THE FEASIBILITY OF USING COMPUTER GRAPHICS IN ENVIRONMENTAL EVALUATIONS

by

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and

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

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ABSTRACT

The purpose of this study was to develop a procedure that could be used to quickly distinguish between proposed transportation projects that would have an effect on the environment, and thus require special approval, and those that would not. It is intended that this procedure be used as a basis for agreements between the Department and other state and federal agencies to expedite evaluations of environmental impact. Data collection, program selection, and retrieval and update procedures are described in this report.

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INTRODUCTION

The Environmental Quality Division of the Virginia Department of Highways and Transportation is directed to assess the probable benefits and damages that will result from the construction of all the Department's proposed projects. For state funded projects, these assessments result in informal reports used as decision-making tools within the Department. For federally funded projects, they result in some form of environmental impact statement (EIS).

Revisions to the National Environmental Policy Act (NEPA) have been made by the federal government with the intent of shortening the overall EIS process; however, the effects have been realized more at the reporting phase than at the data collection and analysis phase. For example, the scoping process (§1501.7 of the CEQ regulations) requires that an agency, as soon as possible after deciding to write an EIS on a proposed project, publish a notice of intent in the Federal Register. Among other objectives, this notice is aimed at assuring that all parties affected by or interested in the proposed action be invited to participate in determining the scope of the EIS, which includes establishing the significant issues to be studied, eliminating from study those issues considered insignificant, identifying and coordinating related EISs being written, and establishing the length of the final EIS. To prepare for and conduct the scoping process, initial data must be collected on all potentially significant variables, such as historic site locations, etc., within the project area.

PROBLEM STATEMENT

Requests for environmental surveys needed to comply with federal regulations are sent to the Environmental Quality Division from the Location & Design Division and from the district environmental coordinators. In response, the Environmental Quality Division staff either performs the survey or contacts federal agencies and other state agencies to obtain information for satisfying the request. In most cases the information is manually maintained or must be collected for the first time, and where the Department is dependent upon other agencies for information, it cannot expedite retrieval.

It would be extremely rare for a project to affect all variables that must be considered in an environmental impact assessment. Some of the more complex projects involve several variables, but the majority of all projects have no environmentally adverse effects. Consequently, a great deal of time is spent surveying projects to determine which of the variables require study.

OBJECTIVE

The objective of this study was to develop a procedure that could be used by the Department to quickly distinguish between proposed transportation projects that would have an effect on the environment, and thus require special approval, and those that would not. It was intended that this procedure would be used as the basis for agreements between the Department and other state and federal agencies to expedite evaluations of environmental impact.

DEVELOPMENT OF THE PROCEDURE

The procedure developed consists of selecting an appropriate computer program, developing a data base, and selecting a means of accessing and updating the information. A suggested agreement for implementing the procedure was devised. These steps are discussed under the subheadings which follow. Although the procedure can be applied for locating many different types of variables, the historic landmarks data base is used in the illustration presented here.

Discussion relating to archeological site locations, land use-land cover, geology, and demographics, those variables identified by the study task force as being relevant, is presented in the Appendix.

Program Selection

Two computer programs were evaluated: SYMAP, a program obtained from Harvard that is designed to produce graphic output on a line printer, and the landmark data and list program (LDLP) developed by the Department from a base program obtained from the Federal Highway Administration and having the capability of producing graphic output on a pen plotter.

SYMAP Program

The SYMAP program, obtained from Harvard University's Laboratory for Computer Graphics and Spatial Analysis in Cambridge, Massachusetts, was selected because of its proven reputation. It was developed at Harvard during the 1960s and is currently the most widely distributed general purpose computer mapping software package. It can produce maps containing point, line, or area data, or combinations of these. By electing certain built-in program options, SYMAP users can manipulate the size and scale of the maps produced and the symbols used to distinguish map features. The program can blow up portions of a map, can be programmed to include only certain data features, and can produce cosmetic features such as legends and directional arrows within the map border. The output is produced by a standard line printer on standard computer paper (see Figure 1).

SYMAP was evaluated using data obtained from the U. S. Geological Survey's land use-land cover map series. "Land cover" describes natural land features such as vegetation, wetlands, rock outcropping, and glaciers. "Land use" refers to man's use of the land for facilities such as highways, bridges, buildings, and dams.

These maps are being developed by the USGS at a scale of 1:250,000 ((1 inch [25.4 mm] on the map equals approximately four miles [6.4 km]). The land use-land cover classification system uses 9 general level I categories further subdivided into 37 level II categories. This evaluation revealed the following information:

- 1. The SYMAP program is an excellent tool for comparing data using an overlay technique. For example, by graphically overlaying variables usually related to archaeological sites, areas of land on which a site may exist will be identified by a dark shading (see Figure 2).
- 2. SYMAP is a reliable canned program and can easily be implemented on the Department's IBM 370 computer.
- 3. SYMAP data can be transmitted from terminal to terminal using equipment already available in the Department's district offices.



Figure 1. SYMAP produced land use map, Winchester, Va.



Figure 2. Sample overlays.

- SYMAP is not as accurate for point location as a program that uses a pen plotter for graphic output.
- 5. SYMAP is best used for representing continuous land use-land cover data rather than point or line data.
- 6. In most cases the collection and reduction of data for SYMAP requires many man-hours. The work required is often in the form of digitizing, which in the Department is performed "blind" and results in downtime for corrections.

Landmark Data and List Program

Several programs available within the Department were consolidated to test the applicability of data graphically produced on a pen plotter. Although the resulting program, since dubbed the landmark data and list program (LDLP), does not provide the convenience of a canned program, the immediate availability of the component programs and the programming expertise make it an economical and tailored system.

The program was evaluated using data obtained from the files of the Virginia Historic Landmarks Commission. These files contain approximately 20,000 historic locations identified in a survey of Virginia. Of these, 1,000 representing locations listed on or nominated for the National Register and those listed on the Virginia Register were selected.

The findings below are relevant to both the computer program and the historic site location data used.

- 1. The pen plotter is accurate for locating sightspecific data.
- 2. The best results were obtained when data were overlaid on a USGS quadrangle map.
- 3. Data in this form could not be transmitted to other locations because of the need for specialized equipment.
- 4. Using the programs available within the Department, data could be retrieved on a statewide basis to coincide with the state map, county map, or USGS quadrangle map.

- 5. By collecting only location data and limited descriptive data, a useful data base could be established.
- 6. The overlay method of depicting data is sufficient, given the time limitations of an environmental evaluation.
- 7. The transmittal of information by mail is sufficient for environmental evaluations.

Conclusions

The findings from the two evaluations led to the selection of the LDLP program for use in establishing the environmental data base. Program SYMAP could be used, it was decided, for some specific studies on a quadrangle level.

Development of a Data Base

Types of Data

For this illustration of the establishment of a data bank using historic site information, representatives of the Virginia Department of Highways and Transportation, the Virginia Historic Landmarks Commission, the Federal Highway Administration, and the registrar from the National Register of Historic Places were involved in the decision as to what types of data would be collected.

In addition to collecting the historic site information mentioned previously, information of interest to agencies other than the Virginia Department of Highways and Transportation was also collected. It was opined that to the extent that other agencies are interested in a specific data bank, they will aid in updating the data.

An effort was made to collect enough data to make the program useful to the Historic Landmarks Commission while at the same time not so complex that the time required to complete the data bank and the effort needed for updating would be unreasonable.

Data Input

The information selected for use was limited to that contained on the coding and input data sheets shown in Figures 3 and 4, respectively. Certain information on these sheets is applicable to all variables. Other information items are to be modified or the data translated in order to be used. The items on the information sheet are explained below, and in cases where these items may need interpretation, examples are given. The following explanations are correlated with the data sheet items in Figure 4.

```
Category (Column 7-46)
                                                                                . 5. Object
6. Public
7. Private
 1. District
       Building
 2.

    3. Structure
    4. Site

Significance (Column 48-61)

    Archeology — prehistoric
    Archeology — historic
    agriculture

                                                                                 51. colonial settlement
                                                                                 52. nautical
53. biological
                                                                                 54. esthetic
55. depth
56. geological
57. hydrological
 4. architecture
 5. art
 5.
      commerce
 7. communications

    community planning
    conservation
    economics

                                                                                 58. paleontological
59. length
                                                                                 60. recreational
11. education
12. engineering
                                                                                 buildingbridge
13. exploration/settlement
                                                                                 53. mill
14. industry
15. invention
                                                                                 54. tavern
65. church

66. canal
67. historic district
68. archeological district

16. landscape architecture
17.
       law
13. literature

    house
    courthouse

19. military
20.
       music
21. philosophy
                                                                                  71. glebe

    22. politics/government
    23. religion

                                                                                  72.
                                                                                 73.
24. science
                                                                                  74.
25. sculpture
26. social/humanitarian
                                                                                  75.
                                                                                  76.
                                                                                  77.
27. theater
28. transportation
29. local history
                                                                                  78. FUTURE EXPANSION
                                                                                  79.
30. scenic
                                                                                 80.
31. medicine
                                                                                  31.
32. presidential birthplace
33. animal husbandry
                                                                                  82.
                                                                                  83.
34. folklife
35. decorative arts
                                                                                  84.
                                                                                  85. urban and built-up land

and built-up fand
and built-up fand
and commercial
urban industrial
urban institutional
urban mixed
cropland and pasture
orchards, groves, vineyards,
horticultural

    19th century townscape
    revolutionary history
    afro-american

    39. fire fighting
    40. civil war

<sup>4</sup>l. printing
42.
42. resort43. stone structure
                                                                                  32. rangeland
                                                                                 93. forestland
94. streams and waterways
95. lakes
44. presidential home site
45. equestrian
46. labor
                                                                                  96. reservoirs
97. bays and e
47. funerary art
43. park planning 49. health
                                                                                        bays and estuaries
                                                                                 93. nonforest and wetland
99. barren land
50. maritime
Registration (Column 106)
  1. National Register of
                                                                                   5. Virginia Historic
  Historic Places
2. National Historic Landmark
                                                                                         Landmark Commission
                                                                                          Toventory

    Virginia Landmark Register
    Determination of Eligibility

    Protected
    Unprotected
```

Figure 3. Historic sites coding sheet.

VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION RESEARCH COUNCIL LANDMARK RESEARCH DATA

FILE NO					
CUL I	-6				
DESCRIPTION	Name of Pr	roperty			
		COL 7-46			
CATEGORY	<u>See</u> Informat 47	ion Key			
AREAS OF SIGNI	FICANCE <u>See</u>	Information Key COL 48-61			
ACREAGE	In even numbers	1 through 1,000			
CITY/COUNTY/TO	WN <u>spelled</u> out	CITY/COUNTY	//TOWN CODE	Standard <u>Code</u> 66-68	State
QUADRANGLE MAP	spelled out	QUADRANGLE	CODE	USGS Code COL 69-72	
LATITUDE _	73-78	LONGITUDE	79-84	_	
UTM COORDINATE	S				
NORTH85	-94	EAST			
HABS	<u>"l"</u> if yes, oth 105	nerwise blank			
REGISTRATION	<u>See</u> Code Sheet 106				
DATE M	ost significant	or earliest			
ORIGINAL USE	111-113	HISTORIC USE	114-110	_ 6	
	For future	e use			

Figure 4. Input sheet.

- File number : This is a six-digit number. The first three digits represent the geographic location of the site, the remaining three identify the specific site within that location. This variable is necessary for retrieval.
- Description : The preferred name of the location. This is not necessary and can be blank.
- Category : A one-digit number that identifies the location as a district, a building, a structure, a site, or an object. This item can be used to designate privately or publicly owned properties.
- Area of Significance : A two-digit number that identifies the reason(s) the site is significant (e.g., architecture, art, commerce, or transportation). This item is used to describe the data and to identify the specific site or area to be recalled (searched). Some of the significance items are very close in meaning in an attempt to accommodate subtle but significant differences in meaning between disciplines supplying the data. A maximum of seven codes can be used to describe and identify a particular item; the more exact the coding the better the chances for a comprehensive retrieval.
- Acreage : The amount of acreage surrounding the site. This number may be an overestimate of the property involved. For example, if the record shows "less than (1) acre", 1 acre will be recorded; and if the property is recorded as a fraction, the next whole number will be recorded.
- City/County/Town : Both the name and a three-digit code assigned by the state are used to identify the geographic location of the site.
- Quadrangle Map : The name and quadrangle number assigned by the USGS are used for location.
- Latitude and Longitude: The coordinate system was used to gather historic data prior to 1966; consequently, these data are gathered and translated

into state plane coordinates (SPC) for use by the Department.* Either this item or UTM should be used; not both.

UTM Coordinates : The UTM system is presently used to locate historic sites. These are translated to SPC for use in the program.* : Either this item or latitude-longitude should be used; not both.

HABS

Date

- : Refers to the Historic American Building Survey. A "l" is used to indicate that the historic site was a part of this survey. This item is used only with historic data.
- Registration : One through five indicate if the landmark is on the National Register, is a National Historic Landmark, has been nominated to the National Register, or is on the Virginia Landmark Register; items 6 and 7 apply to cave data. This item does not have to be used.
 - : This is the most significant date of the item or a date that has been established for the origin of the item. It is important for description and identification.
 - Original Use : The use for which the landmark was originally constructed or used (e.g., nationally, the Alamo was originally a church; in Virginia, the Sutherland Mansion was originally a private residence), exclusively for historic data.

Historic Use : The use for which the landmark is known and because of which it is deemed historically significant (e.g., the Alamo was originally a church but is historically noted as a fortress; the Sutherland Mansion was the last capitol of the Confederacy), exclusively for historic data.

*A program obtained from the USGS is used to make these conversions.

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Data Access and Update

Information from the data bank established can be obtained upon request from the Data Processing Division. Since the process is designed to be easily used by people in various agencies, the information can be retrieved by identifying the code number of the county or quadrangle for which it is desired. Also, the information can be retrieved by identifying the latitude/longitude, UTM, or state plane coordinates that encompass the area for which it is desired. By requesting a search of the data bank, the retrieval can be limited to any of the words under the significance coding, or any date within a ± 25-year interval.

The retrieval process produces a series of standard printouts (Figure 5) and, upon request, graphic representations. As previously noted, the scale can be varied to enable displays at the state, the county, or quadrangle level, as depicted in Figures 6, 7, and 8, respectively.

Information can be added to the data bank with the authorization of the manager of the Data Processing Division. While the frequency of updating information will vary from variable to variable, information stored in the data bank can be changed by submitting a form such as that shown in Figure 9 to the Data Processing Division.

VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION

HISTORIC LANDMARK DATA

DESCRIPTION BRYAN SITE

CATEGORY SITE

AREAS OF SIGNIFICANCE

	ARCHEOLOGY - HISTOR	IC
	ARCHITECTURE	
ACREAGE	10	
CITY/COUNTY	YORK	COUNTY
QUADRANGLE	WILLIAMSBURG	096C
COORDINATES	NORTH	EAST
	18 4215820	353200
	18 4125700	353270
	18 4125800	352890
	18 4125920	352940
	18 4125820	353200
HABS	NO	
REGISTRATION	NATIONAL REGISTER OF	HISTORIC PLACES
DATE	1700	
ORIGINAL USE		
HISTORIC USE		

Figure 5. Typical printout of information contained in historic data bank.



Figure 6. Density map of known historic landmarks.









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TION		REGISTRATION		
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RTMENT OF HIGHWAYS AND TRAN DATA PROCESSING DIVISION 80 COLUMN LAYOUT SHEET	2 9 9 9			
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Figure 9. Data update sheet.

Agreement for Implementing System

To implement the procedure illustrated here, the Department must obtain the agreement of any concerned agencies. Such an agreement is presently being negotiated between the Environmental Quality Division and the Virginia Historic Landmarks Commission. The elements of the agreement that must be worked out are discussed below.

Type and Accuracy of Data to be Used

In the trial use of the procedure developed, the information used was taken from the Landmarks Commission files. Most important was the coordinates designating the location of an historic site. These could be obtained either by copying those in the files or by interpreting the positions of landmarks located on maps. The accuracy of these data depends upon the expertise of those who originally located the sites and the accuracy of those who then transcribed the information for the files.

Method of Data Reduction

In mapping, the Department uses state plane coordinates. However, the files in the Virginia Historic Landmarks Commission contain both latitude/longitude for the period prior to 1966 and UTM since that time.

Accuracy of Graphic Displays

To ensure that the data displayed on the computer-produced overlays were accurate, several random samples were checked against data transcribed on maps at the Virginia Historic Landmarks Commission. Also several of these overlays were field checked. It is important that all data produced by the computer accurately represent data in the files. A breakdown could result in a lack of confidence that could invalidate any agreement between the Department and a concerned agency.

Method of Updating Data

Personnel of the Virginia Historic Landmarks Commission agreed to fill out the computer input sheets for those properties placed on the Virginia register at their monthly meetings and for all newly surveyed properties.

Method of Notification

Once the questions relating to data are resolved, a method of notification must be devised. This method should (a) stipulate how the Department is to give the other party to the agreement prior notice of any planned action, and (b) specify a time period within which the other party shall make any desired response.

COST OF DATA BANK

The costs of establishing a data bank depend upon such factors as the hardware and software available, the programming service needed, and the desired precision of the data desired. However, once the data base is established, updating and maintenance are relatively inexpensive.

The Virginia Department of Highways and Transportation has the expertise to maintain a given data bank, and with other agencies participating in the updating procedures, the costs would be limited to those for storing and retrieving data and processing the updated information. For maintaining the historic site location data, the annual cost is estimated to be \$33.

RECOMMENDATIONS

Recommendations resulting from this study are stated below. They are all predicated upon the implementation by the Department of the procedure for distinguishing projects likely to have an undesirable environmental impact.

- 1. It is recommended that the historic landmarks data bank established in this study be maintained and updated as a routine operation.
- 2. It is recommended that the LDLP program developed by the Data Division of the Department be used to store data on a statewide basis when the data are relatively easy to collect and reduce.

The SYMAP program should be used on a limited basis, such as for analyzing data in an area of the size represented by a USGS quadrangle map.

- 3. Since data collection is the most expensive aspect of this procedure, an effort must be made to gather only information that will (a) aid in determining if a project area is environmentally sensitive, and (b) be of sufficient interest to encourage other state agencies to aid in maintaining and updating the data bases. Therefore, it is recommended that authorization for establishing data banks within the system be obtained through the Environmental Quality Division or the Data Processing Division.
- 4. If data are needed and must be digitized for entry into the system, it is recommended that the Mapping Section of the Location and Design Division be consulted for assistance.
- 5. It is recommended that an agreement be made between the Department and the Virginia Historic Landmarks Commission which states that -
 - a. the data available for the procedure to be implemented are sufficient to determine if there is a question of impact;
 - b. the demonstrated procedure for data collection, interpretation, and method of display gives an accurate representation of the project area;
 - c. the Department can assume that a project is clear of any adverse impact on a historical site when data in the system support this decision;
 - d. in each instance a memo will be sent to the director of the Virginia Historic Landmarks Commission informing him of action to be taken; and
 - e. if no reply is received within a stated time period, the action outlined by the Department would be authorized.

This agreement is appropriate with the information now in the historic landmarks data base and could serve as an example for agreements with other agencies.

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APPENDIX A

DATA VARIABLES EXAMINED

Statewide data banks have been established for historic and archeological site locations and cave locations. In the following paragraphs, the status of data collection and recommendations for future data collection is discussed. The name of each variable will be followed by a brief discussion of the need for or importance of the variable, the source from which the information pertaining to that variable was obtained, and recommendations concerning the future collection of data (statewide or specific area) and frequency of update. Special characteristics such as coding interpretations to inputing data are also noted when applicable.

Historic Site Location

Need for Information

Highway and transportation projects can infringe on historically significant sites that are considered environmentally sensitive. Although most projects do not impact upon sensitive areas, surveys must be conducted to document this fact. Through the use of the historic data bank, site locations can be documented quickly. Sensitive areas that will be impacted can also be identified quickly, and work to mitigate the impact or to design alternatives can be gotten under way. Documentation by computer search is accomplished in a day; manual searches have taken in excess of six months.

Source of Information

Historic Landmarks Commission 221 Governor Street Richmond, Virginia 23219 Phone (804) 786-3144

Data Collection and Update

In the files of the Landmarks Commission there are approximately 20,000 historic locations identified in a survey of Virginia. From those files, only about 1,000 representing locations listed on or nominated for the National Register and those listed on the Virginia Register were selected for this study. In addition, an effort was made to collect enough data to make the program useful to the

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Historic Landmarks Commission while at the same time keeping it simple enough that the time required to complete the data bank and the effort needed for updating would be reasonable.

It is recommended that the historic landmarks data be continually updated with the cooperation of the Landmarks Commission. Routinely, ten sites are added to the Virginia Register every month for ten months of each year and these should be added to the data bank each month. However, it is suggested that whenever a location is surveyed, the data collected be automatically added to the data bank. If the initial data are incomplete, they can be supplemented at a later date.

It is further recommended that an effort be made to include all remaining files now in the landmarks survey.

Archaeological Site Location

Need for Information

The need to identify known archeological sites is much the same as for historic sites. However, the available data on archeological sites are not as complete or exact as those for historic landmarks. Except in unique cases, there is no hierarchy of site status (i.e., there are no listings such as the Virginia Register and National Register for designating significance); therefore, any location encountered is considered to be significant. Since most archeological sites are below ground level and covered they are difficult to locate, and when not discovered until construction is started they can cause costly delays in projects.

Source of Information

Virginia Research Center for Archeology (VRCA) The Wren Kitchen College of William & Mary Williamsburg, Virginia 23186 Phone (804) 253-4836

Data Collection and Update

There are approximately 15,000 known archeological sites in Virginia, and these have been recorded on USGS quadrangle maps and stored in a data bank.

It is recommended that these data be updated as frequently as new sites are entered. This can be accomplished through the Research Center for Archeology by having information sheets submitted as field surveys are completed.

SYMAP Application

A possible solution to the special problem caused by archeological sites uncovered by construction is available through application of the SYMAP program. The following steps are suggestions for study and should not be interpreted as being a fully developed methodology.

- The type of archeological find expected within an area should be identified (e.g., Indian village, grain mills, canal locks, or lime kilns).
- Variables usually associated with the anticipated finds should be listed. Usually these will be related to the trade, transportation, and food supply of the people living at a specific time in a particular geographic area. These variables include roads, rivers, rock types, vegetation, and animal life.
- 3. The variables should be briefly researched to establish the amount of data available.
- Based upon the availability of sufficient data, the most important variables should be selected.
- 5. The information collected should be reduced for use with the SYMAP program. This reduction involves identifying the location of the variables by listing coordinates of their boundaries. The reduction can be best accomplished by using a digitizer, an activity which must be coordinated with both the Location & Design Division and the Data Processing Division.
- 6. The variables can be weighted in relation to their importance in representing the probability of a find. However, since this weighting is usually a complicated operation, each variable can be assigned the same importance. Figure A-l gives typical weighting schemes.

A-3

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Figure A-1. Typical SYMAP produced sensitivity map.

- Once location and weighting data have been developed for each variable, they can be fed into the SYMAP program as separate data items.
- 8. Using the overlay capabilities of SYMAP, probable locations can be identified by dark shaded areas on a selected map of the area. Figure 2 shows a conceptualization of the overlay technique.

Land Use-Land Cover

Need for Information

Transportation planning issues such as the delineation of new growth areas, assessment of new transit requirements, and projections of increases in travel demand are closely tied to geography and can be analyzed using land use maps relating to environmental issues. The Department must evaluate each project to determine if land considered environmentally significant will be encroached upon during project construction. Among the land uses considered in an environmental evaluation are parks, forests, wetlands, and areas falling under the general category of "prime", such as prime agricultural land.

Consequently, it is important to have a capability for identifying these unique land types, especially when they cannot be identified from readily available maps.

Sources of Information

United States Geological Survey (USGS) National Cartographic Information Center National Center Reston, Va. 22092

> (Reference: Lane Use & Land Cover Map, 1974-77 Roanoke, Va. 1:250,000 scale)

Virginia Division of Mineral Geology Natural Resources Building McCormick Road Charlottesville, Va. 22903

(7.5 quadrangle maps of Virginia)

Data Collection and Update

Data collection for this variable has been extremely limited and was restricted to testing of the SYMAP and LDLP programs. With the SYMAP program, land use-cover maps could be developed with shadings used to differentiate land use types. This application appeared to be a duplication of information already available. The USGS has started a program to digitize these land use-cover maps and plans to make them available on computer tapes, and USGS quadrangle maps are already available. Maps such as these provide a good land use-cover base; however, locations of specific land use such as local recreational areas and locally designated prime farmland are not available. This information, when available, can be documented using the same format developed for the preceding variables.

Input to the LDLP program can be accomplished by using the same coding sheets as that used for previous variables. Significance items 85 through 99 are based on the standard USGS land classification (see Table A-1), and should be used when assigning significance to land use-land cover data.

Information on land use can be collected from files, in which case most information is transferred to data input sheets. Commonly, the coordinates of a particular land use variable will not be available. In such cases, the digitizing method mentioned earlier is the most accurate and efficient method for reducing map locations to coordinates for entry into and use by the program.

Table A-1

Land Use-Cover Classification

Land Use Classification

10	Urban	& Built-Up Land
	11	residential — single family dwellings
	115	residential - multifamily dwellings
	116	residential - mobile homes
	117	residential — rural
	12	commercial
	13	industrial
	14	extractive
	15	transportation, communication, utilities
	16	institutional
	18	mixed
	19	open space

Table A-1 continued

- 20 Agricultural Land
 - 21 cropland & pasture
 - 22 orchards, groves, vineyards, horticultural areas
 - 23 feeding operations
 - 24 others

30 Rangeland

- 40 Forest Land
 - 41 Decidious
 - 42 Evergreen
 - 43 Mixed

Water

- 51 Streams and waterways
- 52 Lakes
- 53 Reservoirs
- 54 Bays and estuaries
- 55 Other

60 Nonforested Wetland

61 Vegetated 62 Bard

70 Barren Land

- 71 Salt flats
- 72 Beaches
- 73 Sand other than beaches
- 74 Bare exposed rock
- 75 Other
- 80 Tundra

.

90 Permanent snow and ice fields

Geology

The variables which fall under geological concern are numerous, including soils classification, rock types, sinkholes, and caves.

Clay types which have a great affinity for moisture, such as smecite, and rock types which are extremely flexible, such as mica, cause problems because they are unstable. The graphic location of these variables would be an engineering application of the computer graphics system.

Need for Information

The geological variable of soils classification is especially important to the environmentalist. This information can be used to determine if measures to control erosion and siltation will be needed and to what extent. Much of the information on soils is available on maps, while other information will have to be obtained from on-site inspection. Therefore, it is not recommended that this information be collected statewide; however, it may be desirable to store the data on a project-by-project basis to avoid duplication of effort in the future.

The location of caves is of environmental importance and legally important. The importance of caves is stated in Chapter 12.2 of the Virginia Code, Virginia Cave Protection Act:

> § 10-150.11. Findings and policy.- The General Assembly hereby finds that caves are uncommon geologic phenomena, and that the minerals deposited therein may be rare and occur in unique forms of great beauty which are irreplaceable if destroyed. Also irreplaceable are the archeological resources in caves which are of great scientific and historic value. It is further found that the organisms which have evolved to live in caves are unusual and of limited numbers; that many are rare and endangered species; and that caves are a natural conduit for groundwater flow and are highly subject to water pollution, thus having far-reaching effects transcending man's property boundaries. It is therefore declared to be the policy of the General Assembly and the intent of this chapter to protect these unique natural and cultural resources.

Further, sections 10-150.13 through 10-150.16 explain the types of protection afforded caves under the law. To ensure compliance with these laws, cave locations should be easily identified.

Sources of Information

Soils and Slope

U. S. Department of Agriculture Soil Conservation Service (in cooperation with) Virginia Polytechnic Institute & State University published, March 1977

Soil Conservation Service 830 East Main Street, Suite 200 Richmond, VA 23219

Cave Location

Virginia Division of Mineral Resources Natural Resources Building McCormick Road Charlottesville, VA 22903

Virginia Speleological Survey c/o P. C. Lucas, President VSS 302 Crestfield Ct. Charlottesville, VA 22901

Data Collection and Update

Soils

Soil surveys published by the Soil Conservation Service served as the basis for the soils and slope maps developed in this study. These surveys offer a good beginning point because the entire state of Virginia has been surveyed within the last two decades. The soils map used in this demonstration project was published in 1976 and covers Campbell County and the city of Lynchburg. Its scale is 1:15,840.

Digitizing the soils series as individual units requires extensive amounts of time, and would not be worth the effort nor practical to attempt on a statewide basis. Therefore, it is not recommended that a soils data bank be established on a statewide basis. However, in special cases the SYMAP program could be used to store and display information in a well-defined area.

Caves

A complete statewide data bank listing the location and significance of caves in Virginia was established. This listing includes only those 220 designated as significant or very significant on the "Annotated List of Significant Caves and Karst Areas in Virginia", April 1980. There are 2,500 caves recorded in Virginia, and as these are designated significant they should be added to the data bank.

The information on the data bank includes cave name, county and quadrangle in which the cave is located, its coordinates (lat.long.), the significance that makes it important, ownership (private or public), and if the cave is protected or unprotected.

Demographic

Need for Information

The study task force identified demographics as an important variable. The need for information on ethnic groups, population density, housing costs, income, and age groups was identified as important.

Among the significant effects to a community that must be addressed in an environmental evaluation are the relocation of people in the project area and the possible disruption of services, tax base, etc.; in other words, the general socioeconomic makeup of the community.

The issues which must be addressed include:

- Will the proposed project divide the community or isolate residences from essential services?
- What is the probable effect on the community?
- Will a distinct ethnic group in a neighborhood be split?
- Will the proposed action affect school districts, recreation areas, churches?
- Will the economy (tax base, farms, small business) be adversely affected?
- Will it effect planned and orderly growth?
- Can relocation of residences (households and businesses) be successfully accomplished?

Included on the data required to address these issues in an environmental evaluation are:

- Characteristics of the residents, such as elderly, school children, handicapped, nondrivers, ethnic groups, and income distribution.
- Economic profile of community, such as businesses, tax base, land value, occupations, and employment opportunities.
- Relocation characteristics, such as number of residences to be relocated, number of businesses to be relocated, and neighborhoods with available relocation housing.

Sources of Information

Tayloe-Murphy Institute University of Virginia Charlottesville, Virginia

U. S. Bureau of the Census Department of Commerce Washington, D. C.

Virginia Department of Highways & Transportation Location & Design Division Planning Division 1221 E. Broad Street Richmond, Virginia

Data Collection and Update

Data taken from the 1970 census were used to test this system for the evaluation of the demographic variable. The 1980 data were not available in the form needed and the census maps for Virginia were being revised. Before this census, the enumeration district was used to classify data for geographic areas not designated as a standard metropolitan statistical area, and this usually included all rural areas. The revised maps divide the entire state into block areas and eliminate the enumeration district classification.

No attempt was made to establish a statewide data bank using census data and it is recommended that no extensive effort be made to establish one for this system. The U. S. Census Bureau has developed several programs which combined with the DIME files would be more efficient for demographic evaluation. Special Application

Using the SYMAP program it is possible to identify areas which could be identified for a specific interest. For example, prior to the construction of a transportation project an effort is made to insure that basic services to that community are not disrupted. It would be useful to understand where residents who are dependent on public transit live. Basically, these people would consist of the nondriving population; data such as, age (under 16), income, ratio of people to vehicles, etc., would be important. When these data are overlaid on a map of the community, groups of individuals who depend on public transit would be identified.

The LDLP program can also be used if some specific area is identified on local maps. The coordinates of these areas can be calculated and stored in the computer system.

APPENDIX B



*Quad name data (9,18) is called by exciting the LIBRARIAN. That step is not shown on this flowchart.

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