

**POTENTIAL GIS BENEFITS**

**FOR**

**WEST VIRGINIA**

**Submitted to:**

**Mr. Thomas E. Holder, Manager  
Planning Unit, Research and Strategic Planning  
West Virginia Development Office  
Building 6, Room B-553  
Charleston, West Virginia 25305-0311  
(304) 558-4010**

**Submitted by:**

**Peter L. Croswell, Executive Consultant  
Tom Herrick, Design Analyst  
PlanGraphics, Inc.  
202 West Main Street, Suite 200  
Frankfort, Kentucky 40601-1806  
(502) 223-1501**

**June 8, 1993**

**The preparation of this report was financed in part by an Appalachian Regional Commission grant to the West Virginia Development Office (Project Number WV-11005-92-I-302-0310; Contract Number 92-76).**

## POTENTIAL GIS BENEFITS

### INTRODUCTION

A large portion of ongoing programs in state agencies are land-related and can benefit tremendously from the development and implementation of a statewide GIS. One of the primary intents of developing a statewide GIS is to reduce the duplicative efforts and the limitations and deficiencies that result from inconsistent and dated information. This study reveals that there is a significant level of redundancy, inconsistency, and duplication of effort in the preparation, maintenance, and distribution of maps and geographic information. A geographic information system (GIS) provides the tools and a systematic approach to data management that staff may use to reduce or eliminate redundancies and data inconsistency. By implementing a GIS, West Virginia can realize direct benefits in staff efficiency, improvements in delivery of service, and reductions in capital project costs.

The initial cost of developing a statewide GIS is significant, and the overall project should be undertaken in phases. PlanGraphics recommends that the funds expended toward GIS development be considered an investment for the future.

A properly managed geographic information system can enable its users to derive benefits, both quantifiable and intangible. Estimates of quantifiable benefits can be predicted based on predetermined measurable criteria, and reported as monetary savings or labor reduction. Intangible benefits are not measurable because they are unpredictable (e.g., coordinated emergency response), or because their worth in dollars or labor cannot be measured with any reliability (e.g., improved public image). In this report, PlanGraphics presents the types of quantifiable and intangible benefits that West Virginia is likely to accrue from its GIS project.

Some GIS benefits are realized nearly as soon as the initial phase of GIS becomes operational, and if properly managed, additional benefits will be realized as the system matures. Examples of the processes of a maturing GIS and the benefits that accrue over time are presented below:

- Benefits that can be derived simply by having maps in digital form and using automated drafting plotters can be realized early in the project.
- After more detailed database development and custom application programming have taken place, a wider range of benefits can be realized.
- Over time, organizations and individuals will develop a well rounded experience and education regarding GIS enabling them to take the fullest advantage of the technological and organizational setting available to them.

- Further benefits may be realized when improved analytical capabilities and data availability enable users to respond to an emergency situation with much more speed and effectiveness.

GIS technology can be used by West Virginia to realize a wide range of benefits in daily operations and decision-making processes. In this report, PlanGraphics explains the range of benefits that we believe West Virginia can realize.

The degree to which the potential benefits are realized will depend on how the GIS is implemented. Implementation factors that will influence the level of benefits are presented after the range of benefits.

This report is not a benefit/cost analysis. PlanGraphics was not requested to conduct a benefit/cost analysis, nor does PlanGraphics recommend that one be conducted for a group as large and diverse as the participants in this initial planning study. Such a study would be quite unwieldy and would not account well for the existing situation that encompasses a wide range of activities already under way in local, regional, state, federal, and private organizations. PlanGraphics conducts benefit/cost analyses where we believe their results will provide reliable guidance to management.

### **Summary of Opportunities and Areas for Improvement**

The very fact that this GIS planning project is being undertaken is an acknowledgment of some deficiencies. The number of project participants and their level of interest is a summary demonstration that there are many opportunities for improvement.

The primary opportunity is to share data between the many project participants. Efforts should proceed toward coordinating GIS activities within the decentralized environment. The character of these evolutionary efforts will be determined by funding availability, organizational relationships, and technological advances.

Some of the major opportunities for improvement are as follows:

- Establishing an organizational structure that is formalized and suitably structured to support technical, management, and policy level decision-making regarding GIS
- Reducing duplications of effort in maintaining the same data between state government agencies, and local, regional, federal, and private organizations
- Developing a series of base maps that will support a wide variety of needs for database development, map production, and analysis
- Installing a data communications network that will enable project participants to share data that is currently inaccessible

- Instituting data standards that will improve both the technical ability to share data and the desire to share due to improved usability of data.

Addressing these opportunities will result in an improved environment for the affected organizations. The amount of benefit derived from making these, and other, improvements will depend largely on the level and effectiveness of coordination between the participants.

### **Critical Implementation Factors**

The level of benefits that will ultimately be derived from a statewide GIS is dependent on how the GIS is implemented. PlanGraphics has identified ten factors that we believe are critical to the overall success of the GIS project, and as a result, to the level of benefits that can be expected. We recommend that these factors be carefully considered as West Virginia begins development of its GIS.

1. Experienced staff should 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.

### **Types of GIS Benefits**

PlanGraphics has identified the types of benefits that West Virginia may derive from implementing a GIS in order to provide a framework for understanding. As was stated earlier, there are two general categories of benefits, quantifiable and intangible. Below is a listing of the types of benefits associated with the two categories.

#### Quantifiable Benefits

- Improved efficiency over current practices
- Expanded capabilities
- Non-personnel benefits

#### Intangible Benefits

- Cost avoidance in decision-making
- Citizen perception
- Customer services
- Platform for new applications
- Avoidance of outside contractor expense
- Marketing of GIS products and services
- Unpredictable events

These benefit types are discussed and further explained under their associated headings in this report.

### **QUANTIFIABLE GIS BENEFITS**

#### **Improved Efficiency over Current Practices**

Efficiency of labor can be improved in four areas.

##### 1. Mapping and Drafting

Staff that are involved with mapping and drafting activities often achieve average improvements in efficiency ranging in the neighborhood of 50 to 60 percent. A GIS will enable staff to become more efficient by eliminating most manual, repetitive drafting tasks through the use of automated drafting plotters.

## 2. Collecting, Verifying, and Recording Geographic Data

The GIS will enable users to speed data entry and update while improving data quality and, thereby, can be expected to reduce data collection and processing labor by up to 35 percent. These benefits may be achieved because GIS software can be used to create standard data screens with built-in logic checks (for example, specifying a range of acceptable values) for individual entries. The software can also force an operator to properly enter data by not proceeding with the process until an acceptable entry is provided. Other productivity gains will come about because users will be able simultaneously to update or change multiple records where information is the same (such as mass re-coding of records where a district boundary is changed).

## 3. Using and Analyzing Maps and Geographic Data

This activity has three components: a) finding and handling documents and information (approximately 50 percent of task time); b) working with information, once found (approximately 25 percent of task time); and c) documenting work graphically in text or tables (approximately 25 percent of task time). Generally, the time involved with searching for geographic data (maps and files) can be reduced by about 75 percent through implementation of a GIS. Analysis time, however, can be either reduced or expanded depending on the type of project. Often, more and reliable data may enable analyses that weren't feasible prior to implementing a GIS, so more time is spent in analysis. In general, analysis time may remain the same. Documenting efforts may be significantly reduced by up to 50 percent. Some of the labor saved from searching and documenting efforts can be budgeted toward more in-depth analysis or different kinds of analyses that are not now undertaken.

## 4. Supervision and Quality Assurance

Supervision labor is generally reduced in proportion to the reduction of labor in the previous categories. GIS users will be able to produce products that have more consistency in presentation and data quality than is now possible. Labor saved in each of the categories can be apportioned to additional quality control efforts, particularly in data collection and processing, so that users can come to rely on data collected by others without the need for a new independent evaluation.

### **Expanded Capabilities**

Given that the GIS affords increased access to data and more available labor, user agencies can do things that they were not capable of before. This is distinct from the things that agencies may do better with a GIS. Benefits derived from expanded capabilities from the GIS can be considered equivalent to having additional staff. Tasks that were formerly postponed, avoided, or dismissed as unfeasible because of extraordinary staff time and effort can be accomplished using the GIS to provide new products and services.

## **Non-personnel Benefits**

For governments, increases in staff availability and technical capabilities can reduce the need for some of the work now contracted out. Non-personnel benefits can be gained through added capabilities that a GIS provides, thus reducing the cost and number of outside contracts for services.

## **INTANGIBLE BENEFITS**

In addition to benefits that can be quantified, there are benefits that are not feasible or are impossible to quantify. These benefits remain intangible for three reasons: a) because the time and effort required to quantify some benefits is excessive; b) because the benefit (e.g., improved citizen perception of government) is impossible to quantify; and c) because some benefits are only realized when using the GIS to cope with an unpredictable event. Despite the unquantifiable nature of some GIS benefits, there are enough experiences, case studies, and professional papers published on the intangible benefits realized from GIS that West Virginia should consider them when weighing whether or not to proceed with the project.

The primary types of intangible benefits are identified in the following list:

- Cost Avoidance Decision-making
- Citizen Perception
- Customer Service
- Platform for New Applications
- Marketing of GIS Products and Services
- Unpredictable Events.

Descriptions of the intangible benefits follow.

### **Cost Avoidance Decision-making**

A decision support tool based on information shared between departments, and with different levels of government, enables cost avoidance that is not quantifiable. GIS technology can significantly expand the capability of an organization to perform proactively rather than reactively. The ability to "fix it before it breaks," to include more criteria in a design, or to identify and avoid potential mistakes can result in cost reductions.

There are many scenarios for cost avoidance decision-making using GIS technology, whether that cost is in dollars or public perception. The most common case is avoiding damage to one project while planning or performing another. For example, a planned minerals exploration that is under consideration by an environmental agency may not be coordinated with plans for a new trail planned by a parks and recreation agency.

Retrofitting the landscape for the recreational trail will likely cost more than if the design was considered during the minerals permitting process.

GIS technology can be used to identify patterns of complaints (potholes) or work orders that can be used to focus maintenance activities. Further, the GIS can be used to identify and plan maintenance activities on a regular scheduled basis. Planned maintenance is less costly than reactive maintenance, and minimizes loss of service to the citizens. The savings of lost service or energy is not quantifiable, but is a major reason for developing a GIS.

Plans for future capital construction can increase significantly if conflicting land use limitations or other factors are not considered. GIS can be used as a conflict avoidance tool by performing "what if" inquiries, and developing alternatives for review by all concerned parties. Least cost alternatives can also be investigated using the planned GIS. Plans for capital construction projects, land use, and development are expensive to correct after implementation and capital investment. The savings from avoidance of such loss is not quantifiable.

### **Citizen Perception**

The perception of government is marred when citizens witness one agency spending tax dollars to defeat the plans of another agency. Arguably, the cost in confidence and support for government is greater than the lost dollars for the extra work to correct the conflict. Another aspect of the intangible value to perception applies to West Virginia government staff. Use of this technology allows more timely and professional response to inquiries for information. Providing better services is not limited to an improved perception of government efficiency by the public. Several authors have noted the increased effectiveness and longevity of staff that are proud of the job they perform. If one valuable staff member stays with an agency due to the GIS, a significant benefit is achieved.

### **Customer Service**

Many requests for information are made today and are met with oral or written responses. Users of a GIS can more effectively coordinate information from diverse sources, and establish graphic versions of the answers that reduce volumes of complex text into a more easily understood picture. GIS use can enable staff to provide responses to information requests from the public and business that were not feasible to undertake in the current environment. This ability will also be visible in the production of better materials to be included in the many publications of the West Virginia government. The benefits that West Virginia may realize from improved services to citizens and businesses cannot be quantified.

## **Platform for New Applications**

The application development opportunities provided by a GIS are dynamic. There are many standard or common ways that governments apply GIS technology. However, there are many applications that aren't anticipated because no one has invented them as yet. The longer the GIS is available to staff, the better they will be able to take advantage of the capabilities and to apply their own ingenuity and inventiveness to solving problems using the technology. The potential for increased benefits grows exponentially with the creation of new applications.

## **Marketing of GIS Products and Services**

Many governments that implement a GIS plan to sell information products and services to offset maintenance costs or to partially recover system development costs. Standard products, custom products, analyses, and subscriptions to GIS databases can be offered for user fees. West Virginia has an opportunity to realize financial benefits once databases are completed. The potential for such cost recovery is a benefit of implementing the GIS that cannot be quantified.

Another aspect of GIS product marketing is the opportunity to share costs for developing databases with entities outside of the government who need the same or similar data. The potential addition of timber companies, mineral resources companies, or utilities and other corporations as partners in developing parts of the GIS database where mutual interest is served will reduce development costs for all parties concerned. Such opportunities are unique benefits of this project that cannot be quantified until they take place, but have been proven in many other projects to be an effective way to reduce the costs of GIS development for all participants.

## **Unpredictable Events**

Hundred-year storm events, forest fires, and other emergency situations generally involve the potential use of GIS, both in pre-emergency planning and in emergency response. The benefits of such GIS applications are quantifiable only after the event, and are thus intangible. Of particular note is the protection against internal catastrophic loss of paper records, which will no longer be at risk once the existing paper information base is converted to digital form with appropriate backups.

## **CONCLUSION**

All of the participants in the GIS Long-range Planning Study conduct land-related activities that fall into the various categories of potential GIS applications discussed in this report. More GIS applications will be available in the future to match evolving missions and new activities, as well as more creative support of existing activities using the GIS technology in ways not yet anticipated. Most of the entities participating in the

study could make significant use of GIS technology, and PlanGraphics believes that the underlying justification for developing a statewide GIS is confirmed.

The opportunities identified in this report are vast, and each incorporates significant quantifiable and intangible benefits. Improvement in land development decisions, long-range planning, resource management and allocation, and infrastructure management are all reasons that could alone justify further development of GIS technology. Implementation of a GIS will place West Virginia in a position to take advantage of investments being made by other entities such as the federal government and large corporations. Inherent in the West Virginia GIS is a potential theme for increased cohesion between state agencies, and with the outside entities with which the state interacts.

The potential benefits, whether examined on the basis of economies or improved service, are compelling. Any plan for GIS will encounter difficulties and will require innovative action by the parties involved to champion its successful implementation. The vision of potential benefits, whether or not quantifiable, should be regularly reviewed and results spread among policymakers in state government in order to keep the institutional progress moving forward.

Perhaps the greatest overall benefit of GIS technology is the cooperation among traditionally independent agencies that it requires. Cooperation and information sharing among diverse agencies does not automatically result from a study concluding that better service would result. However, in many cases, forward-looking individuals can use the GIS project to inspire the joint planning, pooled resources, and enhanced inter-agency communication that are necessary to actually produce the potential benefits.