management plan. In 1998 Paul Whitefield, the then Natural Resource Specialist, began using ArcView 3.x for basic mapping applications. Data creation was contracted with the McKinley GIS center for GIS data and Intermountain Mapping Services for surveying. This system resulted in a poor data management structure with no centralized data

archive. Documentation was poorly done and much of the early GIS data remains ambiguous.

In 2002, GIS was implemented as an internally run program. Brad Shattuck, the then Chief of Natural Resources trained in ArcGIS 6.0 and started organizing the park database. Contractors were utilized to collect new data sets. Chaco obtained funding through the service- wide comprehensive call and hired a seasonal GIS technician, Sarah Lowry, in the summers of 2006- 08. She has been responsible for updating infrastructure, organizing data, writing metadata and drafting the GIS plan.

Current Status

Personnel

The GIS personnel currently consist of one seasonal GIS technician (GS- 1371- 04/05) who dedicates 100% of his/her time to the GIS program. Supervisory/off season is work done by the Chief of Maintenance/Natural Resources (GS- 061- 11) with less than 3% of his time.

Equipment and Software

The GIS program is located in the Chaco Visitor Center offices. The computer workstation is located in an office shared by the Chief of Natural Resources/Maintenance and the Management Specialist. There is a plotter primarily dedicated to the GIS program and Facility Management located in the library. This plotter is rarely used by any other division, although it is not exclusively intended for the either program. ArcGIS 9.2 is currently installed on five office computers, including the computer attached to all of the data (hereafter referred to as the GIS computer). Two of these computers run GPS Pathfinder Office 3.10 and Terrasync. Manifold System 7.x is installed on four computers. The park currently utilizes three GPS units. The most precise unit is a Trimble GeoXT, but the park also has a Trimble GeoExplorer 3 and a Garmin GPSmap 76. For a complete inventory of GIS hardware and software see appendix II.

Park Geospatial Reference Stations

The continuously operating receiver stations (CORS) for differential correction in Chaco Canyon is located above the visitor center on the canyon rim (see figure 1). The National Geodetic Survey (operated by NOAA) installed CORS p028 (CHACOCNHP_NM2005) in 2005. Users can access information about this station at: (http://www.ngs.noaa.gov/cgi- cors/corsage.prl?site=P028). The Plate Boundary Observatory, a research component of UNAVCO, in Boulder, CO, owns the station. It provides accurate 15- second continuously updated data.

There are several other reference stations commonly used in the park (see figure 1 below for a map of geodetic survey markers). There is also a marker in the visitor center parking lot that Scott Andre placed for reference purposes.

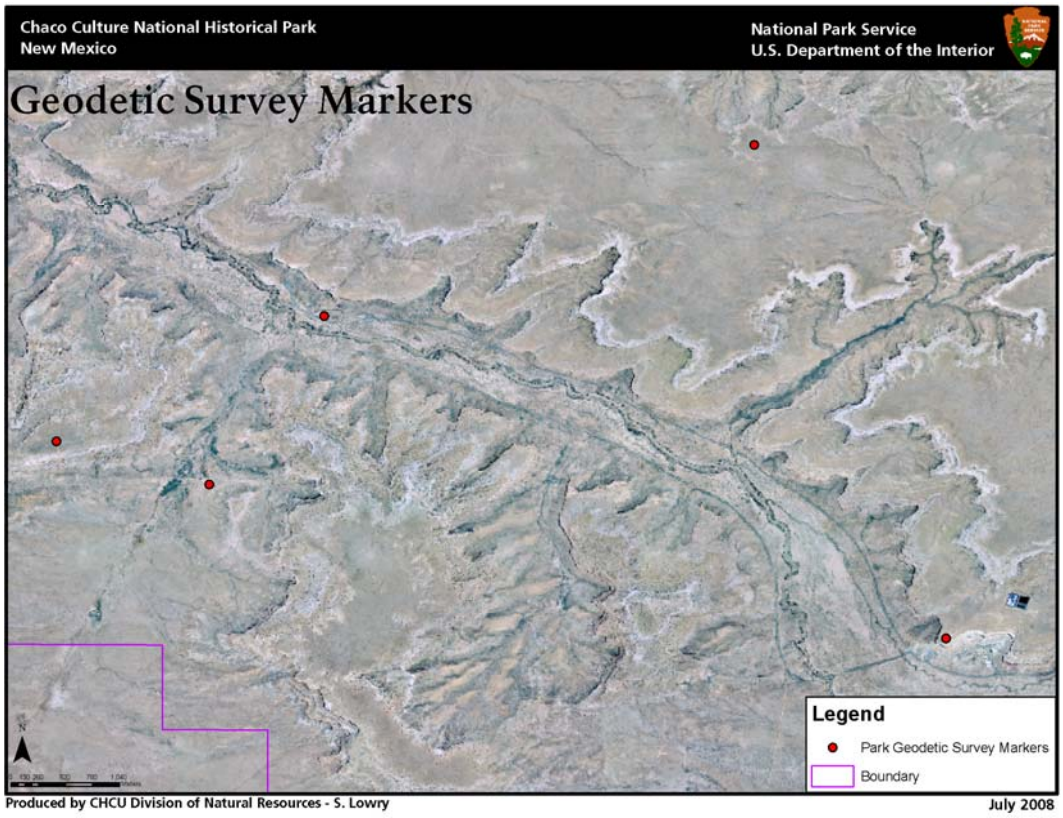

Figure 1 – The Geodetic Survey markers within the park.

Funds

Funding for the GIS program is derived primarily from project funding from the service- wide comprehensive call special emphasis project allocation system (SEPAS). This is an IMR process for grant applications. These funds pay for the GIS technician position, equipment, supplies, etc. The Southern Colorado Plateau Network (SCPN) has paid for orthorectified imagery (1 foot pixel). The Cultural Resource division financed work done by Rich Friedman, a GIS specialist working for the city of Farmington, for several projects. The Federal Lands Recreation Enhancement Act (FLREA) provided the funds for a fence line survey.

Arc GIS is provided through an enterprise license agreement (ELA), a blanket agreement between the Department of Interior (DOI) and ESRI allows the NPS to use this software on as many computers as desired. This agreement makes it possible for Chaco to install GIS software on the computer of any interested personnel. In the near future, there will be a similar agreement with Trimble that

will greatly reduce the cost of Trimble software purchases (i.e. GPS Pathfinder Office and Terrasync)

Data Collection and Processes
GPS data is often collected by a variety of personnel including volunteers and staff. Post processing of these data (differential correction, quality control, metadata writing, etc.) are usually done by staff members or the GIS technician. Often post- processing (differential correction, QA/QC) is never conducted. There are few users who are qualified and also have time to post- process the data. One goal of this plan is to streamline this process so it will become standardized for all new datasets.

Coordination
Currently most of the coordination is done within the park or the Geographic Intermountain Mapping Program. There has been some contact with other GIS personnel for the purpose of exchanging data (i.e. BLM Farmington Field Office, Farmington GIS). The park GIS coordinator takes an active role in coordinating with agencies, partners and other applicable organizations for the purposes of data acquisition and sharing. For a complete list of partnership contacts see appendix VIII.

Data Status
Directory Structure (list of databases)
Park spatial data is currently stored directly on a removable hard drive that is attached to the GIS computer. These data are available through the networked computers. The data are organized under a single directory called "GIS data." All data underneath this folder are organized according to the IMR- GIS recommended data structure (a data map is included in appendix III). Metadata, or textual information about specific data and its collection method, exists for all newly acquired data and all data which metadata could be inferred from ancillary information. There is some data for which metadata could not be created due to the ambiguity of the source, collection method or ancillary documentation (see the data map for an outline of the existing data).

Standard Quality
There is no documented standard data quality for the park. However, with the GPS unit all data is collected with minimum standards. The max PDOP is 4.0. A minimum of 30 points are collected to determine an average, although a 60 point minimum is desired. The reference base coordinates are Universal Transverse Mercator North American Datum 83 (UTM NAD 83). The park is in both zone 12 and 13 (but all data is collected in zone 13 for uniformity). The cultural resource personnel collect data in NAD 27 and the archive data is projected to NAD 83.

Documentation

A number of contemporary park datasets have documentation that comply with NPS standards. Most with complete, compliant documentation have been posted to the NPS Data Store. Most datasets from outside sources have no documentation. CHCU has posted approximately 75% of the non- sensitive data to the online data store. In the future, CHCU should work to get the metadata for sensitive information onto the data store; it is important that the existence of the data be known, even if they are not available.

Implementation Strategy

Objectives and Vision

The Chaco Culture GIS program has two major objectives:

1. To consolidate all spatial data in one location with correct metadata (when possible). This data should be backed up and archived in a manner congruent with other park records.
2. To make all data accessible to park personnel and the public (with the exception of sensitive data) and make it possible for anyone with the interest and need to make their own simple maps.

In the next two years the vision of this plan is that:

- Park employees will be more aware of GIS, its benefits and any application suited to their needs.
- All of the parks spatial data will be collected in one location and is organized according to a transparent data structure.
- Data will be accessible to all park employees (when sensitivity allows) in an easy to use format.
- Standard Operating Procedures (SOPs) will exist to guide most common GIS and GPS tasks.
- All existing park data will be brought up to the standards outlined in this document and in the national level inventory and management plan.
- The NPS Data Store will contain metadata for all park data (for which metadata can be written).

In the next five years the vision of this plan is that:

- Park employees will be able to generate their own simple maps as needed.
- GIS technology and personnel will be integrated into park operations and decision making.
- Park GIS personnel will have a close working relationship with other GIS programs, including those outside the park.
- GIS personnel will back up and archive all GIS digital data frequently using sufficient archival materials.
- GIS personnel will archive created maps in Adobe PDF format for future reference.

Personnel
As the GIS program is unlikely to garner more funds than are already available it is recommended to continue staffing one seasonal GIS technician position. This position should continue to focus on data organization, writing metadata, data collection (on an as- needed basis), GIS mapping and analysis projects and the implementation of this GIS plan. This position should strive to serve all of the divisions on an as needed project basis. However, in analyzing the park's GIS needs assessment, many GIS needs specified by division chiefs would necessitate the skills of a year- round GIS coordinator. In the future. the Eastern Four Corners group should consider sharing a GIS position (CHCU, AZRU, MEVE).

Equipment and Software
The space available to the GIS position is adequate. The desktop computer assigned to the GIS positions is currently meeting demands. At current use levels, most GIS- related equipment is adequate. The plotter should function reliably for several years and a variety of GPS units are available for use. Because of the size of datasets GIS staff work with and the complexity of analyses they perform, GIS computers are often more expensive and have shorter life spans. The current GIS computer will need to be replaced, as it is three years old currently. The current GPS units are meeting the parks needs. It would be ideal to purchase an external antenna to attach to the Trimble GeoXT when using it for more technical applications, such as mapping archaeological sites. It would also be ideal to replace the GeoXIII with either another GeoXT or a GeoXH (providing less than 10 cm accuracy preferable for mapping archaeological sites).

ArcGIS Desktop is available with unlimited licensing (free to parks) because there is a blanket purchase agreement (BPA); GIS software can be made available to any user who would benefit from it. Trimble software is also available through NPS BPA providing decreased pricing for individual licenses. Manifold system is available through individual licenses purchases on a per user basis and will be updated as the opportunity arises.

Users
Some park staff would benefit from the ability to make their own maps and GIS personnel would benefit from the available time to spend on other job responsibilities. Many park staff expressed an interest in a system that would allow them to create their own basic maps when the seasonal cartographic technician is unavailable. GIS users at Chaco can be divided into 3 different groups, which require different types of access to the data and software:

- GIS Administrators: staff in charge of managing GIS data and making it available.
- Power users: staff making maps and doing more complex analysis and maps, needing access to the complete GIS functionality.

- Occasional users: staff making simple maps without needing or wanting a more complex interface.

At Chaco most users are occasional, not desiring any other map interface. These users will have access to a simple internet based map service where basic park information would be available. This demand can be served by the new online map database established by the Intermountain Region GIS program (http://imgis.nps.gov/intermountain_parks.html). Ideally in the future, there would be some way for select users to access sensitive data in a similar interface. This would rely on the availability of sensitive information to GIS personnel and managements desire for its implementation.

There are a few power users in the park who make more complex maps. These users should have read- only access to data through a networked data service. This is the best way for any park staff member to access, protect and disseminate sensitive information.

There is no year- round staff member charged with acting as GIS administrator. In the summer there is a GIS technician, who manages the data and runs the program full- time. This staff member provides access to other divisions as they need it. In the off- season, the chief of maintenance/natural resources conducts basic system maintenance and acts as GIS administrator.

It would be ideal for the GIS coordinator in the park to offer a short (1- 2 hour) training session on an as- needed basis to park personnel so they can manage and display their own spatial data in ArcGIS. This was not a popular option for the division chiefs, but if they were trained enough to understand the simplicity of many basic ArcGIS processing steps, some of this trepidation could be reduced. The training could be offered once a year to interested staff members or more frequently as requested.

Data Management Strategy

Directory Structure

The data directory structure currently in use is relatively clear and follows a logical order. The data are stored on one two terabyte removable hard drive. There is also one large file with data from the Bureau of Land Management (BLM) Farmington Field Office that is not integrated with the park data. There are no plans to integrate this outside agency data because it lacks metadata and does not necessarily contain park specific information. In many cases, outside data is immediately integrated into the parks database when it supports the park's mission.

The long- term goals for data management are to have a password protected server allowing power users to access data in a read only format. This server

would also password protect data within a sub- directory for sensitive information. This allows different tiers of access to different in- park users. Currently, sensitive information is not separated from the rest of the data structure because the external hard drives are not available to staff and all data access is controlled locally.

Data Distribution
Non- sensitive data will be distributed online through the NR/GIS Data Store website, if it is small enough to allow posting. Larger files or sensitive data will be available through request. Information about the data release strategy is available in appendix III.

Spatial Data Standards
The coordinate system and datum for all data will be Universal Transverse Mercator (UTM) North American Datum (NAD) 83. The park is in both zones 12 and 13 and data is to be recorded in zone 13 to increase uniformity. In the past, cultural resources has not collected data in this system (instead using NAD 27). This is unlikely to change with the current personnel and under the present park management. In the future, all of the digital data will be transformed to comply with this standard. This spatial information will have their coordinate system and datum embedded in ESRI software and documented in the metadata.

NAD 83 and NAD 27 are two different datum systems used to describe the size and shape of the earth. The earth is not perfectly round and instead is refereed to as an ellipsoid or geoid; the NAD systems describe the shape of the earth in two different measurements. NAD 27 is based on the Clarke Ellipsoid of 1866 and was created based on manually surveying the entire continent. NAD 83 was implemented to correct some of the insufficiently accurate data from NAD 27. It is based on the GRS80 ellipsoid, derived from satellite geodesy as opposed to manual survey. Cultural resources for the state of New Mexico utilize NAD 27, mandating our data to be displayed and projected into that datum for that consumption. However, because data collected and displayed in NAD 83 are many meters more accurate data should be reprojected and displayed in this system for park use. All new data should be collected in this datum system.

Whenever possible, data will be accumulated for an area that extends beyond park boundaries, as time allows (i.e. data will be gathered for the entire county if readily available, but if data can only be collected for one mile outside of the boundary with significant effort then the scope will be limited). This will ensure that data covers any map likely to be produced in the park.

GPS data will be collected at the highest possible accuracy and data dictionaries will be created considering possible future uses. When new GPS equipment is purchased, it will be of the highest possible accuracy and priority will be placed

upon acquiring an external antenna. The GPS unit will have a maximum Positional Dilution of Precision (PDOP) of 4, or as low as possible for the conditions. While collecting data there will be a minimum of four satellites, which gives three dimensional positions. For more information concerning GPS standards, consult the NPS field data collection standard operating procedures.

Documentation

Executive Order 12906 (April 1994) mandates that all federal agencies create metadata or "information about data" for all geospatial data. The Executive Order states that 'Geographic information is critical to promote economic development, improve our stewardship of natural resources, and protect the environment. Modern technology now permits improved acquisition, distribution, and utilization of geographic (or geospatial) data and mapping.' Additionally, the order clarifies that this "means the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data." The National Inventory and Management Plan outlines the process and procedures for metadata documentation.

As a result of EO 12906, the NPS GIS Program has a clearinghouse specifically designed to host all non- sensitive NPS GIS data. The clearinghouse is linked to the Federal Geographic Data Committee (FGDC) Clearinghouse search which enables web users to locate NPS data from anywhere in the world. The park will comply with EO 12906 in the following ways:

- All new park created data will have metadata written for it as soon as it is possible, ideally within a week of finishing data collection.
- A reasonable effort will be made to create FGDC compliant metadata for data created outside the park or done in the past. For the purpose of this plan "reasonable" involves attempting to contact past data creators and/or attempting to discern data creation variables.
- The data will all be posted on the data store to facilitate public access to the metadata and data (if sensitivity and storage space allows).

The data management strategy for projects, created by the Inventory and Management program, will be followed with minor revisions. In appendix IV the process is outlined in more detail. Existing Standard Operating Procedures (done in the style of a manual) are intended as a guide for establishing a standardized data collection and processing format. For more information, see appendix V.

Backup and Archives

All data will be copied from the GIS removable hard drive onto another hard drive twice a year. The hard drive will be stored in Maintenance trailer in order to ensure that the data will be safe from any unforeseen physical damage to the GIS office or GIS computer equipment. This data backup will be documented

through a log stored both with the backup removable hard drive and on the wall next to the GIS computer. If a significant amount of work is done on the GIS, data backups will be made more frequently at the discretion of the GIS technician and the Chief of Maintenance/Natural Resources.

Security Privileges and Sensitive Data

Sensitive data is currently stored in a separate directory labeled sensitive with an identical structure to rest of the data. In the directory, the folder would be accessible to specific individuals on a read- only basis. Information about what is considered sensitive is contained in appendix VI.

If individuals demonstrate a commitment to managing their own data and learn enough about GIS, they may be given "modify" privileges for the applicable spatial data. A demonstration of commitment could be defined as taking more than one ESRI course and providing a relevant justification to the park GIS personnel. For the definition of security levels see appendix VIIII.

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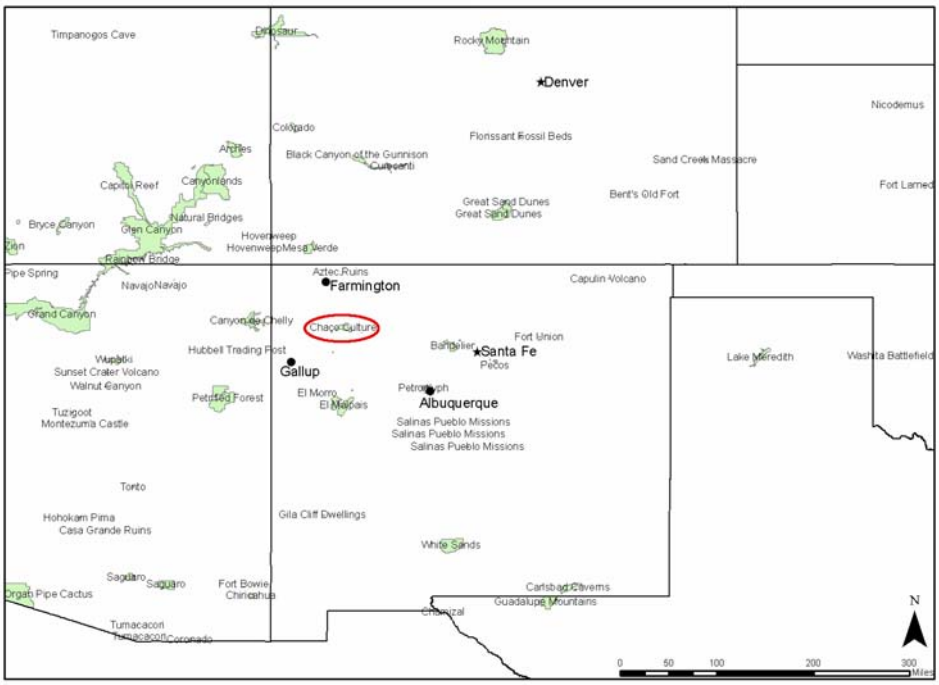
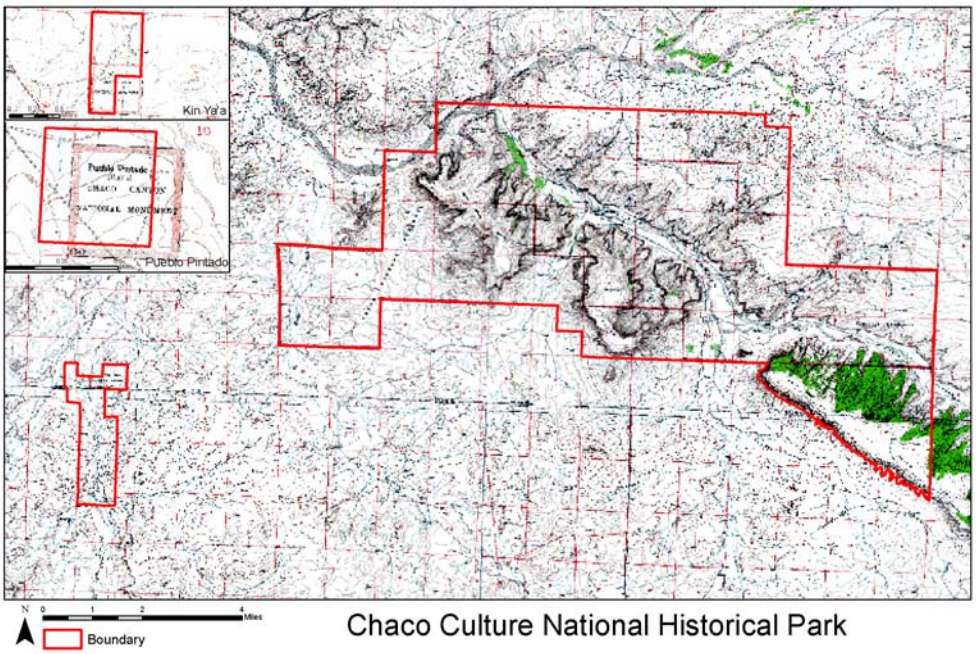
Maps

I. Geographical Political Boundaries



*II. Map Depicting Unit Boundary**



*This represents the correct park unit boundary. The WASO lands file boundary is incorrect and needs replacing with the boundary file available on the data store website.

Appendices

Appendix I – GIS Needs Assessment Summary

A GIS needs assessment survey was conducted in order to thoroughly gauge the park managements uses of GIS and their goals for the program. The survey was given to every division chief. Comments were favorable in terms of the utility of the GIS program. Each division has its own uses for the program. There were several comments common to all of the park personnel. The primary way GIS could better suit their needs is to provide a user- friendly mapping program where minimum training is required to produce basic maps.

Map use varied by division ranging from interpretation only using basic maps to assist in directing visitors to management using legal land boundary maps. Spatial information is primarily needed as a graphic tool to support written documentation. Most users do not utilize GIS software. There are a few power users who occasionally access spatial data.

Map accuracy was generally adequate for division chiefs. However, utility maps need to be further ground- checked. Most people were interested in the creation of specific maps where the spatial data is already collected. For example, Protection was interested in the creation of large scale maps with park resources mapped to understand what resources need to be protected. Interpretation needs maps of the housing areas and maps of areas open to visitors. A complete inventory of new spatial data requested is listed below (this is data that would need to be collected).

The park cooperates with a variety of organizations through formal and informal data sharing agreements including the Navajo Nation Chaco Protection Sites Program, City of Farmington GIS, McKinley County GIS, San Juan College and the BLM. The cooperation is facilitated by the park's current GIS capabilities. Few park computers have the hardware necessary to run GIS software and those computers that do are typically not used frequently. The staff expressed little interest in training to become more powerful GIS users. In fact, it seemed that park divisions are most interested in having some sort of GIS program available to use for spatial information management, cartography and spatial analysis. It is unclear how this would be financed. The staff expressed confidence in the abilities of GIS as a useful method of storing and interpreting spatial data.

Need Requested and Proposed Solution:

- Need: Up to date inventory of current GIS data and access to that data and its related metadata.
    - Proposed Solution: Set up a networked GIS database with read only access to data (with security protection) available on any CHCU networked computer.

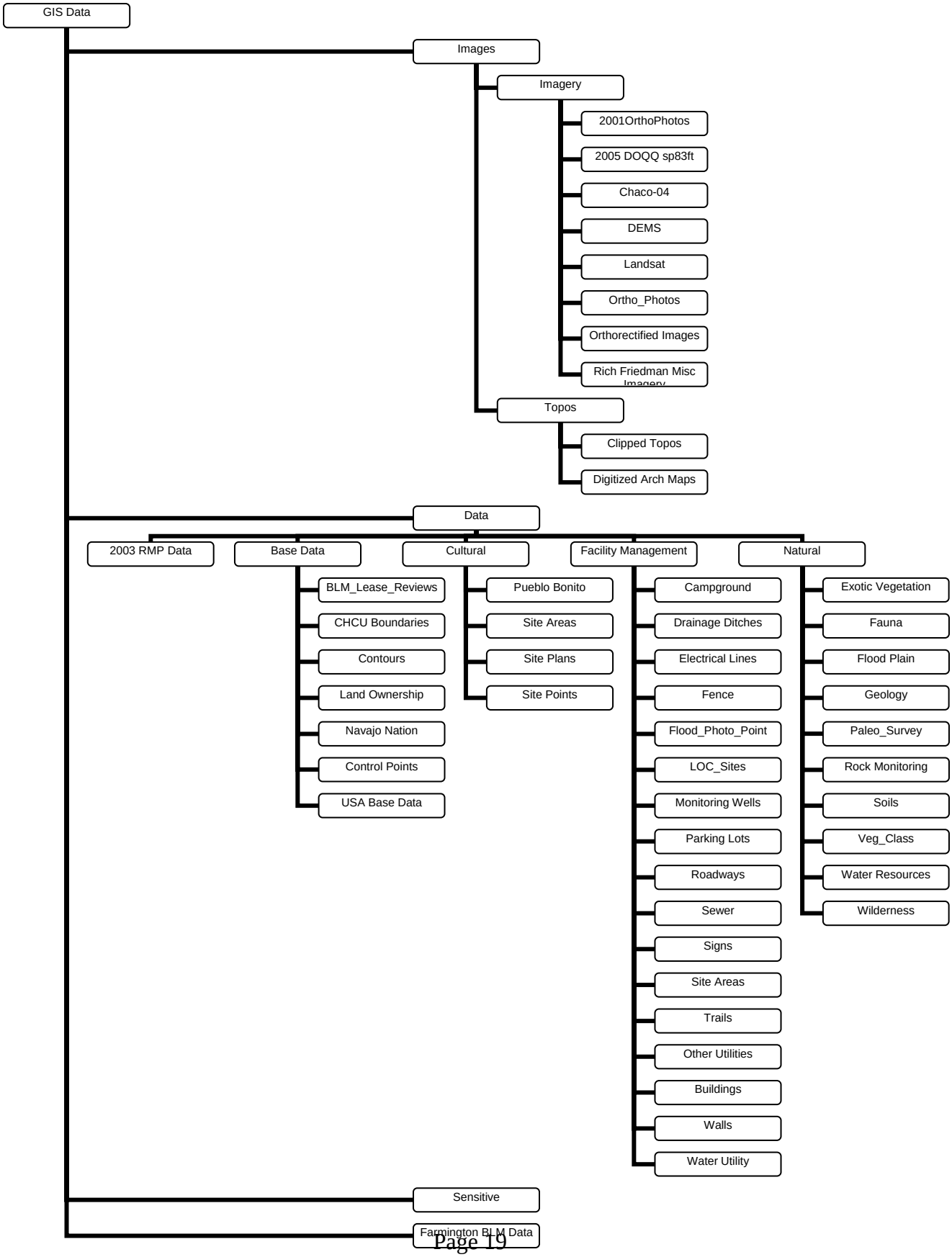
- Need: Map making software with access to Chaco's spatial data with a more user friendly interface.
    - Solution: Contacted the regional office which has provided an easy to use internet based mapping program with publicly available GIS data.
    - Proposed Solution: Offer training sessions and communicate training opportunities to park staff to further the ease use of ArcGIS software.

Appendix II – GIS Property Inventory

A complete accounting of property used by the GIS program is difficult to ascertain as no property is "owned" by the GIS program. There are many pieces of equipment (particularly computers) that are used for GIS for a small percentage of the time. This list attempts to categorize all of the equipment that is used by the GIS program.

Hardware	**Percent Used for GIS Program**	**FY Purchased**
Dell Optiplex GS 280 Workstation	90%	2005
Trimble GeoXT	100%	2006
Trimble GeoExplorer3		2005
Garmin GPSmap 76		2005
Lacie 250GB Removable Hard Drive	90%	2006
Lacie 250GB Removable Hard Drive	100%	2007
Lacie 2 TB Removable Hard Drive	100%	2008
Software	**Number of Computers installed**	
ArcGIS 9.2	4	n/a
Manifold	2	2007
Terrain Navigator Pro	3	2005
Terra Sync	2	2006
GPS Pathfinder Office 3.10	2	2006

Appendix III – Standard Directory Structure and Existing Spatial Data



Appendix IIII – Data Release Policy

Data will be released to the public in two different ways. The NPS data store hosts much of the park's non- sensitive data. The park strives to post as much with FGDC compliant metadata as possible. If non- sensitive data is requested, the park will communicate with any interested parties' requests for data and attempt to post appropriately data promptly.

For sensitive data, any interested party needs to communicate directly with the Chiefs of Cultural and Natural Resources. Access to data will be determined on a case- by- case basis taking into account the requesting party, their intended use of the data and relevant legislation. To determine what constitutes sensitive data, see the below statement on sensitivity.

Appendix IV – Project Data Standards

The park will strive to follow a basic data life cycle (as recommended in the NPS inventory and management data management guidelines, see figure 2). This cycle includes raw data, working data base, certified data and metadata, a master database and the final distribution of data. This is a structure the park already follows with its spatial data projects, but formalizing the network and including an archival element will help to ensure steps are not skipped.

1. Acquiring **Raw Data** is done on the GPS unit, through digitization or another method of spatial data acquisition. The data is imported from the GPS device.
2. This raw data is made into a **Working Database** through adding attribute information and the process of data verification. Attribute information is often added in the field during GPS data collection through the use of data dictionaries.
3. **Certified Data** is created after the raw data has been completely verified and completed. **Metadata** is written following FGDC standards in order to ensure that the data acquisition process is documented. Certified data should be **archived** into the GIS hard drive data structure and in a backup storage drive on a regular
4. This data is then added to a **Master Database** where it can be utilized for analysis, and other **products**. It can be distributed at this point through online national databases. Any changes should be tracked and approved by the GIS administrator before being made to the master data structure.

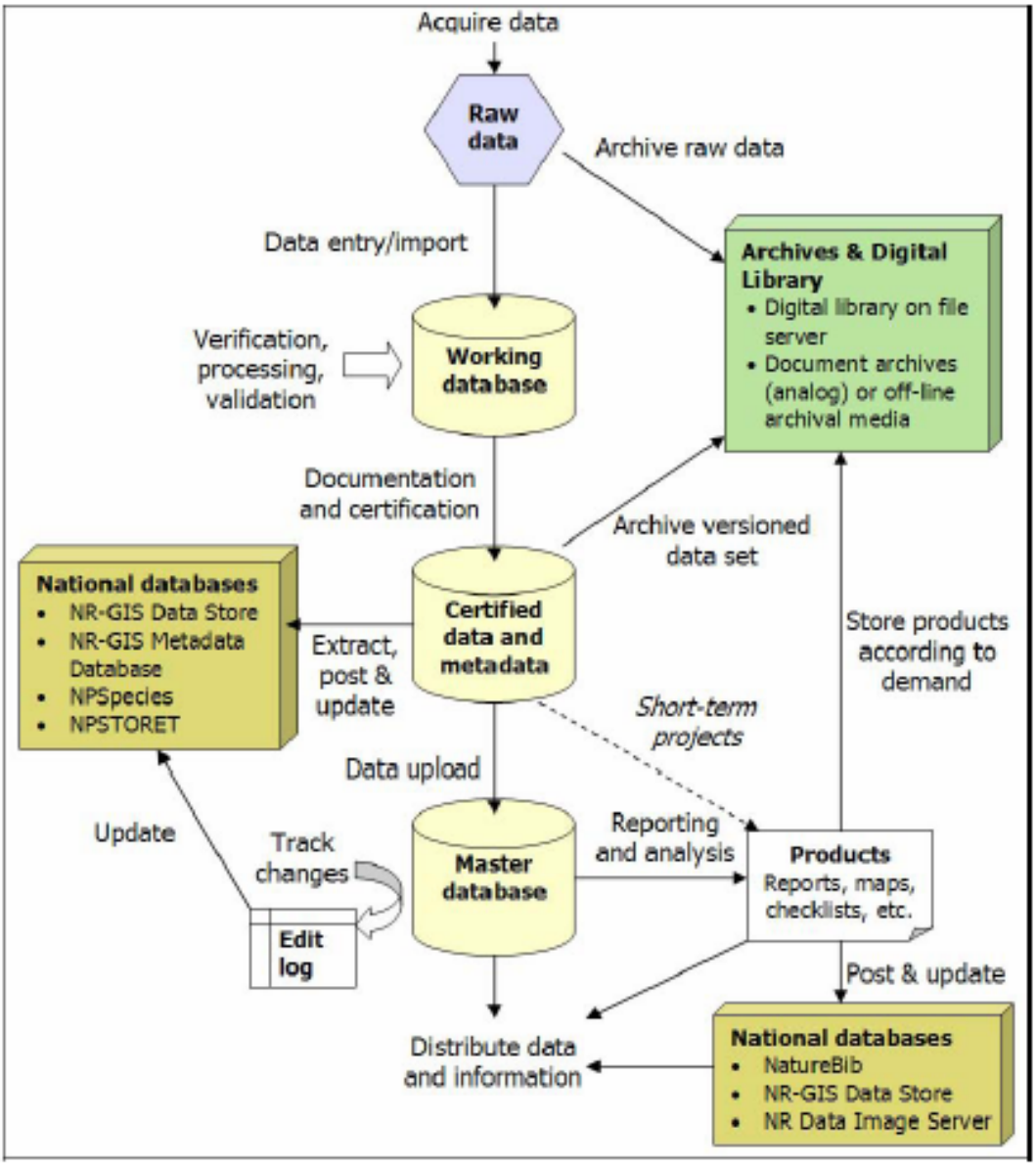


Figure 2 – Inventory and Monitoring data management plan guidelines for data life cycle.

Appendix V – Standard Operating Procedures

For GPS data collection see:
G:\Data_Tools\Manuals\GPS_CollectionManual_General.pdf
For GPS data downloading through shapefile creation see:
G:\Data_Tools\Manuals\GPS_Datadownload_ShapefileManual.doc

Appendix VI – Sensitivity Statement

Much of the spatial data for Chaco is sensitive data, is defined as data that could be used to "adversely affect valuable resources, the national interest, the conduct of federal programs, or individual privacy" (National Park Service 2008). In

Chaco, this data takes the form of rare fauna species and cultural resources, as well as utility locations. This information is protected by legislative direction which also dictates disclosure conditions. Utility locations are considered sensitive because of park security and public safety.

Legislation dictating the protection of sensitive information:

- Executive Order No. 13007: Indian Sacred Sites – requires that the park "avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites."
- National Parks Omnibus Management Act (16 U.S.C. 5937) – Requires that "Information concerning the nature and specific location of a National Park System resource which is endangered, threatened, rare, or commercially valuable, of mineral or paleontological objects within units of the National Park System, or of objects of cultural patrimony within units of the National Park System, may be withheld from the public in response to a request under section 552 of title 5, unless the Secretary determines that—
    - disclosure of the information would further the purposes of the unit of the National Park System in which the resource or object is located and would not create an unreasonable risk of harm, theft, or destruction of the resource or object, including individual organic or inorganic specimens; and
    - disclosure is consistent with other applicable laws protecting the resource or object."
- National Historic Preservation Act (16 U.S.C. 470w- 3) – "Authority to withhold from disclosure. The head of a Federal agency or other public official receiving grant assistance pursuant to this subchapter, after consultation with the Secretary, shall withhold from disclosure to the public, information about the location, character, or ownership of a historic resource if the Secretary and the agency determine that disclosure may—
        - cause a significant invasion of privacy;
        - risk harm to the historic resources; or
        - impede the use of a traditional religious site by practitioners."
- Archaeological Resources Protection Act (16 U.S.C. 470hh) – Under Disclosure of Information, "Information concerning the nature and location of any archaeological resource for which the excavation or removal requires a permit or other permission under this chapter or under any other provision of Federal law may not be made available to the public under subchapter II of chapter 5 of title 5 or under any other provision of law unless the Federal land manager concerned determines that such disclosure would—

- further the purposes of this chapter or the Act of June 27, 1960 (16 U.S.C. 469–469c) [16 U.S.C. 469–469c–1], and
- not create a risk of harm to such resources or to the site at which such resources are located."

To release this information governors may request disclosure as long as they state:

- "the specific site or area for which information is sought,
- the purpose for which such information is sought,
- a commitment by the Governor to adequately protect the confidentiality of such information to protect the resource from commercial exploitation,"

Upon reception of this information, "the Federal land manager concerned shall provide to the Governor information concerning the nature and location of archaeological resources within the State of the requesting Governor."

The park will protect such data by not posting the data online and instead posting the metadata alone on the Data Store. Metadata documentation provides the means to label sensitive data. The park will archive original datasets. Park access to sensitive information will be regulated through password control and limited physical access to the storage place. In the future, when security is available, sensitive spatial information will be available online.

Appendix VII – GIS Layer Priorities

- Utilities, legacy and present (updates to existing data)
- Cultural landscape identification and inventory (buildings, roads, earth modification)
- Archaeology Sites (sensitive)
- Wash cross section vertical profiles
- Erosion control structures over time
- Management units change over time
- Paleo- resources with conditions
- Trail conditions
- Fence location and data relating to installation and repairs
- LiDAR data of geomorphology
- Elk trail movements
- Detailed architectural documentation
- A database of legacy and current case incidents including the type of incident and its location
- Baseline aerial imagery collected every five years at minimum and every year if possible
- High quality digital elevation model (DEM) data
- Satellite imager on a landscape scale once every ten years

- LiDAR scanning of the Chaco wash once every ten years.
- Topographic maps (raster) scanned at high resolution to avoid pixilation when zoomed in too closely.

Appendix VIII – GIS Contacts

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Appendix VIIII – Security Privileges Defined

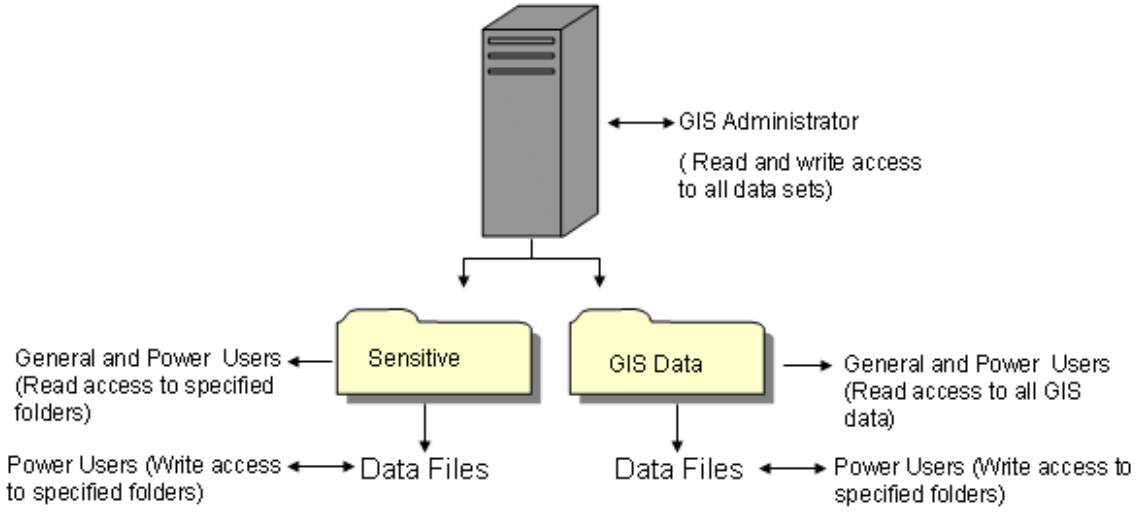

Figure 3 – The data structure as it will be visible to all users on the hard drive. The notes on the sides define the access permission given to different users in each folder.

- General User – A basic GIS user with read only privileges to all non-sensitive data on the removable hard drive. This would be password protected, allowing users to download relevant shapefiles for map making. A general user may also have access to sensitive folders depending on his/her needs and management approval.
- Power User – A more advanced GIS user with read only privileges to all non- sensitive data on the removable hard drive. This user would have write/modify privileges on specific folders relevant to their position in the park. This user would have to provide a justification for this access and demonstrate knowledge of GIS through ESRI or IMR GIS course work. This access will be granted at the discretion of the GIS administrator.
- Administrator – The GIS administrator has full access to all folders on the GIS hard drive. This is an advanced GIS user who manages the entire system.