

FINAL DRAFT

GEOGRAPHIC INFORMATION SYSTEM DEVELOPMENT PLAN FOR WEST VIRGINIA

Submitted to:

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SECTION 1 INTRODUCTION

1.1 PURPOSE AND FORMAT OF PLAN

This *GIS Development Plan* is the culmination of investigations and planning work which began in the Summer of 1992. PlanGraphics, an independent consultant, has worked with state government agencies and other organizations in West Virginia in a project directed by the West Virginia Development Office. The project's purpose has been to evaluate GIS requirements and develop a plan for statewide GIS development. This plan has been preceded by the following reports:

- *Geographic Information System Needs Assessment for West Virginia*, October 1, 1992; Revised, January 4, 1993
- *GIS Conceptual Design*, February 17, 1993.

For more details about existing conditions and GIS design ideas which form the foundation of this plan, please consult the reports listed above.

1.2 PARTICIPATING ORGANIZATIONS

Through direct interviews and written surveys, PlanGraphics has gathered information for a large number of organizations in the state, including state government offices, university groups, Regional Planning and Development Councils, local governments, and private companies. These groups represent current and prospective users of GIS and other organizations that could have a role in GIS development in West Virginia.

Table 1-1 lists all the agencies included in the study.

**TABLE 1-1
PARTICIPATING ORGANIZATIONS**

State Agencies

Administration	IS&C
Agriculture	Commissioner
Commerce, Labor, Environmental Resources	Bureau of Employment Programs
Commerce, Labor, Environmental Resources	Division of Forestry
Commerce, Labor, Environmental Resources	Division of Natural Resources
Commerce, Labor, Environmental Resources	Division of Tourism and Parks
Commerce, Labor, Environmental Resources	Geological and Economic Survey
Commerce, Labor, Environmental Resources	Miner's Health, Safety & Training
Commerce, Labor, Environmental Resources	Solid Waste Management Board
Commerce, Labor, Environmental Resources	Water Development Authority
Commerce, Labor, Environmental Resources	WVA Development Office
Commerce, Labor, Environmental Resources	Div. of Environmental Protection
Department of Education	Staff
Education and the Arts	Higher Education Central Office
Education and the Arts	Culture and History
Education and the Arts	Network Educational Telecomputing
Governor's Office	Health Care Planning Commission
Health and Human Resources	Bureau of Public Health
Health and Human Resources	Division of Human Services
Health and Human Resources	Health Care Cost Review
Health and Human Resources	Management Information Systems
Legislative Services	Staff
Public Safety	Emergency Services
Public Safety	State Police
Public Safety	Regional Jail Correctional Authority
Public Safety	State Fire Marshall
School Building Authority	Staff
Secretary of State	Secretary
State Soil Conservation Committee	Staff
Tax and Revenue	Property Tax Division
Transportation	Aeronautics Commission
Transportation	Division of Highways
Transportation	Port Authority
Transportation	Parkways, Economic Development & Tourism

TABLE 1-1 (continued)
PARTICIPATING ORGANIZATIONS

Federal Agencies

Corps of Engineers	Huntington District
Office of Surface Mining	Charleston Field Office
USDA	Forest Service
USDA	Soil Conservation Service
USDI	National Park Service
USEPA	Region III
USGS	Water Resources Division

Universities

Marshall University	Institute for Regional Development
WVA University	Agriculture & Forestry
WVA University	Geology & Geography

Local/Regional Organizations

City of Beckley	Department of Engineering
City of Huntington	Sanitary Board
City of Morgantown	Planning and Housing
Morgantown Utility Board	
City of Weirton	Police Department
City of Weirton	Fire Department
City of Weirton	Finance Department
City of Weirton	Department of Public Works
Putnam County Planning Commission	
Regional Planning & Development Councils	Region I
Regional Planning & Development Councils	Region III
Regional Planning & Development Councils	Region IV
Regional Planning & Development Councils	Region V
Regional Planning & Development Councils	Region IX
Regional Planning & Development Councils	Region X
Regional Planning & Development Councils	Region XI

Private Organizations

Appalachian Power Company
Chesapeake and Potomac Telephone Company
Union Oil & Gas
West Virginia Association of Counties
Western Pocahontas Properties
WESTVACO

1.3 BASIC PRINCIPLES AND GOALS GUIDING THE GIS DESIGN

1.3.1 Overall Goals

The GIS program is based on a desire for greater coordination in the management of geographic information in West Virginia. Geographic information impacts a large number of programs for which state government offices are responsible. In addition, the use and efficient management of geographic information is critical for Regional Planning and Development Councils, local governments, and private companies (e.g., utility companies, resource management companies). State government staff have recognized the long-term benefits to be realized by reducing redundant collection and storage of information and by improving data consistency. Overall goals guiding the GIS design include the following:

1. **Minimize duplication** in the management of geographic information and inefficient labor-intensive business functions.
2. **Increase productivity**, both in volume and scope of business functions dependent on geographic information.
3. **Establish and act on a long-range plan** for a statewide GIS development.
4. **Establish** and enforce **data standards** to facilitate use of information pools from multiple sources inside and outside state government.
5. **Establish a data network** to facilitate access to geographic data and analysis by multiple users.
6. Define and **establish database(s)** that support GIS applications with the greatest utility **for multiple organizations**, and that constitute a foundation for enhancements to meet future needs.
7. **Pool** financial, staff, and technical **resources** to build a unified GIS.
8. Establish **cooperative development** and geographic information sharing with federal agencies, local governments, universities, and private sector participants.

1.3.2 Specific Issues Impacting GIS Design

PlanGraphics found several major factors that influenced preparation of the *GIS Conceptual Design*. We considered the following pervasive factors in all aspects of this project:

- The participants in this study are a very diverse collection of organizations, including federal, state, regional, and local government; universities; large

publicly regulated utility firms; and small private firms. While diverse in the scope of their activities, many of the participants share some commonality in their need for geographic information. Opportunities for these organizations to share information was one of PlanGraphics' prime considerations when evaluating approaches to developing a statewide GIS.

- The participants in this study are also spatially diverse. The largest single collection of participant organizations are state government agencies located in Charleston; the second largest contingent is located in Morgantown. Many of the other participants are distributed throughout the state. The wide spatial distribution of the participants adds dimension and complexity to issues of sharing and managing geographic data.
- Several participating organizations have already made significant use of computer mapping, GIS, and image processing software for certain projects. Experience with such public domain packages as GRASS and MOSS, as well as commercial software like AutoCAD, Intergraph, MIPS, ERDAS, SPANS, GeoSQL, and ARC/INFO, provides a base of knowledge about GIS. The diversity of experience with multiple systems is an obvious benefit to the overall project, but, is also a source of added complexity for sharing data and programs.
- The West Virginia Geographic Information Systems Coordinating Committee (WVGISCC) has established an ad hoc forum through which organizations, both experienced and inexperienced with GIS, can communicate. The nature of this organization encourages sharing of experience and ideas without the restrictions normally inherent with a formal committee. The activities of the WVGISCC have been, and will continue to be, of significant benefit to the State of West Virginia. The group has initiated and forged relationships between organizations that, otherwise, may not have occurred. PlanGraphics recommends that when project participants consider activities and responsibilities of state government organizations necessary to manage GIS development, the role of the WVGISCC be taken into account.

1.3.3 Critical Success Factors

The success of coordinating a statewide GIS will be dependent on a number of technical and institutional factors. PlanGraphics identified several factors that we believe are critical to the success of West Virginia's GIS. We recommend that management ensure that the factors listed below be fully considered when implementing this plan.

1. It is necessary that experienced staff be assigned to oversee and coordinate GIS development, particularly among the many participating organizations.

2. Technical support staff must be assigned within user departments and the Technical Support Center to support GIS implementation, specifically data capture and GIS application development.
3. Data standards must be developed for geographic data formats and coding schemes. Standards must be established to support statewide sharing of GIS data.
4. Individual agencies that are currently engaged in GIS projects should continue with their work. These agencies should also participate in defining statewide standards and in complying with those standards.
5. Participants should ensure that their hardware architecture and communication network allow for flexible exchange of data between GISs. They should also work long-term toward system integration with non-GIS information systems.
6. Clear guidelines should be developed for procurement of specific GIS software and hardware by state agencies.
7. The state must allocate sufficient resources to develop a comprehensive GIS database. Existing automated geographic databases should be used to the extent practical.
8. An adequate level of funding must be allocated to support GIS development. State government representatives should actively pursue cooperative programs for database development with outside organizations (e.g., federal government and private firms).
9. State government should become the focal point of a statewide GIS that encourages participation by all levels of government, universities, and private companies in West Virginia.
10. Clear procedures and responsibilities must be established for maintaining geographic data.

1.4 LAND-RELATED ACTIVITIES AND POTENTIAL GIS APPLICATIONS

1.4.1 Land-related Activities

Initial project work included interviews and information surveys to determine the types of land-related activities that are being carried out by project participants. PlanGraphics reviewed the land-related activities to determine potential applications of GIS technology.

1.4.2 Potential GIS Applications

GIS application programs will be developed to generate information (e.g., screen displays) or physical products (e.g., map plots, printouts) that support one or more of the land-related activities. PlanGraphics identified and categorized potential GIS applications that will support the land-related activities of project participants. PlanGraphics' approach is to first determine how GIS technology may be applied by the users. Identifying potential GIS applications provides a foundation for long-range planning for GIS implementation.

GIS application development efforts should build upon programs already being used by various participants, or those in planning stages. The factors listed below will directly affect the process of preparing a schedule for GIS application development:

1. Importance to individual users
2. Importance to multiple users
3. The complexity and the time it takes to create a particular database
4. The difficulty in preparing a particular GIS application program.

1.4.3 Summary of Applications

The *West Virginia GIS Needs Assessment* report contains a listing of applications and their priority. PlanGraphics grouped the potential GIS applications into three categories (listed below) that can be used as a general guide for planning application development work. We acknowledge that these priorities may not reflect critical needs of individual participants. It may be necessary to implement some Medium and Low Priority applications early in the GIS development effort.

- High Priority: design and implementation during Phase 1 and Phase 2
- Medium Priority: design and implementation during Phase 2 and Phase 3
- Low Priority: design and implementation during Phase 3 and Phase 4.

Table 1-2 lists the applications by their priority.

TABLE 1-2
POTENTIAL GIS APPLICATION PRIORITIES

High Priority

Incident Map Production
Standard Queries and Data Display
Standard Map Maintenance and Production

Medium Priority

Thematic Map Production
Maintenance Planning and Scheduling
Utility, Facility and Equipment Inventory
Land Ownership/Lease Tracking
Permit Tracking
Development Review/Impact Assessment
Network Analysis
Address Matching
Demographic Analysis

Low Priority

Custom Map Compilation and Production
Publication and Presentation Graphics
Public Information and Inquiry Response
Complaint Tracking
Comprehensive Planning Analysis
Emergency Preparedness Planning
Terrain Analysis
Engineering Drafting
Preliminary Engineering Planning

SECTION 2 GIS CONCEPTUAL DESIGN SUMMARY

2.1 OVERVIEW OF GIS CONCEPTUAL DESIGN

The *GIS Conceptual Design* report presented PlanGraphics' recommendations and considerations for developing a statewide GIS. The report covered three primary areas of concern; these included:

- Database development
- System configuration
- Organizational and staffing concerns.

PlanGraphics developed a model for the statewide GIS database to satisfy application needs at a variety of scales and accuracy levels. The model presents the general content and format of the database. Further, we discussed methods for developing the database and estimates of its development cost.

Our description of the statewide GIS configuration included a model for data communications, links to outside systems, and a typical hardware configuration.

Requirements for GIS management and staffing were presented in terms of an organizational structure for the statewide GIS. PlanGraphics made specific recommendations on staffing required to support management and coordination of the GIS.

Below we present encapsulated versions of recommendations described in the *GIS Conceptual Requirements* report.

2.2 CONCEPTUAL DATABASE MODEL

A good way to understand the GIS database model is to consider it as a series of map overlays, or "layers." Each layer includes a set of map features along with information about those features. This concept of map layers is depicted in Figure 2-1.

**FIGURE 2-1
GIS DATA LAYER CONCEPT**

[USE FIGURE A-3 FROM 448.3 APPENDIX A].

Information or characteristics about map features are stored and linked to the map layers in the form of tabular attribute files enabling flexible mapping and geographic analysis as shown in Figure 2-2.

**FIGURE 2-2
GRAPHIC/TABULAR DATA RELATIONSHIP**

[USE FIGURE A-2 FROM 448.3 APPENDIX A].

We can best categorize the West Virginia GIS database in two parts:

1) a core set of map layers and associated attributes that are routinely used by multiple agencies, and 2) external tabular databases maintained independently that can be linked with the map layers for a specific analysis. External tabular data that now resides on existing computer systems such as mainframe computers and microcomputers will continue to be maintained externally but will be used by the GIS, when needed, to support mapping and geographic analysis.

2.2.1 Database Tier Concept

This project includes a wide variety of participants, each with different types of land-related activities. The focus of these activities ranges from parcel-specific site details to statewide aggregations of data. Perhaps ideally, one database with a singular level of detail and accuracy could meet the wide range of activities. However, this ideal is not yet practical in the current environment of data processing. The use of tiers is a practical approach for organizing the base of mapping and geographic data in tiers.

The concept of tiers, as applied to the GIS database, refers to developing separate groups of data at different levels of accuracy and detail. Different applications require different levels of accuracy and detail. For example, site analysis for a potential sewage treatment plant should be conducted using large-scale mapping with a high degree of accuracy; to prepare a statewide statistical map of current flow from treatment plants does not require the high degree of accuracy required for the site analysis. The difference between these applications, as related to a discussion of data tiers, has to do with data resolution. Practical data processing factors, such as data storage, database structure, and retrieval, must also be considered. A tiered database approach is designed to address the practical issues of GIS data storage and performance in a way that supplies users with the types of data, covering the appropriate areas, that are needed to support the different requirements of their land-related activities.

By structuring the GIS database into four tiers by level of detail, data will be organized efficiently to balance the trade-offs of data content, map accuracy, and geographic coverage that impact all land-related activities. Figure 2-3 indicates the relative area of coverage in each of the tiers.

[USE FIGURE 2-1 FROM 448.3 CONCEPTUAL DESIGN]

- *Local Data:* The map and tabular databases associated with this tier can be used to perform many site-specific or aggregated analyses, to identify or inquire about specific locations, and to create large-scale maps. Activities associated with this tier include tracking property ownership, tax assessment, case tracking, field operations, local infrastructure, and others. The primary users of databases that fall within the Local Tier category are local governments and utilities. State agencies that perform site-specific functions, such as hazardous waste contamination remediation, will often require data at the level of detail and accuracy associated with this tier. Databases in this tier will be primarily stored and maintained at the municipal or county government level.
- *Sub-regional Data:* Databases that are associated with the Sub-regional Tier will support land-related activities that typically require a larger view of an area than the local data tier supports. The Sub-regional data tier would provide map data appropriate for viewing an entire county, or perhaps multiple counties. The base map accuracy for this tier should be approximately ± 40 feet. As in the local data tier, map data in the Sub-regional Tier will likely be divided into geographic sub-areas for storage and retrieval, although the extent of each map file will be larger than those used for the local data tier.

For example, if an agency has data that are effectively shown on USGS 1:24,000 scale topographic maps, that data would be included in the Sub-regional data tier.

- *Regional Data:* Map data in this tier will be used to support land-related activities that typically require a view of larger regions. Map accuracy requirements for activities supported by this tier will be less than for the Sub-regional and Local Tiers. PlanGraphics recommends that the USGS 1:100,000 scale DLG files be used as the base map for the Regional Tier. These files are designed to maintain a horizontal accuracy tolerance of approximately 400 feet.

Additional map data to be included in this tier may be input from sources at scales other than 1:100,000. For example, soils data recommended for this tier is available at an original input scale of 1:250,000. In some cases, it may be more appropriate to generalize data directly from the Sub-regional data tier. Because the regional databases contain less data, they are generally less costly to produce, easier to store and manage, and faster to process than Sub-regional databases, particularly when large areas are being mapped or analyzed. Map and tabular data in this tier will also likely be divided into sub-areas for storage and retrieval.

- *Statewide Data:* This tier is designed to meet the needs of land-related activities that require an overview of the entire State. This tier will depict political boundaries, the major transportation network, and other major locational reference features. PlanGraphics recommends that the base map for statewide data be the USGS 1:500,000 scale map of West Virginia.

In large measure, map data at the Statewide Tier would be prepared as special maps for display or publication. Few permanent databases containing specialized thematic data are required at this level. Data at this level can be used for generalized thematic mapping or statewide presentations. To a large extent, this tier provides a large-area coverage of basic boundary and landmark features to serve as a foundation for special mapping projects.

For each tier, PlanGraphics recommends particular factors for scale and accuracy. The recommended factors should be applied to the base map, which will be used in support of database development within that tier. Base maps of a known level of accuracy and detail will come to be associated with a particular tier by those involved with the planning and use of the GIS. PlanGraphics' recommendation for base maps for each of the tiers is shown in Table 2-1.

[USE TABLE 2-1 FROM 448.3 CONCEPTUAL DESIGN].

2.2.2 GIS Database Recommendations

In the *GIS Conceptual Design* report, PlanGraphics presented detailed recommendations on the composition of the GIS database. The GIS layers listed below have been defined with varying content, format, source, and conversion strategy for each database tier. For the purpose of organizing a development and maintenance strategy, GIS database layers can be grouped into two categories: a) **Common** GIS layers which include those that will be used routinely by agencies outside the custodian agency, and b) **Agency-specific** layers which will not routinely be shared and are the specific responsibility of a particular agency. We have listed the recommended basic data layers below and have identified each layer with a "C" for common or an "S" for single agency use. The division between what is labeled as C or S is based on anticipated general usage of an entire layer, not individual data items that may reside within the layer. Our groupings are also not intended to be restrictive, but simply to indicate our vision of the general trend of data use.

- Survey Control Points and Grid (C)
- Orthophoto/Planimetric (C)
- Transportation Network (C)
- Hydrography (C, S)
- Topography (C)
- Political Boundaries (C)
- Administrative Boundaries (C)
- Parcels (S)
- Energy Transmission (S)
- Utility Distribution/Collection (S)
- Land Use/Land Cover (C)
- Bedrock Geology (C)
- Floodplains (C)
- Well Locations (C, S)
- Environmental Features (C)
- Soil Classification Boundaries (C)
- Incidents/Point Features (S)
- Historical/Archeological Sites (S)
- Recreational Facilities (S)
- Demography (S)
- Meteorological Data (S)
- Biological Distribution (S).

This reference to “common” vs. “single agency” use refers to the core set of map features and attributes on the particular layer. It will be normal practice for individual agencies to build additional tabular attribute sets and enhance existing GIS layers with additional features to meet their needs.

The main purpose of this designation of common or agency-specific is to establish a basis to assign roles for custodianship. Custodianship implies a responsibility for update and

for maintaining meta-data to facilitate access to GIS layers. All common layers are to be accessible by all GIS participants.

2.3 SYSTEM CONFIGURATION

2.3.1 Overall Assumptions

PlanGraphics made the following assumptions in preparing the system configuration:

- The GIS must allow for communication and data exchange among sites which are geographically dispersed around the state. There will be no single, central GIS that will be used by all potential GIS participants. Rather, the system will allow for a decentralized approach to GIS.
- Existing use of GIS by state government departments, universities, and other organizations will influence, in part, decisions on hardware and software used by participants in West Virginia's GIS.
- A decision should be made to identify a small number of commercial and/or public domain GIS software packages for use by participants. At the same time, procedures should be instituted to ensure the ability to exchange data with other automated mapping and GIS software packages.
- Systems should grow incrementally through the series of development phases, with measured expansion of hardware and software as GIS databases and applications are developed.
- System acquisition and development should be guided by appropriate standards for hardware, software, and data communications, in order to encourage long-term system integration and flexibility. To the greatest extent possible, GIS standards should be developed in concert with broader information system and database standards being defined through IS&C.
- There are many existing non-GIS tabular databases and files residing on mainframe and microcomputer systems which contain geographically-related data useful for GIS applications. There must be procedures established for efficient exchange of data with these systems.
- UNIX workstations and servers will be the principal hardware platform for GIS, although DOS microcomputers will be used as stand-alone automated mapping workstations or networked to GIS servers for direct query and display. It will be assumed that existing microcomputers will be used, where possible, to support appropriate GIS applications.
- The technology itself is changing, and computer hardware and software vendors are making rapid advances in product performance and degree of "openness" allowing for better integration with other systems. The GIS should be

developed in a way that will provide the greatest flexibility in growth and upgrade.

A central theme guiding system development is incremental expansion. PlanGraphics recommends that West Virginia avoid acquiring a large amount of hardware and software in early phases and instead concentrate on putting in place a sound organizational structure, detailed technical design, database development, and the development of key applications.

2.3.2 Recommended Configuration-Decentralized Network

PlanGraphics recommends a decentralized approach to the system configuration. The configuration includes a combination of stand-alone UNIX workstations and local area networks at distributed sites in Charleston, Morgantown, and other locations around the state. One site should be designated as a service center for users needing copies of digital data or hard copy products to be generated from the GIS. User agencies' UNIX workstations will enable them to conduct their GIS processing locally; they will access central storage of the database through a data communications network. In some cases, microcomputers will be used for stand-alone processing or as query workstations accessing a UNIX server or workstation.

PlanGraphics recommended that the main site be established at West Virginia University in Morgantown with technical support provided by designated university staff with support from the West Virginia Geological and Economic Survey. Initially, this site will function as a technical center supporting database development, application development, and technical support. It will evolve later into a service center providing GIS data and hard copy products to users. GIS use by state agencies will continue and expand as the GIS implementation progresses. High-speed digital communication links will be established between state offices in Charleston and the Morgantown site when the GIS database reaches a point where data exchange requires such a link. Relationships and technical links between the main network at other non-state government sites (cities, counties, and Regional Planning and Development Councils) will evolve over Phases 1, 2, and 3. Figure 2-4 presents the concept for this decentralized network which will guide system growth.

[FIGURE 3-1 FROM 448.3 CONCEPTUAL DESIGN]

2.3.2.1 Phase 1 GIS Configuration

Phase 1 will concentrate on establishing the organizational framework for the GIS and on initial database and application development. The system will not be highly "operational" during most of this phase except for applications already in place or those that are currently being developed by organizations that now have GIS technology. PlanGraphics does not recommend major procurement of hardware and software for users during this phase. Communications between remote sites will not be sophisticated during this phase because the status of the database and maturity of applications at user sites will not demand high-speed or frequent exchange of data.

During this phase, State government and WVU representatives will work closely with federal agencies and private companies in database development. GIS development by local government agencies and Regional Planning and Development Councils will be encouraged and supported and data will be exchanged with these organizations through media transfer.

2.3.2.2 Phase 2 Configuration

In this phase, GIS use has been expanded within state government agencies and additional local governments, and Regional Planning and Development Councils have instituted GIS programs. The communication network has increased in sophistication at local sites and in linking remote sites together. Local area networks will be installed in Charleston and Morgantown, and a high-speed communication line has been established to link these sites. Other remote users still rely largely on media transfer to exchange data, although where appropriate, remote users may be linked by direct lines for batch file transfer.

It is anticipated that a significant amount of additional hardware and software will be acquired during this phase to support an expanded set of users and applications supported by a completed Tier 3 and 4 database and parts of the Tier 2 database in development during this Phase. The role of the Technical Support Center at WVU will increase to fulfill a demanding need for technical assistance and application development. Additional technical staff will also be needed in Charleston to provide on-site support to systems in operation there.

2.3.2.3 Phase 3 Configuration Overview

Phase 3 is characterized by a well-integrated system with a completed Tier 2, 3, and 4 database. GIS use has expanded considerably in state government agencies in Charleston, Morgantown, and other state offices. Significant hardware/software procurements have been made to support expanded use, and existing systems are upgraded as necessary. Individual local area networks operating at Morgantown and Charleston are linked by high-speed bridges, and high-speed communication lines are established with key remote sites at cities, counties, and Regional Planning and Development Councils. Regional Planning and Development Councils have taken on the role as the principal GIS service centers for counties and municipal governments where

needed within their region. Some county and municipal governments (such as Charleston, Beckley, Morgantown, and Jefferson County) will likely be more self-sufficient in their GIS operations, given their population and economic condition. During this phase, high-speed links are also put in place to exchange data with external systems such as the state's mainframe in Charleston.

2.3.2.4 Phase 4 Configuration

No specific configuration is provided for Phase 4. It represents long-term operation of the system characterized by additional expansion of GIS use, particularly at the local level, and greater integration of systems with higher-speed communication lines linking remote sites around the state.

2.4 ORGANIZATIONAL STRUCTURE

2.4.1 Organizational Challenges

Any organization or group of organizations developing a GIS will be faced with multiple challenges which are both technical and institutional in nature. While technical concerns are important, it is generally accepted that management and organizational issues are particularly critical for the success of GIS installations and demand a great deal of attention in the early phases of system planning. The impact of these institutional issues on the development process becomes greater as the organizational environment increases in complexity.

The following institutional challenges face West Virginia and must be addressed in the GIS design and in formulation of a GIS development strategy:

- Defining the proper role and placement of GIS management and oversight to direct activities of state government agencies and coordinate with outside organizations
- Establishing a process for collective policy decisions and consensus building at senior levels in state government
- Creating and maintaining effective relationships and vehicles for communication with outside organizations, including private companies, federal and local governments, and Regional Planning and Development Councils
- Routine system management and operation at a technical level and liaison with users
- Cost allocation among participants and developing a long-term funding strategy
- Establishing a process for collective procurement of systems and database development services

- Defining, adopting, and coordinating standards for database development, maintenance, and sharing
- Addressing requirements for education and outreach at all levels.

2.4.2 Recommended Organizational Structure

The *Conceptual Design* report presented background information supporting recommendations for an organizational structure for the West Virginia GIS. Based on an evaluation of management approaches, PlanGraphics recommends that West Virginia develop an organizational structure that has the following key components. Figure 2-5 is a diagram depicting this structure.

[TABLE 4-1 FROM THE 448.3 CONCEPTUAL DESIGN]

2.4.2.1 GIS Policy Body

We recommend establishing a state government Policy Body with representatives from all state government agencies that are key participants in the GIS. In addition to representatives from key user agencies serving on the existing Steering Committee, this Policy Body should have representatives from the Governor's Office, and Information Systems and Communications (IS&C). In keeping with the high-level function of this Body, members should be selected from senior management levels and should have the authority to make decisions on issues impacting statewide policy, funding and expenditures, inter-agency coordination, and relationships with organizations outside state government.

2.4.2.2 GIS Management Recommendations

GIS coordination and system administration should be centralized to a sufficient degree to support the work of individual user agencies and ensure compatibility and consistency in GIS development. To address multi-agency coordination and management, we recommend that the state establish a full-time **GIS Coordinator** position. This position, during Phase 1 will be administratively assigned to an existing state government office without the formation of a new formal **GIS Management Unit**. In Phase 2 and beyond, the state should establish a formal GIS Management Unit with necessary staff to handle the ongoing operation of an expanded GIS. At the beginning of Phase 2, this staffing of the Management Unit should be expanded to include a full-time System Administrator and an administrative support staff person. Through an evaluation of options for administrative placement of GIS management, it is recommended that the GIS Coordinator and the Management Unit be placed in CLER.

In addition to this GIS coordination position evolving to a formal management unit in Charleston, we recommend that a **Technical Support Center** be established at West Virginia University. The purpose of this center is to provide support, in coordination with state government personnel, in technical areas of system development and operation, including the following:

- Preparation of detailed database designs
- Database development for specified GIS layers with an oversight and quality control role on GIS layers development by other parties (e.g., federal government agencies, private contractors)
- Working with users to design, develop, and test applications
- Training and technical assistance in the use of GIS software
- Assistance in the promotion and expansion of GIS use in local governments and Regional Planning and Development Councils

- Acting as a service bureau to provide GIS products and services to government and non-government “customers.”

The specific duties and responsibilities of this Technical Support Center would need to be negotiated and documented in a formal agreement. The Center would operate with a designated director who would report and be responsible to the State GIS coordinator in Charleston. This Technical Support Director would not be a member of the GIS Policy Body but would sit on the Steering Committee. This Director would be active in the GIS Users Group (see below) and would participate (along with other University staff) in activities of Technical Sub-committees.

2.4.2.3 State GIS Steering Committee

PlanGraphics recommends that the state establish a formal GIS Steering Committee that would be based on the informal Steering Committee now established. It would include Agency Coordinators from state government agencies now on the Committee along with representatives from state universities. It would formalize the function of the current Steering Committee. This Committee would have a rotating Chair. The state’s GIS Coordinator would attend all meetings of the Steering Committee. This Committee would deal with important issues of a technical nature or problems and concerns involving inter-Departmental coordination. Decisions would be reached and acted upon at this level where appropriate. When necessary, this Committee would seek approval or decisions from the Policy Body and would provide the Policy Body with the background information and recommendations upon which to make decisions.

2.4.2.4 Technical Sub-committees

On an as-needed basis, the GIS Coordinator or the Steering Committee may establish time-limited technical sub-committees to investigate any technical issues and provide results and recommendations for action. Generally, these sub-groups will include selected members of the Steering Committee and GIS User Group, but they may include any state government staff, University staff, or other appropriate representatives of other government agencies or private companies.

2.4.2.5 External Organization Policy Advisory Body

The involvement of non-state government organizations is essential for the long-term success of the GIS program. The Policy Body described above is limited to state government representatives, but it is important to have high-level input from other organizations that may affect decisions reached by this group. An External Organization Policy Body should be established to meet this need. It would include senior representatives from all interested private companies and government agencies which have a demonstrated interest in the state’s GIS. It would be the responsibility of the GIS Coordinator to seek input, by mail or phone, from these representatives and, where appropriate, to convene meetings of this group. On occasion, members of this group would be invited to participate in meetings of the state’s Policy Body to provide opinions on issues being evaluated.

2.4.2.6 GIS User Group

The purpose of this User Group is to provide a forum for GIS users in the state to share ideas, technical accomplishments and solutions, technology news, and information that helps maintain a collective atmosphere for GIS development and operation. This User Group would evolve from the current WVGISCC, and all members of the WVGISCC would become part of this group. Membership would be open to representatives from state government agencies, Universities, local and federal government agencies, and private companies who are current users of GIS or who had an interest in using GIS technology. The GIS Coordinator should participate in meetings and activities of this group. It should include at least one member from each state agency active in GIS, but multiple representatives from any single state agency may be included. The User Group should be chaired by a person agreed to by group consensus who would have the responsibility for keeping records, informing all members of the Group's activities, and organizing meetings. The chair position should rotate, probably on an annual basis.

2.4.3 Staffing and Technical Support in State Government Departments

The previous sub-section provided recommendations about staff to support central GIS coordination and system administration functions through the establishment of a state GIS Management Unit and a Technical Support Center. While these centralized roles ensure proper communication and coordination among state agencies with significant GIS use. Individual Departments and Divisions will need to assign staff to GIS development and maintenance and coordination functions.

Principal roles that must be filled in the user agency are described below:

- GIS Agency Coordinator: This position functions as a user agency's representative to the Steering Committee and will require approximately a 10 to 30 percent full-time equivalent (FTE) depending on the agency, the level of delegation of tasks to other personnel, and the stage of GIS development or operation.
- Database Administration: This function involves detailed GIS database design; establishing procedures for and overseeing database development; setting up and overseeing ongoing data maintenance; establishing procedures and overseeing database documentation and the creation of data dictionaries or meta-databases; and work with user agencies to evaluate GIS data that may be incorporated in the system.
- System Administration: In coordination with GIS system administration staff, this function includes overseeing the acquisition, installation, and testing of hardware and software; establishing communication networks; setting up user accounts and security; and providing technical support to users on GIS hardware/software questions.

- **GIS Application Development/Programming:** This function would be performed by individuals with in-depth knowledge about the software package(s) being used for GIS as well as the structure and design of GIS databases. These staff would work with users to design applications and carry out programming, customizing, documentation, and training.
- **GIS Database Capture:** While it is recommended that outside contractors be used to develop high-volume layers of the GIS database, it will be appropriate in some cases, for user agencies to assign internal stages for data capture which may include digitizing, keyboard entry, re-formatting of existing digital data from other sources, and other steps in GIS database development. These staff people must be trained on the rudimentary skills, and user-customized entry routes to carry out this work.

Depending on the specific agency and stage of development or operation, any one of these positions may be full or part-time. In early phases or where GIS use is not intense, these functions may be combined in one or more individuals. In some cases, one user may "share" staff time with another to satisfy internal requirements.

In several cases, most notably in CLER, staff time has been formally or informally assigned to provide these internal GIS support roles and other information system support requirements. PlanGraphics recommends that participating departments assign full-time equivalent staff to address technical administration and development activities. In the summary below, a burdened salary figure is included reflecting the recommended staff levels. Where possible, these functions should be assigned to existing staff and therefore not all of the estimated salary costs summarized here represent "new" funds for staff. A more detailed evaluation of staff requirements in departments must be carried out as part of detailed operational planning at the department and division level. The projected costs below do not include salaries of the GIS Coordinator or other staff of the recommended state GIS Management Unit.

Fiscal Year	System Admin.	Database Admin.	Application Development	Data Capture	Total FTE	Projected Cost*
93-94	1.0	1.0	1	2	5	\$170,000
94-95	1.5	1.0	3	3	8	\$280,000
95-96	1.5	1.5	3	4	10	\$340,000
96-97	1.5	1.5	3	4	10	\$340,000
97-98	1.5	1.5	3	4	10	\$340,000

*1993 dollars; does not include state GIS Management Unit personnel costs.

These additional staff costs represent approximately ten positions to support GIS activities. Internal decisions need to be made as to whether any or all of these positions are re-assigned from existing positions or whether they represent new hires. In all cases,

a key concern is training on specific aspects of the GIS hardware and software important for these positions. WVU staff associated with the recommended Technical Support Center can supply some of this training. This should be augmented by training provided by the vendors themselves and in-house training programs conducted by State government personnel.

2.5 SUMMARY OF CONCEPTUAL DESIGN AND COST ESTIMATES

The *GIS Conceptual Design* provides recommendations for the structure and development of the GIS. These recommendations are based on a considerable amount of study, information collection, and discussions with study participants as documented by previous reports prepared by PlanGraphics. Key points of the recommended strategy for GIS development can be summarized as follows:

- The statewide GIS will be directed through a central management unit allowing proper coordination among state government users and outside organizations.
- The management structure includes the following: a) GIS Coordinator and Management Unit within CLER, b) a University-based Technical Support Center, c) a Policy Advisory Body for participation and input by non-State government organizations, d) a GIS Steering Committee, e) a GIS User Group.
- GIS development and use in state government offices will be developed in coordination with overall state information system strategies.
- Appropriate staff will be assigned to support the GIS.
- The system configuration for state government users will follow a decentralized network approach with standardization on a small number of GIS software packages.
- The GIS database model will be organized into a series of "tiers" in which geographic data will be organized to meet application needs requiring different levels of scale and accuracy.
- Database development will proceed quickly for those tiers that meet high-priority application needs and for which digital data already exists from outside sources.
- The GIS development will follow a phased approach concentrating first on organizational development, database development, and continuation of current GIS programs, with gradual expansion into more operational use of GIS and tighter relationships between state agencies and non-state government organizations.

This GIS study has revealed that there is great interest in GIS. In many cases, there are GIS activities already underway in state agencies and many of the other participants. The conceptual design provides a framework for efficient GIS development that will minimize overall costs while maintaining a level of coordination that is vital for an effective long-term GIS program.

Table 2-2 shows totals of \$470,000; \$1,137,500; \$1,177,500, 1,322,500 and \$1,322,500 for fiscal year 1993-1994 through fiscal year 1997-1998, respectively. These estimates include the hardware, software, and database costs explained in the *Conceptual Design*. Also included are costs for staff for the GIS Management Unit.

Table 2-2 does not include estimates for staff in user departments. Departmental staff costs, reported in the *Conceptual Design*, are anticipated to be \$170,000 in the first fiscal year with an increase to \$280,000 in the second fiscal year, to a base amount of \$340,000 ongoing. These departmental staff costs are based on a calculation of full-time equivalent (FTE) personnel costs, and are to be used as budget figures. PlanGraphics expects, however, that in many cases existing staff may either be performing these functions or could be cross-trained to carry out the duties and that new hires will not be required.

TABLE 2-2
PROJECTED GIS COSTS FOR FIRST FIVE YEARS OF PROJECT

[TABLE 5-1 FROM THE 448.3 CONCEPTUAL DESIGN]

SECTION 3 RECOMMENDED STRATEGIC APPROACH

3.1 OVERVIEW

The strategic plan tasks presented below are organized into the following five tracks, each of which represents a set of activities which are logically related:

- Pilot Projects: A pilot project for the Regional Tier will be initiated as soon as possible. The primary objective for the pilot is to test alternative approaches to database development. Data produced as a by-product of the pilot can also be used to demonstrate GIS technology and key applications that will illustrate the usefulness of GIS technology. Pilot projects for additional database tiers would be conducted prior to conversion of that data.
- Organizational and Administrative Development: Includes tasks that relate building and organizational structure, formalizing relationships between state government agencies and outside organizations, and addressing important staffing and administrative issues in GIS development and operation.
- Database Development: Encompasses all tasks that involve the design and development of the GIS database with a strong focus on the adoption of standards allowing easy information exchange.
- System and Application Development: Includes all tasks that relate to the specification, acquisition, and set-up of hardware, software, and communications systems, as well as the design and development of GIS applications.
- System Promotion and Coordination with Outside Organizations: Tasks in this track involve internal promotion and education and activities that involve building relationships and establishing agreements with communities of interest inside and outside of West Virginia, including the distribution and sale of GIS products and services.

3.2 DESCRIPTION OF TASKS AND RELATIONSHIPS BETWEEN TASKS

Table 3-1 lists all proposed project tasks. Figure 3-1 illustrates the general relationships between tasks. This figure does not include tasks of the GIS Pilot Project but, as discussed in this section and in Section 4, the Pilot Project will be timed and coordinated with other project tasks, particularly tasks of the Database Development track. The descriptions below summarize critical concerns and activities for each task and important relationships between tasks.

Table 3-1
Proposed Project Tasks

PP. GIS Pilot Project

- PP1. Prepare Database Development Plan
- PP2. Plan GIS Pilot
- PP3. Execute and Monitor Pilot
- PP4. Document Results of Pilot
- PP5. Present and Demonstrate Pilot Results

OD. Organizational and Administrative Development

- OD1. Approve GIS Plan
- OD2. Prepare First Year's Budget
- OD3. Assign GIS Coordinator
- OD4. Establish Technical Support Center
- OD5. Assign Resources to Technical Support Center
- OD6. Formalize Management/Policy Body
- OD7. Establish Policy Advisory Body and Identify Participants
- OD8. Formalize User Group/Steering Committee
- OD9. User Group/Steering Committee Meetings
- OD10. Establish Technical Sub-Committees
- OD11. Develop Long-term Funding Strategy
- OD12. Detailed State-wide Planning
- OD13. Long-term Budget
- OD14. Assign Departmental Staff
- OD15. Formalize Procedures
- OD16. Responsibilities for Data Maintenance
- OD17. Establish Formal Management Unit
- OD18. Program for Ongoing Training
- OD19. Conduct Periodic Audits

DD. Database Development and Maintenance

- DD1. Database Design - Common GIS Layers
 - DD1.1: Database Design for Tier 3 and 4 Common Layers
 - DD1.2: Database Design for Tier 2 Common Layers
- DD2. Identify Sources for Common Layers
 - DD2.1: Identify Sources for Common Tier 3 and 4 Layers
 - DD2.2: Identify Sources for Common Tier 2 Layers
- DD3. Database Specs - Common Layers
 - DD3.1: Database Specs - Tier 3 and 4 Common Layers
 - DD3.2: Database Specs - Tier 2 Common Layers

Table 3-1 (continued)
Proposed Project Tasks

DD. Database Development and Maintenance (continued)

- DD4. Database Design - Agency-specific Layers
 - DD4.1: Database Design - Tier 3 and 4 Agency-specific Layers
 - DD4.2: Database Design - Tier 2 Agency-specific Layers
- DD5. Identify Sources for Agency-specific Layers
 - DD5.1: Identify Sources for Tier 3 and 4 Agency-specific Layers
 - DD5.2: Identify Sources for Tier 2 Agency-specific Layers
- DD6. Database Specs - Agency-specific Layers
 - DD6.1: Database Specs - Tier 3 and 4 Agency-specific Layers
 - DD6.2: Database Specs - Tier 2 Agency-specific Layers
- DD7. Acquire Existing Digital Data
 - DD7.1: Acquire Existing Digital Data for Tiers 3 and 4
 - DD7.2: Acquire Existing Digital Data for Tier 2
- DD8. Select Vendors/Assign In-house Resources for Development of Common GIS Layers
 - DD8.1: Select Vendors/Assign In-house Resources for Building Tier 3 and 4 Database
 - DD8.2: Select Vendors/Assign In-house Resources for Building Tier 2 Database
- DD9. Design QC/Acceptance - Common Layers
 - DD9.1: Design QC/Acceptance - Tier 3 and 4 Common Layers
 - DD9.2: Design QC/Acceptance - Tier 2 Common Layers
- DD10. Conduct Database Development - Common Layers
 - DD10.1: Conduct Database Development - Tier 3 and 4 Common Layers
 - DD10.2: Conduct Database Development - Tier 2 Common Layers
- DD11. Carry out QC for Common Layers
 - DD11.1: Carry out QC for Tier 3 and 4 Common Layers
 - DD11.2: Carry out QC for Tier 2 Common Layers
- DD12. Select Vendors/Assign In-house Resources for Development of Agency-specific Layers
 - DD12.1: Select Vendors/Assign In-house Resources for Tiers 3 and 4
 - DD12.2: Select Vendors/Assign In-house Resources for Tier 2
- DD13. Design QC/Acceptance - Agency-specific Layers
 - DD13.1: Design QC/Acceptance - Agency-specific layers for Tiers 3 and 4
 - DD13.2: Design QC/Acceptance - Agency-specific layers for Tier 2
- DD14. Conduct Database Development - Agency-specific GIS Layers
 - DD14.1: Conduct Database Development - Agency-specific GIS Layers for Tiers 3 and 4
 - DD14.2: Conduct Database Development - Agency-specific GIS Layers for Tier 2
- DD15. Carry Out QC - Agency-specific Layers
 - DD15. 1: Carry out QC for Tier 3 and 4 Agency-specific Layers
 - DD15. 2: Carry out QC for Tier 2 Agency-specific Layers

Table 3-1 (continued)
Proposed Project Tasks

DD. Database Development and Maintenance (continued)

- DD16. Data Maintenance and Exchange Procedures
- DD17. Database Directory and Meta-database

SD. System and Application Development

- SD1. Approve GIS Software and Hardware Procurement Guidelines
- SD2. Negotiate Software Purchase Agreements
- SD3. Application Development Strategy
- SD4. Develop Documents Standards/Application Directory
- SD5. Acquire Phase 1 Hardware and Software
- SD6. Design High-priority Applications
- SD7. Install/Test Phase 1 Hardware and Software
- SD8. Develop/Test High-priority Applications
- SD9. Phase 2 Communications/Data Exchange
- SD10. Acquire Phase 2 Hardware and Software
- SD11. Design Medium-priority Applications
- SD12. Install/Test Phase 2 Hardware and Software
- SD13. Develop Medium-priority Applications
- SD14. Establish Phase 3 Communications Networks
- SD15. Acquire Phase 3 Hardware and Software
- SD16. Install/Test Phase 3 Configuration
- SD17. Design Lower-priority Applications
- SD18. Develop Lower-priority Applications
- SD19. Design Phase 4 GIS Configuration
- SD20. Develop Phase 4 Configuration

PO. System Promotion and Coordination with Outside Organizations

- PO1. Prepare Promotional Materials
- PO2. Internal Briefings to Management and Senior Officials
- PO3. Seminars for Technical Staff
- PO4. Promote Support for GIS with Federal Agencies
- PO5. Promote Support for GIS with Private Companies
- PO6. Agreements with other Governmental Organizations
- PO7. Agreements with non-Governmental Organizations
- PO8. Cooperative Programs with Universities
- PO9. Examine Legal and Policy Implications of Cost Recovery
- PO10. Policies/Procedures for Distribution of Products/Services
- PO11. Program for Product/Service Distribution

Figure 3-1

PP. GIS Pilot Project

PlanGraphics recommends that West Virginia state government conduct a pilot project to iron out approaches to GIS database development and to demonstrate GIS technology. Pilot project recommendations include five tasks:

- Prepare Database Development Plan
- Plan GIS Pilot
- Execute and Monitor Pilot
- Document Results of Pilot
- Present and Demonstrate Pilot Results.

Each of these tasks are described within this series.

PlanGraphics believes that several pilot projects will be carried out during successive phases of the GIS project - one for each database tier. For example, since databases comprising the Regional Tier will likely be developed first, a pilot project may focus on that tier alone. Another pilot project may be in order when participants are ready to begin planning in earnest for the Sub-regional Tier, and so on for additional tiers. We believe that conducting separate pilot projects will allow appropriate focus on the different approaches and products associated with the various database tiers. The strategic plan schedule indicates that there will be three separate pilot projects conducted prior to development of the Regional, State-wide, and Sub-regional Tier databases.

PP1. Prepare Database Development Plan

PlanGraphics recommends that a plan for database development within each tier be prepared as the first task in each Pilot Project. Those plans will provide guidance in preparing source data, determining a conversion approach, establishing quality control standards, and identifying expected levels of in-house staff involvement.

For each database within a tier, a complete plan should be prepared that addresses each of the following topics:

Source Data

- Identify the source(s) for map data
- Identify sources for tabular data
- Describe preparation work that may be required prior to data conversion

Conversion Approach

- Determine technical approach(es) to converting map data
- Determine method of registering map data to base map
- Determine approach for converting, and/or translating, and/or reformatting tabular data

Quality Control

- Determine what level of quality control review must be accomplished to ensure that the database is reliable
- Determine method of quality control review

Administrative Issues

- Determine whether data will be converted by a contractor or done in-house
- Determine levels of management and staff activity.

A careful review of all prospective source materials will be necessary to make decisions about the topics listed above. The source material review should be conducted by staff that maintain the data in concert with the GIS Coordinator, or a consultant who can provide technical guidance.

PlanGraphics recommends that three database development plans be prepared. They would include:

- Regional Tier Database Development Plan
- State-wide Tier Database Development Plan
- Sub-regional Tier Database Development Plan.

The Database Development Plans should include a schedule that reflects priorities based on technical requirements, user needs, and funding expectations. Development priorities should also take into account the need for expedited conversion of sources that are one-of-a-kind, fragile, and critical to government operations. The database development plan should reflect priorities of database building. Final determination on the priority and pace of database development will be established by the GIS Policy Body, based on recommendations from the GIS Steering Committee and the GIS Coordinator.

Preparing Database Development Plans should be the first step in the process of converting data for the GIS. The planning process should continue with a pilot project, detailed database designs, and finally data conversion specifications. Upon completing each pilot project, the Database Development Plan should be revised to reflect the findings and any changes to the approach.

Work should begin as soon as possible to prepare the Regional Tier Database Development Plan. After the Regional Database Development Plan is completed, additional steps (pilot, detailed database designs, conversion specifications) must be completed before data conversion takes place. In order to keep the project on schedule, PlanGraphics recommends that work to prepare the Regional Tier Database Development Plan be accomplished during fiscal year 1994.

Task Dependencies and Relationships: Dependent on funding being available to conduct pilot. Results of this planning provides input to the Database Development (DD) track.

PP2. Plan GIS Pilot

GIS Management Unit staff should be responsible for managing the planning and execution of each pilot project. The steps listed below should be used to plan for all pilot projects:

- Identify data layers that need to be included in the alternatives analysis
- Identify source maps for conversion
- Determine specific pilot applications and products to be generated
- Identify representatives from user agencies who will work with Technical Support Center staff during the pilot
- Establish a pilot project schedule.

The GIS Coordinator should work with members of the GIS Steering Committee to plan the pilot project. Not all map layers need be tested to determine the best conversion approach; the approach for some layers will be quite straightforward. PlanGraphics recommends that pilot project planners focus their efforts on testing map layers for which a single approach is not clear.

As an example, the Regional Tier Pilot Project could include clean-up of a 1:100,000 scale DLG file; integration of soil data from the SCS 1:250,000 digital mapping; conversion of USGS 1:250,000 land use mapping; and assignment of highway classification categories based on WVDOT files. The highway classification categories can be applied to highway segments in the DLG file, and a plot using different symbols for the various classifications can be prepared.

PlanGraphics does not recommend that significant work to develop complex application programs be prepared as part of a pilot project. Rather, the applications should be fairly simple to demonstrate the capabilities of the system.

The GIS Coordinator will establish an agreement with a contractor to conduct the pilot project.

Task Dependencies and Relationships: Dependent on approval of the Database Development Plan in PP1.

PP3. Execute and Monitor Pilot Project

Pilot project work will likely be contracted to an independent contractor, Technical Support Center, or West Virginia Geological and Economic Survey. Based on each Pilot Project Plan, specifications should be developed jointly by the GIS Coordinator, or consultant, and staff currently responsible for maintaining or using the data. The pilot project's primary purpose is to test and evaluate recommended approaches to conversion as put forth in the Database Development Plan. Ancillary benefits demonstrate to senior management and elected officials that the technology is viable.

There are three prerequisites to conducting a pilot project for each database tier:

- At least some of the base mapping for the tier being tested must be available in digital form.
- The Database Development Plan for the appropriate tier must be complete.
- Each agency that has data being converted in the pilot project must provide a representative who is quite familiar with that data.

The pilot project contractor should be provided with three basic items:

- Copies of digital base map files of two adjacent map sheets
- Pilot project specifications
- Map and tabular data intended as the sources for the GIS database.

The contractor will convert the source maps to digital form and adjust source map features to the base maps as required by the specifications. The GIS Coordinator and designated user agency staff, in conjunction with the pilot project contractor, will evaluate the pilot project results and determine whether the approach to database conversion needs to be modified. Where modifications to the conversion approach are determined to be appropriate, they should be reflected in the Database Development Plan.

Pilot project data files should be delivered to the GIS Coordinator for review by staff that are responsible for making and maintaining the maps that were converted. Staff review should be coordinated and methodical to ensure that responses and recommendations are appropriate in light of the new technology.

PlanGraphics recommends that the pilot projects be conducted directly after their associated Database Development Plan is complete. Specifications for pilot projects must be prepared beforehand, which may take approximately one to two months allowing for their preparation, review, and finalizing. Pilot project data conversion will take approximately two to four months, and review by the user agency representatives may take an additional two to four weeks.

Task Dependencies and Relationships: Dependent on developing Database Development Plan and GIS Pilot Plan. Information and specifications provide input to DD1 to DD8 and SD3, SD4, SD6, and SD8.

PP4. Document Results of Pilot

A document containing pilot project results should be prepared. The document should be the primary responsibility of the contractor, but with input and assistance from user agency staff as well. The document should indicate the database building processes used and why a particular approach was selected. The selected approach should be documented most thoroughly as it will be used as initial input for database design and conversion specifications.

Task Dependencies and Relationships: Dependent on completion of Pilot Project PP3.

PP5. Present and Demonstrate Pilot Results

The pilot projects will result in a series of database layers being created for a small area. These database layers can be used in a presentation to senior management and elected officials. The data will be specific to West Virginia and can be used to demonstrate the types of analyses possible with GIS technology.

Task Dependencies and Relationships: Dependent on completion of Pilot Project PP4.

OD. Organizational and Administrative Development

OD1. Approve GIS Plan

This *GIS Development Plan* is presented to and formally approved by the current Steering Committee, senior management in participating State government departments, and the Governor's Office.

Task Dependencies and Relationships: Initiates formal Statewide GIS development.

OD2. Prepare First Year's Budget

A budget must be prepared by the current Steering Committee to support first year activities in Phase 1 covering fiscal year 1993-94. This budget should include modest funds for hardware/software procurement as recommended in the *Conceptual Design*. A key issue for this first-year budget is the allocation of funds for a GIS Coordinator. It is recommended that this position be supported by a contribution of funds by departments represented on the current Steering Committee. In addition, it will be necessary to explore the need for allocation of resources to support the Technical Support Center at West Virginia University, and to conduct a pilot project and acquire digital data for building databases in the Regional and State-wide Tiers.

Task Dependencies and Relationships: Dependent on approval of plan in OD1.

OD3. Assign GIS Coordinator

A full-time GIS Coordinator is assigned. As explained in Section 2, this individual takes the lead role in GIS planning and communication with user departments. This Coordinator also participates in all meetings and activities of the Steering Committee, acts as a liaison to the Policy Committee, and oversees the operation of the Technical Support Center at West Virginia University. It is recommended that the salary to support this Coordinator be covered by an allocation from each department participating in the current GIS Steering Committee. Specific amounts should be based on group consensus.

Task Dependencies and Relationships: Dependent on approval of Plan (OD1) and allocation of resources through OD2.

OD4. Plan and Establish Technical Support Center

Discussions, through the current Steering Committee, should begin immediately with West Virginia University to plan and establish the Technical Support Center. This Support Center should rely on current staff and use the GIS facilities now in place in the Department of Geography and Geology. A plan should be prepared to define the detailed functions of this group, procedures for operation, administrative relationships with state agencies, and resources required to support its operations. The ultimate goal of this task is to complete an operational plan and negotiate an agreement that formally establishes the Center.

Task Dependencies and Relationships: Dependent on approval of plan in OD1.

OD5. Assign Resources to Technical Support Center

In this task, the plan and agreement established in Task OD4 are put in place.

Task Dependencies and Relationships: Must be preceded by formal establishment of Center in OD4 and allocation of resources in first year budget (OD2) and long-term budget (OD13).

OD6. Establish GIS Policy Body

As called for by the *Conceptual Design*, a formal policy body will be formed made up of senior management representatives from designated State Government departments and Offices (particularly those represented on the current Steering Committee). At a later time, participating departments should consider broadening the role of this Policy Body to formally include decision-making on all information system issues--GIS being one important element.

Task Dependencies and Relationships: Dependent on approval of Plan (OD1); necessary for formal approval of subsequent organizational tasks.

OD7. Establish Policy Advisory Body

As called for in the *Conceptual Design*, this Body has direct links to and communication with the state GIS Policy Body and to the GIS Coordinator. It includes representatives from key organizations outside state government (e.g., private companies, federal agencies) whose involvement in a statewide GIS is important. This task involves the formal definition of this body, "recruitment" of participants from outside organizations, and the establishment of procedures for operation.

Task Dependencies and Relationships: Dependent on approval of plan in OD1; established by the Policy Body (OD6) and in direct communication with GIS Coordinator (OD3); can facilitate development of multi-organizational agreements in PO6 and PO7.

OD8. Formalize Role of User Group and Steering Committee

As described in the *Conceptual Design*, a state government Steering Committee would be established with representatives from each key department and office. This Steering Committee would be based on the current Steering Committee, but it would be further formalized through executive order and possible inter-departmental memoranda of agreement defining roles and responsibilities. A Chairperson would be selected by consensus. This Chair position would rotate on an annual basis.

A formal User Group would also be defined with broader participation from any current or prospective GIS users in state government or government and non-governmental organizations outside state government. The current West Virginia GIS Coordinating Committee forms the basis for this group. A User Group Chairperson would be assigned from State government.

Task Dependencies and Relationships: Approved through formal policy decision from senior management as defined in OD6.

OD9. Hold Regular Meetings of Steering Committee and User Group

Meetings are held on a regular basis, and proceedings are documented.

Task Dependencies and Relationships: Dependent on formal definition of User Group and Steering Committee in Task OD8.

OD10. Establish Technical Sub-Committees as Appropriate

When actions require information gathering, research, and recommendations on technical issues, Technical Sub-groups will be assigned through action of the GIS Coordinator or the Steering Committee. These Sub-Committees are given specific tasks and are active for limited, defined time periods. The Sub-Committees include designated members of the User Group or other designated department staff.

Task Dependencies and Relationships: Formed through formal action of GIS Management (assigned in OD6) or the GIS Steering Committee (formalized in OD8). Critical tasks for action of Sub-Committees include DD1, DD2, DD3, DD15, DD16, SD3, SD4, PO1, PO3, and PO9.

OD11. Develop Long-term Funding Strategy

The GIS Coordinator, with direct input from the Steering Committee, should take the lead role in preparing a long-term budget for GIS development through Phase 2 (Fiscal Year 96-97). This budget should be accompanied by detailed proposals on the source of funds for GIS development, including cooperative agreements with outside parties that may result in like-kind exchanges of data or staff resources to off-set development costs.

Task Dependencies and Relationships: Dependent on assignment of GIS Coordinator (OD3); carried out in concert with Departmental Planning in OD12; impacted by outside agreements explored and established in PO4, PO5, PO6, PO7, and PO8.

OD12. Carry out Detailed Operational Planning in Departments

This *GIS Development Plan* gives an overall framework for statewide GIS development. It must be followed by detailed operations planning in individual agencies of state government (in parallel with GIS projects in outside organizations). These plans should address the following operational issues: a) assignment of staff to GIS functions, b) hardware/software procurement, c) training, d) data capture and data acquisition, e) application development, and f) funding. This is most important for agencies that have current GIS activities or which anticipate initiating programs in the near future.

Part of this task should involve working with the state personnel department to establish personnel classifications for GIS positions. A common series of well defined classifications should be available to state government departments from which to make personnel requests. It is not necessary for any personnel that use a GIS to be reclassified under a new GIS-related job classification; use of the tool does not constitute need for a title change. The type of duties to be performed should be categorized in order that distinct types of job classifications can be developed.

Task Dependencies and Relationships: Dependent on approval of Plan (OD1) and assignment of Liaison to Steering Committee in OD8. Drives initiation of Tasks OD14, OD15, DD4, DD6, DD12, DD14, DD15, SD4, SD6, SD11, and SD17.

OD13. Develop Long-term Budget

In this step, a multi-year budget would be established to support GIS activities, including staffing at the department level and in the GIS Management Unit, database development, operations of the Technical Support Center, and other GIS cost items. This long-term funding plan should cover at least a three-year period and form the basis for annual budget submittals for approval. The Steering Committee and GIS Coordinator should take a lead role in this budget preparation. The funding levels determined through the departmental GIS operational plans (Task OD12) should be considered in developing this funding plan.

Task Dependencies and Relationships: Takes input from Departmental Plans (OD12); must be approved by Policy Committee; impacts direction of long-term development after first year.

OD14. Assign Appropriate Staff in State Government Departments

As a direct result of detailed planning in Task OD12, appropriate staff should be assigned to support GIS coordination and technical support in state government departments. These staff roles include assignment of time to Steering Committee, system

administration roles, database administration, and database capture as described in the *Conceptual Design*.

Staff positions should be requested based on the job classifications established by the user departments through the state personnel office.

Task Dependencies and Relationships: Dependent on completion of Departmental Planning in OD12.

OD15. Formalize GIS Technical Standards and Procedures

Requirements for various levels of standards are described in the *Conceptual Design*. Of prime importance is the definition of standards relating to data coding and structure which will facilitate the sharing of information among, within, and between state government offices and with other governmental and non-governmental organizations (including the federal government, Regional Planning and Development Councils, local governments, and private firms). Complementing the technical standards are policies and procedural standards that govern data access and data update.

Task Dependencies and Relationships: Dependent on approval of Plan (OD1) and Departmental Planning (OD12).

OD16. Assign Responsibilities for Data Maintenance

With a view toward technical standards developed in Task OD15 and the database design in Tasks DD1 and DD4, formal responsibilities for data maintenance and custodianship will be established. The GIS Coordinator and Management Unit will oversee compliance with standards. Data maintenance responsibilities will be assigned as appropriate, to individual state government offices and/or the Technical Support Center. It will be the responsibility of the Steering Committee with input from the User Group to recommend roles and procedures for data maintenance. These roles should then be documented in writing and formalized through an inter-departmental agreement.

Task Dependencies and Relationships: Occurs in coordination with development of standards and database design (Tasks OD15, DD1, DD6, DD16, DD17).

OD17. Establish Formal Management Unit

By the end of Phase 1 (late 1994) or sooner, a formal Management Unit, as called for by the *Conceptual Design*, should be established for the Statewide GIS. This will include the GIS Coordinator, appointed early in Phase 1, and a small number of support staff, including a System Administrator.

Task Dependencies and Relationships: Dependent on approval of Plan (OD1).

OD18. Set up Program for Ongoing Training

As each GIS use expands within state government and among outside organizations, it will become important to set up internal training programs to support this growing user

community. To avoid becoming dependent on outside support for routine training, programs should be set up that concentrate on specific aspects of the system to bring new users up to speed quickly.

Task Dependencies and Relationships: No critical task relationships.

OD19. Conduct Periodic Audits

The purpose of periodic audits is to evaluate progress against planned objectives and make necessary adjustments to operations, and perhaps, organizational structure. Since all variables that will impact the system cannot be predicted during the planning process, yearly audits will help examine problems and drive adjustments that need to be made.

Task Dependencies and Relationships: No critical task relationships.

DD. Database Development

Full use of the GIS is dependent on development of a GIS database covering the entire state. The *Conceptual Design* identifies four database tiers, each addressing different levels of map feature and positional accuracy. Since the Local Tier is primarily the interest of local government and utility distribution companies, recommended tasks in this series will concentrate on the Sub-regional, Regional, and State-wide Tiers. It is important that West Virginia move ahead on database development as quickly as possible. However, participants must also recognize that database building will take several years if an adequate level of detail and quality is to be maintained. In particular, the Sub-regional Tier database layers, which are significantly more detailed than the Regional and State-wide Tiers, will require several years for development.

Tasks listed below imply that they will be an initial focus on completion of the Regional and State-wide Tier database layers early in the process, relying to a large extent on existing digital data sources, and in-house automation work from source materials. While these tiers are being completed, work on Sub-regional Tier layers will proceed aided where possible through agreements and with outside parties (Federal government, private companies) that may maintain or be in a position to provide Sub-regional Tier data. Sub-tasks for many of the tasks below reflect the organization of development work on Regional and State-wide Tiers.

Tasks within this series are dependent on completing the GIS Pilot Project for the respective database tier.

DD1. Carry out Detailed Database Design for Common GIS Layers

A necessary pre-cursor to database development is a GIS database design that defines map features and associated attributes for all common map layers (see common layers identified above in Subsection 2.3 of this Plan). These detailed designs include a comprehensive description of map features for all layers and associated tabular attribute data definitions. It is recommended that these designs initially be implemented under

physical design rules for a recommended GIS package for use by state government agencies (see Task SD1). Where appropriate, these designs will form the basis for physical designs of specific layers for other packages that may be used by state government or outside organizations.

Two sub-tasks are defined to organize work for specific database tiers:

DD1.1: Database Design for Tier 3 and 4 Common Layers

DD1.2: Database Design for Tier 2 Common Layers.

Task Dependencies and Relationships: Carried out in coordination with the GIS Pilot Project is complete, and in coordination with OD15; forms basis for identification of sources and conversion planning (Tasks DD2 and DD3).

DD2. Identify Sources for Common GIS Database Layers

A direct step following the database design is to identify, in detail, the sources for common GIS database layers (see common layers identified in Section 2 of this Plan). The *Conceptual Design* identified major sources for most GIS database layers, and this should be used as a basis for a more detailed examination and identification of source materials. This should include final determination of the suitability of sources and identification of alternate sources taking into account and documenting such parameters as a) geographic coverage, b) quality and completeness, c) currency, d) availability in digital form, and e) cost to acquire and to convert data into the department's GIS. Strong attention should be given to those GIS database sources that already exist in automated form with a determination of necessary steps to re-format, rectify errors, and translate the data for use by GIS participants.

Two sub-tasks are defined to organize work for specific database tiers:

DD2.1: Identify Sources for Common Regional and State-wide Tier Layers

DD2.2: Identify Sources for Common Sub-regional Tier Layers.

Task Dependencies and Relationships: Uses information collected as part of the GIS Pilot Project.

DD3. Prepare Detailed Database Development Plan(s) and Specifications for Common Layers

This task uses the results of the detailed database design for the preparation of a complete plan and set of specifications for database development. This includes a clear definition of all procedures for source document preparation and automation and a designation of responsibilities and timing for steps in the process.

Two sub-tasks are defined to organize work for specific database tiers:

DD3.1: Database Specs - Regional and State-wide Tier Common Layers

DD3.2: Database Specs - Sub-regional Tier Common Layers.

Task Dependencies and Relationships: Uses information developed for the GIS Pilot Project. This task is dependent on completion of database design, standards development, and identification of sources (Tasks OD15, DD1, DD2).

DD4. Carry out Detailed Database Design for Agency-specific Layers

This task work will follow procedures in DD1 applied to agency-specific layers as those layers which are needed to support the applications that are predominantly specific to particular state government departments or divisions. While, by definition, agency-specific layers will not be routinely shared, there are still statewide database design standards that should be followed.

Two sub-tasks are defined to organize work for specific database tiers:

DD4.1: Database Design - Regional and State-wide Tiers Agency-specific Layers

DD4.2: Database Design - Sub-regional Tier Agency-specific Layers.

Task Dependencies and Relationships: Carried out in coordination with OD15 and Departmental Planning in OD12. Required for conversion planning in DD5.

DD5. Identify Sources for Agency-specific GIS Database Layers

This task follows a process similar to Task DD2 except that it is carried out by individual divisions or departments for data layers that will not normally be shared with other state government offices or outside agencies (see agency-specific layers identified above in Subsection 2.3 of this Plan).

Two sub-tasks are defined to organize work for specific database tiers:

DD5.1: Identify Sources for Regional and State-wide Tier Agency-specific Layers

DD5.2: Identify Sources for Sub-regional Tier Agency-specific Layers.

Task Dependencies and Relationships: Dependent on detailed Departmental Planning (OD12).

DD6. Prepare Detailed Database Development Plan(s) and Specifications for Agency-specific Layers

This task follows a process similar to DD3 except that it is carried out by individual departments or divisions for data layers that will not normally be shared with other state

government offices or outside organizations (see agency-specific layers identified above in Subsection 2.3 of this Plan).

Two sub-tasks are defined to organize work for specific database tiers:

DD6.1: Database Specs - Regional and State-wide Tier Agency-specific Layers

DD6.2: Database Specs - Sub-regional Tier Agency-specific Layers.

Task Dependencies and Relationships: Dependent in coordination with Departmental Planning (OD12). Uses results of database planning in PP1.

DD7. Acquire Existing Digital Data from Outside Sources

Following Tasks DD2 and DD5, in which source materials were identified, existing digital data will be acquired where that data is maintained by an outside party. This outside party may include another state agency, a federal agency, or a private firm. In some cases, this may require the development and ratification of formal agreements as described in Track PO of this Plan.

Two sub-tasks are defined to organize work for specific database tiers:

DD7.1: Acquire Existing Digital Data for Regional and State-wide Tiers

DD7.2: Acquire Existing Digital Data for Sub-regional Tier.

Task Dependencies and Relationships: Dependent on completion of Tasks DD2 and DD6.

DD8. Select Vendors and/or Assign In-house Resources for Conversion of Common Layers

In this step, resources are assigned to carry out conversion of common layers. In all cases, agency personnel must be assigned for project management, map source preparation, and in-house quality control. In cases where a private contractor is used, part of this step involves ongoing contract management and liaison with the contractor. Individual agencies may choose to perform some or all conversion using in-house staff. While privately contracted conversion for base maps is the most traditional approach, in-house conversion may be used if sufficient management and technician time can be applied. When a private contractor is being used, preparation of procurement documents, competitive or non-competitive selection, and contract preparation will occur in this step.

Two sub-tasks are defined to organize work for specific database tiers:

DD8.1: Select Vendors/Assign In-house Resources for Building Regional and State-wide Tier Databases

DD8.2: Select Vendors/Assign In-house Resources for Building Sub-regional Tier Databases.

Task Dependencies and Relationships: Dependent on completion of database development plans (Task DD3).

DD9. Design and Set up Program for QC and Acceptance of Common Layers

Whether conversion is being performed by in-house staff or by a private contractor, agencies must design and set up internal procedures for quality checks and formal acceptance of converted products. This includes checking hard copy map plots for completeness, accuracy, proper coding, annotation, and feature placement. It is equally important to develop a set of automated checks for digital files before loading and final acceptance. These internal quality control checks should complement those checks performed by private contractors.

Two sub-tasks are defined to organize work for specific database tiers:

DD9.1: Design QC/Acceptance - Regional and State-wide Tiers Common Layers

DD9.2: Design QC/Acceptance - Sub-regional Tier Common Layers.

Task Dependencies and Relationships: Occurs in coordination with database development planning (DD3); QC procedures tested in early phases of conversion (DD10); drives actual implementation of QC and acceptance in Task DD11.

DD10. Conduct Conversion of Common GIS Layers

In this step, the conversion work is carried out (in-house or by contractor) for the specific base map layers identified in the *Conceptual Design*. As called for in that document, there will be several incremental phases for completion of different components of the parcel-level and general databases.

Two sub-tasks are defined to organize work for specific database tiers:

DD10.1: Conduct Database Development - Regional and State-wide Tiers Common Layers

DD10.2: Conduct Database Development - Sub-regional Tier Common Layers.

Task Dependencies and Relationships: Resources allocated based on database development plan (Task DD3), selection of vendors (DD8), and allocation of in-house staff identified in detailed Departmental Plans (OD12).

DD11. Carry out QC and Accept Products for Common Layers

A schedule for conversion developed in DD3 includes specific timing for completing parts of the conversion. This is usually defined by laying out a precise time frame for completing sets of map sheets covering the area to be converted. Quality control would begin by manual review of a check plot with notation of problems and errors to be corrected. This would be followed by additional checkplots if needed, culminating in a final approved confirmation plot. Completion and delivery of digital files follow a similar track until all products are formally approved and loaded on the system.

Two sub-tasks are defined to organize work for specific database tiers:

DD11. 1: Carry out QC for Regional and State-wide Tiers Common Layers

DD11. 2: Carry out QC for Sub-regional Tier Common Layers.

Task Dependencies and Relationships: Dependent on design of the QC program in DD9.

DD12. Select Vendors and/or Assign In-house Resources for Conversion of Agency-specific Layers

This task follows the same procedures as those in Task DD9 for common GIS layers. Two sub-tasks are defined to organize work for specific database tiers:

DD12.1: Select Vendors/Assign In-house Resources for Regional and State-wide Tiers

DD12.2: Select Vendors/Assign In-house Resources for Sub-regional Tier.

Task Dependencies and Relationships: Based on Departmental Plans (OD12) and agency-specific database development specifications (DD6).

DD13. Design and Set up Program for QC and Acceptance of Agency-specific Layers

This task follows the same procedures as those in Task DD9 for common GIS layers. Two sub-tasks are defined to organize work for specific database tiers:

DD13.1: Design QC/Acceptance - Agency-specific layers for Regional and State-wide Tiers

DD13.2: Design QC/Acceptance - Agency-specific layers for Sub-regional Tier.

Task Dependencies and Relationships: Occurs in coordination with database development planning (DD6); QC procedures tested in early phases of conversion (DD14); drives actual implementation of QC and acceptance in Task DD15.

DD14. Conduct Conversion of Agency-specific GIS Layers

This task follows the same procedures as those in Task DD9 for common GIS layers. Two sub-tasks are defined to organize work for specific database tiers:

DD14.1: Conduct Database Development - Agency-specific GIS Layers for Regional and State-wide Tiers

DD14.2: Conduct Database Development - Agency-specific GIS Layers for Sub-regional Tier.

Task Dependencies and Relationships: Resources allocated and identified based on database development plan (Task DD6), formal selection (DD12), and allocation of in-house staff identified in detailed Departmental Plans (OD12).

DD15. Carry out QC and Accept Products for Agency-specific Layers

This task follows the same procedures as those in Task DD11 for common GIS layers. Two sub-tasks are defined to organize work for specific database tiers:

DD15. 1: Carry out QC for Regional and State-wide Tiers Agency-specific Layers

DD15. 2: Carry out QC for Sub-regional Tier Agency-specific Layers.

Task Dependencies and Relationships: Dependent on design of QC program in DD13.

DD16. Establish Data Maintenance and Exchange Procedures

Technical procedures for data maintenance and database directory/meta-database maintenance are set up and tested in this task. This includes the development of customized procedures for making changes to the database and for loading and re-formatting data acquired from another source.

Task Dependencies and Relationships: Occurs in coordination with assignment of maintenance responsibilities (OD16), and technical standards (OD15); dependent on completion of the design of the GIS database and meta-database (DD1, DD17).

DD17. Establish Database Directory and Meta-database

In conjunction with the database design tasks (Tasks DD1 and DD4) and development of conversion specifications (Tasks DD3 and DD6), the Steering Committee, along with the GIS Coordinator, the User Group, and the Technical Support Center, should establish a format for a database directory and meta-database that contains a description of the content, custodian, quality, geographic coverage, and other information about GIS layers. This will serve as an automated "card catalogue." Along with this, technical and administrative procedures should be established, with oversight from the GIS Coordinator, on keeping this up-to-date and providing access by users.

Task Dependencies and Relationships: Dependent on completion of database design and identification of source materials (DD1, DD2).

SD. System and Application Development

SD1. Formally Approve GIS Software and Hardware Procurement Guidelines

The *Conceptual Design* recommends that one or a small number of GIS software packages be approved as a "standard" for use by state government departments. In this task, the Steering Committee takes action on this recommendation and works with IS&C to establish guidelines for both GIS software and hardware.

Task Dependencies and Relationships: Must be completed to proceed with subsequent tasks in this track.

SD2. Negotiate Purchase Agreements with Software Vendors

After formal approval of software recommendations, the GIS Coordinator, with support from the Steering Committee, should negotiate purchase agreements with each vendor. A key objective of the negotiations is to secure favorable software license fees, preferably tied to a site or number of users, not processor size or a simple seat license. It will be advantageous to investigate the terms secured by existing users in West Virginia and coordinate with these users to achieve more favorable terms. Other items that may be successfully negotiated include level of training, documentation, and on-site support.

Task Dependencies and Relationships: Dependent on approval of software in SD1; must be completed for subsequent software procurements in Tasks SD5, SD10, SD15).

SD3. Prepare Application Development Strategy

The first PlanGraphics report, *Business Functions and Applications*, introduced a range of applications for automated mapping and GIS. This step is suggested for a more detailed, agency-specific characterization of those applications which would define specific products and data requirements as well as those agencies who would have a role as data providers or receivers of products from the applications. Applications would then be categorized by importance and complexity to establish classes of priority for implementation.

Task Dependencies and Relationships: Must be coordinated with Pilot Project Planning (PP2). Drives detailed application design in Tasks SD6, SD11, and SD17 and completion of documentation standards and a directory in Task SD4.

SD4. Develop Documentation Standards and an Application Directory

The GIS Coordinator, working closely with the Technical Support Center, should have oversight responsibility on the development of standards for documenting all GIS applications developed and used by state government departments. These standard, can

become accepted by GIS users outside of state government as well. The purpose is to provide a format for user and technical documentation that is consistent department-wide and therefore makes applications easier to use and easier to modify. A directory would serve as a catalogue for all Departments to inform all users of the existence of applications to avoid duplicative development.

Task Dependencies and Relationships: Documentation standards should be used in all application development activities (SD8, SD13, SD18).

SD5. Acquire Computer Hardware and Software for Phase 1

Hardware and software defined for acquisition in Phase 1 will be acquired in this task. As described in the *Conceptual Design*, hardware and software procurements in this phase will be limited, relying, to a large extent, on existing hardware and software already acquired by state government offices and West Virginia University.

Task Dependencies and Relationships: Dependent on identification of software and hardware and negotiation of purchase contracts in SD1 and SD2.

SD6. Design High-priority Applications

High-priority applications, based on the categorization finalized in SD4, would be designed in detail during this task. This detailed design is system-specific and is the basis for actual development and testing of those applications.

Task Dependencies and Relationships: Dependent on completion of Departmental Plans (OD12) and application development strategy (SD4).

SD7. Install and Test Phase 1 Hardware and Software

This step would include the installation, by the vendor, of hardware and software acquired in Task SD5. The testing would be a combination of vendor-defined acceptance tests and user-defined procedures with a test data set to ensure that the system is operating properly. The payment schedule should be contractually tied to a final testing and acceptance process.

Task Dependencies and Relationships: Follows acquisition of hardware and software in SD5.

SD8. Develop and Test High-priority Applications

As early as possible, high-priority applications should be developed based on the design in SD4. These high-priority applications will concentrate on database update and map generation procedures, simple queries, and report generation. It is recommended that the Technical Support Center play an important role in this development with the possible participation of an outside consultant. Users of the applications should be directly involved in the design process and testing process. It is recommended that the development process follow a "rapid-prototyping" approach in which application

prototypes are developed quickly and reviewed by users throughout the development process. This approach results in a process of incremental development with considerable user interaction delivering a finished application that very closely matches the needs of users when completed.

Task Dependencies and Relationships: Dependent on application design in SD6; applications documented and catalogued according to standards developed in SD4.

SD9. Establish Remote Communications and Data Exchange for Phase 2

As discussed in the *Conceptual Design*, there will be a need for a moderate level of remote communications between sites around the state during this Phase. The design calls for a high-speed link between Morgantown and Charleston and among offices in Charleston. This task has two main objectives: 1) to establish the necessary remote communication lines (likely leased phone lines), and 2) to develop and test data exchange and re-formatting procedures for the exchange of GIS data between different software platforms in cases where this is appropriate.

Task Dependencies and Relationships: Dependent on technical procedures for data exchange developed in DD16; coordination with overall state government initiatives in data communications network development.

SD10. Acquire Hardware and Software for Phase 2 Configuration

An initial part of this task is to define specific hardware and software needs for State government users. When final decisions are reached as to the types and number of hardware devices and software, these items should be procured using standard license agreements with vendors.

Task Dependencies and Relationships: Based on plans developed by departments in OD12 and on application development strategy in SD4. Dependent on identification of software and hardware and negotiation of purchase contracts in SD1 and SD2.

SD11. Design Medium-priority Applications

As the system expands and the database becomes more mature, the system will be able to support new users and applications. During this task, as in SD6 for High-priority applications, Medium-priority applications will be designed.

Task Dependencies and Relationships: Dependent on completion of Departmental Plans (OD12) and application development strategy (SD4).

SD12. Install and Test Phase 2 Hardware and Software

This step would include the installation, by the vendor, of hardware and software acquired in Task SD10. The testing would be a combination of vendor-defined acceptance tests and user-defined procedures with a test data set to ensure that the system

is operating properly. The payment schedule should be contractually tied to a final testing and acceptance process.

Task Dependencies and Relationships: Follows acquisition of hardware and software in SD10.

SD13. Develop Medium-priority Applications

Medium-priority applications as designed in SD11 will be developed in this task.

Task Dependencies and Relationships: Dependent on application design in SD11; applications documented and catalogued according to standards developed in SD4.

SD14. Establish Communications Networks for Phase 3

The *Conceptual Design* calls for a more detailed and sophisticated communications environment for GIS, both in terms of local and remote networks. Local area networks at Charleston sites will be expanded, and links to many of the field offices and Regional Planning and Development Councils will be put in place. Augmentation of the communications network should follow overall and statewide communication network development using facilities supported by WVNET and C&P Telephone.

Task Dependencies and Relationships: Dependent on technical procedures for data exchange developed in DD16; coordination with overall state government initiatives in data communications network development.

SD15. Acquire Hardware and Software for Phase 3 Configuration

An initial part of this task is to review original projections of hardware and software needs presented in the *Conceptual Design* for Phase 3 and make any refinements and changes to this projection. When final decisions are reached as to the types and number of hardware devices and software, these items should be procured using standard license agreements with vendors.

Task Dependencies and Relationships: Dependent on identification of software and hardware and negotiation of purchase contracts in SD1 and SD2.

SD16. Install and Test Phase 3 Configuration

This installation and testing step follows the procedure in SD12. In this step, however, testing of the communication network becomes more critical since it is much more complex than in Phase 2.

Task Dependencies and Relationships: Follows acquisition of hardware and software in SD15.

SD17. Design Lower-priority Applications

This step follows the procedure laid out for steps SD6 and SD11.

Task Dependencies and Relationships: Dependent on completion of Departmental Plans (OD12) and application development strategy (SD4).

SD18. Develop Medium-priority Applications

Lower-priority applications designed in SD17 will be developed in this task.

Task Dependencies and Relationships: Dependent on application design in SD11; applications documented and catalogued according to standards developed in SD4.

SD19. Prepare Design for Phase 4 GIS Configuration

This mature phase of the GIS, as described in the *Conceptual Design*, is characterized by wide use of the GIS with considerable distribution of processing platforms and data. This requires sophisticated hardware, software, communication lines, and management procedures. At a point where medium priority applications are developed, it is important to develop a long-range plan for system expansion.

Task Dependencies and Relationships: Dependent on application needs, status of state communication networks (WVNET and C&P Telephone fiber links), and technical advances in hardware and software.

SD20. Develop Phase 4 Configuration

At the appropriate time, technical development tasks associated with hardware, software, communication lines, and application development should be undertaken.

Task Dependencies and Relationships: Dependent on plans developed in SD19.

PO. System Promotion and Coordination with Outside Organizations

PO1. Prepare Promotional Materials on the GIS Plan

Coincident with the approval of this Plan, materials should be prepared to help educate and promote the concept of GIS development in the State. These materials may include a high-level executive summary, a slide presentation, and other materials aimed at senior management in both government and non-government organizations.

Task Dependencies and Relationships: No critical dependencies.

PO2. Conduct Internal Management Briefings and Presentation

This step will include a series of management presentations using materials developed in PO1. The current Steering Committee should define a target audience for a high-level presentation. It should include senior departmental management personnel and, if possible, elected officials. These high-level presentations should focus on the GIS needs of state agencies and the opportunities for successful development through a statewide approach. It may also be possible for GIS offices that have already developed GIS applications or university groups to present several GIS products to illustrate tangible applications for GIS in West Virginia.

Task Dependencies and Relationships: No critical dependencies.

PO3. Conduct Educational Seminars for Technical Staff

This will be an ongoing activity with the objective of educating users in state government offices and outside organizations and giving them an exciting and realistic impression of how GIS can be used to meet their needs. These seminars should concentrate on major GIS concepts and applications directed at user program areas. They should make use of various types of presentation techniques, including slides, videos, and live GIS demonstrations.

Task Dependencies and Relationships: No critical dependencies.

PO4. Promote Support for GIS Effort with Federal Agencies

A critical step in long-term GIS development will be forging relationships with federal agencies as partners in GIS development. Relationships with federal agencies may be in the form of direct grants, funding and participation for GIS demonstration projects, cooperative mapping and database development efforts, and acquisition of databases for West Virginia already developed or in the process of being developed by federal agencies. One key role of the GIS Coordinator, with support from the Steering Committee and Policy Body, will be to explore opportunities, lobby for support from the federal government agencies, and negotiate agreements. Agencies which are prime candidates for involvement in the West Virginia GIS program include the U.S. Geological Survey, Soil Conservation Service, Forest Service, Federal Emergency Management Administration, Appalachian Regional Commission, National Geodetic Survey, Office of Surface Mining, Federal Highway Administration, and Environmental Protection.

The current uncertainty in the federal fiscal climate makes it hard to predict exactly what funds or programs may be available, but it is safe to say that opportunities can be capitalized on if they are pursued aggressively. It should be noted that some federal agencies, like the Geological Survey, have cost-sharing programs with states for large mapping programs. For this reason, allocation of "seed money" by the state will encourage initiation of large database development projects critical for the GIS.

Task Dependencies and Relationships: Dependent on assignment of a GIS Coordinator in Task OD3; formal, long-term participation of federal agencies is carried out through involvement in the Policy Advisory Body (OD7) and User Group (OD8); drives agreements established in PO6.

PO5. Promote Support for GIS Effort with Private Companies

There is a variety of private companies in West Virginia which play a very important role in the long-term success of the West Virginia GIS program because they are large users and/or producers of geographic information that is of potential value to multiple parties. Private companies such as Appalachian Power, C&P Telephone, CNG Transmission Corporation, Union Oil & Gas, Western Pocahontas, and WESTVACO have already been involved in this study. It will be important to solicit support from these groups, first by encouraging their participation in the Policy Advisory Body and then in negotiating agreements for direct participation and exchanges of information. In some cases, it may be possible to have private companies contribute funds for GIS development - for instance, to contribute "seed money" for cooperative mapping programs with the federal government.

Task Dependencies and Relationships: Dependent on assignment of a GIS Coordinator in Task OD3; formal, long-term participation of private companies is carried out through involvement in the Policy Advisory Body (OD7) and User Group (OD8); drives agreements established in PO7.

PO6. Establish Formal Agreements with other Local, State, and Federal Governmental Organizations

In this task, agreements for cooperative programs, information sharing, and direct funding which were explored in Task PO4 and in work with local governments and Regional Planning and Development Councils are prepared and ratified.

Task Dependencies and Relationships: Dependent on formalizing a Policy Body in OD6 and supported through Policy Advisory Body in OD7; dependent on Task PO4.

PO7. Develop Agreements with Major Non-governmental Organizations

Formal partnerships should be forged with non-governmental organizations (e.g., private utility companies). In this task, formal agreements would be established to define responsibilities and terms for information sharing and funding relationships.

Task Dependencies and Relationships: Dependent on formalizing a Policy Body in OD6 and supported through Policy Advisory Body in OD7; dependent on Task PO5.

PO8. Develop Cooperative Programs with Universities

Relationships should be developed with WVU and other universities and colleges as part of the overall GIS program. Agreements should be reached to provide for cooperative

project work for GIS application and database development tasks and, where appropriate, for formal internship or co-op programs to support time-limited employment for qualified university students.

Task Dependencies and Relationships: Uses programs established through the Technical Support Center in West Virginia University (OD4) as a basis and model for other university programs.

PO9. Examine Legal and Policy Issues Impacting Distribution and Sale of Products/Services

It is recommended that the Steering Committee investigate legal and policy issues impacting the sale and distribution of products and services from the GIS for partial cost recovery. This issue is impacted by a number of important legal considerations such as government liability, privacy, state open records laws, and anti-trust issues governing fair competition with the private sector. It is also necessary to investigate current precedents for sales of information, case law in West Virginia, general philosophies surrounding government accountability, and relationships with the private sector that influence the direction the state takes.

Other states and local governments around the country have developed successful programs for sale of GIS products and services addressing these legal and policy issues. In many cases, these programs have resulted in very strong, mutually beneficial relationships with private sector companies which can use data generated by government agencies and, in some cases, produce their own custom products for sale. The objective of this task is to establish a policy for cost recovery, based on the background investigations, and establish goals for an operational program.

Task Dependencies and Relationships: Dependent on formalizing a State GIS Policy Body in OD6; dependent on effective communication with outside parties which can be encouraged through the Policy Advisory Body (OD7); must be completed as a basis for establishing a program in PO10. This task should include departmental legal staff and perhaps a representative of the Attorney General's Office since it potentially impacts information sales and distribution outside of the GIS arena.

PO10. Set up Program for Product/Service Sales and Distribution to Outside Parties

Setting up a formal sale/distribution program, with the intent of full or partial cost recovery, begins with an identification of potential clients, specific types of products and services, and a projected demand. This is followed by an evaluation of costs for providing these products and services (including all or part of the costs for developing and maintaining a database). Fees are then established based on the costs, projected demand, policy decisions dictating level of cost recovery, and legal limitations.

Based on the groundwork in Task PO9, the program for outside distribution would be put in place. It should begin with a defined list of products and services and a limited amount of "advertising" to inform interested "clients." Specific ordering and payment

procedures should be established, and an internal accounting procedure to record staff time and system resources should be put in place. The Technical Support Center could serve as a central service bureau for fielding requests from outside parties, and this may be a suitable initial approach. It is preferable, however, for this function to be decentralized at individual departments for the most part, as long as each are adhering to statewide policies for product/service distribution.

Task Dependencies and Relationships: Dependent on formalizing of research and goals set in PO9; requires commitment of staff to administer distribution and sales activities.

SECTION 4 TIMING FOR GIS DEVELOPMENT

4.1 PHASED DEVELOPMENT

While the development of the West Virginia GIS will be a continual process, four development phases are defined which identify key milestones in the process from Phase 1 (Detailed Design/Organizational Development) through Phase 4 (Mature Operations). All participants should adopt an attitude that the GIS is never “completed” or fully mature. In the long term, there will be user needs that can be addressed by the GIS and technological changes which cannot be fully anticipated at this time. The intent of the system design, therefore, is to create a structure that allows the system to grow easily, to respond to new applications, and to take the best advantage of improvements in the technology. GIS development phases are explained below. These phases will form the basis for the GIS Plan.

In defining these phases, it is acknowledged that some state agencies, University groups, and private companies that have participated in this GIS planning process have been conducting GIS activities for several years. This existing experience with the technology provides a sound basis to proceed with a statewide coordinated approach to GIS. We recommend that current GIS activities continue, while a firm organizational foundation is being established for a long-term, multi-organizational GIS program.

4.1.1 Phase 1: Detailed Design/Initial Development

This phase will begin in mid-1993 and will last approximately 18 months. Its purpose is to lay a strong technical and institutional foundation for the GIS and detailed development to be initiated in Phase 2. This includes an organizational structure addressing state government agencies as well as other governmental and non-governmental organizations that are critical participants in the statewide GIS. A GIS Pilot Project will be planned and completed, and GIS activities currently ongoing will continue within the framework of a statewide plan. While there will be a focus on state agencies during this phase, significant “outreach” efforts will occur with non-state organizations encouraging long-term participation and cost-sharing for the GIS. Where applicable, formal agreements will be established with non-state government groups for cost sharing and data exchange. Appropriate staff and GIS development responsibilities will be assigned, and a long-term organizational structure will be put in place. Technical activities will include development of database standards, procurement specifications and procedures for GIS hardware and software, initial database development, and implementation of several key applications.

4.1.2 Phase 2: Continued Development and Early Operation

At the start of this phase, which will last approximately two years, the organizational structure established in Phase 1 will be firmly in place, and initial applications relying on available portions of the GIS database will be in operation. Operating procedures for accessing and exchanging GIS data will be put in place, and GIS capabilities will be expanded to all major state agencies with high-priority GIS applications. Continued outreach to non-state government organizations will occur, and agreements not reached in Phase 1 will be established. A critical objective of this phase will be completion of the GIS database layers needed to support high-priority applications and the development of key applications.

4.1.3 Phase 3: Expanded Operation

This phase will last approximately two years. During this period, all high-priority and many lower-priority applications will be developed and placed in operation, and development work will continue with lower priority applications. All database development work for GIS layers needed to support high and medium priority applications will be completed, and portions of the database needed for future applications will be developed. During this phase, there will be significant expansion of GIS capabilities to many organizations in the state, and batch data transfer over data communications lines will be in operation.

4.1.4 Phase 4: Mature Operations

Phase 4 is open-ended and describes a period of continued GIS expansion during which additional applications and users are added to the system. A key aspect of this phase is the adoption of higher-speed communications networks and more mature system and data standards that will permit more flexible distribution and exchange of GIS data. This phase is described to depict the long-term direction of the system—the specific nature of which will become more clear later in the development cycle. No specific configuration information and cost estimates are presented for this phase.

4.2 PROPOSED SCHEDULE

Figure 4-1 defines a general schedule for implementation. It assumes that system development begins in early 1993 with formal approval of this strategic plan.

Insert Figure 4-1

Insert Figure 4-1, pg.2

Page 3

SECTION 5 GIS DEVELOPMENT RESPONSIBILITIES

GIS implementation must be viewed as a cooperative effort with explicit assignment of resources and involvement in planning and development by participating organizations. This *GIS Development Plan* is one step toward a firm assignment of resources which will be further refined as detailed GIS plans at the Department and Division level are completed. In addition to offices in West Virginia State Government with implementation responsibilities, there will be other outside groups involved, including system and database vendors, other government agencies, consultants, and university groups.

Table 5-1 describes major responsibilities for tasks assigning lead or support roles to particular groups. This table presents a recommended level of participation or responsibility for each task for the following state government and outside groups:

- GIS Management Unit and GIS Coordinator
- GIS Policy Body
- GIS Policy Advisory Body
- GIS Technical Support Center (WVU)
- GIS Steering Committee
- GIS User Group
- Technical Sub-committees
- Department and Division Management
- Division Technical Support
- Federal Agency
- Regional Planning and Development Councils and Local Governments
- Private Sector GIS Users
- University
- Database Vendor/Contractor
- Hardware/Software Vendor
- Independent Consultant.

This table is intended to give an initial basis for allocating staff time and for clarifying long-term responsibilities in GIS development.

Insert Table 5-1

Insert Table 5-1, pg 2

SECTION 6 FUNDING APPROACH

6.1 FUNDING PHILOSOPHY

Section 2 presented a summary of the conceptual design for West Virginia's GIS as well as estimates of the costs associated with its development. While these costs are significant, PlanGraphics believes that they are reasonable when one considers the benefits--both tangible and intangible--that the system will deliver. The basis for developing and operating a statewide GIS is to eliminate inconsistent and duplicative handling of geographic information and to create a mechanism that can deliver the information to users quickly and in the desired format.

GIS development can and should be considered analogous to major capital projects undertaken by public agencies. As a capital improvement project, funds allocated for GIS development are an investment in the future. If the statewide GIS is developed cooperatively, elected officials, senior management, and users should expect that benefits will be delivered to government, and to the public and private entities they serve. This idea is consistent with the concept of an "information infrastructure" promoted by many experts and more recently articulated in the form of a Congressional Bill submitted by Senator (now Vice President) Albert Gore. There is a strong and growing demand for information--particularly spatial information. The GIS as part of an "information infrastructure" can be considered analogous to utility or transportation infrastructure. It is built to provide a mechanism to deliver a service or a commodity to users.

Looking at GIS in this context puts a focus both on the physical side of the system (the computer hardware, software, and data communication lines) and on the commodity being delivered--the data or information. Building the GIS and allocating staff time to operate it require funding which is relatively high during initial stages (first 4 to 5 years) while the system is being built. A large part of this cost is for developing the database. Much of this cost, however, is devoted to improving the quality of existing data and augmenting records that may exist only in hard copy or partially automated form. Many states have accepted the cost of this database development because it is the data that has value and which represents the real investment in the future. The computer hardware, software, communication lines, and trained people are the elements of the system which help keep that data up-to-date, make useful products from it (maps, reports, etc.), and deliver these products to users.

For the state's GIS program to be successful, it will be necessary for state funds to be allocated to cover at least part of the development costs. Funding allocation similar to what PlanGraphics is recommending for West Virginia has been done in other states, including North Carolina, Kentucky, South Carolina, Minnesota, Utah, Washington, Vermont, and others. Each of these states has operational GIS programs. GIS development in state and local governments is most successful when multiple departments and organizations cooperate in the development effort. West Virginia's initial GIS planning has been conducted as a cooperative effort of multiple organizations,

and this cooperation should remain as a key focus of the program throughout development and operation.

When evaluating other states' successful GIS programs, funding requests are most readily received and approved when tied to specific programs associated with state or federal legislation or programs mandated through executive orders. In many cases, these programs have an explicit or implied directive to develop and use spatial information. In some cases, special funding has been allocated to build information systems to fulfill program requirements. Examples of key programmatic themes driving GIS in other states are listed below.

- **Natural Resources and Growth Management:** important programmatic focus in Colorado, Florida, Maryland, Minnesota, New Jersey, Ohio, South Carolina, Texas, Utah, Vermont, and Washington.
- **Environmental Protection:** important programmatic focus in Georgia, Kentucky, Illinois, Michigan, Minnesota, New Jersey, and Ohio.
- **Fish and Wildlife Management:** important programmatic focus in Arizona, Colorado, Kentucky, and Tennessee.
- **Transportation Planning and Engineering:** important programmatic focus in Missouri, North Carolina, North Dakota, Pennsylvania, Texas, and Wisconsin.
- **Public Land Management:** important programmatic focus in Arizona, Colorado, Tennessee, Texas, and Washington.
- **Statewide Property Mapping, Appraisal, and Equalization:** important programmatic focus in Kansas, Kentucky, New York, North Carolina, Oklahoma, and Wisconsin.
- **Economic Development:** important programmatic focus in Illinois, Mississippi, and South Carolina.
- **Emergency Management and Public Safety:** important programmatic focus in Alaska, Florida, Louisiana, New Jersey, South Carolina, and Washington.

Databases and systems developed for specific programs are very often useful for other programs as well. If a cooperative approach is taken to system design and establishing inter-organizational relationships, resources for GIS development may be pooled. These cooperative efforts have the combined effect of reducing overall project costs and providing greater benefits to all parties than will separate efforts. All of the programmatic areas listed above have some importance in West Virginia. Those associated with environmental protection, transportation, public land management, economic development, and fish & wildlife management are perhaps the most critical.

6.2 FUNDING AND COST SHARING OPPORTUNITIES

6.2.1 General Fund Allocation

Part of the costs associated with GIS development and operation in state government should be allocated from the state's general fund. These funds should be directed toward elements of the system that will benefit all GIS participants and which are not tied to specific users within government Departments or Divisions. Costs for salaries for the GIS Coordinator and other central Management Unit staff should be included in this category as well as costs for the Technical Support Center at West Virginia University. PlanGraphics also believes that allocating general fund moneys to cover all or part of the cost for developing core database layers is a viable option.

6.2.2 Current State Programs

As part of the Departmental and Division planning described in Section 3 under Task OD12, individual state agencies should evaluate funding opportunities associated with state programs for allocation of funds for computer hardware, software, staffing, and database development. In large part, current GIS activities in state government have used this approach for funding support. West Virginia state government programs that can be assisted by GIS technology and which should be evaluated for funding are briefly discussed below:

- Surface Mining Regulatory Programs: The Mines and Minerals Section of the Division of Energy in the Department of Commerce, Labor, and Environmental Resources (CLER) is responsible for surface mine permitting, enforcement, and other regulatory activities. These functions include requirements for collecting, analyzing, and distributing geographic information. Other states, most notably Kentucky and Illinois, have developed and are operating comprehensive GIS programs in support of state surface mining regulations and the Federal Surface Mining Reclamation and Control Act. West Virginia environmental regulations, with their basis in federal regulations and programs, are all strong justifications for implementing GIS capabilities. Some of these federal programs and regulations include the EPA National Pollutant Discharge and Elimination System (NPDES) permitting, U.S. Fish and Wildlife Service wetland protection, soil and water conservation programs of the U.S. Soil Conservation Service and U.S. Forest Service, and U.S. Office of Surface Mining Reclamation (OSM) and Enforcement environmental and safety requirements.

- Solid Waste Planning and Management: A number of states, including Minnesota and Kentucky, have partially funded and used GIS for landfill siting. This involves providing assistance to counties in determining appropriate locations for sanitary landfills, and for their development. Solid waste management is a concern for CLER's Division of Natural Resources and Solid Waste Management Board. There is considerable potential to use GIS technology to support programs that can be categorized in this topic area.
- Surface and Groundwater Protection: The Division of Environmental Protection, Division of Natural Resources, the West Virginia Geologic and Economic Survey in CLER, and the Bureau of Public Health in the Department of Health and Human Resources have responsibilities to inventory surface and groundwater resources in the state and to manage programs for their protection. Many of these programs have their basis in federal regulations (primarily managed by the U.S. EPA) and in state regulations. Many states have based GIS efforts on a response to water resource programs, often with some federal funding assistance. Programs in place in West Virginia have already utilized GIS capabilities, and this program area continues to be a focus for applying GIS technology.
- Fish and Wildlife Management: Programs for management of fish and wildlife in West Virginia, including licensing and enforcement activities for hunting and fishing, are managed by CLER's Division of Natural Resources. These programs are supported in large part by license fees. Other states such as Colorado and Arizona have allocated part of these fees to developing GIS in support of wildlife management efforts. This is one option for West Virginia to consider.
- Property Mapping and Equalization: For a number of states who have specific authority to direct and oversee property mapping and appraisal (such as New York, North Carolina, Kansas, Utah, and Kentucky), GIS has been part of overall programs to encourage consistent mapping, information standards, and equalization in property appraisals. Significant funds have been allocated for this purpose in other states and there is an opportunity for a strong state GIS program in West Virginia which would not only contribute to state-level GIS development but also would encourage map and GIS development at the local level. Like Kentucky, West Virginia has in place legislation that permits property appraisals based on the value of unmined minerals. Estimating land values based on such resources is challenging and is an application well-suited to GIS. The state of Kentucky, and major coal companies operating in Appalachian states, have been pursuing the use of GIS to deal with this program. There is an opportunity for West Virginia, through the Tax and Revenue Department, to use this program as a basis for GIS development, possibly in direct association with coal producers who own land or hold mineral rights to land in the state.

- **Economic Development:** This area includes all programs designed to explore and encourage wise development activities in the state, including recreation and tourism. For large industrial projects, the ability to conduct initial site suitability evaluation is a critical issue. Having information availability with tools to “screen” for certain criteria may often determine whether a firm gives serious consideration to a development project. In states like South Carolina, North Carolina, and Illinois, GIS has been used as a promotional and information generation tool for site evaluations with private industry. The West Virginia Geologic and Economic Survey has a primary role in gathering, storing, and analyzing information on mineral resources which are fundamental to mining development. The Survey has already applied GIS technology in this area, and there are opportunities for expanding the use of GIS. GIS may also be used a basis to promote tourism from out-of-state by providing a geographic picture of recreational and cultural activities. As a long-term investment, GIS can play an important role in these programs.
- **Transportation Planning and Engineering:** Over the past five years, many state transportation agencies have become very interested in using GIS technology to support mapping activities, highway siting and impact studies, right-of-way management, and for facility inventory and reporting. The federal Intermodal Surface Transportation Act places additional emphasis on various transportation planning dealing with traffic congestion, highway safety, and other planning areas. GIS technology has a natural fit for many Department of Transportation functions.

The program areas listed above, along with others not discussed, should be considered as foci for allocating funds for GIS development. In some cases, a strong case may be made for using federal funds associated with those programs for GIS development.

6.2.3 Cooperative Database Development with Federal Agencies

Potentially, a significant part of the cost of GIS development in West Virginia can be offset through formal cost-sharing agreements with federal agencies for mapping and GIS development. In fact, certain state agencies such as the West Virginia Geologic and Economic Survey and the West Virginia Soil Conservation Committee have already pursued some cooperative programs with the federal government. The most important candidate is the U.S. Geological Survey (USGS) which is responsible for the National Mapping Program and manages federal programs for aerial photography and for topographic, hydrologic, and geologic mapping. USGS has launched an ambitious program for digital data production and has, as part of its mission, the responsibility to provide this information to users. USGS also supports cost-sharing programs with state

governments to accelerate mapping and database development efforts. Some of the digital mapping programs of particular importance to West Virginia include:

- 7 1/2 minute quadrangle DLG topographic map files
- 7 1/2 minute quadrangle digital elevation model (DEM) files
- 7 1/2 minute geologic quadrangle map files (bill for funding is before Congress)
- Digital orthophoto coverage (demonstration project for the national orthophoto project is underway with full funding still pending).

Some of this data already exist for West Virginia, and the USGS can supply data for several layers of the Regional Tier.

In addition to the USGS, other federal agencies are developing digital mapping and GIS programs. Some of these additional federal agencies that should be considered for cooperative database development include:

- The U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency for wetland mapping and related land cover database development
- The U.S. EPA for database and application development associated with surface and groundwater management programs
- The U.S. Forest Service and the Soil Conservation Service to support digital soil map production, land cover mapping, and orthophoto production
- The National Geodetic Survey of NOAA to support development and densification of the geodetic survey control network.

With a new federal administration, and federal budget development still in its early phases, it is very difficult to predict the availability of federal funds (usually through a match for state-generated funds) for cooperative database development programs. It is certain, however, that strong mandates at the federal agencies support the building of a "National Spatial Data Infrastructure" and encourage better cooperative programs with states and local governments. It is equally certain that cost-sharing arrangements will not be realized in West Virginia without some aggressive promotion and negotiation on the part of state personnel. This is one major role for the State GIS Coordinator. With an active program to investigate and pursue opportunities with federal agencies, prospects for cooperative programs for database development are quite good.

6.2.4 Federal Agency Funding

There are opportunities for direct grants from some federal agencies for GIS development. As discussed above, this time of uncertainty in the federal budget makes it difficult to predict availability of federal funding. However, some funding programs that have been used by other states include:

- Appalachian Regional Commission grants: ARC's support for this project, as well as a separate GIS planning project being carried out by PlanGraphics for ARC involving a survey of the GIS needs and resources of the 69 Local Development Districts (LDDs), has demonstrated ARC's interest in GIS and a role that they may play in technology transfer. West Virginia is in a unique position since it is the only state that falls entirely within the ARC region. The state should explore funding possibilities with ARC, perhaps with the idea of using West Virginia as a pilot for programs that may be implemented in the rest of ARC's area of jurisdiction.
- EPA Grants: In the past, the U.S. EPA has allocated money for GIS pilot programs in a number of states. EPA moneys have supported database development, acquisition of hardware and software, and the development of applications that address EPA mandated programs at the state level. The availability of EPA funds for water resource regulatory programs and associated GIS development should be investigated.
- U.S. Office of Surface Mining (OSM): As indicated above, Kentucky and Illinois funded major portions of their GIS development efforts with funds associated with state implementation of the Federal Surface Mining Control and Reclamation Act of 1977. While these types of program development grants allocated in the late 1970s and early 1980s are not now available, there may still be opportunities for OSM funding for specific projects that impact surface mining permitting and enforcement.
- Federal Highway Administration: In recent years, the FHA has become interested in applying GIS technology to transportation programs. Several states (including Colorado and North Carolina) have used federal funds for GIS development in transportation. The state examines areas for funding that ties GIS to directives of the Intermodal Surface Transportation Act and pursues funding opportunities with the FHA.
- Federal Emergency Management Administration (FEMA): FEMA has responsibility for the federal government's flood insurance rate mapping and for emergency response programs of the federal government. FEMA has been evaluating GIS, both as a basis for automation of flood zone mapping and for disaster planning. Some possibility exists for funding from FEMA to support GIS development associated with emergency management programs in the state.
- Economic Development Administration (EDA): EDA provides economic planning, technical assistance, and operating grants, to state, regional and local economic development organizations. Computer hardware and software are

eligible program costs, and a number of Regional Development Councils have used EDA funds to support GIS activities.

6.2.5 Partnerships with Private Companies

Certain private corporations in West Virginia have had an interest in GIS for several years. Several private firms, including Appalachian Power Company, CNG Transmission Corporation, and WESTVACO, have put considerable resources into GIS development. Private companies that are strong candidates for use of GIS technology include large land holders such as mining and forestry companies and utility transmission and distribution companies with operating areas inside the state. In the last three to four years, local governments in the U.S. have actively pursued partnerships with private companies (principally gas and electric distribution) to help fund GIS projects or to share data. Such arrangements are not common at the state level, but interest exists and several states, including South Carolina, Vermont, and Michigan, have pursued cooperative GIS programs with the private sector.

West Virginia's GIS planning program has been designed to involve private firms, and recommendations for an organizational structure include an advisory body with participation from private firms. Funding support and like-kind exchanges of information with private companies can potentially provide major support for the state's GIS programs. Any agreements reached with private companies would need to provide benefits to both parties and hopefully provide a long-term relationship to support ongoing database maintenance. The state should take the lead role in pursuing agreements with private GIS users focusing on like-kind exchange of data and contributions of funding to provide "seed" money for database development efforts with state and federal agencies.

6.2.6 Special Fees

Fees placed on permits, licenses, and certain government services have been used quite extensively by local governments and, to a lesser extent, state governments, to augment revenue from other sources. State and local governments in West Virginia have the authority to impose fees on specific services as long as those fees do not exceed the cost of providing services. There is generally some latitude for setting fees for permit and license processing in programs that make direct use of GIS, such as environmental and health regulatory programs. It may be possible to make a viable argument that some costs for GIS development should be considered as part of the overall costs for evaluating permit and license applications, and providing services. Where this argument is successful, the agency may impose license fees that recover some costs for GIS development.

Two states, Wisconsin and Michigan, have passed legislation which attaches filing fees for recording property transfer deeds. These fees, collected by local taxing authorities, are designated specifically for GIS and related development projects. Part of the funds collected are allocated to the county and part for program administration by the state. Legislation establishing these funds was preceded by a considerable amount of education

and lobbying efforts. Now that the precedent has been established, it gives other states an opportunity to pursue similar programs. In both of these states, the focus has been on collecting fees on property-related transactions to improve the quality and availability of land information.

Several local governments around the country have coordinated GIS development programs with the development of E-911 and emergency dispatch systems. The rationale is that both systems rely on geographic information and, increasingly, digital maps. Time-limited add-on fees to local phone bills have provided funds for these development efforts.

6.2.7 Bonds and Tax Levies

Bonds have been used in West Virginia in the past to help finance major public improvement projects (e.g., highway development). The issuance of bonds provides a mechanism for upfront revenue generation with an established period for payback. This implies, of course, that there is a defined mechanism for paying back moneys in that bond fund and retiring all bond purchases over a specified period of time. This approach has been used in a few cases to generate funds for GIS development in several local governments in the U.S. (e.g., Knox County, TN, and Scottsdale, AZ). It is a successful approach to generate funds to support the relatively high initial costs of a GIS project incurred during the first few years of the development effort. Payback mechanisms that could include user fees are established for retiring the bonds.

Tax levies have also been used in some cases to generate funds for GIS development. Both sales taxes and add-ons to local property taxes have been successfully used to help fund information system development projects.

Bond issues and tax levies are politically sensitive and often must be approved by popular referendum. This makes these approaches a volatile and uncertain source of funds for GIS. Despite this uncertainty, they warrant some consideration, particularly if the bond or tax can be tied to a specific, popular state program such as transportation improvements, emergency response, etc.

6.2.8 Revenue Generation through Product/Service Sales

As the demand for geographic information increases, government agencies have turned to programs for sales of GIS products and services to provide partial cost recovery for GIS development and operation. This includes cost recovery for system development costs (database and computer system), not just for the personnel and material cost for producing a product. The major activity in GIS product and service sales has occurred at the local government level, but state agencies are becoming increasingly interested in recouping costs through sales.

Several important legal and programmatic issues impact the approach taken by government agencies in West Virginia to develop cost recovery programs. Among these are:

- State **open records laws** which define procedures and fees for distribution of “public records” by public or private requesters
- **Liability** issues and disclaimers which establish an agency’s responsibility for claims of damage incurred through use of an information product
- **Privacy** limitations which restrict access to certain types of information held by government agencies
- **Antitrust** issues that limit unfair competition and potentially restrict government’s ability to “compete” with the private sector in the sale of information-based products and services.

West Virginia’s open records statutes are similar to many other states--keeping a broad definition of a “public record.” West Virginia’s statute defines an open record as “any writing containing information related to the conduct of a public’s business.” Requests for copies must be granted for the cost of reproduction. This definition does not encompass digital information and thereby clouds the status of digital data and products derived therefrom as records subject to the state’s open records laws. A growing number of states, including Alaska, Colorado, Kentucky, Oregon, Iowa and others, have amended their open records laws to make provisions for sale of GIS data and products.

While the legal issues associated with the sale of databases and GIS products and services are complex, the groundwork has been laid by other local and state agencies for establishing programs that can provide partial cost recovery. The demand for spatial information products is growing, and it makes sense to put in place reasonable fee schedules for GIS products which provide revenue that encourages long-term maintenance and enhancements for the system.

The approach for implementing a program for GIS cost recovery would include the following steps:

- Conduct a legal setting analysis reviewing applicable statutes and case law in West Virginia to determine legal limits on information sales
- Define a potential market and key products for which there is high demand and project the volume of demand for those products
- Evaluate costs for GIS development and operation
- Develop a fee schedule for specific products comparing expected demand with system costs
- Develop internal procedures to respond to requests, and prepare literature “advertising” products and fees

- Implement the program and log requests.

It is not realistic to assume that cost recovery through GIS product and service sales will ever allow for recovery of a large majority of GIS costs. However, it is quite reasonable to expect product/service sales to generate sufficient revenue to off-set staff costs, ongoing system upgrades, and a part of the original GIS development cost.

6.3 CONCLUSION

This section has provided an overview of funding approaches for the GIS. In summary, PlanGraphics strongly recommended that a base level of funding be allocated by the state. The base funding would support GIS Management Unit staff, the Technical Support Center at West Virginia University, and some portion of the core database development. From this initial base funding, individual Departments and Divisions should carry out detailed planning and examine ways that funds and existing resources (staff and equipment) can be devoted to GIS development and operation activities.

West Virginia should also identify and actively pursue outside funding sources and cooperative agreements with the federal government and the private sector to provide a broader base of funding to support database development. A number of potential opportunities are discussed in this section. To a large extent, the likelihood of capitalizing on those opportunities is related to the willingness, energy, and creativity with which the state pursues them.

Other, long-term, and perhaps more politically sensitive options, were presented in this section. These included financing approaches employing bonds, tax levies, special fees, or assessments. Each of these have been used by other states and local governments for GIS and related information system projects. These mechanisms should be considered by West Virginia.

PlanGraphics strongly recommends that West Virginia examine the legal issues impacting product/service sales. Once the legal setting is established, the state should begin to develop a program for partial cost recovery through the sale of special products, on-line access to data, and subscriptions to the database. Such a program must take into account statutory issues, legal percents, and existing policy in state government. In addition, a cost recovery program must take into account participation by private companies or other organizations which may contribute resources to GIS development and therefore be a recipient of revenue generated for product/service sales.

**TABLE 2-1
DATABASE TIERS**

Database Tier Name	Geographical Extent to which Tier is Typically Applied	Base Map and Recommended Scale	Map Layers Typically Associated with Tier
Local	<u>Small:</u> Parcel or site-specific, up to an entire county. Each base map file typically covers an area ranging from 1/4 to 4 square miles.	Possibly photogrammetric base map (e.g., orthophoto). Accurate parcel-level maps compiled from plats and survey data. Depending on density of development, scales should range from 1" = 100' to 1" = 400'.	Survey control Parcel Utility infrastructure Zoning Voting precinct
Sub-regional	<u>Medium:</u> Entire county to multiple counties. A base map file may cover an area from 25 to 50 square miles.	USGS topographic quad sheets or reduced local base maps. Recommended scale is 1:24,000.	Survey control, planimetric, district boundaries, energy transmission, land cover, environmental, large tracts of land (parcels), and others which require a reasonably accurate small-scale base map to create and maintain.
Regional	<u>Large:</u> Large regions of the state. A base map file may cover 1,000 to 3,000 square miles.	1:100,000 scale USGS topographic map files.	Same layers as the regional database; tabular data removed and aggregated into larger files. Some layers may be generalized graphically.
Statewide	<u>Very Large:</u> Whole state is shown on a single map. Data portrayed at the statewide tier may be at a scale for wall display or perhaps for inclusion in a bound report.	An overview map that may show county boundaries, primary highways, primary rivers, and a few features for general location reference. The 1:500,000 scale USGS state map is recommended for the statewide base map.	Primarily used for the portrayal of generalized information. Few thematic databases would be created for ongoing maintenance in this tier.

**TABLE 2-2
PROJECTED GIS COSTS FOR FIRST FIVE YEARS OF PROJECT**

	FY 93-94	FY 94-95	FY 95-96	FY 96-97	FY 97-98	Total
Hardware/Software ¹	\$60,000	\$270,000	\$270,000	\$362,500	\$362,500	\$1,325,000
Database ²	\$220,000	\$675,000	\$675,000	\$675,000	\$675,000	2,950,000
GIS Management Staff	\$60,000	\$110,000	\$150,000	\$200,000	\$200,000	\$720,000
Technical Support Center	\$30,000	See Footnote ⁴	See Footnote ⁴	See Footnote ⁴	See Footnote ⁴	See Footnote ⁴
Consulting Assistance ⁵	\$90,000	\$75,000	\$75,000	\$75,000	\$75,000	420,000
Other Costs ⁶	\$10,000	\$7,500	\$7,500	\$10,000	\$10,000	45,000
TOTAL	\$470,000	\$1,137,500	\$1,177,500	\$1,322,500	\$1,322,500	\$5,460,000

¹Budget based on projected hardware and software costs from Table 3-2 of the GIS Conceptual Design.

²Includes average estimated database development costs for the Sub-regional, Regional, and State Tiers from Tables 2-10 through 2-13 of the GIS Conceptual Design. Costs for database items, particularly base mapping, could be shared with other entities such as the US Geological Survey, SCS, and others.

³GIS Management Unit staff costs are based on salary requirements stated in Appendix F of the GIS Conceptual Design. Although a total is shown at the end of the table, these are ongoing annual costs.

⁴Ongoing costs for the Technical Support Center will be based on need by user agencies and through negotiations with WVU.

⁵Includes costs for assistance from consulting firms to support detailed design and specifications; implementation assistance; application development; and GIS management consulting.

⁶May include costs to support in-house training programs; travel expenses associated with GIS activities; expendable materials; and other items associated directly with GIS programs.

**Table 5-1
Responsibilities for GIS Development Tasks**

Legend:

- | Lead role
- 3 Oversight/Approval
- s Review/Comment
- n Recommended Technical Support/Participation
- Optional Technical

Tasks	GIS Coordinator/Management Unit	GIS Policy Body	GIS Policy Advisory Body	GIS Technical Support Center (WVU)	GIS Steering Committee	GIS User Group	Technical Sub-committees	Department/Division Management	Division Technical Staff	Federal Agency	Private Sector GIS Users	Regional Planning/Development Council/Local Gov't.	University	Database Vendor/Contractor	Hardware/Software Vendor	Independent Consultant
PP. GIS Pilot Project																
PP1. Database Development Plan				n	s	n	n					n				n
PP2. Plan GIS Pilot		3	s	n	s	n	n	s				n				n
PP3. Execute and Monitor Pilot					s	n	n					o		o		
PP4. Document Results					s	n	n									o
PP5. Present and Demonstrate Pilot Results		s	s		s	n	n	s								
OD. Organizational and Administrative Development																
OD1. Approve GIS Plan					3			3				s				
OD2. Prepare First Year's Budget												s				o
OD3. Assign GIS Coordinator								3								
OD4. Establish Technical Support Center	n			n												o
OD5. Assign Resources to Technical Support Center	n	3			n											
OD6. Formalize Policy Body	n							3								
OD7. Establish Policy Advisory Body and Identify Participants	n									o	o	o				
OD8. Formalize User Group/Steering Committee		3			n			3								
OD9. User Group/Steering Committee Meetings	n	s	s	n	n	n		s		n	n	n	n			
OD10. Establish Technical Sub-committees				n		n	n	s	n	o	o	o	o			o
OD11. Develop Long-term Funding Strategy		s	o	n	n	s		s				s				
OD12. Detailed Departmental Planning	n	s		o				3	n							n
OD13. Long-term Budget		3	s		n							s				o
OD14. Assign Departmental Staff	n	s			n											
OD15. Formalize Procedures		s	s		n	s		s	n							o
OD16. Responsibilities for Data Maintenance		s		n				s				o				o
OD17. Establish Formal Management Unit	n				n											
OD18. Program for Ongoing Training					n	n	n					n			o	n
OD19. Conduct Periodic Audits	n				n											n
DD. Database Development and Maintenance																
DD1. Database Design--Common GIS Layers	3		s		s	n	n				s	n		o	o	n

**Table 5-1
Responsibilities for GIS Development Tasks**

Page 2

Legend:

- | Lead role
- 3 Oversight/Approval
- s Review/Comment
- n Recommended Technical Support/Participation
- Optional Technical

Tasks	GIS Coordinator/Management Unit	GIS Policy Body	GIS Policy Advisory Body	GIS Technical Support Center (WVU)	GIS Steering Committee	GIS User Group	Technical Sub-committees	Department/Division Management	Division Technical Staff	Federal Agency	Private Sector GIS Users	Regional Planning/Development Council/Local Gov't.	University	Database Vendor/Contractor	Hardware/Software Vendor	Independent Consultant
DD2. Identify Sources for Common Layers	3			s n n						n n				o		o
DD3. Database Specs-Common Layers	3			s n n								n		o		n
DD4. Database Design--Agency-specific Layers	3			n s										o		n
DD5. Identify Sources for Agency-specific Layers	3			n s						n				o		o
DD6. Database Specs--Agency-specific Layers	3			n s										o		o
DD7. Acquire Existing Digital Data	3			s		n				n n						
DD8. Select Vendors/Assign In-house Resources	3	s	s													o
DD9. Design QC/Acceptance--Common Layers	3					n								o		n
DD10. Conduct Conversion--Common Layers	s					n		n		o o				n		
DD11. Carry out QC--Common Layers	s					n		n		o						
DD12. Select Vendors/Assign In-house Resources	s 3	s	n 3			n										o
DD13. Design QC/Acceptance--Agency-specific Layers	s			n												o
DD14. Conduct Conversion--Agency-specific GIS Layers	s			n s				3						o		
DD15. Carry out QC--Agency-specific Layers	s			n s				3								
DD16. Data Maintenance and Exchange Procedures	3	3	n n	s n	s	n s				s s				n		n
DD17. Database Directory and Meta-database	3	3	n	s n	s	n s								n		n

**Table 5-1
Responsibilities for GIS Development Tasks**

Legend:

- | Lead role
- 3 Oversight/Approval
- S Review/Comment
- n Recommended Technical Support/Participation
- n Optional Technical

Tasks	GIS Coordinator/Management Unit	GIS Policy Body	GIS Policy Advisory Body	GIS Technical Support Center (WVU)	GIS Steering Committee	GIS User Group	Technical Sub-committees	Department/Division Management	Division Technical Staff	Federal Agency	Private Sector GIS Users	Regional Planning/Development Council/Local Gov't.	University	Database Vendor/Contractor	Hardware/Software Vendor	Independent Consultant	
PO10. Policies/Procedures for Distribution of Products/Services		3	3	n	n		n	s			s	n					n
PO11. Program for Product/Service Distribution		3	3	n	n		n	s		s	s	n					n