FINAL REPORT

# FEASIBILITY STUDY FOR THE ESTABLISHMENT OF A GIS/GPS RESOURCE CENTER AT THE UNIVERSITY OF CONNECTICUT

February 1995

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Prepared for the
Joint Highway Research Advisory Council
University of Connecticut
Connecticut Department of Transportation

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16. Abstract

This report is intended to support a proposal for the establishment of a resource center that will provide education, service, and research in the technologies of Geographic Information Systems (GIS) and the Global Positioning System (GPS). The center would be called "The Connecticut Geographic Systems Institute" and would be established on the Storrs campus of the University of Connecticut. The Proposal was developed by a study team consisting of representatives from throughout the University working closely with the Connecticut GIS Policy Committee. It is estimated that steady-state funding on the order of $6 million per year would be required for the Institute to reach its full potential.

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# SI* (MODERN METRIC) CONVERSION FACTORS

## APPROXIMATE CONVERSIONS TO SI UNITS

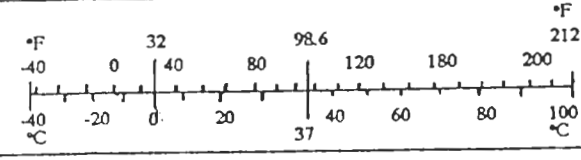
| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| **LENGTH** | | | | |
| in | inches | 25.4 | millimetres | mm |
| ft | feet | 0.305 | metres | m |
| yd | yards | 0.914 | metres | m |
| mi | miles | 1.61 | kilometres | km |
| **AREA** | | | | |
| $in^2$ | square inches | 645.2 | millimetres squared | $mm^2$ |
| $ft^2$ | square feet | 0.093 | metres squared | $m^2$ |
| $yd^2$ | square yards | 0.836 | metres squared | $m^2$ |
| ac | acres | 0.405 | hectares | ha |
| $mi^2$ | square miles | 2.59 | kilometres squared | $km^2$ |
| **VOLUME** | | | | |
| fl oz | fluid ounces | 29.57 | mililitres | mL |
| gal | gallons | 3.785 | Litres | L |
| $ft^3$ | cubic feet | 0.028 | metres cubed | $m^3$ |
| $yd^3$ | cubic yards | 0.765 | metres cubed | $m^3$ |
| **MASS** | | | | |
| oz | ounces | 28.35 | grams | g |
| lb | pounds | 0.454 | kilograms | kg |
| T | short tons (2000 lb) | 0.907 | megagrams | Mg |
| **TEMPERATURE (exact)** | | | | |
| °F | Fahrenheit temperature | 5(F-32)/9 | Celcius temperature | °C |

NOTE: Volumes greator than 1000 L shall be shown in $m^3$.

*SI is the symbol for the International System of Measurement

## APPROXIMATE CONVERSIONS TO SI UNITS

| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| **LENGTH** | | | | |
| mm | millimetres | 0.039 | inches | in |
| m | metres | 3.28 | feet | ft |
| m | metres | 1.09 | yards | yd |
| km | kilometres | 0.621 | miles | mi |
| **AREA** | | | | |
| $mm^2$ | millimetres squared | 0.0016 | square inches | $in^2$ |
| $m^2$ | metres squared | 10.764 | square feet | $ft^2$ |
| ha | hectares | 2.47 | acres | ac |
| $km^2$ | kilometres squared | 0.386 | square miles | $mi^2$ |
| **VOLUME** | | | | |
| mL | millilitres | 0.034 | fluid ounces | fl oz |
| L | litres | 0.264 | gallons | gal |
| $m^3$ | metres cubed | 35.315 | cubic feet | $ft^3$ |
| $m^3$ | metres cubed | 1.308 | cubic yards | $yd^3$ |
| **MASS** | | | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.205 | pounds | lb |
| Mg | megagrams | 1.102 | short tons (2000 lb) | T |
| **TEMPERATURE (exact)** | | | | |
| °C | Celcius temperature | 1.8C + 32 | Fahrenheit temperature | °F |



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# 1. Introduction

The following report is intended to support a proposal for the establishment of a resource center that will provide education, service, and research in the technologies of Geographic Information Systems (GIS) and the Global Positioning System (GPS). The Center would be established on the Storrs campus of the University of Connecticut. The fact that the study team consisted of representatives from throughout the University attests to the multi-disciplinary nature and value of the technologies.

## 1.1 Study Team Members

The members of the Study Team represented a broad cross-section of University Faculty and Staff. They are listed below in alphabetical order.

D. L. Civco, Assistant Professor, Natural Resource Management and Engineering
R. G. Cromley, Professor and Department Head, Geography
C. F. Davis, Professor and Director, Transportation Institute
C. R. Ferguson, Lecturer, Civil Engineering
F. Maryanski, Associate Provost (Ex Officio)
T. P. McGlamery, University Librarian III
S. R. Sacks, Professor, Economics
D-G. Shin, Associate Professor, Computer Science and Engineering
J. A. Silander, Jr., Professor, Ecology and Evolutionary Biology
T. E. Steahr, Professor, Agriculture and Resource Economics

Overall project management was under the direction of C. F. Davis.

## 1.2 Descriptions of GIS and GPS.

While numerous definitions of GIS have been suggested, the following are sufficient for present purposes:

> A GIS is "a system of hardware, software, data, people, organizations, and institutional arrangements for collecting, analyzing, and disseminating information about areas of the earth."[1]

Or, "a computerized database management system for the capture, storage, retrieval, analysis, and display of spatial (i.e. locationally defined) data."[2]

All definitions of GIS include:

- An element of information that contains a geographic reference, allowing the information to be mapped, and
- Attribute information, either statistical or textural in nature, which can be tied to a geographic reference.

**In short, GIS deals with the management of geographically based information**

Although the above concept of managing spatially referenced information has existed for many years, it is only fairly recently that it has gained the maturity and ubiquity that permit serious consideration for its introduction as a management tool for the diversity of municipal government functions operating within Connecticut.

It is difficult to imagine an activity of an agency at any level of goverment that would not be able to make use of GIS technology and a complete listing of potential uses would be impossible. However, the following examples give an idea of the power of GIS: In the area of automated mapping/facilities management (AM/FM), a GIS is used by utility companies and government agencies to locate underground pipes and cables, track energy use, provide digital inventories of physical facilities and to help plan their maintenance. Land information systems (LIS) are used to maintain cadaster ownership records, to aid in subdivision planning and zoning decisions, to help prepare environmental impact statements, to manage water quality information. Resource inventory and management systems are used in the management of forests, wildlife habitats, wetlands, aquifers, recreation resources, agricultural lands and floodplains for example. Finally, urban (or socio-economic) information systems are used to facilitate government functions by maintaining census data on social and economic statistics, police records, and data collected by various agencies. These systems are also used by business for marketing and retailing activities, real estate analysis, site selection, vehicle routing and scheduling and many other applications.

The Global Positioning System (GPS) is somewhat simpler to define. It is a navigation and surveying system which utilizes a constellation of twenty-one Block Two , high altitude satellites plus three spares. The satellites are in orbit at altitudes of approximately 10,900 nautical miles. Using radio waves from several of the satellites, and suitably equipped receivers, it is possible to determine the location and elevation of a point on the surface of the earth or in the air. A major potential use of GPS is to provide the locational reference required by GIS technology.

## 1.3 Needs and Challenges

The rapid growth in the use of GIS has presented both significant challenges and significant opportunities in Connecticut as elsewhere. Recognizing the power of GIS in coordinating planning and operations in any activity with locational and database components, many governmental agencies and businesses are turning to GIS to aid them in the management of human and environmental resources. In an era of budget shortfalls, governments are looking for ways of coordinating economic development, managing natural resources, planning transportation systems, providing social services, and, in general, using available resources more efficiently. GIS is used because it provides a regional perspective to local issues by integrating many formerly separate databases.

Although GIS is very impressive from a technological viewpoint, it is only of real value if it

aids in performing activities more efficiently and, more importantly, permits timely, informed decisions. Perhaps the simplest use of GIS technology is the most powerful. With modern hardware and software, even the most inexpensive of systems provide extraordinary display capability. The assistance this visualization provides to decision-makers and the public warrants the use of the technology even if there were no other justification. However, the benefits of GIS extend far beyond the ability to produce attractive maps. They include the ability to integrate the planning and management of large, costly systems. GIS is also capable of displaying tradeoffs involved in alternatives selection. From a social perspective, GIS can be a powerful tool in ensuring equity in effects on various geographic regions and across various strata of society. Finally, successful implementation of a GIS requires that many agencies coordinate their efforts. If this coordination can be achieved, it alone will justify the cost of the investment.

Implementation of GIS is not without problems however. Historically, the efforts of Connecticut's early agency pioneers have been largely independent of those of other agencies. This is particularly unfortunate, not only because of the redundancies and inefficiencies involved, but also because it fails to take advantage of the great potential for GIS as a high level planning tool for decision makers. Problems have arisen for a variety of reasons, some technical and some administrative. For example, the proliferation of disparate databases that are being collected by agencies under the auspices of different mandates often involves the creation of databases that are either incompatible with one another in form or redundant with respect to their spatial or thematic coverage. Moreover, many agencies, especially at the more local levels, lack the expertise to sustain a successful GIS. Problems of trained personnel and long-term commitments to database maintenance have resulted in high failure rates for operational systems. Millions of dollars invested in initiating these systems may be wasted because of a lack of an understanding of the capabilities and requirements of GIS technology.

As described more completely in Appendix A, a state center for GIS/GPS can provide the infrastructure necessary for ensuring the success of long-term statewide GIS efforts. It is obvious that, as the State's only major research university, the University of Connecticut has the broad range of expertise required to most effectively serve as the location for the Center. For example, several departments within the University of Connecticut (UConn), including Geography and Natural Resource Management and Engineering have strong research and educational programs in GIS and remote sensing. The UConn Babbidge Library has played an active role through its responsibilities as a repository of cartographic information. The Department of Ecology and Evolutionary Biology has used GIS to monitor ecological changes across the landscape and to develop species inventory databases for natural communities throughout the world. More recently, the Transportation Institute has embarked on major initiatives directed toward the application of GIS to infrastructure management.

## 1.4 The Existing GIS Infrastructure

As noted above, GIS capability has become increasingly ubiquitous in Connecticut as elsewhere. While the Connecticut Department of Environmental Protection (ConnDEP) was

the first State agency to make significant use of GIS, a significant effort is underway by the Department of Transportation (ConnDOT). Due, in part, to the mandates of the Federal Intermodal Surface Transportation Efficiency Act of 1991, ConnDOT will develop several management information systems for spatial data. ConnDOT will take full advantage of GIS technology to integrate these information systems and has engaged a consultant to perform a needs analysis and develop an implementation plan for a Geographic Information System for ConnDOT.

Recognizing the importance of coordinating GIS development, ConnDOT, ConnDEP, and the Office of Policy and Management (OPM) pioneered the development of a statewide GIS Policy Committee in an effort to coordinate data and policy issues that relate to statewide access to GIS technology. OPM chairs the Policy Committee, whose members include, among others, the Office of Information and Technology (OIT), ConnDOT, ConnDEP, and UConn. One of the primary goals of the GIS Policy Committee is to support OIT in the development of data standards and also to define management policies for sharing and maintaining spatial data. Data sharing, as defined by the state-wide GIS initiative, means the ability to transfer data across all state, federal, regional, and municipal agencies, as well as the private sector. The Policy Committee also serves as an information clearinghouse for current and prospective users of GIS technology.

Also, the private sector, most notably public utilities have major efforts in GIS in the form of Automated Mapping/Facilities Management (AM/FM) and have indicated a willingness to cooperate in joint efforts.

## 1.5 The Connecticut Map Project

As work on the feasibility study progressed, OPM, in concert with the GIS Policy Committee, initiated plans for the Connecticut Map Project (CMP), and the need for a Center became imperative. Thus, the focus of activity under JHR 93-1 shifted somewhat to emphasize the Center's potential role in support of the CMP. Among the consequences of this shift in emphasis was the need to provide a more extensive proposal to OPM. **Since, in essence, that Proposal addresses the objectives for this report it is presented here as Appendix A and, in fact, represents the bulk of this report.**

## References

1. Dueker, K. J., and D. Kjerne. "Multipurpose Cadastre: Terms and Definitions", in Technical Papers ACSM Annual Convention, Baltimore, 1979 pp. 94-103.

2. Simkowitz, H. J. "Transportation Applications of Geographical Information Systems". Computer, Environment and Urban Systems, 1988, pp. 253-271.

# Appendix A

# A Proposal

# for the

# Establishment of a Connecticut

# Geographic Information Systems Institute

University of Connecticut

Storrs

July 9, 1994

# 1. Introduction

## 1.1 Background

The State of Connecticut, under the leadership of the GIS Policy Committee, is in the process of building a statewide geographical information system (GIS) through the Connecticut Map Project (CMP) using state/local/federal and private partnerships. The product of this activity will be an information infrastructure which will be available for all partners and which will find wide application in many areas such as economic development, natural resource management, property valuation, public health and safety, and transportation, to name just a few.

In order to protect the significant investment in this infrastructure and to insure its efficient dissemination and optimal use, it is proposed to establish a Geographic Information Systems Institute at the University of Connecticut. The Institute will provide service, education, and research in the technologies of GIS and the Global Positioning System (GPS). The specific functions to be performed by the Institute are described in this proposal.

### *Partnerships with the State University System and Others*

The proposed organization of the Institute is described more fully below. However, it is important to note that the Institute will form partnerships with the Connecticut State University System, with the Community and Technical College system, and with other entities as appropriate. These partnerships will be especially important in providing the outreach services required in connection with the statewide GIS. The establishment of equitable and efficient partnerships will be a major initiative of the first year of operation of the Institute.

## 1.2 Descriptions of GIS and GPS.

For the unfamiliar reader, it is helpful to define the terms GIS and GPS . While numerous definitions of GIS have been suggested, the following are sufficient for present purposes:

> A GIS is "a system of hardware, software, data, people, organizations, and institutional arrangements for collecting, analyzing, and disseminating information about areas of the earth."[1]

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It is difficult to imagine an activity of an agency at any level of government or in the private sector that would not be able to make use of GIS technology, and a complete listing of potential uses would be impossible. However, the following examples give an idea of the power of GIS: In the area of automated mapping/facilities management (AM/FM), a GIS is used by utility companies and government agencies to locate underground pipes and cables, track energy use, provide digital inventories of physical facilities and to help plan their maintenance. Land information systems (LIS) are used to maintain cadaster ownership records, to aid in subdivision planning and zoning decisions, to help prepare environmental impact statements, to manage water quality information. Resource inventory and management systems are used in the management of forests, wildlife habitats, wetlands, aquifers, recreation resources, agricultural lands and floodplains for example. Finally, urban (or socio-economic) information systems are used to facilitate government functions by maintaining census data on social and economic statistics, police records, and data collected by various agencies. These systems are also used by business for marketing and retailing activities, real estate analysis, site selection, vehicle routing and scheduling and many other applications.

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The rapid growth in the use of GIS has presented both significant challenges and significant opportunities in Connecticut as elsewhere. Recognizing the power of GIS in coordinating planning and operations in any activity with locational and database components, many governmental agencies and businesses are turning to GIS to aid them in the management of human and environmental resources. In an era of budget shortfalls, governments are looking for ways of coordinating economic development, managing natural resources, planning transportation systems, providing social services, and, in general, using available resources more efficiently. GIS is used because it provides a regional perspective to

local issues by integrating many formerly separate databases.

Although GIS is very impressive from a technological viewpoint, ***it is of most value if it aids in performing activities more efficiently and, more importantly, permits timely, informed decisions.*** Perhaps the simplest use of GIS technology is the most powerful. With modern hardware and software, even the most inexpensive of systems provide extraordinary display capability. The assistance this visualization provides to decision-makers and the public warrants the use of the technology even if there were no other justification. However, the benefits of GIS extend far beyond the ability to produce attractive maps. They include the ability to integrate the planning and management of large, costly systems. GIS is also capable of displaying tradeoffs involved in alternatives selection. From a social perspective, GIS can be a powerful tool in ensuring equity in effects on various geographic regions and across various strata of society. Finally, successful implementation of a GIS requires that many agencies coordinate their efforts. If this coordination can be achieved, it alone will justify the cost of the investment.

Implementation of GIS is not without problems however. Historically, the efforts of Connecticut's early agency pioneers have been largely independent of those of other agencies. This is particularly unfortunate, not only because of the redundancies and inefficiencies involved, but also because it fails to take advantage of the great potential for GIS as a high level planning tool for decision makers. Problems have arisen for a variety of reasons, some technical and some administrative. For example, the proliferation of disparate databases that are being collected by agencies under the auspices of different mandates often involves the creation of databases that are either incompatible with one another in form or redundant with respect to their spatial or thematic coverage. Moreover, many agencies, especially at the more local levels, lack the expertise to sustain a successful GIS. Problems of trained personnel and long-term commitments to database maintenance have resulted in high failure rates for operational systems. Millions of dollars invested in initiating these systems may be wasted because of a lack of an understanding of the capabilities and requirements of GIS technology.

As described more completely below, the proposed Institute will provide the infrastructure necessary for ensuring the success of long-term statewide GIS efforts. It is obvious that, as the State's only major research university, UConn has the broad range of expertise required to most effectively serve as the primary location for the Institute. For example, several departments within the University, including Geography and Natural Resource Management and Engineering have strong research and educational programs in GIS and remote sensing. The UConn Babbidge Library has played an active role through its responsibilities as a repository of cartographic information. More recently, the Transportation Institute has embarked on major initiatives directed toward the application of GIS to infrastructure management. Representatives of these and several other departments comprised the task force that developed this proposal.

2. The Existing GIS Infrastructure

As noted above, GIS capability has become increasingly ubiquitous in Connecticut as elsewhere. While the Connecticut Department of Environmental Protection (ConnDEP) was the first State agency to make significant use of GIS, a significant effort is underway by the Department of Transportation (ConnDOT). Due, in part, to the mandates of the Federal Intermodal Surface Transportation Efficiency Act of 1991, ConnDOT is planning to utilize the advantages of GIS technology to integrate these information systems.

Recognizing the importance of coordinating GIS development, ConnDOT, ConnDEP, and the Office of Policy and Management (OPM) pioneered the development of a statewide GIS Policy Committee in an effort to coordinate data and policy issues that relate to statewide access to GIS technology. OPM chairs the Policy Committee, whose members include, among others, the Office of Information and Technology (OIT), ConnDOT, ConnDEP, and UConn. One of the primary goals of the GIS Policy Committee is to support OIT in the development of data standards and also to define management policies for sharing and maintaining spatial data. Data sharing, as defined by the state-wide GIS initiative, means the ability to transfer data across all state, federal, regional, and municipal agencies, as well as the private sector. The Policy Committee also serves as an information clearinghouse for current and prospective users of GIS technology.

Also, the private sector, most notably public utilities, have major efforts in GIS in the form of Automated Mapping/Facilities Management (AM/FM) and have indicated a willingness to cooperate in joint efforts.

***The Connecticut Map Project***, mentioned at the beginning of this proposal, is under the direction of OPM. Its overall goal[3]

> is to build a statewide geographical information system (GIS) using state/local/federal and private partnerships. (Some features are:)
>
> - State will pay to build a system to state standards
>
> - The process of constructing the data base includes:
>   Aerial photography, ground control, and analytics
>   Digital orthophotography (raster data)
>   Contour digitizing (vector data)
>   Planimetric feature digitizing (vector data)
>
> - Mapping will be at the 1" = 100' and 200' scales. All data base construction will use the English system. The ability to perform metric conversion will be a software requirement.
>
> - Local governments, with state coordinated assistance, will maintain the data

that flows through them.

- A mechanism will be developed for the involvement of other public and private entities, both fiscally and as data providers and customers.

- State agencies will maintain the data that flows through them.

- Data will be freely shared between state and local sources.

- GIS products will be available for all appropriate local and state applications including such areas as economic development, planning, property valuation, public safety, utilities, etc.

***The UConn task force conducted a survey*** of current and potential uses of GIS by state, regional, and local agencies, and by private business. Of the 1851 questionnaires mailed, a total of 349 were returned. Figure 1 shows the municipalities that participated in the survey. Figure 2 shows, for the responding towns, those 21 who currently use GIS. While an attempt was made to get the most complete view possible, it is likely that Figure 2 somewhat understates usage. Indeed, Figure 3, based on a survey by the Connecticut Conference of Municipalities (CCM), shows additional towns (such as Tolland, Simsbury, and Brooklyn) currently using GIS. Conversely, there are towns such as East Windsor, Vernon, and Manchester, that appear on Figure 2 and not on Figure 3. Combining Figures 2 and 3, it appears safe to say that at least 29 towns are currently operating some form of GIS. In addition, it should be noted that the Metropolitan District Commission operates a GIS that includes its 10 member towns.

The UConn survey further shows that 134 of all of the respondents are currently using GIS and 172 are considering using it. The vast majority of users are using some form of ESRI software (i.e. ARC/INFO, ArcCAD, ArcView). The computer of choice appears to be the PC, although there is a significant number of workstation, mini, and mainframe users. There is a wide variety of data sources; 231 respondents are using drafted maps, 124 are using Digital Line Graphs, 138 are using TIGER files, 183 are using other digitized map files, 192 are using aerial photographs, 64 are using satellite imagery, and 29 are using GPS. 193 respondents are manually inputing data, 98 are using optical scanning, 137 are using purchased data, and 130 are using shared data. Intended use of GIS include land records (170), planning, land use and zoning (209), engineering (196), topographic maps (178), and environmental applications (203). The survey asked the respondents to indicate, on a scale from 1 (least) to 5 (most), the significance of problems faced in using or adopting GIS. As might be expected, the most significant problems were costs of hardware and software. However, lack of staff, cost of training, and steep learning curve were seen as very nearly as significant. Lack of data, quality of data, and cost of data were also significant problems. **Note that the Connecticut Map Project and the proposed GIS Institute will directly address all of these problems.**

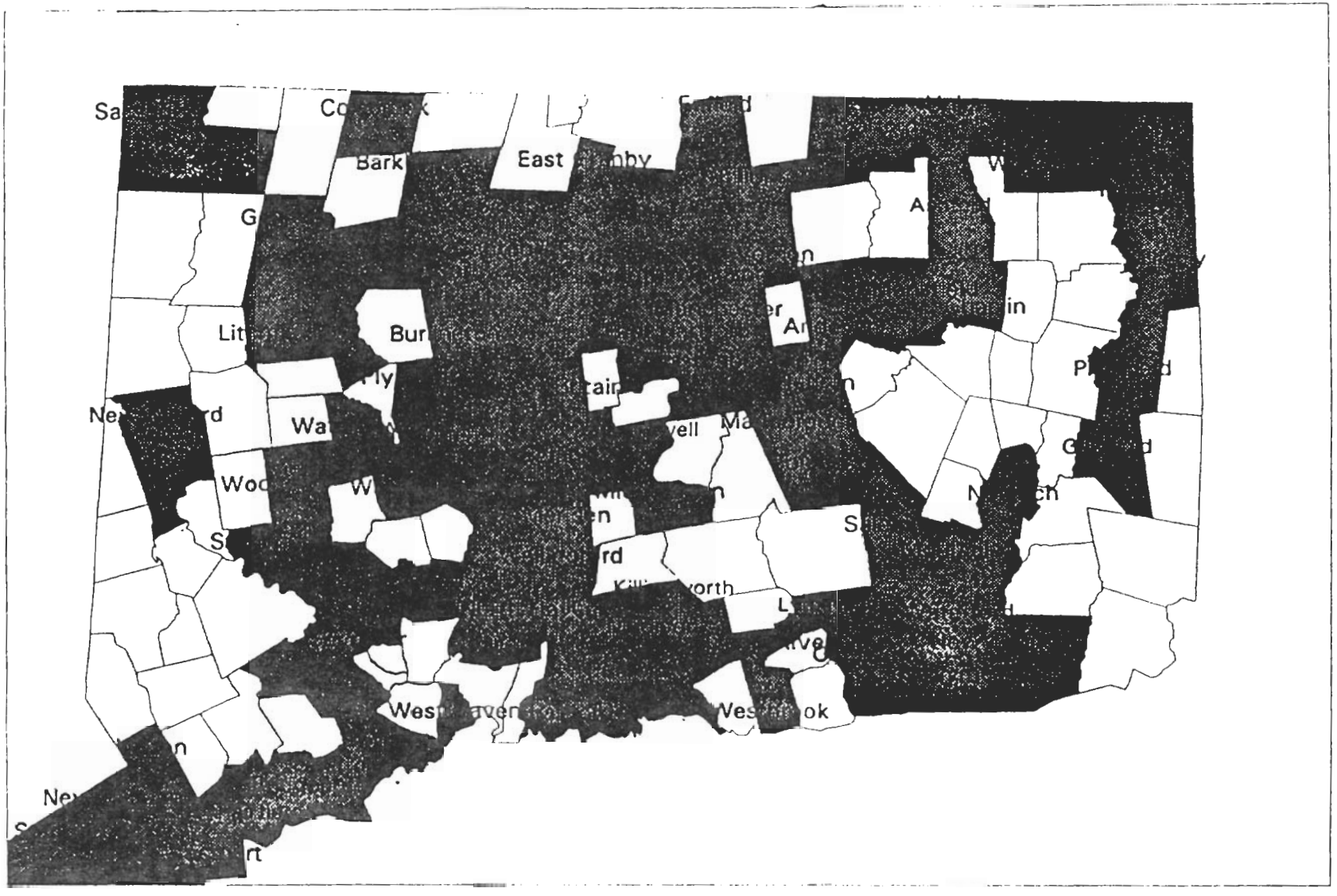


**Figure 1. Cities and towns that participated in the UConn survey**

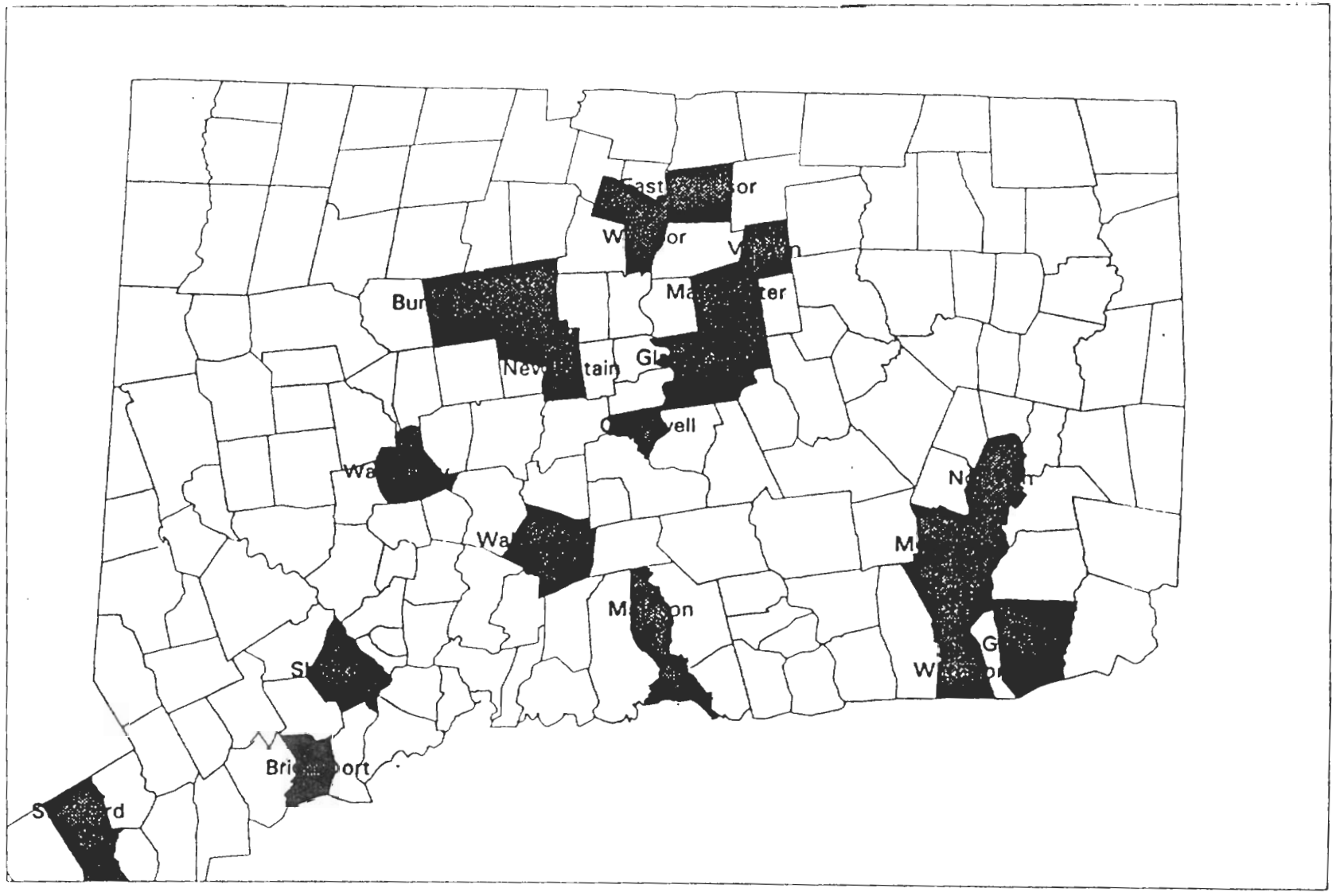

**Figure 2.** Cities and towns that indicated using GIS in UConn Survey

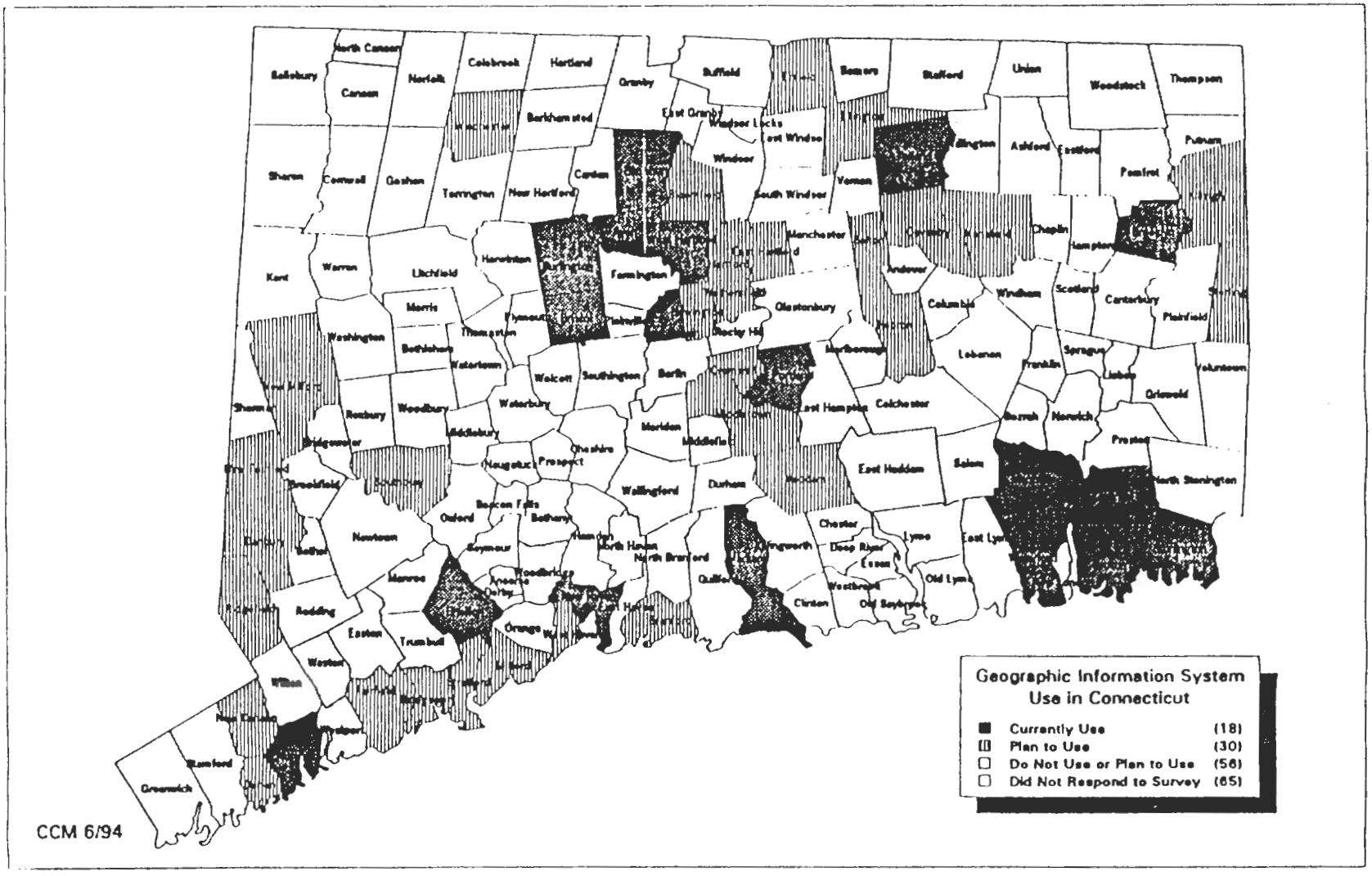


**Figure 3.** **Results of the CCM survey**

## 3. The Role of the Institute

In keeping with the tripartite mission of the University, the mission of the Institute will be to provide the citizens of Connecticut with service, education, and research in the technical, administrative and policy issues associated with GIS. As noted above and more completely described below, ***UConn will take the lead in forming partnerships, as appropriate, with other state institutions and entities to carry out this mission.***

While it is convenient to categorize the several roles of the Institute as service, education, and research, it should be noted that there is considerable overlap in these areas. The role of the Institute as the technical mechanism for managing the Connecticut Map Project is a case in point. The ***service*** provided by the Institute in that initiative will include (but not be limited to) assistance in developing and maintaining standards, serving as a repository of data and metadata, ***training*** of town and agency personnel, and ***researching*** a wide variety of additional valuable applications of the resource.

### 3.1 Service

Obviously, the Institute will have a strong service component. Basically, the general questions addressed in this sub-section are: What services should the Institute provide and to whom should they be provided?

Institute services will include training, advising, and coordinating start-up activities for state, regional, and local agencies. The Connecticut Map Project will give the first opportunity for the Institute to provide these services.

As the survey revealed, there is considerable interest among the towns in implementation of GIS technology. However, there is also a lack of hardware, software, and training. Moreover, experience elsewhere has consistently demonstrated that the major cost of a system is in the data collection and in maintaining the databases. In addition, for most fully functional GIS's there is a long learning curve. It is unlikely that administrators with significant decision-making responsibilities will be willing or able to devote the time required to become proficient in their use. In fact, to be truly proficient, one must have a continuing "hands on" association with the technology. Thus, most of the smaller towns will likely be unable to devote full-time personnel to the activity. The challenge to the service function of the Institute will be in addressing all of these difficulties.

***The Institute will take an advisory role on statewide data standardization.*** In June 1992, the Federal Geographic Data Committee (FGDC) discussed and suggested the need for a common set of metadata elements for data transfer and for use in GIS data cataloging. In Connecticut, the authority for acceptance and promulgation of standards lies ultimately with OIT. To aid the process, the Institute will closely interface with FDGC and other GIS centers nationally to maintain the most up-to-date information on

standardization.

In addition to providing advice to the Policy Committee, ***the Institute will provide technical assistance to cities and towns, state agencies and other entities such as regional planning organizations,*** to insure adherence to federal and state GIS data standardization. The relationship of the Institute to the Connecticut Map Project is an example of the type of assistance to be provided. ***The Institute will serve as the central repository of the products of the Connecticut Map Project.*** It will assist the towns in maintaining and updating cadaster data at the parcel level. The large geographic and attribute databases which will be created by that project will require extensive coordination between numerous agencies. After the base map is created, there will be an equally important role for the Institute in assisting the towns in timely updating of the files. In connection with the CMP and other initiatives, it is anticipated that the Institute's activities will include:

- Delineation of the differences (if any) and commonalities between federal GIS data standardization and current State GIS data standardization.

- Identification of conflicts between ways of representing GIS data within state agencies and existing town GIS facilities.

- Maintenance of historical information and metadata related to establishing town GIS facilities in anticipation of using them for establishing other facilities.

- Recommendation of ways of facilitating data exchange among and between state agencies, towns, academia, and the private sector.

- Maintenance of continuous technical ties between the Institute, state agencies, towns, and the private sector to address the evolution of standards.

- Presentation of technical workshops.

***The Institute will maintain certain databases and a database directory.*** Certain databases will be developed (or enhanced) by the Institute. It will also develop and maintain the substantial volume of metadata related to GIS/GPS operations at State, Regional, and National institutions and agencies. We expect that this data directory information will be accessible by State agencies and the public. These metadata will be stored in a format that is consistent with the FGDC's metadata specifications.

3.2 Education and Training

**Within the University**

***The Institute will be a coordinator of GIS/GPS education at the University of Connecticut.*** In this regard, the Institute would:

- Maintain a list of GIS/GPS courses offered in various academic departments on campus. A more detailed description of each course offering outlining topics and hardware/software systems would be included.

- Maintain a list of related courses in surveying, remote sensing, cartography, database management, etc. and a description of their connection to GIS/GPS.

- Maintain a list of, and affiliation with, computer laboratories on campus used for GIS/GPS education. The list would include the equipment and software systems supported in each laboratory.

- Coordinate software maintenance agreements.

- Foster GIS/GPS education at the regional campuses.

- Provide guidance and expertise to assist academic departments at the University of Connecticut, the State University and Community College systems, and private universities and colleges in establishing new GIS/GPS courses.

**Throughout the State**

***Through cooperative agreements with the State University System and other entities, the Institute will provide training to cities and towns.*** This will be especially important in connection with the Connecticut Map Project wherein a wide spectrum of staff expertise is represented. It is anticipated that the Institute will have the role of "training the trainers" as well as that of direct training of town personnel in the Storrs geographic region. ***Salaries for trainers from partner institutions are included in the proposed Institute budget for Fiscal Years 1995/96 and beyond.***

The Institute will also initiate short courses/workshops for agency personnel, as well as the business community and the general public, in areas such as:

- software systems

- database management

- data standards

Finally, the Institute will disseminate information regarding GIS/GPS science and technology to high school teachers and students.

***The Institute will continue to host the Annual Connecticut GIS Exposition***. With full-time staff available, the Institute will be in a position to continue and improve upon this very popular activity.

3.3 Research

In order to maintain a state-of-the-practice, ***the Institute will engage in an active program of research and development.*** This program will include the following components:

- Research and development in new spatial and database techniques.
- Integration of GIS technology with other computer modeling techniques such as transportation planning, land development, and demography.
- Use of GIS to further economic development and to assist in a variety of areas such as public health and safety, environmental management and site remediation, etc.
- Development of a network and information infrastructure to support the above components.

In general, the research agenda of the Institute will address issues of importance and interest to governmental agencies within the State as well as private industry, business, and non-governmental organizations. Close research ties with these to these groups will be forged. On campus, the Institute will coordinate faculty research (especially multi-disciplinary) in GIS and GPS.

**The Consortium**

In order to promote professional development of faculty, ***a Consortium will be formed during FY 95/96 which will include UConn and certain of: the State University System, the Community and Technical Colleges, and private universities.*** The program of the Consortium will provide funds for the introduction of new and innovative educational initiatives, for research in areas of interest to the State and the institutions, and for travel for faculty from the participating institutions to conferences, etc. The Consortium will be managed by the Institute and will consist of an Executive Board with voting membership of all of the participating institutions. The Executive Board will have authority for soliciting proposals from faculty of the participating institutions and for awarding funding for research and professional development.

4. Organization of the Institute

The Institute will be centered at the Storrs Campus of the University of Connecticut. As noted above, ***other state institutions and agencies will be very important partners***. The specific agencies and their roles will be identified during the first year of operation of the Institute. However, it is clear that the State University System will be represented and will make a major contribution in training of town personnel. The establishment of formal agreements with these entities will also be an important activity of the first year.

## 4.1 Storrs Campus

A schematic diagram of the organization on the Storrs Campus of the University of Connecticut is given in Figure 4. As proposed, the Institute would be administratively located within the Office of the Provost and Vice President for Academic Affairs. Note that the core of the Institute would be located in the Central Offices and Laboratory, which will be placed in the center of the campus. At the present time, five "satellite" laboratories will intersect with the central offices. These are: the existing laboratories of the Transportation Institute, the Department of Ecology and Evolutionary Biology, and the Laboratory for Earth Resources Information Systems (LERIS), the Department of Geography, and the Environmental Research Institute. Figure 4 also shows the intersection with two other very important entities: the Booth Research Center and the Babbidge Library. The relationship of the Institute with the former is completely described in Section 4. While it is neither an academic department nor a laboratory, the Babbidge Library, in view of its role as a repository of all types of information, will obviously have a close relationship to the Institute.

## 4.2 Off Campus

The relationship with a variety of entities off campus is depicted schematically in Figure 5. Obviously, the Institute will continue to be represented on, and work closely with, the GIS Policy Committee. Other universities and colleges, state and private, will form formal partnerships with the Institute. They will participate in the delivery of training and service to the cities and towns, and through the Consortium described in Section 3.

## 4.3 Advisory Board

The Institute will have an Advisory Board. The membership will include, but not be limited to, representatives of the Office of Policy and Management, the Department of Transportation, the Department of Natural Resources, the Department of Economic Development, the Connecticut Conference of Municipalities, and the Council of Small Towns. Additional representatives will be added as required. The Board will meet quarterly or as required. Procedures for Board operations will be established by the Board itself. It will be solely advisory. All issues of administration of the Institute will be handled as any other unit of the University and will be subject to the authority of the Board of Trustees of the University. In addition to the high-level Advisory Board, Technical Advisory Committees will be formed. These will consist of technical representatives of the same agencies comprising the Advisory Board. They might also consist of technical representatives of utility companies etc.

# 5. Hardware, Software, and Network Support Systems

## 5.1 Introduction

It is important that the Institute maintain a state of the art profile of computing

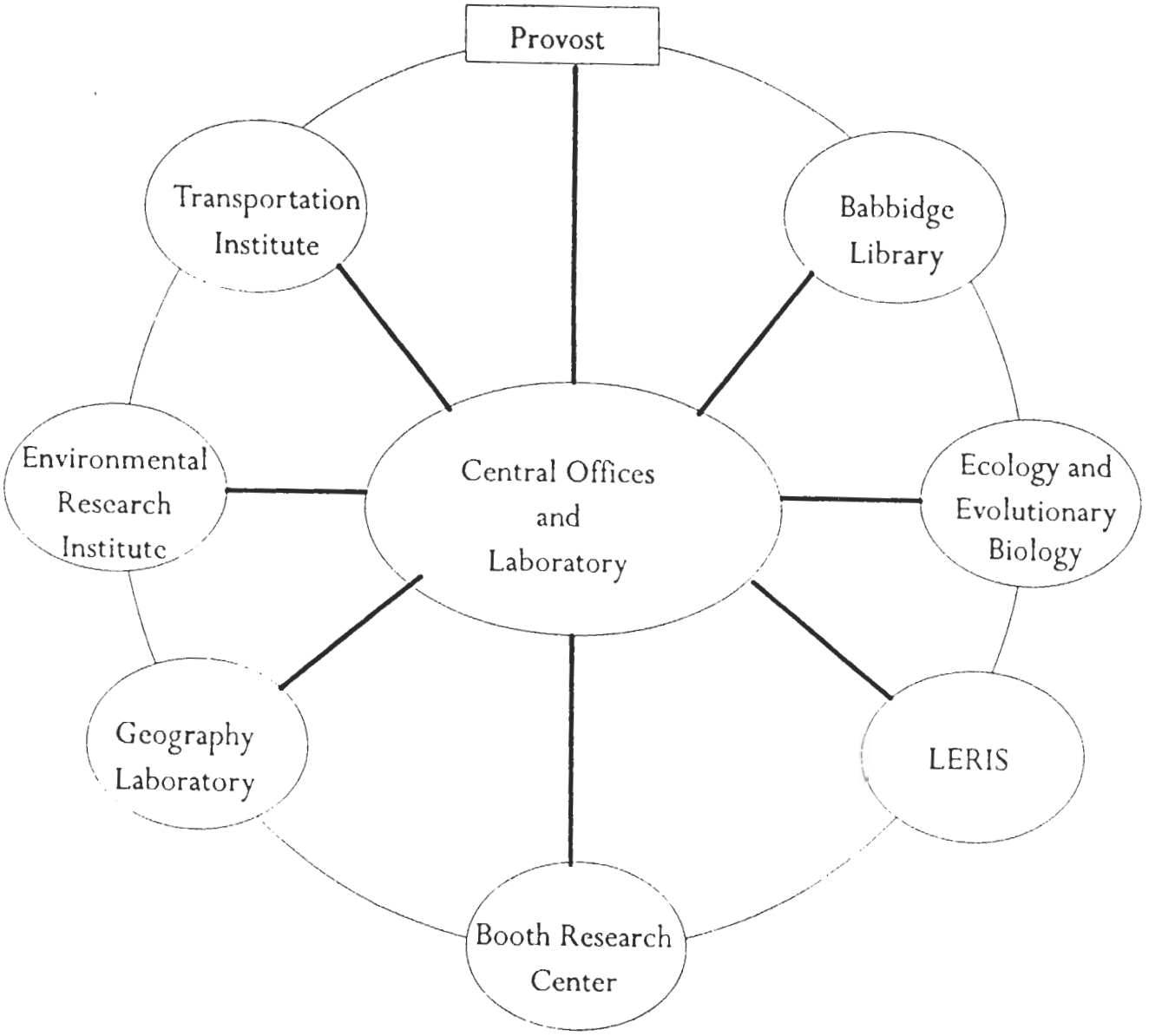


**Figure 4. Relation of the Institute with other units at Storrs**

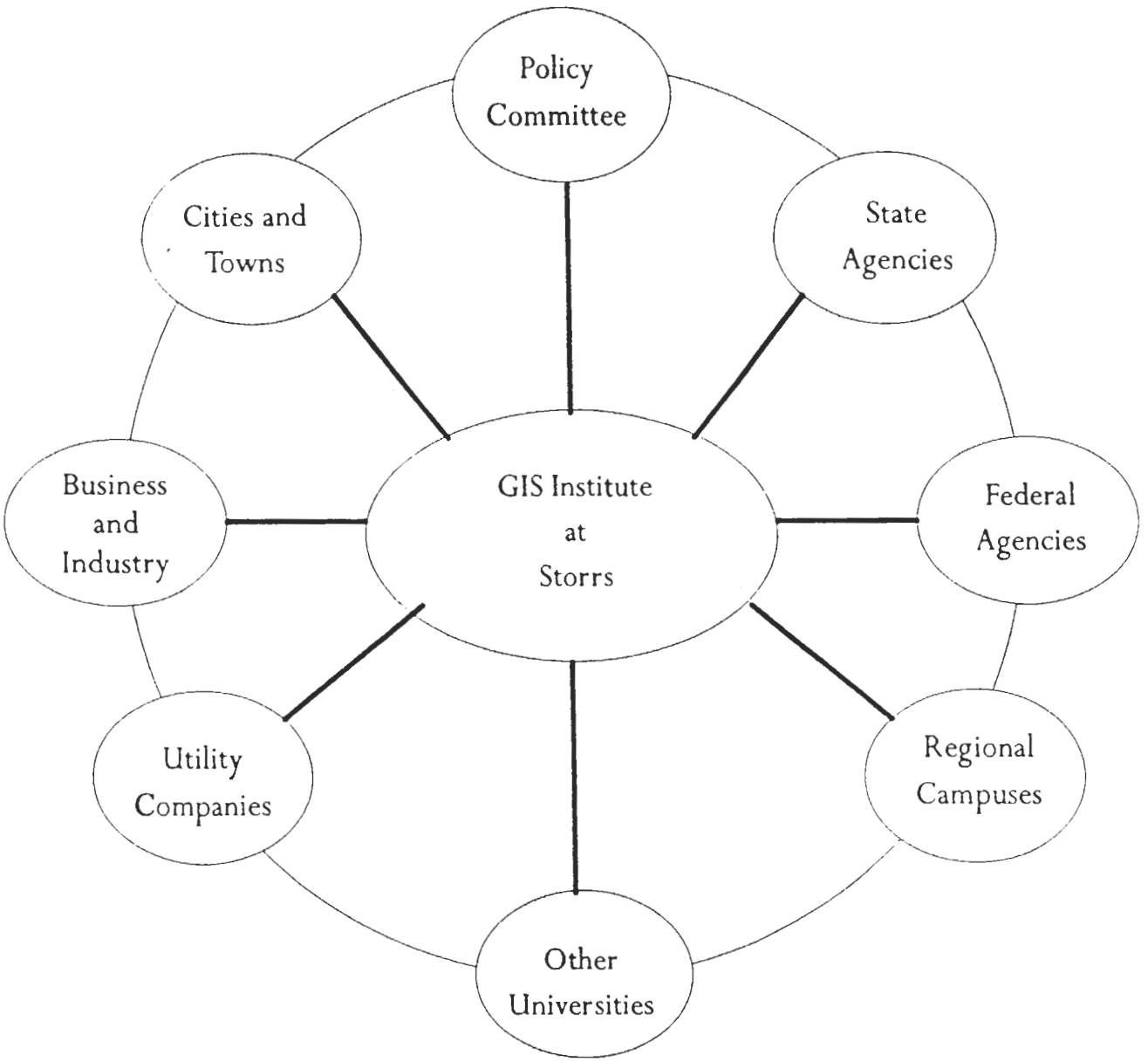


**Figure 5.** **Off-Campus relationships**

facilities (hardware, software, and network access) to insure that the primary functions of research, education/training, and service can be carried out. This means:

- that an initial configuration of essential available facilities (hardware and software) be defined in a state of the art manner;
- that facilities upgrade and maintenance plans be defined to insure the continuance of functions;
- that appropriate support personnel and administrative structure exist to carry out the mission effectively.

This section proposes a solution to these concerns which takes advantage of existing UConn facilities, where feasible. The plan assumes a small but complete initial profile, which will self-size based on income derived from funded research and from service charges from clientele.

## 5.2 Networked Hardware/Software Systems

This sub-section defines a recommended computing support environment to address the needs of the composite research/education/service communities for GIS/GPS. A related budget is provided in section 5.4.

### Recommended Computing Environment

There are two types of computing environments proposed: a local environment at Storrs which provides state of the art facilities suitable for research in the various aspects of GIS/GPS that will ensure a strong technical base for state/industry/town service support; and a "virtual" center as perceived by the remote users of GIS/GPS resources, who enter the system through a workstation or PC from their own location.

***On the Storrs Campus,*** the Institute will be electronically and geographically located close to the existing major support facilities already at UConn. This allows for maximizing research interaction between groups and efficiency in obtaining computing support. Figure 6 shows this relationship. The Babbidge Library is already active in developing a map library database and will provide a reliable repository for collections of fixed GIS information. The Taylor L. Booth Center for Computer Applications and Research (BRC) already plays a strong campus role in support of computing research and applications. The proposed GIS Institute has a research affiliate relationship with the Booth Research Center. This would allow research access of BRC's major networked facilities and experienced support personnel to form a strong and reliable network and equipment base. As shown in Figure 7, the University Computing Center already provides a campus network backbone, supports an Internet connection, provides PC educational laboratories, and maintains a large IBM computing system available for research/educational areas with high computational requirements. The GIS Institute would have access to these facilities.

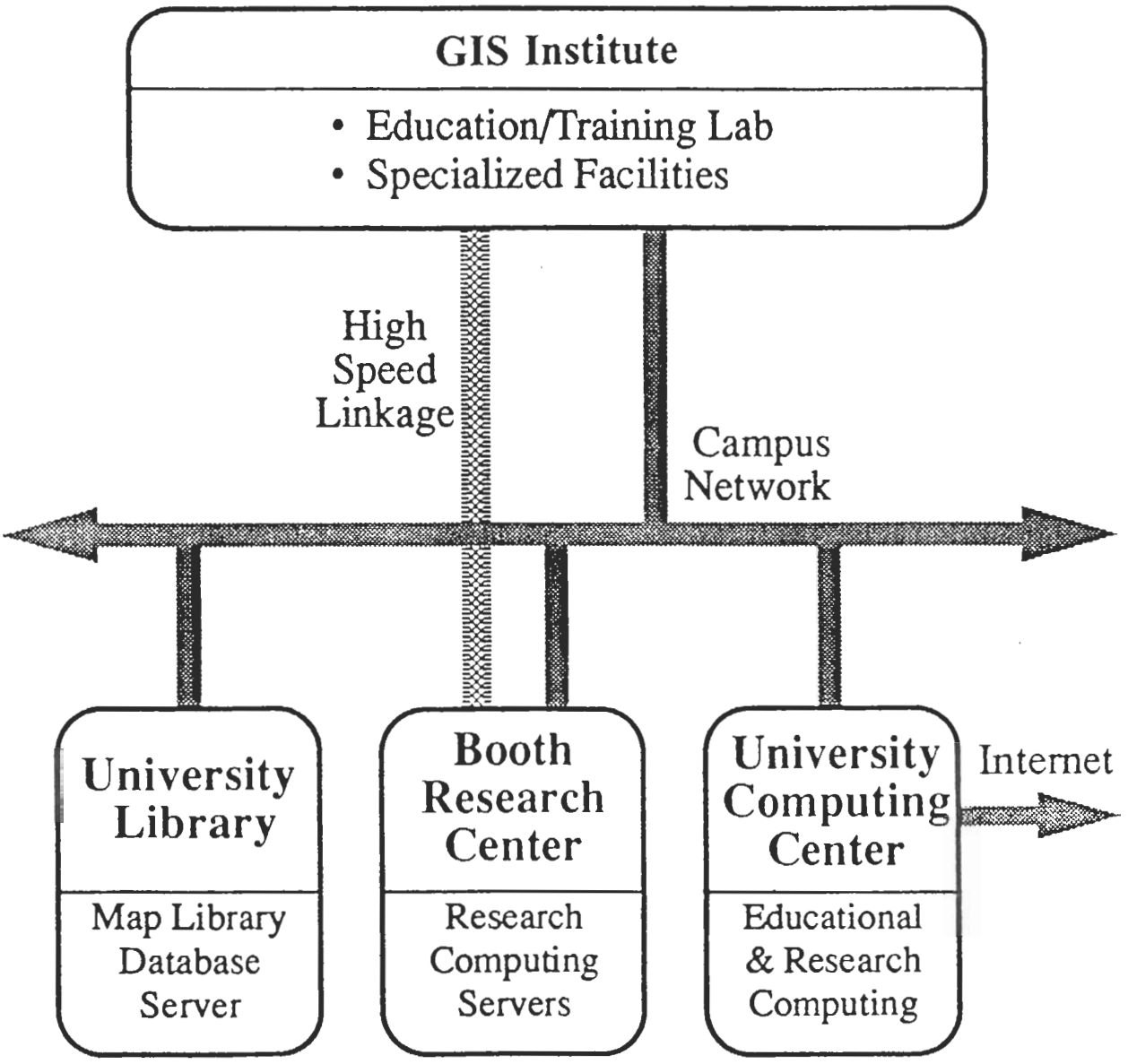


**Figure 6.** **Electronic relationships of the Institute on the Campus**

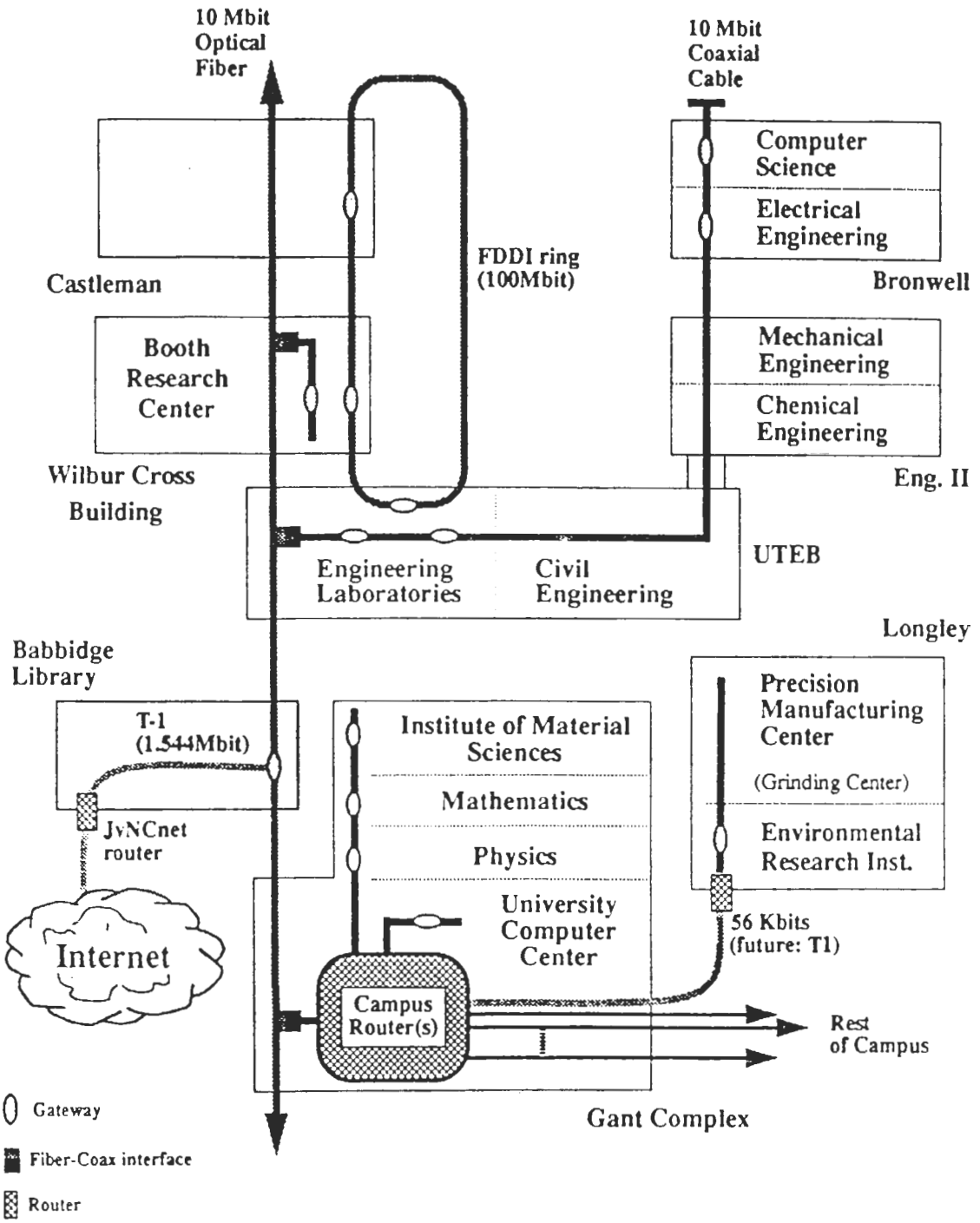


**Figure 7.** **Network configuration**

In addition to the network access of facilities and services in these organizations, the proposed Institute also requires a dedicated computing laboratory, to provide for specialized GIS/GPS facilities and to allow independent scheduling/access for training and educational programs. This laboratory would also be networked to provide wide accessibility. The laboratory would be equipped with a selected set of GIS computing platforms (hardware/software), for which the Institute would have training and support expertise. These platforms would then be used in educational and training applications, and would otherwise provide additional research support resources.

***Remote access*** of the data and data processing facilities at the Institute is essential. There are several ways in which this can be accomplished:

- Direct access through the Internet.

This approach provides virtually the same interaction capability as if one were at the university. A user would need a PC or Workstation with appropriate software and a connection to the Internet. Costs for doing this on an occasional basis need to be established. The line speed of the connection would be a factor in data file transfer, if that were necessary. Clearly only some users would be able to do this at the outset; however, the approach would create the effect that the user is "at" the Institute.

- Regionally-based laboratories/access points.

UConn computer network access is maintained at all branch campuses. It is possible for other state or Institute sponsored locations to be defined/implemented as well. Thus, users would travel to one of these remote sites for access. Specific locations and the required equipment and software configurations would be determined during the first operating year.

- The mail approach.

Data disks can be exchanged by mail (or through an occasional trip to UConn). Here, requests for specific data sets can be accepted, and the data written on disk files to be returned to the sender.

In all of these cases, the support costs for access would be borne by the user. The cost rates for interacting with the Institute through these mechanisms will be determined through analysis of each case. The rates will be defined for cost recovery on a non-profit basis.

### Hardware and Software Support

Below we describe a more detailed view of the needed computational facilities for the education/research/service functions. Included as well are summary approaches for managing both the maintenance and facilities upgrades, including an assessment of the support personnel

needed. Cost estimates were derived from representative manufacturer data for both hardware and software situations.

*Equipment Needs*

A. Hardware Facilities:

- PC-based lab component, consisting of 14 state-of-the-art PCs
  ( Gateway PCs were used as cost-representative)
  Cost: $55,356 (hardware, DOS6.0, Windows 3.1)

- Workstation lab component, consisting of 3 high end work stations and 8 lower end workstations, including one system configured for 12 Gb of file service.
  (Cost estimate derived from a Silicon Graphics Indigo 2 based lab) Upgrade of existing Sun SparcStation.
  Approximate cost: $274,900 (including three years maintenance)

- Peripheral Equipment:

| | |
|---|---|
| "E" size color ink jet printer | $10,000 |
| Smaller size color ink jet printer | $ 5,000 |
| Two color Postscript printers | $ 6,200 |
| Three scanners | $ 6,000 |
| Three Digitizers | $ 7,000 |
| Writable CD | $10,000 |
| Exabyte tape | $ 3,500 |
| (9 track already available) | |
| Total: $47,700 | |

- GPS Equipment:

| | |
|---|---|
| Base Station | $12,000 |
| Support PC | $ 3,000 |
| Four Receivers | $52,000 |
| Radio Modules | $ 3,000 |
| (2) Notebook Computers | $ 8,000 |
| Total: $78,000 | |

- Grand Total Hardware: $455,956

B. Software:

Total Software Costs, assuming:

* Fortran, C, NFS will not be placed in software maintenance.
* The ARCINFO University Lab Kits are purchased for a 14 user Workstation and for a 10 user PC environment.
* ERDAS is used for both environments.
* All GIS software is covered by software maintenance.
* Known system-implicit software is excluded.

Workstation level: Licenses: $61,000
Annual Software Upgrade Service: $15,340

PC level: (incl. GPS Software) Licenses: $28,100
Annual Software Upgrade Service: $ 7,100

3. Overall Totals, Hardware and Software

$545,056 one-shot, includes 3 years maintenance for the workstation facilities
$ 22,440/year software upgrade support

***Maintenance Planning/Approach***

A. Hardware:

All major hardware (e.g., workstations, servers, etc.) is to be purchased with an implicit multiyear (e.g., 3-year) warranty. This will provide a maintenance support baseline to keep the centralized lab facility functional. Management personnel (as to be described below) are still needed to provide the daily support and computer system management functions. Minor hardware will be repaired/replaced on an as-needed basis. As the equipment ages (e.g., beyond three years), a regular upgrade policy is needed. This is described in the next section.

The GIS research laboratories will work with the Booth Research Center and will be able to access that center's facilities and services in support of their component laboratories. Since BRC is a cost center, a mechanism exists to route lab support/development funds, derived from research grants/contracts, back to individual labs. Each laboratory will identify a contact person in that lab who is primarily responsible for that lab's facilities. The BRC technical staff will work with that individual to insure that facilities (hardware, software, networking) problems are efficiently resolved. No additional funding is required for this service.

B. Software:

All primary software systems require both a license fee (right to use purchase) an annual upgrade fee. These costs are implicit in the proposal. Secondary/minor software packages will not all need an annual upgrade; therefore, upgrade of these less-needed facilities

will be decided on a case by case basis.

***Upgrade planning,*** which will allow the Institute to maintain the facilities in at least a "state of the practice" form, requires a policy. Computing hardware facilities typically need replacement before a 5 year period. This is true not because they are worn out, but rather because the software tool development will require much higher capacity hardware to execute effectively. Therefore the following policy will be followed to insure a regular rollover of facilities occurs. All major equipment will have an implicit 3-year warranty (as described above). After the three year period, the equipment will continue to be utilized until a failure occurs. At that point, if the equipment is still vital it will be repaired; otherwise, it will be used as a source of spare parts to be drawn from as other similar equipment fails. As these individual items become nonfunctional, they will be replaced with new versions, again with three year warranties. In addition, each year (after the initial three years) an added fraction of facilities replacement will be considered to supplement the above policy.

Upgrade funding for the hardware facilities can typically then be estimated as an additive 20% per year of the total facilities value. As described above, software upgrades normally are required by the software company on a yearly basis. Funding for this need is included above.

***Support personnel*** are required to perform the daily system management and diagnostic functions required for the regular set of activities to occur in the laboratory. While the research laboratories are to be handled individually as described above, the central laboratory requires added personnel support. One full-time technical position is requested as part of this proposal to support both the operation and management of the central laboratory. This person will insure that all facilities are kept in an upgraded and functional state, perform software installations and testing as required, and control the management of the software operating systems. In addition, this person will be able to call upon the technical personnel in the Booth Research Center for assistance and coordination, as required. BRC personnel will also provide technical leadership in the initial installation of the lab facilities, in order to insure a proper and compatible networking connection and environment exists. BRC support costs are included in the overall computing budget.

## 5.3 Functional Summary of Provided Facilities Access/Service

This section summarizes the expected availability of GIS Institute facilities and services, from both local and remote locations. It is assumed that a set of usage and service fees would be developed to allow appropriate cost recovery.

**Locally-available**

- Direct access of system resources to carry out GIS-related studies using available data bases and available laboratory equipment. This means a person would sit in the laboratory at a workstation or PC

and perform access, research, and reporting tasks.

- Training sessions on the use of GIS hardware, software facilities. There would be a regular schedule of workshops and seminars, which are designed to train new users to function effectively in the available GIS environments.

- Consulting services to assist users in various GIS-related problems and applications. It is intended that regular hours would be available for consulting assistance.

**Remotely-available**

- Remote access of system resources would be developed to allow "virtual" direct access from specific locations in the state. This means that a networked connection would provide nearly the same type of services to be carried out. Differences would certainly exist in that the remote equipment configuration would be less robust that at the local Institute, and therefore the services offered would also be less varied. Within the offered service set, however, the system behavior (and user perception) would be virtually identical. Included in this class would be obtaining updated copies of available data sets.

- Contracted job assignments may be requested from the Institute. Institute personnel would then clarify the job specifications, carry out the GIS data analysis/preparation task, and meet with the customer to review and explain results.

5.4 Budget and Explanation

The summary budget in support of the facilities portion of activity includes the following items:

| | | |
|---|---|---|
| (1) | Hardware and Software Facilities (upfront expense) | $545,056 |
| (2) | Annual software upgrade costs | $ 22,440 |
| (3) | Hardware/software upgrade/replacement (per year) | $106,213 |
| (4) | Booth Research Center Support Services | $ 25,000 |
| Total (first year) | | $698,709 |

Explanation:

Section 5.2 already explained the basis for each of these items in more detail. The largest component represents the establishment of a General GIS lab that would be the functional focal point of the Institute's operation. The cost level indicated includes hardware, software, an implicit 3 year maintenance agreement, and some initial support costs to get the lab initially installed and functional. The remaining costs would recur each year, and represent those costs needed to maintain the lab at a "state of the practice" technical level. These latter costs include regular hardware and software upgrading and replacement, and also personnel and service costs. These include a technical computer system administrator, and sufficient supplemental technical support from the Booth Research Center to insure a strong support base.

6. First Year Activities

The budget as proposed assumes start-up early in FY 94-95. During that year, the primary activities will be:

- Hiring personnel
- Purchasing equipment for the Center
- Occupying the central office facilities
- Working with a "pilot" set of towns to identify personnel, organizational and operational issues that will need to be addressed by the program
- Identifying "partner" institution and agencies

The FY 94-95 organization reflects the need to give initial priority to the areas of education, database services, and communications and facilities. Each of these areas is of critical importance and thus requires the attention of a senior level faculty person (Director). The need for the "Systems Specialist" is described in Section 5.2. Since it is anticipated that the Institute will become a "special service facility" and will be involved in numerous contractual relations, it will be very important that a full-time "Technical Records Coordinator" be brought into the organization as early as possible.

In view of the proposed role of the Institute in connection with the ***Connecticut Map Project***, one of the highest priorities will be the examination of town facilities. The mail-in survey conducted during the summer of 1993 provided a broad picture of the State, but much more information specific to individual towns will need to be acquired. The examination of town facilities will consider both hardware and software (GIS and other). In addition it will consider the organizational, institutional, and legal issues that must be addressed if the project is to be of maximum utility. We propose to accomplish this by first working intensely with several, say ten, towns that are representative of the spectrum of towns in the State. This work would begin in the fall of 1994. A general informational meeting will first be held with the towns. This would be followed by visits to each of the towns by a UConn team. Following these visits, a report will be prepared identifying required hardware and software. The report will also recommend policies and procedures that will insure the smooth integration of the technology into the existing environments. The report will be circulated to

the towns and other appropriate agencies (including OPM) for a review. When comments and concerns have been addressed, the report will serve as a model for the examination of the needs of the rest of the towns in the State.

The delivery system for providing the training and technical assistance to the towns is depicted conceptually in Figure 8. In this figure, the four entities in rectangles represent possible "service bureaus"; the small circles represent towns. Note that each of the service bureaus serves several towns and that the Institute will provide training to the service bureaus and to towns in the geographic vicinity of Storrs. The geographic distribution of these entities is shown in Figures 9 through 13. The selection of the specific service providers to be utilized will be based on a matching of training needs with institutional interests and resources and geographic distribution. The determination of which of the potential providers will actually participate will be made during FY 94/95.

***During FY 95-96,*** the following activities will be added:

- Trainers will be added to the staff. These individuals will provide most of the routine direct training to town personnel. They will be stationed at "remote" locations (Regional Campuses, State Universities, and Community and Technical Colleges)
- Three additional centers will be added. These deal with the extremely important areas of GPS and Remote Sensing, Demographics, and Infrastructure Systems.
- The Consortium will begin operation.

As noted earlier, in addition to providing the trainers described above, certain of the State Universities, Community and Technical Colleges, and private universities will participate as members of a "Consortium", and will have available a budget that will support a program of professional development for these institutions.

7. Budget

The proposed budget for FY 94/95 is given in Table 1.

***For FY 95/96***, we estimate the budget to be approximately $5,300,000 of which approximately $740,000 will fund operations at the partner institutions.

8. Summary

In order to protect the significant investment in this geographic information infrastructure which will be created by the Connecticut Map Project, and to insure its efficient dissemination and optimal use, it is proposed to establish a Geographic Information Systems Institute at the University of Connecticut. The Institute will provide service, education, and research in the technologies of GIS and the Global Positioning System (GPS). The specific functions to be performed by the Institute and its organizational structure have been described in this proposal.

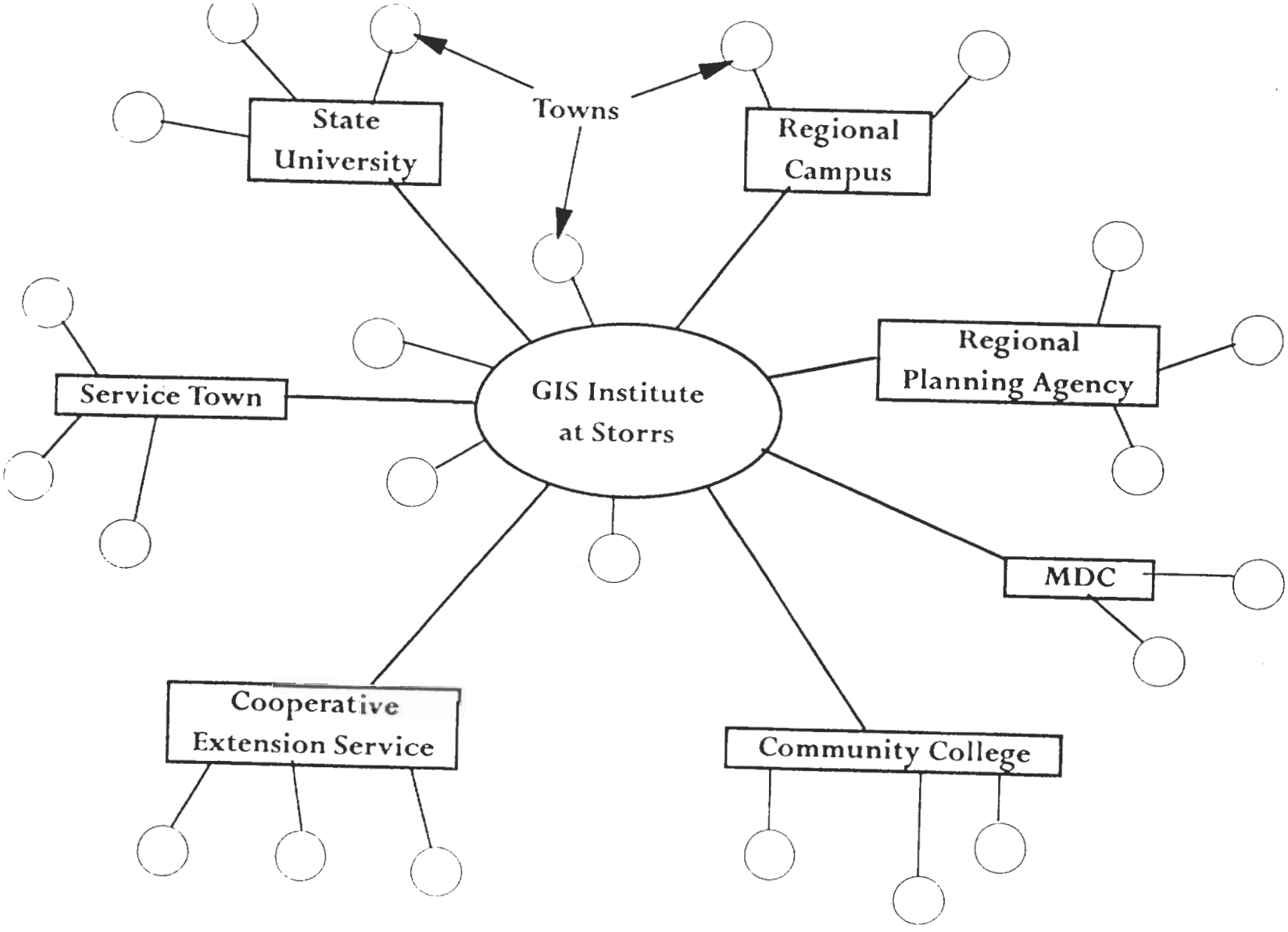


**Figure 8.** **Service delivery system**

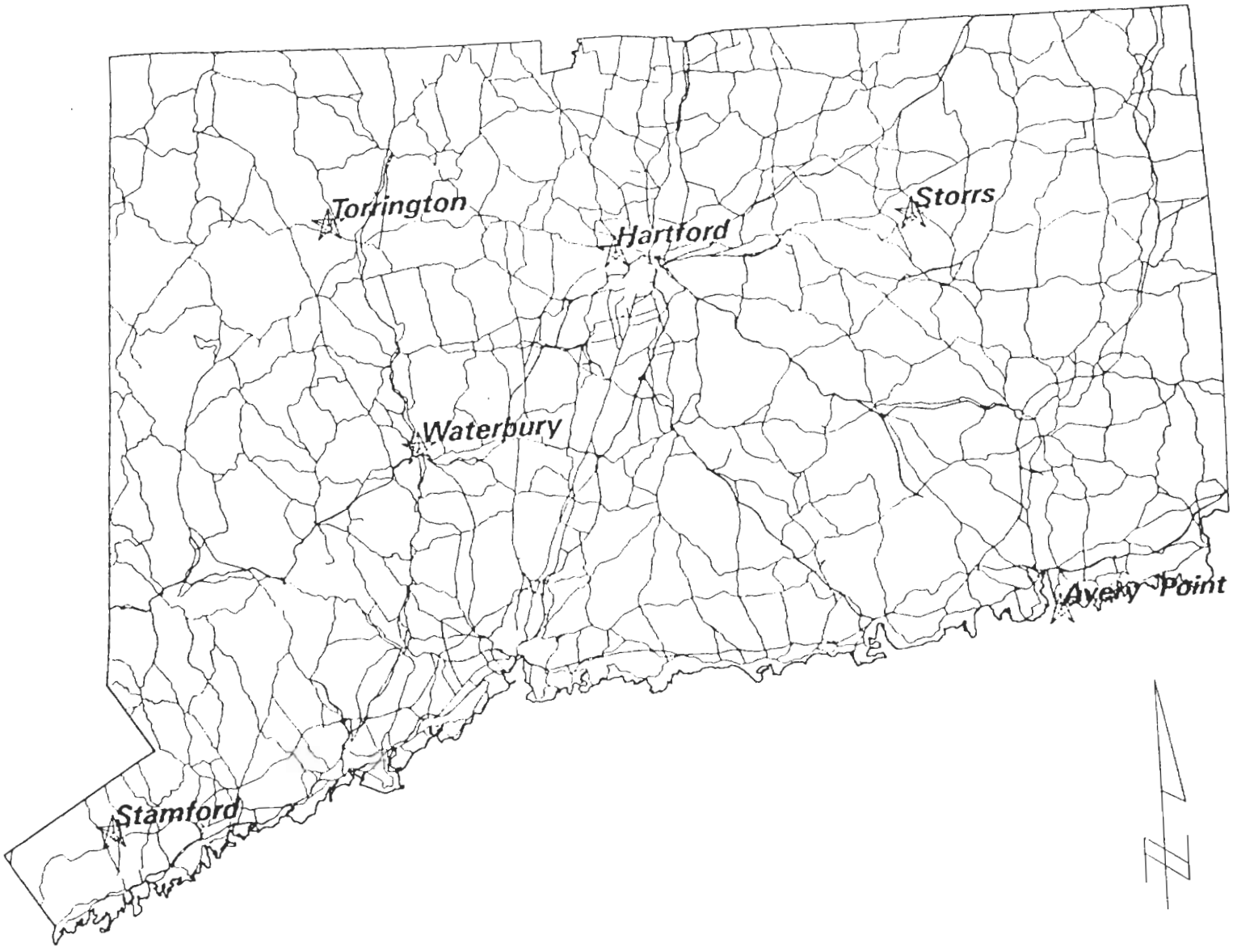


**Figure 9.** The Regional Campuses

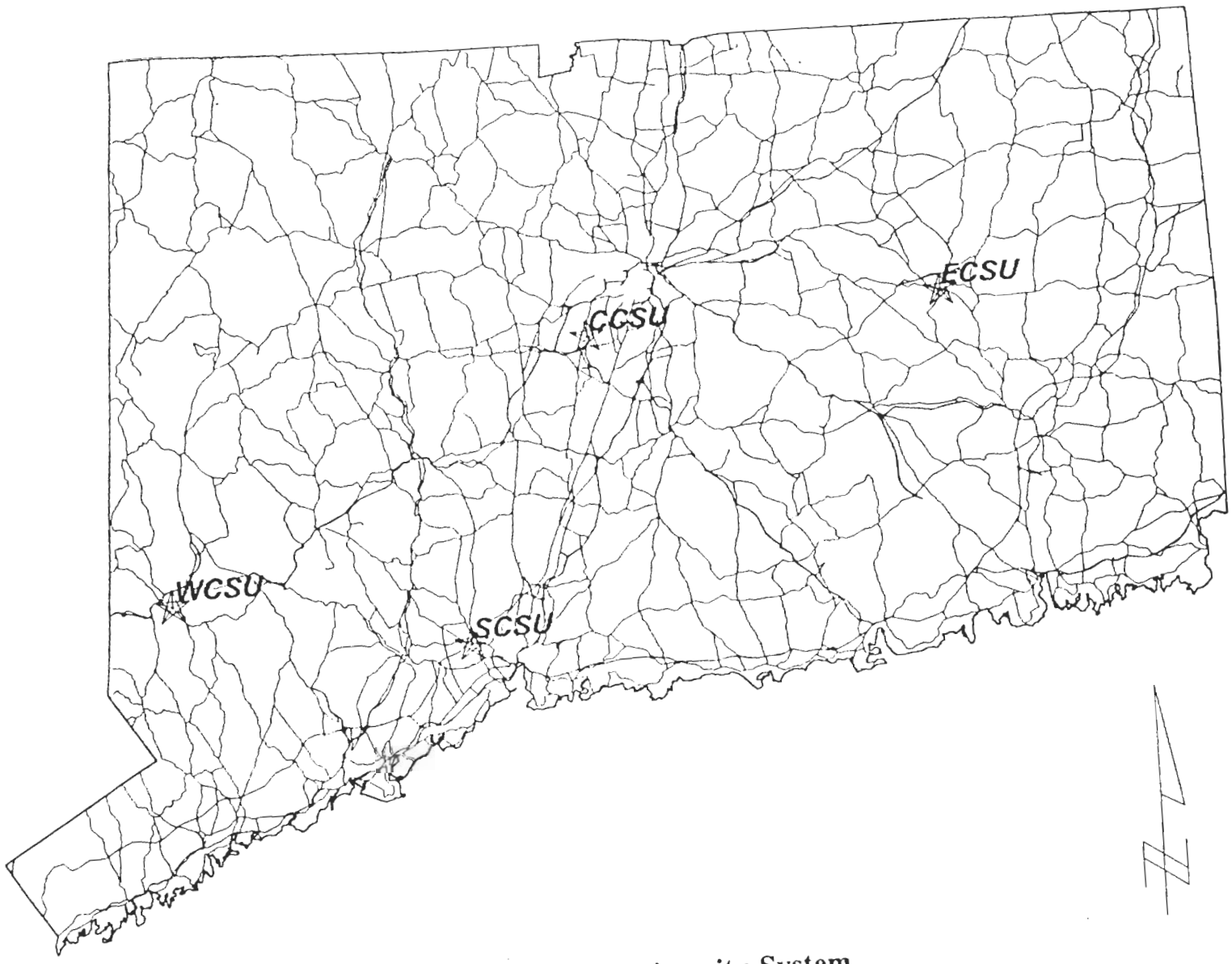


**Figure 10.** The State University System

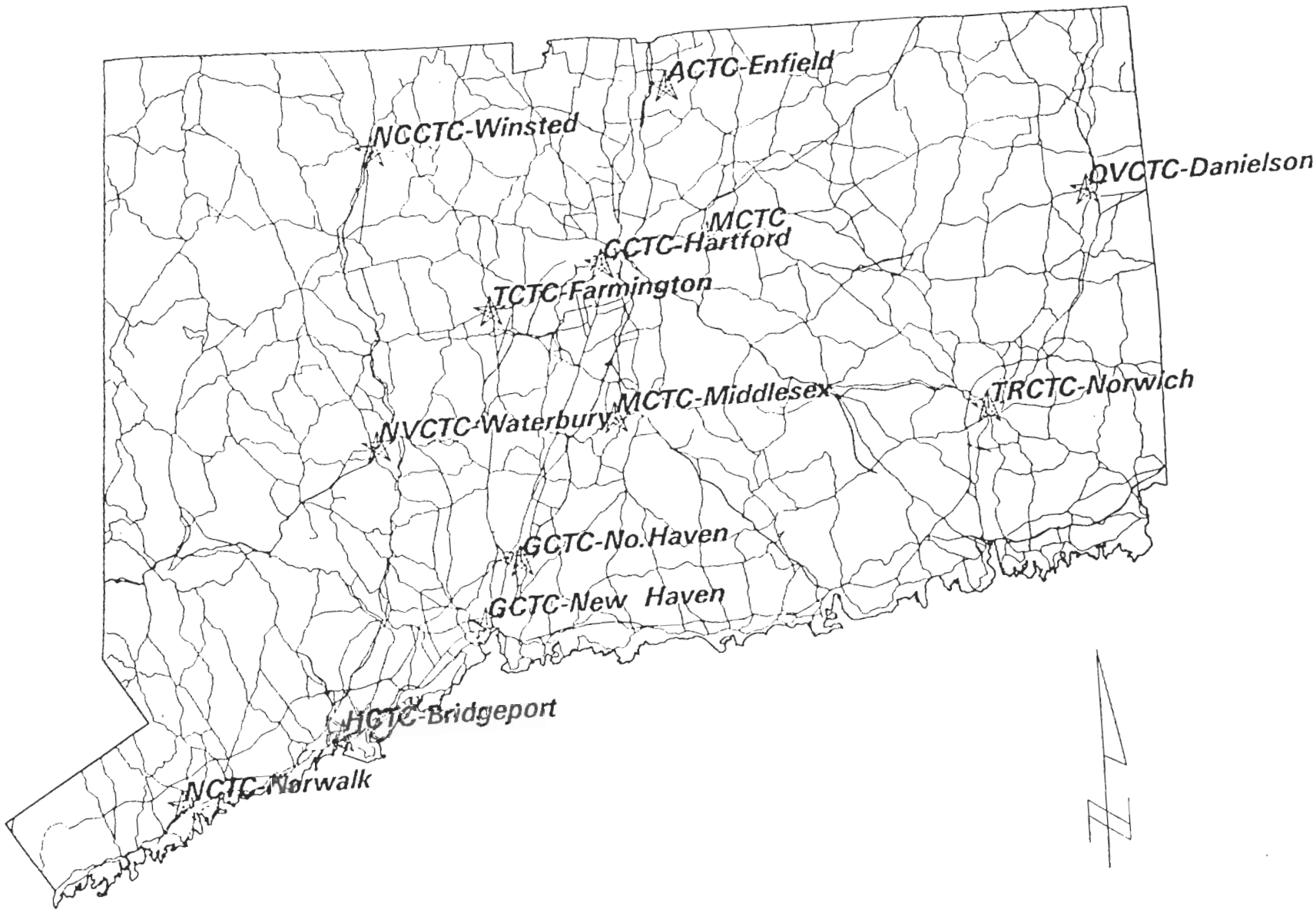


**Figure 11. The Community and Technical College System**

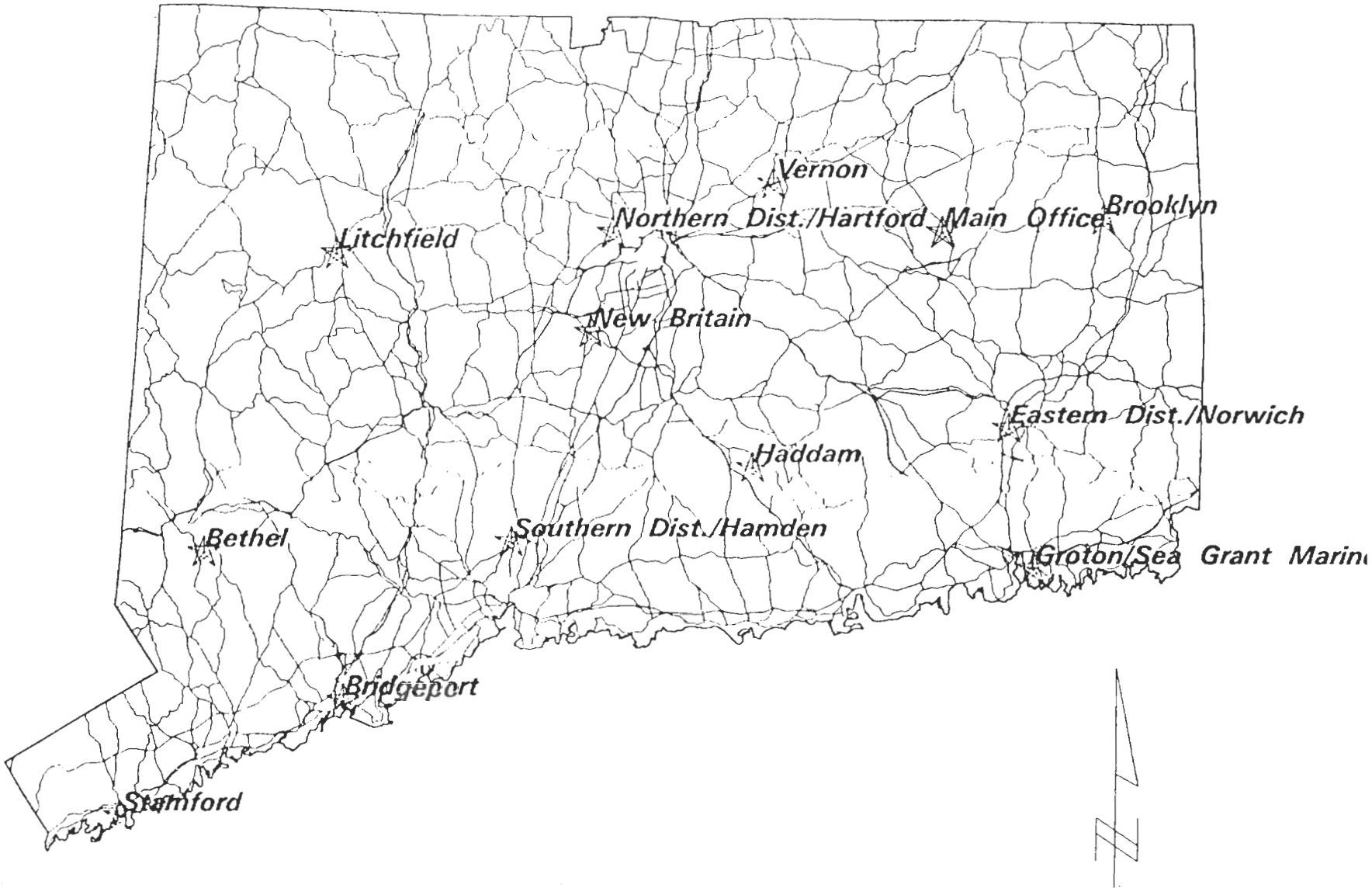


**Figure 12.** The Cooperative Extension System

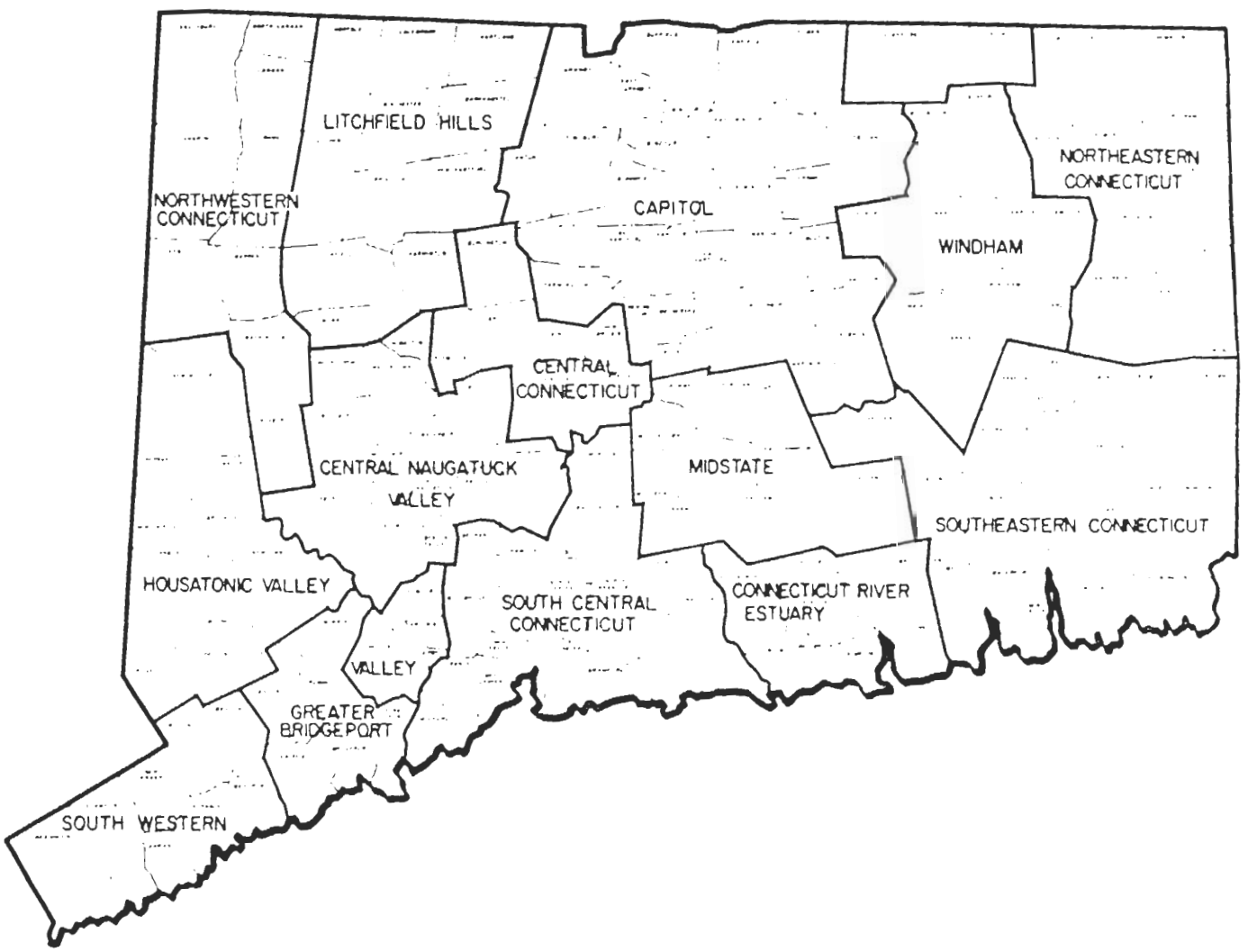


**Figure 13.** **Connecticut Planning Regions**

## Table 1 Budget for FY 94/95.

| | I.C. @ 25% SALARIES YEAR I |
|---|---|
| Senior Personnel | |
| 1 Exec. Dir. @ $95,400 @ 75% TO BE NAMED | 71,550 |
| 2 Ex. Dir. Summer salary 1/9 | 10,600 |
| 3 3 Directors @ 1/2 time To be named | 103,350 |
| 4 summer salary | 11,484 |
| 5 | |
| Total Senior Personnel | 196,984 |
| 1. Other Professionsls | 34,683 |
| 2. Other Professionsls | 26,012 |
| 3. Graduate Assistants (2) | 31,600 |
| 4. Undergraduates | |
| 5. Secretarial/Clerical | |
| 6. | |
| Total Salaries and Wages | 289,279 |
| Fringe Benefits | 105,803 |
| Total Salaries and Fringes | 395,082 |
| Equipment * | 696,709 |
| Travel 1. Domestic | 3,500 |
| 2. Foreign | |
| G. Other Direct Costs | |
| Materials and Supplies | 5,000 |
| Printing and duplication | |
| Consultants | |
| Computer * | |
| Subcontracts * | |
| Other | 23,000 |
| Total Other Direct Costs | 28,000 |
| H. Total Direct Costs | 1,123,291 |
| I. Indirect Costs | 72,320 |
| J. Total Direct & Indirect Costs | 1,195,611 |

* Not subject to indirect costs

The Institute will be located on the Storrs campus of the University of Connecticut and will thus have available the considerable expertise of a major research university. In addition, the Institute will form partnerships with the Connecticut State University System, with the Community and Technical College system, and with other entities as appropriate. The establishment of equitable and efficient partnerships will be a major initiative of the first year of operation of the Institute. The partnerships will become in effect during the second and subsequent years of operation. They will be especially important in providing the outreach services required in connection with the statewide GIS.

The requested budget for FY 94/95 is $1,195,611.

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1. Dueker, K. J., and D. Kjerne. "Multipurpose Cadastre: Terms and Definitions", in Technical Papers ACSM Annual Convention, Baltimore, 1979 pp. 94-103.

2. Simkowitz, H. J. "Transportation Applications of Geographical Information Systems". Computer, Environment and Urban Systems, 1988, pp. 253-271.

3. Office of Policy and Management. June 25, 1994.

# SUPPLEMENT TO A PROPOSAL FOR THE ESTABLISHMENT OF A CONNECTICUT GEOGRAPHIC INFORMATION SYSTEMS INSTITUTE JULY 27, 1994

**Rationale for using bond funds.**

The Connecticut Map Project is a far sighted, significant investment in an information infrastructure which will serve the State well into the future. The analogy between this information infrastructure and the rest of the public works infrastructure is complete. Thus, **if they are to be protected**, they must be:

- properly planned and designed,
- properly constructed.
- made available to the user, and
- maintained.

The proposed Institute will play a major role in each of these activities and will have the lead role in the last two.

Personnel from the University of Connecticut who will participate in the Institute have already been intimately involved in the ***planning and design*** of the CMP. It is anticipated that this involvement will increase as the project moves forward. This is important in order to ensure that the resulting product is optimal and will serve the needs of its intended users.

As the CMP is ***constructed***, the Institute will assist in the very significant job of monitoring that construction to ensure that standards have been adhered to.

The heaviest involvement of the Institute will be in ***making the investment available to the users.*** This will come through assisting the towns in system development and providing the training necessary for town personnel to use the map. There is no doubt that this will be a huge undertaking. Based on the results of a survey of Connecticut cities and towns in the summer of 1993, it is apparent that without this training, the significant investment in the map is likely to remain unused by many of the towns. In response to the question, "What are the major problems being faced in using or adopting GIS in your organization?" the most frequent response (after "cost") was **"lack of trained staff"**. When it is considered that the towns who returned the questionnaire are likely to be among the most enlightened, it is clear that there is a big job of training to do. It is equally clear that the respondents felt that the Institute will be able to provide that service. In response to the question, "If a GIS/GPS Resource Center were established at the University of Connecticut, which activities would be useful to your organization?", the overwhelming majority of respondents answered **"Training"**. Very nearly as many (not significantly different) listed **"Technical Assistance"**. Again, this is a primary role envisioned for the institute.

The infrastructure must be ***maintained.*** The Institute will serve as the primary repository of the GIS database. As noted by the GIS Policy Committee, **"Local governments, with State coordinated assistance, will maintain the data that flows through them."** This assistance will be provided by the Institute. Without this assistance, the product will become obsolete and worthless in a very short time. There another important consideration (and the analogy to the highway and bridge infrastructure again serves well here). **Because of the very important liability issues involved, use of an obsolete product is potentially worse than not using it at all.**

In summary, it is obvious that without an effective design, delivery system and maintenance procedure the large capitol investment in the CMP will be wasted. The primary purpose of the Institute will be to see that this does not happen.

**Revised Budget for Fiscal Year 94-95**

The proposed equipment budget for FY 94-95 of $696,709 was developed through thoughtful consideration of the responsibilities that the Institute will be given, and we believe it is quite realistic. Nevertheless, we recognize the tight fiscal constraints faced by the State in the current year. Therefore, **we are prepared to reduce the FY 94-95 budget** to a "bare bones" amount of $227,225 and shift the remaining purchases to FY 95-96. The remainder of the budget stays as in the proposal, giving a revised grand total of $726,127.

**Budget Projections Fiscal Years 95 through 2000**

Budget projections for fiscal years 95 through 2000 are shown below. These projections were developed based on the assumption of 5 % inflation in equipment replacement costs and 7 % inflation otherwise. While the workload will increase over the period, there is likely to be increased efficiency of operations as experience is gained.