(C)

Glassboro State College Senate Curriculum Committee

Approval Form

Proposal Title: ADVANCED GEOGRAPHIC INFORMATION SYSTEMS

Sponsor(s) RICHARD A. SCOTT Dept.: GEOG/ANTHRO ☎Ext. 6447

DEPT OF GEOG/ANTHRO 7311

Check one: ☒ Course ☐ Specialization ☐ Concentration ☐ Minor ☐ Achievement Certificate

☐ Certification Program ☐ Major Program ☐ Minor Change _____ (please name deletion or credit/title/catalog change)

☒ Undergraduate ☐ Graduate 3 Credit Hours

Step 1 (Department)

☑ Approved May 12, 1989 Date

☐ Not Approved

Dept. CC Chairperson

☑ Reviewed _____ Date

Dept. Chairperson

Step 2 (Receipt)

☐ SCC# 1989-90-02 1.

Proposal Received June, 1989 Date

Logged in for next year

Brenda A. Boly

SCC Chairperson

Step 3 (School CC)

Reviewed _____

☒ Approved

☐ Not Approved

Comments:

School Curr. Comm. Chairperson

Step 4 (Academic Dean)

☒ Recommend

☐ Not Recommend

☐ Conditionally Recommend (see comments)

Reviewed 10-18-89 Date

Comments:

Signature, Dean of School

Step 5 (SCC)

Open Hearing 11/13/89 Date ☒ Approved by Senate Curriculum Committee 11/13/89 Date

Linda Ross

☐ Returned to sponsor(s) for the following reasons:

Step 6 (Senate)

Presented to Senate 11/7/89 Date ☐ Approved ☐ Not Approved

Notification to Executive Vice-President/Provost _____ Date

Signature, SCC Chairperson

Step 7 (Executive V.P./Provost)

Received 12/7/89
Date

Approved ☐ Yes ☐ No

If no, reasons are as follows:

Student credit hours 3

Faculty load hours 3

Equalized credit hours 3

Official copy and approval sheet filed _____
Date

Signature, Executive Vice President/Provost

Registrar

Approved course description received _____
Date

Hegis Taxonomy and Course Number assigned _____

_____ _____
Signature, Registrar Date

Notification forwarded:

- ☐ Senate Curriculum Committee Chairperson
- ☐ Department Chairperson(s)
- ☐ Academic Dean
- ☐ Registrar
- ☐ Sponsor(s)

Course Proposal:

Advanced Geographic Information Systems

1. Details:

   a. Course Title: Advanced Geographic Information Systems [GIS]

   b. Sponsors: Richard A. Scott, Department of Geography and Anthropology, and the Geography and Anthropology Department

   c. Credit Hours: 3

   d. Course Level: Undergraduate (Junior and Senior level)

   e. Curricular Effect: The course will serve Geography majors as a Specialized Elective in the Geographic Techniques course bank. The course might also be of interest to and serve as an elective for Computer Science majors.

   f. Prerequisites: Introduction to Geographic Information Systems. Recommended: introductory computer language courses [e.g., Basic].

   g. Time and scale of implementation:

      1. Time of implementation: Fall 1990

      2. Scale of implementation: The course will be offered once a year in rotation with the introductory GIS course.

   h. Adequacy or resources required to offer the course:

      1. Staff: The department currently has one full time faculty member who is capable of teaching this course. In addition several professionals working with Geographic Information Systems have expressed an interest in teaching a GIS course on an adjunct basis. We plan to offer the course using full time staff, unless demand for the course is such that it needs to be offered on a more frequent basis than proposed here [once a year].

2. Computing Facilities: In the advanced GIS course students' learning of GIS concepts, analysis techniques, algorithms, and data structures will be aided and illustrated by hands on exercises with three software packages: 1) the Map Analysis Program (MAP) available through Ohio State University, 2) the IDRISI program available through Clark University, and 3) the ERDAS program from the ERDAS Corporation. MAP and IDRISI are inexpensive but limited capability programs developed by academic institutions and distributed specifically to support instruction in GIS. These programs will run on the IBM PS/2 computers in the Social and Behavioral Sciences Computing Laboratory (SBS Lab) in 122 Robinson Hall. The fourteen computers available in the SBS Lab provide ample computing facilities to support this class. Moreover, as the campus achieves more integrated networking capabilities, the prospect is that, in the near future, programs available on the SBS Lab file server will be accessible from many campus locations. The ERDAS program is a state-of-the-art commercial product that is available on one computer located in the Geography and Anthropology Department. This program can accommodate large data sets and has a range of functionality that enables it to work more effectively with real world research and policy analysis problems than the MAP or the IDRISI programs. The ERDAS program will be used by students to carry out a group term project.

3. Space Needs. The classroom and computer laboratory space currently available to the Geography and Anthropology Department are adequate for the support of this course.

4. Library Holdings. Library holdings are adequate to support offering undergraduate education in Geographic Information Systems. The Department of Geography and Anthropology has offered courses in computer cartography, quantitative analysis, and remote sensing since the later part of the 1970s. At that time we began to order library materials to support these course offerings. Inasmuch as GIS is an outgrowth of these areas, we already have significant holding to support this GIS course. In anticipation of offering courses in GIS we have begun to increase orders for materials focused more specifically on the GIS area. For example, the department recently ordered the journal, Geographical Information Systems.

2. Rationale:

The value of the map as a fundamental tool for use in the analysis and presentation of spatial data is well known and appreciated by geographers, planners, resource managers, engineers, and others who work with geographically referenced information. The time, effort, and money required to construct maps by hand is also well known by practitioners in these fields. The advent of widely available digital computing resulted in attempts to automate the painstaking processes required for producing maps. This technology, which initially saw the mimicking of manual methods as its goal, is now well developed. Given good software and high quality plotting devices, in many instances the only distinction between computer generated and hand generated maps is that one was made by a computer and the other was not.

Although success in mimicking manual methods was slow in coming, even before this achievement geographers, landscape architects, planners, computer scientists, and other analysts saw that the computer promised much more than drafting capability: once locational data are stored in the computer and tied there to attribute information [i.e., data describing characteristics of or magnitudes occurring at locations], a new set of possibilities arose. Namely, the computer could be used to query, compare, and analyze the information while maintaining the spatial context of the data. Thus, from the initial goal of automated display grew the additional objective of carrying out computer-assisted spatial analysis. Instead of merely asking the computer to reproduce a map, the analyst could use the computer as a tool to assist in answering questions about sets of spatial data. For instance, a person seeking to find acceptable sites for residential development using a GIS can produce a land use map, a zoning map, a slope map, a soils map, and a transport route map for display. However, one can also accomplish much more than this by asking the computer to use the information stored in it to produce a composite overlay that identifies those areas that are candidates for residential development. For instance, the analyst might ask the computer to make a map depicting those locations that are vacant in land use, zoned residential, have a slope of greater than 1 and less than 10 percent, have well drained soil, and are within one quarter mile of a highway. The ability to accomplish this kind of analysis has made GIS technology very attractive to government agencies, private developers, trucking companies, cellular telephone companies, and others. [See the accompanying example of a simple GIS analysis carried out using the MAP program].

GIS technology is thus an outgrowth of automated mapping, spatial analysis and related fields. In essence, it is a selective integration of these fields. For the Department of Geography and Anthropology to offer courses in this rapidly growing field

a logical outgrowth of our previous focus on computer cartographics, remote sensing, and quantitative spatial analysis. This new course and the one preceding it [see proposal for introductory GIS course] will bring the department to the forefront of undergraduate programs offering clusters of courses in digital cartography, remote sensing, quantitative analysis, and GIS. As such the course will serve to provide our students with a fuller understanding of the current state-of-the-art in the field of geography and will at the same time provide them with skills that are much in demand in the marketplace.

3. Essence of the Course:

a. Objectives of the course. Upon completion of the course, Advanced Geographic Information Systems, students will be able to:

1. define the concept of GIS in general terms and differentiate GIS from computer mapping, computer aided design, and other related technical areas.

2. explain the importance of geo-referencing and rectification of multiple data sets to efficient and accurate GIS analysis.

3. outline the elements of GIS database concepts including the advantages and disadvantages of various conceptual approaches

4. explain the broad differences between raster and vector mode data structures and outline the advantages and the disadvantages of each of the two approaches to representing graphic objects

5. outline frequently used raster data structures citing advantages and disadvantages of each structure

6. outline frequently used vector data structures citing advantages and disadvantages of each

7. describe and program simple GIS algorithms for carrying out operations such as line simplification, point in polygon detection, and slope determination

8. demonstrate mastery of advanced GIS analysis techniques

b. Topical Outline:

I. Brief Review of Introduction to Geographic Information Systems

A. Definition of GIS

B. Review of Spatial Data Types and Elementary Analysis Techniques

II. Geographic Coordinate Systems and Geo-referencing of Data

A. Map coordinate systems and map projections

1. state plane coordinates

2. Universal Transverse Mercator coordinates

B. Techniques for transforming spatial data for map rectification

1. techniques for vector data

2. techniques for raster data

C. Conversion of data modes

1. vector to raster

2. raster to vector

III. Vector Data Structures for Representing Geographic Point, Line, and Area Data Types

A. Full polygon or simple polygon structure

B. Point dictionary structure

C. Chain encoding with neighbor identification

IV. Raster Data Structures for Representing Geographic Point, Line, and Area Data Types

A. Full raster representation [pixel by pixel]

B. Chain codes for raster data

C. Run length codes for raster data

D. Block codes [two dimensional run codes]

E. Quadtree data structures

V. Logic of Analytical Techniques [e.g., how GIS operations for overlay, and other operations work]

A. Calculation of spatial statistics

1. length,

2. area,

3. centroid calculation

B. Line generalization techniques

1. systematic point removal

2. crucial point retention methods

C. Polygon overlay operations

D. Digital Elevation Model [DEM] operations

1. calculating slope and aspect of a point from DEM data

2. locating ridges and valleys from DEM data

3. visibility determination

VI. Application of Advanced Analytical Techniques

A. Overview of problem to be assigned for project

B. Laboratory and tutorial sessions for project work

c. Evaluation of students:

The students' progress in mastering course material will be ascertained in several ways: 1) a midterm essay and problem examination, 2) computer laboratory assignments, and 3) a final integrative GIS problem that will require students to demonstrate a broad mastery of GIS analysis techniques.

d. Course evaluation:

I will use a course evaluation strategy in this course similar to that I use in the other courses I teach. For overall evaluation of the teaching quality I will use the SIR form. For evaluation of the content, exercises, examinations, demonstrations, and laboratory sessions I will use a questionnaire designed specifically for the course.

IV. Results of consultation: Consultation under separate cover. The consultants are:

A. Jack Cimprich, Director of Academic Computing and Professor of Computer Science

B. Leigh Weiss, Professor, Department of Industrial Education and Technology

V. Catalogue Description:

Advanced Geographic Information Systems begins with a review of GIS concepts and capabilities. The course then moves to a consideration of the inner workings of GIS by exploring a sample of raster and vector data structures, and computational algorithms used in GIS analysis. Finally, the course treats more advanced analysis techniques. Students learn the workings of GIS and GIS analysis techniques through lecture and laboratory sessions. Student evaluation is based on performance on examinations and projects.

GLASSBORO STATE COLLEGE
Academic Computing Glassboro, New Jersey 08028 (609)863-6515

TO: Faculty Senate Curriculum Committee
FROM: Jack Cimprich, Coordinator of Academic Computing JRC.
RE: Geography Department's Course Proposals
DATE: October 11, 1989

I have reviewed the course proposals for "Introduction to Geographic Information Systems" and "Advanced Geographic Information Systems" submitted by Dr. Richard Scott of the Geography and Anthropology Department. As a professor in the Mathematics and Computer Science Department and as the Coordinator of Academic Computing for the entire campus, my observations are:

1. These are new courses which are aimed at incorporating the latest computer applications and techniques in the Geography curriculum. As such, they are vitally important in helping the College maintain currency in its offerings, attractiveness to prospective students, and marketability for its graduates.

2. Although computer usage is heavy in other departments, especially Computer Science, Business, and Technology, these proposed courses do not represent an overlap or redundancy with the content or interests of these other areas. In fact, these courses, along with the existing Computer Cartography course offered by the Geography Department, provide excellent free elective choices for majors in other computer-related disciplines.

3. Finally, regarding the impact of these proposed courses on computer resources, there is always the concern that additional demand may cause some problems. However, because the Geography Department has access to the excellent IBM lab on the first floor of Robinson, and, because there is inherent backup and room for overflow in several of the other student labs on campus, and, because of the implementation of a campus fiber optic backbone that will occur this year which will further allow sharing of computer resources, I see no problems in meeting the equipment needs.

In summary, these courses will be valuable to both the Geoagraphy/Anthropology Department as well as the rest of the college and can be accomodated by existing computing facilities.

Example of GIS Problem Solving

Suppose that you were charged with locating a sawmill in a developing nation. Since transport of sawn timbers is more efficient than transport of the raw material [i.e., unsawn timbers], the sawmill must be located near the site of the raw material, the forest. The sawn lumber must be transported from the forest to market by way of the existing road system. In practice this means that the new sawmill must be located within 2.5 kilometers of the highway. This country has tourism as an industry. To preserve the esthetics of the landscape the sawmill must not be visible from the highway. Where are the potential sites for the sawmill? Clearly those sites must be: 1) near the forest, 2) within 2.5 km from the road, and 3) invisible from the road.

To begin your search for a suitable site you map the forests of the area [as in Figure 1] by extracting the location of forest from a coverage containing land cover information.

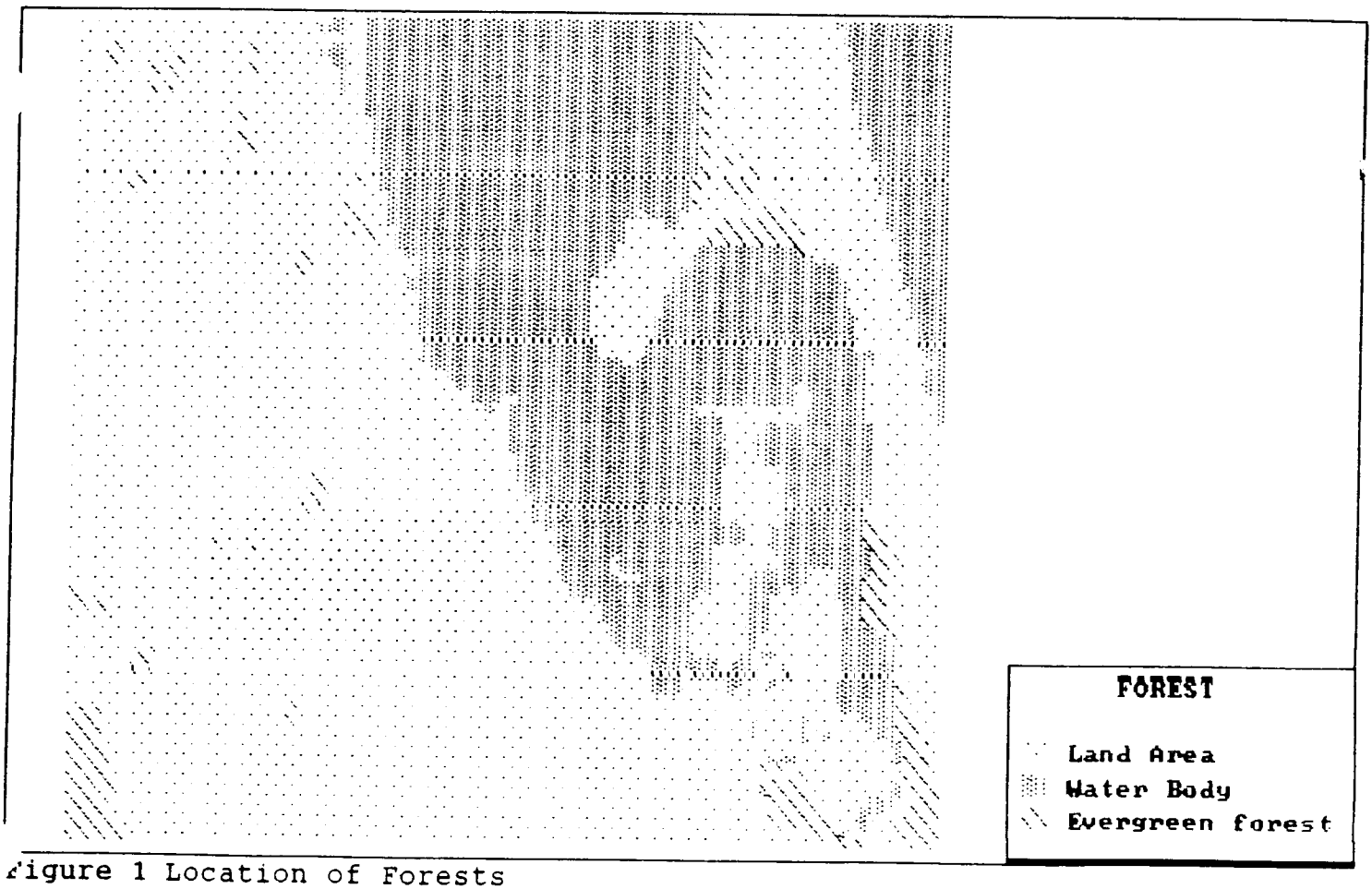

Figure 1 Location of Forests

After determining the location of the forest, the next task is to map the highway network that will be used in transporting the sawn timber to market. Figure 2 depicts the location of roads suitable for transporting the timber.

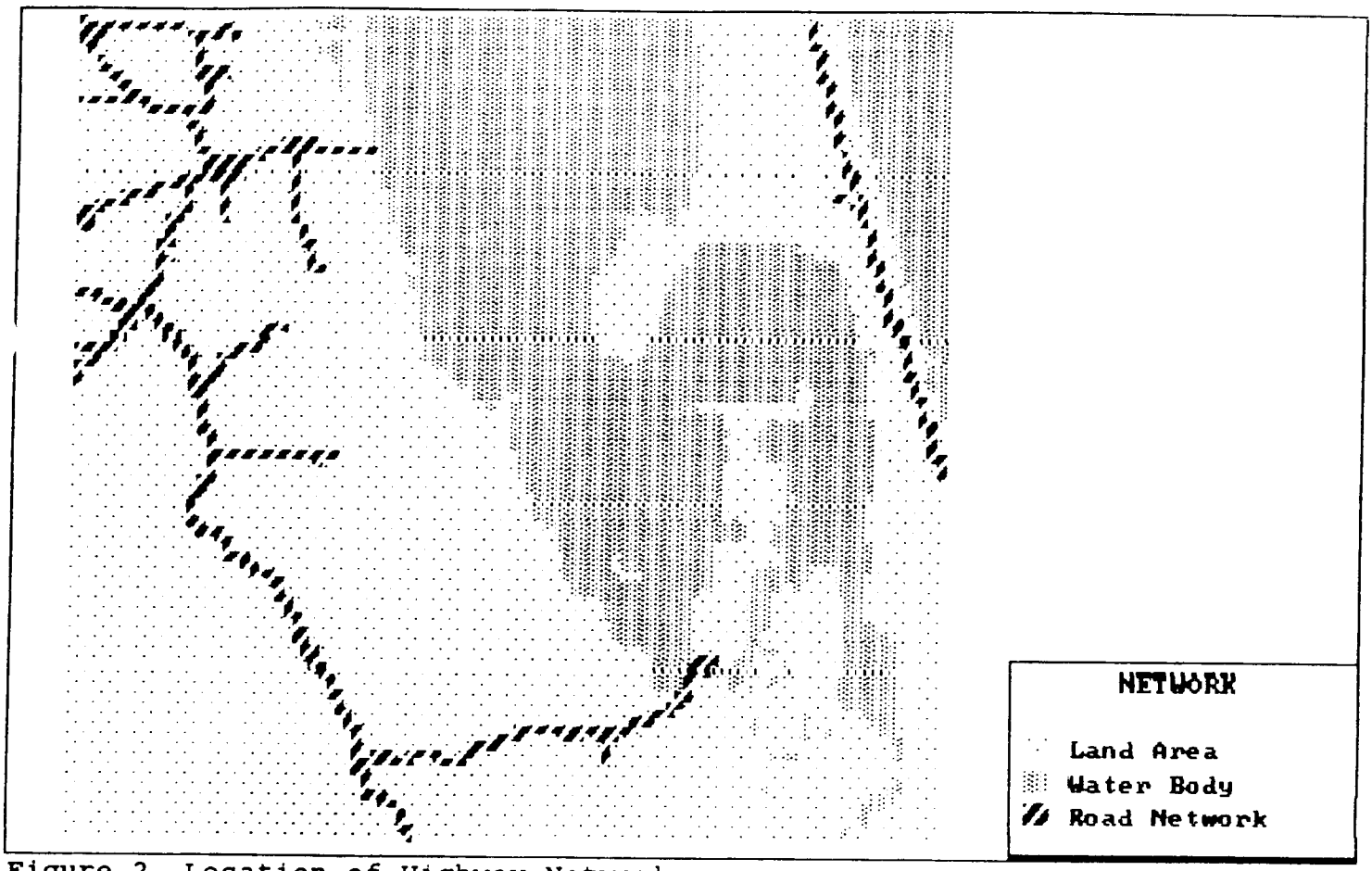

Figure 2 Location of Highway Network

Next you must determine the visibility of the landscape from the highway in order to create a map depicting places visible and invisible from the road. Figure 3 shows the locations of sites that are acceptable from the standpoint of the visibility criterion. The map was generated using a view shed program in conjunction with a topographic overlay on the highway network.

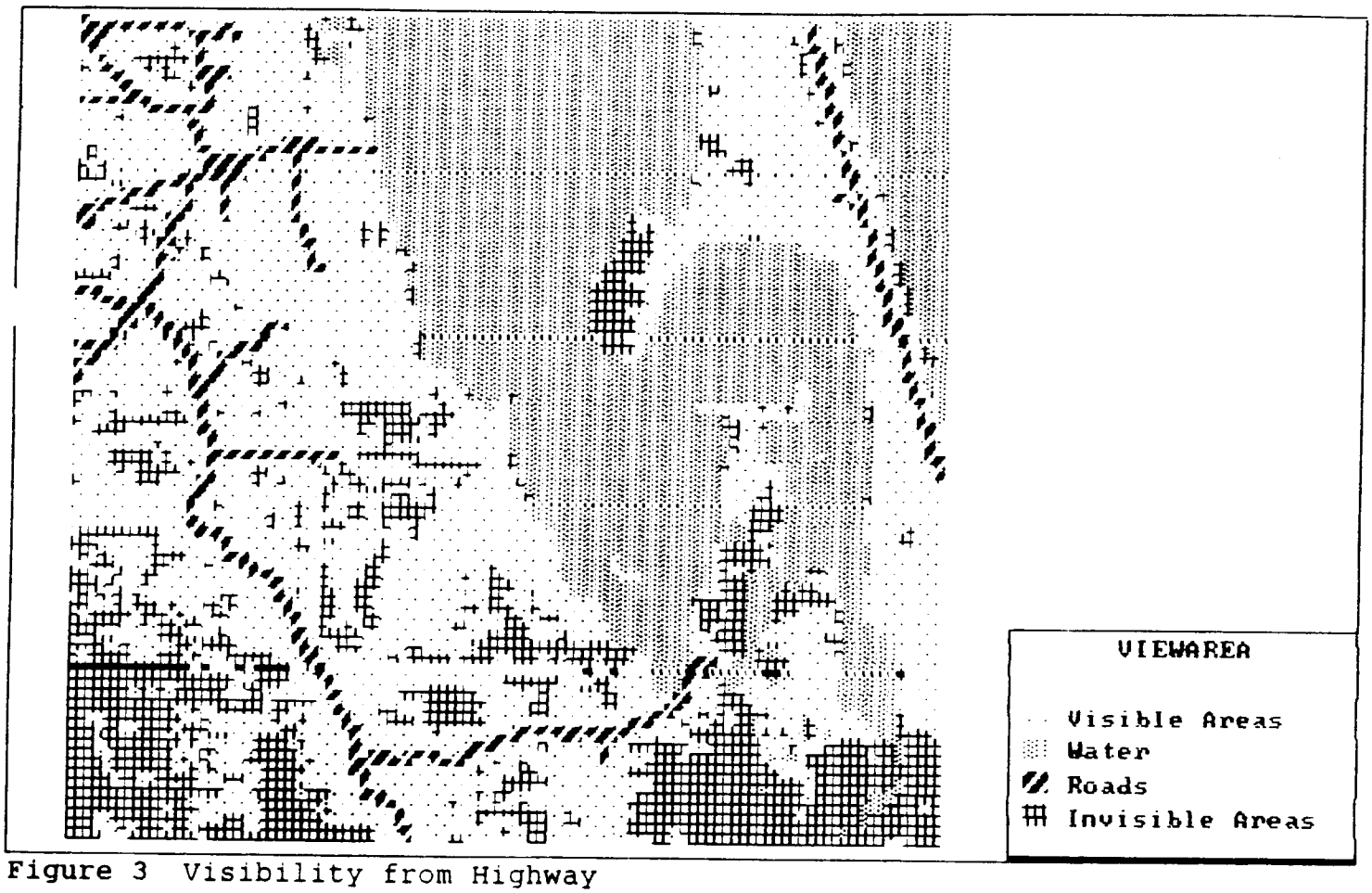

Figure 3 Visibility from Highway

You now need to identify all locations that fulfill the criterion of being within 2.5 km of the highway. Figure 4 shows the corridor of sites that are acceptable from the standpoint of highway access.

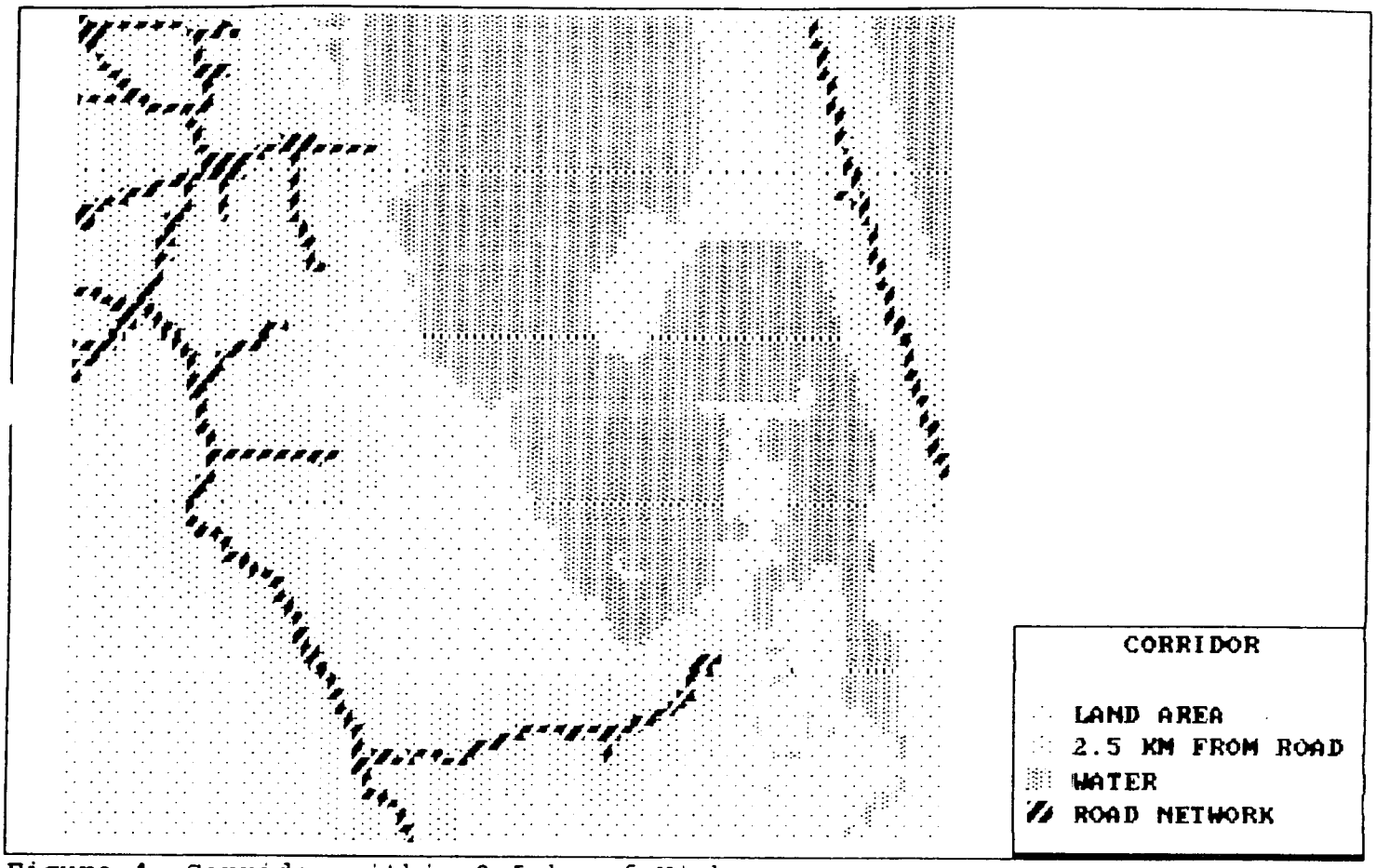

Figure 4 Corridor within 2.5 km of Highway

The final step in the analysis requires that you overlay the map of forest, the 2.5 km corridor, and visibility to identify the sites that are near to the forest, within 2.5 km of the highway, and invisible from the road. Figure 5 shows the acceptable sawmill sites and the location of forest.

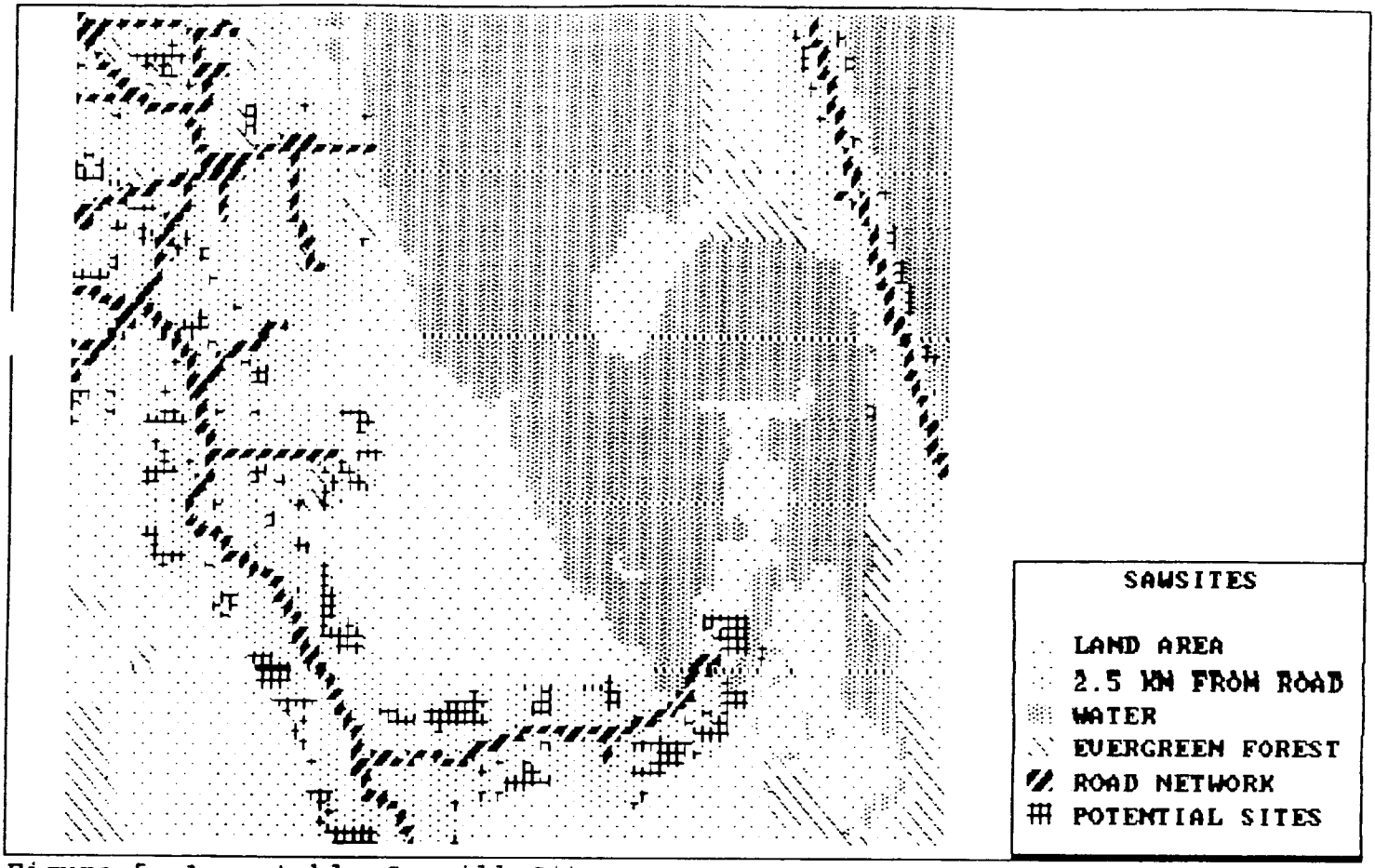

Figure 5 Acceptable Sawmill Sites

TO: Faculty Senate Curriculum Committee

FROM: Leigh Weiss, Technology Department

RE: Geography Department's Course Proposals

Date: October 12, 1989

I strongly support the course proposals "Introduction to Geographic Information Systems" and "Advanced Geographic Information Systems" submitted by Dr. Richard Scott of the Geography and Anthropology Department.

These new courses offer a unique opportunity for incorporating state of the art computer applications and techniques into the Geography curriculum. They will enable the Geography and Anthropology Department to offer curricular content that is timely and practical and allows students to develop skills that are marketable in a variety of industrial, commercial, educational and governmental arenas.

GIS (Geographic Information Systems) yield data that is vital for a wide range of professionals. It would be an attractive elective for students in Industrial Technology who wish to enhance their expertise and proficiency with computer aided drafting and design and develop proficiency in the analysis and presentation of spatial data.

The "real world" applicability of these courses will make them important components of the Geography and Anthropology Departments and practical electives for Industrial Technology students.