



**A MICRO-COMPUTER MAPPING SYSTEM
FOR RESOURCE MANAGEMENT
AT
RICHMOND NATIONAL BATTLEFIELD PARK
RICHMOND, VIRGINIA
FINAL DRAFT: MARCH 17, 1988**



Recreation Resources Administration

School of Forest Resources
North Carolina State University

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Executive Summary

Graphically representing information in the form of maps has long been an effective tool utilized by managers of all types of resources. Almost all decisions in the field of resource management can be aided by some sort of drawing or map. Today, with the evolution of micro-computer technology, managers of natural resources are beginning to realize the potential of the microcomputer's mapping capabilities in aiding day-to-day decision making.

Recent technological advances have given micro-computer mapping capabilities that were only available in past years on large, expensive computer systems. These technological advances have enabled software developers to produce affordable easy-to-use mapping packages which will operate on the same micro-computers currently used by many agencies for little more than word processing.

It was the purpose of this project, undertaken through a cooperative agreement between the National Park Service and North Carolina State University, to develop and implement a practical micro-computer map display system at Richmond National Battlefield Park in Richmond, Virginia. The Department of Recreation Resources Administration's Computer Cartography Lab at NCSU has focused the majority of it's efforts over the past 10 years on the teaching, research and development of large, sophisticated mapping systems. Following the trends in the scaling down of automatic mapping systems, this lab is currently involving itself with agencies who did not have the ability to pursue this technology. Richmond National Battlefield Park exemplifies this type of agency.

RNBP manages 10 decentralized park units surrounding Richmond, VA preserving important Civil War battle sites which range from 2-300 acres in size. Upon implementation of this mapping system on-site at RNBP, managers will be able to inventory, edit, and produce maps with boundaries, soils, roads, topography, streams, trails, earthworks, buildings/structures, current vegetation, historic vegetation, and adjacent ownership information of each park unit.

This report includes three different articles concerning this project. The first article, The Development of a Micro-computer Mapping System for Resouce Management at RNBP is a general overview of the project and

will be sent to the NPS publication *CRM Bulletin* for publication consideration. The second article in this report, A Cost/Benefit Analysis of Implementing a Micro-computer Mapping System at RNBP, will be submitted to the NPS publication *Park Science*. The third article, A Micro-computer Mapping System for Resource Management at RNBP, is a hybrid of the two previously mentioned reports and is to be sent to a third NPS publication called *The Courier*.

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- II. A Cost/Benefit Analysis of Implementing A Micro-Computer Mapping System at Richmond National Battlefield Park (Park Science article)
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**THE DEVELOPMENT OF A MICRO-COMPUTER
MAPPING SYSTEM
FOR RESOURCE MANAGEMENT
AT
RICHMOND NATIONAL BATTLEFIELD PARK**

INTRODUCTION

Graphically representing data in the form of maps has long been an effective tool utilized by managers of all types of resources. Managers of natural resources especially benefit from some sort of drawing or map when faced with land use decisions. Manually producing these maps for each situation is both costly and difficult within the time constraints often present. Today, as a result of the advancement of the micro-computer, managers of natural resources are beginning to realize the potential value of these machines in aiding day-to-day decision making through their ability to handle spatial data.

The evolution of the micro-computer has focused on the development of software systems which manage tabular data (Table 1). As a result there are many quality software systems which handle this alphanumeric data on the market today.

Table 1.

<u>Vegetative Stand</u>	<u>Secondary Vegetation</u>	<u>Fuel Load</u>
1	Yellow Poplar	3
2	Hickory	1
3	Viburnum	2

The ability of the micro-computer to manage data which "describes" a spatial feature is relatively new in terms of software development. Incorporating the technologies of tabular and spatial data handling capabilities has been a natural occurrence enabling software developers to produce affordable, easy to use mapping packages which will operate on the same micro-computer currently used by many agencies for little more than word processing.

PROJECT DEVELOPMENT AND OBJECTIVES

The Department of Recreation Resource Administration's Computer Cartography Lab at North Carolina State University has focused the majority of its efforts over the past 10 years on the teaching, research, and development of large, sophisticated mapping systems. These systems were frequently valued at amounts in excess of \$50,000 dollars. Though the initial objectives of these projects have been successful, the mapping systems never reached their full potential of usefulness simply because of their inconvenience to the user. Resource managers found it difficult to foresee when a particular map would be useful; then arrange for the operators of these large systems to create the map off-site. As a result, individual land managers made day-to-day resource decisions without the requisite map information in-hand.

The National Park Service has been an active participant in utilizing computer mapping technology to its advantage, but like most other agencies they too have focused on large centralized systems. The high costs of hardware, software, and personnel necessary to implement these large mapping systems limited their use to only large park service units with relatively large budgets. Until now, small decentralized park service units could not benefit from automated mapping technology.

It was the purpose of this project, undertaken through a cooperative agreement between the National Park Service and NCSU, to implement a practical micro-computer map display system at Richmond National Battlefield Park in Richmond, Virginia. Richmond National Battlefield Park (RNBP) manages ten decentralized park units preserving important Civil War battlesites ranging from 2 to 300 acres in size. This park unit exemplifies natural resource agencies who until now did not have the ability to pursue computer mapping technology.

SYSTEM SELECTION CRITERIA

The selection of hardware and software for this project was driven by the following criteria.

1. Hardware systems had to be compatible with existing computer facilities in the park. It was important that the mapping program operate on basically the same equipment as the park was using for its word processing and data base management computer functions. This was to insure both minimum additional costs and minimum difficulty in learning a new program (i.e. the mapping software).

2. Software had to be low cost. The park units that are affected by this effort do not have access to large computing budgets. Therefore only software in the \$5,000 range was considered. This was not a significant barrier as there are a number of systems available in the low range and the next price groups occurs at about the \$20,000 bracket.

3. The selected system must be operated by existing park personnel. The small parks cannot afford a separate mapping staff nor can they afford substantial training for map system operators. Therefore the mapping system for these units must be easily operated by a casual operator (i.e. very frequent use is not necessary for efficient operation for the program) and familiarity with word processing or data base programs is the only prerequisite to system operation.

In addition to the operational criteria a series of application criteria were also developed. Mapping programs have functional differences (i.e. types of maps that they produce) that relate to the success of their use in a park setting. For purposes of this selection two functions were examined. These functions were raster versus vector display and geographic information systems versus map display systems.

1. Mapping systems deal with data in two display formats, raster and vector. The raster systems display maps as a series of dots or cells as opposed to a set of lines. A good way to envision how these systems would operate in a manual environment is to imagine producing a map with a standard typewriter. The map would be drawn reducing the map information to a series of cells with each cell represented by a keystroke on the typewriter. The accuracy of these maps is a strict function of the size of map area represented by each cell. Cell based systems are very efficient from the standpoint of computer processing but suffer in that loss of accuracy often accompanies their use. Vector systems display maps in the same manner as their hand drawn counterpart. That is, they connect points and lines into map drawings. These systems do not suffer from loss of accuracy but require more computer resources (i.e. memory, disk space, machine speed, etc.) to perform standard map operations. These requirements often translate into more expense or training for the operator when vector mapping systems are employed.

2. Mapping systems can also be delineated by the levels of map based analysis they support. Geographic Information Systems (GIS) allow the map user to automatically perform operations that literally create new data by combining two or more existing maps. For example a GIS program could create a new map of soils and vegetation combinations from an existing soils and an existing vegetation map. This new map would "create" new lines that were the boundaries of each combination and would simultaneously measure the area of each of these combinations. GIS program exists in both raster and vector formats, but the vector programs are relatively quite expensive (\$20,000 and up). Map Display Systems (MDS) do not have the ability to create new maps from the combination of existing data. These systems can display existing map information at different scales and

with varying shading patterns and they can literally plot one map upon the other, but they do not produce new lines or automatically calculate new area measurements from existing maps. In the soils and vegetation example, an MDS could display both existing maps at the same scale and produce a transparent "overlay" of the soils map to be placed on the vegetation map but it could not create a new map of the combinations without manually redrafting them. MDS system also exist in both raster and vector formats with both versions available in the low price group (i.e. under \$5,000).

SYSTEM EVALUATION

Given the above criteria and system characteristics a series of potential systems were evaluated for use in this project. It was determined that, at least for the initial effort, it was important that the maps produced by the potential system be very similar in appearance to the hand drawn maps that the park currently employs in its management decisions. Switching to a raster based system would potentially reduce the accuracy of existing data and would require acceptance of a less aesthetic produce by the staff. In addition, conversion to a raster format is a rather simple procedure if at some later time the park would wish to use that type of system. Several raster system were considered. These included PMAP available from Dr. Joseph Baery of Yale University, GRASS available from the U.S. Army Corps of Engineers, and MAPIT available from Questionnaire Service Company. These were all inexpensive systems ranging from 0 to 1,000 dollars in cost. PMAP and MAPIT meet the ease of use criteria but GRASS is relatively difficult to operate. PMAP and GRASS are GIS programs and MAPIT is a MDS.

Only one vector GIS system was found to meet the cost criteria. This was SAGIS available from the National Park Service. SAGIS did not run on a microcomputer (it is currently being converted) and did require some

extensive training to operate. Therefore system selection was focused on a vector based MDS.

Three vector MDS programs were considered. These were ATLAS*GRAPHICS available from Strategic Locations Planning, MULTIMAP available from Planning Data Systems, and AUTOCAD available from Autodesk. All three systems operated on the existing hardware but AUTOCAD was comparatively expensive (\$3,000 as compared to \$500) and also was rather difficult to use especially in a mapping environment. MULTIMAP was slightly more difficult to operate than ATLAS*GRAPHICS and produced a lower quality drawing than the ATLAS*GRAPHICS package. Therefore for this project ATLAS*GRAPHICS became the system of choice.

PROCEDURE DEVELOPMENT

The primary objectives of system development were to present Richmond National Battlefield Park with an accurate, useful, low cost, map display system which could be installed and operated on-site with existing personnel. Through the implementation of the system, the park service hoped to see many long-term benefits accrue from this initial cooperative agreement

System development consisted of three basic stages. Stage one involved creating accurate boundary maps to use as a base. Stage two consisted of manually transferring the desired information onto these base maps, and the final stage was to physically enter this information into the computer's memory via a process called digitizing. Digitizing, in this study, involved describing each mapped feature with paired coordinate data (e.g. lat/long's) using an electronic grid called a digitizing tablet.

Boundary maps were produced using a software package developed at NCSU called Interactive Traverse Mapping and Analysis Program (ITMAP). Official boundary descriptions, taken from legal deeds, were entered into

A hand-drawn sketch of a five-pointed star. The star is oriented with one point at the top. The left side of the star is concave, with the bottom-left point being the most prominent. The lines are drawn with a black pen or marker on a white background. The star is centered within the page.

A horizontal line with an arrow pointing to the right. On the line, there is a point labeled z and a point marked with an asterisk $*$ to the right of z . Above the line, there are four short, parallel diagonal lines slanting downwards from left to right.

1' = 700
FEET

ITMAP for each park unit. Base maps could then be plotted at any scale and acreage figures calculated. Plots of each park unit were produced at a scale convenient for digitizing (Fig. 1).

Stage two involved acquiring the most up-to-date maps available which displayed the following information for each park unit; topography, soil types, roads, streams, trails, buildings/structures, earthworks, current vegetation, historic vegetation, and adjacent ownership maps. Transferring this information onto the ITMAP-produced maps was done by tracing the attributes onto their respective base maps by the use of a zoom-transfer scope to deal with information transfer between maps of different scales. Maps were now ready to be digitized, but were first sent to RBNP to be proofed for accuracy.

After the attributes were digitized for each individual park, they were saved into a corresponding computer file. These files are called boundary files because they contain the paired coordinate data that describe the individual attribute's shape or boundaries. To organize the boundary files a coding system was necessary in order to identify both attribute and park unit. Since each of the ten park units at RBNP were already referred to by park managers in numeric code, the attributes were also given a numeric code. Files were then named by appending the existing park unit code with the attribute code. For example, the boundary file containing soil type boundaries for the park unit of Cold Harbor would be coded 0702; 07 is the code for Cold Harbor and 02 is the code for the soil type attribute.

The final attribute involved in the development of this system was to map all land under private ownership that was directly adjacent to each of

the park units. Adjacent ownership maps were handled a bit differently than the other ten attributes because of two reasons. Firstly, this attribute was not one which would later be combined with any other in an overlay of attributes and did not require the use of the zoom-transfer scope. Secondly, these maps were physically larger and more complex. To accurately map adjacent boundaries, county tax maps were obtained for the areas surrounding each park unit. Then, base maps were again produced in ITMAP only this time at the same scale as the tax maps themselves. These ITMAP boundaries were cut and placed on the tax maps in order to show an exact park boundary in relation to surrounding properties. These maps were then digitized in the same manner as the other attributes.

RESULTS

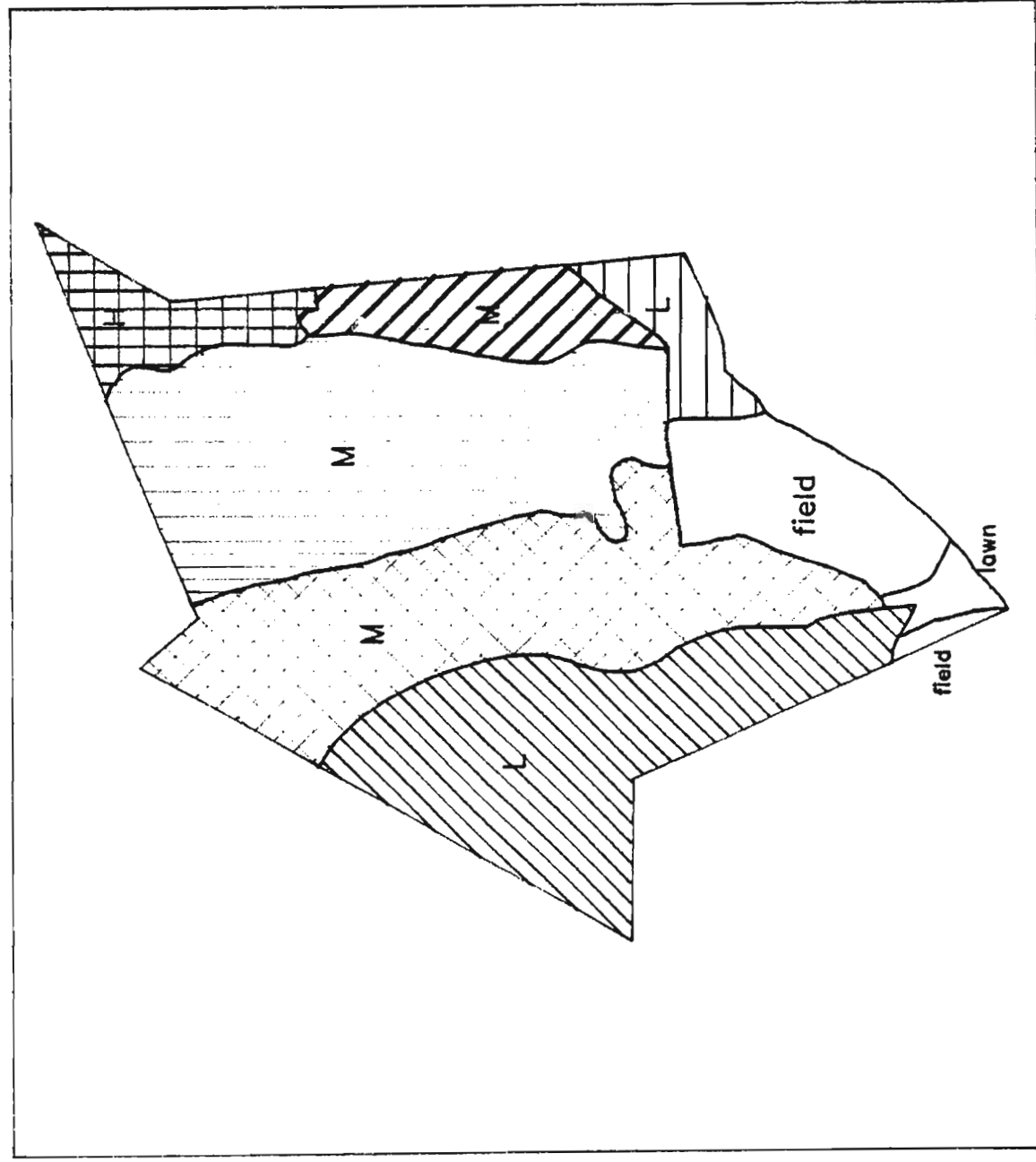
In order to demonstrate the usefulness of this map display system, three current management activities that could be aided by the system were identified by staff members at Richmond National Battlefield Park. The following maps were produced to help the managers at RNBFP conceptualize and communicate their resource decisions:

- 1) A map useful in planning a prescribed burn in an area dominated by the excessive growth of honeysuckle. (Fig. 2)

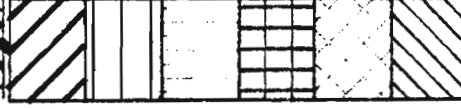
This map shows the spatial relationships of understory vegetation along with each stand's respective fuel load rating as determined by a U.S. Forest Service study done at the park in 1984. This data would be extremely difficult to visualize from many columns of tabular data, but once displayed graphically offers the managers of this park a valuable tool in planning a successful prescribed burn.

RICHMOND NATIONAL BATTLEFIELD PARK - COLD HARBOR CATTLE

Secondary Understory Vegetation/Fuel Load Distribution



Vegetation and Burn Rating



Yellow Poplar

Hickory

Viburnum

Red Maple

Dogwood

Honeysuckle

L = Low Fuel Load

M = Medium Fuel Load

H = High Fuel Load

2) A map displaying the location of an earthwork being used in an ongoing study of vegetation management. (Fig. 3)

Since the preservation of Civil War earthworks is a main objective of RNBP managers, a current study is underway to determine the usefulness of the herbicide *Round-UP*. Should this management technique be expanded to the other earthworks of this park unit, the ability of this mapping system to inventory and determine the exact footage of earthworks within the park would be of great benefit to park managers.

3) A map demonstrating the integration of information imported from the data base management software, Dbase III Plus, then displayed on an adjacent ownership map. (Fig. 4)

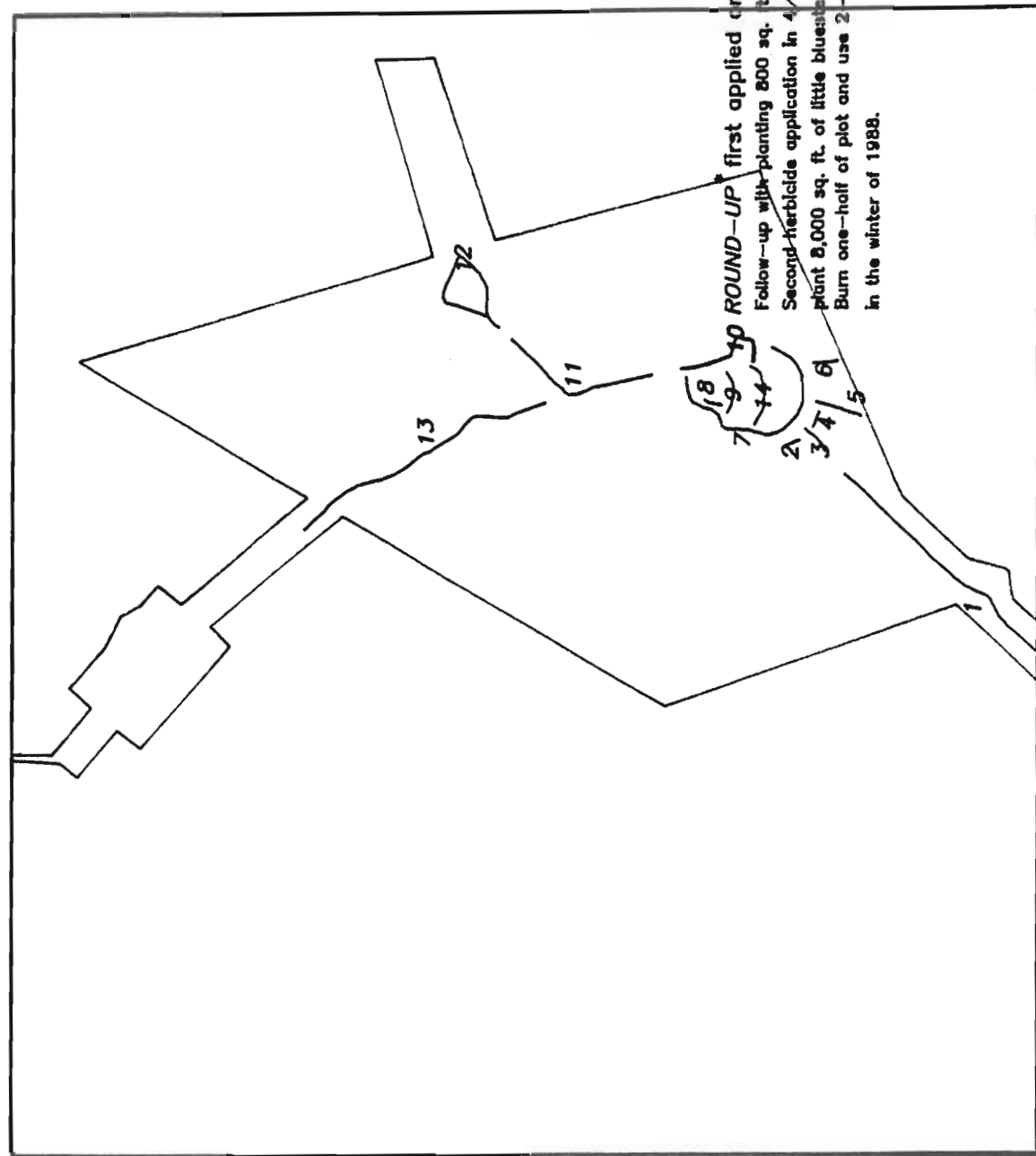
In the near future, data managed by the administration at RNBP will be done with the powerful and popular software package Dbase III Plus. The linkage of this mapping system with data contained in Dbase files was therefore a concern. A file was created in Dbase III Plus containing landowner name, address, and assessed land values for parcels adjacent to the Cold Harbor park unit. Numeric data from this Dbase file was then successfully imported into *ATLAS*GRAPHICS* and displayed.

CONCLUSION

Creating a map in this system is an easy and logical process. A boundary file is first loaded into the computer's memory. Next, a data file is associated to the appropriate boundary file. There can be any number of data files associated to one boundary file. For example, data files

RICHMOND NATIONAL BATTLEFIELD PARK — FORT HARRISON

Earthwörk Vegetation Test Plot



RICHMOND NBP - COLD HARBOR / GARTHRIGHT HOUSE UNITS

Adjacent Land Value/Acre

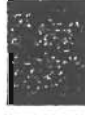
Land Value/Acre



\$1000 to \$2000



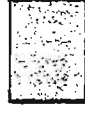
\$2000 to \$5000



\$5000 to \$10000



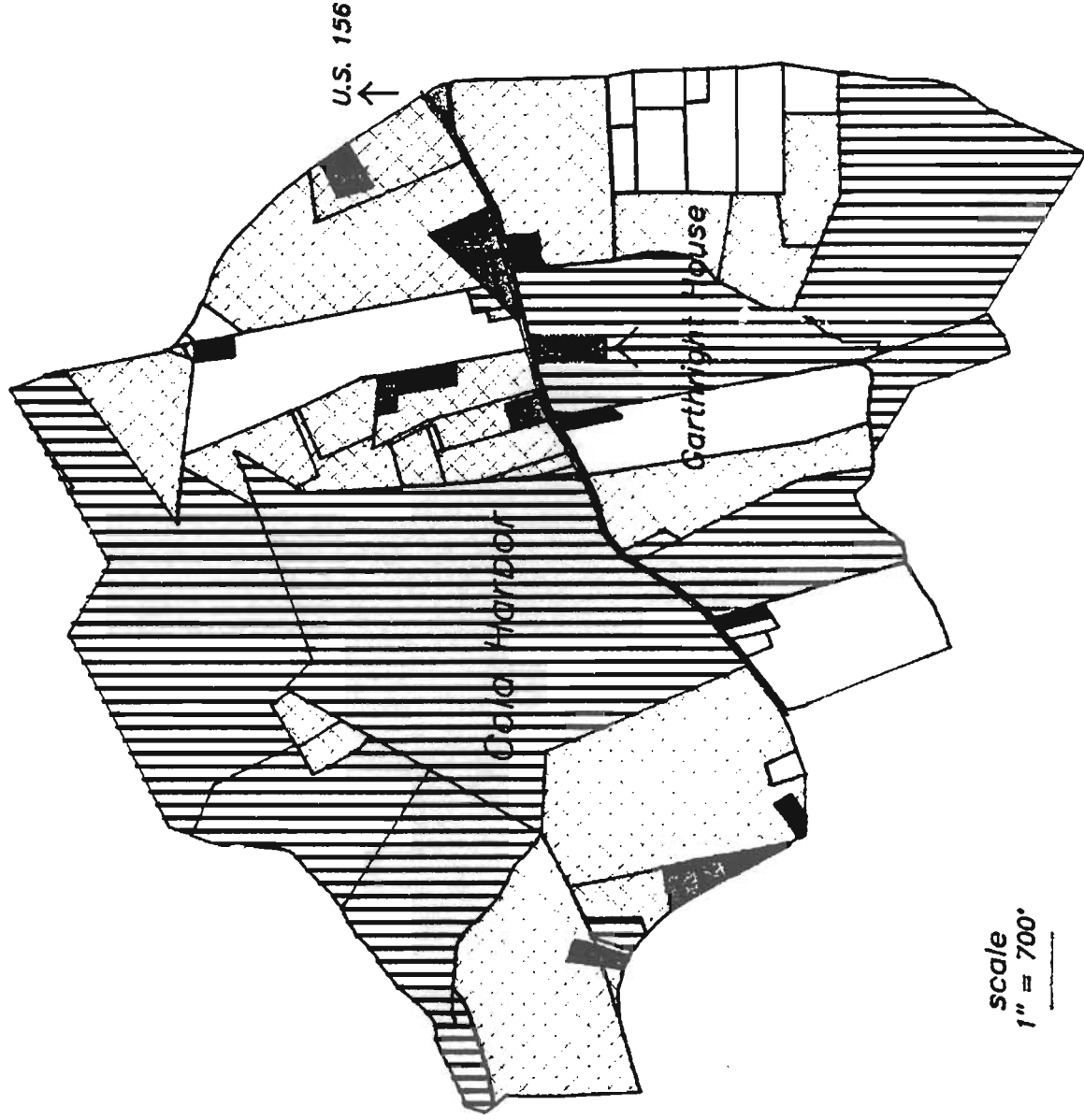
\$10000 to \$20000



\$20000 to \$30000



\$30000 to \$40000



scale
1" = 700'

containing primary vegetation, secondary vegetation, site index, and board feet of timber could each be displayed using the same vegetative stand boundary file.

Once the data attribute is chosen and associated to the appropriate boundary file, the data is arranged in a manner which it can best be communicated on the map. Colors and hatch-patterns are then chosen for each data range. Titles and sub-titles are then typed in with sizes and fonts selected for each. The map is then displayed on the computer screen or plotted on paper with a machine that uses colored felt tip pens. The amount of time it takes to create a map in *ATLAS*GRAPHICS* is approximately 30 minutes.

Though there will be benefits immediately derived by Richmond National Battlefield Park upon system implementation, many additional benefits will be realized in the future. The process of keeping maps up-to-date will be aided, for editing existing digital information is a quick and easy task. Maps can be quickly produced when a management decision needs to be made. Paper maps will become practically disposable in the context that they can be cheaply reproduced. Managers and workers will not be afraid to take these maps out-of-doors and use them in the field.

The design of this system presents the managers at RBNP the flexibility to customize maps to their liking. Maps of attributes for any given park may be combined in any manner simply by plotting one on a piece of paper, and then plotting another directly on top of it. The amount of time it takes to create an average map in *ATLAS*GRAPHICS* is approximately 30 minutes.

Additional long-term benefits of this micro-computer mapping system include it's adaptability in the ever changing world of hardware

and software development. This digital information will not become obsolete as it will always be possible to move this data between hardware and software systems. Though technology will continue to advance, this initial effort will not be lost.

Measuring the benefits of this mapping system in dollars is obviously a worthy justification for its existence, but when you consider that it is an effective tool managers can use to facilitate decisions concerning the fragile resources which preserve our very heritage, it proves worthy indeed.

**A COST/BENEFIT ANALYSIS OF IMPLEMENTING A
MICRO-COMPUTER MAPPING SYSTEM
FOR RESOURCE MANAGEMENT AT
RICHMOND NATIONAL BATTLEFIELD PARK**

EXECUTIVE SUMMARY

Recent technological advances have given micro-computers mapping capabilities that were only available before on large, expensive computers. This now enables the benefits of automated mapping to be realized by many more of those with mapping needs.

This paper analyzes the development and implementation of a micro-computer map display system for resource management at Richmond National Battlefield Park (RNBP). This park is a small, decentralized unit of the National Park Service which did not have the ability in the past to benefit from automated mapping technology. Through a cooperative agreement with the Computer Cartography Lab at North Carolina State University, RNBP has pursued an inexpensive micro-computer map display system.

Projected over a three year period, the present value of this system is estimated to be \$94,638.87 at a 7% discount rate. The benefits of error avoidance, information efficiency, and map creation, editing, and repeatability all contribute to the positive net benefits of the system.

Not automating the mapping needs of RNBP not only means foregoing these benefits, but managers and administrators at RNBP document that hand drawn maps cannot be produced quickly enough on a day-to-day basis to aid in natural resource decision making. For these reasons the alternative of not having this micro-computer map display system is undesirable.

INTRODUCTION

Graphically representing data in the form of maps has long been an effective tool utilized by managers of all types of resources. Almost all decisions in the resource management field require some sort of drawing or map. Today, as a result of the advancement of the micro-computer, managers of natural resources are beginning to realize the potential of the micro-computer's mapping capabilities in aiding day-to-day decision making.

The evolution of the micro-computer has favored the development of software which will manage tabular data over software capable of handling spatial data. As a result there are many fine software systems currently available which handle alphanumeric data. Recent technological advances have enabled software developers to produce an affordable easy-to-use mapping package which will operate on the same micro-computer currently in use by many agencies for little more than word-processing.

The Department of Recreation Resources Computer Cartography Lab at North Carolina State University has focused the majority of its efforts over the past 10 years in the teaching, research, and development of sophisticated mapping systems on large, expensive, centrally based mini-computers. Though the initial objectives of these projects have been successful, the mapping systems never reached their full potential of usefulness simply because of their inconvenience to the user. Individual land managers ^{who} ~~that~~ could have continually used the systems to facilitate resource decisions found it difficult to foresee when a particular map would be useful; therefore, day-to-day resource decisions were made without information in hand. This is basically the same as not having any automated mapping capabilities at all, for hand-drawn maps can rarely be

produced within the timeframe given.

The National Park Service has long been an active participant in utilizing computer mapping technology to its advantage, but like most other agencies they too have focused their efforts on large centralized systems. The costs in both dollars and specialized personnel to operate these large systems limit their effectiveness to small decentralized National Park Service units.

The Computer Cartography Lab at NCSU through a cooperative agreement with Richmond National Battlefield Park in Richmond, Virginia, agreed to develop a practical and useful micro-computer map display system between 2/27/87 and 12/31/87. Richmond National Battlefield Park (RNBP) manages ten small, decentralized park units preserving important Civil War battlesites ranging from 2 to 300 acres in size. The system will not require any major investments to the park in hardware or personnel. The main focus of the system will be to develop a flexible, easy-to-use map display system which will operate at the park unit itself.

It is the purpose of this paper to develop a cost/benefit analysis of the cooperative agreement made to develop and implement this mapping system at RNBP. Should the benefits identified exceed the costs of this system over the next three years, this system will be perceived as useful, for the alternative is to have no method at all which will produce maps quickly enough to facilitate resource decisions on a day-to-day basis.

COSTS

In general, the costs in a cost/benefit analysis are easier to accurately measure than are benefits. However, care must be taken in determining the costs, for implementing an on-site map display system at RNBP involves more than just hardware and software purchases. This analysis will discuss four categories of costs involved in the development

and operation of the mapping system; system development costs, purchase costs, personnel costs, and maintenance/supply costs.

System Development Costs

Included in these costs to the National Park Service (NPS) are personnel salaries, travel costs, computer time, and supplies as seen in the project budget contract listed in Table 1. These costs identify the initial costs of the project.

Table 1. NPS - NCSU Cooperative Agreement Project Budget

National Park Service Share:

1. Salaries

A. Principle Investigator	\$4,789
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B. Graduate Student	\$6,700
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2. Travel	\$2,750
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3. Computer Time	\$1,000
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4. Supplies	<u>\$ 600</u>
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NPS Total	\$15,839
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North Carolina State University Share:

1. Equipment, facilities, and admin.	<u>\$7,337</u>
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Grand Total	\$23,176
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Purchase Costs

Included in purchase costs are the actual hardware and software costs that must be incurred to possess the necessary tools needed to operate the mapping system developed at NCSU. Often these are the only costs considered when a decision exists involving the acquisition of an automated mapping system. Hardware and software choices were approved by NPS administrators upon recommendations made from NCSU. The

system developed was centered around an existing micro-computer at RBNP in order to keep costs to a minimum. Additional hardware peripherals and software costs to be purchased by the NPS are outlined in Table 2. It is noteworthy to mention that the value of these hardware and software purchases will be completely depreciated after a three year period. At this time their salvage value will be zero.

Table 2. NPS Hardware and Software Purchases

1. NEC Multisync 13 inch color monitor	
Model #JC-1401P3A	\$ 540
2. Hewlett-Packard Draft Pro Plotter	
Model #7470A	\$4,104
3. Numonics 20x20 inch Digitizing Tablet	
Model #2200	\$1,412
4. Paradise EGA 480 Autoswitch	\$ 340
5. Atlas*Graphics Mapping Software	\$ 500
6. Mapedit Digitizing Software	<u>\$ 300</u>
Total	\$7,196

Personnel Costs

The first obvious cost involved in implementing the actual system on-site at RBNP, is the training time of park service staff. Fortunately, the design of the system and the chosen software do not require extensive training of map system users. A training session two days in length is all that will be necessary to train current staff members at RBNP in the proper procedures of system operation. It is anticipated that three NPS employees from RBNP will attend the training session. This cost in personnel salaries would total \$330 when an average salary of

\$20,000/year ~~is~~ used for computations.

Actual operating costs involved will of course vary with the frequency of use of the system. Through development experience a conservative estimate of 30 minutes is needed to produce a useful map. Should system use produce an estimated 5 maps/week, personnel time consumed would total \$1,250/year.

Though it is estimated that 80% of the time spent creating a map is taken up through the digitizing process (Devine and Field, 1986), for this analysis it will be given this cost is included in the \$1,250/year operating cost as previously discussed. This cost can be incorporated because maps produced frequently by the system can be saved to an individual file allowing for a reproduction time of less than 5 minutes. The assumption is made that this will balance out new or more complicated maps which take longer than 30 minutes to create.

Maintenance and Supply Costs

The sophistication and proven reliability of both the hardware and software used in this map display system make it very difficult to estimate the costs which may be incurred. It will then be assumed that these costs will not be of sufficient size to be included in this analysis, but should be included in larger geographic information system cost/benefit considerations.

Consumable supplies needed to sustain this system are also minimal but will be included in the overall total costs of system operation. Annual supply costs of this system are identified in Table 3.

Table 3. Annual Micro-Computer Map Display Supply Costs

144 Felt-Tip Pens	\$ 200
500 Sheets C-Size Paper	<u>\$ 100</u>
Total	\$ 300

BENEFITS

Compared to the costs of implementing a micro-computer mapping system at RBNP, the related dollar benefits are much harder to accurately identify. In order to systematically assign dollar values to the benefits of this map display system, the following approaches to benefit calculations as identified by in 1986 by Devine and Field will be used:

- a) error avoidance benefits
- b) information efficiency benefits
- c) map creation, editing, and repeatability

These methods of benefit determination are all estimates of "costs that are avoided" at RBNP as a result of implementing this system.

Error Avoidance Benefits

This first approach to quantifying the benefits associated with this micro-computer mapping system consist of calculating the potential costs of management decisions caused by a lack of information should the system not exist. Since automated mapping systems can be easily kept up-to-date, we will assume that current information will be available at any given time. To determine the potential "loss of production" resulting from inaccurate information obtained without this mapping system specific cases must be used.

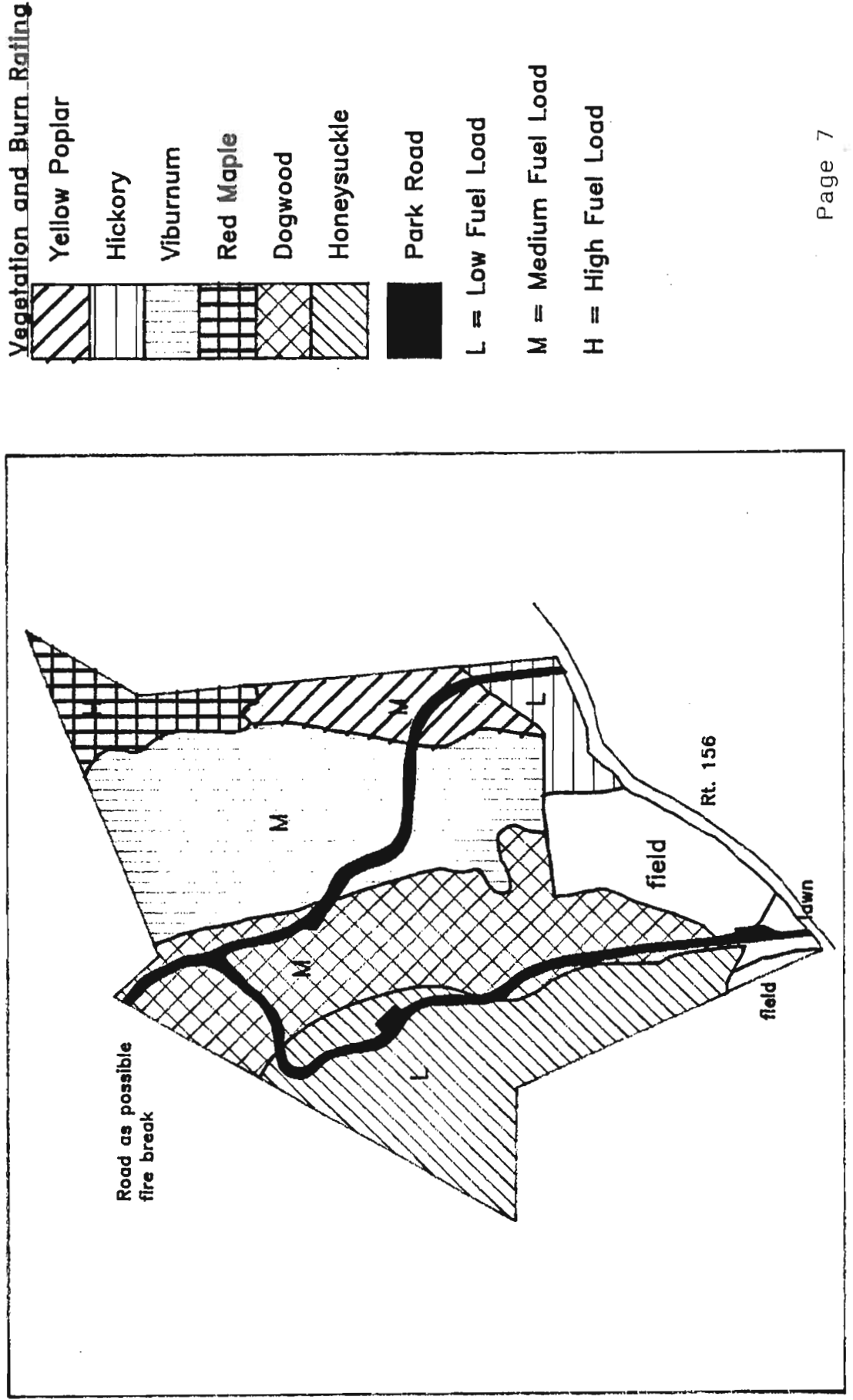
Example 1:

In the final stages of the development of this system, three current management problems were identified by RBNP employees which were used to demonstrate the practical application of the map display system. One management concern was to plan a prescribed (controlled) burn of a park to rid an area overtaken by undesirable vegetation. By combining different attributes of tabular data, vegetative maps were produced displaying the spatial relationships of understory vegetative stands and their respective stand fuel load values (Figure 1).

FIGURE 1.

RICHMOND NATIONAL BATTLEFIELD PARK --COLD HARBOR UNIT

Secondary Understory Vegetation/Fuel Load Distribution



This data would be extremely difficult to visualize strictly from many layers of tabular data. A map of this type could very well aid managers to the extent that it prevented the spread of fire to "hot-spots" within the park. Though dollar values cannot easily be determined from the loss of park visitation and historic preservation values, restoration costs are estimated at \$250/acre. With this park containing 149.3 acres, the potential benefit for this map is calculated to total \$37,325.

Example 2:

Another example of an error avoidance benefit can be calculated through a second management concern at RBNP. The preservation of Civil War earthworks is a main objective of this agency. For accurate preservation of historic battlefield scenes and erosion control, the management of the vegetation on these earthwork networks is of major concern.

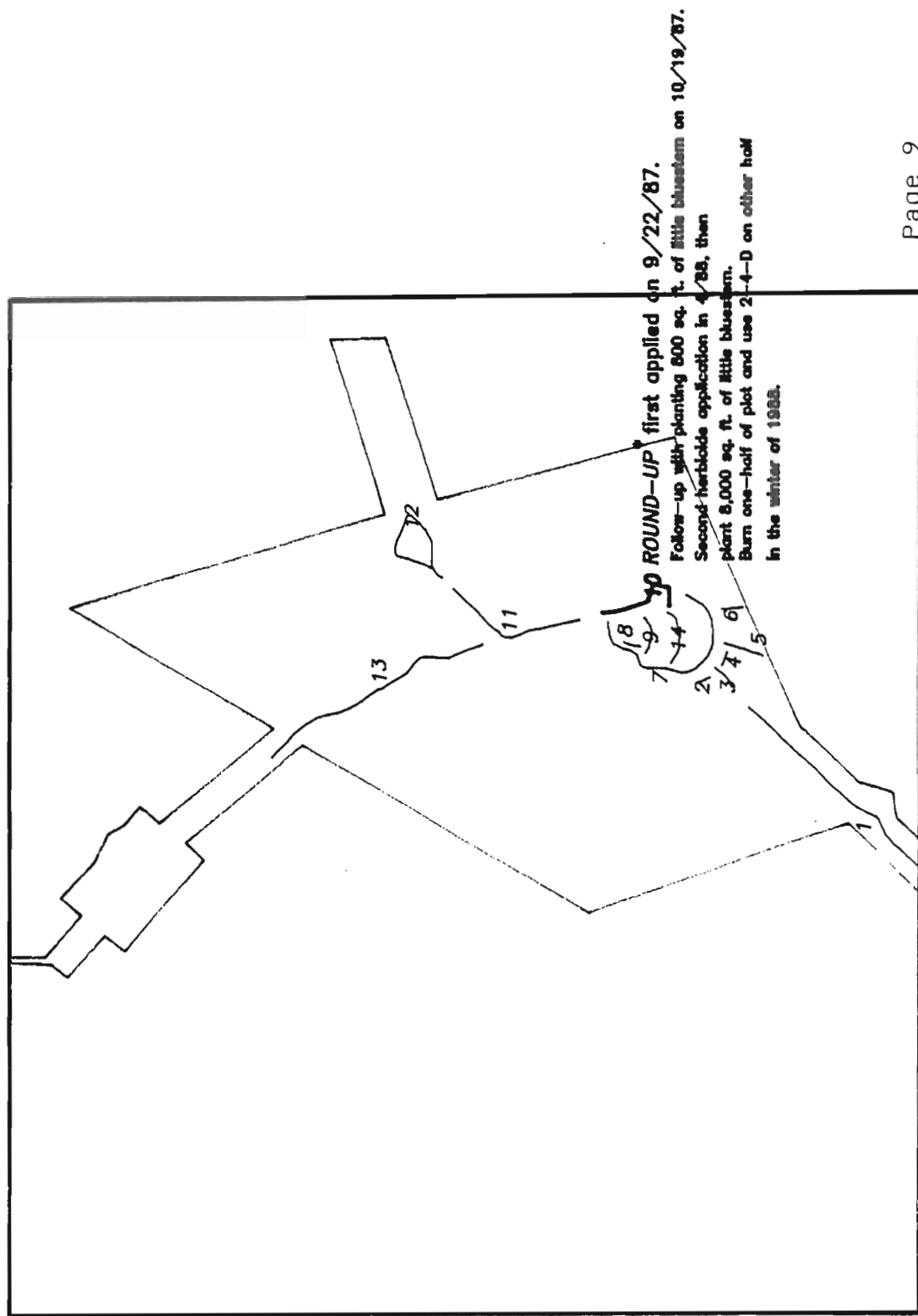
A current study underway on one of these earthworks involves the use of the herbicide *Round-Up* (Figure 2). Should this management technique be expanded to the other earthworks of this park unit, the ability of this mapping system to inventory and determine the exact footage of earthworks within the park would be of great benefit to the planners in determining the amount of *Round-Up* needed. Available only in 5 gallon containers at \$60/gallon, a savings of just one five gallon container of *Round-Up* would benefit RBNP \$300.

Information Efficiency

This second estimation of benefits involves identifying efficiencies in the production of useful management information currently being handled without an on-site mapping system. Data such as acreage

RICHMOND NATIONAL BATTLEFIELD PARK — FORT HARRISON

Earthwork Vegetation Test Plot



calculations, land status, and resource inventories are such cases.

The map display system delivered to RNBP will have the ability to display all acreage calculations of polygons within a map with an input in manpower of approximately 5 minutes. At an average of 50 polygons/park unit and \$10/hour personnel salary, a cost of \$8.30 would cover acreage calculations for all ten park units using the abilities of the mapping system. To manually calculate acreages by the use of a digital planimeter a person would spend approximately 10 minutes/polygon. This effort at \$10/hour totals \$833.33 in salary time. The difference between these two efforts is an information efficiency benefit to the park service of \$825.03.

Another example of information efficiency benefits can be seen in the adjacent land value/acre map shown in Figure 3. This information was created from land acreage data and total land value data taken from county tax maps of the area. Land value/acre values were calculated in the data base manager within the system in one minute. Calculating this data manually is estimated to take one hour of employee time. An efficiency benefit of \$10 dollars is thus achieved in less than one minute. Displaying this data in a professional manner is of course the most beneficial element of this mapping system saving many dollars in drafting costs to RNBP. These benefits are outlined in the next section.

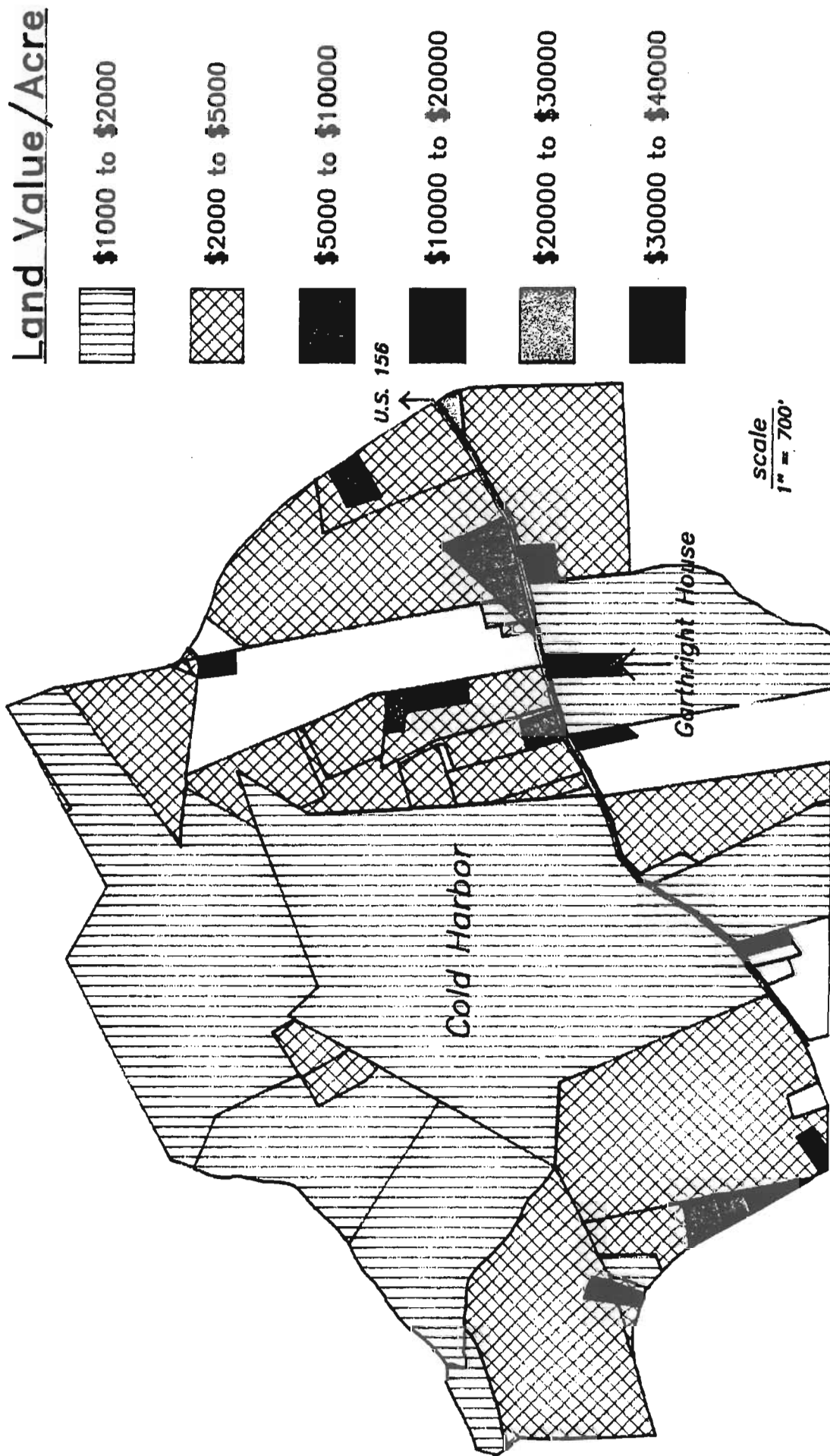
Map Creation, Editing, and Repeatability Benefits

With this mapping system, an existing park service employee can create a map displaying one variable in approximately 30 minutes. This represents approximately \$5 dollars in personnel salary time. A small sampling of draftsmen in the area determined the average hourly wage of map drafting to be \$25/hour. It is estimated that a qualified draftsman could reproduce a map of comparable quality and complexity in approximately 4 hours. Therefore, each map created by this mapping

FIGURE 3.

RICHMOND NBP —COLD HARBOR/GARTHRIGHT HOUSE UNITS

Adjacent Land Value/Acre



system represents a total of \$95 dollars of costs saved by the park service. At a \$95 benefit/map and 365 maps/year, this represents a potential annual benefit of \$34,675 dollars. With ten park units managed by RBNP, each having eleven mapped attributes (boundary, topography, soils, roads, trails, streams, earth- works, structures, current vegetation, historic vegetation, and adjacent land boundaries), and many data variables/attribute there are by a conservative estimate, 1,000 possible combinations of maps available to the managers at RBNP at the present time.

Another cost savings of an automated mapping system is the ability to update individual mapped features. Each edit then also represents a benefit to the park service of \$95 dollars, for each change in a manually produced map must be made (my drawing a whole new map. It is beyond the scope of this project to predict how many edits will be made over the next three years, but keeping maps up-to-date is none-the-less a tremendous benefit of any automated mapping package.

Maps that are to be produced repeatedly also fall into this category of benefits. Certain maps are periodically needed for reports or visitor information purposes, so these maps also represent a \$95/map benefit to the park service. Unfortunately, it is not possible at this time to estimate the extent of this benefit.

DISCOUNTING AND TIME-STREAM OF BENEFITS

In order to better comprehend the timing of benefits of this mapping system over the next three years, net benefits will be determined and present values will be calculated. Discount rates of 5, 7, and 9 percent will be used to see what effect these changes will have on present value.

Table 4. Time Stream Chart

	Initial Implementation	Year 1	Year 2	Year 3
<u>COSTS</u>				
System Development	\$23,176	-	-	-
Purchase Costs	\$ 7,196	-	-	-
Personnel Costs	\$ 330	\$1,250	\$1,250	\$1,250
Maintenance Costs	<u>\$ 300</u>	<u>\$ 300</u>	<u>\$ 300</u>	<u>\$ 0</u>
Total Costs	\$30,942	\$1,550	\$1,550	\$1,250
 <u>BENEFITS</u>				
Error Avoidance	\$37,625*	-	-	-
Information Efficiency	\$ 10*	\$ 825*	-	-
Map Creation Edit & Repeat	<u>\$ 0</u>	<u>\$34,675</u>	<u>\$34,675</u>	<u>\$34,675</u>
Total Benefits	\$37,635	\$35,500	\$34,675	\$34,675
Net Benefits	\$ 6,693	\$33,950	\$33,125	\$33,425

Present Value at 5% Discount Rate = \$97,943.87

Present Value at 7% Discount Rate = \$94,638.87

Present Value at 9% Discount Rate = \$91,530.83

Though varying the discount rate from 5 to 9 percent does not radically effect the positive outcome of present value calculations, further sensitivity tests should be performed on the estimated number of

maps produced annually at RNBP for this is the biggest guess involved in the estimates used in this analysis. An increase in map numbers would only increase benefits, so map production outputs less than the estimated 365/year will be studied (Table 5). The only category effected by decreasing the number of maps/year produced will be the map creation, edit, and repeatability category.

Table 5.

Net Benefits and Present Value of System per Map Production/Year

<u>Maps/Year</u>	<u>Year 1 NB</u>	<u>Year 2 NB</u>	<u>Year 3 NB</u>	<u>PV at 7%</u>
200	\$18,275	\$17,450	\$17,750	\$53,502.97
250	\$23,025	\$22,200	\$22,500	\$65,968.40
300	\$27,775	\$26,950	\$27,250	\$78,433.82

Decreasing the map output/year by 54% from 365 maps/year to a very conservative estimate of 200 maps/year still provides a positive present value of \$53,502.97. This shows a strong relationship between benefits derived and total maps produced. The more the system is used, the greater the benefits.

CONCLUSION

From this analysis it is obvious that by automating the mapping needs at RNBP, the park will be greatly benefited. The \$35,292 dollars in costs over the next three years to have this system would have only purchased a total of 352 hand drawn maps. Therefore, not having this mapping system means giving up many useful maps over the same 3 year period. Also as previously mentioned, hand drawn maps are so time consuming that decisions which could benefit from a map are often done without a map simply because of the time constraints often present.

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A
MICRO-COMPUTER MAPPING SYSTEM
FOR RESOURCE MANAGEMENT AT
RICHMOND NATIONAL BATTLEFIELD PARK

INTRODUCTION

Graphically representing data in the form of maps has long been an effective tool utilized by managers of all types of resources. Managers of natural resources especially benefit from some sort of drawing or map when faced with land use decisions. Manually producing these maps for each situation is both costly and difficult within the time constraints often present. Today, as a result of the advancement of the micro-computer, managers of natural resources are beginning to realize the potential value of these machines in aiding day-to-day decision making through their ability to handle spatial data.

The evolution of the micro-computer has focused on the development of software systems which manage tabular data (Table 1). As a result there are many quality software systems which handle this alphanumeric data on the market today.

Table 1.

<u>Vegetative Stand</u>	<u>Secondary Vegetation</u>	<u>Fuel Load</u>
1	Yellow Poplar	3
2	Hickory	1
3	Viburnum	2

The ability of the micro-computer to manage data which "describes" a spatial feature is relatively new in terms of software development. Incorporating the technologies of tabular and spatial data handling capabilities has been a natural occurrence enabling software developers to produce affordable, easy to use mapping packages which will operate on the same micro-computer currently used by many agencies for little more

than word processing.

PROJECT DEVELOPMENT AND OBJECTIVES

The Department of Recreation Resource Administration's Computer Cartography Lab at North Carolina State University has focused the majority of its efforts over the past 10 years on the teaching, research, and development of large, sophisticated mapping systems. These systems were frequently valued at amounts in excess of \$50,000 dollars. Though the initial objectives of these projects have been successful, the mapping systems never reached their full potential of usefulness simply because of their inconvenience to the user. Resource managers found it difficult to foresee when a particular map would be useful; then arrange for the operators of these large systems to create the map off-site. As a result, individual land managers made day-to-day resource decisions without the requisite map information in-hand.

The National Park Service has been an active participant in utilizing computer mapping technology to its advantage, but like most other agencies they too have focused on large centralized systems. The high costs of hardware, software, and personnel necessary to implement these large mapping systems limited their use to only large park service units with relatively large budgets. Until now, small decentralized park service units could not benefit from automated mapping technology.

It was the purpose of this project, undertaken through a cooperative agreement between the National Park Service and NCSU, to implement a practical micro-computer map display system at Richmond National Battlefield Park in Richmond, Virginia. Richmond National Battlefield Park (RNBP) manages ten decentralized park units preserving important Civil War battlesites ranging from 2 to 300 acres in size. This park unit exemplifies natural resource agencies who until now did not have the ability to pursue computer mapping technology.

In order to limit necessary hardware purchases, the system was developed around an existing IBM compatible micro-computer already in use at RBNBP. The software *ATLAS*GRAPHICS*, developed by Strategic Locations Planning, was chosen for this project because of it's powerful map display capabilities, ease of use, and low cost. Other software packages considered for this project included *MULTIMAP* and *AUTOCAD*.

MULTIMAP did not have the display capabilities or the easy-of-use *ATLAS*GRAPHICS* presented. It was however, in the same \$500 dollar price range. *AUTOCAD* presented basically the same display capabilities as *ATLAS*GRAPHICS*, but because of its orientation to the professional draftsman it was much harder to use and cost approximately 4 times as much.

SYSTEM DEVELOPMENT

The primary objectives of system development were to present Richmond National Battlefield Park with an accurate, useful, low cost, map display system which could be installed and operated on-site with existing personnel. Through the implementation of the system, the park service hoped to see many long-term benefits accrue from this initial cooperative agreement.

System development consisted of three basic stages. Stage one involved creating accurate boundary maps to use as a base. Stage two consisted of manually transferring the desired information onto these base maps, and the final stage was to physically enter this information into the computer's memory via a process called digitizing. Digitizing, in this study, involved describing each mapped feature with paired coordinate data (e.g. lat/long's) using an electronic grid called a digitizing tablet.

Boundary maps were produced using a software package developed at NCSU called Interactive Traverse Mapping and Analysis Program (ITMAP).

Official boundary descriptions, taken from legal deeds, were entered into ITMAP for each park unit. Base maps could then be plotted at any scale and acreage figures calculated. Plots of each park unit were produced at a scale convenient for digitizing.

Stage two involved acquiring the most up-to-date maps available which displayed the following information for each park unit; topography, soil types, roads, streams, trails, buildings/structures, earthworks, current vegetation, historic vegetation, and adjacent ownership maps. Transferring this information onto the ITMAP-produced maps was done by tracing the attributes onto their respective base maps by the use of a zoom-transfer scope to deal with information transfer between maps of different scales. Maps were now ready to be digitized, but were first sent to RBNP to be proofed for accuracy.

After the attributes were digitized for each individual park, they were saved into a corresponding computer file. These files are called boundary files because they contain the paired coordinate data that describe the individual attribute's shape or boundaries. To organize the boundary files a coding system was necessary in order to identify both attribute and park unit. Since each of the ten park units at RBNP were already referred to by park managers in numeric code, the attributes were also given a numeric code. Files were then named by appending the existing park unit code with the attribute code. For example, the boundary file containing soil type boundaries for the park unit of Cold Harbor would be coded 0702; 07 is the code for Cold Harbor and 02 is the code for the soil type attribute.

The final attribute involved in the development of this system was to map all land under private ownership that was directly adjacent to each of the park units. Adjacent ownership maps were handled a bit differently than the other ten attributes because of two reasons. Firstly, this

attribute was not one which would later be combined with any other in an overlay of attributes and did not require the use of the zoom-transfer scope. Secondly, these maps were physically larger and more complex. To accurately map adjacent boundaries, county tax maps were obtained for the areas surrounding each park unit. Then, base maps were again produced in ITMAP only this time at the same scale as the tax maps themselves. These ITMAP boundaries were cut and placed on the tax maps in order to show an exact park boundary in relation to surrounding properties. These maps were then digitized in the same manner as the other attributes.

COST/BENEFIT ANALYSIS

In an effort to quantify the benefits of this automated mapping system, a cost/benefit analysis of the development and implementation of the system was done. The costs involved will first be identified, and then benefits will be calculated with the aid of some practical applications of the system itself.

COSTS

In general, the costs in a cost/benefit analysis are easier to accurately measure than are benefits. However, care must be taken in determining the costs, for implementing an on-site map display system at RNBP involves more than just hardware and software purchases. This analysis will discuss four categories of costs involved in the development and operation of the mapping system; system development costs, purchase costs, personnel costs, and maintenance/supply costs.

System Development Costs

Included in these costs to the National Park Service (NPS) are personnel salaries, travel costs, computer time, and supplies as outlined in the cooperative agreement contract between the NPS and NCSU. These costs identify the initial costs of the project, and total \$23,176.

Purchase Costs

Included in purchase costs are the actual hardware and software costs that must be incurred to possess the necessary tools needed to operate the mapping system developed at NCSU. Often these are the only costs considered when a decision exists involving the acquisition of an automated mapping system. Hardware and software choices were approved by NPS administrators upon recommendations made from NCSU. Purchase costs of this system total \$7,196.

Personnel Costs

The first obvious cost involved in implementing the actual system on-site at RBNP, is the training time of park service staff. Fortunately, the design of the system and the chosen software do not require extensive training of map system users. A training session two days in length is all that is necessary to train current staff members at RBNP in the proper procedures of system operation. It is anticipated that three NPS employees from RBNP will attend the training session. This cost in personnel salaries would total \$330 when an average salary of \$20,000/year is used for computations.

Actual operating costs involved will of course vary with the frequency of use of the system. Through development experience a conservative estimate of 30 minutes is needed to produce a useful map. Should system use produce an estimated 5 maps/week, personnel time consumed would total \$1,250/year.

Though it is estimated that 80% of the time spent creating a map is taken up through the digitizing process (Devine and Field, 1986), for this analysis it will be given this cost is included in the \$1,250/year operating cost as previously discussed. This cost can be incorporated because maps produced frequently by the system can be saved to an individual file allowing for a reproduction time of less than 5 minutes. The assumption

is made that this will balance out new or more complicated maps which take longer than 30 minutes to create.

Maintenance and Supply Costs

The sophistication and proven reliability of both the hardware and software used in this map display system make it very difficult to estimate the costs which may be incurred. It will then be assumed that these costs will not be of sufficient size to be included in this analysis, but should be included in larger geographic information system cost/benefit considerations.

Consumable supplies needed to sustain this system are also minimal but will be included in the overall total costs of system operation. Supply costs of this system are estimated at \$300/year.

BENEFITS

Compared to the costs of implementing a micro-computer mapping system at RBNP, the related dollar benefits are much harder to accurately identify. In order to systematically assign dollar values to the benefits of this map display system, the following approaches to benefit calculations as identified in 1986 by Devine and Field will be used:

- a) error avoidance benefits
- b) information efficiency benefits
- c) map creation, editing, and repeatability

These methods of benefit determination are all estimates of "costs that are avoided" at RBNP as a result of implementing this system.

Error Avoidance Benefits

This first approach to quantifying the benefits associated with this micro-computer mapping system consist of calculating the potential costs of management decisions caused by a lack of information should the system not exist. Since automated mapping systems can easily be kept up-to-date, we will assume that current information will be available at

any given time. To determine the potential "loss of production" resulting from inaccurate information obtained without this mapping system, a specific case must be used.

In the final stages of the development of this system, three current management problems were identified by RBNP employees which were used to demonstrate the practical application of the map display system. One management concern was to plan a prescribed (controlled) burn of a park to rid an area overtaken by undesirable vegetation. By combining different attributes of tabular data, vegetative maps were produced displaying the spatial relationships of understory vegetative stands and their respective stand fuel load values (Figure 1).

This data would be extremely difficult to visualize strictly from many layers of tabular data. A map of this type could very well aid managers to the extent that it prevented the spread of fire to "hot-spots" within the park. Though dollar values cannot easily be determined from the loss of park visitation and historic preservation values, restoration costs are estimated at \$250/acre. With this park containing 149.3 acres, the potential benefit for this map is calculated to total \$37,325.

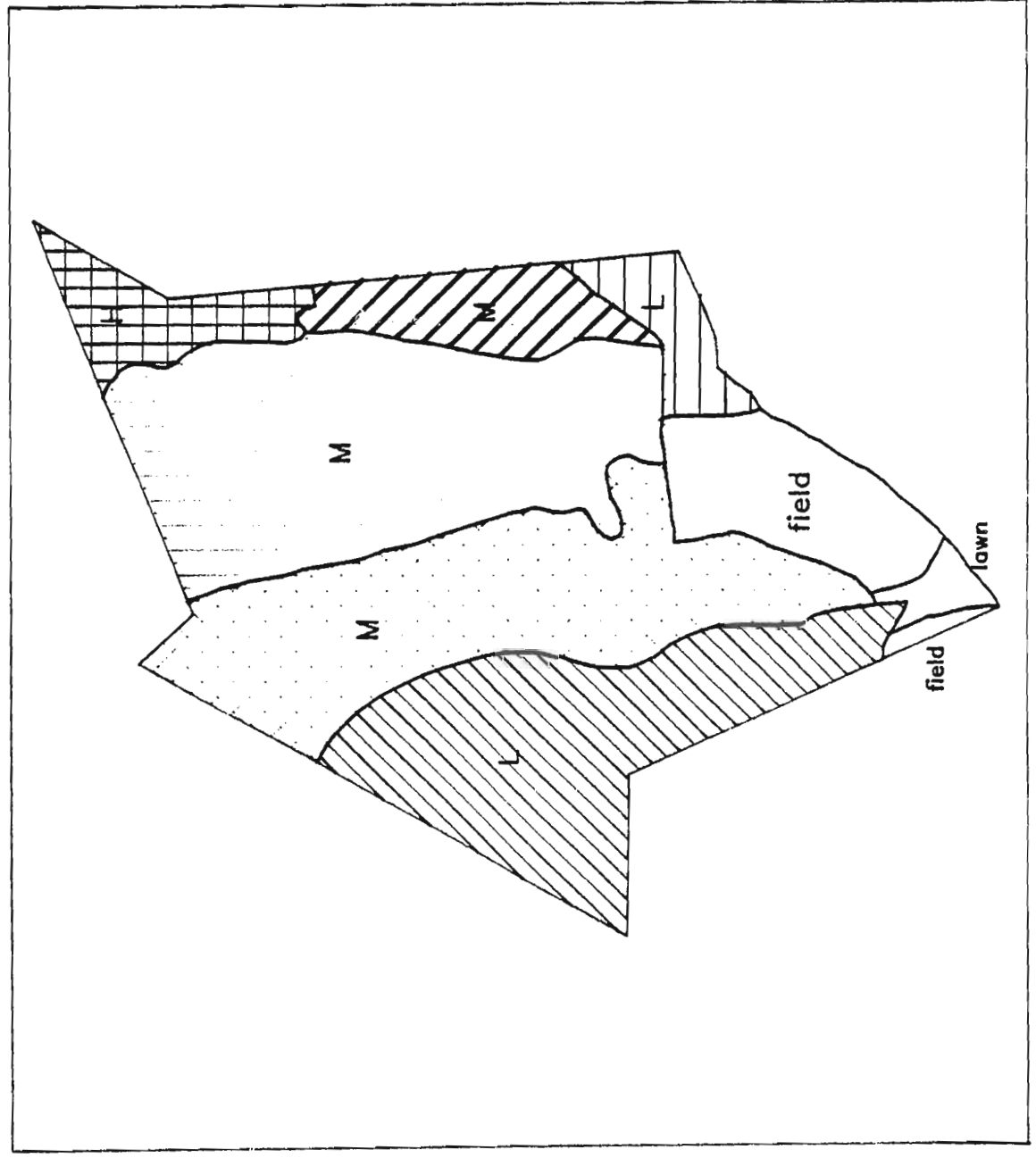
Information Efficiency

This second estimation of benefits involves identifying efficiencies in the production of useful management information currently being handled without an on-site mapping system. Data such as acreage calculations, land status, and resource inventories are such cases.

The map display system delivered to RBNP will have the ability to display all acreage calculations of polygons within a map with an input in manpower of approximately 5 minutes. At an average of 50 polygons/park unit and \$10/hour personnel salary, a cost of \$8.30 would cover acreage calculations for all ten park units using the abilities of the mapping system. To manually calculate acreages by the use of a digital planimeter

RICHMOND NATIONAL BATTLEFIELD PARK - COLD HARBOR UNIT

Secondary Understory Vegetation/Fuel Load Distribution



Vegetation and Burn Rating



L = Low Fuel Load

M = Medium Fuel Load

H = High Fuel Load

a person would spend approximately 10 minutes/polygon. This effort at \$10/hour totals \$833.33 in salary time. The difference between these two efforts is an information efficiency benefit to the park service of \$825.03.

Another example of information efficiency benefits can be seen in the adjacent land value/acre map shown in Figure 2. This information was created from land acreage data and total land value data taken from county tax maps of the area. Land value/acre values were calculated in the data base manager within the system in one minute. Calculating this data manually is estimated to take one hour of employee time. An efficiency benefit of \$10 dollars is thus achieved in less than one minute. Displaying this data in a professional manner is of course the most beneficial element of this mapping system saving many dollars in drafting costs to RNBP. These benefits are outlined in the next section.

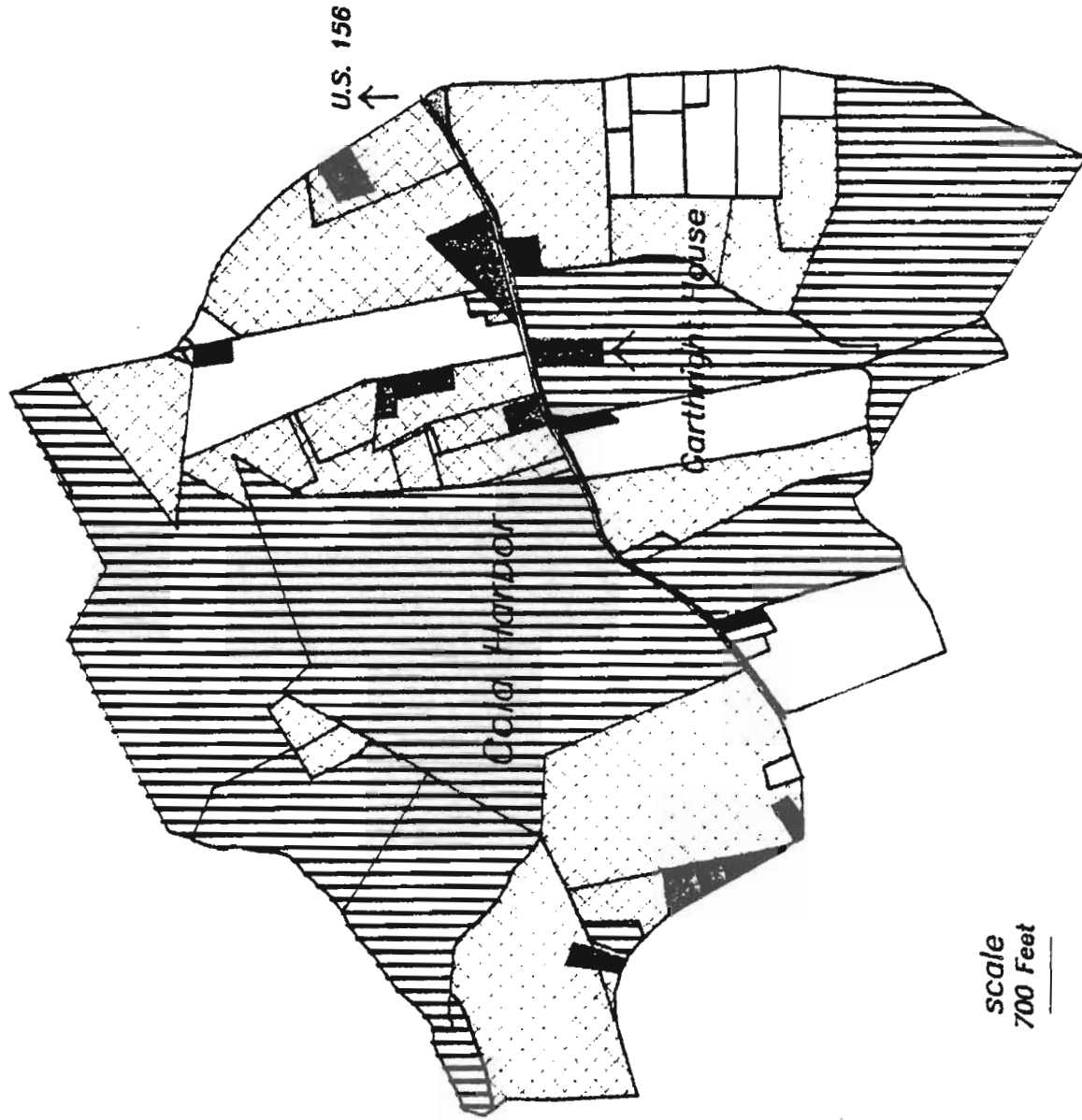
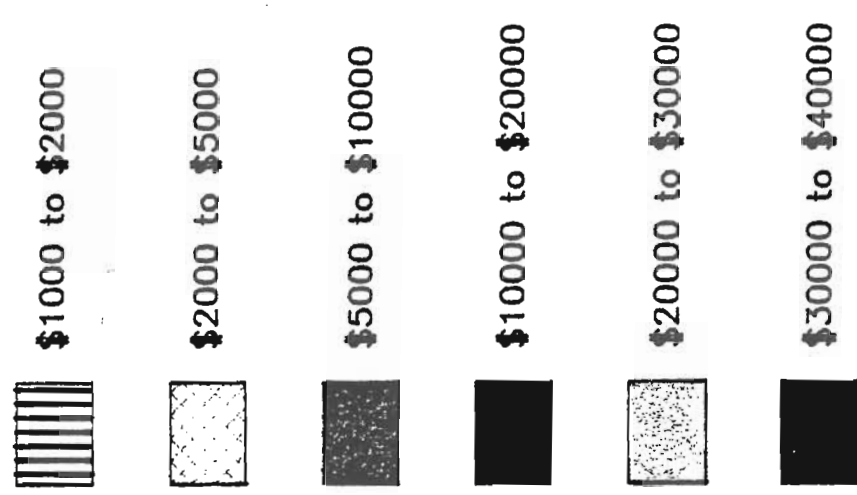
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RICHMOND NBP - COLD HARBOR / GARTHRIGHT HOUSE UNITS

Adjacent Land Value/Acre

Land Value/Acre



scale
700 Feet

Another cost savings of an automated mapping system is the ability to update individual mapped features. Each edit then also represents a benefit to the park service of \$95 dollars, for each change in a manually produced map must be made by drawing a whole new map. It is beyond the scope of this project to predict how many edits will be made over the next three years, but keeping maps up-to-date is none-the-less a tremendous benefit of any automated mapping package.

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DISCOUNTING AND TIME-STREAM OF BENEFITS

In order to better comprehend the timing of benefits of this mapping system over the next three years, net benefits will be determined and present values will be calculated (Table 2). Discount rates of 5, 7, and 9 percent will be used to see what effect these changes will have on present value.

Table 2. Time Stream Chart

	Initial Implementation	Year 1	Year 2	Year 3
<u>COSTS</u>				
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Total Costs	~~\$30,942~~	\$1,550	\$1,550	\$1,250

BENEFITS

Error

Avoidance	\$37,625*	-	-	-
Information				
Efficiency	\$ 10*	\$ 825*	-	-
Map Creation				
Edit & Repeat	\$ 0	\$34,675	\$34,675	\$34,675
Total				
Benefits	\$37,635	\$35,500	\$34,675	\$34,675
Net				
Benefits	\$ 6,693	\$33,950	\$33,125	\$33,425

Present Value at 5% Discount Rate = \$97,943.87

Present Value at 7% Discount Rate = \$94,638.87

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Though varying the discount rate from 5 to 9 percent does not radically effect the positive outcome of present value calculations, further sensitivity tests should be performed on the estimated number of maps produced annually at RNBP for this is the biggest guess involved in the estimates used in this analysis. An increase in map numbers would only increase benefits, so map production outputs less than the estimated 365/year will be studied (Table 3). The only catagory effected by decreasing the number of maps/year produced will be the map creation, edit, and repeatability catagory.

Table 3.

Net Benefits and Present Value of System per Map Production/Year

<u>Maps/Year</u>	<u>Year 1 NB</u>	<u>Year 2 NB</u>	<u>Year 3 NB</u>	<u>PV at 7%</u>
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CONCLUSION

From this analysis it is obvious that by automating the mapping needs at RNBP, the park will be greatly benefited. The \$35,292 dollars in costs over the next three years to have this system would have only purchased a total of 352 hand drawn maps. Therefore, not having this mapping system means giving up many useful maps over the same 3 year period. Also as previously mentioned, hand drawn maps are so time consuming that decisions which could benefit from a map are often done without a map simply because of the time constraints often present.

Creating a map in this system is an easy and logical process. A boundary file is first loaded into the computer's memory. Next, a data file is associated to the appropriate boundary file. There can be any number of data files associated to one boundary file. For example, data files containing primary vegetation, secondary vegetation, site index, and board feet of timber could each be displayed using the same vegetative stand boundary file.

Once the data attribute is chosen and associated to the appropriate boundary file, the data is arranged in a manner which it can best be communicated on the map. Colors and hatch-patterns are then chosen for each data range. Titles and sub-titles are then typed in with sizes and fonts selected for each. The map is then displayed on the computer screen or plotted on paper with a machine that uses colored felt tip pens. The amount of time it takes to create a map in *ATLAS*GRAPHICS* is approx-

imately 30 minutes.

Though there will be benefits immediately derived by Richmond National Battlefield Park upon system implementation, many additional benefits will be realized in the future. The process of keeping maps up-to-date will be aided, for editing existing digital information is a quick and easy task. Maps can be quickly produced when a management decision needs to be made. Paper maps will become practically disposable in the context that they can be cheaply reproduced. Managers and workers will not be afraid to take these maps out-of-doors and use them in the field.

The design of this system presents the managers at RBNP the flexibility to customize maps to their liking. Maps of attributes for any given park may be combined in any manner simply by plotting one on a piece of paper, and then plotting another directly on top of it.

Additional long-term benefits of this micro-computer mapping system include its adaptability in the ever changing world of hardware and software development. This digital information will not become obsolete as it will always be possible to move this data between hardware and software systems. Though technology will continue to advance, this initial effort will not be lost.

Measuring the benefits of this mapping system in dollars is obviously a worthy justification for its existence, but when you consider that it is an effective tool managers can use to facilitate decisions concerning the fragile resources which preserve our very heritage, it proves worthy indeed.

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**ATLAS
BOUNDARY FILES DIRECTORY
RICHMOND NATIONAL BATTLEFIELD PARK**

PARKS		ATTRIBUTES	
0100	Chimborazo	0001	Boundary
0200	Malvern Hill	0002	Topography
0300	Fort Harrison	0003	Soils
0400	Chickahominy	0004	Roads
0500	Beaver Dam Creek	0005	Trails
0600	Watt House	0006	Streams
0700	Cold Harbor	0007	Earthworks
0800	Garthright House	0008	Buildings/Structures
0900	Parker's Battery	0009	Current Vegetation
1000	Fort Darling	0010	Historic Vegetation
		0011	Adjacent Ownership

MAP SCALE

Chimborazo	= 100'
Malvern Hill	= 700'
Fort Harrison	= 400'
Chickahominy	= 350'
Beaver Dam Creek	= 300'
Watt House	= 700'
Cold Harbor	= 700'
Garthright House	= 200'
Parker's Battery	= 250'
Fort Darling	= 300'

*.ABF map files as of 8/20/87:

0101	0201	0301A	0301B	0301C	0301D
010	0202	0302A	0302B	0302C	0302D
010	0203	0303A	0303B	0303C	0303D
0104	0204	0304A	0304B	0304C	0304D
010	020	030	0305B	030	030
010	020	030	0306B	030	0306D
010	0207	0307A	0307B	0307C	0307D
0108	0208	030	0308B	030	030
0109	0209	030	0309B	030	030
01	0210	0310A	0310B	0310C	0310D
01	0211	0311A	0311B	0311C	0311D

0401	0501&B	0601	0701	0801&A	0901
0402	0502	0602	0702	0802	0902
0403	0503	0603	0703	0803	0903
0404	0504	0604	0704	0804	090
0405	05	0605	0705	080	090
0406	0506	0606	0706	080	090
0407	050	060	0707	080	0907
0408	0508	0608	0708	0808	0908
0409	0509	0609	0709	080	090
0410	0510	0610	0710	08	09
0411	0511	0611	0711 (with	0811)	0911

1001
1002
1003
1004
1005
1006
1007
100
1009
10
1011

Note: Not all parks have all attributes.
109 files total.

NPSITMAP DATA FILES

The following is a list of the NPSITMAP data file names and the park unit they represent:

MALVHILL.DAT = Malvern Hill east and west sections
combined*

MALVGRAV.DAT = Malvern Hill east

MALGRAVW.DAT = Malvern Hill west

FTHAR.DAT = Fort Harrison*

CHICK.DAT = Chickahominy Bluffs*

BCNORTH.DAT = Beaver Creek north parcel*

BCSOUTH.DAT = Beaver Creek south parcel*

BCAQIRE.DAT = Beaver Creek acquired parcel - 1982

BCFORFET.DAT = Beaver Creek traded parcel - 1982

BEAVER43 = Beaver Creek boundaries in 1943

WATT.DAT = Watt House*

COLDHARB.DAT = Cold Harbor*

GARTH.DAT = Garthright House*

PARKBAT.DAT = Parker's Battery*

PARKBMON.DAT = Parker's Battery Monument

FTDAR.DAT = Fort Darling*

*Maps display official NPS acreages not NPSITMAP calculated
acreages

Fort and National Battleground Park ATLAS*GRAPHICS Computer Mapping Exercise

Introduction:

This exercise has been completed to help you become familiar with some of the techniques used in displaying mapped information using the software ATLAS*GRAPHICS. A map displaying vegetative stands at Cold Harbor will be created at the end of this exercise.

About ATLAS*GRAPHICS

ATLAS*GRAPHICS, written by Strategic Locations Planning of San Jose, California, is a highly acclaimed and widely used mapping package for IBM PCs and Compatibles. Since appearing on the market about 3 years ago, ATLAS has developed large numbers of users in business, academia, and government planning agencies. ATLAS*GRAPHICS combines power and sophistication with ease of use and extremely low cost. Strategic Locations Planning has taken great pains to render ATLAS*GRAPHICS intuitive, and thereby second nature. To a large extent, they have succeeded. The basic process which you will follow each time you start ATLAS is as follows:

- (1) Load a Boundary (Map) File
- (2) Load a Data File
- (3) Assign the Data Ranges
- (4) Customize the Legend
- (5) Add Text to the Map (if desired)
- (6) Set Map or Plotter Configuration Options (if needed)
- (7) Plot the Map

Notice that you can Plot the Map anytime after you load the boundary file to see how you are doing and then continue with the subsequent steps which just further customize the appearance of your map. Although this procedure outlines the logical approach to mapping with ATLAS, when you become proficient, you will be able to do almost any of these steps in any sequence. But for now, just follow the detailed steps below in order to

begin producing high quality maps.

ATLAS*GRAPHICS is a relatively simple software system. Like Lotus 1-2-3 and many other popular software packages, it works by a system of nested menus (lists of options). You select the option you wish to use by simply typing the first letter of that option or using the cursor movement (arrow) keys to move the highlighted rectangle on to the desired option and pressing RETURN or ENTER. Notice that often when the highlighted rectangle is on a command, you will be able to see the next line of commands that can be accessed by choosing the highlighted rectangle. This is characteristic of the nested menu structure.

Running ATLAS*GRAPHICS

From the copyright/serial number screen, press ENTER to bring up the ATLAS*GRAPHICS Program Menu. This menu gives you access to the various modules/programs comprising the ATLAS system. The one that is most heavily used, and our primary interest, is ATLAS. This module handles all the map customizing and display. Select ATLAS. Remember that there are two ways of doing this (as explained on the screen): (1) moving the highlighted box to ATLAS and pressing ENTER (since it is already on ATLAS, you just need to press ENTER) or (2) pressing the first letter of ATLAS, A.

After doing this, you should see the ATLAS Main Menu across the top of the screen:

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BOUNDARY DATA LEGEND TEXT ZOOM CONFIG MAPFILE PLOT SLIDE HELP QUIT
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At the bottom of the screen you will see information on the Program Status. This will tell you the name of the map file, the name of the data file, the name of the variable being displayed, and information about some of the map settings. This ATLAS Main Menu/Program Status Screen is very important. You will be at this screen repeatedly, selecting commands to enter and display your map.

4. CREATING AND PLOTTING A MAP IN ATLAS*GRAPHICS

4.1 Loading a Boundary (Map) File

For now, ATLAS*GRAPHICS is already highlighting the most likely selector from the Main Menu, BOUNDARY. Notice that the Main Menu is a

nested menu. If we were to select BOUNDARY, our next choices would be SINGLE or LIST. Select BOUNDARY (Henceforth, when you see "Select," this means to type the first letter of the item being selected or to move the highlighter on to it and press ENTER.).

From the nested submenu, select SINGLE. This indicates to ATLAS that we wish to load (bring up) a single map file. After selecting SINGLE, you will see the ATLAS file loading and saving screen. This is how information (in this case cartographic/boundary data) is loaded into ATLAS. You are being prompted to type in the name of the boundary file to load. As usual, there is more than one way to give ATLAS the name of the file. The quickest way is to type in the file name at the prompt and press ENTER. If you don't know the name of the file, press ENTER and a list of map files will appear. This is called a File Menu. Use the cursor movement keys to move the highlighter on to the file you wish to load and press ENTER.

We wish to load the boundary file showing the vegetative stands at Cold Harbor (coded 0709), type in this file name and press ENTER or use the file menu technique just described. ATLAS will load 0709 and return you to the ATLAS Main Menu. Note at the bottom of the screen under the Program Status section that it now tells us 0709 is our boundary file.

If you would like to see the map up on the screen at this point, simply select PLOT. Then, from the nested submenu, select DISPLAY. ATLAS will draw a simple black and white map on the screen. When done, the Main Menu will appear back at the top of the map. Now comes the time to customize the map.

(2) Loading a Data File

From the Main Menu, select DATA. This indicates to ATLAS that we wish to load some data to display on the map. From the Data nested submenu, select FILE because we want to load a new data file. After selecting FILE, you should see a familiar screen: the ATLAS file loading and saving screen. Whereas before, we loaded a boundary file, this time we want to load an ATLAS data file also called 0709. Follow the same procedure as outlined above: either type in 0709 and press ENTER or use the File Menu feature. After choosing the data file, ATLAS will display a list of variables in this data file. This allows you to keep several pieces of information about the polygons in the county map. Select the variable concerning planning regions by highlighting it, then press ENTER. ATLAS will load the

information for that variable and take you to another screen (Data Ranges Assign) where you will specify how to group the data to be displayed.

(3) Assigning the Data Ranges

Grouping data for display depends on how your data was coded. Maximum and minimum values of the data file are displayed as well as other statistics on the data variable chosen. Use your own discretion as to how many data ranges are appropriate. To make sure each discrete value is represented, move the red highlighted rectangle up two spaces to the Ranging Method selection. Presently, it is probably set on Equal π . Move the red rectangle one space to the right to the Even Ranging Method and then press ENTER. Don't worry about all the decimal places that appear in the Data Ranges. What is important is that ATLAS has given you discrete categories with an equal increment of .9. Press F10 to have these ranges take effect and to return to the ATLAS Main Menu and Program Status screen. Notice that the Program Status section has been updated to reflect what you just did.

(4) Customizing the Legend

Now that we've selected our map and data files and set our data ranges, we can customize our legend, titles, and hatching (shading) patterns. To do this, select LEGEND from the ATLAS Main Menu. Since the TITLES option is now highlighted, select it first. Now you can see where the ATLAS+GRAPHICS title came from when we previewed the map before. Type in your own Title, Subtitle, and Legend Heading. Just type over the existing text. Make up your own appropriate titles. Use the up and down arrow keys to move between titles. You can change the default font, size, color, and other attributes of each title by pressing the PgDn or PgUp key when that title is highlighted. Then use the up and down arrow keys to move among the font, size, color, and other options and the side arrow keys to select your particular font, size, color, etc. When you want to return to the titles area, press PgDn or PgUp again. Once you have set the titles to your satisfaction, press F10 to return to the ATLAS Main Menu.

Select LEGEND again from the ATLAS Main Menu. From the nested submenu, select DESCRIPTIONS. A new screen appears showing the Data Ranges which you previously set. The Legend Descriptions option allows you to specify text in your legend rather than getting the data range numbers. This is particularly helpful when you are mapping discrete data. Simply

type in the respective stand next to their appropriate range/category number. To move between ranges, use the up and down arrows. To set the font, size, and color of these descriptions, use the FgOn and FgOff keys to move to the appropriate section. When you are done typing in the descriptions and setting their font, size and color, press F10. Be sure to view your work on the monitor by selecting PLOT then DISPLAY to make sure your customizing is to your satisfaction.

Select LEGEND once again from the ATLAS Main Menu. From the nested submenu, select FILL. Now we will assign a hatch/shade pattern to each range. You will see 26 hatch patterns on the left of the screen and your ranges on the right. Working with range 1, you will note that the present hatch is probably empty and the color is likely red. Use the + and - keys to select your desired hatch patterns. After you have set the hatch pattern, use the left and right arrow keys to toggle between possible colors. Notice that the box color may not change as you toggle among colors. Seeing the different colors on the screen depends on the type of graphics card and monitor you are using. Even if you can't see the colors you have selected, they are still important because these are the colors of the page the computer will prompt you to place in the plotter when you go to plot the map. Repeat the procedure of setting a hatch pattern and color for each planning region. Use the up and down arrow keys to move among the regions. When you have finished, press F10 to register the fill patterns and return to the ATLAS Main Menu.

(5) Adding Text to the Map

We will not use this option for this map.

(6) Setting Map or Plotter Configuration Options

We will not change anything for this map.

(7) Plotting the Map

NOW FOR THE MOMENT OF TRUTH! Select PLOT from the ATLAS Main Menu. From the nested submenu, select DISPLAY to view the map on the screen. Don't worry, all the information is there and it will look fine when plotted. Select PLOT from the ATLAS Main Menu. From the nested submenu, select PLOTTER. At this point you should make sure that the plotter is on, connected to your computer, and loaded with paper. The computer will

prompt you to insert the appropriate colored pens. Put these pens in the plotter and then press ENTER. The plotter should now begin doing your map. Continue this procedure as long as the computer keeps asking you to change the plotter's pens. When the plot is complete, the ATLAS Main Menu will appear back at the top. Congratulations on your first computer map!

Should you desire to save this map just as it looks now, select MAPS 12 from the ATLAS Main Menu. From the nested submenu, select SAVE. At the ATLAS file loading and saving screen, simply type in the name you wish to give to this mapfile. If ATLAS warns you that that file already exists and you have not previously created it file, it is another person's mapfile; then answer **N** (or select NO) and then type in a different file name. If you do not wish to save this map for further use, simply select QUIT and follow the prompted questions presented to you to exit the program.

FOR 405 Forest Management
Computer Mapping Exercise I
August 25, 27 1987

Introduction:

In order to accomodate the increasing, often-competing demands placed on forests, modern forest management has increasingly turned to more sophisticated tools and techniques. One of these tools is the computer. Computers have penetrated virtually all aspects of life. Forests managers have not been immune to this revolution. Word processors, spreadsheets, database managers, computerized growth & yield models, forest simulation models, inventory managers, automatic data collection devices, and economic forecasting models have been welcomed by office and field-based foresters as tools to enhance human productivity and efficiently manage the modern forest.

More recently, computerized mapping systems have been employed by public and private forest managers to better organize and display spatially oriented information in order to facilitate decisionmaking. These mapping systems may assume many different forms and cost thousands of dollars depending on the degree of software and hardware sophistication. Several common threads, however, run through most computerized mapping systems. First, a computerized mapping system allows you to create and display maps (through a process called digitizing, that is, converting existing maps to digital form) of cartographic data (i.e. the geometric points, lines, polygons, and alphanumerics that comprise any map). Second, some type of database manager is generally available to store information to be displayed on the map. This could be the soil or stand classification of the polygons, line label for contour lines, or point label for particular sites. This allows a mapper to create maps where all the loblolly pine stands may be shaded green while hardwood stands are shaded blue. Once the map is in digital form, many mapping systems allow automatically changing scale or computing certain map analytics such as area of polygons (stands or soil types), lengths of lines (roads, streams, and trails), proximity analysis (buffers along streams or trails, locating features within a certain area), etc. These are the tasks you would have generally used a planimeter to accomplish in the past. It is at this stage in particular where computerized mapping systems outshine their manual counterparts. And, lastly, most computerized mapping systems allow you

to print or plot your map on some output device (printer, pen plotter, laser printer, etc.).

Objective:

This laboratory is designed to provide you with an initial exposure to computer mapping concepts and applications in forestry by giving you some "hands-on" experience using a microcomputer mapping program (ATLAS*GRAPHICS) running on an IBM PC-AT. Using NCSU's Schenck Memorial Forest, you will plot two existing (already digitized) maps: soils and stands. Then you will zoom in (enlarge) a particular area on the soils map and on a topography map (5 foot contours) and overplot them on a single map on the plotter. Upon completion of this exercise, therefore, you should have produced three 8 1/2 x 11 inch maps for use in your land typing exercise.

About ATLAS*GRAPHICS

ATLAS*GRAPHICS, written by Strategic Locations Planning of San Jose, California, is a highly acclaimed and widely used mapping package for IBM PCs and Compatibles. Since appearing on the market about 3 years ago, ATLAS has developed a large cadre of users in business, academia, and government planning agencies. ATLAS*GRAPHICS combines power and sophistication with ease of use and extremely low cost. Strategic Locations Planning has taken great pains to render ATLAS*GRAPHICS intuitive, and thereby second nature. To a large extent, they have succeeded. The basic process which you will follow each time you start ATLAS is as follows:

- (1) Load a Boundary (Map) File
- (2) Load a Data File
- (3) Assign the Data Ranges
- (4) Customize the Legend
- (5) Add Text to the Map
- (6) Set Map or Plotter Configuration Options
- (7) Plot the Map

Notice that you can Plot the Map anytime after you load the boundary file to see how you are doing and then continue with the subsequent steps which just further customize the appearance of your map. Although this procedure outlines the logical approach to mapping with ATLAS, when you become proficient, you will be able to do almost any of these steps in any sequence. But for now, just follow the detailed steps below in order to begin producing high quality maps of the Schenck Forest.

ATLAS*GRAPHICS is a relatively simple software system. Like Lotus 1-2-3 and many other popular software packages, it works by a system of nested menus (lists of options). You select the option you wish to use by simply typing the first letter of that option or using the cursor movement (arrow) keys to move the highlighted rectangle on to the desired option and pressing **RETURN** or **ENTER**. Notice that often when the highlighted rectangle is on a command, you will be able to see the next line of commands that can be accessed by choosing the highlighted rectangle. This is characteristic of the nested menu structure.

Getting Started

For this exercise, you will not need any floppy disks. All program and data presently reside on the IBM PC-AT hard disk. In order to begin, make sure the computer and monitor are on. The computer's on/off switch is on the right side of the system unit. If you turn the machine on, it should, after a few seconds of booting, show the ATLAS*GRAPHICS copyright and serial number screen with a globe displaying the western hemisphere. If the machine was on or you do not see this screen, simply type in **AG** and this should start the program. If this still does not work, you must determine and move to the appropriate directory or subdirectory where ATLAS*GRAPHICS resides..

Please note the convention employed in this exercise, that commands you should type in the computer are shown in **BOLD CAPS**. Also, this exercise assumes you have properly configured the ATLAS system to utilize the desired output devices and to find your files.

Running ATLAS*GRAPHICS

From the copyright/serial number screen, press **ENTER** to bring up the ATLAS*GRAPHICS Program Menu. This menu gives you access to the

various modules/programs comprising the ATLAS system. The one that is most heavily used, and our primary interest, is ATLAS. This module handles all the map customizing and display. Select ATLAS. Remember that there are two ways of doing this (as explained on the screen): (1) moving the highlighted box to ATLAS and pressing **ENTER** (since it is already on ATLAS, you just need to press **ENTER**) or (2) pressing the first letter of ATLAS, **A**.

After doing this, you should see the ATLAS Main Menu across the top of the screen:

BOUNDARY DATA LEGEND TEXT ZOOM CONFIG MAPFILE PLOT SLIDE HELP QUIT

At the bottom of the screen you will see information on the Program Status. This will tell you the name of the map file, the name of the data file, the name of the variable being displayed, and information about some of the map settings. This ATLAS Main Menu/Program Status Screen is very important. You will be at this screen repeatedly, selecting commands to alter and display your map.

A. PLOTTING THE SCHENCK FOREST SOILS MAP

(1) Loading a Boundary (Map) File

For now, ATLAS*GRAPHICS is already highlighting the most likely selection from the Main Menu, BOUNDARY. Notice that the Main Menu is a nested menu. If we were to select BOUNDARY, our next choices would be SINGLE or LIST. Select BOUNDARY (Henceforth, when you see "Select", this means to type the first letter of the item being selected or to move the highlighter on to it and press **ENTER**.).

From the nested submenu, select SINGLE. This indicates to ATLAS that we wish to load (bring up) a single map file. After selecting SINGLE, you will see the ATLAS file loading and saving screen. This is how information (in this case cartographic/boundary data) is loaded into ATLAS. You are being prompted to type in the name of the boundary file to load. As usual, there is more than one way to give ATLAS the name of the file. The quickest way is to type in the file name at the prompt and press **ENTER**. If you don't know the name of the file, press **ENTER** and a list of map files will

appear. This is called a File Menu. Use the cursor movement keys to move the highlighter on to the file you wish to load and press **ENTER**.

We wish to load a soils map of Schenck Forest called SKSOILS. Type **SKSOILS** and press **ENTER** or use the file menu technique just described. ATLAS will load SKSOILS and return you to the ATLAS Main Menu. Note at the bottom of the screen under the Program Status section that it now tells us SKSOILS is our boundary file.

If you would like to see the map up on the screen at this point, simply select PLOT. Then from the nested submenu, select DISPLAY. ATLAS will draw a simple black and white map of Schenck soils on the screen. When done, the Main Menu will appear back at the top of the map. Now comes the time to customize the map.

(2) Loading a Data File

From the Main Menu, select DATA. This indicates to ATLAS that we wish to load some data to display on the map (in this case, the soil type information associated with each polygon on the map). From the Data nested submenu, select FILE because we want to load a new data file. After selecting FILE, you should see a familiar screen: the ATLAS file loading and saving screen. Whereas before, we loaded a map file, this time we want to load an ATLAS data file also called SKSOILS. Follow the same procedure as outlined above: either type in **SKSOILS** and press **ENTER** or use the File Menu feature. After choosing the data file, ATLAS will display a list of variables in this data file. This allows you to keep several pieces of information about the polygons on the soils map. For example, for each soil polygon, you may have information on its type, geologic history, fertilization needs, etc. You can map any of these variables. SKSOILS, however, only contains information on the soil type. To indicate to ATLAS that this is the variable you wish to map, move the red highlighter on to Soil Type (it should already be there) and press **ENTER**. ATLAS will load the information for that variable and take you to another screen (Data Ranges Assign) where you will specify how to group the data to be displayed.

(3) Assigning the Data Ranges

Grouping data for display depends on how your data was coded. The Schenck **SKSOILS** data was coded as follows:

<u>Code</u>	<u>Soil Type</u>
1	Eroded Land
2	Lloyd Loam
3	Wedowee Clay Loam
4	Wake Loam
5	Congaree Sandy Loam
6	Paculet Clay Loam
7	Wake Sandy Loam
8	Wedowee Sandy Loam
9	Lloyd Clay Loam
10	Mixed Alluvial
11	Cecil

This means that there are 11 discrete soil classes or ranges we wish to map. To indicate that to the program, use the cursor movement (arrow keys) to move the red highlighted rectangle to # of Data Ranges. Then **push the right arrow key until the number in the box is 11** and then press **ENTER**. ATLAS will recalculate the data ranges and show you that there are now 11 ranges. We must do one more thing to make sure each discrete soil category is represented. Move the red highlighted rectangle up two spaces to the Ranging Method selection. Presently, it is probably set on Equal #. Move the red rectangle one space to the right to the Even Ranging Method and then press **ENTER**. Don't worry about all the decimal places that appear in the Data Ranges. What is important is that ATLAS has given you 11 discrete categories with an equal increment of .9, each containing a soil type. Press **F10** to have these ranges take effect and to return to the ATLAS Main Menu and Program Status screen. Notice that the Program Status section has been updated to reflect what you just did.

(4) Customizing the Legend

Now that we've selected our map and data files and set our data ranges, we can customize our legend, titles, and hatching (shading) patterns. To do this, select **LEGEND** from the ATLAS Main Menu. Since the **TITLES** option is now highlighted, select it first. Now you can see where the

ATLAS*GRAPHICS title came from when we previewed the map before. Type in your own Title, Subtitle, and Legend Heading. Just type over the existing text. Make up your own appropriate titles. Use the up and down arrow keys to move between titles. You can change the default font, size, color, and other attributes of each title by pressing the PgDn or PgUp key when that title is highlighted. Then use the up and down arrow keys to move among the font, size, color, and other options and the side arrow keys to select your particular font, size, color, etc. When you want to return to the titles area, press PgDn or PgUp again. Once you have set the titles to your satisfaction, press **F10** to return to the ATLAS Main Menu.

Select LEGEND again from the ATLAS Main Menu. From the nested submenu, select DESCRIPTIONS. A new screen appears showing the Data Ranges which you previously set. The Legend Descriptions option allows you to specify text in your legend rather than getting the data range numbers. This is particularly helpful when you are mapping discrete data like soils or vegetation. Simply type in the 11 soil types next to their appropriate range/category number. To move between soil types/ranges, use the up and down arrows. To set the font, size, and color of these descriptions, use the PgDn and PgUp keys to move to the appropriate section. When you are done typing in the descriptions, press **F10**.

Select LEGEND once again from the ATLAS Main Menu. From the nested submenu, select FILL. Now we will assign a hatch/shade pattern to each soil type/data range. You will see 26 hatch patterns on the left of the screen and your soil types/data ranges on the right. Working with the first soil type, eroded land, you will note that the present hatch is probably empty and the color is likely red. Use the + and - keys to select the desired hatch pattern for eroded land. After you have set the soil type's hatch pattern, use the left and right arrow keys to toggle between possible colors. Notice that the box color may not change as you toggle among colors. Seeing the different colors on the screen depends on the type of graphics card and monitor you are using. Even if you can't see the colors you have selected, they are still important because these are the colors of the pens the computer will prompt you to place in the plotter when you go to plot a map. Repeat the procedure of setting a hatch pattern and color for each soil type. Use the up and down arrow keys to move among the soil types. When you have finished, press **F10** to register the fill patterns and return to the ATLAS Main Menu.

(5) Adding Text to the Map

We will not use this option for this map.

(6) Setting Map or Plotter Configuration Options

We will not change anything for this map.

(7) Plotting the Map

NOW FOR THE MOMENT OF TRUTH!!! Select PLOT from the ATLAS Main Menu. From the nested submenu, select DISPLAY to view the map on the screen. Depending on the resolution of the screen and the complexity of the map, it may all look like a bowl of spaghetti. Don't worry, all the information is there and it will look fine if you zoom in on a portion of the map (we will do that in a little while). For now, let's make a hardcopy plot of the map using a HP7470A pen plotter.

Select PLOT from the ATLAS Main Menu. From the nested submenu, select PLOTTER. At this point you should make sure that the plotter is on, connected to your computer, and loaded with paper. The computer will prompt you to insert two pens of a certain color. Put these pens in the plotter and then press **ENTER**. The plotter should now begin doing your map. When the computer finishes using these colors it will stop and prompt you to put two more pens in and then press **ENTER**. Continue this procedure as long as the computer keeps asking you to change the plotter's pens. When the plot is complete, the ATLAS Main Menu will appear back at the top. Congratulations on your first computer map!!!

Since you will need to regenerate this soils plot later in this exercise and we don't want to have to go through all the setup steps, you should create an ATLAS Mapfile which will contain all the parameters you just specified in order to create the soils map. To do this, select MAPFILE from the ATLAS Main Menu. From the nested submenu, select SAVE. At the ATLAS file loading and saving screen, simply type in the name you wish to give to this mapfile. Since other groups will be saving a similar file, you should give this mapfile a name unique to your group and press **ENTER**. If ATLAS warns you that that file already exists and you have not previously created

it (i.e. it is another group's mapfile) then answer N (or select NO) and then type in a different file name. Once you have saved your mapfile, move on to Part B.

B. PLOTTING THE SCHENCK FOREST STAND MAP

Now that you are practically an expert at ATLAS, I will not provide detailed instructions on plotting the Schenck stand map. Basically, you should follow the same steps detailed above (or use your intuition). In summary, you will need to:

- (1) Load boundary file called: SKSTAND
- (2) Load data file called: SKSTAND
- (3) Use the variable: Vegetation Type
- (4) There are 5 Data Ranges/Vegetation Types

<u>Code</u>	<u>Vegetation Type</u>
1	Loblolly Pine
2	Upland Hardwoods
3	Bottomland Hardwoods
4	Yellow Poplar
5	Other

- (5) Set up your Legend with appropriate titles, descriptions, and fill patterns
- (6) Preview your map on the screen
- (7) Plot the map on the plotter
- (8) Save this map in a mapfile for future use (**don't** use the same name you used for your soils mapfile!)

Once you have completed the Schenck **stand** map, move on to part C.

C. OVERPLOTting SCHENCK SOILS AND TOPOGRAPHY

For the final part of this exercise, you will learn how to zoom into (enlarge) an area of the map, label geographic features with data, overplot on the plotter, and specifically configure your map. The first thing you need to do is recall your previous Schenck soil map. To do this, select MAPFILE from the ATLAS Main Menu. From the nested submenu, select LOAD. At the ATLAS file loading and saving screen, type in your mapfile name and press **ENTER** or use the File Menu. ATLAS will load all the parameters you previously specified in creating the soils map. To assure yourself that this is the case, select PLOT from the ATLAS Main Menu and then select DISPLAY from the nested submenu. ATLAS will regenerate your plot on the screen.

(6) Setting Map or Plotter Configuration Options

Since the titles and legend consume a large portion of the map space, let's turn them off. To suppress the titles and legend, select CONFIG from the ATLAS Main Menu. From the first nested submenu, select MAP. From the second nested submenu, select CONTENTS. ATLAS will display 10 different map configuration options. Use the up and down arrow keys to move to the TITLE option which is presently set to on (i.e. show the title on the map). Press the right arrow key once to turn the title display off. Do the same thing with the LEGEND option (i.e. set it to off) and then hit **F10** to exit to the ATLAS Main Menu. Select PLOT and then DISPLAY to see the soils map without the legend and title.

Now we want to zoom in to a particular area of the Schenck soils map in order to enlarge it. Not surprisingly, to do this you should select ZOOM from the ATLAS Main Menu. From the nested submenu, select IN. You will notice that a white rectangle appears at the middle of the map. This is the zoom window which you will size and move on to the area (select) which you wish to enlarge. The area we are interested in is the western portion of the Schenck. In order to fit the appropriate area into the zoom window, you should press the - key three times to shrink the window. Then press the left arrow key ten times to move the zoom window so that it covers the western Schenck. When the zoom window is in place, set it by pressing **ENTER**. ATLAS will redraw the map so it shows only the area

that was within the zoom window.

Now that you have zoomed into the western area and suppressed the title and legend, send the map to the pen plotter with the PLOT PLOTTER commands. **WHEN THE MAP IS COMPLETE, DO NOT REMOVE THE PAPER FROM THE PLOTTER.** Removing the paper from the plotter at this point will likely detract from the quality of the overplot (the next step).

After you have created the hardcopy zoomed soils map, you are ready to bring up the Schenck topography map for overplotting. To do this select BOUNDARY and SINGLE from the ATLAS Menus. At the ATLAS file loading and saving screen, type in or use the File Menu feature to load SK5TOPO which contains the 5 foot contours for the western portion of the Schenck. Once the file has been loaded, plot the map on the screen with the PLOT DISPLAY commands. You will note that the titles and legend are still turned off and that the map shows contour lines for the entire Schenck. This is fine.

Now you will need to zoom into the same western area of the Schenck that you did in creating the zoomed soils map. This entails the ZOOM IN commands and then sizing and moving the zoom window with three - key presses and ten left arrow key presses (or, if you didn't use the 3 and 10 sequence, then use whatever combination you used for the soils map. The important thing is that the zoom window covers exactly the same area on both maps). Press ENTER so ATLAS will redraw the zoomed topography map.

(5) Adding Text to the Map

The 5 foot contour lines are useless unless they are labeled. ATLAS can do that for us. Select CONFIG from the ATLAS Main Menu and then select MAP from the first nested submenu and CONTENTS from the second nested submenu. This screen should look familiar. You will notice that it still reflects the fact that you suppressed the titles and legend. Also notice that the option for CURVE LABELS is set to off. Move down and set the CURVE LABEL option to on. Since ATLAS recognizes the contour lines as curves, turning this option on will cause ATLAS to label the contours with their value. Press F10 to return to the ATLAS Main Menu and then PLOT

DISPLAY to see the labeled contour map.

You will notice that ATLAS has a contour label of 370 in the lower left corner and there is no contour line there. Since it doesn't belong there, you should ~~hide~~ this label. To do this, select TEXT from the ATLAS Main Menu and from the nested submenus select LABELS and then EDIT. A white crosshair will appear at the middle of the map. Use the arrow keys to move this crosshair down on to that 370 contour label. When you are on it, press -. At the top of the screen you will be prompted whether this particular item is what you wish to hide. Just press **ENTER** and this label will be removed from the map. Press **F10** to remove the label editing comments at the top of the screen and to restore the ATLAS Main Menu.

And now for the final step, send this zoomed in topography map to the plotter so that it plots on top of your soils map. When the plot is done, simply select QUIT from the ATLAS Main Menu and then Y (for yes to confirm your desire to quit). You will be returned to the ATLAS*GRAPHICS Program Menu. Simply press **Q** for quit and you will be exited to the operating system.

COMING ATTRACTIONS: Next week ... digitizing your own land type map.

FOR 405 Forest Management
Computer Mapping Exercise II
September 1, 3 1987

Introduction:

In Exercise I of this computer mapping sequence, you learned how to display, customize, and plot computer maps utilizing an inexpensive, easy-to-use computerized map display system, developed by Strategic Locations Planning, known as ATLAS*GRAPHICS. Using ATLAS, you plotted a soil type map, a stand map, and an overplot of 5 foot contour lines on a "zoomed in" western portion of the Schenck soils map. These were maps that had been digitized previously for your use. Using these outputs and what you have learned about land typing, you should have manually drawn a map of the land types occupying the western portion of the Schenck.

The intent of this second exercise is to expose you to the actual process involved in creating a computer map from scratch. This process is known as digitizing. As the term implies, digitizing entails converting an existing graphic or map into a digital (i.e. numeric) format which is readily handled by the computer. One computer mapping myth that you will find debunked early in this exercise is the notion that the computer creates the map. For most mapping systems, this is not the case. Typically someone (Cartographer, Surveyor, Forester) must collect the raw data and draft an original map which is then digitized - thereby creating a computer map. Digitizing is a tedious, labor-intensive task requiring that an individual (often referred to as a digitizer) literally retrace the original map's features using an electronic tablet (also referred to as a digitizer or digitizing tablet). The electronic digitizing tablet sends to the computer the X and Y coordinates of each digitized point and the mapping software assembles this information into the points, lines, and polygons comprising a map.

The main objective of this exercise is to digitize your hand-drawn Schenck land type map utilizing MapEdit, ATLAS*GRAPHICS' special program for creating and editing computer maps. MapEdit is technically **not** a part of the ATLAS*GRAPHICS system, although many of its functions have been incorporated into the ATLAS*GRAPHICS' BoundaryEdit Module. Nonetheless, to create a digital map for ATLAS, you must still cope with MapEdit.

MapEdit:

By virtue of the fact that it has not yet been incorporated into the ATLAS*GRAPHICS system, MapEdit functions somewhat differently than ATLAS*GRAPHICS. Whereas ATLAS*GRAPHICS operates via a Main Menu command line with a series of nested submenus, MapEdit operates via the Function Keys (F1-F10). These serve as the Main Menu which you use to invoke commands in order to bring up submenus. Unfortunately, these menus and submenus do not display the next options under a particular command so you can't tell where you are headed before you select a command. This means MapEdit places a higher premium on your memory - particularly in terms of knowing what command each Function Key invokes. MapEdit does come with a template that can be placed over the Function Keys to help remember what command each key invokes. We do not have a template for every machine so we will forgo using them. The following list displays the Function Keys and their commands:

KEY - FUNCTION	OPTION LIST
F1 - Help	: Screens or on Files, Map, or Target
F2 - Configure	: Tablet, Joystick, or Colors
F3 - Zoom	: In, Out, Restore, Load or Save
F4 - Screen Image	: Load or Save
F5 - Add	: Grab, Site, Circle, Polygon, Line, Begin, End, Off, Reopen
F6 - Label	: Medium or Small
F7 - Select	: View, Name, Load, Save, Flip, Undo, Type, Window
F8 - Edit	: Copy, Name, Delete, Reverse, Split, Aggregate, Undo, Move
F9 - Map File	: Load, Save, New, Target, Xform, Editlist
F10 - Quit	: Yes or No

Two keys which are also very important in using MapEdit are the ESC (Escape) and ENTER keys. You can generally press one of these keys to extricate yourself from an unwanted prompt on the screen.

Getting Started:

To accomplish this exercise, you will need to have a properly installed, MAPEDIT-supported digitizer hooked to your IBM PC-AT/Clone. Digitizing tablets will be provided in lab for this exercise. To begin, you must gain access to the MapEdit program. For this exercise, MapEdit has been placed in the Schenck subdirectory on your IBM PC-AT/Clone. Your PC-AT/Clone has been configured to automatically commence running MapEdit when you turn the machine on. (NOTICE: For anyone using this tutorial outside the context of FOR405, your machine will not be configured like this and you

will have to consult with someone who knows how to access these programs.) If you are at the ATLAS*GRAPHICS System Menu and wish to run MapEdit, you need to select QUIT in order to exit to the operating system (DOS). You will know you are at the operating system and in the correct directory if you see any of the following: C:\ATLAS >, D:\ATLAS >, or E:\ATLAS >. The first letter indicates the logical hard disk partition and the word ATLAS means we are in the ATLAS directory. To start MapEdit, simply type **MapEdit** and press **ENTER**. At this point, the MapEdit program will load and you will see the MapEdit Title Screen.

Press **ENTER** to continue as indicated at the top of the Title Screen. You should now see a screen displaying the 10 Function Keys and their corresponding Option Lists/Menus. Unfortunately, this is the only time you will see this screen which is why it was included above and given to you as a separate handout. Now we are ready to begin.

Configuring the Digitizing Tablet:

When creating a new map with MapEdit, the first Function Key you will use is F2 to configure your tablet. Press **F2**. From the Configure submenu, select **TABLET**. (You should have noticed at this point that MapEdit submenus do not support moving a highlighted rectangle to the desired option and pressing **ENTER** like ATLAS*GRAPHICS does. Thus, to select a command, simply press the first letter.) On the screen you should see a rectangle labeled "Active Tablet Area" and in the lower left corner the current X and Y coordinates of the tablet cursor. If you move the tablet cursor (heretofore known only as cursor) notice that the X and Y coordinates change. The origin (0,0) of the tablet is in the lower left hand corner.

At this point, MapEdit is waiting for you to establish a coordinate system. As discussed previously, digitizing is the means by which an existing paper map is entered into the computer. Perhaps the best way to think of digitizing is in terms of the old connect the dot pictures (dot-to-dot pictures) everyone likely did in their childhood. The dots describing a picture existed on a piece of paper and you just connected the dots with lines in order to draw the picture. This is precisely how a computer handles a digital map. Digitizing simply captures the critical "dots" (each with a unique X and Y coordinate) and the mapping software connects them in particular ways depending on whether the object is a point, line, or polygon. Your digitizing tablet is nothing but an electronic piece of graph paper. We have all plotted information on graph paper based on values of X

and Y. You don't see the grid cells on a digitizer, but that is the basic idea behind it. The resolution (# of grid cells in the X and Y directions) of the digitizing tablet varies depending on the type of digitizer. Rest assured, however, that the # of cells in the X and Y directions is many times greater than any graph paper you have ever used. When you move the cursor around the tablet, none of the coordinates are being used by the mapping software except to let you know where on the tablet the cursor is located. To send an X, Y coordinate to the computer in response to a prompt, simply move the cursor to the desired point and press the appropriate button.

What we need to do is determine in which coordinate system we wish to digitize our map. We will do ours in a relative, cartesian coordinate system. Draw a square (or rectangular) box around your map and designate the lower left corner 0,0. Make sure the square (rectangle) fits on the active surface of the digitizer. Measure the length of the Y axis (inches, centimeters, or whatever, just be consistent). Then measure the length of the X axis. You should label the 4 corners of the square (rectangle) with the coordinates you measured: **lower left 0, 0; upper left 0, Measured Y; upper right Measured X, Measured Y; and lower right Measured X, 0.** This is our grid/coordinate system that the mapping software will translate all the digitizer coordinates into. So in response to the three prompts:

- (1) Click Tablet on map's upper left corner
- (2) Click Tablet on map's lower right corner
- (3) Click Tablet on map's lower left corner

click any button on the appropriate corner of the square (rectangle) surrounding your map. After clicking the three 3 corners you will be prompted to:

- | | |
|-------------------------------------|--------------------|
| (1) Enter X (Long.) of Upper Left: | <then Press ENTER> |
| (2) Enter Y (Lat.) of Upper Left: | <then Press ENTER> |
| (3) Enter X (Long.) of Lower Right: | <then Press ENTER> |
| (4) Enter Y (Lat.) of Lower Right: | <then Press ENTER> |

Type in the appropriate values of your Upper Left and Lower Right grid corners at the correct prompt and then press ENTER. After hitting ENTER to the last prompt, you should get the message "Tablet configured. Press Enter" at the top of the screen.

When you press **ENTER**, the screen will go blank (a nasty part of MapEdit, but don't panic). MapEdit is waiting for you to choose a command from the Function Keys. The one we want is **F9**, the Map File command. (Notice that this command differs greatly from the ATLAS*GRAPHICS MAPFILE command.) From the MAP menu, select **NEW** to indicate we are starting a new map. MapEdit will prompt you to:

Enter File Name (and ext):

<then Press **ENTER**>

Type in a unique name of 8 characters or less and then put the extension **.BNA** on the end. For example, my filename might be **DEANFT.BNA**. The **.BNA** extension indicates to MapEdit that this is to be an ASCII boundary file (as opposed to binary) so we will be able to import it into ATLAS*GRAPHICS. When MapEdit asks whether to:

Make this a Lat-Long Map File: Yes or No?

Press **N** for No as we aren't using the latitude/longitude coordinate system. MapEdit will ask the following:

Zoom Window: Previous, Tablet, or User?

Respond with a **T** for Tablet since we want the screen to reflect what we are digitizing on the tablet. After this selection, the screen will go black again as MapEdit is waiting for you to press another Function Key. We are now ready to digitize.

Digitizing:

MapEdit allows you to enter points, lines, circles, and polygons by typing in coordinates or using a digitizing tablet. Since we will be using digitizing tablets, we need to familiarize ourselves with what command/function each of the four buttons on the cursor invokes. The Function Key that you use the cursor in place of is **F5** - Add (the command you issue to add features to the map). The Summagraphics Summasketch digitizing tablets and the Numonics tablet have been set up as follows:

Numonics #

Summasketch Color

Commands

1	Yellow	Polygon/Enter
2	White	Line/Delete Point
4	Blue	Circle/End Copy/OFF
8	Green	Site/Begin Copy

Thus, whenever MapEdit is waiting for a Function Key command, you can select the F5 - Add command by pushing any cursor button (make sure the cursor is on the tablet). You should see the "Point Window", a little box, appear on the screen. This means you are in the F5 - Add command ready to enter a Polygon, Line, Circle, or Site.

Adding the First Polygon:

Whenever you are digitizing a polygon, make sure you digitize in a clockwise fashion around the polygon. Move the cursor crosshair to the start of the first polygon - at a node or some other distinct part of the polygon that you will easily remember as a starting point. Press the Yellow (Numonics #1) Polygon button. MapEdit will prompt you to:

Enter name for Polygon:

<then Press **ENTER**>

You should type in a unique name for this polygon regardless of its land type. For example, you could use P1 to indicate polygon 1. After you press **ENTER**, the prompt will disappear and you will be ready to digitize the polygon. Do this by moving clockwise around the outline of the polygon on the map, clicking the Yellow (Numonics #1) Enter button to enter a point whenever the polygon boundary changes direction. This is called "point mode" digitizing because you are not tracing (which is called stream or trace mode), but rather sending only the critical points that define a polygon to the computer. Don't get carried away sending points. If you are following a straight section, you only have to give the point at the beginning of the straight section and at the end and the computer will connect the dots. Thus you are describing the polygon by a series of points or straight lines. When you get back to where your next click would be on your starting point, press the Blue (Numonics #4) OFF button and the software will close the polygon. Notice that the polygon changed color to indicate that it has been entered. Congratulations on your first polygon!!!

Adding More Polygons:

Usually every polygon you digitize will share a common border with other polygons. Thus when you digitize subsequent polygons that share the border of an already digitized polygon, you must take great care to assure

that the two shared borders exactly match. MapEdit provides the copy command to allow you to copy points from an existing side of a polygon into a feature being digitized. This **guarantees** that the boundaries will **precisely** overlap so there won't be any "slivers". To do this, digitize a polygon that shares a border with the one you just digitized. If the Point Window is not on the screen (i.e. you aren't in the F5 - Add command), press one of the cursor buttons. Once you can see the Point Window, move it to the start of the next polygon (at a node or other prominent point) and press the Yellow (Numonics #1) Polygon button. At the prompt:

Enter name for Polygon:

<then Press **ENTER**>

enter the next polygon's name (e.g. P2). When the prompt disappears, begin digitizing clockwise the prominent points of this polygon up to the node where it shares a boundary with an already digitized polygon. To digitize this shared boundary, press the Green (Numonics #8) Begin Copy button. Notice the prompt at the top of the screen:

X, Y Press Enter.

MapEdit has just "grabbed" that point in the existing polygon. Press **ENTER**. Then move to the point at the end of the shared boundary and press the Blue (Numonics #4) End Copy button. Notice the prompt at the top of the screen:

X, Y Press Enter.

MapEdit has just "grabbed" that point at the end of the boundary you wished to copy. Press **ENTER** as instructed and you'll see MapEdit "whiten" the boundary as it copies the X, Y coordinates that describe the boundary of the existing polygon into the polygon you are digitizing. After you have copied this boundary in, continue digitizing points in the polygon using the Yellow (Numonics #1) Enter button to complete the new polygon up to the point where you would digitize the starting point again. For this point, press the **BLUE** (Numonics #4) OFF button to close out that polygon. When completed, MapEdit will redraw the polygon in a different color.

This is the basic procedure you should follow to finish digitizing the polygons on your map. Be sure to **pay** close attention to when you need to copy coordinates of an existing polygon's boundary into a new polygon. You

may have to do this several times for a new polygon if it shares boundaries with several previously digitized polygons. You will readily see that it helps to label your polygons in advance and then to check them off as you digitize them. This will assist you in knowing when you need to copy coordinates from an existing polygon.

At this point, you should finish digitizing all the polygons on your land type map. If you do not wish any additional digitizing information about adding lines, points, circles; showing labels, and doing other editing tasks, move to the section marked **Target Files**.

Digitizing a Line:

You probably won't have any lines on your land type map; so feel free to skip this section. Digitizing a line is very similar to digitizing a polygon. First, if the Point Window is not on the screen, invoke the F5 - Add command by pressing a cursor button. Move the cursor crosshair to the start of the line and press the White (Numonics #2) Line button to indicate you wish to digitize a line. You will see the prompt:

Enter name for curve:

<then Press ENTER>

Type in the name of this linear feature (e.g. TRAIL1) and then press ENTER. When the prompt clears, you are ready to digitize the line by clicking the Yellow (Numonics #1) Enter button on the critical points describing the line. When you get to the end of the line, click the Blue (Numonics #4) OFF button to signal that you wish to terminate the line. After clicking the button to terminate the line, MapEdit will redraw the line in a different color. Notice that if you wish to follow a polygon boundary, you should use the copy command to copy those existing points into the new line. One difference though is that the copy of points from existing polygon to new line proceeds in a counterclockwise direction whereas copying from existing polygon to new polygon proceeds in a clockwise direction.

Digitizing a Site:

Since you probably won't have any sites on your land type map, feel free to skip this section. Digitizing a site is very simple. First, if the Point Window is not on the screen, invoke the F5 - Add command by pressing a cursor button. Move the cursor crosshair to where the site is to be located and press the Green (Numonics #8) Site button to tell MapEdit you wish to add a site (e.g. a spring, building, snag tree, etc.). You should see the prompt:

Enter name for point:

<then Press **ENTER**>

Type in the name of this point/site (e.g. SPRING1) and then press **ENTER**. Once you press ENTER, the site is registered on the map.

Digitizing a Circle:

You will probably not have any need for a circle on your map either; so feel free to move to the next section. Adding a circle to your map may be quite useful for showing a market area or area of influence. Perhaps you are trying to show that visitors to the forest come from a certain distance (e.g. within a 10 mile radius). To digitize a circle, make sure the Point Window is on the screen (if not, press any cursor button to invoke the F5 - Add command). Move the cursor crosshair to the center of your circle and press the Blue (Numonics #4) Circle button. You should see the prompt:

Enter name for circle:

<then Press **ENTER**>

Type in a name for this circle (e.g. CIRCLE1) and press **ENTER**. The next prompt will be:

Enter radius in units:

<then Press **ENTER**>

Type in the radius of the desired circle and press **ENTER**. The radius should be based on your coordinate system. For example, if your grid was an 11 inch by 11 inch square, enter 2 for a 2 inch radius circle. When you press ENTER, the circle will be drawn.

Showing Feature Labels:

If, while your map is showing on the screen, you wish to see the names you have given each feature, simply select **F6 - Label** and you will get a prompt:

Label: medium or small?

Press the first letter of your choice and MapEdit will label all the features on the screen.

Removing Features:

Up to this point, we have only looked at adding features (Polygons, Lines, Sites, and Curves). What happens if you make a mistake while digitizing or

you wish to remove features from the map? The way to do this is to select **F7** - Select from the Function Key Menu. The submenu lists the following commands available under **F7** - Select: View, Name, Load, Save, Flip, Undo, Type, Window. If you remember the name of the feature (you can use the **F6** - Label command described above to show the name of each feature on the feature) you wish to remove press **N** for Name and you will see this prompt:

Select if feature name equal to:

<then Press **ENTER**>

Type in the name of the feature you wish to remove and then press **ENTER**. This feature has been selected for an action. If you had the feature names on the screen, the name of the one you selected should have changed color. Now select the **F8** - Edit command from the Function Key Menu. The following options are available under the Edit submenu: Copy, Name, Delete, Reverse, Split, Aggregate, Undo, Move. Press **D** for Delete and MapEdit will redraw the map with that feature removed.

Alternatively, to remove features, particularly in bulk, you could have pressed **V** for View when the **F7** - Add submenu was displayed. Choosing this option would have put a list of all the feature names on the screen. You could then use the up and down arrow keys to move to the feature (or features if you wish to remove many features at once) you wish to select. Put the red highlighted rectangle on top of the feature to be selected and press **ENTER**. Notice in the upper right corner of the screen there is a "Selected" message. If you made a mistake and wish to de-select, simply hit **ENTER** on the feature again. Once you have selected all the feature names that you wish to remove, press **F8** to get the Edit submenu and then press **D** for Delete. MapEdit will delete the selected features. To see this on the map, select the **F3** - Zoom Function Key. From the **ZOOM** submenu of In, Out, Restore, Load, or Save, press **R** for Restore. MapEdit will redraw the map without the deleted features.

Odds and Ends about MapEdit:

The **F7** - Select and **F8** - Edit Function Keys are very powerful commands. Using them, you can manipulate your map feature by feature (deleting, changing names, reversing rotation, splitting features, etc.). One useful feature is the ability to copy features into another file to create subsets of your map. For example, you could copy all the lines into one file, all the polygons into another file, and the sites into yet another file. This would give you three layers of information you could look at individually

or in concert.

Another task you can do is aggregate polygons into one. For example if you have six adjacent states (e.g. FL, GA, SC, NC, VA, AL) you can aggregate these states into one region (e.g. the Southeast) by having MapEdit remove the internal boundaries.

Target Files:

When you first start digitizing a new map, MapEdit considers the name you gave the new map to be the target file name where you want the map data saved after digitizing. This is intuitive. But if you are resuming digitizing a map (more on this below) after having exited MapEdit, then after you load what you have digitized so far back into the computer, MapEdit will prompt you for a target file name. The best way to think of a target file, therefore, is where MapEdit will store your map after you have made changes to it. Thus, when you save your changes to this target file, it will reflect your most up-to-date map. The map you started with originally will also exist, but this will not have any of the changes you made. It is a backup. This is a precaution. Think of it as a way of safeguarding the work you have done previously by saving the changes under the target file name. It will be confusing at first, but it makes good sense when you get used to it. If you are an expert who makes no mistakes then, when MapEdit prompts you for a target file name, give it the name of your existing file and MapEdit will write any changes you make into this file. Before doing this, however, it will ask you to verify that you wish to overwrite on this file.

So if you have just completed digitizing all your polygons and wish to move on to the next section of this lab, select **F10 - Quit** to exit MapEdit. You will see the prompt:

Save current map to Target: Yes or No?

Press **Y** and MapEdit will save your map under the name you gave when you created the new file and exit you to the operating system. If you are ready to move on, skip to the section titled From MapEdit to ATLAS*GRAPHICS.

Resuming Digitizing:

Now that you have exited MapEdit, if you wished to edit the map you just made, follow the steps given above for gaining access to MapEdit and setting up a grid/coordinate system. Note, it doesn't matter if your map

has been moved from the digitizing tablet or not. Follow the same steps up to the point of selecting F9. Select **F9** - Map File, but rather than selecting **New** from the submenu, press **L** for Load to load your map. You should see the prompt:

Enter File Name (and ext): <then Press **ENTER**>

Type in the name of the map you created above and press **ENTER**. Reply **N** for No to the prompt whether this is a Latitude of Longitude Map. Then you should see the prompt:

Enter Target Name (& ext): <then Press **ENTER**>

As explained above, this is the new file name in which to save the most current copy of your map after you make changes. Type in a unique target name (e.g. **DEANFT2.BNA**) and press **ENTER**. MapEdit will redraw your map and you will be all set to resume adding, deleting, or editing features.

Advanced MapEdit Concerns:

There are a number of special digitizing processes that need to be employed if you encounter certain geographic occurrences such as included and excluded polygons. An included polygon occurs when more than one polygon describes a unit area. For example, if you are digitizing a map of the United States, Hawaii is comprised of several polygons each which need to be referenced as Hawaii. Other states where this would occur is Michigan, New York, and, perhaps, North Carolina depending on the level of detail included on the map (i.e. the Outerbanks). Excluded polygons occur when you have nested polygons - that is a polygon within a polygon and you want the two polygons to be considered separate areas. Perhaps you are dealing with a map of the state of Utah, home of the Great Salt Lake. The lake would be a nested polygon within the Utah polygon. If you wanted to shade Utah one color and the lake another, you must make sure that the Great Salt Lake follows the excluded polygon rule (probably the most difficult MapEdit concept to master). Time does not allow covering these topics, but if you are interested or happen to have one of these phenomenon occur on your map, see the instructor for how to cope with it or look in the MapEdit manual.

From MapEdit to ATLAS*GRAPHICS:

Now that you have endured MapEdit to create your digital land type map, we can get back to familiar ground: ATLAS*GRAPHICS to customize and

display your map. But before using the ATLAS module with which you are expert, we will use two new modules: BoundaryEdit to "import" your file from MapEdit and DataEdit to enter your land type data. At this point, it is assumed that you are in the operating system in the Schenck subdirectory. Before running ATLAS*GRAPHICS, you should copy your MapEdit .BNA file on to the provided floppy disk which should be in Drive A. From heretofore, all your mapping data will be stored on this floppy disk. Type in the following with your filename substituted for DEANFT.BNA:

COPY DEANFT.BNA A:

Provided you are in the Schenck subdirectory, this should copy your MapEdit file to the disk in Drive A.

You are going to be responsible for this disk. Treat it kindly. Don't bend it, sit on it, expose it to magnetic fields, or spill anything on it. You will need to turn this floppy disk in upon completion of your EIS. From now on, when you use ATLAS*GRAPHICS, make sure your floppy is in Drive A and the drive door is closed.

To start ATLAS*GRAPHICS, type **AG** and then press **ENTER**. Press **ENTER** again to leave the copyright serial number screen. This brings up the ATLAS*GRAPHICS Program Menu. First, let's make our MapEdit map accessible to ATLAS.

BoundaryEdit:

Select **BoundaryEdit** from the Program Menu. Remember, now that we are back in the ATLAS*GRAPHICS system, you can select by typing in the first letter (**B**) or moving the highlighter on to BoundaryEdit and pressing **ENTER**. Notice that our system of nested submenus and being able to see where we are going is back. We will use BoundaryEdit to "import" our MapEdit map. Not surprisingly, therefore, you should select **IMPORT**. At the Custom BoundaryEdit Warning screen simply press **ENTER**. You should now see the familiar ATLAS*GRAPHICS file loading and saving screen. BoundaryEdit wants to know the name of the ASCII map file you wish to load. Go ahead and hit **ENTER** to bring up the File Menu and select your MapEdit file. When prompted for the Projection of file, select **USER-DEFINED**. BoundaryEdit will display the ATLAS*GRAPHICS file loading and saving screen again. This time you should type in a name to reference this file by from within ATLAS. In order to prevent name

proliferation, use the same name you gave it in MapEdit but **don't** put the **.BNA** extension on it (don't worry, that file will not be overwritten). Once you have typed in the name, press **ENTER** and BoundaryEdit will prompt you to type in a description of the file. This is just a few words to remind you what the map contains. For example, you could type in Schenck Land Types or you can just omit a description altogether. Since it is good form, type in a brief description and press **ENTER**. BoundaryEdit will import your map data into ATLAS so now it is an official, accessible ATLAS*GRAPHICS boundary file.

When BoundaryEdit is done, you should get an "Import Completed Successfully" message at the top of the screen. Press **ENTER**. From the BoundaryEdit menu, select QUIT and then YES to return to the ATLAS*GRAPHICS Program Menu.

DataEdit:

The only hurdle that remains before you can display and customize your land type map is that we have to create the data to be displayed on the map. In the first exercise, the data we mapped were soil and stand types. Since there were 11 soil types, they were coded 1 through 11 and then entered in DataEdit. Similarly, since there were 5 distinct stand types, they were coded 1 through 5. (ATLAS only works with numeric data.) You need to code your land types similarly. After you have done so, you are ready to enter DataEdit.

Select **DataEdit** from the ATLAS*GRAPHICS System Menu. From the menu, select EDIT and from the nested submenu, select NEW. At the Type of boundary file to match nested menu, select SINGLE. You should see the even-more familiar ATLAS*GRAPHICS file loading and saving screen at this point. Use the File Menu or type in the name of the ATLAS boundary file (formerly your MapEdit file) and press **ENTER**. DataEdit will read your boundary file and display a "spreadsheet" where the names of the features you digitized are the row headings at left and the column headings are a list of empty variable names. Use the Arrow Keys to move the highlighter on to Variable #1 and begin typing a variable name, for example Land Types. Notice how what you type appears in the upper left corner of the screen. It does not occupy the cell you highlighted until you press **ENTER**. This is true for any entry you make on the spreadsheet. It doesn't occupy the cell you highlighted until you press ENTER, at which point it is move from the upper left to the cell you highlighted.

Now use the down arrow key to move down cell by cell (or to any cell you choose) and type in the data for the region/polygon displayed at left and press **ENTER**. For example, P1 (Polygon 1) may be of land type 3, so you would want to type 3 and press **ENTER**. Do this for every polygon/region that you digitized and for which you have data. You may also desire at this point to begin other variables and enter their data too.

Once you have finished entering your coded data, press **F10** to exit. DataEdit will prompt you whether you wish to Save this Spreadsheet. Select YES. You will see the ATLAS*GRAPHICS file loading and saving screen again. Type in the same name as your boundary file (to prevent having to remember many different names) and press **ENTER**. DataEdit will save your data and put the DataEdit menu on the screen. Select Quit and then YES to exit DataEdit for the ATLAS*GRAPHICS Program Menu.

Congratulations!!! Now you are ready to select ATLAS and display and customize your map like you did in Exercise I of this computer mapping sequence.

Notes:

Several batch files were used to move to and from MapEdit. An AUTOEXEC file starts up MapEdit. A batch file named AG in the Schenck/MapEdit directory starts ATLAS*GRAPHICS and a batch file named MapEdit in the ATLAS directory starts MapEdit. If you do this exercise outside the context of FOR405, these batch files will likely not be present. If this is the case, you will need to know where your data files, the ATLAS*GRAPHICS system, and MapEdit reside.

RRA 451

Computer Mapping Exercise

Due: April 18, 1988

Introduction:

This exercise is designed to provide you with an initial exposure to computer mapping concepts and applications by giving you some "hands-on" experience using a microcomputer mapping program (ATLAS*GRAPHICS) running on an IBM PC-AT. Using a county map of North Carolina, you will plot an existing (already digitized) map.

Automating the mapping needs of planners, managers of natural resources, marketing specialists, etc. has proved to be an invaluable tool in managing geographic data. Maps can be organized, up-dated, and created in a fraction of the time it took professional draftsmen to hand-draw maps as little as 5 years ago. This exercise will only give you a brief exposure to the field of computer cartography. Courses are available at this university which deal exclusively with the subject, and many employers are looking for college graduates that have a working knowledge of the subject.

About ATLAS*GRAPHICS

ATLAS*GRAPHICS, written by Strategic Locations Planning of San Jose, California, is a highly acclaimed and widely used mapping package for IBM PCs and Compatibles. Since appearing on the market about 3 years ago, ATLAS has developed large numbers of users in business, academia, and government planning agencies. ATLAS*GRAPHICS combines power and sophistication with ease of use and extremely low cost. Strategic Locations Planning has taken great pains to render ATLAS*GRAPHICS intuitive, and thereby second nature. To a large extent, they have succeeded. The basic process which you will follow each time you start ATLAS is as follows:

- (1) Load a Boundary (Map) File
- (2) Load a Data File
- (3) Assign the Data Ranges
- (4) Customize the Legend

(5) Add Text to the Map (if desired)

(6) Set Map or Plotter Configuration Options (if needed)

(7) Plot the Map

Notice that you can Plot the Map anytime after you load the boundary file to see how you are doing and then continue with the subsequent steps which just further customize the appearance of your map. Although this procedure outlines the logical approach to mapping with ATLAS, when you become proficient, you will be able to do almost any of these steps in any sequence. But for now, just follow the detailed steps below in order to begin producing high quality maps.

ATLAS*GRAPHICS is a relatively simple software system. Like Lotus 1-2-3 and many other popular software packages, it works by a system of nested menus (lists of options). You select the option you wish to use by simply typing the first letter of that option or using the cursor movement (arrow) keys to move the highlighted rectangle on to the desired option and pressing **RETURN** or **ENTER**. Notice that often when the highlighted rectangle is on a command, you will be able to see the next line of commands that can be accessed by choosing the highlighted rectangle. This is characteristic of the nested menu structure.

Getting Started

For this exercise, you will not need any floppy disks. All program and data presently reside on the IBM PC-AT hard disk. Choose computer #1 or #2 in the Apple-Lab; they are connected to the plotter sitting near the middle of the room. In order to begin, make sure the computer and monitor are on. When the computer is turned on you should see a **C>** in the upper left corner of the screen. Type **cd\atlas** at this prompt and then hit the Return or Enter button. Now the screen should read **C>atlas**. This puts the computer's memory in the correct "directory" so that it will find the ATLAS*GRAPHICS program. To start the program type **ag**.

(Please note the convention employed in this exercise, that commands you should type in the computer are shown in **BOLD CAPS**. Also, this exercise assumes you have properly configured the ATLAS system to utilize the

desired output devices and to find your files.)

Running ATLAS*GRAPHICS

From the copyright/serial number screen, press **ENTER** to bring up the ATLAS*GRAPHICS Program Menu. This menu gives you access to the various modules/programs comprising the ATLAS system. The one that is most heavily used, and our primary interest, is ATLAS. This module handles all the map customizing and display. Select ATLAS. Remember that there are two ways of doing this (as explained on the screen): (1) moving the highlighted box to ATLAS and pressing **ENTER** (since it is already on ATLAS, you just need to press **ENTER**) or (2) pressing the first letter of ATLAS, **A**.

After doing this, you should see the ATLAS Main Menu across the top of the screen:

BOUNDARY DATA LEGEND TEXT ZOOM CONFIG MAPFILE PLOT SLIDE HELP QUIT

At the bottom of the screen you will see information on the Program Status. This will tell you the name of the map file, the name of the data file, the name of the variable being displayed, and information about some of the map settings. This ATLAS Main Menu/Program Status Screen is very important. You will be at this screen repeatedly, selecting commands to alter and display your map.

A. CREATING AND PLOTTING A MAP IN ATLAS*GRAPHICS

(1) Loading a Boundary (Map) File

For now, ATLAS*GRAPHICS is already highlighting the most likely selection from the Main Menu, BOUNDARY. Notice that the Main Menu is a nested menu. If we were to select BOUNDARY, our next choices would be SINGLE or LIST. Select BOUNDARY (Henceforth, when you see "Select", this means to type the first letter of the item being selected or to move the highlighter on to it and press **ENTER**.).

From the nested submenu, select SINGLE. This indicates to ATLAS that we wish to load (bring up) a single map file. After selecting SINGLE, you will see the ATLAS file loading and saving screen. This is how information (in

this case cartographic/boundary data) is loaded into ATLAS. You are being prompted to type in the name of the boundary file to load. As usual, there is more than one way to give ATLAS the name of the file. The quickest way is to type in the file name at the prompt and press **ENTER**. If you don't know the name of the file, press **ENTER** and a list of map files will appear. This is called a File Menu. Use the cursor movement keys to move the highlighter on to the file you wish to load and press **ENTER**.

We wish to load the boundary file showing the counties of North Carolina. I have named this file NCSCORP, type in this file name and press **ENTER** or use the file menu technique just described. ATLAS will load NCSCORP and return you to the ATLAS Main Menu. Note at the bottom of the screen under the Program Status section that it now tells us NCSCORP is our boundary file.

If you would like to see the map up on the screen at this point, simply select PLOT. Then from the nested submenu, select DISPLAY. ATLAS will draw a simple black and white map on the screen. When done, the Main Menu will appear back at the top of the map. Now comes the time to customize the map.

(2) Loading a Data File

From the Main Menu, select DATA. This indicates to ATLAS that we wish to load some data to display on the map. From the Data nested submenu, select FILE because we want to load a new data file. After selecting FILE, you should see a familiar screen: the ATLAS file loading and saving screen. Whereas before, we loaded a boundary file, this time we want to load an ATLAS data file also called NCSCORP. Follow the same procedure as outlined above: either type in **NCSCORP** and press **ENTER** or use the File Menu feature. After choosing the data file, ATLAS will display a list of variables in this data file. This allows you to keep several pieces of information about the polygons on the county map. Select the variable concerning planning regions by highlighting it, then press **ENTER**. ATLAS will load the information for that variable and take you to another screen (Data Ranges Assign) where you will specify how to group the data to be displayed.

(3) Assigning the Data Ranges

Grouping **data** for display depends on how your data was coded. The data for these SCORP planning regions was coded as follows: 1=Region A, 2=Region B, 3=Region C 17=Region R.

This means that there are 17 discrete planning regions or ranges we wish to map. To indicate that to the program, use the cursor movement (arrow keys) to move the red highlighted rectangle to # of Data Ranges. Then **push the right arrow key until the number in the box is 17** and then press **ENTER**. ATLAS will recalculate the data ranges and show you that there are now 17 ranges. We must do one more thing to make sure each discrete planning region is represented. Move the red highlighted rectangle up two spaces to the Ranging Method selection. Presently, it is probably set on Equal #. Move the red rectangle one space to the right to the Even Ranging Method and then press **ENTER**. Don't worry about all the decimal places that appear in the Data Ranges. What is important is that ATLAS has given you 17 discrete categories with an equal increment of .9, each containing a planning region. Press **F10** to have these ranges take effect and to return to the ATLAS Main Menu and Program Status screen. Notice that the Program Status section has been updated to reflect what you just did.

(4) Customizing the Legend

Now that we've selected our map and data files and set our data ranges, we **can** customize our legend, titles, and hatching (shading) patterns. To do this, select **LEGEND** from the ATLAS Main Menu. Since the **TITLES** option is now highlighted, select it first. Now you can see where the **ATLAS*GRAPHICS** title came from when we previewed the map before. Type in your own Title, Subtitle, and Legend Heading. Just type over the existing text. Make up your own appropriate titles. Use the up and down arrow keys to move between titles. You can change the default font, size, color, and other attributes of each title by pressing the PgDn or PgUp key when that title is highlighted. Then use the up and down arrow keys to move among the font, size, color, and other options and the side arrow keys to select your particular font, size, color, etc. When you want to return to the titles area, press PgDn or PgUp again. Once you have set the titles to your satisfaction, press **F10** to return to the ATLAS Main Menu.

Select LEGEND again from the ATLAS Main Menu. From the nested submenu, select DESCRIPTIONS. A new screen appears showing the Data Ranges which you previously set. The Legend Descriptions option allows you to specify text in your legend rather than getting the data range numbers. This is particularly helpful when you are mapping discrete data like our planning regions. Simply type in the 17 regions next to their appropriate range/category number. To move between ranges, use the up and down arrows. To set the font, size, and color of these descriptions, use the PgDn and PgUp keys to move to the appropriate section. When you are done typing in the descriptions and setting their font, size and color, press F10. Be sure to view your work on the monitor by selecting PLOT then DISPLAY to make sure your customizing is to your satisfaction.

Select LEGEND once again from the ATLAS Main Menu. From the nested submenu, select FILL. Now we will assign a hatch/shade pattern to each planning region. You will see 26 hatch patterns on the left of the screen and your planning regions on the right. Working with Region A, you will note that the present hatch is probably empty and the color is likely red. Use the + and - keys to select your desired hatch pattern for Region A. After you have set the regions hatch pattern, use the left and right arrow keys to toggle between possible colors. Notice that the box color may not change as you toggle among colors. Seeing the different colors on the screen depends on the type of graphics card and monitor you are using. Even if you can't see the colors you have selected, they are still important because these are the colors of the pens the computer will prompt you to place in the plotter when you go to plot a map. Repeat the procedure of setting a hatch pattern and color for each planning region. Use the up and down arrow keys to move among the regions. When you have finished, press F10 to register the fill patterns and return to the ATLAS Main Menu.

(5) Adding Text to the Map

We will not use this option for this map.

(6) Setting Map or Plotter Configuration Options

We will not change anything for this map.

(7) Plotting the Map

NOW FOR THE MOMENT OF TRUTH!!! Select PLOT from the ATLAS Main Menu. From the nested submenu, select DISPLAY to view the map on the screen. Depending on the resolution of the screen and the complexity of the map, it may all look like a bowl of spaghetti. Don't worry, all the information is there and it will look fine when plotted.

Select PLOT from the ATLAS Main Menu. From the nested submenu, select PLOTTER. At this point you should make sure that the plotter is on, connected to your computer, and loaded with paper. The computer will prompt you to insert the appropriate colored pens. Put these pens in the plotter and then press **ENTER**. The plotter should now begin doing your map. Continue this procedure as long as the computer keeps asking you to change the plotter's pens. When the plot is complete, the ATLAS Main Menu will appear back at the top. Congratulations on your first computer map!!!

Should you desire to save this map just as it looks now, select MAPFILE from the ATLAS Main Menu. From the nested submenu, select SAVE. At the ATLAS file loading and saving screen, simply type in the name you wish to give to this mapfile. Since other people will be saving a similar file, you should give this mapfile a unique name and press **ENTER**. If ATLAS warns you that that file already exists and you have not previously created it (i.e. it is another person's mapfile) then answer N (or select NO) and then type in a different file name. If you do not wish to save this map for further use, simply select QUIT and follow the prompted questions presented to you to exit the program.