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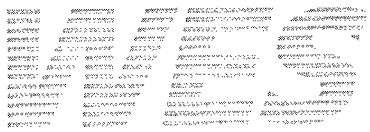
A GIS Pilot Study for Euro-American Cultural Resources: Fort Leonard Wood, Missouri

by W. J. Bennett, Jr., William Isenberger, Jeffrey Blakeley, John Northrip, Archeological Assessments, Inc.
Robert A. Dunn, Clay Mathers, Frederick L. Briuer, WES



Prepared for U.S. Army Engineer Center and Fort Leonard Wood

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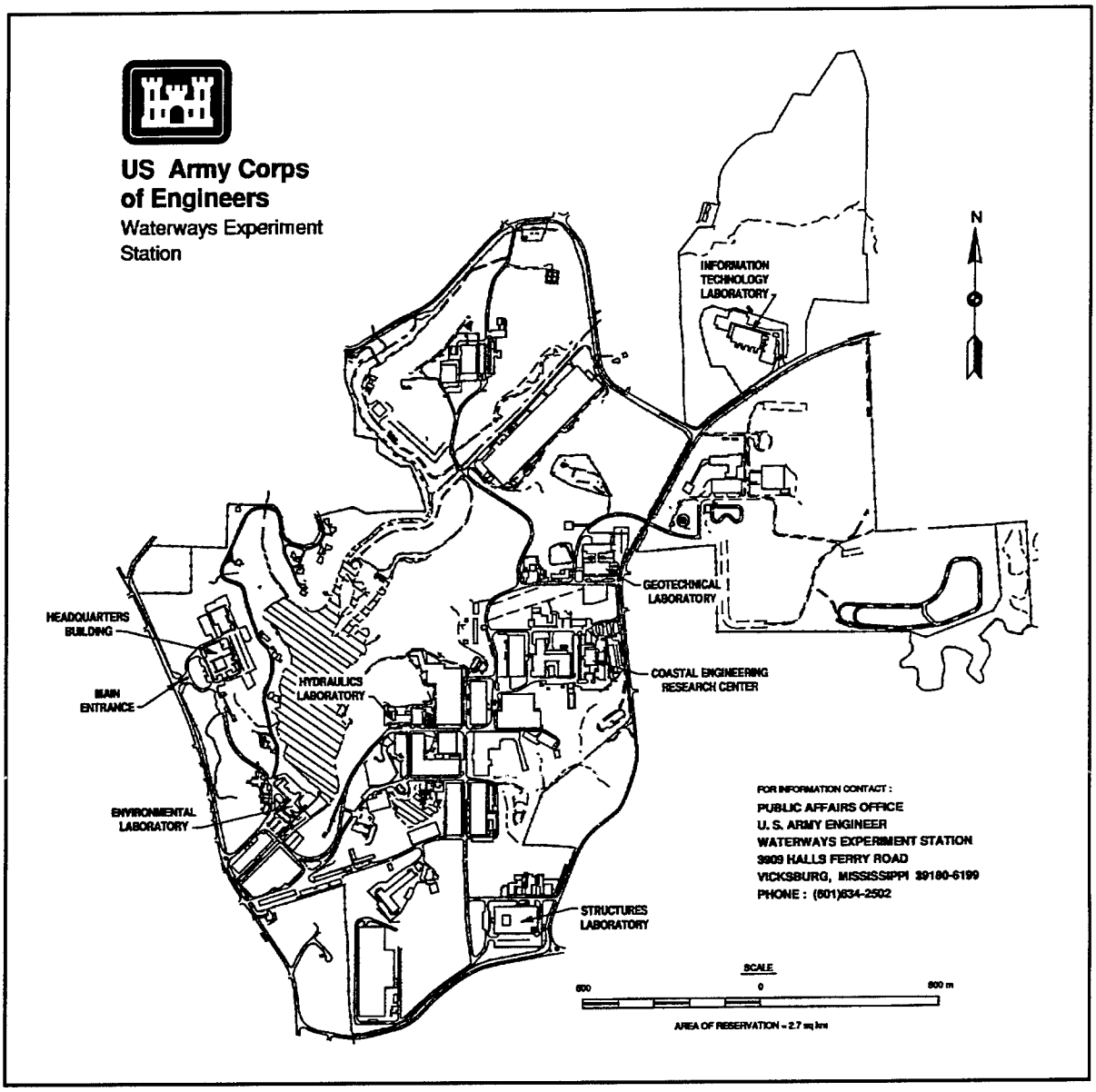

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PREFACE

The U.S. Army Engineer Waterways Experiment Station (WES) was authorized to conduct this investigation by the U.S. Army Engineer Center and Fort Leonard Wood on DD Form 448, MIPR No. 5EWES0018D, dated 9 March 1995. Dr. Richard Edging, Fort Leonard Wood Cultural Resources Manager, was the Program Manager for this study. The WES Principal Investigator was Mr. Robert A. Dunn, Resource Analysis Branch (RAB), Environmental Laboratory (EL), WES. Dr. Clay Mathers, National Research Council Post-Doctoral Fellow at WES, reviewed both the report and the GIS database prepared by Archeological Assessments, Inc. His research is part of a WES work unit that has been funded by Headquarters, U.S. Army Corps of Engineers, as part of the Evaluation of Environmental Investments Research Program. Technical review of the GIS database was carried out by Mr. Jerry Ballard, Environmental Characterization Branch, EL.

Data acquisition, GIS database development, and report preparation was undertaken by Archeological Assessments, Inc. (AAI), of Nashville, AR, under BAA Contract DACA39-95-K-0044. Dr. W. J. Bennett, Jr., served as the AAI Principal Investigator.

Part I of this report entitled "Data Base Development" was prepared by Dr. Bennett, Mr. William Isenberger, Dr. Jeffrey Blakeley, and Mr. John Northrip of AAI. Part II entitled "The Use of GIS in Managing Cultural Resources and Evaluating Archaeological Significance" was prepared by Mr. Dunn, Dr. Mathers, and Dr. Frederick L. Briuer, RAB.

This investigation was performed under the direct supervision at WES of Mr. Roger Hamilton, Chief, RAB, and Dr. Robert M. Engler, Chief, Natural Resources Division, EL, and under the general supervision of Dr. John W. Keeley, Director, EL.

At the time of the publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

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FOREWORD

The use of geographical information systems for evaluating historic sites at Fort Leonard Wood (FLW) is a goal that has obvious overlap with the objectives of one of our current research efforts at the Center for Cultural Site Preservation Technology (Waterways Experiment Station (WES)). Direct allotted research funds provided by Headquarters, U.S. Army Corps of Engineers, has provided the support for a work unit at WES entitled *Objective Evaluation of Cultural Resources,* which has as its principal objective the development of more explicit and efficient criteria for evaluating cultural resource significance. This research at WES forms part of a larger interdisciplinary effort known as the *Evaluation of Environmental Investments Research Program* (EEIRP).

Recognition of the common research and management goals at FLW and WES has presented an excellent opportunity to share technical expertise and resources, and in the process, has generated mutually reciprocal benefits for both projects. On the one hand, the results of the EEIRP research at WES have direct application to the future direction of cultural resource management at Fort Leonard Wood (in the form of pragmatic recommendations for analysis and management). On the other hand, efforts to formulate a significance evaluation strategy for this installation has made it possible to refine many of the ideas and approaches developed in the course of a more broadly based WES research project. By systematically exploiting this GIS database, as well as the concepts and assessment strategies outlined in this report, future significance evaluations at FLW will make a major contribution towards our understanding of historic resources in the Ozarks *and* towards more effective ways of managing them.

The work illustrated here also underlines the intellectual and financial advantages of collaborative research. Effective partnering and interdisciplinary cooperation clearly have a central role to play in ensuring the successful creation and maintenance of GIS databases and automated resource management tools. Given the costs associated with many significance evaluation projects, for example, it is increasingly important for archaeologists, resource managers, and others to find resourceful ways of integrating their work with colleagues, institutions, and agencies working in areas of mutual interest. Furthermore, networking of this type will make it possible to implement management strategies for cultural resources that are more flexible, comprehensive, and cost-effective.

Frederick L. Briuer, Ph.D.
EL, WES

PART 1 DATA BASE DEVELOPMENT

Background and Objectives

Army Regulation 420-40 requires that all Army installations develop an Historic Preservation Plan (HPP) to insure that mission related activities do not result in unmitigated adverse impacts to significant cultural resources, designated in this regulation as Historic Properties. An essential part of such an HPP and an essential component for compliance with the 1966 National Historic Preservation Act (P. L. 89-0665, as amended) is the development of an inventory of the cultural resources located on lands under federal management. Typically at DoD installations and facilities constructed during the 20th century, a significant portion of these cultural resources are related to the Euro-American occupation of the area prior to installation construction. The identification, evaluation, management, and public interpretation of these cultural resources are now major concerns for all installations.

Unlike prehistoric sites created prior to Euro-American settlement, there exists a large amount of documentary, photographic, cartographic, and oral historical information associated with Euro-American archeological sites. Since these sources of information must be considered in the evaluation and management of such properties, it is critical that standardized methods of identifying and organizing these data sources be developed. This is the on-going research effort of the Waterways Experiment Station (WES) fully described in Part II.

The objective of this pilot study was to demonstrate how a spatial database management system (Geographic Information System/GIS) could be used to provide a framework for the acquisition, assessment, and manipulation of historic period data at the Fort Leonard Wood Army Garrison, Missouri (FLW). The specific goals of this effort were to demonstrate how such a system could:

(1) *combine information derived from archeological investigations, documentary research, and oral historical interviews with historic cartographic and photographic data into a spatially- oriented database*;

(2) *be integrated with other installation GIS programs*;

(3) *provide managers with an essential tool for the development of criteria for the identification, evaluation, and management of this portion of the installation's cultural resource inventory; and,*

and (4) *assist in the creation of a plan for public presentation to increase local, regional, and national awareness and involvement related to these resources.*

Data base development was undertaken by Archeological Assessments, Inc. (AAI), Nashville, Arkansas. Project oversight was provided by WES as part of its on-going research on GIS databases and the evaluation of archeological site significance. The funding for this

project was provided by the U.S. Army Engineer Center and Fort Leonard Wood (ATZT-DPW-EE).

Historic Property Definition

AR 420-40 defines a Historic Property as

> ***"Any prehistoric or historic building, district, site, structure, or object that is included in, that is eligible for inclusion in, or that may be eligible for inclusion in the NRHP* (National Register of Historic Places, ed.). *The term includes artifacts and remains that are related to such a building, district, site, structure, or object."***

The criteria to be used for determining eligibility for inclusion in the NRHP are stated in 36 CFR.60 as follows:

"The quality of significance in American history, architecture, archeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or

B. that are associated with the lives of persons significant in our past; or

C. that embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. that have yielded, or may be likely to yield, information important in prehistory or history."

Of the properties already recorded and expected to be present on FLW all but a very few must be evaluated using Criterion D; that is, they must be assessed on the basis of their information potential as emphasized in Smith (1993: 110).

> ***"It has been argued in Chapter I that the value of archaeological resources is measured primarily, perhaps wholly, in their potential or ability to reveal information about the past. Therefore, in order for cultural resource managers at Fort Leonard Wood to properly evaluate installation historic sites in terms of their eligibility for listing in the National Register, and then to manage these resources in compliance with the mandates of federal and U. S. Army regulations, historic archaeological resources must be evaluated within the context of their history and the research that can reveal their past."***

In order for an installation to carry out the objective of responsible management for its Historic Properties, AR 420-40 mandates that all installations will complete an inventory of its cultural resources and that, among other things (AR420-40.2-11),

> *"The inventory will --*
>
> *a. Contain identification of a property sufficient to evaluate its historic significance, per paragraph 2-12."*

Paragraph 2-12 (Evaluation standards) lists ten items. The first five are of particular importance to our present concerns.

> *"2-12. Evaluation standards*
>
> *The evaluation will --*
>
> *a. Define the classes of historic properties on the installation based on the characteristics of the inventoried properties.*
>
> *b. Describe the essential characteristics of each class.*
>
> *c. Assign the inventoried properties to their appropriate class.*
>
> *d. Interpret the National Register criteria for each class to determine the significant classes.*
>
> *e. Evaluate the members of each class according to the degree to which they exemplify the characteristics of the class."*

It is these procedures which provide the framework for site assessment.

Historic Contexts and Property Types

In applying the criteria for eligibility for inclusion on the NRHP the following statement from National Register Bulletin 16, "Guidelines for Completing National Register of Historic Places Forms" [U. S. Department of the Interior, National Park Service, Interagency Resources Division 1986] (NAB 16: 6) is particularly helpful.

> *"The Secretary of the Interior's standards state three distinct requirements for properties listed in the National Register of Historic Places. First of all, properties must possess significance. Second, the significance must satisfy at least one of the National Register criteria. And finally, significance must be derived from an understanding of historic context. The standards recognize that all that possesses age is not necessarily significant, and what is significant can only be determined in relationship to the historic development from which it emerged and in relationship to a group of similarly associated properties."*

In applying this to FLW the final judgment regarding which portions of the archeological record are to be considered significant, that is, as Historic Properties, must be made by a process which proceeds from the general to the particular. In this process, the general is understood as an Historic Context which is defined in NAB 16 in the following way.

> ***"A historic context is a body of information about historic properties organized by theme, place, and time. It is the organization of information about our prehistory and history according to the stages of development occurring at various times and places."*** (NAB 16: 7)

Bulletin 16 further describes Historic Contexts by stating:

> ***"Historic contexts may be developed at a variety of geographical levels or "scales." The geographic area selected may relate to a pattern of historic development of political division, or it may relate to the present day division of planning jurisdictions. All of the historic contexts for a geographical area, whether a state, land management area, or locality, together make up the history or prehistory of the area broken down into a series of historically meaningful segments, each segment being a single historic context. Grouped together as a set, the historic contexts for a specific community form a comprehensive summary of all aspects of the community's history and prehistory."*** (NAB 16: 7-8)

Thus the Historic Context provides the general frame of reference for the assessment of particular properties. The bridge between historic contexts and particular properties is provided by the concept of Property Type.

> ***"Historic context is linked with tangible historic resources through the concept of property type. A property type is a grouping of individual properties based on a set of shared physical or associative characteristics. Physical characteristics may relate to structural forms, architectural styles, building materials, or site type. Associative characteristics may relate to the nature of associated events or activities, to associations with a specific individual or group of individuals, or to the category of information about which a property may yield information."*** (NAB 16: 8)

Euro-American Historic Contexts and Property Types

Smith (1993) has effectively drawn together a number of previous studies at FLW and developed an outline regional history, a general Historic Context, and suggestions regarding appropriate property types. This has been done within what is called "landscape archaeology" (Smith 1993: 8-9; cf. Adams 1990).

> ***"Landscape archaeology approaches the human occupation of space on both a multiscalar and diachronic level; integrating social variables with land-human relationships."*** (Smith 1993: 8-9)

"The landscape approach is especially useful in providing a theoretical framework for resource management within a fixed area like Fort Leonard Wood, since landscapes are also closely related to historic contexts." *(Smith 1993: 9)*

Smith (1993) develops this theme through a description of three landscapes.

"The landscapes developed for Fort Leonard Wood will describe the interactions between the people and the land and attempt to reconstruct a sense of place in time and space. The developments and changes in these landscapes will identify historic themes. Each landscape will also provide an expectation of site types, their pattern on the landscape, and their physical characteristics." *(Smith 1993: 9)*

Smith goes on to define three landscapes for the FLW region under the Chapter Headings of "Initial Occupation and Settlement To 1866," "Farming and Tie-Hacking: The Landscape from 1867 to 1910," and "The Landscape Exhausted: 1910 to 1940."

At the conclusion of these detailed descriptions, Smith offers a summary within which he outlines what he believes to be an appropriate Historic Context and provides suggestions regarding specific property types.

"The single most encompassing and unifying theme defining the people, culture, ideology, and landscape of southern Pulaski County is the cultural tradition of the Upland (sometimes referred to as the upper, upcountry, or along the Atlantic-back country) South. It is argued herein that the culture of this particular region is a local derivation or adaptation of Upland South culture within the greater northern Ozarks." *(Smith 1993: 113)*

"In summary, the people who settled southern Pulaski County brought with them what is called an Upland South cultural tradition. Since initial settlement, this cultural tradition has developed and been modified to meet local historic and environmental conditions. The succeeding discussion details various characteristics that make-up the Upland South cultural tradition and the modifications seen in southern Pulaski County. The patterns and characteristics described below are offered as a model or general hypothesis for testing against the actual physical (archaeological) resources found at Fort Leonard Wood." *(Smith 1993: 115)*

Within this context Smith discusses a series of issues or themes including Settlement Patterns, Economic Patterns, Upland South Ozark Agricultural Model, Social and Political Patterns (Smith 1993: 116-128) and offers a number of specific examples of Site Classes and Types.

"The archaeological manifestations of this historic context are primarily farms, homesteads, small service centers, and associated activity areas like trash

dumps. Table 5.1 lists the expected types of pre-installation historic archaeological sites to be found at Fort Leonard Wood, along with their date range, hypothesized visibility on the landscape, visibility as a particular site type, and sensitivity to human impact...It is expected that this table will be refined, modified, or even rejected based on future work." *(Smith 1993: 128)*

The following is a modified version of Smith (1993 Table 5.1: Classes and Types of Archaeological Sites in Fort Leonard Wood).

Table 1: Site Class/Types (after Smith 1993)

Agricultural Sites	*Community Service Centers*	*Special Activity*	*Transportation*
Hunter-Squatter	*Mills*	*CCC camps*	*Bridges*
Subsistence	*General Store/Post*	*Tie-hacking*	*Ferries/Fords*
Pioneer	*Office*	*Slides*	*Roads*
General	*Schools*	*Civil War*	*Railroad Tunnel*
Specialized	*Churches*	*Outlaw Camps*	
Share-tenant	*Cemeteries*	*Stills*	
Renter	*Hamlets, Villages*	*Portable Sawmills*	
Rural Resident		*Trash Deposits*	

Smith's discussion concludes with a listing of Historic Themes grouped under the heading of Historic Themes: Ozark Life and Landscape, an Upland South Derivation which he suggests are integral to the Historic Context and Property Types defined and suggests a series of research questions or emphases appropriate to each (see Table 11 in Part II).

These themes and their associated emphases and questions currently constitute the research framework for the location, evaluation, and management of Euro-American properties at FLW; that is, the context within which a property's ability to provide important information is to be assessed.

This GIS pilot study was undertaken to provide assistance in this effort through the creation of a link between the archeological record at FLW with those other sources of information existing in the documentary, cartographic, photographic, and oral historical record which will be needed to carry out the type of investigations and assessments envisioned by Smith (1993: 135) when he proposed:

"...that future management and research should take place in a multidisciplinary framework, sometimes called ethnoarchaeology, but essentially

meaning the incorporation of the techniques and theories of archaeology, oral history, and history into a holistic approach to discovery of the past .... At Fort Leonard Wood, the discipline of cultural geography is also an extremely useful approach in examining the past. All of these disciplines can offer a more complete look at the history and culture of the area, which today is represented mostly by the archaeological resources."

Summary of Investigations

Activities undertaken during the initial phase of this project included:

(1) A pre-work conference including AAI, FLW, and WES personnel on 17 May 1995. This meeting focused primarily on issues of hardware and software to be used by the installation. It was attended by Robert Dunn and Clay Mathers (WES), John Northrip and William Isenberger (AAI), and Richard Edging and Lester Trigg (FLW). At that time it was determined that the installation would be implementing a GIS system associated with the Microstation program;

(2) A literature review of existing regional, local, and installation-related literature and studies related to the historic period settlement and use of the area;

(3) Archival research related to: (a) primary land ownership documents including the search of General Land Office (GLO) Documents, State Tract Records, Title Abstracts, Tax Records, and other sources; (b) an analysis of available historic cartographic data including GLO maps, county atlases, highway maps, topographic maps, and soils maps; and, (c) a review of available pre-installation aerial photographs;

(4) Oral historic research using video capture techniques to identify major sources of local oral history and to enhance the public awareness and appreciation of these resources. This portion of the project was coupled with an open-house and school reunion hosted by FLW to mark the opening (re-opening) of the Rolling Heath School House. As a part of this event participation was solicited from former residents of the area, as well as from area schools, in the gathering of data related to Euro-American settlement of the area. The opportunity to participate in this investigation was the focus of two days of public demonstration during 18, 19 May 1995 at the Rolling Heath School House, the oldest surviving structure on Fort Leonard Wood.

The following is a press release prepared for the Rolling Heath Open House held on Wednesday, 18 May 1995:

"May 14-20 1995 is National Historic Preservation Week, and activities throughout the DoD are being sponsored by the National Trust for Historic Preservation in partnership with the Department of Defense Legacy Resource Management Program and the National Park Service. The theme for 1995 is

"Real People, Real Places, Real History!" As part of the Preservation Week activities at Fort Leonard Wood a public open house will be held at the Rolling Heath School on Wednesday, May 18th, 1995, from 10am-4pm. Constructed in 1912, this is the oldest building on Fort Leonard Wood and has recently been restored to serve as a meeting and interpretive center. As part of the activities at the open house John Northrip of Archeological Assessments, Inc., will be demonstrating image and information gathering techniques currently being used by AAI to build a more comprehensive context for the historic cultural resources being managed by the Environment, Energy, and Natural Resources Division at Fort Leonard Wood. Mr. Northrip will be using video and computer graphics to record information available from local sources, and will be working with students from the Waynesville public schools to develop a program designed to locate and record privately held documentary, pictorial, and oral historical sources of local history. If you have any information about the Rolling Heath School, the history of the Fort Leonard area in general, or an interest in how new information technologies can provide access to the past, please plan on being at the Rolling Heath School on May 18th. John Northrip AAI 501-785-053."

During this event at Ft. Leonard Wood, students and teachers from the Waynesville Public Schools were able to tour the facility and see demonstrations of the tools and techniques used by AAI to gather information of an area's past from privately held document and photographic collections, as well as recording information from the former residents of the area through video-taped oral histories. John Northrip of AAI demonstrated the integrated use of video recording, digital image acquisition and interpretation, spatial modeling, image rendering, and the GIS developed for the Fort Chaffee Military Garrison. After seeing the demonstration, students from the Waynesville Public School LEAP program were able to work with video frame grabs and scanned aerial photographs. Terry Primus, sponsor of LEAP, expressed a strong interest in the possibility of involving the students in any future public research conducted as part of the FLW Historic Preservation Program.

On Thursday, May 19, the Rolling Heath School House was the site of a school reunion, and approximately 35 former students, friends, and family members were able to participate in the recording of information about the past of the school and surrounding area. Photographs were scanned and printed for participants, as well as being added to the image database for the FLW GIS. Several people expressed an interest in participating in further research, and indicated the existence of substantial private collections of photographs and documents.

(5) Analysis of previously recorded archeological data including state and installation site files and records;

(6) The creation of GIS coverages referenced to the USGS 7.5 minute quadrangle public land survey system (PLSS) depicting:

(a) the initial private acquisition of all property now managed by the installation;

(b) the private ownership of all installation lands at the time the land was acquired for the installation;

(c) elements of the built environment visible on aerial photography acquired during the late 1930s (pre-installation); and,

(d) elements of the built environment and property ownership as represented on other historic cartographic sources, including the General Land Office Maps, an atlas of Pulaski County (ca. 1890-1900), and an abstract-type map of Pulaski County (1920/1930). Since the activities associated with this aspect of the project are central to the effort these are described in detail below;

(7) The integration of the data sets specified in (6) with the location and information available for previously recorded historic period archeological sites. This consisted in receiving from FLW a digital copy of files in a .dbf format. These files were entered as a theme or coverage within the created GIS system;

(8) The development of an identification, evaluation, management, and public awareness structure for historic cultural resources which places identified and anticipated resources within clearly defined Property Types and Historic Contexts;

(9) A project review meeting between AAI, FLW, and WES personnel on 22 August 1995 at FLW and at Digital Mapping and Graphics, Springfield, Missouri. Participants at this meeting included William Isenberger, John Northrip, Mary Bennett, and W. J. Bennett, Jr. (AAI), Richard Edging and Lester Trigg (FLW), Robert Dunn, Fred Briuer, Jerry Ballard, and Clay Mathers (WES); and,

(10) The production of a report detailing the activities undertaken and the results achieved.

GIS Development: Compilation of Data Sets

Data Entry. All digitizing was done in AutoCad r. 12 by William Isenberger using a CalComp 95600 high accuracy digitizer and Sun Solaris workstation. Tabular data was entered using the dBase III+and dBase IV programs. Association of map entities and tabular data was done with ArcCad 11.3. ArcView 2.0 and 2.1 programs were used to check and correct coverage features.

The Study Area. The initial task undertaken in this effort was to insure that all lands currently under the control of FLW were included in this study. This was accomplished by first digitizing in the boundaries of FLW as depicted on a xerox copy of an installation map created using information available in 1978 and compiled at a scale of 1:50,000 under the direction of the Commander XVIII Airborne Corps, Fort Bragg, North Carolina, Published by the 63rd

Engineer Company (Topographic). This boundary outline was compared to that created by digitizing in the boundaries as depicted on seven USGS 7.5 minute quadrangle sheets compiled at a scale of 1:24,000. The quadrangle sheets include the information listed in Table 2 (below):

Table 2: Boundary Information for USGS 7.5 Minute Map Quadrangles Covering Fort Leonard Wood

USGS Map Sheet	*Publication Date*
Roby, MO	1954
Big Piney, MO	1954, pr 1976
Winnipeg, MO	1954, pr 1976
Brownfield, MO	1954, pr 1976
Bloodland, MO	1954, pr 1976
Devils Elbow, MO	1954, pr 1976
Waynesville, MO	1954, pr 1976

Since the northern and southern boundaries of the installation are (with one small exception) set along the township lines for Township 35N and 34N respectively, these township lines were used as the northern and southern extent of the present study. Where the eastern and western limits of the study area did not follow section or quarter section lines a small buffer was established by extending the area under consideration a minimum of .25 miles and a maximum of 0.50 miles beyond the eastern and western boundaries of the installation as depicted on the 1:50,000 scale installation map.

Development of an Ownership Grid. The next task undertaken was the development of a grid system to be used to record property ownership. This was done by first digitizing the public land survey system (Township, Range, Section) present on the 7.5 minute Quadrangle Sheets. These units were then subdivided into quarter/quarter section (40 acres) and lots on the basis of land divisions indicated on xerox copies of the General Land Office (GLO) maps provided by FLW.

In order to correlate the data from the GLO maps with that contained in the Quadrangle Sheets, the section corners of the GLO maps were rectified to those of the Quadrangle Sheets using a node-snap method within the ARC/INFO system. Quarter/quarter segments were established by snapping to the mid points of quarter section boundaries. Lots were derived from the rectified GLO's and the quarter/quarter intersections. The resultant product was then visually inspected and refined. The GLO map sources included maps for the areas listed in *Table 3* (below):

Table 3: General Land Office Map Sources for the Fort Leonard Wood Area

Township	*Range*	*Date*
34	10	9 November 1861
34	11	13 August 1855
34	12	13 August 1855
35	10	30 November 1861
35	11	15 August 1845
35	12	7 September 1839
36	10	30 November 1861
36	11	27 September 1839
36	12	7 August 1839

The scale listed on the copies of these map sources was "40 chains to one inch." On the actual map source used in this effort the scale was 2.9 cm = 1 mile. Each of the polygons created at this stage (originally approximately 1,780 polygons) was assigned a label point with an individual identification number. A plot of the polygons with identification labels was used to correlate legal descriptions with polygons identifications. The polygon identifications were added to the ownership database and used to relate it to the coverage.

In a number of instances property ownership did not match exactly with 40 acre polygons; e. g. 12 acres, 70 acres, and the like. In such instances new polygons were created by annotating a plot of the ownership grid through visual inspection of the map source and ownership grid. These annotations were then digitized directly into the ownership grid to create additional polygons.

Creation of a Land Ownership Database. A database containing information regarding land ownership at three particular periods was created. These periods are linked to three specific data sources.

First Entered and Patented. In order to determine the date a parcel of land was first entered and the name of the person who first entered the land as well as the name and date associated with the original land patent we used the records of the Missouri State Land Office (SLO). These were obtained as xerox copies of the appropriate sections of the SLO books from the Bureau of Land Management (BLM) in Springfield, Virginia. A map of the parcels first entered was made by Jeffrey Blakely by creating a database in dBase keyed to the individual polygon numbers assigned in the ownership grid. This information included the date, name, method of entry, cost, and acreage. In the same way, the date and name for the successful land patent (where available) were recorded and entered into the database.

While complete in itself, this database does not contain information about all of the first

individuals to acquire land which was to become FLW. This gap in information is related primarily to two situations; Section 16 lands which were originally set aside for educational purposes and lands granted to the railroads. Typically these lands were sold to individuals during the latter part of the 19th century. In order to determine the original owners of these lands it will be necessary to examine the title abstracts for the particular lands in question. These title abstracts are currently housed in the Federal Repository in Kansas City, but are accessed only through the Real Estate Section of the U. S. Engineer District, Kansas City (USAED,KC). In order to gain access to these records it will be necessary to provide the USAED,KC with the designations of the particular lands in question and they will arrange for appropriate access to the title abstracts.

1930(?) Plat Map of Pulaski County. Information regarding land ownership in the 1930s was taken from a map source discovered in the Missouri Department of Natural Resources (DNR) and was originally identified in Smith (1993). In Smith's best estimate, this map probably dates

> ***"...to the late 1920s and early thirties. This date is based on: 1) the advertisements surrounding the maps; 2) the fact that the map shows Wharton and Wildwood post offices which closed in 1933; and 3) none of the land was platted in Forest Service ownership. The map shows the main county roads ... plus a few roads leading away from the old Houston Road. The map also is useful for showing the location of houses."*** *(Smith 1993: 91)*

This map source consisted of a xerox copy of a map on microfilm at the DNR, Rolla. The original source of this map is unknown and the xerox copy used in this study contained no written indication of its original scale. The scale of the map source used in this effort was 3 cm = 1 mile. This map primarily shows streams, roads, property units (ownership plots), and structures (indicated by small, solid squares). The copy quality was extremely poor and many times the names of owners were entirely or partially illegible. In those instances, illegible letters were entered as "x". Ownership was designated in the same way as on Tract Books.

1941 Acquisition. Data regarding property owners at the time the land was acquired by the U. S. Government for FLW was obtained from a series of maps called in this study the Tract Maps. These are the Final Project Map prepared in 1941 by the War Department, Office of the Division Engineer, Missouri River Division and are the basis for real estate maps at FLW. This map source consisted of a xerox copy of a folio of individual maps. Attached to the drawings was a notation that the ***"drawings in this folio have been reduced to 1/2 the size of the original scale."*** As measured in this project the scale of this map source varied considerably from sheet to sheet. In this map source tract numbers had been assigned to individual parcels and were keyed to five map sheets designated A - E and an ownership list. Tract numbers indicated their location on a particular map sheet (A through E) along with numbers assigned sequentially; e.g. a1, a2, b110, c260, d358. Since Sheet E depicted only easements along a road, data from this sheet were not entered. A list of owners was compiled in the dBase III+ program, keyed to the tract designations. This included fields for the tract number, owner, and the acres within the parcels. The ownership list of the tract map contained approximately 515 individual listings.

Summary. Combining data from these various sources, the ownership database file was developed into the Owners Theme. The fields within this theme are listed in the general description of the other developed themes.

The Built Environment. Both the GLO maps and the 1930s Pulaski County abstract map contained additional information useful to this project. These included the graphic location of several different types of cultural features. The cultural features from the GLO, roads, fields, and one structure (as well as the mapped location of Big Piney and Roubidoux Creek) were digitized directly from the GLO maps. The cultural features from the 1930's abstract map included roads and structures (depicted as small solid squares). After rectification using section corners, the road locations were digitized directly from the map source. The structures were plotted through a visual comparison of the ownership grid map and the map source in which the approximate location of the structure was marked on a plot of the ownership grid map and these plots were then entered.

Another, very important source of information about the cultural landscape is a map of Pulaski County created most likely during the later part of the 19th or early part of the 20th century. Smith (1993: 68) describes this map as follows:

> ***"While this map has a number of intriguing details, it does little to assist in refining the exact settlement pattern, other than noting that the Fort Leonard Wood area seems to be well settled with homesteads widely dispersed across the landscape by the turn of the twentieth century. There are no large gaps in the homesteading shown across the map. However, the location of the houses appear to be placed according to their section but were not accurately located within each section. That is, the map maker was emphasizing the names of landowners, using symbols for houses, not the exact location of the structures on a property. No topographic detail was drawn on the map either, although some hollows were named. Whether or not houses were located down in the hollows or on the ridge tops of whether the names were those of landowners or tenants has not been indicated."***

The xerox copy of this map, called in this study the Pulaski County Atlas, was provided by FLW and has no name or scale listed. On the copy used in this study the scale was 2.6 cm = 1 mile. This map depicted primarily roads and structures to which names, presumably owners, were attached. Three different types of structures (houses, schools, and churches) are depicted as three different types of icons. The locations of roads shown on this map source were digitized in directly from the rectified map source. Structure location was treated as point data and this information was entered with the point placed on the center point of the map icon.

A great deal of information about the pre-installation cultural landscape is contained in aerial photographs taken in the late 1930s. In order to determine how a maximum amount of this data could be incorporated within the financial and temporal constraints of this efforts, several experiments in scanning these images were conducted by Dr. James Ebert. After viewing various scanned products it was decided that for this particular effort it would be most efficient to incorporate some of these data into this project a vector map created to depict the

location of both individual structures and clusters of structures. This map could then be used to identify or "flag" locations at which major cultural features (primarily structures and groups of structures) were noted. The more detailed description and analysis could be accomplished later on a case by case basis.

This vector map was constructed by John Northrip using stereo-pairs of aerial photographs at a scale of ca. 1:20,000. The images had been acquired during 20 and 21 October 1938 by the U.S. Department of Agriculture. The flight lines and numbers are listed in *Table 4* (below):

Table 4: List of U.S. Department of Agriculture Aerial Photographs for the Fort Leonard Wood Area

Flight Line	*Flight Number*
BMA 2	*23 through 27*
BMA 2	*86 through 90*
BMA 3	*3 through 16*
BMA 3	*58 through 69*
BMA 3	*79 through 90*
BMA 4	*41 through 50*
BMA 4	*86 through 93*

The images were inspected using a Topcon stereoscope; a folding, mirror imaging device with two levels of magnification. Stereo pairs were examined at using both levels of magnification. The higher to locate standing structures and the lower to locate positions relative to larger landforms and built features. The area was covered from both north to south and east to west and structures were located on a section-by-section basis; that is, sections were located, and then structures were located within sections. These locations were then transposed onto the appropriate 7.5 quadrangle map using topography and assumed section lines as control. It is our best estimate that at some locations the accuracy may be off as much as 100 m, but most will fall within 40-50 m. Individual structures within the community of Bloodland were not positioned separately.

Each location was given a unique number, which contains the flight line and image number. The coverage does not include the northern end of the installation as aerial photographs for this portion of the installation were not available.

GIS Development: Developed Themes

The following is a description of the various themes created within ArcView for this project. Themes are similar to entities often called Data Layers or Coverages in other GIS programs. Many of these themes include database fields called Shape, Area, Perimeter, Length, Lpoly,

Rpoly, Fnode, Tnode, as well as fields ending in _ , _i, or _id which were assigned by the ArcView program. These are not listed in the discussion which follows. Figures which illustrate these themes and subsequent applications are grouped together at the end of this presentation.

Table 5: GIS Themes Developed for the Fort Leonard Wood Database

Theme Name	*Elements*
US Quads	*Name - Name of 7.5 Minute Quadrangle Sheet*
Recorded Sites (Figures 6, 12, 13,)	*Easting - UTM designations* *Northing - UTM designations* *Type - Assigned by FLW* *Landform - Assigned by FLW* *Cult_aff - Assigned by FLW* *Soils - Assigned by FLW* *D_h20 - Assigned by FLW* *Nrhp - Assigned by FLW*
Airphoto Structures (Figures 5, 13)	*Label -* *Photo-pairs - Air photo frame structure appears on* *Structures - S = Single Structure, M = Multiple Structures (Cluster of Structures)*
1930 Roads (Figures 4, 14)	-
1930 Building (Figures 4, 14)	-
Pulaski County (Figures 3, 15)	*Feature -* *Place_name - individual or community names*
Pulaski Buildings (Figures 3, 15)	*Frstname95 - first name of listed owner* *Lastname95 - last name of listed owner* *Pub_priv -* *Photo - attachment field for photos* *Id*
GLO Features (Figure 2)	*Features - Streams, Fields, Ponds, Roads* *Place_names - individual or community names*
PLSS (Pulaski Land Survey Divisions) (Figures 1 - 15)	*Probably the most basic element in the spatial framework is that provided by the land survey; that is, the Township, Range, Section, Quarter, and Quarter/Quarter lines which are illustrated in Figure 1. This basic theme provides a familiar visual reference for all other themes.*

Theme Name	*Elements*

Owners (Figures 7-11)	*T_n - Township, north* *R_w - Range, west* *Sec - Section* *Fstentfn - first name of individual listed as First Entry* *Fstentln - last name of individual listed as First Entry* *Fsentdate - date of First Entry* *Fnlentfn - first name of individual listed as Final Entry* *Fnlentln - last name of individual listed as Final Entry* *Fnlentdate - date of Final Entry* *Act - Act (if any) under which land was acquired* *Warrant - Warrant (if any) by which land was acquired* *Costacre - Cost per acre for the initial purchase* *Patfn - first name of individual listed as Patent, if any* *Patln - last name of individual listed as Patent, if any* *Patdate - date of land Patent, if any* *Fstnm1930 - first name of individual listed on Pulaski County Plat Map* *Lstnm1930 = last name of individual listed on Pulaski County Plat Map* *Tranctno 41 - number of tract on 1941 Tract Book* *Owner41 - owner as listed on 1941 Tract Book* *Acres41 - number of acres in the 1941 tract* *Fst_year - year of first entry (derived from Fsentdate)*

Sample Applications

The GIS provides a framework that connects the physical aspects, the archeological record with the documentary, cartographic, and photographic record. It puts names with places; and, by so doing, opens the riches of the public records (tax, census, property) and private resources. In the following examples we illustrate how this system can be used to address a variety of issues and problems.

Testing Hypotheses: Cultural Affiliation. The development of Smith's primary Historical Context rests on certain assumptions regarding the original settlers of the region. He states that (Smith 1993:113, 114)

> ***"The Upland South defines a tradition and ideology originating among the Celtic and Welsh peoples who migrated to America and initially settled in western Virginia. Blending with Chesapeake Tidewater, German and English traditions of southern Pennsylvania, this multicultural amalgamation resulted in "..an independent small farm owner/operator who relied on traditional solutions to everyday problems which affected their economic, social, and settlement systems" (Smith et al. 1982:9). These highly individualistic, overwhelmingly lowland Scots and Scotch-Irish peoples rapidly migrated down***

the Appalachian chain beginning as early as the 1720s. (While the term "Scots-Irish" is more technically correct, common usage of "Scotch-Irish" has become acceptable, see Jordan and Kaups 1989) With the arrival of another flock of Scots highlanders, who were being forced from their lands between 1760s and 1815 (some 52,000 Scots left for North American during this time [Johnson 1991:220]), they began to spread north through the woodlands of southern Ohio, Indiana, and Illinois, west through Kentucky, Tennessee, south through upper Alabama, Mississippi, Arkansas, Louisiana, and Texas, and the Missouri Ozarks."

Further, Smith (1993:115)

"It is the contention here that a distinct cultural tradition defined as the Upland South did and still does exist across the South and in southern Pulaski county. The origins of its architecture and material folk culture may in fact be Northern European, but the people who brought it through the mid-south to Missouri were primarily Scotch-Irish."

By providing the names of those who first acquired lands within FLW the GIS now makes it possible to trace a large number of these individuals using census and tax records back to their places of origin to determine if they were, in fact, part of this Scotch-Irish movement. This will provide important confirmation, correction, or re-definition of the most basic of the assumptions upon which the current Historic Context is based.

Further, with additional research in the abstract, tax, and census records it will be possible to determine whether those persons who were part of the development or re-development of the area after the Civil War were, in large measure, directly connected to the early (pre-War) settlers and, if not, where these newcomers originated.

Testing Hypotheses: Settlement Patterns. It is assumed by most students of early Ozark settlement that the settlement of the region began along the rivers and spread up into the steeper (less agriculturally productive) uplands. *Figures 7* through *10* depict the early land acquisition of FLW lands. *Figure 7* shows lands deeded to the railroad in the late 1850s and *Figure 8* shows lands set aside for the support of schools (Section 17 lands). At a practical level, these lands were not open for initial settlement, regardless of their agricultural potential and it is unlikely that individuals established farms or other facilities within these lands until after the Civil War.

Figure 9 illustrates lands taken during the 1830s (the earliest entry we have is 21 May 1831). (While a detailed search was not made of the possible pre-emption records for the area, an examination by Yoshpe [1949] indicated that the chance of existing pre-emption claims for lands within FLW was very remote.) The distribution of these lands along the Big Piney on the eastern portion of FLW and Roubidoux Creek are consistent with the observations made on the basis of other data that "bottom land" was the land first taken. These data have particular practical implications for the FLW cultural resource management program as these may contain evidence of the very earliest evidence of Euro-American settlement on FLW lands.

Figure 10 shows the distribution of land purchased by private interests prior to the Civil War. This figure reflects the data in *Table 6* (below) which describe the "rhythm" of private land acquisition for FLW lands.

Table 6: Private Land Acquisition at Fort Leonard Wood (c. 1830-1920)

Decade/Year	*Acres*	*Percentage*
1830s	2120	3.06%
1840s	1920	2.77%
1850s	38920	56.15%
1860s	14520	20.95%
1860	2880	4.15%
1861	400	0.58%
1862	0	0.00%
1863	0	0.00%
1864	0	0.00%
1865	2400	3.46%
1866	5720	8.25%
1867	1560	2.25%
1868	1040	1.50%
1869	520	0.75%
1870s	1080	1.56%
1880s	1440	2.08%
1890s	*4760*	*6.87%*
1900s	*4480*	*6.46%*
1910s	*0*	*0.00%*
1920	*80*	*0.12%*
Railroad Land	*7520*	*10.85%*
School Land	*1720*	*2.48%*
Total	***69320***	***100.00%***

Location of Particular Properties. It is possible to query the system for the location of properties associated with the names of particular individuals either at the time of their first entry, depiction on the Pulaski County Plat Book (1920/1930), or who owned lands in 1941.

Figure 11 illustrates lands taken within what is now FLW by one Washington Smith who is reported to be one of the earliest settlers in the county acquiring land in Section 6, Township 34 N, Range 10 W in 1833 (Smith 1993: 30). As *Figure 11* shows Washington Smith was the name of record for first entry on 280 acres within our project area. Of these 120 acres in Section 32, Township 35 N, Range 10 W were entered on 5 November 1831 and 160 acres in Section 6, Township 34 N, Range 10 W were entered on 12 December 1831, two years earlier than the date reported for his entry onto lands within Sec. 6, Township 34 N, Range 10W as reported in Goodspeed (1889; Smith 1993:30). Another of the early settlers mentioned by Smith (1993: 30) was Rowley Williams. This was the name of record for first entry on 80 acres within our project area (Section 3, Township 34 N, Range 12 W). The date of entry was 3 January 1838; three years later than Goodspeed (1889; Smith 1993:30) reports his entry onto lands in Section 3, Township 34 N, Range 12 W.

At the conclusion of his presentation Smith (1995:141-143) describes what is called "An Experimental Application" in which specific locations on FLW are visited and described. In order to demonstrate how this GIS can function with particular locations, we selected three of these locations, sites 23PU397, 23PU398, and 23PU399 (Smith 1993: 142-143) as test examples.

Figure 12 illustrates the relative locations of these three sites and the following data summarize the information contained in the Owner Theme (*Table 7* - below).

Table 7: Example of Owner Theme Information for Three Historic Sites at Fort Leonard Wood

Ownership Information	*Site 23PU397*	*Site 23PU398*	*Site 23PU399*
1941 Owners	*Lolla M.-Ichord et vir*	*B. E. Page et ux*	*Richard W. Miller et ux*
1920/30 Plat	*I. O. Gilbert*	*B. F. Page*	*Mrs. T. Aleander*
First Entered	*John L. Matthews*	*Matthew Dickson*	*Jonathan W. Alexander*
Date First Entered	*27 July 1857*	*29 November 1859*	*3 January 1860*

Each of these sites rest on lands which were acquired prior to the Civil War. Each of these properties seem to have changed hands (and families) several times during the approximately 70 years they were held privately. (We suspect that, in the case of 23PU399, the name shown on the 1920/30 plat map should really be Alexander).

Data related to the built environment from the 1936 aerials, 1920/30 Pulaski County Plat Map, and 1890/1900 Pulaski County Atlas provide additional information about the development and use of these properties, and are illustrated below:

Table 8: Example of Data Relating to the Built Environment for Three Historic Sites at Fort Leonard Wood

Data Sources	*Site 23PU397*	*Site 23PU398*	*Site 23PU399*

1936 Aerials	*x*	*x*	*x*
1920/30 Plat Map	*Within 1/4 mile*	-	*x*
1890/1900 Atlas	-	*Within 1/4 mile*	*Within 1/4 mile*

Figure 13 demonstrates that, as of 1936, there were structures standing at, or very close to, each of these locations, strongly suggesting that, at least at the end of their use, these facilities were contemporary. Examinations of the tax records for the property owners for the period 1936 - through 1941 would provide detailed information about the differences and similarities of these properties during that period.

Figure 14 shows that these locations are all very close to the major road as depicted on the 1920/30 Pulaski County Plat Map. (This may have been the case on the 1936 aerials as well). However, at only one location, 23PU399, is there a structure shown in the immediate vicinity. The absence of evidence for the existence of structures at 23PU397 and 23PU398 can be interpreted in a number of different ways, of course. One of which is that those structures shown on the 1936 aerials were relatively new, built since the creation of the Pulaski County Plat Map. It may, however, be that the structures at 23PU397 and 23PU398 were of such a type (not a home) that they were simply not mapped as part of the Pulaski County Plat Map.

Figure 15 shows major differences between the 1890/1900 Pulaski County Atlas and the 1920/1930 Pulaski County Plat Map. Clearly the major road shown on these maps is located at different places. Further, the structures shown on the Atlas are clearly oriented toward the road at that time (although this may have simply been a mapping device). If, however, this shift in the road and its associated built environment is correct, it has strong implications for understanding the development of the area and the way in which these sites should be interpreted. This would mean that sites 23PU397, 23PU298, and 23PU399 are all related to the development of the area in the 20th century and that the sites related to the 19th century settlement have yet to be identified.

Description, Interpretation and Evaluation of Properties. If properties at FLW are judged solely on the basis of their archeological records it will be very difficult to distinguish between them. These archeological records often appear very similar; some foundation stones, a well, some barbed wire nailed to a tree, jonquils pushed up into disturbed piles of earth, and a sparse scatter of ceramic and glass fragments along with some bits of rusted metal. Deciding how much effort is appropriate to describe these archeological records and making judgements regarding the relative merits of these properties are usually particularly vexing management issues. This observation is mirrored in the comments of Wilson (1990:23).

> ***"The small "single family" farm is perhaps the most ubiquitous Historic period archaeological site in America, and numerous examples are regularly found by CRM surveys across the continent. Indeed, the title of this paper includes a comment frequently voiced to and by federal land managers, SHPOs, and CRM contractors: "We've got thousands of these." This statement seldom implies dismissal of the entire topic. Much more often, it is delivered in an exasperated***

tone, challenging the listener to explain "what's so great about this one?"

Wilson then proceeds to outline a strategy for dealing with this issue which, while it does not explicitly consider the use of a GIS, contains several of the elements included in the GIS developed for FLW.

> ***"This paper presents an approach to determining National Register significance which involves screening of large numbers of farmsteads within a given study area during early stages of CRM survey, in a manner which directs further efforts at individual sites toward supporting site eligibility under criterion (d): "likely to yield information important in history." This approach could be especially useful for district or multiple property nominations, where the time and expense of examining primary documents for each site -- such as deeds, probate records, daybooks, etc. -- can be prohibitive and often poorly rewarded.***
>
> ***The key feature of the approach is extensive exploitation of readily available secondary sources such as county atlases and maps, town and county histories, and U. S. D. A. soil surveys to obtain comparable data for large numbers of sites in a manner which facilitates placement of sites in a broader geographic and socio-economic context.*** (Wilson 1990:23)
>
> ***The author suggests that a synthetic approach to these sources, using them as a "data package," can assist substantially in placing historic farmsteads in national, regional, and local contexts for the purpose of assessing their significance, rather than merely identifying them."*** (Wilson 1990:24)

Using this "data package" Wilson organized the 196 farms in the community of Surry, New Hampshire, into various categories, primarily on the nature and length of their occupation as described in the documentary sources. This effort, based entirely on the documentary and cartographic record, provided for a refinement of this property type (farmstead). This exercise led to the construction of a comprehensive framework for the occupation of the entire community within which the occupational history of each individual unit could be assessed. This procedure provided for an objective basis upon which to design a locational and identification strategy as well as insuring that when sites were evaluated they could be compared with other sites of comparable occupational histories rather than evaluated against a random sample or mix of properties.

It is critical to remember that the farms and facilities which make-up this portion of the archeological record on FLW were not created in splendid isolation. Each of these functioned as a part (or parts) of communities (cf. Blakely and Bennett 1988, Blakely, Bennett, and Isenberger 1990; Bennett *et al.* 1995). The structural form of these communities was varied. In some instances they were what we would recognize as small towns or villages such as Bloodland and Cookville. In other cases, they might only have a single focal point; a school, church, and/or cemetery. In some cases, the physical or spatial focal point of community was even more ephemeral. Regardless of the form, however, if we are to interpret the history and lifeways of the people who settled here, it is important that we understand how the individual

properties on FLW were integrated into such community systems and how these systems changed through time.

Furthermore, using this type of approach it is possible to expand considerably the depth of the information potential of these properties by enlarging our conception of what a "site" might be. Typically, the locations most often recognized and defined as Euro-American (historic period) archeological sites are only those elements of the archeological records at which investigators have located remnants of the house or, as they are sometimes called, the house-lot, which was the residence or central structural element of a farm. This, however, is almost always only a small part of the former farm. This point has been made forcefully by Adams (1990: 92, 93) in his discussion of "rural" or "landscape archaeology."

> ***"Archaeologists would have a better understanding of rural sites by focusing on landscape history. Because archaeology began as a study of urban sites and monuments, the concept of the archaeological site has been that of the house lot, containing the house, yard, and outbuildings. Such a definition is appropriate only in an urban setting, if even then. Using a systems approach, that kind of site is but one small subsystem of the urban system. The system is what archaeologists should be trying to understand, not the subsystem of the house lot.***
>
> ***Some scholars refer to the built environment as being separate from a natural environment. While this dichotomy is useful for some purposes, it is nevertheless artificial. The built environment, of course, is never really separate from the natural one, but many human cultures like to think that they are above nature, not part of it. Humans build houses, ditches, and fences, and nature tears them down, rots them away, and covers them over. A better viewpoint would use the affected environment and the unaffected environment. The forest woodlot on a farm provides an example of the affected environment ... From the woodlot has come firewood and fence posts, squirrels for the pot, polk for the salads, and nuts for the Christmas stockings. While the forested woodlot may appear to be "natural" it is no longer unaffected by humans. Certain species of trees have been selected and cut for special purposes, for example, hawthorn cut for fence posts. In addition, when farmers clear adjacent land for planting, the forest is border by an ecotone not previously present, with the wildlife biomass increased in potential, as deer and rabbits, for example, find food in the fields and shelter in the forest. Similarly, a forest stream may be natural and unaffected, but it flows into tilled fields or pastures, it is no longer either natural or unaffected, due to the actions of soil erosion, cattle, and other factors. The fence built across a prairie farm becomes a new habitat for plants and animals as trees and shrubs grow from seeds left in bird droppings. The built environment has become a natural one.***
>
> ***A new definition of what composes a site in a rural setting therefore must be proposed. While this reformulation may cause headaches for cultural resource managers, the rural site is the property owned or controlled by an individual or***

family. A site is more than just the house, yard, and outbuildings. Thus, a 640-acre farm comprises a site. The farm is a higher-order subsystem, containing many other subsystems. It must be studied in its entirety, not in pieces. Such a site includes affected and unaffected environments. All areas used by a farm family to produce a crop or to produce energy would be included whether the land was owned or leased.

This definition of a rural site was espoused by landscape architects in the 1970s as "open space that is vital for maintaining the traditional man-land relationship of our historic small towns, farmsteads, battlefields, ghost towns, agricultural areas, cemeteries, mines, trails, and camps" (Tishler 1976:54) The survey form William H. Tishler (1976:55) used to study farmsteads, included virtually all the variables an historical archaeologist would choose:"The farmstead survey form...contained a matrix for classifying landscape characteristics including topography, vegetation and surface water features for four zones making up the farmstead setting: the vicinity of the buildings, the immediate area around the buildings, the site edges within visual proximity, and the landscape extending around the site.

The landscape history of a farm would detail the history of its land acquisition and usage, and the following questions might be asked: When were forests cleared? When and why were roads and fences built? What tillage practices were used? What crop rotation was used? Once exterior energy sources were captured, what was the effect on the woodlot and on the pasture? Were horses, mules, and oxen kept on the farm after powered farm machinery was used? Was the woodlot cleared for crops, once oil and coal became available for heating and cooking? How does diversification of land use vary through time? What crops were planted? When were orchards planted? Were they replanted after the trees reached maturity?"

There are several very important consequences from viewing the information potential of Euro-American sites from this perspective. First of all, it expands enormously the range of questions (and potentially, answers) for these properties. But these are not necessarily questions which can be put efficiently (or at all) solely to the archeological record. These questions, as exemplified by those cited above (Adams 1990:93), are not questions which can be answered from the archeological record. The answers to these and similar questions can only come from the documentary, oral historical, and photographic records associated with these properties. Therefore, it is crucial that when properties are evaluated both the quality and quantity of information related to a property which resides in these sources be considered. We believe that the framework provided in the GIS constructed in this effort provides a way in which this information can be gathered and systematically identified with particular properties.

Our final point in this regard relates specifically to the differences in both the quality and quantity of information that may be available for these various historic properties. In order to illustrate the different types of information that can be derived from data sources *below ground* (i.e. the archaeological record) and *above ground* (i.e. documentary, photographic and oral

historical records), we present the following example.

The results of investigating an historic farmstead (site 3SB257) located on the Fort Chaffee Military Garrison in Sebastian County, Arkansas highlight the very different research potential offered by these two complementary sources of cultural information. Formal site evaluation work carried out by Mid-Continental Research Associates (MCRA) at this farmstead revealed:

> ***"...a moderate surface scatter of historic trash around a pile of footing stones along with a possible cistern. Eleven of the 28 tests were positive, recovering materials to a depth of 20 cm below the ground surface. The site dimensions were determined to be 60 m x 50 m."***

Excavated shovel tests produced a total of 22 artifacts, most of them glass fragments, over half of which were concentrated in one location. In addition, 120 artifacts were recovered from 3 excavated test units, including 21 nails, 25 glass fragments and 20 ceramic fragments.

These field investigations produced a map of the area showing elements of the vegetation, the location of the chimney fall, depressions, some sandstone blocks and rock wall, as well as shovel test and test unit locations. Sierzchula *et al.* (1994: 45) summarize these findings as follows.

> ***"Domestic artifacts are the dominant artifact class recovered (56.73%), with other functional categories weakly represented. No information was generated which would indicate the nature or level of activities conducted at 3SB257. No makers marks, which might indicate the place of origin of household goods or financial status of the occupants, were noted on the glass or tableware analyzed. Artifacts are in very low density."***

In parallel with the work conducted by Mid-Continental Research Associates (MCRA), oral historical and documentary information was developed by AAI as part of a contractual agreement with MCRA. In sharp contrast to the meager information provided by archaeological fieldwork performed by MCRA, AAI provided a wealth of information about 3SB257 from the documentary, photographic, and oral historical records (Sierzchula *et al.* 1994: 38-40).

Site 3SB257 is located on a parcel of land:

> ***"...originally entered by William Amos in 1858. Amos and his wife, Catherine, sold it to Thomas Arnett in 1868 who sold it the next year to Manda Melvina Morris (18 August 1869). Somehow the land was acquired by Johnathan and Elizabeth Fletcher who sold it to George A. Watson (21 December 1877). It remained in the Watson family from that time until it was acquired by the US government in 1941.***
>
> ***G. A. Watson was born 30 November 1839 and died 21 March 1890. He served as a Private in the Georgia Company D, 14th Battery of the Light Artillery,***

Confederate States of America. His wife, Sarah Ann Watson was born on 7 July 1839 and died on 24 April 1901. Both are buried in the White Oak Cemetery on Fort Chaffee.

According to the 1880 of Big Creek Township Census, George A. Watson was 40 years old and had been born in Alabama of North Carolina parents. His wife, S(arah) A(nn). was also 40 years old. She was born in Alabama of South Carolina parents. Listed as part of the household were L. J. (son) (Joseph Ledbetter?) who was 20 years old and listed as a farm laborer. Also listed as a farm laborer was a second son, L? (Levi Campbell?), who was 11 years old. There were several daughters; Ella Rose 18, Emma, 14, J. H. (Fannie Josephine?) 8, Ursula Caroline 5, and L. I., 3. A baby boy G. M. (George Barry) was two months old (deceased as a minor). Only Ursula, L. I., and George had been born in Arkansas. The rest of the children had been born in Alabama. Another son, Perry Austin, was born sometime after 1880.

On the 1890 personal property tax for Bloomer Township Mrs. S. A. Watson declared the following items; three horses ($125), six neat cattle ($30), 40 hogs ($40), and one carriage. All other household goods were valued at $25. Taxes were paid in School District 8 NW. Also at that time L. C. Watson declared a single horse valued at $35.00.

On the 1903 Plat Book of Sebastian County the property is listed under the name of Ursula Watson and it may be that at this time the property ceased functioning as a working family farm for Ursula Watson (b. 19 October 1875) lived a good portion of her adult life in and around Jenny Lind where she spent at least some time working as a clerk in the coal company store. For at least a portion of this time the house was vacant and, apparently, the land was fallow. She is remembered as being particular close to Buster Joyce.

By the 1930s however, Ursula Watson was again living at this location with her nephew Perry Austin Watson (the son of her brother, Perry Austin Watson). She seems to have moved from the farm in the late 1930s and the Clifford Watson family was occupying the farm at the time it was acquired by the US government. Ms. Watson died on 17 April 1958 and is buried in the White Oak Cemetery.

There are several people who have direct knowledge of the property. These include Bobbi (Durham) Jeffcoat, Robert Pitts, members of the Winford family, William Vaughn, Kenneth Douglas, and Raymond Moore, whose family once occupied the house for about a year and a half. It seems that when he was a boy the house the Oscar Moore family was occupying burned. At that time the Watson house was being used to store hay. With the Watson's permission the Moore removed the hay and moved into the house.

To summarize, the site was occupied by the Watson family from the late 1870s

and, as such, seems to have been home to a rather typical farm family for most of the rest of the 19th century. The extent to which it was an active farm for the 20 years or so between the time it was first entered and the arrival of the Watson family is not currently know. Soon after the beginning of the twentieth century the farm seems to have ceased to function as an operating farm and was occupied only sporadically thereafter."

Description of the House

"Information is consistent that there was only one dwelling on the farm and was located at the site of 3SB257. The house, oriented slightly east of south, was situated to the north-east of the "L" junction formed by an east-west road and the north-south road which ran on to Highway 22 and was north of the creek which ran from the southeast to the northwest. One person estimated the house dimensions as 24 by 24 feet. The single-story wooden house consisted of a large single room. This room was wall-papered and contained what was judged to be at that time very fine furniture, including an organ, chairs, two beds, and a wardrobe. The main entrance to the house was from the front porch which extended the length of the house on the south side as was about 10 feet wide. The porch was somewhat elevated so that there were steps leading up onto the porch. The kitchen was situated on the north of the house and was at least partially enclosed by a lean-to structure which was entered without steps. There was a back entrance through the kitchen. The house was surrounded by ornamental vegetation; spyria and japonaca bushes along the west and south side with flowers (lilies and others) in the back and/or side yards.

There is a bit of conflicting evidence regarding the other elements of the farmlot. Some former residents remember an old barn located to the east and north of the house. Others do not. The aerial photograph shows the presence of a second structure to the east of the house. Most remember a small vegetable garden, also to the east of the house although none seemed to remember any farm animals; cows, horses, hogs, or even chickens at the farm.

Many former residents remember Ms. Watson or Ms. Sula as she was known. She lived in the house with her nephew, Perry Austin Watson, the son of Ms. Watson's younger brother, also named Perry Austin Watson. This nephew died tragically by asphyxiation near Lawton, Oklahoma in the 1960s.

One of the things most former residents remember most about the Watson house was the treats Ms. Sula gave to the children who visited her. All of the former residents remember Ms. Sula as an old woman who spent most of her time in the house. She did not own a carriage or other vehicle but was visited often and, apparently, her groceries were brought in to her."

Summary. The preceding example clearly demonstrates how very effective *above-ground* data sources can be in the location, evaluation, and management of Euro-American sites. When such data is integrated into a GIS it can be used to locate properties owned by particular individuals as well as properties acquired at particular points in time. It can provide the basic starting point for the testing of hypotheses regarding the settlement of the area and those who were involved in the initial settlement. It can provide insight into how particular portions of the landscape evolved over time. The potential of this system is considerable; particularly if it is applied systematically to move from: (1) the identification of communities *to* (2) the identification of the constituent elements of the community *to* (3) the description of particular elements. However, in order for it to be used in a manner that will maximize its potential there are a number of things which are yet to be accomplished. The development of this framework, as useful as it is, is only a beginning.

Future Directions

Specific Activities. There are a number of activities which must be undertaken in order to develop the potential of the system that has been created during this project. The paragraphs below present an outline of three major areas in which we believe such development is particularly important. The order in which they are presented is not intended to imply a priority for these activities.

1. *Spatial Integrity*. The locations of polygons, arcs, and points within this system have all been derived from maps or other remotely sensed data sources. While we believe that these locations are true to the data sources as described above, they do not as yet have actual, on-the-ground, references. It is essential that steps be taken to relate the locations of these data to points on FLW that have been "ground truthed." In particular, it is noted that there seem to be discrepancies and/or errors in the Recorded Site locations. Many sites are depicted as located outside of FLW and others seem to have map locations different from GPS locations as shown in Smith (1993:142). Attempts to locate (or relocate) structures identified from 1936 aerial photographs should be conducted to determine their actual rather than their mapped locations.

2. *Integration with Other Themes or Data Layers*. No attempt has been made to integrate this system with other data currently residing in other FLW GIS systems. It is important that this be done as soon and as efficiently as is possible.

3. *Development of Additional Data and Themes*. The system created here was designed to serve as a framework within which to store and to manipulate large amounts of data related to these historic properties, the people who once owned and/or used these properties, and the activities they conducted there. These data currently reside in a number of places; public records, private documents, photographs, oral history, additional cartographic sources, and the archeological record (cf. Bennett *et al.* 1990; Bennett 1994). Douthit *et al.* (1979) and Smith (1993) provide excellent summaries of available primary and secondary documentation important for this task.

It is important that a strategy be devised that will:

- *incorporate existing data already collected from the archeological record*

- *provide for the acquisition and integration of data from the archeological record as it is acquired from future survey and evaluation efforts*

- *target particular sources of oral historical information*

- *identify and acquire data from the photographic record,*

and

- *provide for the systematic acquisition and integration of data from public and private record sources.*

In this regard, additional photo-interpretation of aerial photographs can provide a wealth of information about the physical surroundings of properties as well as the internal (intra-site) structure of these features of the built environment (cf. Bennett *et al.* 1993). Further, photo-interpretation of these pre-installation aerial photographs, may provide significant clues regarding the locations of elements of the built environment depicted on the Pulaski County Atlas and Pulaski County Plat map.

4. *Public Programs and Public Participation.* This effort has drawn primarily on data available in public repositories. However, much of the important information related to the former communities and farms on FLW currently resides in privately held documentary and photographic records as well as in the oral historical record. In a very real sense these information sources are FLW's most endangered resources. While the physical remains currently on FLW may or may not be adversely impacted by installation activities, it is certain that those who embody the oral historical record and who are currently in possession of the privately held documentary and photographic records will eventually pass away. It is, therefore, imperative that attempts be undertaken to gather these resources in as systematic and comprehensive manner as possible. One of the most effective ways to accomplish this is in connection with well-publicized public presentations and public interpretative efforts. This is all the more effective when coupled with programs designed in connection with local educational and cultural institutions.

FLW has made a significant beginning in this effort with the Rolling Heath School project. This project has the potential to discover and preserve large amounts of endangered and irreplaceable information regarding this community. It is our considered judgment that this program be continued vigorously and expanded to include other communities as well. Using the framework created in this effort it will be possible to link information gained through these programs directly and electronically into the GIS database, thus considerably expanding and extending the effectiveness of this system.

Conclusions

The activities recommended above are not mutually exclusive. Efforts in the development of this system within each of the four areas mentioned can be conducted concurrently and can be made a part of the ongoing program of cultural resource management at FLW. For example, ground truthing of structures plotted from air photographs can be conducted as part of future survey projects. The gathering of data from public records can (and probably should) be a part of the site evaluation process. The gathering of oral histories as well as privately-held photographs can be an important aspect of the public interpretation activities associated with the development and use of the Rolling Heath School facility. To accomplish these goals, however, it will be necessary to insure that this type of work is integrated into these activities from the very beginning of all future projects.

Part II THE USE OF GIS IN MANAGING CULTURAL RESOURCES AND EVALUATING ARCHAEOLOGICAL SIGNIFICANCE

WES' Research Mission and the Fort Leonard Wood Database

WES is now actively engaged in a multi-year research program sponsored by HQ,USACE and concerned with the development of more objective standards for assessing archaeological site significance (Briuer and Mathers 1996). Funded through the Evaluation of Environmental Investments Research Program (EEIRP) this work unit includes the research of Dr. Clay Mathers, a National Research Council Post-Doctoral Fellow . An important aspect of his work is the demonstration of the utility of geographical information systems (GIS) and predictive modeling for the broader, more rapid, and more efficient evaluation of archaeological sites and their significance. The *Significance Work Unit* seeks to make an important contribution to archaeological method and theory, and to the development of more comprehensive methods of site protection and preservation.

When first approached by Fort Leonard Wood's (FLW) archeologist in the fall of 1994 to provide technical support in the development of a GIS database for the recorded historic archaeological sites on base the interest of WES' archeological staff in participating in this effort was immediate and genuine. The needs of the installation and the research interests of WES appeared to be perfectly meshed.

The goals of FLW for the project were stated in their scope of work to WES:

(1) *develop a spatial data base of historic cultural resources which will combine information from archaeological survey and testing, documentary research, aerial photographs, General Land Office (GLO) data, and oral historical interviews*;

(2) *integrate the spatial data listed above with the existing GRASS GIS data base that is temporally sensitive*;

(3) *establish a criteria for testing archaeological significance for historic sites*;

(4) *develop a plan for presentation and involvement in public education*

In Part II of this report we will focus primarily on goals (1) and (3) and discuss how GIS can be used to evaluate site significance in a manner complementary to traditional ways of determining National Register eligibility.

In order to illustrate how a GIS database of this type can be used to evaluate historic site significance, we will begin by briefly describing the traditional approaches used to assess historic sites, and then describe the new research designs being developed by WES under the EEIRP. The concluding section will highlight how traditional management strategies can be enhanced and expanded through the use of geographical information systems. Specific examples of GIS analyses will be outlined in order to illustrate the potential of the FLW historic sites database for more effective management and research.

Traditional Approaches to Archaeological Site Evaluation: Management Implications

The regulatory framework for traditional site evaluation has been described in Part I of this report. The details of the four evaluation criteria set forth in 36 CFR 60 and the *Multiple Property Documentation Approach* using historic contexts and property types are discussed in Part I and will not be repeated here. Smith (1993) has provided an excellent discussion of appropriate historic themes (contexts) and possible property types for the historic archaeological sites at Fort Leonard Wood. We strongly endorse the idea of preparing a National register nomination (*Multiple Property Documentation Form*) for these sites as set forth in National Register Bulletin 16B (Lee and McClelland 1991). However, we would also like to discuss the implications of this approach for the long-term management of these sites.

Traditionally, National Register Criterion D has been used to determine the eligibility of archaeological sites. Archaeologists sometimes characterize it as the *research potential* criteria because of its wording: ***"likely to yield information important in prehistory or history"***. This research potential is traditionally determined through sample excavations commonly referred to as *Phase 2 Testing*. Phase 2 testing typically involves a spatially controlled surface collection and the excavation of sample quadrats, or test units, with strict vertical and horizontal control. This procedure provides critical information concerning the integrity of the cultural deposit(s), as well as the horizontal and vertical extent of the site. Many State Historic Preservation Officers (SHPOs) in the U.S. routinely require Phase 2 testing on archaeological sites as the standard operating procedure (SOP) to determine eligibility for the National Register. This SOP works well for most prehistoric sites, but is less suitable for historic period sites. As the AAI's section of this report makes clear, many of the historic archaeological sites at FLW are characterized by a material and stratigraphic record which is fairly impoverished - based on surface indications and limited sub-surface tests - but, nevertheless, are associated with excellent documentary records. These types of sites may be critical in defining and illustrating the historic contexts which Smith (1993) has defined. They may also be critical in characterizing and exemplifying the various property types within those contexts. The difficult question that remains, however, is how to determine their archaeological significance.

National Register Bulletin 16B (*Multiple Property Documentation Form*) offers the following guidance for establishing the significance of historic property types:

> ***"Consider the following when discussing the significance of property types under Criteria A and B:***
>
> - ***Important dates, events, activities, persons, associations, developmental forces, trends, and patterns relating the property to the relevant historic contexts***
>
> - ***Any direct relationship of the property type to major stages of growth, pivotal events or activities, or personal associations characterizing the historic context".*** (Lee and McClelland 1991: 15)

The range of information assembled by AAI for this project's GIS database appears to

be precisely in line with the type of information called for in the National Park Service guidance document cited above. This suggests that the information contained in the GIS could be used most effectively to determine which sites best define and illustrate the known historic contexts. It is our recommendation, therefore, that all historic sites at FLW be evaluated at an initial stage using both Criteria A and B.

Following an initial screening process using these two criteria, a further review should be performed using the GIS database to identify those historically significant sites which may also contain sufficient archaeological integrity and research potential to qualify for the National Register under Criteria D. These determinations would need to be made on the basis of Phase 2 testing. However, since the number of sites meeting all of these criteria (A or B and D) would be relatively small, the concomitant cost of this evaluation would be reduced drastically. Sites that are both historically significant (i.e., providing the best definition and examples of historic contexts), and archaeologically significant, would qualify for the Register under both Criteria A and D.

If Criterion D is the exclusive basis for evaluating historic period sites at FLW, and the recommended Multiple Property approach is adopted to determine significance, each site should be subject to Phase 2 testing. This is a costly and time consuming process which would do little to improve the definition of the historic contexts or property types needed for this multiple properties approach. In practical terms, therefore, we recommend that the sites contained in the GIS database should first be evaluated for their historic significance - using Criterion A or B. The following section describes how this task might be accomplished using the GIS.

Overview of Site Evaluation Methods

During the past 25 years, the definition and practice of cultural resource management have evolved considerably, as new policies have developed, additional laws have been enacted, and as innovative methods and ideas have emerged. Throughout this period, one of the most critical and difficult issues for archaeological resource managers has been how best to define and evaluate *significance*. Despite an extensive discussion of this question in the archaeological literature (Scovill *et al.* 1972; Glassow 1977; Raab and Klinger 1977, 1979; Schiffer and Gumerman 1977; Moratto and Kelly 1978; Doyel 1982; Tainter and Lucas 1983), the problem of how to assess the significance of cultural resources has remained a major concern.

Given the importance of significance determinations for the effective management of cultural resources, the Center for Cultural Site Preservation Technology (CCSPT) at WES is currently engaged in a major research effort to develop better, more objective methods of evaluating archaeological site significance. As the archaeological community has become increasingly aware of the complexity and dynamic nature of archaeological significance, it has become clear that traditional approaches to assessing cultural resources can be greatly improved and expanded.

Traditional Research Designs. In the past, determinations of archaeological significance were often undertaken on the basis of site-by-site evaluations, with a set of implicit assumptions and criteria that were seldom clear, and often idiosyncratic. To a large extent this eclectic style of management and evaluation persists in archaeology, making it difficult to evaluate variables or patterns at a scale larger than a single site. By continuing to focus on individual sites, rather than landscapes or larger groupings of sites, traditional approaches have over-looked many aspects of regional context (economic, political, administrative, ritual, etc.) which also have some bearing on attributions of significance. Whether or not they are incorporated into a research design which is regional in scale, assessment strategies that are based exclusively on individual sites are likely to mask important sources of variability and patterning that must be considered when managing the resource base as a whole.

Similarly, the number of variables that need to be considered when assessing cultural resource significance have expanded to such an extent, that traditional approaches - and the limited forms of analyses they employ - are simply inadequate for the task. New tools and analytical approaches are required in order to manage the large, complex inventories now faced by archaeological resource managers throughout the country. With these problems in mind, one of the major research programs being carried out by the WES has focused on the development of more efficient, objective and holistic approaches to significance. The current project, at Fort Leonard Wood, forms part of this research effort.

New Approaches. In a review of the significance issue more than decade ago, Dunnell (1984: 62) outlined a situation which has changed very little in the intervening years:

> ***"No concept in cultural resource management has proved more vexing than that of the significance (in a legal and regulatory sense) of archaeological resources. In each instance of significance assessment, the archaeologist is caught in a moral dilemma. On the one hand, there is the certain knowledge that not all resources can be saved. On the other is the recognition that evaluations of significance could determine whether specific sites will be destroyed and, thereby, the nature of the archaeological record for future generations".***

Today, effective policies and strategies for cultural resource management remain as important as ever, particularly in light of the continuing and accelerated destruction of archaeological sites throughout the country. One way to address some of the issues raised by Dunnell (and a large number of other archaeologists who have struggled to define and explore the concept of significance), is to ask whether archaeologists and resource managers are currently making the best use of the ideas, approaches and analytical tools that have been advocated in the literature.

Inevitably, any new approach to archaeological resource management and significance evaluation relies on the existing body of ideas and methods developed within the discipline. *Table 9* (below) provides a list of the major concepts that have been employed by archaeologists to define and evaluate significance. The range of ideas listed here provides ample demonstration of the complexities involved in characterizing and measuring significance. While collectively these ideas might - in theory - provide a set of best practice guidelines for evaluating

significance, in reality there is little agreement amongst archaeologists about either the validity or importance of these concepts. Many of the arguments and discussions over the past twenty years have implicitly regarded existing archaeological approaches as best practice, without a more critical, or comprehensive, review of these methods and approaches. Furthermore, many of the discussions that have called for either new approaches (*Table 9 - nos. 15, 16 & 18*), or the innovative use of existing tools and ideas (*Table 9 - no. 17*), have been considerably more successful as a catalyst for debate, than as a stimulus for pragmatic applications. While there are points of agreement on general management strategies such as adopting regional perspectives and problem-oriented research designs (*Table 9 - nos. 2 & 3*, respectively), many methodological *stones* remain unturned.

Nevertheless, there are several important areas where a considerable degree of consensus has been achieved within the discipline. First, there is widespread agreement in archaeology that significance is a very context-dependent and dynamic concept (*Table 9 - no. 1*). Traditional approaches to significance evaluation have, however, been rather categorical, rigid, and individualistic, and have failed to maintain the kind of flexibility or comparability that is clearly essential when evaluating such a complex, and changeable phenomenon (e.g., see Lynott 1980). What seems to be lacking at present is a set of archaeological policies, tools and approaches that are compatible with the changeable and dynamic nature of significance.

Table 9: Summary List of Significance Concepts

Significance Concepts
1. ***Significance as Dynamic/Relative*** *Idea that archaeological significance is neither static (since it changes through time) nor is it inherent to any body of cultural materials; instead the importance or value attributed to cultural resources will vary, for example, according to ethnic affiliation, gender, education, income, etc..*
2. ***Regional Research Designs*** *Idea regional research design are an essential prerequisite for evaluating archaeological significance*
3. ***Explicit Problem Orientation*** *Idea that explicit problem-oriented research designs should be used for assessing archaeological significance*
4. ***Adequacy and Value of the National Register*** *Ideas concerning the suitability of the National Register as a basis for making archaeological significance evaluations; generally, opinions fall into two basic categories, suggesting the National Register criteria are either: (1) too broad, or not specific enough, to be of value to archaeologists; or alternatively, (2) well suited to suited to significance evaluations in their present form*
5. ***General Categories for Defining Significance*** *Idea that defining general analytical domains or frames of reference is necessary for evaluating significance (e.g., historical, social, monetary, etc.).*
6. ***More Specific and Explicit Evaluation Criteria*** *Idea that a well defined set of criteria should be used for evaluating, or prioritizing, sites with respect to archaeological significance; some of these take the form of quantitative schemes for ranking or comparing groups of sites, while others define specific characteristics such as "integrity", "clarity", etc.*

7. ***Need for Representative Samples***
Idea that a 'representative' sample of resources should be defined in order to preserve the greatest diversity of cultural activities characteristic of a particular time, region and cultural group

8. ***Archaeological Preserves/Conservation Areas***
Idea that the creation of large protected areas of land is necessary to preserve a broad range of cultural activities and landscapes for future archaeological research

9. ***Significance vs. Non-Significance***
Idea that the concept of non-significance is central to the evaluation of cultural resources and is more valuable than traditional approaches which emphasize the significance of only a small number of archaeological sites

10. ***Is CRM Research or Not***
Arguments for, and against, the idea that CRM and basic research represent fundamentally different forms of archaeology

11. ***Proactive Planning and Mitigation Strategies***
Idea that a necessary part of significance evaluation process is the development of approaches which anticipate threats and adverse impacts to cultural resources (as much as possible) before they take place

12. ***Broader Public Education/Involvement and CRM***
Idea that greater interaction between archaeologists and the public will promote a better, more sympathetic understanding of the importance of cultural resources, and the processes by which archaeological resources are evaluated

13. ***Ethnic Significance***
Articles that refer to the idea that archaeologists need to be better educated and sensitive to the belief systems and values of native peoples; that is, decisions regarding significance need to be made in light of an improved knowledge base, and a more enlightened dialogue with native communities

14. ***Multi-Phase Field Investigations***
Idea that repeated field investigations are necessary to establish significance, rather than single surveys

15. ***Interdisciplinary Approaches***
Idea that where possible, significance evaluations should incorporate approaches and expertise from subject areas beyond one's specific expertise or research emphasis - particularly from fields outside of archaeology; some individuals also emphasize the value of archaeological data for non-archaeological research and analysis

16. ***Innovative and Expansive Assessment Strategies***
Ideas that highlight the need for new theoretical and/or methodological strategies for evaluating archaeological significance; some suggest measures that are designed to extend our existing definitions and understanding of this concept, and help us to improve our evaluation procedures

17. ***Use of Non-Intrusive Field Methods***
Idea that the use of non-intrusive methods of identifying, analyzing, and/or protecting cultural resources are important methods of evaluating significance

18. ***Applications of Holistic Evaluation Schemes***

Idea that it is necessary to develop broader contexts for formally evaluating significance using approaches, data or criteria from both archaeological and non-archaeological sources; this idea attempts to move beyond a simple concept of "representativeness" by suggesting the use of an expanded set of tools and ideas for evaluating complex cultural resource inventories

In fact, many of the analytical tools for understanding and exploring significance in this way are already available to us - for example, in the form of predictive modeling, simulation and particularly geographical information systems. GIS technology provides a particularly useful tool in this context. Not only do these techniques offer innovative ways of evaluating older sets of information from museum collections, surveys and excavations (resources which are often ignored or under-exploited), but they are also capable of incorporating a very diverse range of new data; the variety of data formats included in the GIS created for this project (i.e., textual, graphical, photographic and audio) underline the analytical flexibility and power of these approaches. Integration of such varied data sets in this way ensures that the value of both old and new information is considerably greater than the sum of their individual parts.

Another, equally important role for GIS in cultural resource management and significance evaluation is the *large-scale, spatial* evaluation of archaeological data - allowing resource managers to examine complex, multi-dimensional relationships that extend beyond the boundaries of individual, isolated sites. Tools such as GIS make it possible to explore many more dimensions of our data and investigate in a more comprehensive way the definition and nature of archaeological significance. Faced with the range of issues summarized in *Table 1A*, most archaeologists would deny that it was a practical possibility to address more than a handful of these concerns in their day-to-day work, or even in their longer-term management plans. Given the power, flexibility and breadth of GIS analyses, however, more expansive and ambitious evaluations of significance are possible. Patterns of association which would have been prohibitively expensive or impossible to undertake using traditional approaches and analyses, can be accomplished now in a rapid and cost-effective manner using GIS. The historic sites GIS database developed for this project by Archaeological Assessments, Inc. represents an important step towards evaluating significance in a more systematic and comprehensive manner.

Having outlined a wide range of general issues concerning the definition of archaeological significance and the general strategies for evaluating it, the following section is devoted to the more pragmatic issue of how the GIS developed for Fort Leonard Wood can be used to assess the significance of historic period sites on that installation.

Using the GIS: Operational Examples for Management and Research

The Definition and Value of 'Representativeness'. Of all the significance concepts mentioned in the archaeological literature, and summarized in *Table 9*, perhaps the most valuable and operational one in this context is the idea of '***representativeness***' (*Table 9 - no. 7*). While it would be a mistake to think of any single concept as a convenient, all embracing variable capable of summarizing all of the complexity surrounding the issue of archaeological significance, the idea of representativeness appears to come closest to this objective.

As the definition in *Table 9 - no. 7* suggests, the concept of representativeness implies the preservation of a suite of cultural resource types that represent the whole range of activities associated with a specific chronological period, geographic area and cultural group. In order to operationalize this concept for the purposes of a undertaking a GIS analysis and an evaluation of significance at FLW, it is important to consider two basic types of information:

(a) *Representative samples of cultural behavior (ranging from residential, administrative and religious/ritual activities, to industrial, military and recreational ones)*

and (b) *Spatial phenomenon (e.g., topographic and ecological variability)*

A simple example of (a) might be a clustered cell of sites consisting of a small village, the residence of a prominent landowner, satellite tenant farms, a mining site, a grist mill, and a church. If this same pattern of sites were repeated throughout a larger region, it would be important to preserve a representative sample of such associated site clusters in a range of representative environmental zones (i.e., in line with (b)).

Although a truly representative sample of resources is likely to be more of an ideal goal, than a practical reality (see Lipe 1974: 228), it is important to utilize a broad frame of reference in defining what is representative, and in selecting a particular sample of resources to be preserved. This type of broad analytical approach to representativeness has been advocated by a number of archaeologists concerned with the evaluation of historic sites. Hickman (1977), for example, has suggested that the anthropological significance of historic properties depends on ***"their representativeness of historical patterns and on the ways in which they can be used to study those patterns"***. She goes on to point out the importance of preserving historic sites representative of all ethnic and occupational groups within an area - particularly those classes of sites that may be *invisible* to the general public. Furthermore, in his study of historic sites in Arizona, Grady (1977) emphasizes that:

> ***"The preserving, developing and managing for public use of a core of representative sites would not only be a provision for permanently protecting...sites against future disturbances but would at the same time provide an educational facility informing visitors of the history of the area."***

Some of the other general benefits that can be derived from a management policy designed to obtain a representative site sample are:

(a) *A robust body of data for future research* (King and Lyneis 1978)

(b) *Some measure of insurance against changing attitudes and approaches in archaeology* (McMillan *et al.* 1978)

and (c) *Emphasis on some neglected categories of sites and behavior - such as lithic scatters* (Reed 1987)

It is significant that many of the steps that are needed to operationalize the concept of representativeness at Fort Leonard Wood - for historic period properties, at least - have already been undertaken. The discussion by Bennett *et al.* in this report, for example, highlights the importance of looking beyond the material record (in the ground) , and the value of exploiting other (archival) sources of data - particularly documents, photographs and oral history. Similarly, the historic contexts that have been outlined by Smith (1993) for the historic resources at FLW, provide an excellent starting point for an operational definition of representativeness, well suited to both a GIS analysis and to the task of evaluating significance.

Operational Criteria for Assessing Representativeness and Significance. As the last 25 years of archaeological literature has made clear, the indices used to define and measure concepts such as representativeness and significance are dependent on both the:

- *Nature of the resources being studied*

and
- *Geographic, historic and social context of the evaluation (e.g,. the ethnicity, education and gender of the person(s) making the assessment)*

Table 10: Key Characteristics For Evaluating Representativeness and Significance (Examples)

	Characteristics
1.	**Site Chronology** *(earliest/latest date, span of occupation, continuity, etc.)*
2.	**Site Size** *(breadth and depth)*
3.	**Site Function** *(e.g., residential, ritual, military, etc.)*
4.	**Site Integrity** *(degree of mechanical, cultural, animal disturbance)*
5.	**Abundance of Archaeological Remains** *(quantity and density of the material)*
6.	**Interpretive Potential of Archaeological Remains**
7.	**Abundance of Archival Data** *(documents, maps, photographs, oral accounts, etc.)*
8.	**Interpretive Potential of Archival Data**
9.	**Ethnic Significance** *(importance for a specific ethnic group)*
10.	**Spatial Location** *(e.g., topographic, pedological, geological, hydrological, climatic zone)*
11.	**Spatial Association** *(e.g., spatial, functional and other relationships between sites or with areas)*
12.	**Threat of Impact** *(nature, severity, immediacy, etc.)*
13.	**Abundance of Palaeoenvironmental/Palaeoclimatic Data** *(e.g., fauna, pollen, phytoliths, etc.)*
14.	**Proximity to Other Important Areas/Properties** *(e.g., endangered habitats, National Reg. sites, towns)*

Despite the dynamic and context-dependent nature of such evaluations, it is possible for archaeologists to outline a series of measures that can be used to promote more expansive and comprehensive evaluations of cultural resources in a wide variety of contexts. Since the importance attached to these different measures will vary considerably (for the reasons outlined above), any list of assessment criteria should be seen as evolving, rather than static, and as a set of guiding principles, rather than a rigid and inflexible template.

In recent years, an increasing number of articles in the peer-reviewed archaeological literature have been devoted to discussing the significance of historic period sites (e.g., Noble 1987; Hardesty 1990; McManamon 1990; Scott 1990; Smith 1990). Many of these discussions have been concerned primarily with general definitions and concepts of significance. A smaller number, on the other hand, have focused on the more pragmatic issue of assessing significance (and to a lesser degree representativeness) - illustrating their arguments with empirical evidence and analysis (e.g., Briuer *et al.* 1990; Wilson 1990). Although there are important similarities in the approaches used by both Briuer *et al.* and Wilson, notably the use of explicit criteria for evaluating significance, there are also a number of important differences. The comparison of these two approaches (below), has important implications for the evaluation of historic properties at Fort Leonard Wood, and the potential of GIS to aid in these efforts.

The approach to significance evaluation adopted by Wilson (1990) places particular emphasis on the information potential of the material record below the ground (i.e., *archaeological* remains) and the use of specific, measurable characteristics to formally evaluate historic sites. Although there is a wide variety of criteria that can be employed to assess significance (*Tables 9* and *10*, above), Wilson focuses on three basic questions in order to identify sites that may be eligible for the National Register under Criterion D. These questions include:

> (a) ***"Are the features and archaeological deposits temporally and spatially distinct?"***
>
> (b) ***"Was destruction of the superstructure catastrophic (as opposed to deliberate)?"*** *A deliberately burned structure may have been abandoned first and therefore may not reflect the distribution of materials, and range of features present, at the time it was occupied*
>
> (c) ***"Is there a good record of successive occupations, relative to the record for similar sites in the study area?"***

Using these questions, Wilson creates a tripartite typology for classifying the historic farmsteads in the Surry region of New Hampshire, ranging from ***"good"***, to ***"bad"***, to ***"ugly"***. According to Wilson's classification, the definition of these different site types is as follows:

> • <u>Good</u>: *a site characterized by various features and remains that are identifiable and separate, by excellent documentation concerning owners and tenants, and by a structure which was destroyed accidentally on a known date*

- *Bad: a site with poor documentation concerning occupation, a considerable amount of temporally inseparable material, and which was emptied and abandoned before destruction*

- *Ugly: a site displaying various combinations of criteria representing "good" and "bad" farmsteads (e.g., a poorly documented farmstead that was suddenly burned down)*

Wilson suggests that the attribution of "good", "bad" and "ugly" sites would be based on a sliding scale, so that a site's placement in a given category would be relative to the overall condition of all similar sites in the study area.

One of the major advantages of this approach is that it provides a set of specific criteria with which to evaluate a large, complex inventory of sites. This multivariate screening process offers a useful strategy for classifying sites into general categories which are useful for both research and management purposes. By employing such explicit criteria, this approach can be easily comprehended and replicated - factors which are extremely important when attempting to interpret the nature and consequences of cultural resource management practices in an *historical perspective*.

Another important aspect of this analysis is the value placed on documentary records as an aid to significance evaluations. Work by Bennett and his colleagues at Fort Leonard Wood, detailed later in this report, echoes this point by underlining the critical role that archival and oral historical evidence can play in supplementing the material evidence from excavations and surveys.

Finally, Wilson's emphasis on formulating and testing hypotheses about significance, is a welcome departure from so many evaluations of significance that depend on weakly defined procedures and vague, often implicit, assessment criteria.

One of the principle drawbacks of the approach employed by Wilson, however, is the limited *number* of criteria used to characterize the significance of his Surry farmsteads. An additional weakness is the implicit priority given to archaeological derived information over archival sources. Many of the ideas and themes that have been discussed in the archaeological literature on significance (i.e., *Tables 9* and *10*) are not raised in his discussion, and are not operationalized in his classification scheme or significance measures. Environmental variables such as the ecological and topographic settings of his sites are not discussed, for example, nor is there any clear consideration of the associations between a single farmstead and its immediate surroundings. The latter is a particularly significant omission since the strategy adopted by Wilson to evaluate significance is essentially a conventional site-by-site approach. The spatial relationships between farmsteads and other types of sites and activities (e.g., neighboring farms, villages and *satellite* activities such as milling, mining, lumbering, etc.) are not explored. In order to achieve more comprehensive and holistic evaluations of significance, it is necessary to exploit analytical tools such as GIS, which make it possible to explore the spatial and other characteristics of archaeological data in much greater detail.

One of the few examples of a significance evaluation involving the use of GIS, is the investigation undertaken by Briuer *et al.* (1990) to study historic period sites at Fort Hood, Texas (for additional discussion of this work see Williams *et al.* 1990). Using a GIS database, statistical software and a set of explicit measurement criteria, Briuer *et al.* carried out an analysis of more than 1000 historic sites covering an area of 339 square miles.

Rather than relying on a piecemeal assessment of significance (i.e., one site at a time), this study sought to analyze the relationships between sites at a regional scale before attempting to evaluate the significance of any one individual site. In addition, the work at Fort Hood was carefully designed to establish a representative sample of sites that would maximize the interpretive and research potential of historic period sites, while at the same time minimizing unnecessary, expensive and destructive management practices. The methodological perspective adopted by Briuer *et al.* emphasizes that many aspects of site variability may not be apparent unless regional patterning and variability are examined in a detailed and comprehensive fashion.

One of the most important and innovative dimensions of this study is the range of different analytical tools that were utilized in order to evaluate significance, including: cluster analysis, multivariate statistics, spatial analysis (GIS) and Exploratory Data Analysis. By combining these different, but complementary, techniques Briuer *et al.* were able to analyze a very large and diverse set of data (both cultural and environmental). More conventional approaches to significance, by contrast, are characterized by the analysis of smaller and less diverse data sets, and the use of a more restricted spatial frame of reference (i.e., single sites).

Another valuable methodological approach adopted in this study was the strategy used to define measurable criteria for evaluating significance. Although the studies by Wilson (1990) and by Briuer *et al.* (1990) include a set of explicit criteria for defining and measuring significance, there are notable differences in the two approaches. Although there is some overlap in the specific significance criteria used in both studies (such as *occupation span*, *site chronology*, *volume of data*, etc.), the Fort Hood analysis defines these variables in much greater detail, employing several hundred variables in the overall analysis. Another marked difference is the systematic use of environmental/ecological indices in the study by Briuer *et al.* (e.g., erosion status, vegetation, land capability, geology, slope etc.), and the absence of these parameters in Wilson's analysis. Finally, the resourceful inclusion, and use, of data sets that are not traditionally a part of archaeological evaluation strategies, such as US Census (*Tiger*) files, made it possible to explore new and unexpected dimensions of significance. The use of flexible approaches like clustering and Exploratory Data Analysis to help formulate significance criteria, as exemplified at Fort Hood, suggests that it may be prudent to undertake more preliminary analyses of this type *before* arriving at a final set of evaluation criteria. Rather than establishing a limited series of indices, and proceeding directly to the evaluation process, the approach adopted by Briuer *et al.* highlights the value of an additional, intermediate stage analysis (prior to formal evaluation). The importance of this additional stage lies in the potential insights it may provide concerning unexpected relationships and variables that could be critical for understanding significance at both a local *and* regional scale.

In seeking to use the Fort Leonard Wood GIS database for such broad and systematic forms of analysis, it is important not to underestimate the complexity of management issues like

significance and representativeness. It is equally important to recognize the power of tools like GIS to address these complex problems in a pragmatic and efficient manner. In the following section, devoted specifically to the development of the FLW GIS database, a number of practical recommendations will be presented - suggesting how the current system can be used to exploit a broad range of issues concerned with significance evaluation and resource management generally. Building on earlier work undertaken at FLW (Smith 1993), these suggestions are intended to highlight areas where GIS analysis can make a major contribution towards the evaluation and management of historic properties at the installation.

Use of GIS at Fort Leonard Wood: Suggestions for Evaluating Archaeological Significance

Previous work on the historic period sites at Fort Leonard Wood (Smith 1993: 135), has identified two major research themes where "GIS mapping" was seen as one of the appropriate methods for further investigation (see *Table 11* - below). With the new GIS database which has now been developed for FLW, it is possible to expand the list of themes where GIS analyses can be undertaken. At the same time, a number of specific examples of GIS queries can be given which illustrate how the GIS database can be used to evaluate archaeological significance and representativeness at FLW.

Table 11: Historic Themes for Fort Leonard Wood (from Smith 1993:15)

Theme	*Research Methods*
Upland South/Ozark	
• Traditional Lifeways-Folkways	Oral History, Archaeology
• Settlement Patterns	Archaeology, GIS Mapping, Oral History
• Architecture	Oral History, Archaeology, Cultural Geography
• Economics (*Agriculture*)	Archaeology, Oral History, Cultural Geography, Geography, History
• Political/Social Life	Oral History, History, Genealogy
• Archaeological Signature/Visibility	Archaeology, GIS Mapping
• Material Culture	Archaeology, Oral History
Pioneer History in Pulaski County	History, Archaeology
The Civil War in Pulaski County	History, Archaeology
Tie-Hacking, Lumbering in Pulaski County	Oral History, Geography
Effect of Railroads on Southern Pulaski County	Archaeology, Oral History
The Depression Landscape	Archaeology, History (*WPA Documents*)
Outlaws and Bushwackers	History, Oral History

Using the thematic research areas defined by Smith (1993) and listed above, together with the suggested characteristics for evaluating significance and representativeness (*Table 10*), it is possible to extend GIS analyses in a number of directions. In doing so, it is important to remember that GIS is more than simply a mapping tool, and can be used to evaluate any entity or phenomenon that can be assigned a set of spatial coordinates. Our purpose in presenting these examples is only to provide a framework for future analyses using the GIS database.

Upland South/Ozark (*Traditional Lifeways-Folkways*). If the distinctive folk traits of Ozark and Upland South lifeways were mapped - e.g., areas with distinct folk tales, musical traditions and speech patterns (following suggestions by Smith) - these variables could be used in a GIS to suggest cultural traditions with different material records, site functions, site distribution patterns, and other characteristics relevant to evaluating significance. Furthermore, identifying the spatial clusters associated with Ozark and Upland South folk culture should have some bearing on the choice of which sites and areas constitute a *representative* sample at FLW.

Upland South/Ozark (*Settlement Patterns*). There are numerous opportunities here to examine the characteristics of individual sites and larger regional clusters. Attribute data from the GIS database could be used, for example to define important significance variables such as site chronology, function, data abundance and spatial location. Important aspects of archaeological significance could then be evaluated by using these criteria to determine the uniqueness of sites and grouping of sites. Once this task was accomplished, it would be possible to examine the spatial dimension of these characteristics to determine, for example, if the sites with the earliest dates, most continuous occupations and best documentary records all occurred in the same geographic area. Another, more robust avenue for analysis might be the search for repeated *cells* or clusters of sites representing groups and activities which were closely related (e.g., major pockets of arable land with a wealthy landowner and his tenant farms, large churches and schools, farms and special purpose industrial sites, etc.). Identification of such clusters would make a major contribution towards defining representativeness at a regional scale.

Upland South/Ozark (*Architecture*). In this context, it might be possible to identify a relationship between: (a) the techniques used to construct different forms of folk buildings, and (b) the natural resources available in a particular area (e.g., local timber and stone resources). It would also be useful to compare the spatial distribution of architectural types with the distribution of other traits characteristic of Ozark and Upland South folkways (e.g., ethnic origins, speech patterns, etc.), to determine how distinctive these groups were from one another. Another relationship which might be examined is the association between architectural construction techniques/building types, and the quality of arable land in an area. Stone-built structures, for example, may be an indication of both greater wealth and access to better quality land.

Upland South/Ozark (*Economics - [Agriculture]*). Since the continuity and span of occupation for a particular farm, or region, may be closely related to the fertility of locally available land, it should be possible to investigate the relationship between these variables using GIS. Likewise, it would be possible to test the proposition that there are different economic classes present in the FLW area that are closely associated with land quality. From an evolutionary perspective, a GIS analysis could also evaluate the hypothesis that the best quality

land was occupied first, and that later settlements occupied progressively more marginal land. Identification of patterns like these would help define the range and significance of site types found at FLW, and may help to predict the types of historic properties likely to be found in areas of the installation that have not been investigated in detail.

Upland South/Ozark (*Political/Social Life*). Using the spatial and attribute capabilities of the GIS it would be useful to determine where major villages or clusters of farms were located vis-a-vis the overall distribution of sites. If churches and schools played a central role in social life, it would be useful to determine where they were located relative to their potential constituencies. In terms of transportation and communications, it would be possible to calculate the changing proximity and density of farms through time, as well as changes in traveling times due, for example, to new road construction. Different classes of sites may be related to logistical factors that enabled some areas to be better connected with their neighbors than others. In this case, a representative sample of sites should include central, as well as more peripheral, sites.

Upland South/Ozark (*Archaeological Signature/Visibility*). The archaeological signature or visibility of historic sites at FLW is effected by a variety of phenomena that could be analyzed using GIS. It would be useful, for example, to see how many known sites are large, characterized by standing architectural remains and located less than 500 meters from a modern road. Clearly, the visibility of sites may also be closely correlated with land use practices, so that a greater density of sites may occur in areas covered by cultivated fields, rather than in woodland. Using GIS, it would be possible to compare variables such as land use and vegetation cover in an area, with the overall number of known sites. Equally, it might be valuable to compare areas which have been surveyed for archaeological sites, and those that have not, to determine whether there are notable differences between regions with respect to variables such as site size, site function, numbers of sites, etc.. Using the descriptive and graphical information included in the current GIS database, it might also be possible to identify specific types of historic activities and land use practices which have left very subtle traces on the landscape. Many of the clues to understanding the activities that took place in and around historic farms, such as milling, mining and lumbering, may lie in oral history, maps, aerial photographs and documents. By exploiting these sources first, a GIS analysis might help to identify more precisely areas on the ground that would have been the most appropriate for pursuing specialized tasks such as lumbering (e.g., areas suitable for the growth of hardwood forest) or mining (e.g., zones with ore bearing deposits). Investigation of all of these issues would provide insight into the types of sites present at FLW (i.e., representativeness), as well as their uniqueness and significance.

Upland South/Ozark (*Material Culture*). Once the artifactual and architectural attributes of historic properties at FLW are included in the GIS database, it may be possible to identify spatial clusters that are characteristic of specific ethnic groups and economic classes. Spatial patterns that were based on material culture (e.g., areas having particular house forms or ironwork), might also be compared with other spatial patterns, based on non-material attributes (e.g., speech patterns). Identification of sites representing these different groups and classes would constitute an important step in evaluating both representativeness and significance at FLW.

Pioneer History in Pulaski County. In addition to the suggestions made by *AAI al.* later earlier in this report, there are a number of other aspects of pioneer history that could be investigated using the GIS database at FLW. First, it would be useful to determine the general pattern of Euro-American colonization, with respect to which geographic areas and environmental zones were settled first, and how these patterns changed through time. Secondly, it would be useful to determine whether different areas within FLW were characterized by distinct developmental patterns such as (a) continuous growth, (b) long-term contraction or (c) periodic cycles of both growth and contraction. Finally, it might be worthwhile to compare Native American occupation of the area (in the proto-historic and contact periods) with early Euro-American settlement, with respect to variables such as the:

- *Number/Density/Size of residential sites*
- *Topographic/Geological setting*
- *Distance to major rivers*
- *Soil preferences*

and
- *Variety of site types/functions (e.g., residential, industrial, ritual, etc.)*

If there was competition between Native American communities and Anglo-European settlers for the same types of resources and ecological habitats, the distribution and density of early historic sites in the FLW area may have been affected. Euro-American settlement, for example, may have taken place later than expected in some of the more favorable agricultural areas due to the presence (and possible resistance) of extant Native American groups. All of these investigations would provide information about the diversity and importance of historic sites that would be useful in evaluating their individual and collective significance.

The Civil War in Pulaski County. One of the most important issues that could be addressed by a GIS analysis of Civil War period sites at FLW is a systematic characterization of strategic positions and resources. By plotting the locations of features such as mines, railway junctions, roads, river crossings, towns, etc., it would be possible to identify areas which had a fairly major, *or* a relatively minor, strategic value. Topographic analyzes using a GIS might also reveal areas which had particularly useful natural defenses that may have been utilized for temporary encampments or for more long-term defense. All of these areas could then be compared with historical accounts of military encounters in the area. In addition, documentary evidence - in the form of personal letters, photographs, regimental diaries, military correspondence, newspaper accounts, etc. - may provide clues about the general whereabouts of skirmishes, raids, battles, camps, fortifications and hospitals that could be further investigated with a GIS. Using the description of features or activities mentioned in various archival sources as a guide, a GIS analysis could help to identify more precisely the specific geographic area where Civil War engagements and activities may be concentrated. Systematic analyses of this type may help to reveal a range of sites and activities that might otherwise be overlooked when evaluating both significance and representativeness.

Tie-Hacking and Lumbering in Pulaski County. Detailed investigation of the soils and geology in the FLW area, using a GIS, could help to discriminate between areas that were ideally suitable for agriculture, as opposed to lumbering, during the historic period. More

specific and sophisticated queries could also be formulated in order to identify areas that might be appropriate for harvesting different tree species, for example, or pinpointing areas where logs could be felled and transported with the least effort. Examination of the social and spatial relationships that connect these industrial sites on the one hand, with residential locations on the other, would make an important contribution towards an understanding of historic site significance at FLW.

The Effect of the Railroads on Southern Pulaski County. Using a GIS, detailed analyses could be undertaken of settlement systems in the FLW area for the periods before and after the introduction of railroads. By systematically comparing these two periods it would be possible to address a number of important questions concerning, for example, the social and economic development of the area:

- *Where was the central focus of population before, and after, the establishment of the first railroad?*

- *Is there a significant increase in the size, or the diversity, of site types following the initial development of the railway*?

- *Are there notable changes in material culture before and after the introduction of railways (e.g. with respect to the quantity, quality, size and range of goods found in the area)?*

- *How does the presence of this new mode of transportation affect the relative economic balance between individual farms and landowners (i.e., does wealth gravitate towards the areas immediately around railways, and away from areas without them)?*

By posing these and other questions and it may be possible to group historic sites with respect to their distance from early railroads, and evaluate their significance and representativeness with this classification in mind.

The Depression Landscape. Analysis of historic sites from the Depression could be enhanced by using GIS to examine which areas (and types of sites) were occupied prior to, during and after this period. It would also be interesting to see whether there was a relationship between more continuously occupied farms and areas with good, arable soils. A representative sample of sites from this period could therefore reflect the different economic fortunes and outcomes of the Depression in the FLW area. In addition, systematic evaluation of ecological and topographic variables might suggest areas where black market activities may have been pursued (e.g., identifying remote, off-road areas that were appropriate for making 'moonshine').

Outlaws and Bushwackers. Once archival sources such as court documents and newspapers have been used to identify the most regular targets for outlaws and bushwackers, a GIS analysis may help determine why particular areas were more attractive *interception points* than others. Isolated farms and travellers on back roads, for example, may have been consistently vulnerable because of their distance from law enforcement authorities, the

difficulties of patrolling steep terrain, or the low density of population in more rural areas. In addition, once episodes of lawlessness and bushwacking were quantified and mapped, it may be possible to predict where hideouts and refuges may be located. The discovery and comparative evaluation of such sites would add significantly to our notion of a representative sample of historic resources at FLW.

Clearly, there are a wide variety of historic resource management issues that can be addressed more efficiently and systematically at Fort Leonard Wood with the GIS database which has been developed by Archaeological Assessments, Inc. Not all of the thematic questions that have been outlined above, however, can be tackled with the database in its current form. Equally, it is likely that the future development of the database and use of the GIS will expand research and management horizons beyond the important themes identified by Smith (1993). It is also clear that improvements and additions will be required as this new knowledge and information is acquired and as management and budgetary priorities change over time. Nevertheless, the foundation has been established for evaluating historic period sites at FLW in a far more comprehensive and systematic fashion. The development of a GIS database for historic sites on the installation will also make it possible to evaluate significance and representativeness in a more thorough and efficient manner.

Benefits of the Research to the Department of Defense

It is critical that standardized methods of identifying and organizing historic period data sources be developed within DoD. In evaluating the research proposal prepared by Archeological Assessments, Inc. for this project at FLW the WES reviewers noted that:

> ***"This effort will assist WES in developing a state-of-the-art standardized approach for historic archeological data base development and the development of explicit criteria for evaluating archeological significance. There is presently a great need for a good standardized approach among potential WES clients and elsewhere."***

We believe the GIS database developed by WES' contractor for this project, represents a major step forward in the management of historic archeological sites on military installations. We do so for a number of reasons. First, this GIS database allows systematic analysis of cartographic, documentary, and photographic information sources, as well as making very effective use of the traditional archeological record. Second, unique information available from oral informant interviews and the enthusiastic participation of the local community can be used more effectively. Third, it organizes archeological, documentary, and informant-obtained information for use in a flexible and powerful analytical environment. This GIS framework can accommodate new information whether it comes from field investigations, archival research, or from living informants. It will effectively serve the cultural resource managers at FLW for the foreseeable future. More importantly, it represents an approach that can be used for other data sets, areas, and installations.

The principle benefit of this GIS pilot study to other military installations within the DoD is that it provides a pragmatic, cost-effective approach to the management of historic sites, while at the same time, significantly expanding the interpretive potential of these resources. We are confident that these tools and methods can be successfully implemented at FLW, and furthermore, that they will be of value when applied to other cultural resource contexts within the DoD.

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APPENDIX I: GIS FIGURES

NOTE: The following figures have been prepared by Archeological Assessments, Inc.

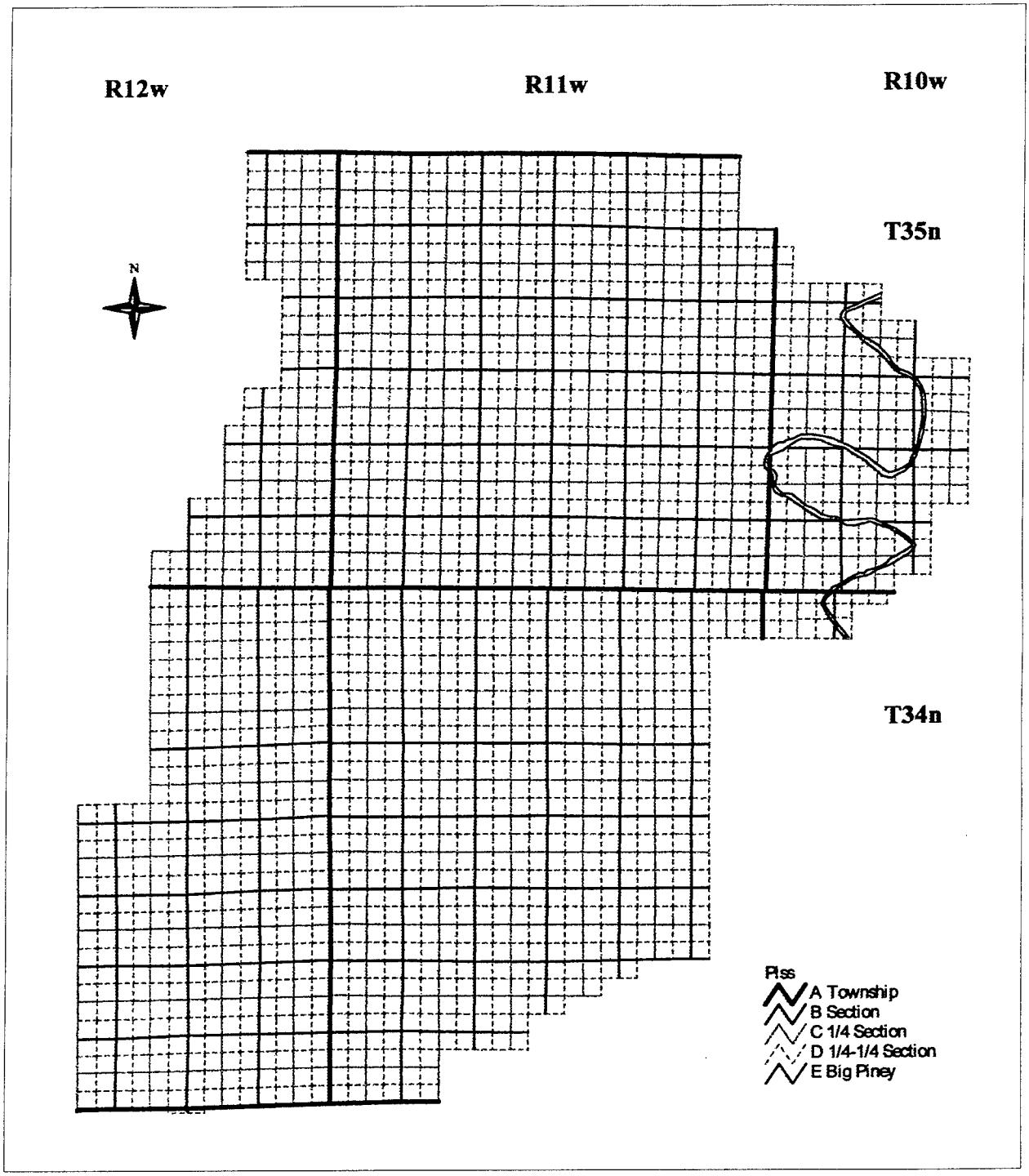

Figure 1. Townships and Sections

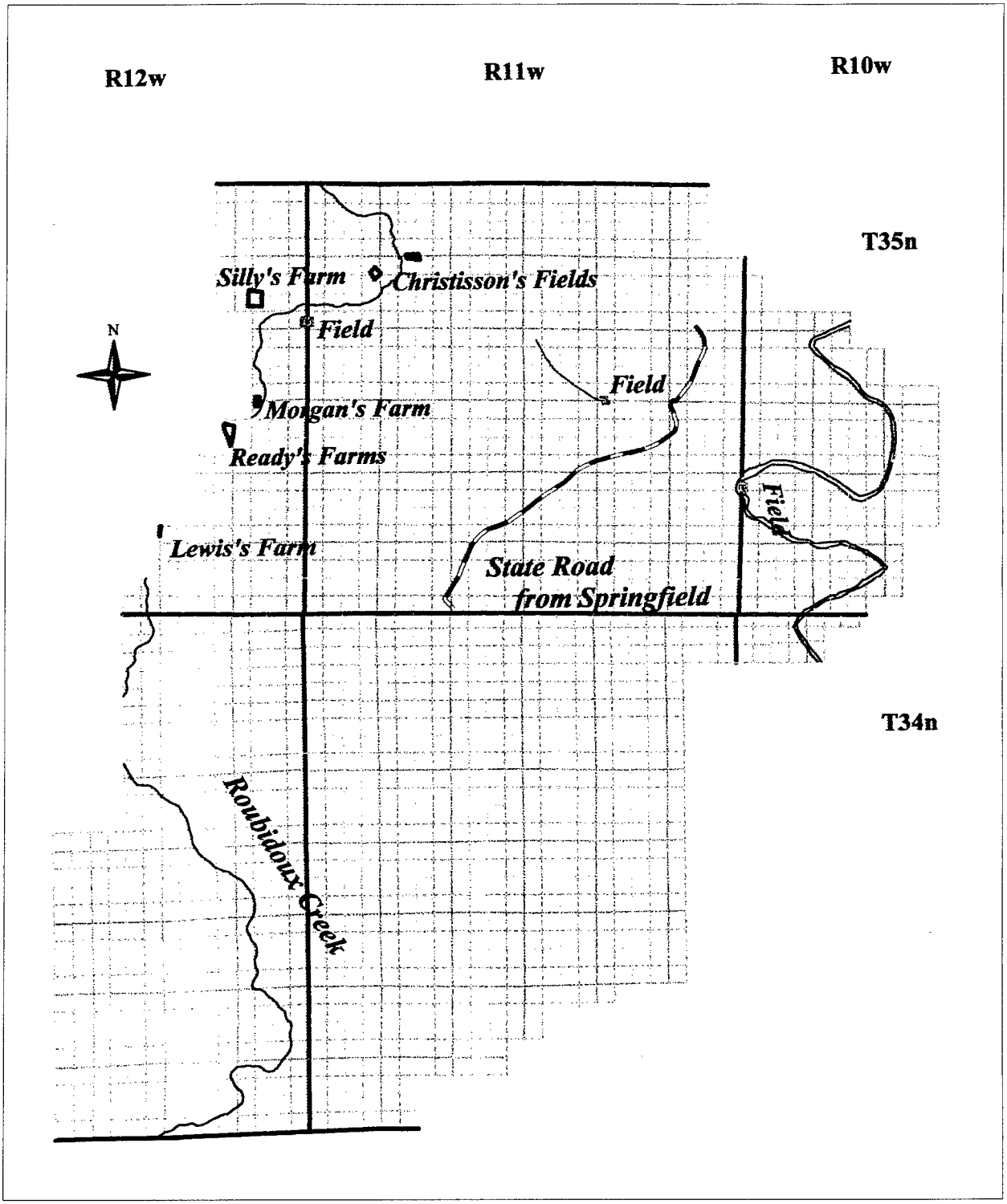

Figure 2. Major Features from General Land Office Map

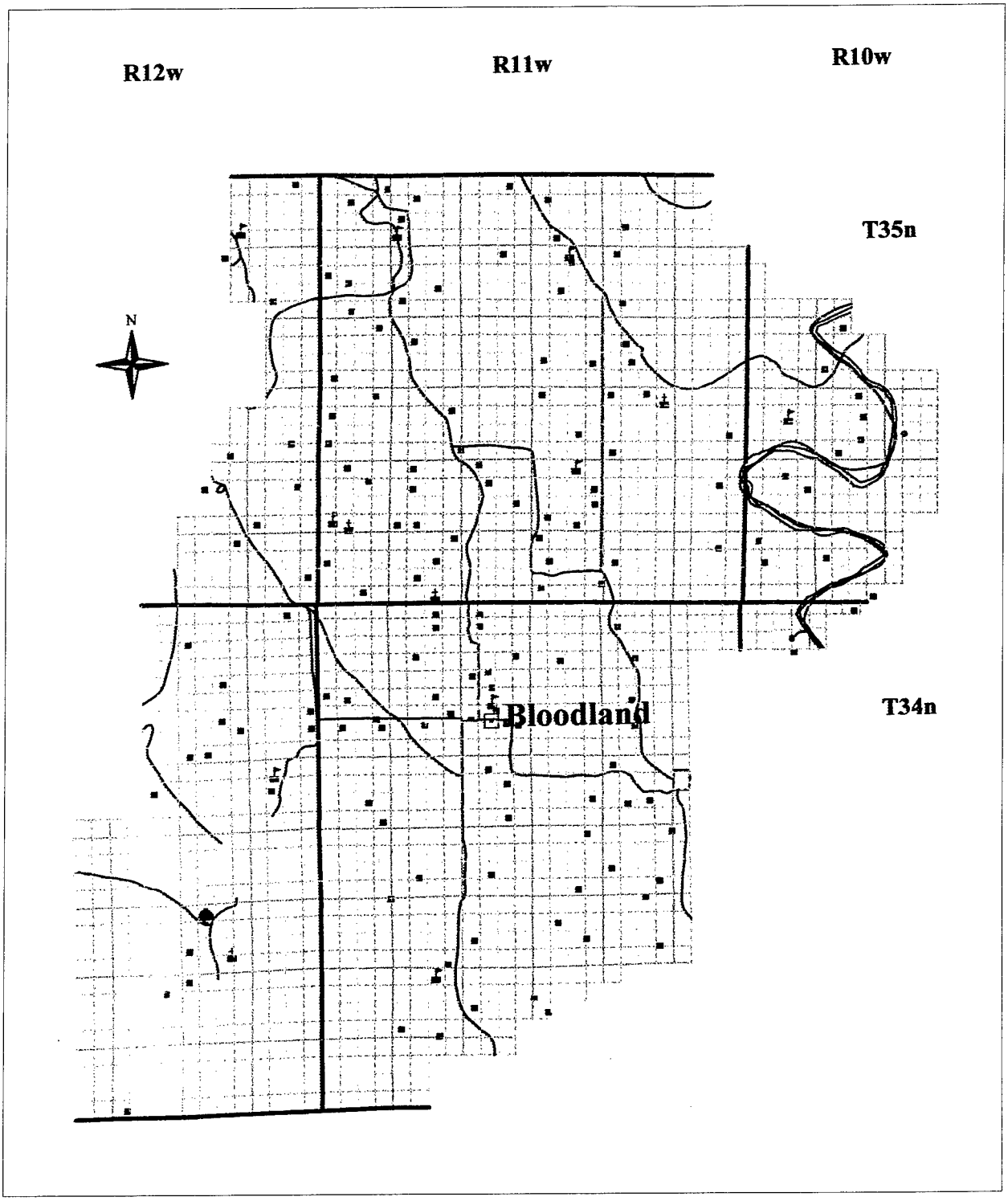

Figure 3. Major Features from the Pulaski County Atlas

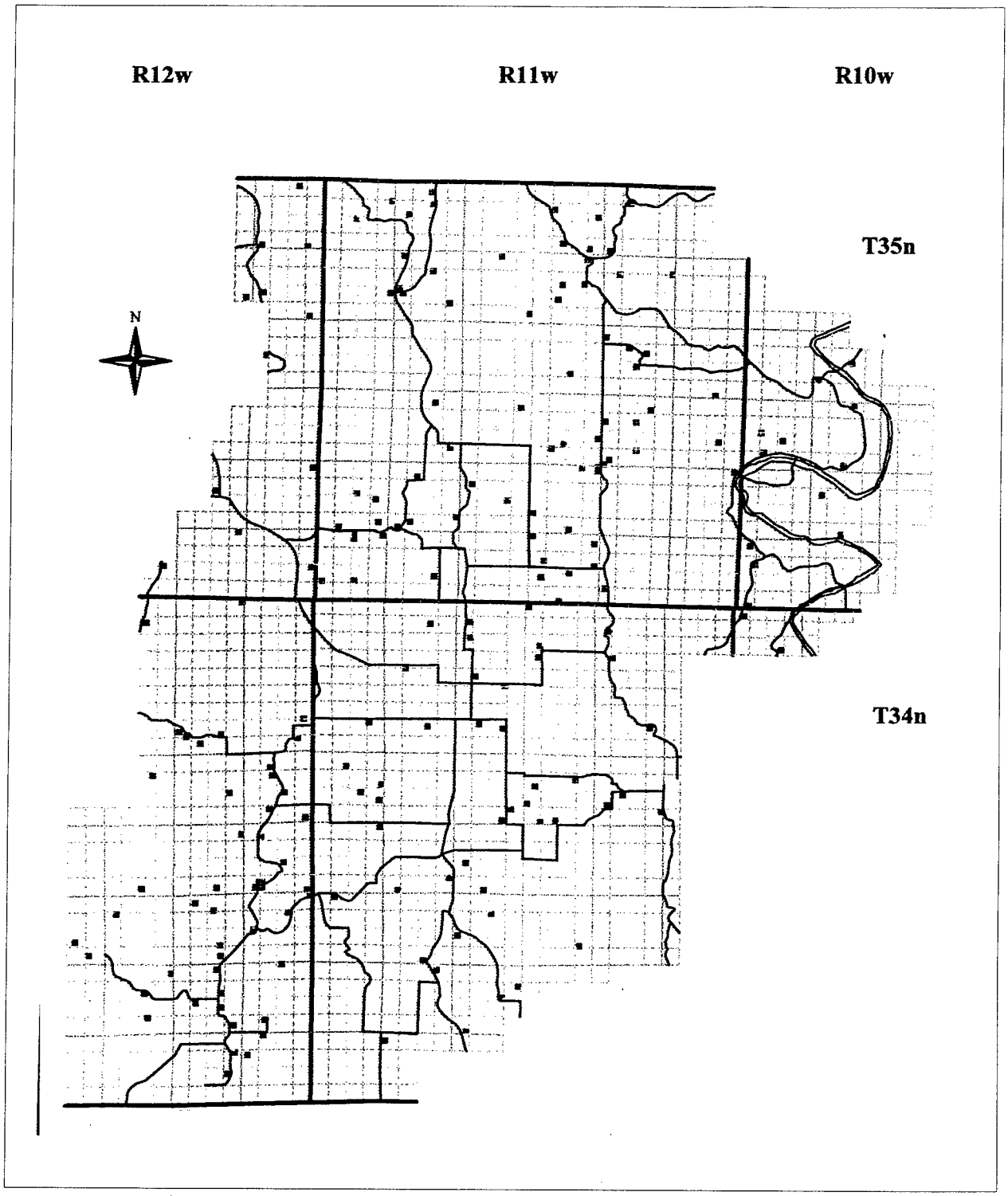

Figure 4. Major Features from the Pulaski County Plat Map

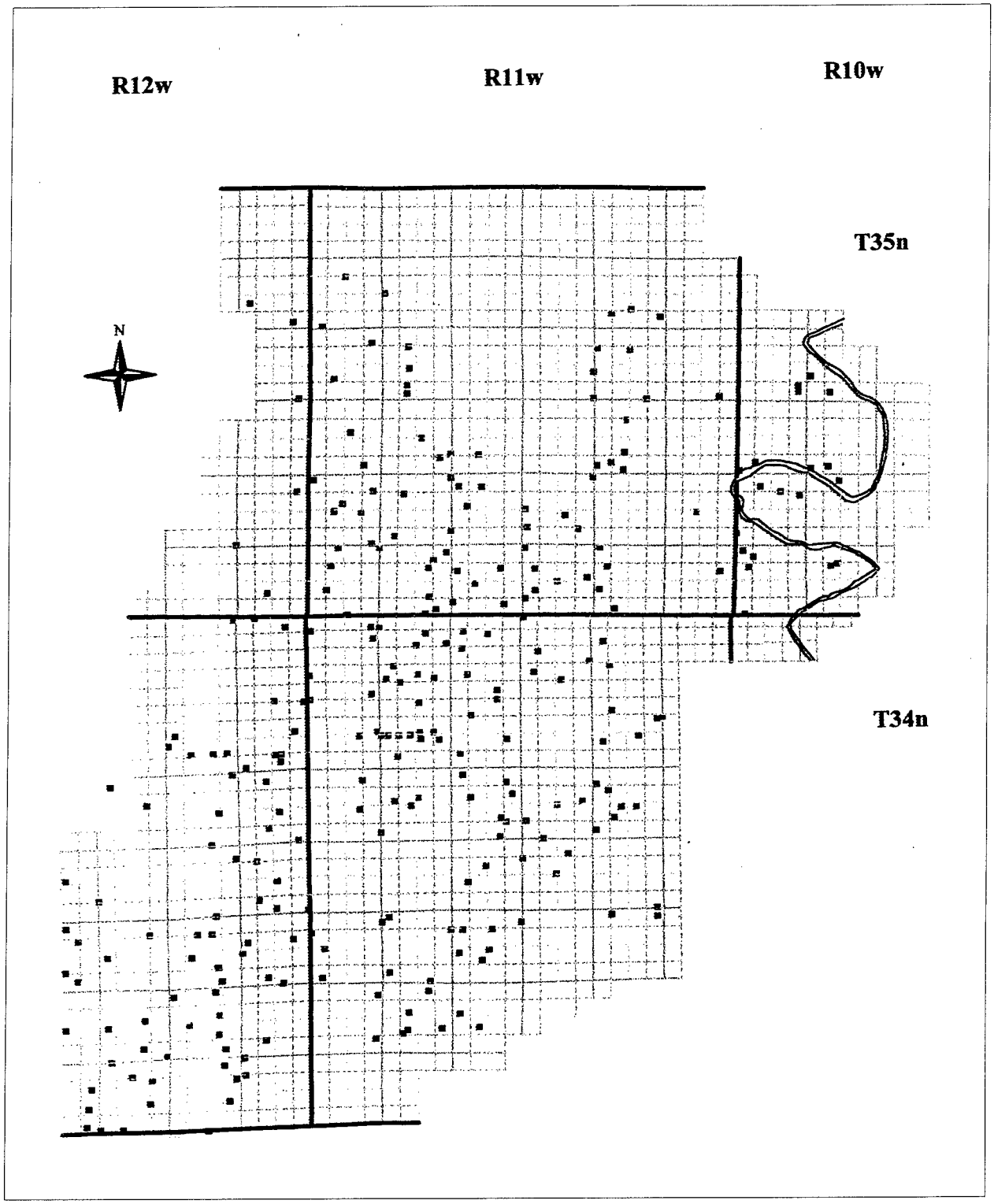

Figure 5. Structures and Clusters of Structures on 1936 Air Photos

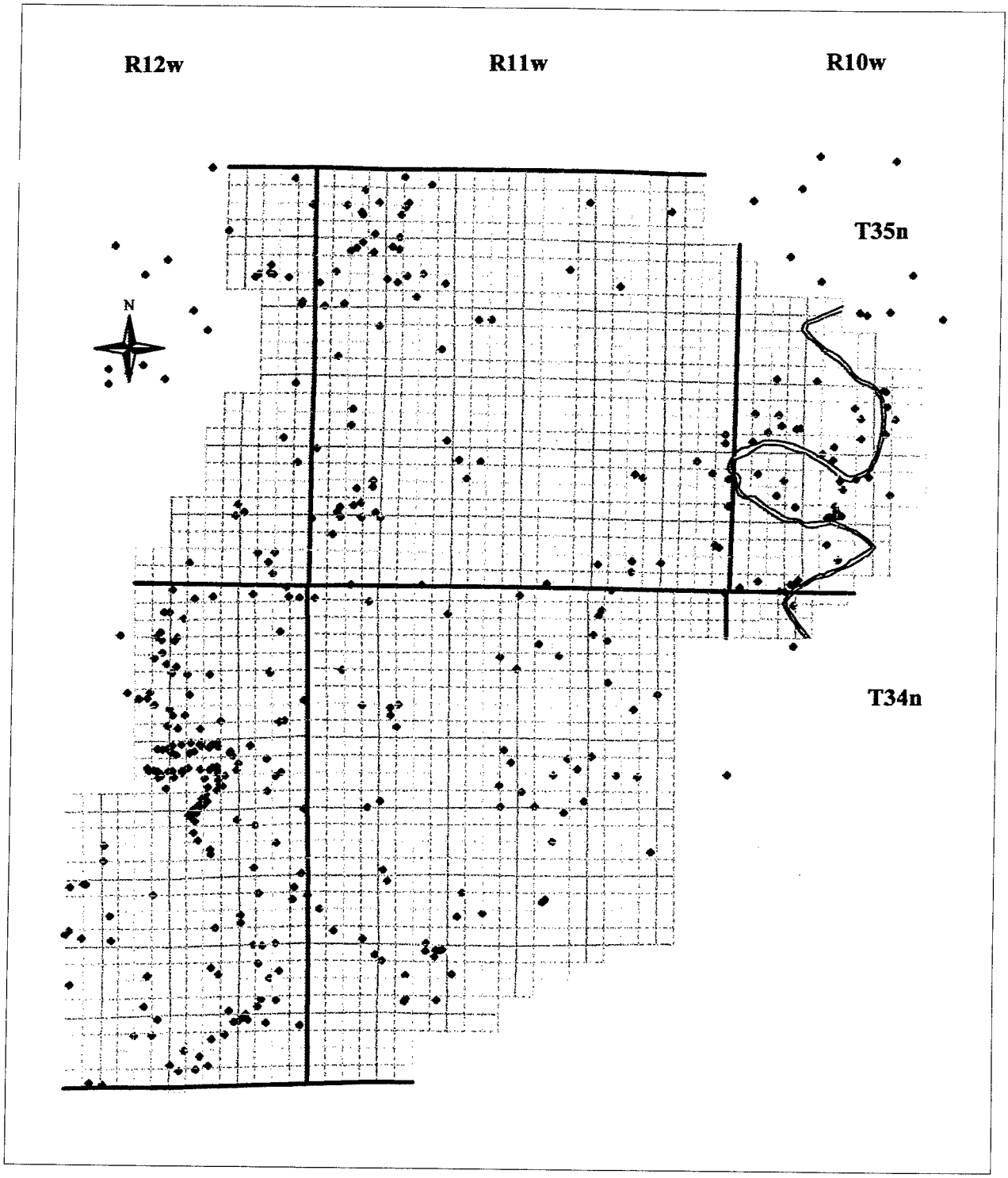

Figure 6. Recorded Sites

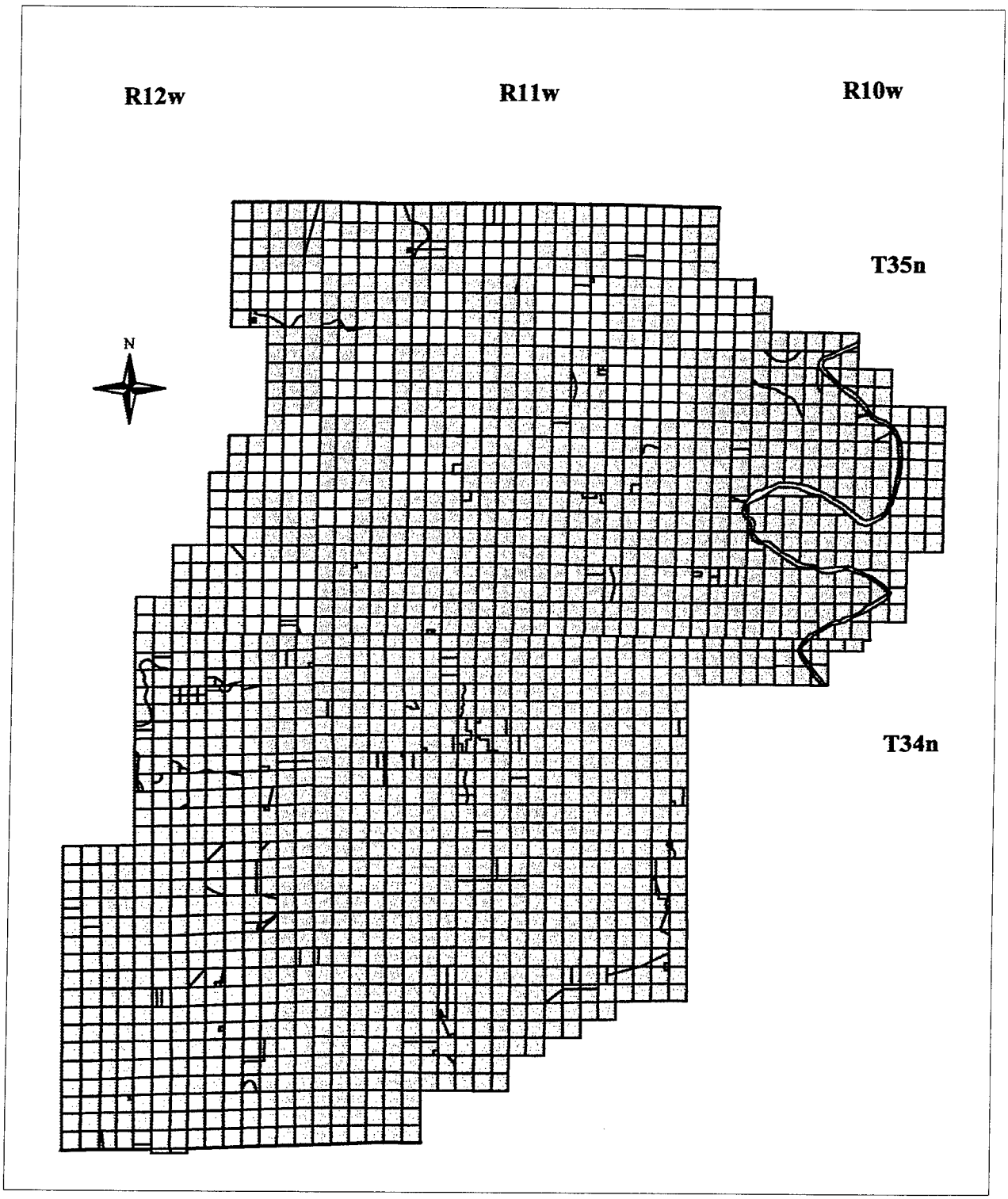

Figure 7. Lands Taken by the Railroad

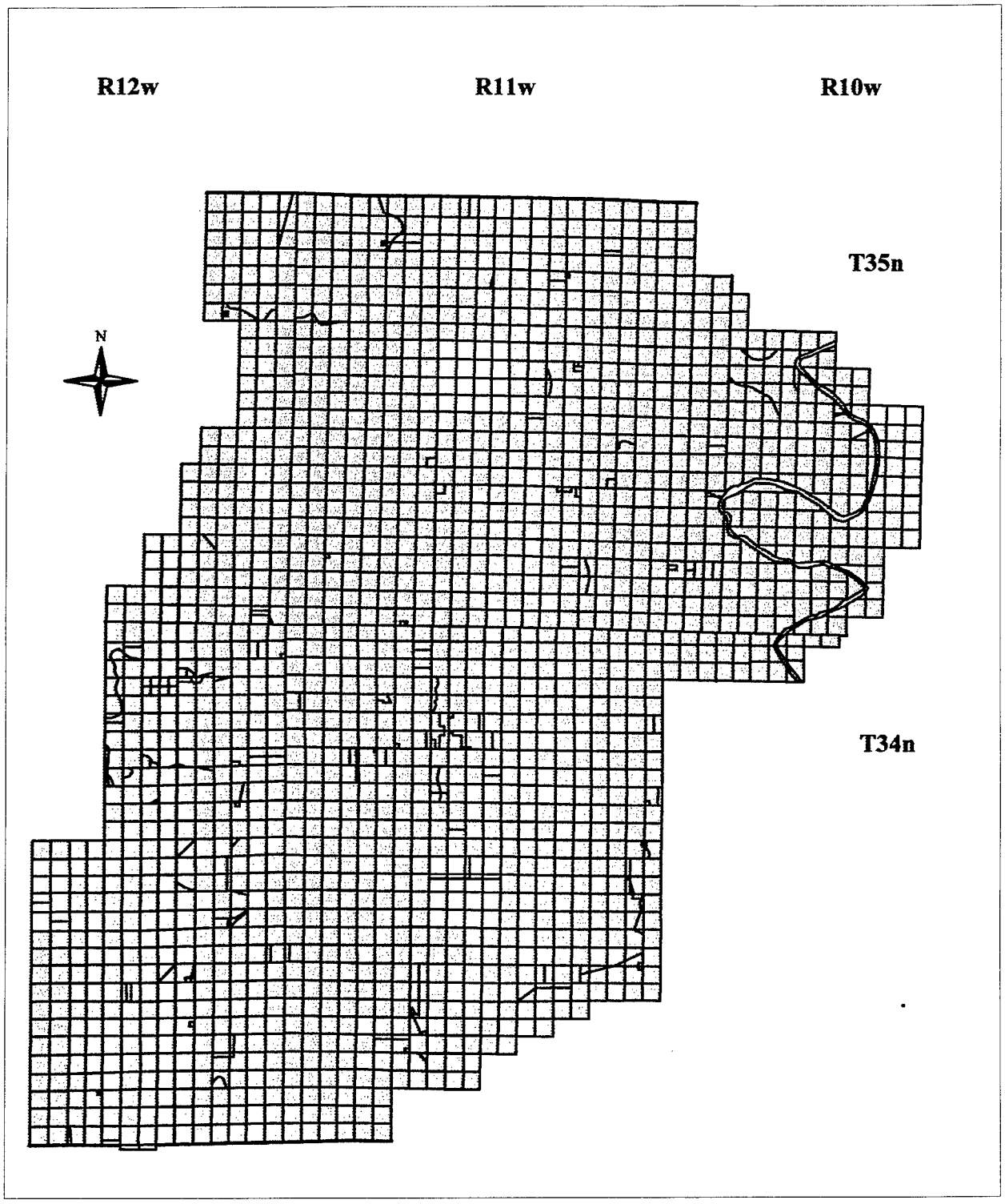

Figure 8. School Lands

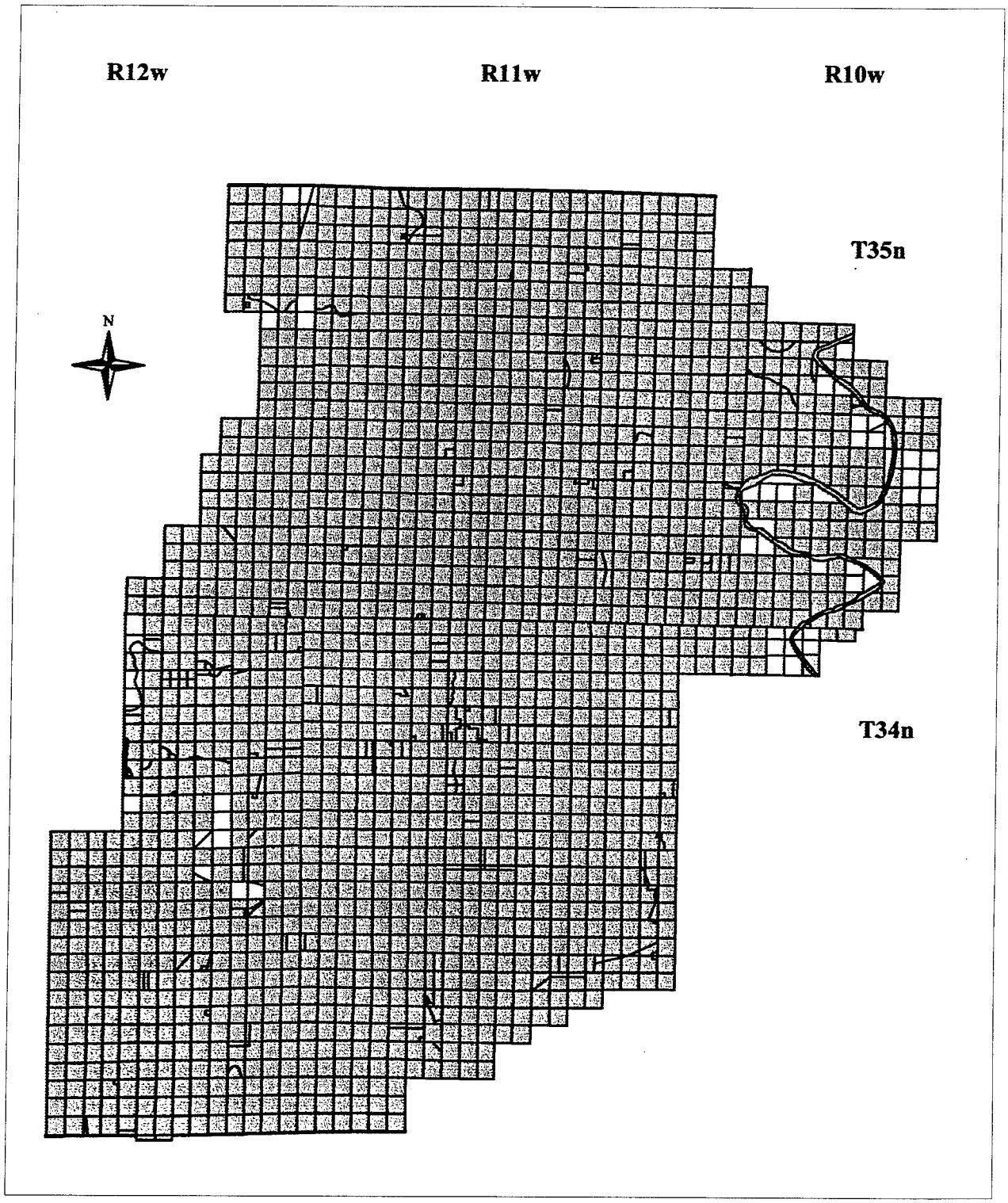

Figure 9. Lands taken prior to 1840

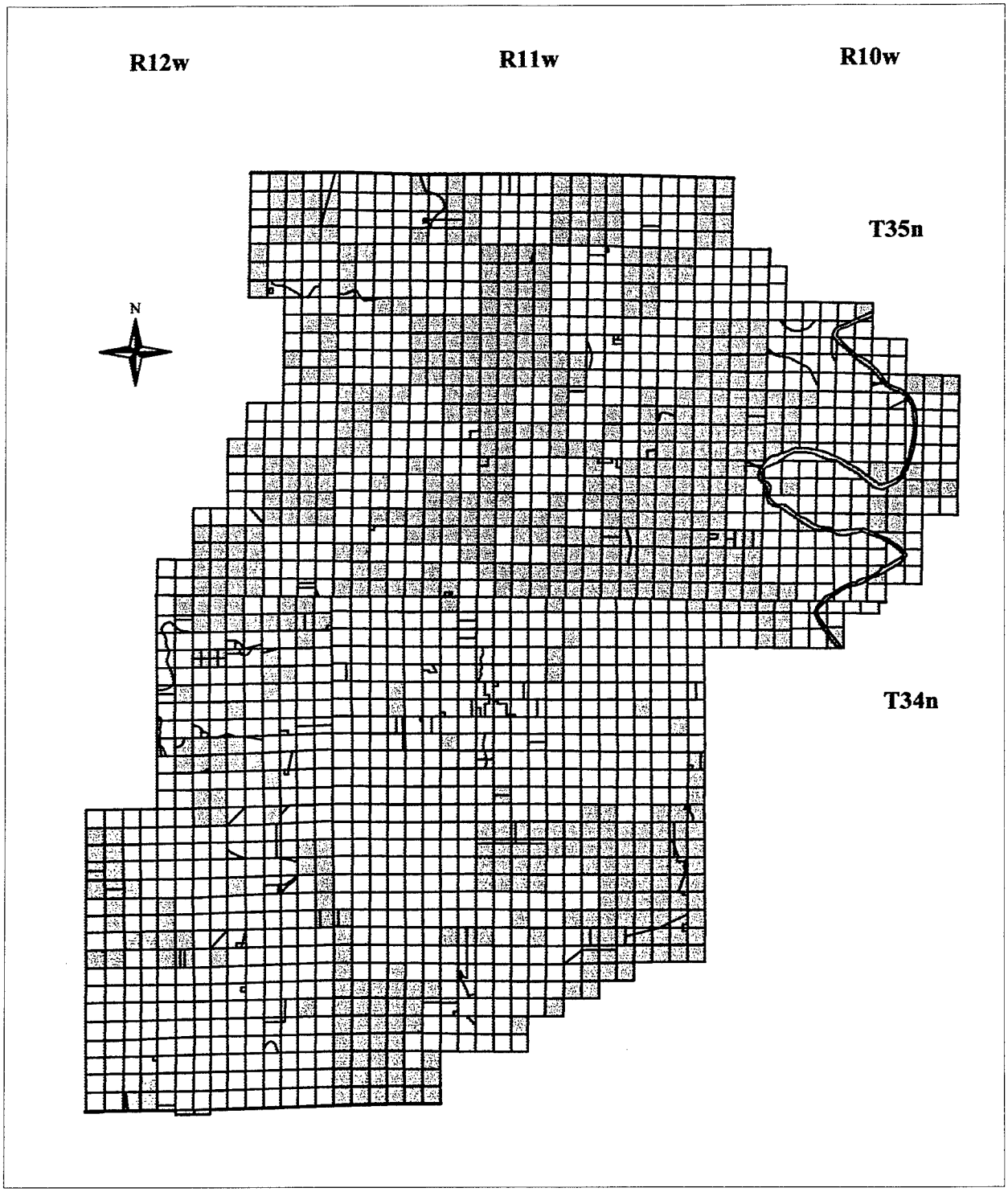

Figure 10. Lands taken prior to 1861

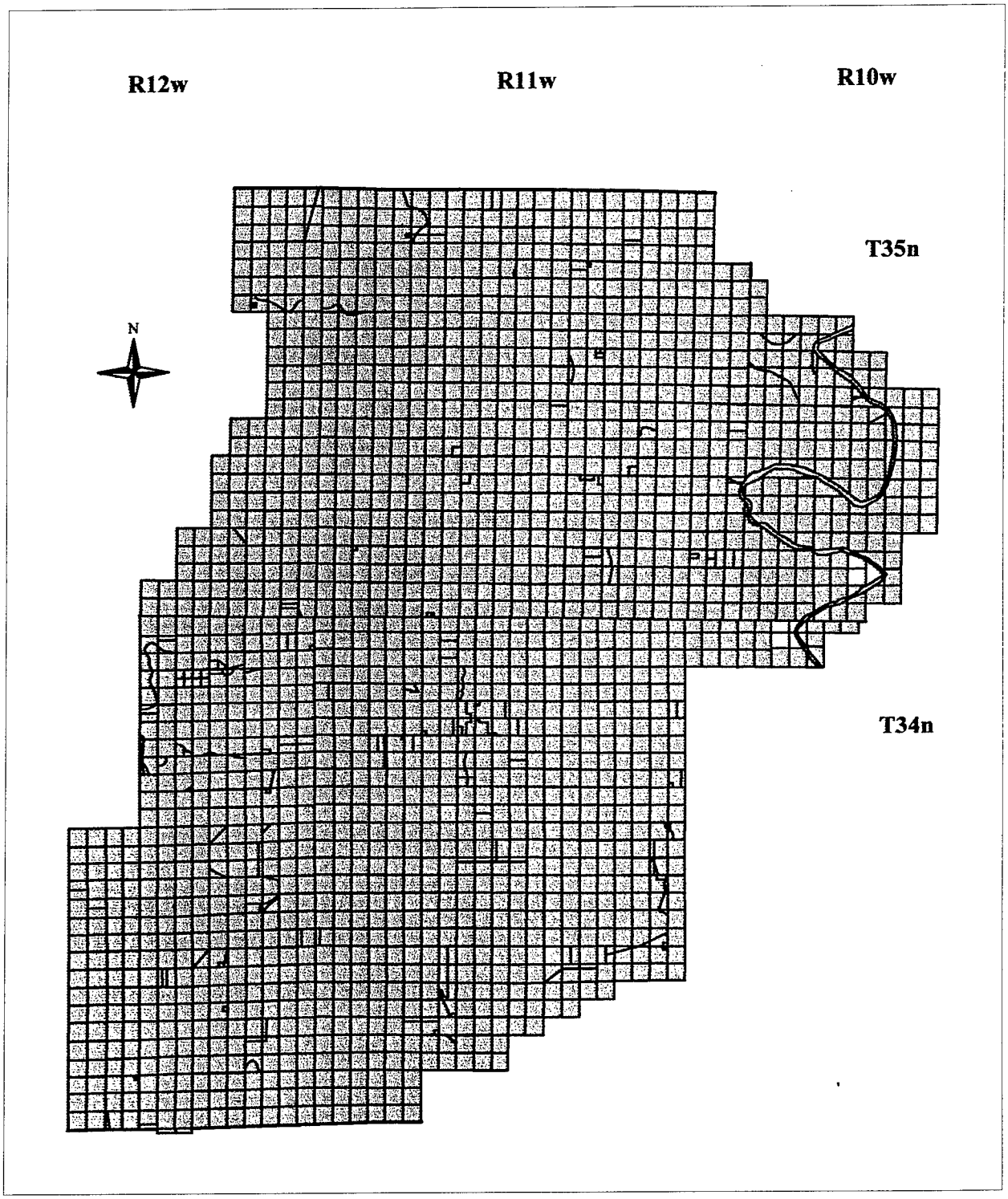

Figure 11. Lands taken by Washington Smith

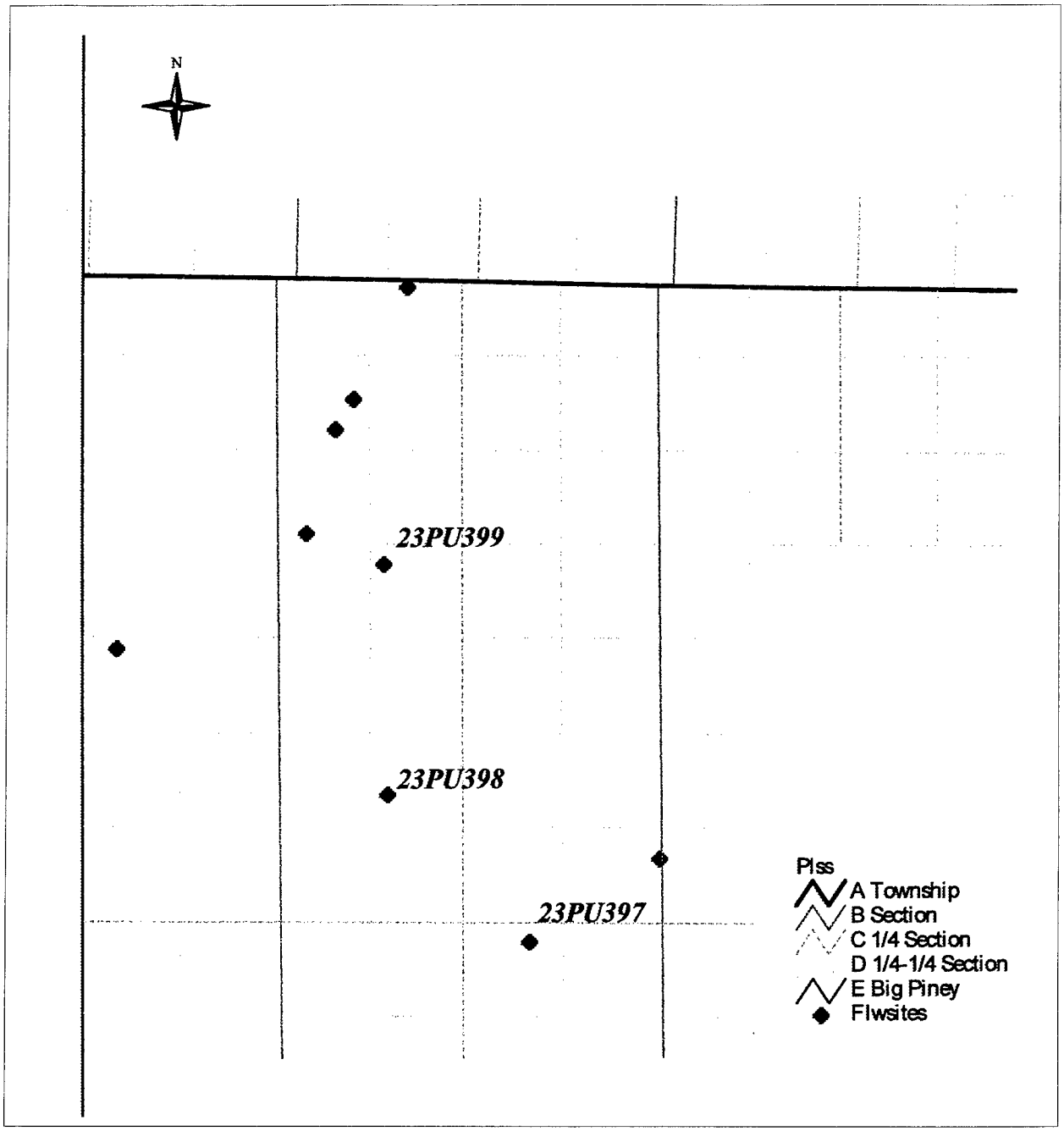

Figure 12. Farmsteads 23PU397, 23PU398, and 32PU399

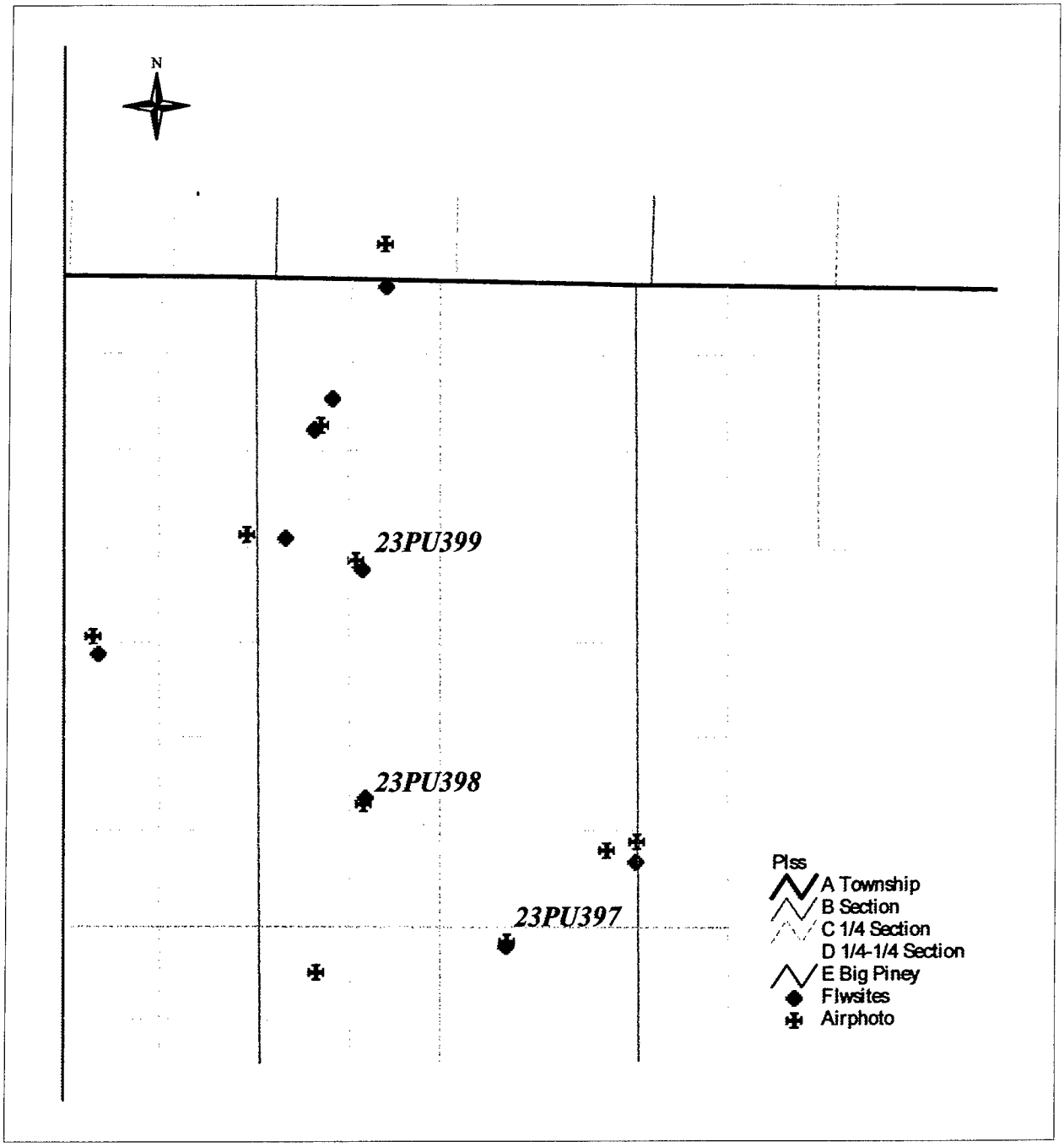

Figure 13. Farmsteads 23PU397, 23PU398, and 32PU399 with Structures from 1936 Air Photos

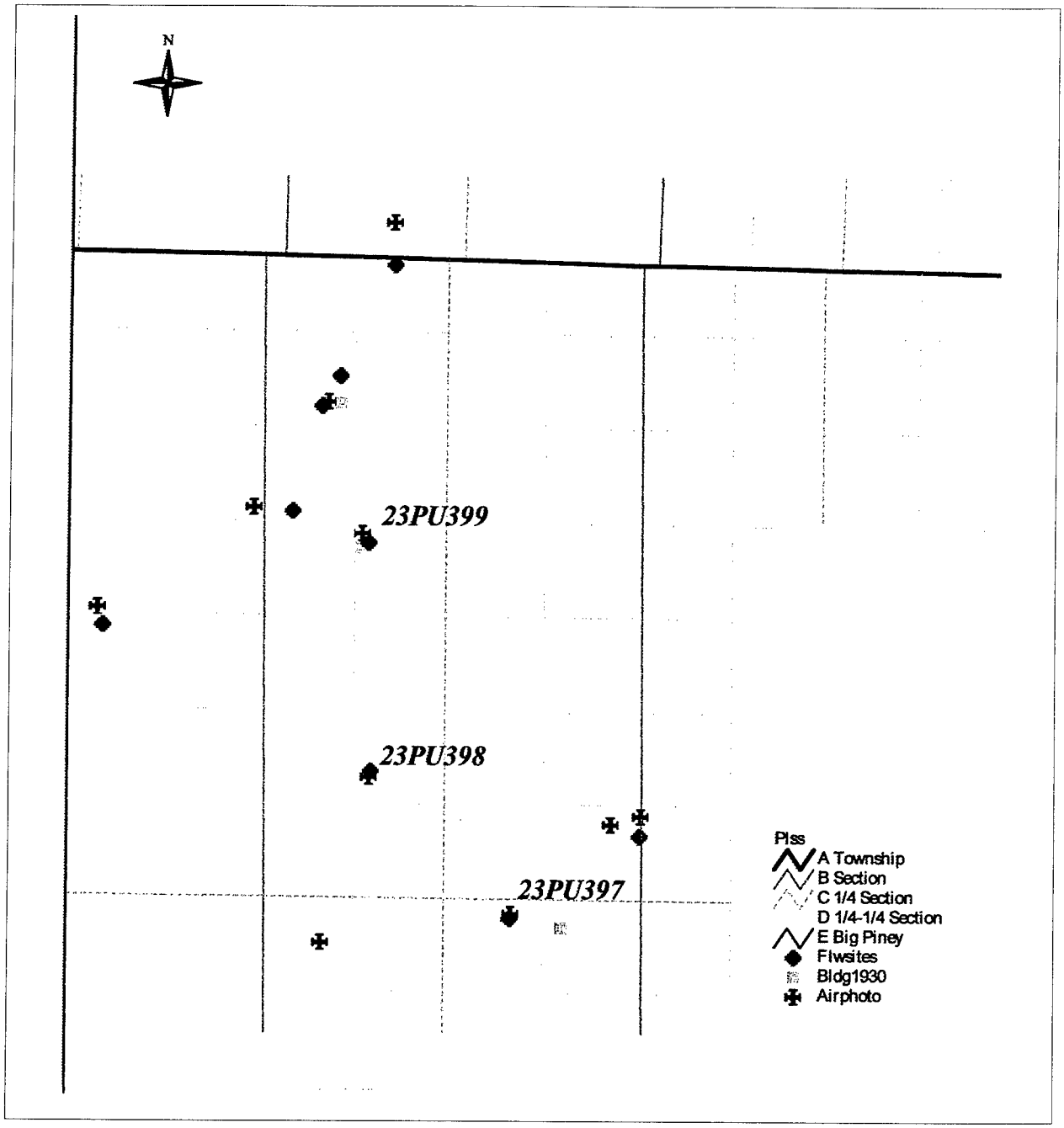

Figure 14. Farmsteads 23PU397, 23PU398, and 23PU399 with Structures from 1936 Air Photos and Pulaski County Plat Map

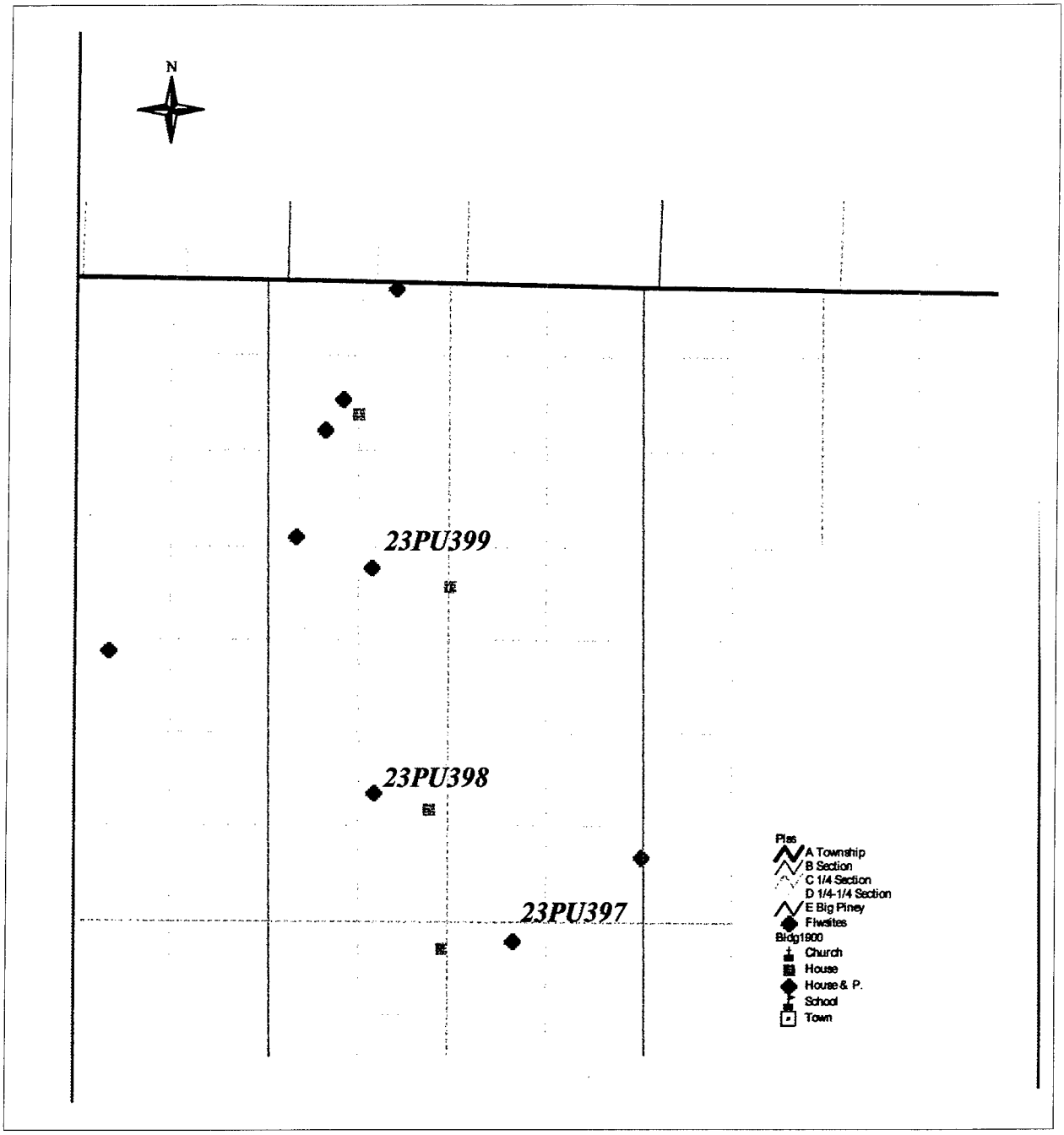

Figure 15. Farmsteads 23PU397, 23PU398, and 23PU399 with Structures from Pulaski County Atlas

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13. ABSTRACT ***(Maximum 200 words)***

This report describes a Geographic Information System (GIS) database developed by Archeological Assessments, Inc., Nashville, AR, and intended for use in the evaluation and management of Euro-American archeological sites at Fort Leonard Wood, Missouri (FLW). The GIS provides coverages designed to identify property ownership and the built environment on the lands which became FLW at various periods from the early 19th century until these lands were acquired by the U.S. Government in 1941. Part I provides metadata on database development and sample applications for its future use by FLW staff. Part II is a general discussion on the use of GIS in evaluating archeological site significance with suggestions for interfacing with previously developed historic contexts and property types. The project was sponsored by FLW, and the project oversight was provided by the U.S. Army Engineer Waterways Experiment Station (WES). The project is part of WES' ongoing research to develop a standardized approach for GIS database development and the evaluation of archeological site significance.

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Fort Leonard Wood	Property types
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Historic archaeology	Settlement patterns
Historic context	Site evaluation
Historic property	Upland South