A DATA BASE MANAGEMENT SYSTEM
For Cultural Resource Managers

Frances Joan Mathien and W. James Judge

ABSTRACT. As part of the research on Chaco Canyon, a computerized data base management system is being created. In addition to information on sites collected during survey and originally coded for the San Juan Basin Regional Uranium Study, environmental data (vegetation zones, soil types, and erosional channels) have been digitized so that these variables can be evaluated in conjunction with site attributes. Other relevant information is being collected and will be added to the data base in order to assist managers in the development and implementation of long-range cultural resource management conservation as it relates to research, interpretation, and development. The program should be flexible enough to permit continual adjustment of protection needs with these goals in Chaco Cultural National Historical Park, and this project is serving as a model that is being used by other areas with similar cultural resource management needs.

Executive Order 11593 signed in 1971 stated that an inventory of all cultural resources on Federal lands must be undertaken. In some areas, such inventories have been successfully completed, and the volume of data is staggering. This point was quite clear to those who participated in the archeological surveys of Chaco Culture National Historical Park (formerly Chaco Canyon National Monument) (Hayes, Brugge, and Judge 1981) where approximately 2400 sites were located. Planned inventories of other National Park Service areas will no doubt result in equivalent amounts of data. To manage these cultural resources properly, much information must be recorded on each site, for example, location, size, type, period of construction, significance, visibility, condition, preservation needs, etc. In addition, data on the natural environment (e.g., vegetation, soils, erosional conditions, etc.) must be recorded for the general site area. All of this information must be readily available to management to permit the development and implementation of a long-range, practical resource conservation program—a program designed to permit the continual adjustment of protective needs with those of scientific research, visitor interpretation, and park development. The only means by which such information can be compiled and processed efficiently, at management request, is through the use of a data base management system developed specifically for archeological resource conservation.

Realizing this, W. James Judge proposed a pilot project designed to develop and implement such a system using the Chaco data base that resulted from the surveys conducted in 1971-1975 by the Division of Cultural Research (formerly the Chaco Center). It

was proposed that implementation of this system would provide Chaco Culture National Historical Park managers and Southwest Region planners with an immediately useful resource management program. It would also provide the National Park Service with a prototype for evaluation and possible adoption Servicewide.

Funding for this project became available in FY 1979 through the Office of the Chief Anthropologist, and the work continues through the present. This paper includes a presentation of the manner in which the project has been carried out to date, what it has accomplished, current and future areas of emphasis, and an evaluation of the results of the project to date.

Basic Requirements

Information, equipment, and personnel were the three main requisites necessary to implement this project.

1. INFORMATION: Data on approximately 2400 archeological sites located during the Chaco Project surveys were computerized by the National Park Service during the San Juan Basin Regional Uranium Study (SJBRUS) (United States Department of the Interior 1980). While the variables coded on the SJBRUS data base were chosen for management purposes and cover a wide spectrum (Wait 1977), it was realized that additional information on environment (soils, vegetation, geology, geomorphology, erosional features), site documentation (additional site names and numbers, bibliographic references), and preservation data (e.g., linear feet of wall space, estimated costs of stabilization), as well as additional site attributes should be added and/or refined in order to provide sufficient data on which to base managerial, interpretive, and research decisions. The data would have to be gathered, converted into computer usable form, and integrated into a separate file for the Chaco site.

2. EQUIPMENT: An agreement was worked out whereby the Chaco Center would have access to a Data General Eclipse minicomputer housed in the Southwest Regional Office in Santa Fe and operated under the direction of the staff of the Branch of Indian Cultural Resources.

   In order to manipulate data (including graphic display), a number of equipment items were purchased. Table 1 summarizes information on this equipment, with date of purchase, cost, and justification.

   Various software packages have been acquired; these include both statistical and graphics data manipulation programs.

3. PERSONNEL: Jim Judge, the principal investigator on this project, was able to secure the assistance of Andrew Drager who had written the interactive program for the SJBRUS data base (Wait 1980); he was hired by the NPS to work half-time on this project. He provided the needed expertise in computer

TABLE 1. Computer Hardware Purchased by the Division of Cultural Research

ITEM	DATE OF PURCHASE	COST	JUSTIFICATION
Tektronix 4052 CRT terminal	August 1979	$11,850.00	Smart terminal needed to access, store and process data base and operate as stand-alone computer.
Tektronix 4663 interactive digital plotter	July 1980	11,900.00	Graphics display unit for producing maps of Chaco data.
Data General Dasher 6040 terminal printer	August 1980	2,650.00	Terminal to access data stored on other computer systems and print out computerized information, results, as well as input interactive statistical program requests.
Houston Complot copier	August 1979		Provides copies of information from screen of Tektronix CRT.
Tektronix 4952 Joystick	August 1980	375.00	Instrument allows precision control of cursor during manipulation of graphic displays on CRT screen.
T-Switch and cable	May 1980	215.00	Switch allows both Tektronix and Data General terminal to be attached to modem simultaneously and eliminates continuous rewiring.
Ven-tel Modem (300 baud)	August 1979		Allows telephone communication between Albuquerque and Santa Fe computer system.
Bell dedicated line and modem		*	Original modem not powerful enough to prevent serious line noises; therefore more sophisticated equipment needed.
50 MB disk drive	July 1980	5,200.00	Provides sufficient workspace on computer.

* Rental item

science, e.g., understanding of both the hardware and software requirements to implement the project goals in addition to his talents as a programmer until Fall 1982. Since that time, Stephanie Sonnleitner has devoted programming time to this project. In addition, F. Joan Mathien was hired half-time to coordinate the gathering of data and its evaluation with regard to Chaco archeological sites, environment, and pertinent management variables.

Accomplishments to Date

Much of the first year of this project was spent acquiring the necessary computer hardware and getting it to work properly, reviewing existing software packages and acquiring some of those that would be useful to the project, and outlining what additional data would be needed to implement the program. As with any pilot project, several snags had to be ironed out.

Once the basic equipment had been installed, it became apparent that telephone communication between the Division of Cultural Research and the computer in Santa Fe was less than desirable. (It was nearly impossible!) A considerable amount of time was spent trying to locate the source of the problem. Several modems and two years later, we now communicate with the computer after the installation of a dedicated line and a high-speed modem that eliminate line noises that, on certain occasions, were fatal during data manipulation.

Manipulation of Chacoan site data on the SJBRUS data base revealed that there were several coding inconsistencies among the variables recorded. This was anticipated to some extent since a number of people were involved during the initial coding phase of the SJBRUS data base in 1977. In addition, information for Chaco sites was taken from the original site survey forms. Continued research and analyses by the Chaco Center staff since the survey was completed in 1975 have led to refinement of existing data and addition of new information. Therefore, hard copies of the Chaco site files were obtained. These were reviewed by John Schelberg and corrected information was entered into the data base by Joan Mathien. While this updating did not include the addition of new variables to the data base, it did improve the accuracy of the Chaco site data since a single individual who had prior archeological experience on the survey crew and a single set of concepts (or definitions of variable attributes) reviewed the coding for each of the 2400 sites.

With regard to the collection of additional data for Chaco Canyon, initial efforts focused on variables that could best be recorded in the form of graphic overlays to the Chaco site survey point data. Therefore, the first step was to isolate the Chaco data from all other data in the SJBRUS file and read it into a separate program. Using the UTM coordinates (761580E, 4000800N for the northwest corner, and 245450E, 3984290N for the southeast

corner) through which all data are located on SJBRUS, a new file called PARKMAN was created by Drager. Modifications to the interactive program were also made by Drager after it was transferred to the PARKMAN file; these included the elimination of solid lines on the graphic display that represent 2km grids and replacement with small crosses where the grids intersect. (These grid marks need not be used in graphic displays.) Figure 1 shows the area included in the PARKMAN file, the total number of sites, and the present boundaries of Chaco Culture National Historical Park. A subroutine was written so that the user sitting at the computer terminal could choose to look at smaller areas of the Park by manipulation of the joystick which causes the cursor on the screen to move in any direction. Using the cursor to pinpoint locations, it is now possible to zoom in on subsections of the area originally chosen, to measure distances between points, and to obtain site numbers for individual points.

A series of maps were digitized by the Technology Applications Center of the University of New Mexico and tapes were provided. These include:

1. Map of the boundaries of Chaco Culture National Historical Park prepared by Mathien using 7.5' quads for Kin Klizhin, Pueblo Bonito, and Sargent Ranch on which Robert Powers had marked the new boundaries approved by the Ninety-Sixth Congress of the United States (PL 96-550, December 1980).
2. Vegetation map of Chaco Canyon National Monument prepared in 1974 by Loren Potter and Ed Kelley (1980) of the University of New Mexico Biology Department.
3. Soils map of Chaco Culture National Historical Park, taken from a soils map of San Juan County, New Mexico, prepared by the U. S. Department of Agriculture.
4. Erosional channels (arroyos/washes) visible on color transparencies taken by Koogle and Pouls (1973 at 1:6000) were analyzed, information mapped, and digitized. One constraint on this map was the lack of photography for the entire Park as these were flown prior to the Park boundary change.
5. Maps of historic and prehistoric roads, stairways, cairns, and visible and invisible recent historic structures prepared by Mathien using data from various sources.

These digitized maps for the new Park boundaries, soils, vegetation, roads, stairways, cairns, historic structures, and main washes in the Canyon have been incorporated into the PARKMAN file and are accessible for analytical purposes.

Some non-digitized data have also been collected but are not yet in the program. In conjuction with the preparation of the Cultural Resources Management Plan prepared by Steve Adams (1981), estimated stabilization costs, linear feet of wall space, 10-237 requests, and 10-238 primary program documents are available for all sites in the Canyon for which these variables are relevant.

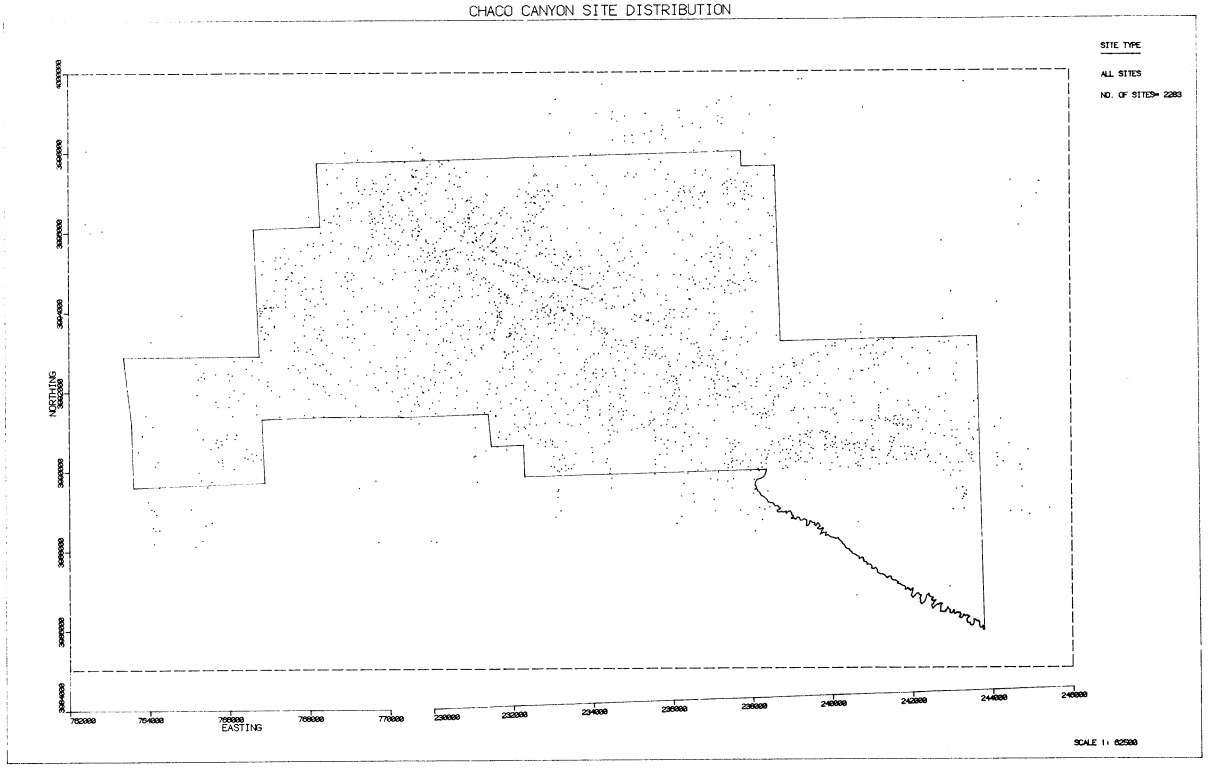


Figure 1. *The area included in the PARKMAN file, the total number of sites, and the present boundaries of Chaco Culture National Historical Park.*

Subroutines to incorporate these data need to be written, and the data need to be entered into the data base.

In conjuction with entry of data from Chaco into other computerized systems (List of Classified Structures, Southwest Archaeological Research Group, Laboratory of Anthropology) and the updating of variables entered into the SJBRUS file, an up-to-date list of all names and site numbers is being prepared. While it will not be finished until the various institutions return a list of site numbers assigned in their system, this aspect of data collection is well underway. The relevance of this is easily seen when an investigator asks for the data on Pueblo Bonito. There is no way this site can be accessed on PARKMAN under that name; it is coded as SJ 387. In addition, Pueblo Bonito has other acronyms such as LA 226, LCS 10287, Bc 253, Fisher's Mound 8 and 2, Jackson's Pueblo 6, SARG Nos. 10,393-10,399.

Similarly, independent rock art surveys have been conducted in Chaco and collection of information on who, when, and where additional data are stored is underway. A bibliography of stabilization reports on the various pueblo sites has also been obtained.

While none of these non-digitized variables have been incorporated into the PARKMAN file at this time, there are still a number of questions that can be answered by managers and researchers using the currently available data. Several examples follow.

1. Research application. Assuming the survey data accurately reflect the use of different soil zones through time it is possible to plot the distribution of sites by major time periods. Figures 2 and 3 were prepared using the PARKMAN file; only habitation sites during Basketmaker III and Pueblo III were plotted and soil zones superimposed. It is possible to observe differences in site distribution on these figures.

   Using this information an investigator could attempt to explain the patterning observed. Hayes (1981) pointed out that there are problems with Basketmaker III site data; he suspects there are numerous undiscovered sites on the mesas and the alluvial floodplain which were not found. He cites three reasons:

   a. Windblown sand can easily conceal sites with low profiles.

   b. Later construction (Pueblo I-III) often covers evidence of earlier pithouses.

   c. There has been considerable fill in the floodplain area (e.g., he estimated 3.9 feet in 500 years between AD 500-1000). Evidence of Basketmaker III sites in the cutbanks of arroyos indicates there are probably numerous buried sites.

   However, Hayes pointed out that this last problem also affected Pueblo I sites. Therefore, the researcher could pursue the question further.

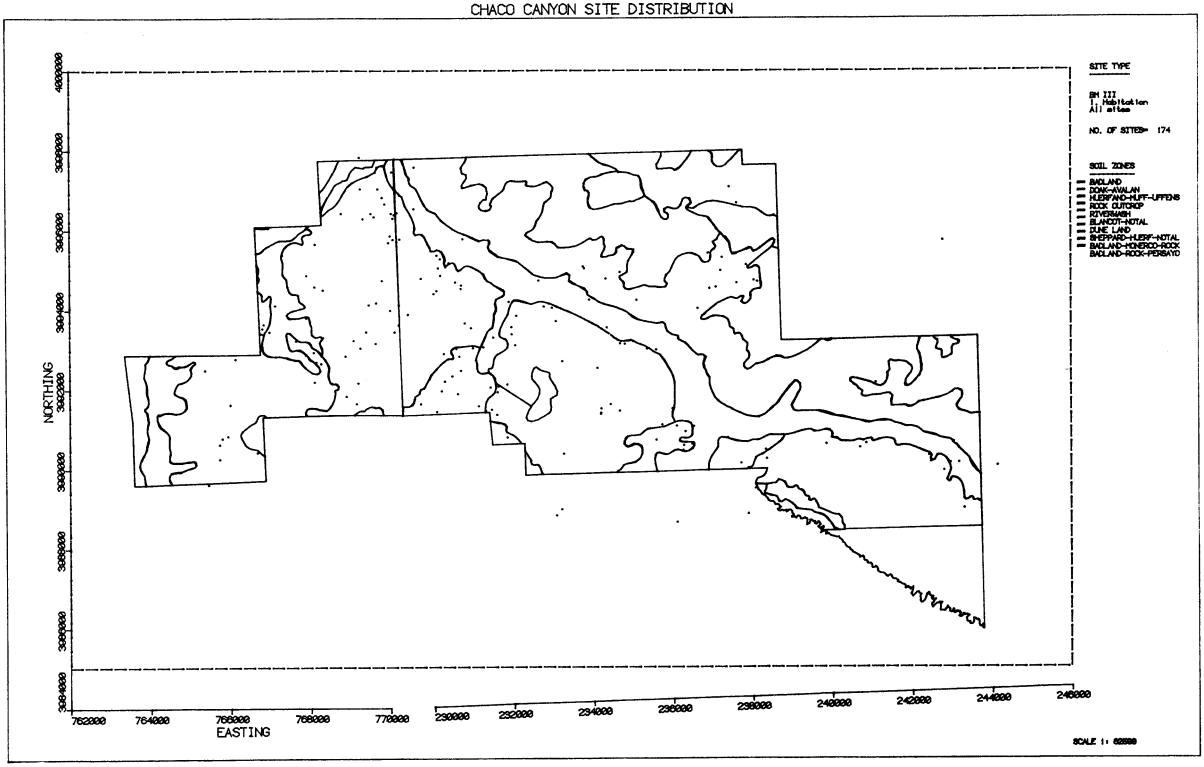


Figure 2. *Basketmaker III habitation sites with soil zones superimposed.*

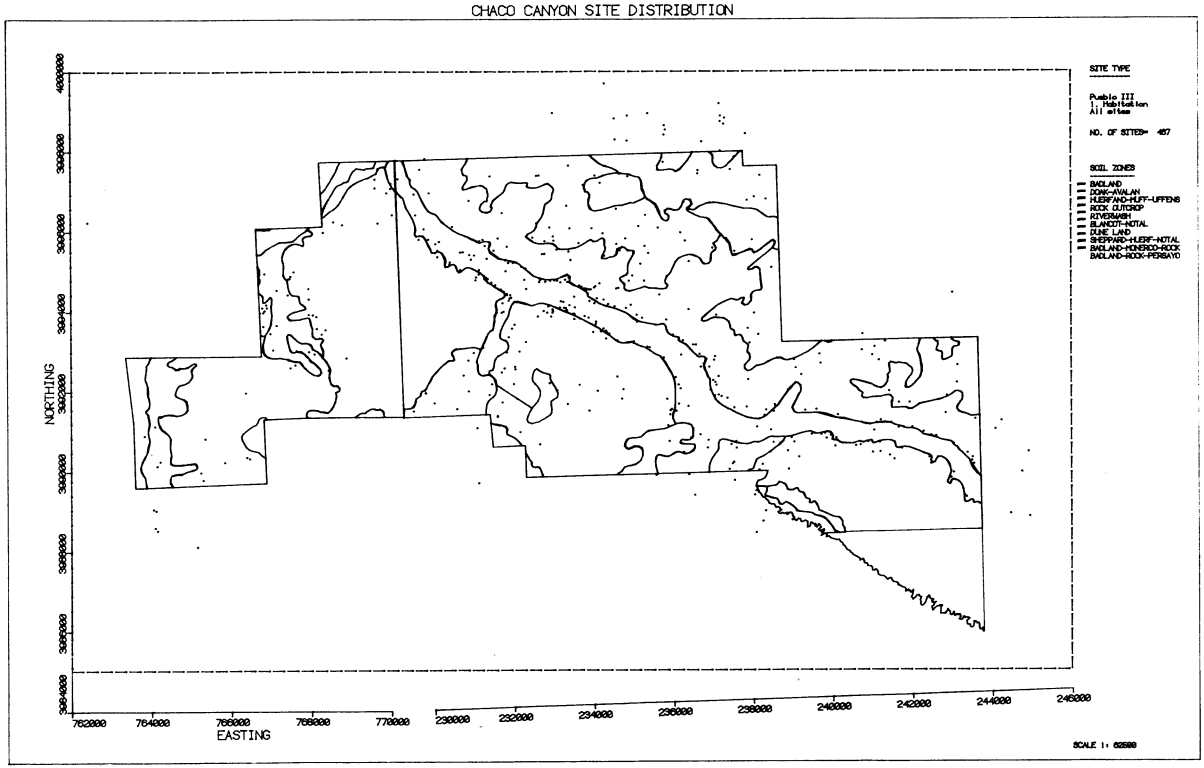


Figure 3. *Pueblo III habitation sites with soil zones superimposed.*

2. Interpretation. Assuming that reports on excavated sites are available and that management wanted to update the visitor interpretation program by including more information on additional sites, it is possible to obtain a list of excavated sites. Table 2 was prepared from a list generated from PARKMAN. Figure 4 is a map locating excavated sites in relation to currently used roads. The manager could then pull out information on these sites and select ones which would be useful in the interpretation program; other variables could also be considered.

TABLE 2. List of Excavated Sites.

29SJ 347	29SJ 398	29SJ 821	29SJ 1360
417	397	1947	625
415	400	823	629
866	395	1928	627
423	396	126	392
1809	827	1118	633
1054	1936	116	391
838	1731	753	299
368	387	750	1664
1764	1935	724	1987
1156	739	1678	240
1746	395	721	515
1769	824	1976	540
1200	738	1925	589
1238	1883	1924	1629
386	389	1922	1613
399	1980	1912	1659
	1930		2385

3. Preservation. Assuming that sites might be disturbed by erosion after a heavy downpour and that stabilization would prevent damage to structures, it is possible to obtain a map indicating their locations with regard to the main entrenched wash, as well as print out a list of site numbers and more detailed information on each site. Figure 5 shows all Pueblo II single component sites in relationship to the main channel. Figure 6 is an example of the information available on one of these sites. Vegetation and soils maps, as well as plots of smaller arroyos that flow into the Chaco Wash can also be superimposed over site areas, and the cultural resource manager can determine which of these sites are highly significant and need either some type of protection and/or mitigation. The fewer number of sites in a particular soil zone may raise their level of significance. (For a discussion of site significance, see below.)

Additional questions can be formulated and, hopefully answered once the PARKMAN data base has been completed. At present, there is much to be added in order to achieve our goals.

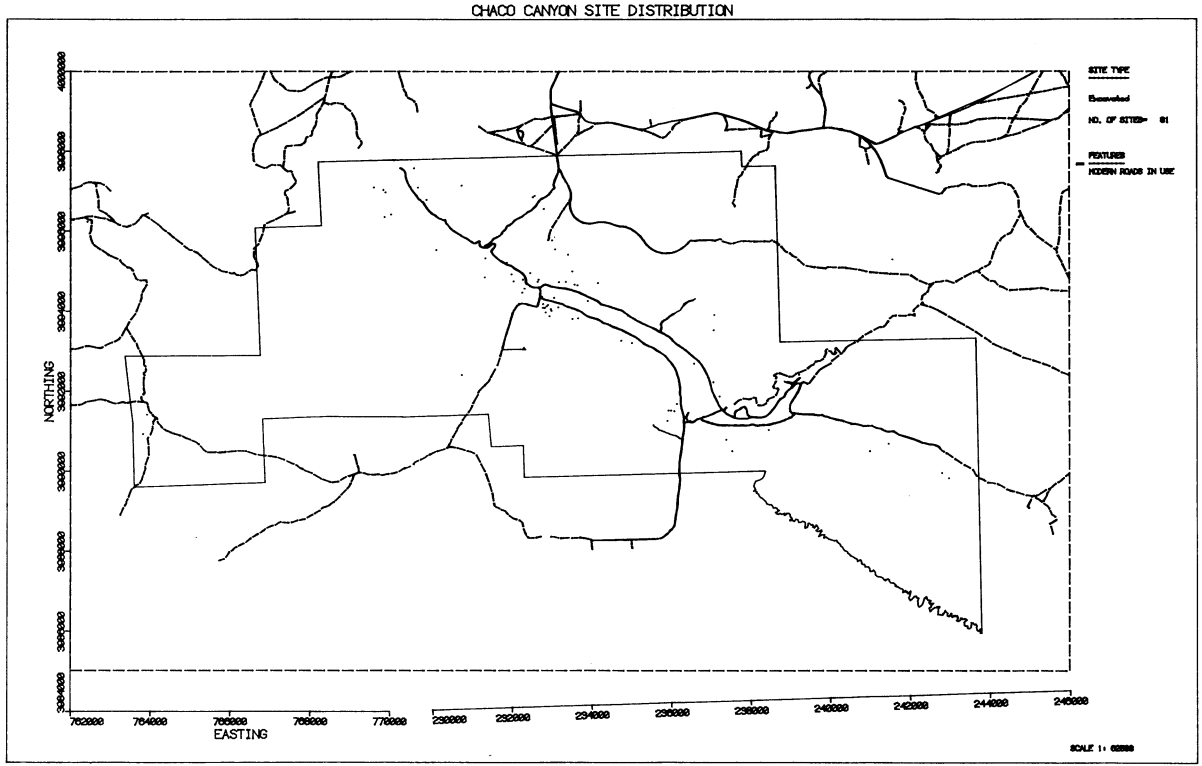


Figure 4. *Location of excavated sites in relation to currently used roads, Chaco Culture National Historical Park.*

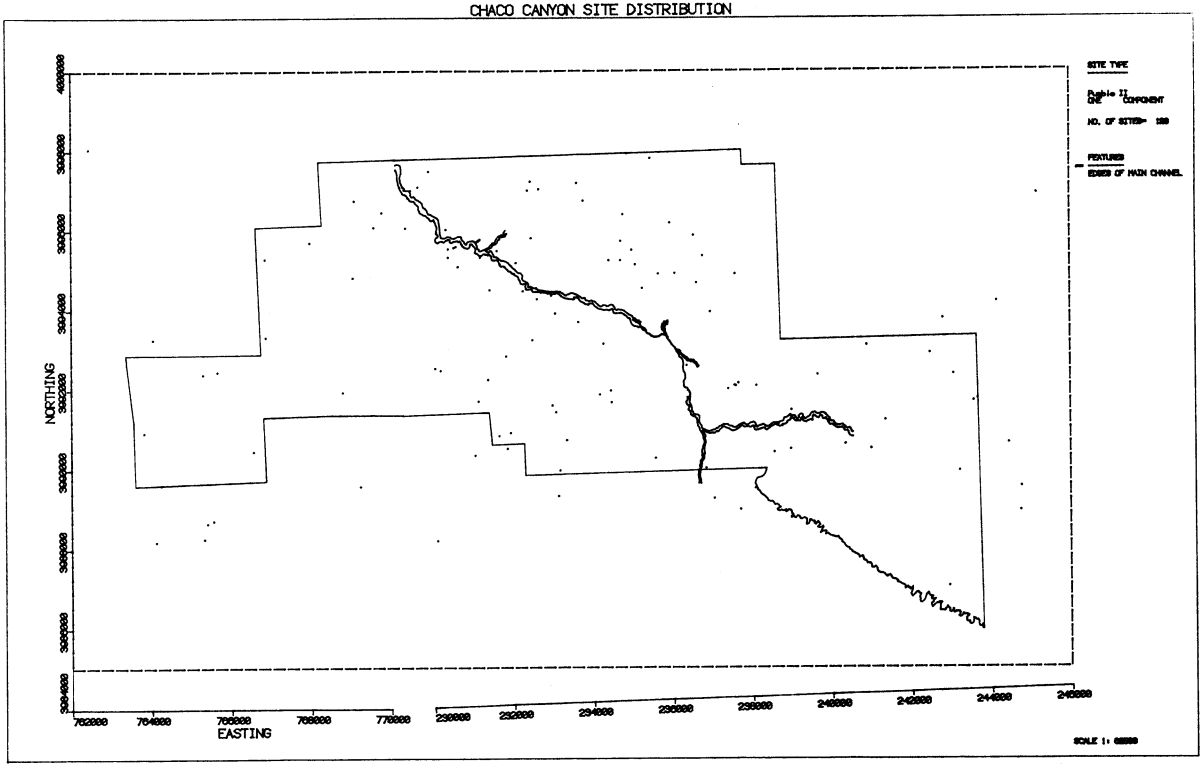
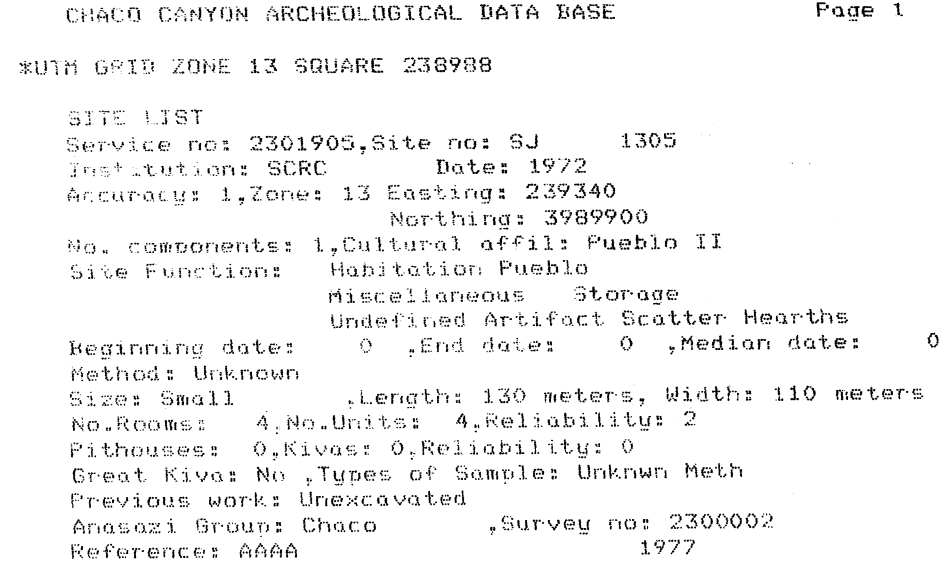


Figure 5. *Pueblo II single component sites in relation to the main channel, Chaco Culture National Historical Park.*



```
CHACO CANYON ARCHEOLOGICAL DATA BASE                    Page 1

XUTM GRID ZONE 13 SQUARE 238988

   SITE LIST
   Service no: 2301905,Site no: SJ      1305
   Institution: SCRC          Date: 1972
   Accuracy: 1,Zone: 13 Easting: 239340
                        Northing: 3989900
   No. components: 1,Cultural affil: Pueblo II
   Site Function:    Habitation Pueblo
                     Miscellaneous    Storage
                     Undefined Artifact Scatter Hearths
   Beginning date:     0   ,End date:     0   ,Median date:     0
   Method: Unknown
   Size: Small          ,Length: 130 meters, Width: 110 meters
   No.Rooms:    4,No.Units:   4,Reliability: 2
   Pithouses:   0,Kivas: 0,Reliability: 0
   Great Kiva: No ,Types of Sample: Unknwn Meth
   Previous work: Unexcavated
   Anasazi Group: Chaco          ,Survey no: 2300002
   Reference: AAAA                              1977
```

Figure 6. *Example of information available on one archeological site in Chaco Canyon.*

Additional Work to be Carried Out

Hopefully, the following information will be added to our PARKMAN file:

1. Digitized Data:
   a. Landforms/geomorphology. Work carried out by the Division of Remote Sensing has provided a geomorphological map of Chaco Canyon National Monument (Ebert and Gutierrez 1981).
   b. Agriculture/water control features. William B. Gillespie has been collecting data on various environmental parameters in the Canyon and evaluating these with regard to prehistoric habitation of the area. When his studies are complete, a map of prehistoric water control features and agricultural lands should be available. In addition, aerial photographs and other documents will provide data on historic water control features as well as Navajo and modern field use (e.g., Judd 1954, Toll et al. 1979).
2. Other Variables. Either additions to or refinement of variables already on the data base are listed here. They include:
   a. Site visibility (e.g., standing wall heights, type of masonry, amount of rubble, sherds, lithics, etc.),
   b. Site dating (list all dates for each method),
   c. Site feature size (list each structure individually),
   d. Site condition, including slope, piping, air quality, etc.
   e. Non-visible site features, such as former Park Service buildings,
   f. Survey artifacts collected, e.g., sherds and lithics, or other, and where housed,
   g. Site excavation dates, including name of investigator, his institutional affiliation, and where notes are stored,
   h. Other disturbances to site,
   i. Stabilization history,
   j. Preservation status,
   k. Site interpretation,
   l. Historic Structures Report, and
   m. References (detailed bibliographic references for each site including unpublished manuscripts, field notes, etc.).

In addition to these new variables, a formula for the determination of site significance devised by Judge will be incorporated into the program once the necessary variables are available on the PARKMAN program. As previously stated (Judge 1980), the issue of site significance must include considerations based on an enduring approach and not simply current research interests no matter how broadly based they may be. He has proposed that

site redundancy within the physical environment (e.g., combination of land form, soils, vegetation) and then stratification by chronological and functional units may allow this determination. "In other words, within each ecological zone, the significance of a specific site type (e.g., P-2 habitation sites) is simply inversely related to its redundance. A ranking of all sites can easily be established based on the relative frequencies of a given site type to all sites within the zone, and sites can be managed accordingly" (Judge 1980).

With passage of PL 96-550, a number (33) of outlying Chaco sites were designated as Archeological Protection Sites. Since these are an integral part of the Chaco Phenomenon and will be managed under a Joint Management Plan currently under review, data on these areas will be gathered and entered into the data base management system.

Evaluation of the Program

At present it is too early to evaluate the success of this project, since much of the information we hope to utilize is still not gathered and incorporated into the PARKMAN file. However, judging from the questions answered by the Chaco Center staff using information currently coded, it has increased efficiency when certain types of questions are asked. For example, it takes about 5-10 minutes to find out how many Pueblo II habitation sites with 25 or more rooms were located during survey, print out the site numbers and other information in the file, and obtain a map of the Park locating these sites by UTM coordinates. It would take many hours to simply read through the 2400 site files and cull this information, let alone map it without the computer. It is anticipated that when all additional variables are entered into the program, a manager who has little background in either archeology or computers will be able to interact with the data base to answer a multitude of questions relating to conservation, research or interpretive problems with a minimal amount of time and effort.

At this time, data gathered during the ongoing survey at Wupatki National Monument, Arizona, and at some other National Parks in the Southwest Region, are being entered into their own PARKMAN programs. The Division of Cultural Research intends to use PARKMAN during its future studies at Bandelier National Monument. In the meantime, Stephanie Sonnleitner is writing a universal PARKMAN program that will allow any park manager to modify several variable labels as needed to adapt the program to a specific area. It will handle natural resource as well as cultural resource data.

References

n.a. (Wait, Walter.) 1977. Guidelines for the San Juan Basin Archeological Data Base Project. Mark Sense Site Forms and Survey Forms. MS on file with the Division of Cultural Research, Albuquerque.

n.a. (Wait, Walter.) 1980. An Informal Guide to the National Park Service Branch of Indian Cultural Resources' San Juan Basin Archeological Data Base and How to Use It. MS on file with the Division of Cultural Research, Albuquerque.

n.a. (Adams, Stephen E., compiler and editor.) 1981. Chaco Culture National Historical Park, GMP, Cultural Resources Management Component, Proposed Final. MS on file with the Division of Cultural Research, Albuquerque.

Ebert, James I., and Alberto A. Gutierrez. 1981. Remote Sensing of Geomorphological Factors Affecting the Visibility of Archeological Material. Technical Paper, American Society for Photogrammetry, pp. 226-236, Falls Church, VA.

Hayes, Alden C. 1981. A Survey of Chaco Canyon Archeology. IN Archeological Surveys of Chaco Canyon, New Mexico, by A. C. Hayes, D. M. Brugge, and W. J. Judge, pp. 1-68. Publications in Archeology 17A, Chaco Canyon Studies. National Park Service, Washington, DC.

Hayes, Alden C., David M. Brugge, and W. James Judge. 1981. Archeological Surveys of Chaco Canyon, New Mexico. Publications in Archeology 17A, Chaco Canyon Studies. National Park Service, Washington, DC.

Judd, Neil M. 1954. The Material Culture of Pueblo Bonito. Smithsonian Miscellaneous Collections 124.

Judge, W. James. 1980. Minimal Impact Archeology: A Plea for a Formalized Ethic. Proceedings, American Society for Conservation Archaeology 6:1-9.

Potter, Loren D., and N. E. Kelley. 1980. Aerial Photointerpretation of Vegetation of Chaco Canyon National Monument. IN Cultural Resources Remote Sensing, edited by Thomas R. Lyons and Frances Joan Mathien, pp. 87-104. Cultural Resources Management Division, National Park Service, Washington, DC.

Toll, H. Walcott, Mollie Struever, Marcia L. Truell, and William B. Gillespie. 1979. Experimental Corn Plots in Chaco Canyon: The Life and Hard Times of *Zea mays* L. MS on file with the Division of Cultural Research, Albuquerque.

United States Department of the Interior. 1980. Uranium Development in the San Juan Basin Region. A Report on Environmental Issues. Final Edition. Prepared by San Juan Basin Regional Uranium Study, Office of Trust Responsibilities, Bureau of Indian Affairs, Lead Agency. Albuquerque.

Frances Joan Mathien and *W. James Judge*, Division of Cultural Research, PO Box 26176, Albuquerque, NM 87125.

This report is also inventoried as Contribution No. 45 of the Chaco Center, National Park Service and University of New Mexico, for purposes of bibliographic control of research relating to Chaco Canyon.