GIS Strategic Plan

Montgomery County, Maryland

PLANGRAPHICS, INC.

Geographic Information Systems Consulting and Implementation Services

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Submitted By: Michael J. Kevany, Senior Vice President
James R. Cannistra, Vice President
Amy J. Purves, Project Manager
PlanGraphics, Inc.
1300 Spring Street, Suite 306
Silver Spring, Maryland 20910
(301) 588 8535

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INTRODUCTION

Summary

A County wide strategic planning effort has been undertaken for GIS implementation efforts at five agencies.

Five agency plans have been prepared for: M-NCPPC, The Montgomery County Executive Branch, Montgomery College, Public Schools, and WSSC.

This County-wide *Strategic Plan* has been developed to identify and address key, common requirements across agencies.

BACKGROUND

GIS activities have been ongoing within Montgomery County for ten years. Initial activities included an analysis of user requirements, the development of implementation planning documents, completion of system and database designs, and the completion of a bi-county GIS Pilot Project (GeoMap). County agencies, including the Executive Branch, Public Schools, Montgomery College, M-NCPPC and WSSC, have formed the MC:MAPS consortium to coordinate and guide GIS implementation activities. M-NCPPC and the Executive Branch have been using GIS technology in an operational environment for the past several years. The development of the MC:MAPS common GIS database is more than half complete. WSSC within the past year has begun full scale data conversion of its water and sewer facilities. In addition, Public Schools has become a GIS user. Montgomery College offers GIS classes as part of its Geography curriculum.

Small-scale County-wide data such as the GBF/DIME and related census data is now complete and the large-scale (1"=200') planimetric, digital orthophoto, topographic and property base layers are complete for a large portion of the County. Over the past several years a significant amount of hardware and software has been installed throughout the County agencies, several system and software upgrade cycles have occurred, selected GIS applications have been developed, a user base has been established, and many mapping products have been generated from the GIS. As the participating agencies have made significant progress in GIS development, the level of investment of resources and staff has also increased.

The GIS will be used as the primary desktop information and analysis tool within the agencies and will streamline many workflows and tasks. *The key challenge to be addressed over the next five years is the expansion of the user base from a core group, to a much larger number of users. It is only with this expansion that the benefits of the County's investment in the MC:MAPS database will be realized.* The agencies must now focus on completing their data conversion initiatives, while at the same time providing economical, high performance GIS access, applications, and support and training resources to users.

STRATEGIC PLANNING CONCEPT

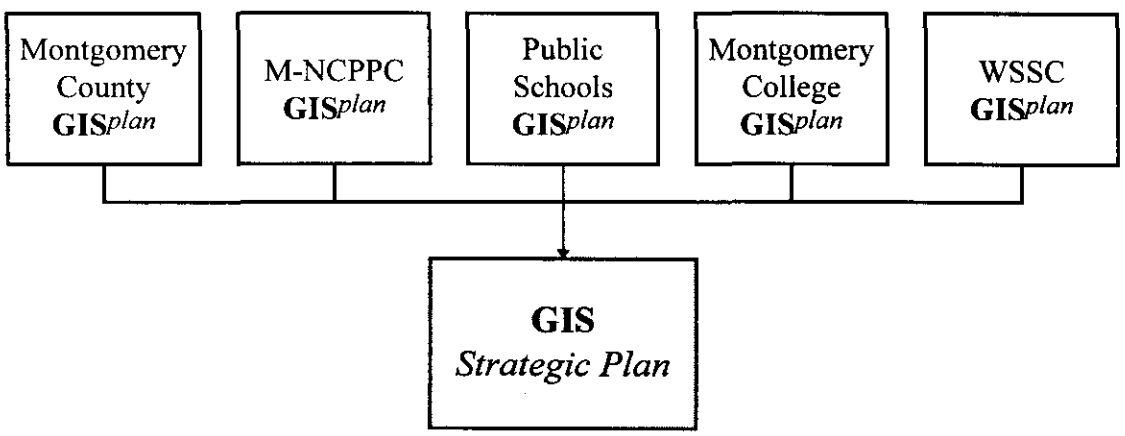
The primary goal of the strategic planning effort is to maximize the County's investment in GIS by recommending ways to expand the GIS user base throughout the five agencies. The agencies involved have engaged in the County-wide strategic planning effort to ensure that GIS development activities are conducted and coordinated as efficiently as possible and that development priorities are evaluated on a County-wide basis.

The objectives of the strategic planning process are as follows:

- To identify key issues that impact County-wide GIS development.
- To identify common GIS requirements that exist across agencies.
- To identify opportunities for greater efficiency through sharing efforts and resources.
- To prioritize GIS development on a County-wide basis.
- To identify areas for standardization and coordination.
- To identify implementation tasks that address the requirements.

The first component of the strategic planning process is the preparation of GIS expansion plans for the five individual agencies that address the particular requirements, issues, and environment of each agency. These plans have been prepared and provided to the agencies and the GIS committees. The second component is the development of the County-wide *Strategic Plan*. This document is the *Draft Strategic Plan* and contains the following elements:

Summary of Requirements
Application Requirements, Priorities, and Action Items
Database Development Requirements, Priorities, and Action Items
System Expansion Requirements, Standards, and Action Items
Organizational Requirements and Action Items
Implementation Cost Factors



AGENCY RESPONSIBILITIES

As described, the agency plans and the County-wide *Strategic Plan* have identified requirements, priorities, resource requirements, and phasing for supporting the GIS implementation effectively. Following the adoption of the plans, the agencies need to develop more detailed approaches for specific implementation areas. These are identified as action items or tasks in the plans.

Each agency will need to finalize staffing resources, develop an internal training plan, and develop budgets for resources to support the GIS, including specific application or database projects. Agencies must budget and procure hardware and software to support LAN expansions. The immediate task of each agency is to prioritize applications and prepare workplans for getting applications developed.

All of the agencies involved in the GIS implementation must work together through the GeoMaP and MC:MAPS policy and technical committees to develop core applications and shared database development efforts. Strategies for apportioning the funding of critical database development areas must be determined. The training program to be utilized by all agencies must be scoped and developed, including funding and fee strategies. The expansion of the WAN and recommended changes to the FiberNET phasing must be budgeted.

Interagency Activities	Agency Activities
• Application Coordination • Database Development • Training Program • WAN Expansion	• Staffing Resources • Training Plan • Application Priorities • HW/SW Acquisition • LAN Enhancement • Budget Preparation

AGENCY PLAN HIGHLIGHTS

Montgomery County Public Schools

The Public Schools will use the GIS to manage school attendance areas and more accurately represent and maintain school boundaries. Projected enrollments and trends will be analyzed by accessing a wide range of GIS data available through the other agencies. It is recommended that the GIS be introduced to the classroom as enrichment activities for special programs, both as a teaching aid and as a study area.

Montgomery College

The College will become an active GIS user, analyzing enrollment patterns, student locations and job sites to better plan campus curriculums and resources. The GIS curriculum offered by the Geography Department currently will be expanded to provide a more complete offering in GIS technology, concepts, and hands-on skills. The College may participate in or provide the full capabilities of the County-wide Training Program which has been conceptualized in this planning effort. The level of involvement and responsibility will depend on the scope of the Training Program and the interagency funding agreements.

Executive Branch

The expansion of the GIS within the Executive Branch departments will be the greatest experienced by any of the GIS agencies. It is recommended that the Executive Branch devote resources to supporting expansion of the user base to 250 GIS users within the five year period. This will require additional staffing and training resources. The Executive Branch core GIS support staff will continue to participate in the development of the parcel database and will enhance the GBF/DIME significantly. The development of a Permits System which is integrated with or accessible from the GIS will be a primary concern. DEP will continue the conversion of the storm drainage facilities data and will develop other natural resources layers.

In addition to supporting the development of utility and core applications, the DIST GIS Team will identify focus areas for other application development.

Public Safety and Emergency Management
Transportation Planning and Operations
Health and Human Services
Infrastructure Management
Permit Review and Tracking
Development Review Support
Floodplain Hazard Analysis and Water Resources Management
Voter Registration Support

The expansion of the FiberNET is a high priority for establishing high speed communications throughout the GIS user community. Connection of WSSC and M-NCPPC to the Executive Branch through the FiberNET or other high speed option is a priority.

M-NCPPC

The development of the parcel and planimetric layers will be completed during the second year of the planning period. M-NCPPC will work with the Executive Branchand Maryland Department of Taxation (MDAT) to develop an integrated, current parcel database which M-NCPPC will maintain concurrent with the parcel GIS layer. It is recommended that the zoning and address GIS layers be jointly funded (perhaps as CIP projects). Like the Executive Branch,

the M-NCPPC will be required to expand staff and training opportunities in order to support the growth to 200 GIS users.

In addition to the core applications which M-NCPPC will have responsibility for developing, the following application areas must be supported:

Community Planning
Development Review Support
Development Tracking
Park Facilities and Inventory, Scheduling
Natural Resources Information Management
Transportation Planning
Zoning Review, Approval, and Regulation

WSSC

WSSC will continue development of the water and sewer facilities data and integration of facilities with the MMIS and other systems. The facilities conversion is dependent on the base map completion. Facilities conversion for a portion of the service area should be completed and made available to users as soon as possible. Key concerns for WSSC include the coordination of data received from Montgomery and Prince George's Counties and the impact of differing approaches on the data conversion and development of applications.

Important application areas for WSSC are:

Water Resources Planning
Flow and Demand Estimation
Development Review Support
Water and Sewer System Maintenance Activities
Survey and Control Data Maintenance

As with the Executive Branch and M-NCPPC, WSSC must prepare to support significant growth in GIS users to 300 users throughout the Commission within the five year planning period. GIS staff resources are needed to provide adequate user support. WSSC must continue to work with both Counties to develop data standardization and exchange procedures. WSSC should continue to participate on the MC:MAPS Committee and support and contribute to the County-wide implementation activities.

SECTION 2
REQUIREMENTS SUMMARY

Summary

The key requirements of the agencies County-wide are:

- Develop **core applications** which will be used by all agencies
- **Applications which span agencies** will be jointly developed.
- A **communications network** is required so that all agencies can effectively communicate through the GIS.
- Develop a **County-wide training program** for GIS.
- **Shared development of major database components** such as zoning and address layers.
- The **MC:MAPS committee** will continue to help coordinate interagency GIS activities in Montgomery County.

INTRODUCTION

The five agency GIS Plans each identified requirements for supporting the GIS implementation as well as each agency's priorities and major benefit areas. In this *Strategic Plan*, several functional areas which can benefit greatly from GIS utilization, especially in concert with refining and streamlining functional workflows which involve multiple agencies are identified. Other areas where interagency cooperation will be essential to efficient GIS implementation were also identified. The County-wide requirements for supporting the GIS are described in this section.

GIS Vision

- The GIS system will be the **repository for accurate spatial information** related to the geography and infrastructure of the County. It will be the primary system where land related data is stored and accessed.
- The GIS will be a **user friendly desktop tool** and will become an inherent part of daily functional operations for a wide range of users.
- The GIS will be **integrated with the information management systems** of the agencies and all new significant systems, which manage spatial information.
- **There will be a core staff of GIS professionals** within each user agency that will manage and support the individual agencies GIS related requirements. The core staff will support users throughout each agency, and represent the agency on interagency issues and concerns.

COUNTY-WIDE REQUIREMENTS

The following requirements were identified during the strategic planning process and are described in detail in later sections of this *Strategic Plan.* Many of these requirements must be met by three of the five agencies: the Executive Branch, M-NCPPC, and WSSC. These three agencies will be performing the bulk of the technical development as the GIS implementation progresses. The MCPS and Montgomery College will participate as appropriate, mostly through continued representation on the GIS committees.

Core and Utility Applications

A set of applications were identified and defined which are essential to supporting database maintenance and enhancements and which provide a wide range of basic GIS functionality. The core applications customize the GIS environment and provide users in all agencies with tools to perform analysis of GIS data. These applications have been prioritized and phasing for their development has been recommended. The agencies must cooperate in their definition and development. They will be used as the basis for development of some of the functional applications to be developed later.

Functional Applications

Many functional areas among the agencies were identified which should be largely supported by GIS applications. Distinct applications were identified in each of the agency plans. Some of these areas involve at least three of the GIS agencies. These are processes in which the agencies participate in various stages of review and analysis, providing input to other agencies and coordinating responses. These areas consume a large proportion of work effort in some agencies and are also very time sensitive and critical to the public and the development community. Supporting these areas effectively with the GIS will provide significant opportunities for streamlining and reducing workload.

Interagency Functional Areas to be Supported by the GIS
Development Review Process
Permit Review, Tracking, and Enforcement
Zoning Approval and Regulation
Water and Sewer System Planning
Public Safety
Environmental Resource Management and Protection

All of these areas involve the three primary agencies: the Executive Branch, M-NCPPC, and WSSC. A major long term benefit of the GIS will be to use the GIS database, applications, and network to facilitate the interagency processes and communications necessary to efficiently conduct these critical functions.

Coordination of application and database development efforts must take place. The committees should determine appropriate agency responsibilities and funding shares for these efforts.

Database Development

Over 25 GIS data layers have been identified which require development during the five year planning period. These will be referenced to the property and planimetric base layers which are currently being developed. Many of these layers will be developed as part of normal operations and will be developed by agency staff. However, a few are fairly major development efforts which will likely require contractor support and which should be jointly funded by the appropriate agencies through the CIP. These include:

Zoning Conversion
Address Data Conversion
GBF/DIME Enhancements
Floodplains
Land Use/Land Cover
Soils

GIS Development Standards

Many requirements and activities must be addressed on a County-wide basis. The need to establish standards for both application and database components as well as documentation and metadata standards was identified. The committees should coordinate the development of these standards. The original GeoMaP data structures for property and planimetric base layers have been modified and redefined in both Montgomery and Prince George's County. Attempts should be made to identify valid changes to the data structure, update the data structure, normalize the data structure for both Counties, and document the current, finalized data structure.

New Technology

Several areas of new technology will be implemented by the agencies. In these areas, the agencies should cooperatively investigate the technology, share experiences, and jointly adopt strategies and standards for their implementation.

An important technology to be used by all agencies is Global Positioning Systems (GPS) to support field survey, inventory of features or sites in the field, and position tracking. The agencies should cooperate in identification of appropriate GPS strategy, equipment, testing, and implementation for selected pilot projects.

Many user groups within agencies have requirements for scanning documents which will be linked to GIS features for automated access. In cases where a large volume of documents and document flow must be managed, the use of an Electronic Document Management System (EDMS) may be necessary. The agencies should evaluate and acquire an EDMS which meets the needs of all the agencies. The EDMS must be integrated with the GIS.

ESRI's new product for spatial analysis, the Spatial Database Engine (SDE) has potential for implementation by the GIS agencies. The SDE stores spatial data in ORACLE and provides an Application Program Interface (API) which supports function calls from the GIS (ArcView) to

the SDE. The primary advantage of implementation of SDE will be much better response times to queries and better support for many users on the network. Particularly for large parcel databases and the large amount of data accessed by WSSC, the SDE may provide advantages.

Wide Area Network Expansion

The County-wide communications network must be significantly enhanced in order to support the high-speed communications needed by the GIS agencies. The FiberNET Master Plan meets most of the GIS needs with the exception of connecting the WSSC Hocevar Office Building in Laurel to the County and M-NCPPC networks. Changes to the phasing of the FiberNET have also been recommended to achieve the GIS connectivity sooner. The County will be responsible for modifying the FiberNET plan and implementing the network as described.

Organizational Requirements

The agencies must cooperate in defining, developing, and conducting the shared Training Program. This will allow all to benefit from reduced training costs. The fees charged must be used to defray the program costs.

All agencies must dedicate adequate staffing to their GIS core support groups as well as to the user organizations that have requirements for internal GIS support.

With these elements of the implementation addressed cooperatively by the agencies, the successful implementation of the GIS and realization of substantial benefits can be assured.

SECTION 3
APPLICATION REQUIREMENTS

Summary

Over **200 distinct applications** have been identified in the agency GIS plans.

The highest priority applications are ***utility* applications** which support database development and maintenance and ***core* applications** which meet broad requirements of all agencies.

The agencies should **cooperate in the development** of core applications and jointly **adopt application standards**.

Each agency should **prioritize functional applications** and prepare an application development plan.

INTRODUCTION

The effective and efficient use of the GIS and the graphic data which has been captured is dependent on the development of GIS applications which provide menu-driven, user-friendly analysis and mapping capabilities. Application development is necessary to customize the user interface, perform repetitive functions, and perform complex analyses of geographic data.

The Executive Branch DIST has completed enhancement of the GBF/DIME which is the County-wide street centerline network. Many application requirements can be supported with this data, including County-wide mapping, address matching, and demographic analysis. The property and planimetric base layers being developed by M-NCPPC are complete for a large area of the County. Parcel-based applications can be developed for use in those areas which are complete and will then be ready for use once the database is completed in July 1997.

Application development should proceed in parallel with the completion of the GIS database and should be a primary focus within the Executive Branch in the next two years.

APPLICATION DEFINITION

Three categories of applications have been defined to support County-wide application identification—utility, core, and functional applications. *Utility* applications are required for developing and maintaining GIS data layers and related databases. These provide essential functions which support database development, quality control, and maintenance. *Core* applications are those which provide common functions required by a broad range of users throughout the participating agencies. *Functional* applications support specific analysis and requirements which are more unique to one set of users.

Application types:

* Utility
* Core
* Functional

Many *utility* applications were identified to support the database development and maintenance responsibilities of individual agencies. These are described in the individual agency plans. For each agency, *core* applications were identified, which provide needed functions across user groups and agencies. The *core* applications also may serve as the foundation for many of the specific *functional* applications identified.

For each agency, applications were identified through the focus groups, interviews, and data collection activities. In each agency plan, all applications are described in tables which provide a cross-reference between the applications and other parameters such as development effort required, development tools, integration requirements, and an overall estimated value. *Only the utility and core applications identified for all agencies are listed in the application table at the end of this section.*

Application Table Elements	
Value	Overall value of the application: 1 Highest 2 Medium 3 Lowest
User-specific	The application is unique to this user.
Multi-use	The application will be used by multiple users and functions
Generic Capability	The application can largely be supported by core applications with minor customization.
Tailored Development	The application requires significant tailored development.
Development Effort	Estimate of development effort: 1 Less than 1 month 2 1 month to 4 months 3 More than 4 months
Development Tools	Tools required to develop an application:
ArcView	Customize views
AVENUE	Menus, remote procedure calls
AML	AMLs for ArcEdit and ArcPlot functions
ORACLE	Database development, screens, reporting
Other database	Integration of other non-ORACLE data
User Departments (*Agency Plans only*)	Identification of users who will benefit from the application.
Development Responsibility (*Strategic Plan only*)	A proposed shared responsibility between agencies for development of each application is provided if appropriate.
Year	For high priority applications, the year during which the application should be developed is indicated. This is not provided for applications which are lower in priority or are contingent on the results of earlier application efforts.

Development Effort

For each application, a rough estimate of the development effort has been made. The development effort indicates a range of person-months of effort, not the duration of the application implementation. The effort is purely technical (programming and documentation), not coordination, scoping, or training related to the applications. It does not include long-term requirements for application maintenance and support. For many applications which have a development effort of "1", which is less than one person-month, the effort may actually be less if the application is based on core applications and very minor customization is necessary.

Core applications should be developed as a cooperative effort between agencies. The primary agencies that will be sharing in application development—M-NCPPC, Executive Branch DIST, and WSSC—will each be responsible for particular core applications and will coordinate requirements analysis and development with the other agencies.

Application Prioritization

Several of the parameters defined for each application can assist in the overall prioritization of application development work. The *value* of the application is an indicator of the relative importance of the application to the functional responsibilities of the organization. A value of "1" indicates that the application should be implemented within 12 to 18 months if possible. A rating of "3" does not imply that applications are not important, but that they should be implemented after those rated with "1" or "2."

By considering the combination of the value and the development effort, as well as other factors, such as number of users benefiting, an overall ranking of the applications can be performed. For this planning effort, an attempt has been made to allocate application development efforts over the five-year planning period. In the Strategic Plan, this is only illustrated for the core applications.

Each agency should prioritize its application areas on a functional basis, identifying high priority or mission critical areas such as development review, code enforcement, or health related applications. Within functional areas, individual applications should be prioritized. This will provide the basis for designing and developing applications in a phased manner.

UTILITY APPLICATIONS

Utility applications for database development, maintenance, and enhancement are very important to the long-term integrity of the GIS database and user confidence in the GIS. Many existing utility applications are in use to support database development and quality control efforts of the agencies. Additional utility application which are needed to support ongoing and new development efforts were identified in the agency plans. The application table at the end of this section describes the key utility applications, including:

Parcel Update	Zoning Data Maintenance
Address Assignment	GBF/DIME Maintenance and Update
Metadata Maintenance	CAD Drawing Index

These applications and others have been described in the individual agency plans. The address and zoning applications will be developed in conjunction with the development of the address and zoning GIS layers. The most critical of the utility applications are:

Parcel Update The existing parcel update procedures will be modified and enhanced to reflect recommended changes in parcel data maintenance procedures, including input of subdivision and record plat boundaries into the GIS, input of unique parcel identifiers in advance of tax account ID assignment, and concurrent maintenance of related parcel attribute data. The enhancement of this application should be done as part of the development of the integrated parcel database.

Metadata Maintenance The development of metadata appropriate to the different GIS layers, GIS features, and attribute data is essential to understanding and utilizing the GIS database. The input and maintenance of metadata should be included in all data maintenance procedures. While metadata should be reviewed and maintained by database administration staff, individual elements will also be maintained in other applications.

GBF/DIME Maintenance The GBF/DIME file will be migrated from the IBM mainframe to the UNIX environment for maintenance through the GIS. An application which supports modification of the GBF/DIME, including adding segments, intersecting segments, enhancing spatial accuracy, and correctly maintaining the GBF/DIME attributes is essential. The application must be robust and ensure that the integrity of the tabular GBF/DIME file is maintained.

CORE APPLICATIONS

A set of GIS applications required by users within all agencies to varying degrees has been identified. These provide access to GIS data and related databases and basic tools for query, display of data, and map generation. These applications are described below and in the table at the end of the section.

The first four core applications should be developed in an integrated fashion. They should form the basis for later development in terms of providing an application template or standard as well as an interface to other applications. They will support many of the functional areas described later with minor modifications needed in some cases. The core applications are priorities for all agencies.

As identified in the application table, the development of many of the core applications should be shared or allocated between the agencies. Plans for funding and acquiring necessary technical support should be developed by the agencies. Most of the core applications should be developed within the first two years of the planning period. Current support structures and staffing cannot support this level of development.

Casual User System	As base mapping is completed, the number of potential users increases significantly, and their initial and primary need is simply access to the GIS coverages and related data. An intuitive, robust ArcView-based ad hoc query and display application for the novice user would support a broad range of new users and reduce the amount of initial end-user support required.
Scale-based Display	Many of the display and analytical requirements of the County involve display of data at small scales to reflect county-wide concerns or large areas such as watersheds. Larger scale display of special study areas or particular sites is also necessary. The development of display options which would automatically select coverages, feature detail, and raster backdrops appropriate to the selected scale or window extent would facilitate ad hoc query and access to information.
Map Production	The ability to quickly generate maps on an ad hoc basis is important to many users. This would support selection of map extent, selection of features, creation of plot frames and legends and title block information. The existing "MapMaker" application should be enhanced and integrated with other applications.
Thematic Mapping	An application which facilitates generation of thematic displays and maps would support ad hoc selection of layer features, related attributes, attribute values and ranges, and rules for layer intersection.
Incident Mapping/ GBF/DIME based	Many existing databases contain property address fields which, if properly formatted, can be compared to the street segment address ranges in the GBF/DIME and displayed in the GIS as points or symbols. Applications for performing this function exist and may wholly or partially meet this need. The Address Validation utility application can be used to prepare the databases for matching.
Incident Mapping/ Property Address based	In addition to street segment based matching, valid property addresses can also be compared to addresses in the parcel file or to address features in the GIS, and used to generate point symbols or to shade the actual parcel polygons to create parcel based incident maps.
Customer Service	Almost every user group requires ready access to a large range of graphic and tabular data in order to respond to requests from the public or other staff. In effect, every unit is a customer service bureau. This application must quickly provide detailed information to staff using a variety of keys, including record plat number, property address, and subdivision name.
Public Access	A version of the Customer Service application should be modified and fitted with an extremely simple user interface using multimedia functionality in order to provide a fool-proof online query for the general public. Options should be simplified, the need to manipulate windows removed, and "help", possibly auditory, provided.

Mailing List Generation	Generate mailing lists, including owner/property addresses and telephone numbers (for emergency contacts), for any selected area based on buffer, radius, polygon, and existing feature boundary.
Development Activity	Many users require access to development information on a parcel basis to support planning and regulatory activities. The actions of interest include zoning cases, special exceptions, variances, map amendments, and the development review process. Initial implementation should provide for display of status on a parcel and subdivision basis within a selected area.
Permit Activity	Access to all permit information is also required, including building permits, work permits, water and sewer authorizations and permits, and preservation permits. Permit status for individual parcels should be accessible as well as the ability to display permit activity during particular time periods on an area-wide basis.
Demographic Analysis	All departments have requirements for performing demographic analysis. Census Bureau data can be analyzed by census tract, policy area, planning areas, and traffic analysis zones. This is currently supported by the GBF/DIME and related data. The ability to correlate census statistics to other departmental data which is parcel or address based is also needed. Examples include health information, property values, and development densities.
CIP Mapping	All County agencies generate projects for the County Capital Improvements Program (CIP). Project locations need to be mapped as project limits or boundaries and keyed by project number. An application which supports inputting these locations along with relevant status information is required. The ability to scale and paste layers from the GIS for the Project Description Form (PDF) vicinity map should also be included. *The County DIST is currently developing this application.*
Document Imaging System	Many departments have requirements to scan 8 ½ x 11 files, maps, and drawings and index them, providing a link to GIS features. Current investigations of EDMS should include the requirements of all departments and should require that the EDMS be interfaced with the GIS.
Video and Image Display	The ability to link and view video, photography, and scanned images to GIS features such as parcels or other point or polygon objects would support evaluation of environmental hazards, development sites, and other special areas.
Online Data Guide	As the GIS database is developed and more users gain access to the GIS, it is necessary to publish the GIS data content in a form that is accessible to all users. A wide variety of data will be available in Arc/Info coverages, in related INFO tables, and in ORACLE databases. An online, user-friendly guide to the accessible data which includes the metadata to be developed and describes the quality, timeliness, and source of all data is necessary. The guide should include keyword searches to identify all data sets containing information related to particular areas of interest such as land use or population projections. Multiple versions of data should be documented.

FUNCTIONAL APPLICATION AREAS

The major functional areas of each agency and the related GIS applications were identified in each agency plan. Over 150 individual functional applications were identified. Some of these can be supported at some level by core applications. As stated, the agencies must prioritize these applications individually, considering a phased approach to some, particularly where they can be supported at an initial level with fuller functionality being implemented at a later date.

APPLICATION STANDARDS

In order to support the development and long-term maintenance of applications for the end user and for database maintenance functions, it is imperative that application standards be established. This will support the GeoMaP and MC:MAPS policies of sharing applications and minimizing development efforts. Standards will enable applications to be more easily transferred between agencies and will allow building of applications on "building blocks" of well-documented basic functions.

As software is updated and new releases are installed, comprehensive updates to applications may be required such as mechanisms for mounting menus or identifying directory paths. Applications which are adequately documented will be easier to modify and keep up-to-date.

Several areas of standardization and documentation are required:

> **Application Interface.** The user interface for all applications should have a common look and feel and set of common icons for similar functions. As software enhancements are available, the interface definition will require revision.
>
> **Program Organization**. Program structure and modularization should be documented, and a standard directory structure for storing programs should be adopted. A library of programs should be documented and available to all developers. Procedures for submittal of new programs to the library should be established.
>
> **Documentation.** Templates for documentation for both user and programmer should be established. Online documentation and "help" text should be built in to applications to the extent possible.

Applications will be developed by a variety of resources, including all agencies and consultant and vendor services. Many applications will be used by multiple agencies. Adherence to standards and provision of adequate documentation will ensure useable applications.

An application directory should be established, similar to the Online Data Guide. This should be available online to provide users with information on available applications and who to contact or where to obtain them.

APPLICATION DEVELOPMENT

Application development will be primarily the responsibility of the agency core GIS support groups. Resources will include both GIS staff and consulting services as needed. User groups will also participate in developing applications, particularly those applications which modify existing or core applications or which provide functions to simply automate repetitive procedures. Application development requires several stages including: initial scoping and definition, design, development, testing, documentation, and training.

The Executive Branch and M-NCPPC will focus application development on core applications during the next two years. Based on current staffing resources, it is recommended that these two agencies each allocate $100,000 per year for contractor application development. In addition to this, significant staff resources must be devoted to the design, review, and oversight of the development efforts. Other high priority application design and development efforts will require additional resources.

APPLICATION ACTION ITEMS

The following are the agency action items related to application development:

	TASK	DESCRIPTION	RESPONS-IBILITY	YEAR
1.	Develop Core Application Workplan	Develop an interagency workplan for the design and development of the core applications. Identify necessary resources and assign responsibilities. Budget resources to support development.	MC:MAPS Agencies	1
2.	Prioritize Agency Application Development	Determine the priority and ranking of individual agencies utility and functional applications. Identify shared responsibilities, if any. Develop a 5 year application phasing plan.	Individual Agencies	1
3.	Develop Application Standards	Develop application standards, templates, documentation, and directory. Obtain interagency agreement.	MC:MAPS	1
4.	Develop Key Applications	Begin development of key applications such as: Online Data Guide Parcel and Development Indexes Utility Applications	Agencies	1-2
5.	Design Applications	Establish design teams and begin design of major applications such as: Development Review and Tracking Permit System Integration	MC:MAPS All Agencies (design team)	1-2
6.	Develop Functional Applications	Continue application development in accordance with agency priorities.	Agencies	1-5

Application Requirements

		Application Type				Dev. Tools											Year				
	Value	User Specific	Multi-Use	Generic Capability	Tailored Dev.	Development Effort	ArcView	Avenue	AML	ORACLE	other database	Executive Branch	M-NCPPC	WSSC	County DIST Development	M-NCPPC Development	WSSC Development	1	2	3	4	5
Database Maintenance																						
Parcel Update	1		●		●	2			●	●		●	●		0.20	0.80		●				
Landbase Update	2		●			2			●				●			1.00		●				
GBF/DIME Maintenance	1	●			●	3			●	●	●	●			1.00			●				
Address Assignment	1	●			●	2	●	●	●	●	●	●	●		0.10	0.90		●				
Storm Drain Facilities Maintenance	1	●			●	3	●	●	●	●		●			1.00			●				
Zoning Maintenance	2		●			2			●	●	●		●			1.00			●			
Metadata Maintenance	1		●		●	2	●	●	●	●		●	●	●	0.20	0.60	0.20	●				
Data Validation	1		●		●	2			●	●	●	●	●		0.30	0.50	0.20		●			
CAD Index and Drawing Management	2		●		●	2	●	●	●	●			●	●	0.40	0.20	0.40			●		
Database Development/Enhancement																						
Address Validation	1		●		●	2			●	●	●	●	●	●		1.00		●				
Storm Drain Facilities Quality Control (QC)	1		●		●	2			●			●			1.00			●				
Zoning Conversion	1		●		●	2			●	●	●		●			1.00		●				
Address Layer Development	1		●		●	2			●	●	●		●		0.10	0.90		●				
Scanning Operations	1		●	●		2	●	●		●		●	●	●	0.40	0.30	0.30		●			
Field Data Collection	1		●	●		1			●	●		●	●	●	0.40	0.40	0.20		●			

Application Requirements

		Application Type				Dev. Tools											Year				
	Value	User Specific	Multi-Use	Generic Capability	Tailored Dev.	Development Effort	ArcView	Avenue	AML	ORACLE	other database	Executive Branch	M-NCPPC	WSSC	County DIST Development	M-NCPPC Development	WSSC Development	1	2	3	4	5
Core Applications																						
Casual User System	1		●	●		1	●	●	●	●		●	●	●		1.00		●				
Scale-based Display	1		●	●		1	●	●	●			●	●	●		1.00			●			
Map Production	1		●	●		1	●	●	●	●		●	●	●		1.00		●				
Thematic Mapping	1		●	●		2	●	●		●	●	●	●		0.40	0.40	0.20		●			
Incident Mapping-GBF/DIME	1		●	●		2	●	●	●	●		●	●	●	1.00			●				
Incident Mapping-Property address	1		●	●		2	●	●	●	●		●	●	●	0.50	0.50			●			
Customer Service	1		●	●		2	●	●		●		●	●	●	0.40	0.30	0.30	●				
Public Access	2		●	●		2	●	●		●		●	●	●	0.50	0.40	0.10			●		
Mailing List Generation	1		●	●		1	●	●		●	●	●	●	●	0.80		0.20	●				
Development Activity	1		●	●		2	●	●	●	●		●	●	●		1.00			●	●		
Permit Activity	2		●	●		2	●	●	●	●		●	●	●	1.00				●	●		
Demographic Analysis	1		●	●		2	●	●		●	●	●	●	●	0.50	0.50		●				
CIP Mapping	2		●	●		1	●		●				●	●	0.80	0.10	0.10	●				
Document Imaging System	3		●	●		3	●	●		●		●	●	●	0.60	0.20	0.20			●		
Video and Image Display	2		●	●		2	●	●	●	●		●	●	●	0.60	0.20	0.20			●		
Online Data Guide	1		●	●		2				●		●	●	●	0.20	0.60	0.20	●	●			

SECTION 4
DATABASE REQUIREMENTS

Summary

Key data requirements County-wide are:

- Complete GIS base layers and facilities data.
- Develop the zoning and address layers.
- Enhance the GBF/DIME spatial accuracy.
- Implement ORACLE and develop an integrated parcel database.
- Develop natural resources, floodplains, wetlands, and land use/land cover information.

INTRODUCTION

The development of a common set of base layers for the GIS has been a major focus of GIS development activities within Montgomery County Government, M-NCPPC, and WSSC over the past several years. Most of the focus to date has been on developing the County's 1" = 200' scale planimetric, topographic, and property base layers. WSSC has been converting water and sewer facilities data which overlay the base layers and DEP is converting the storm drain facilities. In addition to the large-scale data, other small-scale, county-wide data layers have been developed to support specific project and application requirements. Most of these layers are derived from and registered to the County's GBF/DIME file.

Database development, enhancement, integration, and maintenance efforts for the next five years will continue to be a significant GIS activity for all of the MC:MAPS participant agencies. The database development emphasis will however shift from base map development into the following areas:

- *Database Maintenance:* This will include the development of a structured program for maintaining landbase data, and improving and enhancing the parcel update process. It will also involve establishing update procedures and responsibilities for each of the other database layers to be included in the database.

- *ORACLE Development:* Involves use of ORACLE as the primary relational database management system for storing land records related data. It also involves the establishment of indexes to be able to cross-reference address based, parcel based, and subdivision based data files. The DIST ORACLE parcel database will be expanded and integrated with other parcel data.

- *Database Documentation and Metadata Development:* All data layers that are included in the database should be documented in a common and consistent manner across the

agencies, and metadata information that describes the characteristics of each of the data layers and sets of GIS features should be established for each layer.

- *Additional Database Development:* Additional database development will encompass several areas. It will include the creation of new data layers through a variety of techniques (digitizing, scanning, GPS) and the enhancement of several other layers. The enhancements will include improving the spatial accuracy and registration of several layers (GBF/DIME and other small-scale layers), and improving the overall structure to support specific application requirements.

Although work will shift away from base map development over the course of the next five years, it needs to be recognized that over the next 12-18 months, completion of all base mapping elements will continue to be a high priority.

This section of the *Strategic Plan* will describe in more detail the key, bi-county database development requirements and will establish an implementation outline for their completion.

GIS COMMON DATABASE

All of the MC:MAPS agencies have been working towards development of a "common" database. The common database defines those layers that are to be included in a shared database that is available to all MC:MAPS agencies.

As part of the strategic planning process, a new definition of the common database has been developed. This new definition of the common database layers should be used as a basis for planning future database development activities. The table included at the end of this section identifies the components of the common database.

Several of the database development initiatives which have been recommended involve the development of integrated databases to manage nongraphic attribute data. These are discussed later in this section. The integrated ORACLE data which is to be developed to manage parcel, subdivision, development, zoning, and other information will be available to all agencies and will be documented along with graphic data in the Online Data Guide, a core application which has been identified.

The layers in the common database are organized into eight themes:

Reference Grids
Planimetric/Topo
Property
Planning
District
Environmental
Transportation
Facility

As a result of this planning process, 21 additional layers were identified for incorporation into the common database definition.

New Common Database Layers	
Addresses	Preservation Management Areas
Benefit Assessments	Proposed Maint/Reconstr Work
Bikeways	Proposed/Planned WSSC Projects
Building Heights	Site Plan Index
CAD Project Index	Soil Boring Locations
CIP Projects	Special Protection Areas
Conservation Easements	Survey, Control & Monumentation
Construction Site Boundaries	Traffic Signs
Forest Conservation Areas	Water and Sewer Authorizations
Master Plan Required Facilities	WSSC Easements
Park Facilities (Details)	

The GIS Data Layers table at the end of this section defines the following parameters for each data layer in the common database:

GIS Data Layer Table	
Data/Layer Description	brief name describing the data
Scale	scale of source data
Source	identification of source of data
Methodology	possible data development methodology
Agency	agency responsible for long-term maintenance of the data
Status	status of the data layer: D Developed U Under Development N Not Yet Developed E Enhancements Required
Priority	priority of each data layer within each agency

Of the common data layers, only the reference grids and several small-scale data layers such as the street centerlines and administrative features are complete. The large-scale base layers and facility layers are under development and many other layers are not developed yet. Several layers require enhancements.

COMMON DATABASE STATUS	
GIS Data Layers which are under development and need to be completed.	
Planimetric and Topographic Features	Sewer Basins/Minibasins
Property	Sewer Facilities
Digital Orthophotos	Storm Drainage Facilities
Land Use - Existing	Water Facilities
Land Use - Planned	Water Pressure Zones
Neighborhoods/Community Assoc.	
GIS Data Layers which require enhancements.	
Sidewalks - capture all sidewalks, creating logical sidewalk network	
School Service Areas - adjust to property boundaries	
GBF/DIME and TIGER - add segments, enhance spatial accuracy	
Buildings - code Public Facilities	
GIS Data Layers which have not yet been developed (high priority).	
Addresses	Park Facilities
Bikeways	Preliminary Plans
Building Heights	Preservation Management Areas
CAD Index	Record Plats
CIP Projects	Septic System Locations
Conservation Easements	Site Plan Index
Floodplains (P&P)	Soil Boring Locations
Floodplains (FIRM)	Special Protection Areas
Forest Conservation Areas	Water Wells
Historic Sites	Water and Sewer Authorizations
Land Use/Land Cover	Water and Sewer Master Plan
Master Plan Required Facilities	Watershed Boundaries
Master Plan Roads	Wetlands and Nontidal Wetlands
Natural Resources Inventory	WSSC Easements

DEVELOPMENT AND MAINTENANCE RESPONSIBILITIES

For each of the common database layers, agency responsibilities for database development and maintenance have been defined. These are identified in the GIS Data Layers table.

For many of the layers, no clear definition of maintenance procedures and policies has been established. Each agency that is responsible for a specific layer should develop an internal maintenance plan/policy for that layer, and should also develop procedures and applications as necessary to support maintenance of the database layer. As part of the metadata documentation effort, information on maintenance responsibilities, cycles, source documents, etc., for each database layer should be incorporated into the metadata database.

DATABASE DEVELOPMENT PRIORITIES

Some database development activities are essential to GIS users in all agencies. These are described in more detail in this section.

Complete Base Map Development

Completing conversion of the base layers is essential for expansion of the GIS. The base layers consist of:

- Digital Orthophotos
- Planimetric Features
- Topography
- Property Data

This data is currently scheduled for completion in July 1997. It is essential that efforts currently underway be continued to ensure that base map conversion is accomplished on schedule.

Complete Facilities Layers

Conversion efforts are currently underway for facility data layers, including:

- Water facilities
- Sewer facilities
- Stormdrainage facilities

The water and sewer facilities are being completed by WSSC using contract staff. Water and sewer facilities information is mission critical to WSSC and a critical requirement of Montgomery County DEP, DPWT, DFRS (Emergency Management), and M-NCPPC. The timely conversion of this facilities data is dependent on the base map information being provided on schedule in the documented data structure agreed upon by the agencies.

The stormwater facilities conversion is being completed by a private conversion vendor under contract to Montgomery County DEP. This information is necessary to meet the NPDES stormwater management program requirements. There have been delays in obtaining facilities data from the contractor and DEP has now implemented a stringent quality control program which is being enforced by DEP staff.

Initiate Zoning Conversion

Adding zoning data to the common database is a key requirement for all of the MC:MAPS agencies. M-NCPPC currently maintains zoning data on a set of 1" = 200' maps. There are over 80 different zoning classifications represented throughout the County. Zoning classifications apply to parcels, aggregations of parcels, or portions of parcels. Zoning polygons must be adjusted to the new parcel base.

The key issue to be addressed in converting zoning data is whether a sectional map amendment is required once the conversion is complete in order to officially adopt the new zoning maps. Because the zoning boundaries are legally defined, converting the data and adjusting boundaries may require a sectional map amendment. This is particularly true when parcel lines are not coincident with zoning polygons. If sectional map amendments are to be processed separately for each master plan as they are now handled, the cost and length of time to complete the zoning data would be very high.

Many other local government jurisdictions are faced with this same issue in converting the zoning data. Most other jurisdictions perform a transfer directly from existing maps to the GIS. In those areas where zoning boundaries are not coincident with parcels, annotation on maps and/or measurements from maps are used to control placement of zoning lines on the new base. Rigorous quality control procedures are also employed. Once the conversion is complete, and all maps have been approved, the new database (or its representation on a set of plotted maps) is legally adopted as the official zoning map. This is the approach that is recommended by PlanGraphics for M-NCPPC.

In order to obtain the zoning data in a timely manner, the conversion should be completed by outside staff. This conversion may be managed in-house using contract staff, or could be performed by an independent conversion vendor. Prior to initiating zoning conversion, a database design and conversion workplan should be developed, and if the work is to be done in-house a conversion application should be developed.

The cost of the conversion of this data is estimated at approximately $250,000. This estimate includes the development of conversion procedures and applications, completion of conversion, and the production of plots.

Initiate Address Data Conversion

The Development Review Division within M-NCPPC is responsible for address assignment in the County. Addresses are assigned prior to recordation of plats. Staff annotates addresses in red on the record plat. Currently, there is no capability for converting and maintaining address information in the GIS . Premise address information is accessible as an attribute of parcels (the data is from MDAT), however the addresses are considered inaccurate and incomplete, and because they cannot be represented graphically in a cartographically pleasing manner they are not satisfactory for all application requirements.

For conversion of address information, the recommended approach is to automatically annotate addresses from the parcel file, and then compare and correct addresses using the existing address overlays, either a hard copy or a scanned image. The physical placement of the addresses may need to be adjusted for cartographic reasons. As addresses are corrected, they should be written to a file, keyed by tax account ID, so that they can be returned to MDAT for correction of their data.

Like the zoning data, outside resources should be utilized for the conversion of address information because of the level of effort that it will take. The recommended approach would be to use contract staff and have them complete the conversion work in-house (similar to the parcel tagging). This approach is recommended because of the complexity of the process, and the importance of maintaining the integrity of the data. Conversion of this data under in-house supervision will greatly minimize quality control efforts to be completed by existing staff.

PlanGraphics recommends that initially a design and conversion plan be developed to facilitate entry and maintenance of address information. Following this, a well designed application should be developed and resources acquired to perform the conversion. The design, planning and application development work should begin in 1996, with full scale conversion beginning in 1997 as the planimetric and parcel base is nearing completion.

Enhance GBF/DIME File

There are several areas of enhancement for the GBF/DIME file which have been identified and are being studied or implemented by the County DIST.

Spatial Accuracy: It is a key requirement for all agencies that the street segment features in the DIME file be spatially adjusted to correlate to the planimetric centerlines. This will enhance the overall quality of the DIME file and also allow accurate overlay of census geography with parcel blocks which will improve ability to compare census data with parcel and housing unit data. This enhancement effort will enable the DIME based data to be as accurate as the base planimetric data. The County DIST has designed and implemented procedures for improving the spatial accuracy of GBF/DIME features using the planimetric centerline features. As of May, 1996, about half of the County has been completed.

Address Ranges: Actual address ranges were created for each street segment by a Contractor to MCPS. The ranges were derived from the M-NCPPC address overlay which is the primary source of address information. Although these address ranges have not been maintained since they were originally captured, they are an important resource which should be incorporated into the GBF/DIME.

Network Structure: The GBF/DIME coverage should be structured as a topological network so that routing applications can be supported. Data elements might include

travel times, obstructions, number of lanes, and direction of traffic, among others.

New Segments: Additional features are sometimes required to accurately reflect boundaries of some administrative areas. An example is school districts which frequently have boundaries between parcels in a block, particularly along the back property line. Adding features to form these areas splits census blocks. A methodology to accurately represent areas and not impact the census geography needs to developed.

The GBF/DIME has served as the basis for the development of other data sets and applications such as Elections Mapping, the Police redistricting system, the Computer Aided Dispatch (CAD) system, and other demographic, socio-economic mapping applications. Procedures need to be developed for providing updates to these systems since the GBF/DIME is continuously maintained to reflect new streets and accurate addresses.

Enhance Other Small-Scale Data Layers

Many administrative and political boundaries have been created based on the GBF/DIME. Some of these boundaries were initially derived from the left/right attributes of the GBF/DIME records. For some features, it is more appropriate for the boundaries to correspond to parcel boundaries or other more detailed features in the large-scale data layers, which are under development. As the parcel layer nears completion, some of these features should be readjusted to the parcel base. Candidates for this adjustment include—school districts, master plan boundaries, and police and fire districts.

For some layers, it may be easier to recreate the layers rather than adjusting existing features to the new large-scale base. Methodologies must be developed for correlating these features to census geography so that demographic analysis can still be supported. Decisions regarding the approach will need to be done on a layer-by-layer basis.

Develop Integrated Parcel Database

Almost every organizational unit involved in the GIS planning effort requires access to parcel data and most maintain subsets of parcel based data related to their individual functions. These isolated databases, both on mainframes and PC's, are difficult to maintain over the long term, are not documented, and are not available to support other users and requirements in an efficient manner. In order to ensure that parcel based data can be accurately related to GIS parcels to support application requirements, it is important that an integrated relational parcel database be designed and implemented. Individual users will still be able to develop and maintain "personal" parcel data, however the framework for validating data and relating it to the GIS and other parcel tables will be in place.

The parcel files currently used by the County and M-NCPPC are based on copies of the MDAT databases which is maintained by MDAT staff. Updates of the file are provided regularly, however some data elements in the file are not considered to be accurate. Although many of the

data fields in the file contain information which the County and M-NCPPC staff are responsible for, such as property address, land use, and zoning, the MDAT staff makes all edits to the file. Requests for corrections are often transmitted to MDAT by the County. Delays in assignment and entry of parcel tax account ID's by MDAT also means that not all GIS parcels have tax account ID's. The following problems exist in the parcel data which is available:

- timeliness of parcel attribute data available
- parcel attribute data is not always accessible to GIS users
- there is not a one-to-one correspondence between GIS parcels and parcel file records
- some data elements in the MDAT file are not correct

In order to support the agencies need to maintain and analyze parcel and subdivision related data, it is necessary to build a parcel database structure which is integrated with the GIS, is maintainable by appropriate County and M-NCPPC staff, and is timely and accessible to GIS users for application use and query. Implementation of an integrated parcel database requires the following components:

- development of parcel and development indexes which include index tables for cross-referencing key identifiers such as tax account ID, parcel numbers, subdivision codes, lot and block number, and premise address with other identifiers including case numbers, preliminary plan numbers, record plat numbers
- development of related tables which are linked to parcel or other key entities and allow individual user groups to control and maintain their data appropriately
- implement procedures to provide MDAT with updates as data elements are corrected and maintained by the County
- implement a temporary unique parcel identifier to serve as a database key until MDAT assigns tax account ID's
- implement ORACLE fully in all agencies so that it is accessible to the entire GIS network
- modify the parcel update procedures to include maintenance of ORACLE data and keys to ensure concurrency between graphic and nongraphic data.

The establishment of this integrated parcel database is a major process that will significantly effect existing procedures, and enhance greatly the overall utility of the data. It is recommended that a detailed design of this database be developed initially. This design should be reviewed and supported by all MC:MAPS agencies prior to actual implementation. The implementation process will also entail modifications to existing applications and procedures.

Permits Processing System

The County is in the preliminary stages of developing a new Permits Processing System. The system should be accessible from the GIS by address or parcel ID. This means that users would be able to access permit information from the GIS, selecting parcels for query graphically. The County should also analyze other requirements for interfacing the two systems. Ideally, the system acquired or developed should be based on ORACLE. If this is not possible, it should utilize a non-proprietary ANSI SQL standard RDBMS. The interface should be Xwindows based so that the Permits Processing System can be accessed from a window on a GIS workstation.

Some other requirements for the development of the system are the incorporation of appropriate identifiers into the permit information. Changes in the parcel update process and the management of address information should make it easier to obtain accurate identifiers at the time a permit is processed. While tax account IDs are usually not available at the time that permit applications are submitted, M-NCPPC plans to begin assigning a unique identifier to each new parcel on a record plat which can be used temporarily to identify a parcel. When tax account ID are available (permits on developed property) they should be added to the database along with the address. Also, correct address information should be a requirement for the application. M-NCPPC will be responsible for adding the property address to the GIS and parcel file at the time a plat is recorded.

Metadata

As the GIS system grows, and the number of data layers available increases, metadata information for each data layer needs to be readily available. Metadata is information that describes the characteristics of information in the database. It can apply to several levels, ranging from the overall database theme to specific coverage information to information about an individual feature. Characteristics include, among other items:

Scale	Source	Vintage
Accuracy	Owner	Method
Datum	Date modified	Status

Metadata information for each layer in the database should be developed in several formats. It should be available as on-line documentation, accessible from workstations or over the internet, and as hard copy documentation.

Several applications are under development by ESRI and others that allow metadata information to be maintained for each coverage in the database. An application should be acquired and customized as appropriate and used as the mechanism for maintaining metadata information. The maintenance of metadata should be incorporated into all data update applications.

DEVELOPMENT MECHANISMS

Several GIS database development activities, which are not currently funded or underway, have been identified as critical to all agencies and as the highest priority amongst agencies. These are:

- Zoning Conversion
- Address Conversion
- GBF/DIME enhancement
- Floodplains
- Land Use/Land Cover Mapping

These major development efforts should be jointly funded (CIP projects). It is recommended that all or portions of these database development efforts be supported with contract staff or conversion services due to their scope and importance to GIS application areas.

These five initiatives represent the most significant, labor intensive database development efforts. The agencies roles, particularly for the Executive Branch and M-NCPPC will involve contract management and data conversion quality control. As discussed, the work effort may be done in-house using contract staff or may be done by conversion contractors, depending on the data layer.

Of the other new data requirements, the following are highest priority and could be supported by inhouse efforts or incorporation into current practices and workflows:

- Preliminary Plan Boundaries (M-NCPPC, as part of the Development Review process)
- Record Plat Boundaries (M-NCPPC, as part of the parcel update process)
- Natural Resource Inventory Data (M-NCPPC and DEP, compiled by environmental and natural resources staff from a variety of data sources)
- Water and Sewer Service Areas (Montgomery County DEP staff)
- Planned Transportation ROW (M-NCPPC transportation planning staff)
- Survey Control Data (WSSC)

Other high priority database requirements which will require conversion efforts, field inventories, or data capture to develop are:

- Bridges (DPWT)
- Bikeways (DPWT)
- Traffic Signs (DPWT)
- Transit Routes (DPWT)
- Snow Plow/Salt Routes (DPWT)
- Super Fund Sites (DFRS)
- Other Hazmat Sites (DFRS)
- Historic Sites and Buildings (M-NCPPC)

DATABASE DEVELOPMENT ACTION ITEMS

The key action items to support database development are listed below.

	TASK	DESCRIPTION	RESPONS-IBILITY	YEAR
1.	Confirm GIS Base Layers Database Design	Review the data structure for the planimetric and property GIS layers and confirm that they currently meet all users requirements.	MC:MAPS agencies	1
2.	Update Data Dictionary	The original GeoMaP data dictionary should be updated and revised to reflect the current database design and content.	MC:MAPS agencies	1-2
3.	Complete Base Map Conversion	Includes planimetric, topographic, digital orthophotos, and property conversion.	M-NCPPC County	1-2
4.	Complete Water and Sewer Facilities Conversion	Underway by WSSC	WSSC	1-2
5.	Complete Stormwater Conversion	Conversion contract underway and managed by DEP	DEP	1-2
6.	Develop Zoning Design and Conversion Workplan	Develop Arc/Info database design and workplan for converting zoning data.	M-NCPPC consultant services	1
7.	Initiate Zoning Data Conversion	Complete a zoning pilot project and then begin full scale conversion. Perform QA/QC.	M-NCPPC	1
8.	Develop Address Data Design and Conversion Workplan	Develop Arc/Info and ORACLE database designs, test possible methodologies, estimate resource requirements.	M-NCPPC consultant services	1
9.	Develop Address Conversion Application and Complete Pilot Project	Initial prototype and application development, completion of pilot, and establishment of procedures.	M-NCPPC County consultant services	1
10.	Address Data Conversion	Address data conversion, reconciliation, quality control.	M-NCPPC contractor	2

	TASK	DESCRIPTION	RESPONS-IBILITY	YEAR
11.	Design and Develop Integrated Parcel Database	Structured design of ORACLE database for parcel and related data. Develop database tables, modify applications and procedures, document design.	M-NCPPC County consultant services	1-2
12.	Develop Metadata	Design metadata system, including analysis of available applications. Develop necessary databases and elements and modify applications as necessary.	MC:MAPS All Agencies	2
13.	Integrate Permit System	Address the integration of the Permits System and the GIS during the requirements analysis and design of the Permits System.	MC:MAPS All Agencies	1-2

GIS Data Layers

Status:
D=Developed
U=Under Development
N=Not Developed
E=Enhancements Required

Priority:
1=High
2=Medium
3=Low

Theme Name / Data/Layer Description	Scale	Source	Methodology	Agency	Status	Priority				
						Montgomery College	Public Schools	WSSC	County Government	M-NCPPC
REFERENCE GRIDS										
ADC's 1000' Grid	N/A	Alexandria Drafting Co.	Generated	WSSC	D	1	1	1	1	1
Geodetic Control: NAD 1983	N/A	Aerial Photography	Photogrammetric	WSSC	D	2	2	1	1	1
Maryland State Plane Grid	N/A	U.S.G.S Origin	Generated	WSSC	D	1	1	1	1	1
Md. DAT Grid	N/A	MDAT Origin	Generated	WSSC	D	1	1	1	1	1
Reference Grid	N/A	Grid - WSSC	Generated	WSSC	D	2	2	1	1	1
WSSC Grid	N/A	WSSC Origin	Generated	WSSC	D	2	2	1	1	1
PLANIMETRIC/TOPO										
Bridges, Major Culverts, Overpass	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	1	1	1	1	1
Building Footprints	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	1	1	1	1	1
Building Heights	1:2400	Air Photos	Photogrammetric	M-NCPPC	N	3	3	1	1	1
Cultural Ftrs, Minor Structures	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	2	3	1	1	1
Hydrologic Features	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	1	1	1	1	1
Natural Features	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	1	1	1	1	1
Points: Lg. Tree, Pylons	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	3	3	1	1	1
Road Pavement Edge	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	2	3	1	1	1
Sidewalks	1:2400	Aerial Photography	Photogr./Digitize	M-NCPPC	U/E	3	2	1	1	1
Spot Elevations	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	2	3	1	1	1
Street Centerline	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	1	1	1	1	1
Topography	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	2	3	1	1	1
Trans. Features (Non-Roads)	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	1	1	1	1	1
Utility Features	1:2400	Aerial Photography	Photogrammetric	M-NCPPC	U	1	2	1	1	1

GIS Data Layers

Status:
D=Developed
U=Under Development
N=Not Developed
E=Enhancements Required

Priority:
1=High
2=Medium
3=Low

Theme Name / Data/Layer Description	Scale	Source	Methodology	Agency	Status	Priority: Montgomery College	Public Schools	WSSC	County Government	M-NCPPC
PROPERTY										
Addresses	1:2400	MDAT File/Overlay	Generate/Verify	M-NCPPC	N	1	1	1	1	1
Record Plat	1:6000	Final Subdivision Maps	Capture with Parcels	M-NCPPC	N	3	2	1	1	1
Preliminary Plan	1:6000	Preliminary Subdivision Maps	TBD	M-NCPPC	N	3	1	1	1	1
Parcels	1:2400	County Prop/WSSC Asses. maps	Digitize/Manuscript	M-NCPPC	U	1	1	1	1	1
Subdivisions	1:2400	P&P Subdivision Maps	Digitize Boundary	M-NCPPC	N	2	1	2	1	1
PLANNING										
CAD Project Index	1:6000	CAD Drawings	Project Boundary	All	N	1	1	1	1	2
CIP Project	1:6000	Agency CIP's and PDF's	Digitize	All	N	2	2	1	1	1
Landuse - Existing	1:36000	Master Plans/Landuse Maps	Property Attribute	M-NCPPC	U	1	2	1	1	1
Landuse - Planned	1:36000	Master Plans/Landuse Maps	Property Attribute	M-NCPPC	U	1	1	1	1	1
Master Plan Required Facilities	1:2400	Existing Maps	Digitize	All	N	3	2	2	1	1
Neighborhoods/Community Assoc.	1:36000	Citizen/Homeowners Assoc. Map	Digitize	M-NCPPC	U	3	1	3	1	1
Planning Areas	1:36000	Planning Area Map	Centerline Attribute	M-NCPPC	D	3	1	1	1	1
Policy Areas	1:36000	MDAT w/M-NCPPC Bndy	Centerline Attribute	M-NCPPC	D	1	1	2	1	1
Proposed/Planned WSSC Projects	1:2400	As-builts	Digitize	WSSC	N	3	3	1	1	2
School Service Areas	1:2400	ADC School Maps	Centerline Attribute	MCPS	E	1	1	2	1	2
Site Plan Index	1:6000	Site Plan	Capture Point/Boundary	M-NCPPC	N	3	3	1	1	1
Trans. Plng and Analysis Zone	1:36000	TPAZ Maps	Digitize/Manuscript	M-NCPPC	D	1	1	3	1	1
Zoning	1:2400	M-NCPPC Zoning Maps	TBD	M-NCPPC	N	1	2	1	1	1

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						Montgomery College	Public Schools	WSSC	County Government	M-NCPPC
DISTRICT										
Election District/Pcrts	1:36000	Co Board of Election Maps	Centerline Attribute	County	D	3	2	3	1	2
Fire/Rescue Bndy	1:36000	Battalion Response Areas	Digitize/Manuscript	County	D	3	2	3	1	3
Health Catchment Areas	1:2400	Health Catchment Map	Digitize/Manuscript	County	N	3	3	1	1	3
Police Beats and Districts	1:36000	ADC Police Reporting Areas	Centerline Attribute	County	D	3	2	2	1	3
Post Office Areas	1:24000	ADC Map Books	Centerline Attribute	County	N	3	2	3	1	3
Recreation Areas	1:2400	County Property Maps	Digitize/Manuscript	County	N	3	2	3	1	2
Sanitary Inspection Districts	varied	PG Co 200' shts./MoCo St. Map	Digitize/Manuscript	County	N	3	3	1	1	3
Sheriff Bailiwick Areas	1:36000	MoCo Street Maps	Property Attribute	County	N	3	3	3	1	3
Solid Waste/Refuse Districts	1:24000	ADC Maps	Digitize/Manuscript	County	D	3	3	3	1	3
Solid/Haz. Waste Disp.	N/A	Located by Address	Digitize/Manuscript	County	N	3	3	1	1	3
Tax Rate Areas	1:36000	MDAT Maps	Property Attribute	County	U	3	2	3	1	3
Tiger-Centerline	1:10000	U.S. Census TIGER Files	File Translation	County	E	1	1	3	1	3
U.S. Census Boundary File	1:10000	U.S. DIME or TIGER File	File Translation	County	E	1	1	1	1	1
Zipcodes	Varied	U.S. Postal Service Records	Digitize/Manuscript	County	D	1	1	2	1	1

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						Montgomery College	Public Schools	WSSC	County Government	M-NCPPC
ENVIRONMENTAL										
Bedrock Geology	1:62500	U.S. Geological Survey	Digitize/Manuscript	County	N	3	3	1	1	3
Conservation Easements	1:2400	Existing Maps	Digitize	M-NCPPC	N	3	3	2	1	1
Floodplain -P&P	Varied	P&P Flood Maps	Digitize/Manuscript	M-NCPPC	N	2	2	1	1	2
Floodplains (FIRMS)	1:6000	FIRMs	Digitize/Manuscript	M-NCPPC	N	2	3	1	1	2
Forest Conservation Areas	1:2400	Existing Maps	Digitize	M-NCPPC	N	3	3	2	1	1
Historic Sites	1:2400	Historic District Maps	Property Attribute	M-NCPPC	N	2	2	1	2	1
MD SCS Soil Data	1:24000	MD Soil Conservation Services	Translation	County	D	3	3	1	1	2
National Wetlands Inventory Data	1:24000	U.S. D.O.I.F & W.S. maps	Digitize/Manuscript	County	N	3	3	1	1	1
Nontidal Wetlands		Field Inventory	Digitize	County	N	3	3	2	1	1
Park Facilities	1:2400	Park Plans	Digitize/Scan Site Plans	M-NCPPC	N	3	1	2	1	1
Preservation Mgmt Areas	1:2400	Existing Maps	Digitize	M-NCPPC	N	3	3	2	1	1
Special Protection Areas	1:2400	Existing Maps	Digitize	M-NCPPC	N	3	3	2	1	1
Watersheds	1:2400	Storm Water Drainage Maps	Digitize/Manuscript	County	N	3	3	1	1	2
TRANSPORTATION										
Bikeways	1:2400	Existing Maps	Digitize	M-NCPPC	N	1	1	3	1	2
Master Plan Roads	1:36000	County Master Plan Maps	Digitize/Manuscript	M-NCPPC	N	3	2	2	1	1
Planned Transportation/ROW	1:3600	Planned Transportation Maps	Digitize/Manuscript	M-NCPPC	N	1	1	2	1	1
Public Transportation Routes	Varied	Public Transit Maps	Centerline Attribute	County	N	2	1	3	1	1
School Bus Routes	N/A	Written Descriptions	Centerline Attribute	MCPS	D	3	1	3	3	3
Snow Routes	1:24000	Routes/Notes on ADC Maps	Centerline Attribute	County	N	2	1	2	1	2
Snow/Salt Trk. Routes	1:24000	Routes/Notes on ADC Maps	Centerline Attribute	County	N	2	1	3	1	3
Traffic Signs	1:2400	Field Inventory	Digitize/GPS	County	N	3	3	3	2	3
WSSC Meter-Route	1:2400	WSSC Meter Route Maps	Digitize/Manuscript	WSSC	N	3	3	1	3	3

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						Montgomery College	Public Schools	WSSC	County Government	M-NCPPC
FACILITY										
10-Year Sewer Master Plan	1:24000	Sewage Plan Maps	Digitize/Manuscript	County	N	3	2	1	1	1
10-Year Water Master Plan	1:24000	Water Supply Plan	Digitize/Manuscript	County	N	3	2	1	1	1
Front-foot Benefit Assessments	1:2400	Existing Maps	Digitize	WSSC	N	3	3	1	3	3
Construction Site Boundaries	1:24000	Construction Plans	Digitize	WSSC	N	3	3	1	3	3
Monitoring Stations	N/A	County Permits	Address Match	County	N	3	3	1	1	3
Proposed Maint/Reconstr Work	1:2400	Maintenance Documents	Digitize	WSSC	N	3	3	1	2	3
Septic System Locations	N/A	County Permits	Address Match	County	N	3	3	2	1	3
Sewer Basin/Mini-Basin	1:2400	Sewer System Map	Digitize	WSSC	U	3	3	1	1	1
Sewer Facilities	1:2400	Sewer System Map	Digitize/Manuscript	WSSC	U	2	2	1	1	2
Sludge Disposal Sites	N/A	Sewer System Map	Property Attribute	WSSC	N	3	3	1	1	3
Soil Boring Locations	1:2400	Soil Boring Logs & Database	Digitize/GPS	County/WSSC	N	3	3	1	1	2
Storm Drainage Facilities	1:2400	County DNR Maps	Digitize/Manuscript	County	U	3	3	2	1	2
Survey, Control & Monumentation	1:2400	Surveys, GPS, Records	various	WSSC	N	3	3	1	1	1
Water and Sewer Authorizations	1:2400	Authorization Reports	Digitize	WSSC	N	3	3	1	2	2
Water Facilities	1:2400	Water System Map	Digitize/Manuscript	WSSC	U	2	2	1	1	2
Water Pressure Zones	1:2400	Water System Map	Digitize/Water Attribute	WSSC	U	3	3	1	1	3
Water Wells	N/A	County Permits	Address Match	County	N	3	3	2	1	3
Water/Sewer Service Areas	N/A	Service Area Maps	Digitize/Manuscript	County	N	3	3	1	1	1
WSSC Easements	1:2400	Water and Sewer As-builts	Digitize	WSSC	N	3	3	1	1	1

SECTION 5
SYSTEM REQUIREMENTS

Summary

The County must support **significant expansion of the GIS user base.** This requires expansion of local area networks and many additional PC-based workstations.

Enhancement of the **County wide area network** is necessary to support interagency applications and data access, and to minimize redundant data storage.

New technologies such as **document imaging and GPS** must be implemented by the agencies.

The **ORACLE RDBMS** must be expanded and developed into an integrated database to support the GIS.

INTRODUCTION

More than 60 GIS workstations are in place County-wide to support the GIS database development efforts that are ongoing and an initial cadre of GIS users. The agencies which have implemented GIS local area networks (LANs) are: County Executive, M-NCPPC, WSSC, and the Montgomery County Public Schools (MCPS). All of the agencies have adopted the Arc/Info software as the standard GIS software. The MC:MAPS committee has agreed to implement ORACLE as the primary RDBMS to support GIS applications and nongraphic database development. Both Hewlett Packard (HP) and SUN UNIX workstations are being used throughout the agencies as well as some PC's for GIS access.

In order to achieve the expected benefits of GIS implementation, agency staff must have access to the GIS resources. There is a large demand within the County for access to GIS data to support many functional areas and departments. Over the next five years, it will be necessary to greatly expand the GIS network and support many additional GIS workstations. The total number of projected workstations will exceed 300 within the five year timeframe.

Projected GIS Workstations	Public Schools	Montgomery College	County Executive	M-NCPPC	WSSC	TOTAL
Class 1 Workstations (PC based)	5	7	90	75	150	327
Class 2 Workstations (UNIX or RISC based)	-	5	28	32	12	77

Several initiatives must be undertaken by the agencies in order to ensure that the GIS can expand efficiently and reliably. These include:

- Expansion of the wide area network (WAN) supporting GIS communications between agencies and remote sites.

- Integration of the GIS and the office automation LANs within each agency.
- Implementation of the ORACLE RDBMS in the client/server environment, providing accessibility to all GIS users.
- Incorporation of less expensive microcomputers as the standard end user GIS workstation.

AGENCY GIS CONFIGURATIONS

Each of the agencies currently supports GIS LANs operating in parallel with office automation networks. The majority of GIS workstations are HP and SUN UNIX workstations, however each agency has acquired several PC's which run ESRI's ArcView software and can access the GIS data on workstation servers. As described in the individual agency GIS Plans, requirements for increasing the speed and capacity of the LANs and for combining the GIS and the office automation networks have been identified.

The typical configuration includes a workstation functioning as the GIS database server and other workstations and PC's accessing the server and executing Arc/Info software both on the server and locally. Primary database servers will include a server at the County on which is "published" the GBF/DIME and its derivative coverages and related attribute data, a server at M-NCPPC on which will be published the cadastral and planimetric coverages, and a server at WSSC where the water and sewer facilities data coverages will reside. Many other coverages which are part of the "common" MC:MAPS GIS database will reside on these servers. The wide area network must support access between agencies.

The majority of additional GIS workstations will be Pentium PC's. With enhancements to ArcView as well as the impending release of Arc/Info for Windows NT, the PC's are more functional and can meet nearly all of the user requirements for access to the GIS. More processing can occur on the PC's, and server data will be more accessible to them. Fewer RISC-based UNIX workstations will be required in the configurations.

SOFTWARE STANDARDS

The following software standards have been adopted by the MC:MAPS agencies as part of the *Strategic Plan*ning process.

GIS Software

The GIS software will continue to be ESRI's Arc/Info which will be used to maintain the GIS data layers, perform spatial analysis, and produce maps. Specialized modules of Arc/Info such as GRID, TIN, and NETWORK will be required for certain applications, such as hydrologic analysis, terrain analysis, surface modeling, and routing. ArcScan provides functions for handling scanned images, ArcPress supports plotting larger maps, and ArcStorm manages the tiled spatial database seamlessly.

ArcView will be the software used primarily for ad-hoc display and query of data, thematic mapping, and for geocoding and address matching applications.

GIS software should be limited to the Arc/Info suite and ArcView. Other desktop mapping software should be considered only in very special circumstances.

CAD Software

Several design sections within the County, M-NCPPC, and WSSC currently use AutoCAD to support planning, design, and construction activities. Several applications have been identified which will support the organization of CAD data, indexing CAD drawings, access to CAD data through the GIS, and exchange of CAD and GIS data.

AutoCAD should continue to be used as a CAD tool by design staff. Data structure and exchange standards should be developed and enforced.

Document Management

All agencies have substantial requirements for scanning documents, both graphic such as plans and sketches, and text such as logs, applications, and forms. Some user groups manage large volumes of complex documents which warrant implementation of an EDMS to effectively manage the images and data. Other requirements are effectively met by linking individual scanned images to GIS features and managing the indexing and viewing of images with the Arc/Info and ORACLE capabilities.

If the agencies implement EDMS, it should be software which can be integrated with the GIS environment and which meets the needs of all organizations. Because of the complexity of EDMS applications, it is recommended that a county-wide EDMS needs analysis and design be conducted.

Image Processing

Arc/Info provides limited capabilities for image processing when compared with other image processing systems on the market today. GIS users throughout the industry typically use software from ERDAS or PCI to perform image processing functions. Both of these systems can be integrated, and/or can share data with ARC/INFO. The systems can also operate on the same type of workstation. Although not an immediate requirement, there is a long-term need to incorporate image processing functionality into the overall GIS configuration.

RDBMS Implementation

The ORACLE RDBMS will be the GIS relational database for the County and M-NCPPC. WSSC will also use ORACLE for some GIS related databases and applications. An ORACLE server will exist at both the County, operated by DIST, and at M-NCPPC, operated by the Research and Information Systems Division. ORACLE on the servers will be accessible to all users both for use with the GIS and independently. Users will be able to access multiple

ORACLE databases residing on different network nodes concurrently, including local PC ORACLE databases.

ORACLE tables will be related to Arc/Info coverages using the ESRI Arc/Info database interface. As discussed in Section 4, Database Requirements, both the County and M-NCPPC should use ORACLE comprehensively to build parcel and address-related databases and to support GIS applications.

Although ORACLE will be the RDBMS to support development of the integrated databases for parcel and development information, individual users and departments may still develop data in other databases such as Paradox, dBase, and Access. It is recommended that guidelines for address formats and key field contents be followed closely to ensure that the data can be related to other data and GIS features reliably.

Spatial Database Engine

ESRI has announced its Spatial Database Engine (SDE) which is an application or "driver" that manages and manipulates spatial data stored in an RDBMS, such as ORACLE. The SDE includes functions which perform a wide variety of spatial analysis on the spatial data elements and attribute data related to them. The SDE does not include a user interface of its own currently but will be able to be accessed by future versions of ESRI's ArcView and Arc/Info software.

Possible advantages of implementing SDE include improved:

- Integration of Arc/Info, ArcView, and RDBMS data
- Significantly improving access speed to attribute data from Arc/Info and ArcView
- Client/Server access and PC integration.

Long-term SDE implementation in the County is dependent on many factors. This is a newly announced product, and not all necessary information is available at this time. An evaluation of SDE should be undertaken by the agencies within the next year.

SPECIAL HARDWARE REQUIREMENTS

There are some special hardware requirements beyond GIS workstations, printers, and plotters which need to be introduced widely in order to support GIS applications. These are described below.

Laptops

Because of the capability of laptops which are now available, they can now be effectively used as self-contained GIS workstations. Disk space and memory are adequate to store, retrieve, and display graphic data. Many applications throughout the agencies have been identified which require field access to geographical information and data collection capabilities.

Scanners

At all agencies, there are opportunities for scanning hard copy documents which can then be accessible from the GIS as a raster image. Some examples are archived documents which must be frequently referenced such as record plats and inspection records. Others are Planning Board actions and transactional documents which can be scanned as part of daily operations. The overall hardware requirements include several large and small format scanners.

GPS Field Data Collection

Many different inventory and data collection operations can be supported by the acquisition of GPS technology. GPS equipment is already being used by the agencies to support field surveys. Recent developments in GPS technology have made the use of hand-held GPS receivers affordable and more accurate. The County, in coordination with the other MC:MAPS participants, should adopt a standard and purchase several hand-held units, and related field data collection equipment over the next 1 to 2 years.

Digital Camera

Another technology to be implemented is the digital camera. Digital cameras can be used by staff investigating alternative sites to review complaints, cases, and environmental problems. No film processing or printing is required. The images can be loaded directly into the RDMBS and linked to the site in question by parcel ID or another available identifier just as for any other image.

NETWORK REQUIREMENTS

As the County-wide GIS evolves from a developmental stage to an application environment, the user base will significantly expand. Users at all agencies will require access to data maintained by other agencies as well as to applications which are shared between agencies. In addition to adequate LANs within agencies, the wide area network (WAN) must be significantly enhanced to support high speed access by multiple users between the agencies.

Existing Wide-area Network

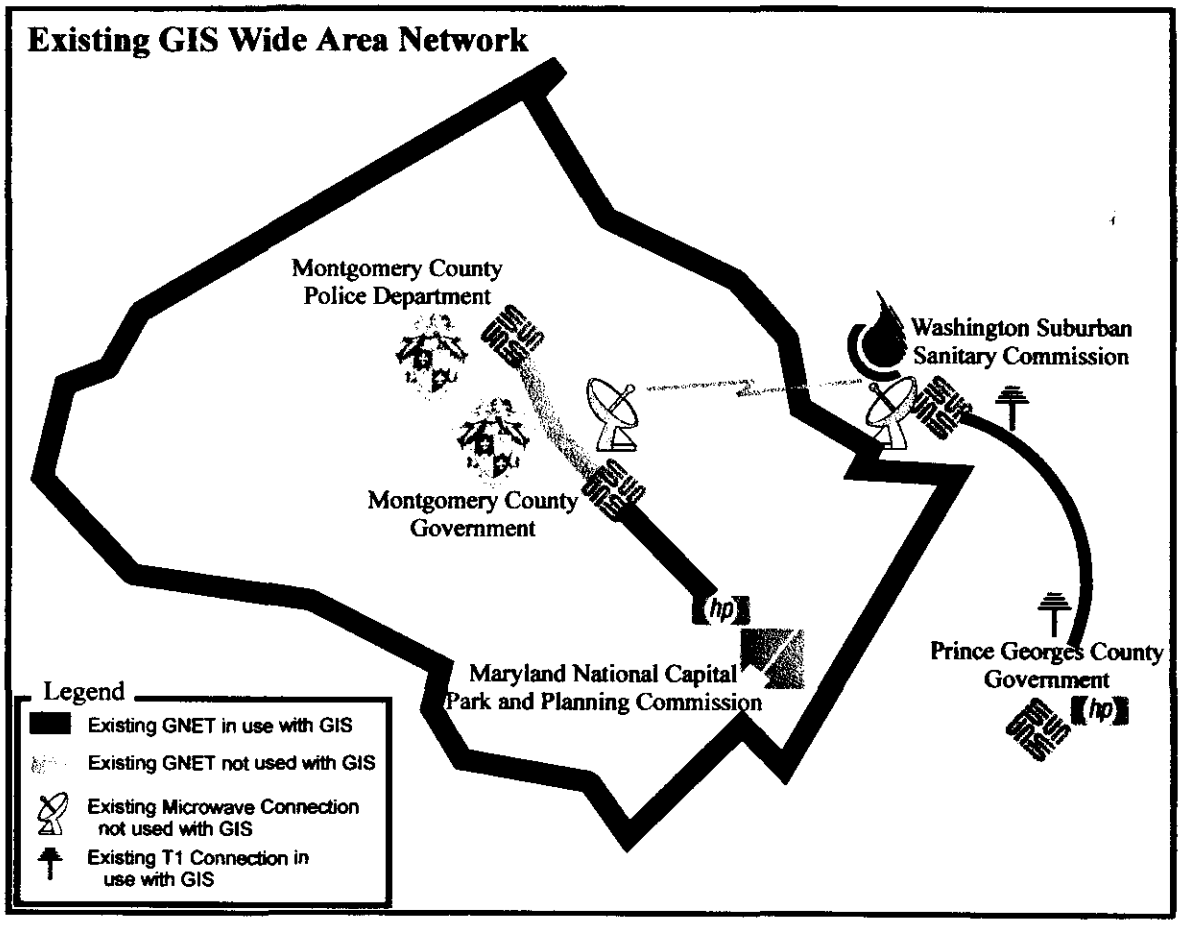
Montgomery County makes extensive use of the "G-NET" (Government Network) as the wide area network (WAN) backbone. The G-NET is a broad band cable system originally installed for Montgomery County Government during the installation of the cable TV system. The cable supports a host of communication requirements, including remote traffic TV monitors, computer terminal connectivity, and video transmission. The G-NET provides network connectivity for multiple Montgomery County offices, including Police Department facilities, the Office of Procurement, Fire and Rescue, DEP, DPWT, Permitting Services, Health and Human Services (HHS) and M-NCPPC in Silver Spring. GIS connectivity on the G-NET is provided through an Ethernet link, and the Office Automation network is supported with a Novell token ring connection.

The G-NET supports the connection to the GIS at M-NCPPC. The connection provides network services, including remote disk mounts allowing direct access to data and file transfers. This line also supports the DEP GIS workstations at Metro Center.

The Police Department and MCPS have Token Ring access to the G-NET, however, additional hardware (Token Ring cards) is needed in both cases to connect to the GIS network. The Police Department may gain access soon through funding from a Department of Justice supported project..

The Parks office at the Parkside headquarters is connected to the M-NCPPC office in Silver Spring with a T-1 line. This connection can be configured to support GIS users. There are no other communications capabilities between M-NCPPC sites within Montgomery County.

During the GIS Pilot Project, the WSSC Hocevar Office Building (HOB) was linked to the County GIS via a microwave link. A portion of the available bandwidth on this connection was used during the pilot for a 9600 baud connection. This bandwidth cannot support GIS activity.



Although the G-NET has provided the County with significant WAN capability, its bandwidth has limited potential for the GIS connectivity. Multiple users accessing M-NCPPC from the County and vice versa simultaneously cannot be supported. Additionally, bridges used to connect the G-NET into the GIS network are no longer manufactured.

GIS WAN Requirements

The agency GIS plans project significant increases in the number of anticipated GIS users and applications in the next five years. A large percentage of these users will require access to the latest, up-to-date data stored at other agencies. The GIS database is distributed among three agencies. The parcel and landbase data is maintained by M-NCPPC, water and sewer facilities data by WSSC, and the GBF/DIME and stormdrainage facilities and other layers are maintained by the County. A user in the Montgomery County Department of Transportation engaged in a road widening project would require access to the most recent updates to the water and sewer data located at WSSC. Additionally, access would also be required to the most recent parcel and planimetric data maintained by M-NCPPC. In order to realize the full potential of the GIS implementation across the GeoMaP agencies, a robust wide area network which will provide real time access to the entire database will be required.

A variety of WAN options are available through the commercial networking and telephone companies. The following is a basic list of the wide area networking options and the level of services provided by each. It should be noted that the County's G-NET corresponds to the Ethernet alternative and the FiberNET system corresponds to the Fiber alternative.

Wide Area Networking Options

Alternative	Speed	Required Equipment	Applications
9600 Baud	9600 baud	Modem, Regular Telephone Line	Email, Very small file transfer
28.8 Kbs.	28.8 Kbs.	Modem, Regular Telephone Line	Email, Very small file transfer, Internet access
56 Kbs.	56 Kbs.	ISDN Modem, Router, ISDN Telephone Line.	Email, Medium file transfer, Internet access
T1	1.54 Mbs.	DSU Modem, Router, T1 Line	Email, File transfer, Online GIS activity for less than 3 simultaneous users.
Ethernet	10 Mbs.	Specialized Bridges, GNET Line	Email, File transfer, Online GIS activity for less than 15 simultaneous users.
T3	45 Mbs.	DSU Modem, Router, T3 Line, (Workstation and Server Network Cards)*	Email, File transfer, Online GIS activity for less than 30 simultaneous users.
Fiber (FDDI)	+100 Mbs.	FDDI Hubs, FiberNET, Workstation and Server FDDI Network Cards.	Email, File transfer, Online GIS activity for more than 50 simultaneous users.

Given the options described, the Fiber provides the most suitable alternative for the GIS network. It should be noted that the 100 Mbs. throughput offered by the Fiber technology can only be achieved in networks where 100 Mbs. transfer rates exists across the full length of the network. As an example, if M-NCPPC using the proposed FiberNET connects its existing 10 Mbs. Ethernet network to the Montgomery County's 10Mbs. Ethernet network, the resulting

configuration would yield the effective transfer rate of 10Mbs., or the slowest segment of the network. In order for M-NCPPC and Montgomery County as well as other participating agencies to realize the full potential of the Fiber technology, 100Mbs. speed must be created in the Local Area Network (LAN) at each agency to match the 100Mbs. speed provided by Fiber.

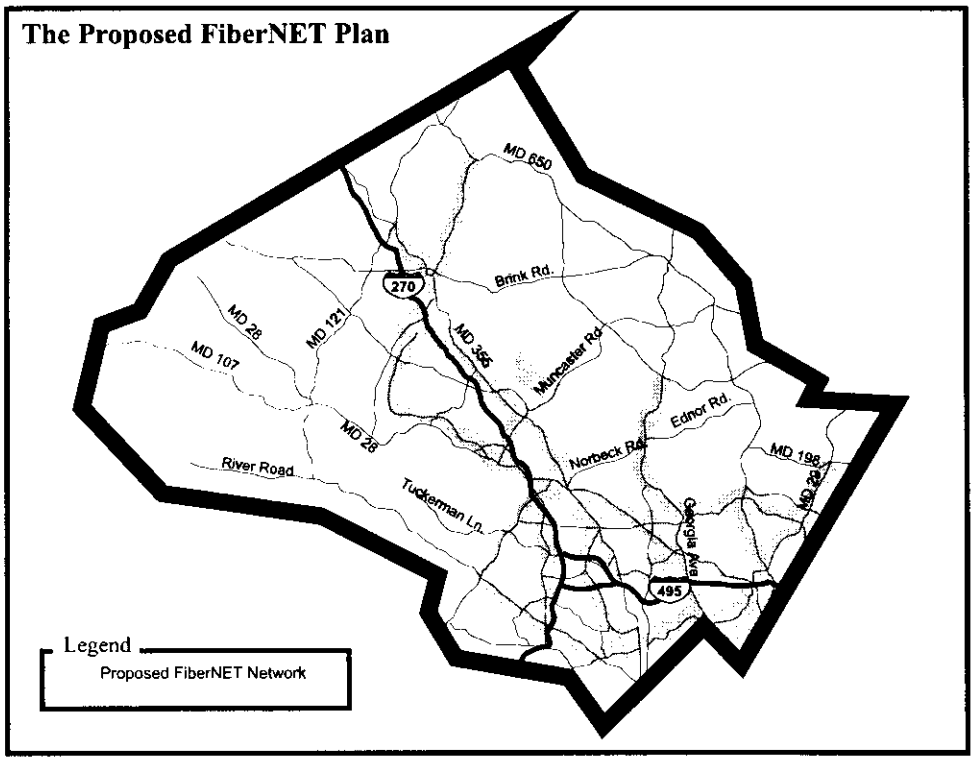
For agencies and offices which require access to the GIS datasets, but are not in the planned FiberNET, commercially available T1 lines are recommended. This includes the remote locations serving various Parks offices. T1 lines provide good performance for small groups of users at a reasonable cost of approximately $500.00 per month.

A T3 line is the next step in commercially available wide area networking options. T3 lines provide significantly improved network performance. The use of T3 lines is however, not recommended, unless absolutely required by the predicted network load. T3 lines typically range over $2,000.00 per month and require specialized networking equipment which may not be compatible to other existing and planned networking equipment.

FiberNET Implementation Schedule

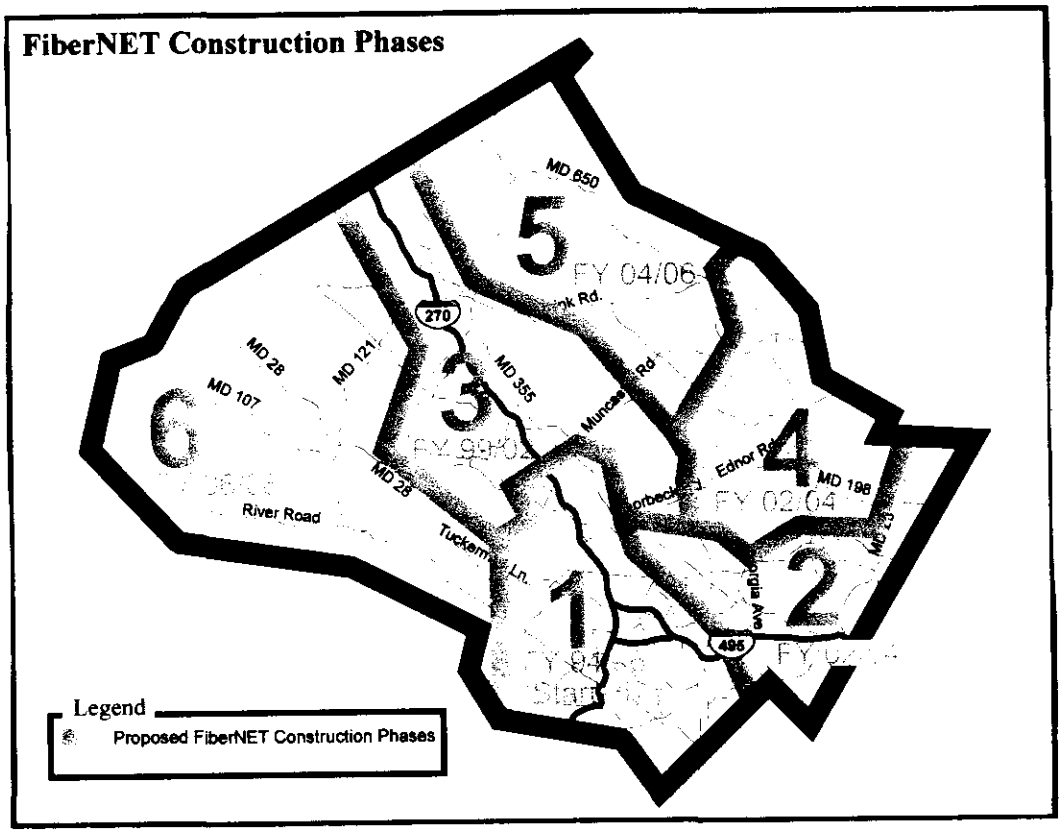
As previously discussed, the FiberNET provides the most optimal method for connectivity between the various agencies within Montgomery County which require access to the GIS data sets. The FiberNET will support a 100 Mbps bandwidth. The Fiber Net will initially replace the existing G-NET routes and later will be expanded to all County facilities and schools.

Based on the FiberNET Master Plan, developed by the Montgomery County FiberNET committee, the construction of the FiberNET is currently in a six-phase plan which will be completed in Fiscal Year 2008. The completed FiberNET will provide connectivity to all of the primary MC:MAPS sites, with the exception of WSSC. The FiberNET will extend to the intersection of Rt. 29 and Rt. 198 which is a few miles from the WSSC's HOB on Sweitzer Lane. *A review of the effort required to extend the FiberNET to WSSC's Hocevar Office Building is recommended.*



Since the FiberNET provides an ideal network platform supporting GIS functions required by the various agencies, its implementation schedule is critical to the development of the GIS Wide Area Network. Although the primary GIS sites are scheduled to be connected in the first two phases of the FiberNET construction, this period spans from 1995 to 1999.

The following plan illustrates the construction phases for the FiberNET project, based on the Montgomery County FiberNET Master Plan dated March 1995.



Network Recommendations

The following are recommendations on the implementation of a Wide Area Network which will satisfy the primary connectivity requirements of the GIS implementation plan.

- The current CIP schedule for the implementation of the FiberNET creates connectivity among primary Montgomery County Agencies (EOB, Police Department, College etc.) during the first phase of the project planned for completion in Fiscal Year 1996. Connectivity to the M-NCPPC's Georgia Ave. office is in phase two of the project which is planned for completion in Fiscal Year 1999. It is recommended that the FiberNET construction plan be reviewed for the possibility of implementing the connection to the M-NCPPC's 8787 Georgia Ave. in the early part of Phase 2, (or within the Fiscal Years 1996 and 1997).

- In phase 2 of the FiberNET construction plan, the network is to be extended to the intersection of Maryland Route 29 and Maryland Route 198. This location is within a minimal distance (of less than 5 miles) to the WSSC's Hocevar Office Building. It is recommended that the effort required to extend the FiberNET to this WSSC site be considered. Additionally, the implementation of the segment connecting the WSSC site to the rest of Montgomery County be scheduled for the early part of Phase 2, (or within the Fiscal Years 1996 and 1997).

- Sites which require connectivity but are not scheduled for connection to the FiberNET, should be connected using commercial T1 lines. It should be noted that the implementation of a T1 line requires specialized hardware including: network routers compatible to the existing LANs and DSU modems at both ends of the T1. There are network routers with built-in DSU modems on the market which could be used for this purpose.

- Future network equipment purchases by M-NCPPC, Montgomery County, and WSSC should consider the ultimate implementation of the FiberNET. As such, it may be cost effective to purchase network equipment which can be upgraded to support Fiber connections.

- The upgrade of internal GIS LANs at the various agencies should coordinated directly with the schedule for the construction of the FiberNET. A lead time of approximately 6 months would be required to coordinate the implementation of the upgrades required to the internal LANs for connection to the FiberNET.

SYSTEM DEVELOPMENT ACTION ITEMS

The following action items are required of the GIS agencies to adequately support the GIS expansion. The last column indicates the year within the five year planning period that the activity should be undertaken. The first year of the planning period is assumed to be the fiscal year of 1997.

	TASK	DESCRIPTION	RESPONS-IBILITY	YEAR
1.	Revise FiberNET plan and implement Phase 1	Revise the FiberNET Master Plan to prioritize the primary GIS sites, M-NCPPC and WSSC, and complete Phase 1.	County	1
2.	Implement Phase 2 of the FiberNET plan.	Implement Phase 2 which will connect M-NCPPC and WSSC to the FiberNET.	County	2
3.	Establish standards and procedures for acquiring GIS workstations and peripherals.	To support the high volume requirements for GIS hardware and software expansion, develop streamlined procurement procedures.	County MC:MAPS WSSC	1
4.	Implement networked ORACLE.	Implement ORACLE on the networks at the County, M-NCPPC, and WSSC providing access to all GIS users.	All	1
5.	Evaluate migration to Windows NT	Evaluate the migration of the agency GIS workstations to the Windows NT operating system, particularly implementing database servers as NT servers and PC's as NT systems.	MC:MAPS	2
6.	Evaluate use of SDE	Evaluate the benefits of utilizing SDE for graphic data management and spatial analysis among the agencies.	MC:MAPS	2
7.	Acquire and test GPS	Test the use of GPS in several application areas, involving all agencies. Establish a standard and make initial acquisitions.	All	1
8.	Evaluate EDMS requirements and solutions.	Analyze the EDMS requirements of each Agency and coordinate evaluation of software solutions.	All	2

	TASK	DESCRIPTION	RESPONS-IBILITY	YEAR
9.	Acquire GIS System Components	Agencies budget and plan for acquisition of next phase system components.	All	1-5

SECTION 6
ORGANIZATIONAL REQUIREMENTS

Summary

It is projected that the **GIS user base will expand to 600** users within the 5-year planning period.

Core GIS support services will be provided by **GIS support teams** within each agency. User support will be provided by the support teams as well as within user organizations.

Additional staffing will need to be dedicated to the GIS within core support groups and in user departments.

The agencies should develop and adopt a **professional GIS job classification system**.

There are **extensive training requirements** for technical staff and GIS users.

INTRODUCTION

Organizational structures currently in place within the agencies include the core GIS support groups as well as the interagency Committees which have been functioning for several years to coordinate GIS efforts. The County Executive Department of Information Systems and Telecommunications (DIST), M-NCPPC's Research and Information Systems Division, and WSSC's Information Systems Division (ISD), all provide a team of GIS staff responsible for providing GIS technical support within their agencies. Each of the 5 agencies has participated in the GeoMaP and MC:MAPS committees and has been involved in planning and implementing the GIS County-wide as well as with Prince George's County.

With the availability of the GBF/DIME file to support County-wide applications and the completion of a significant portion of the large-scale planimetric and property data, there is now sufficient data to support a major expansion of the GIS user base. Applications are available currently for accessing and plotting data and many additional applications are in development stages or have been identified for future development. At this point in time, the expansion of the user base is dependent on access to GIS workstations, to support staff, and to training resources.

This section of the Strategic Plan describes the County-wide requirements for GIS staffing and training, and other organizational needs such as data distribution and public access to the GIS.

GIS SUPPORT ORGANIZATIONS

The GIS is managed and supported by a GIS group within the information systems support organization of each agency. These core groups perform system management, administration, network management, database development, application development, and end user support functions. They provide GIS services to user departments and provide support to GIS users who are developing within the departments.

Core GIS Support	
GIS Management **Interagency Coordination** **Department User Coordinators**	
Database Maintenance QA/QC Data Conversion	System Management Network Management RDBMS Administration
GIS Application Development RDBMS Application Development	User Support Customized Training Personal Training

The core support groups perform many functions. The initial focus during the early stages of the GIS implementation was on database development and the related system requirements. The core staff primarily focused on data development, quality control, system and network acquisition, installation, and management.

Activities have now expanded to include application development and production of GIS maps. Most of the GIS applications and products have been produced by the core GIS groups operating in a service bureau role. This has primarily included the production of County-wide maps, presentation materials, master plan maps, and thematic maps for a variety of users. The number of actual "end users" within agency departments who have hands-on access to the GIS and perform GIS analysis independently is still small. It is currently 3 to 5 at WSSC, M-NCPPC, and the County, and 2 at MCPS.

STAFFING REQUIREMENTS

As stated previously, the priority County-wide is to expand the existing user base of approximately 15 as quickly as possible so that the full benefits of the GIS may be realized. It is projected that within five years, up to 400 staff could have access either full or part time to the GIS within the County and WSSC. The bottleneck to this expansion is the ability to provide support staff and training to users. Currently each organization only has 1 to 2 dedicated user support staff and their duties include supporting the ongoing database development efforts and developing applications.

GIS Positions	
GIS Manager	
System	System Manager Network Manager System Operator
Database	GIS Database Mgr. RDBMS Admin. Data Coordinator Data Analyst/Tech
Applications and User Support	GIS Appl Progr. GIS/RDBMS Progr. GIS User Support

The GIS agencies must increase user support staff within the core support groups as well as build up experienced GIS staff within the user groups. Increases in core staff have been

identified for each agency. These increases fall into several categories: system, database, application, and user support. The specific positions and justification for them have been described in detail in the individual agency GIS Plans.

Core GIS Staff	MCPS	County Executive	M-NCPPC	WSSC
Existing Agency Staff	0.5	6	8	4
Existing Contract Staff	0.5	0	11	4
Recommended Total**	2	21	21	16
Projected GIS Users	20	250	200	185

** includes existing staff and continued requirements for contract staff.

The existing and recommended core GIS staffing for each agency has been summarized. Of the total recommended, approximately half within each agency are application developers and user support staff. This category of staffing is extremely important in providing adequate support to user departments.

Based on the recommended staffing, the ratio of GIS staff to users overall is approximately 1:10, the ratio of support staff to users is 1:20.

The WSSC staff projection is actually 185 full-time users and 300 part-time users. Staffing has not been estimated for Montgomery College. This is because the nature of the curriculum, training programs, and technical resources which the College will develop is unknown at this time. Outside of the College training resources, there will be approximately 5 users of the GIS and technical support will come from the County's DIST or the College's instructional staff.

The existing staff at M-NCPPC, MCPS, and WSSC is currently augmented by contract staff, providing data conversion services, QC services, and technical support. The level of contract staffing will decrease as major data conversion efforts are completed, however, contract staff can still be utilized in the future to augment each agencies internal staff resources.

GIS staff should also be dedicated within the user groups. This will include current staff who develop GIS expertise as part of performing regular functions and staff who are dedicated to GIS development and support of other users within their groups. GIS staff within the larger user groups such as the Montgomery County DPWT, DEP, and Permitting Services will ensure a consistent level of dedicated, customized support.

It is essential that the recommended GIS staffing be developed. The realization of GIS benefits and cost effective implementation is dependent on this level of staffing. The development of GIS staffing resources within the core support groups and user organizations may be accomplished in several ways:

- creation of new positions
- reallocation of positions between organizational units
- reclassification of current positions

As the agencies plan and implement reorganizations and reengineering efforts which are underway, the allocation of staffing should be carefully analyzed and adjusted to obtain the necessary GIS positions.

GIS Professional Job Classification System

As part of each Agency GIS Plan, detailed descriptions of the required GIS positions were provided. The descriptions are functional in nature and do not include recommended grade or relative levels of the positions. However, it is important for each agency to adopt a GIS position classification system which appropriately relates the GIS positions to the overall job classification scale. GIS responsibilities require a broad technical background and specific training.

GIS resources overall are in short supply due to the rapid increase in GIS activity nationwide. The adoption of a classification system by each agency will ensure that GIS positions are professional positions with specific career tracks available. The classification system will assist in recruiting and retaining qualified staff.

TRAINING REQUIREMENTS

GIS is a very complex technology involving many aspects such as cartography, map composition, spatial analysis, and relational database management. Support of the GIS and its users requires computer programming, relational database management, system management, network management, and database administration skills. The effective implementation and use of the technology requires expertise at several levels. Training must be provided for all personnel who will be using the GIS as a tool and who will be supporting the GIS.

The GIS user also requires training. Although the software available is much more user friendly than previous versions, training in spatial concepts, GIS capabilities, database content and structure, and effective use of the software is still required. Most users do not have backgrounds in the technical areas required to utilize the GIS. Training in use of specific applications which have been developed for users is also necessary.

There are also many educational opportunities available through local and national GIS conferences and seminars. Many of the agencies staff currently participates and are members of national organizations which focus on GIS technology and implementation and of local chapters which provide a forum for sharing experiences and ideas. Management staff should attend national conferences which provide a mechanism to stay abreast of trends and management strategies as well as to share the agencies experiences with other local governments. Technical staff should attend software user group conferences which also provide an opportunity for sharing experiences and provide technical sessions and training on new products, new releases, and specialized GIS software. Local conferences, such as the Towson State Annual GIS Conference provides an opportunity for communication and coordination with other Maryland state and local agencies.

The training requirements presented here will focus on training resources which the County agencies must develop rather than external sources such as conferences and seminars.

Training Concept

The overall training program to be implemented by the County will include several components.

GIS Classes — Training classes will be provided ranging from introductory GIS to advanced Arc/Info training. A County training program will be developed which will offer training in basic GIS software packages such as ArcView, Arc/Info, and ORACLE. Vendor training in more advanced technical subjects will also be utilized.

Personal Training — GIS support staff will spend a portion of their time providing personalized training to 1 to 2 GIS users at a time. This training will provide hands-on, customized orientation and guidance to users in their own GIS environment. Staff will "float" among user organizations and resources will be scheduled based on user requests and demand.

GIS Lab — GIS Labs consisting of up to 10 networked GIS workstations will be used for classes as well as for user practice and informal help sessions. The labs can be used to support the County Training Program.

Help Line — A telephone and E-mail "help" line should be supported by one or more of the core GIS support groups. This would provide immediate help and response to GIS users throughout the agencies. With the projected number of users, this will ensure that help is always available and users are not dependent on one or two liaison staff or assigned support staff.

Training can be provided either as standard, generic curriculums addressing particular software or technical areas, or customized to the user's needs and environment. It is recommended that all training which is aimed at the end user be customized to the extent possible. *The training should utilize the County's and WSSC's data as the basis for examples and hands-on exercises and the trainers should be familiar with the functional work areas and applications of the users being trained.*

Training Plan

The following specific elements of a comprehensive training program are recommended for the GIS agencies.

Concepts and Use

This category of training covers most of what will be needed by GIS end users.

Introductory GIS — Almost all staff who will be exposed to the GIS at some level or who will be responsible for making decisions regarding GIS use within their units should receive *Introductory GIS* training. This training will be provided by in-house staff or consulting services who are familiar with the County's

GIS environment. This training will be provided as 1 to 2 day workshops to groups of approximately 10 users with common work areas.

Personal Training GIS users with responsibility for using the GIS to perform their jobs will require some amount of Personal Training. This training will consist of one-on-one or small groups up to 3 users and will be provided mostly by in-house GIS support staff. The amount of time will be highly variable depending on the needs of the users and level of GIS knowledge required. The GIS support staff in the core GIS support groups will largely provide this training. Users groups will request blocks of time which will be prioritized and scheduled. The training will be provided at the users locations with their GIS workstations.

ArcView Training GIS users will require 1 to 3 days of ArcView training which will provide hands-on experience with all of the ArcView tools and capabilities. This training will be provided to groups of approximately 10 and will require training facilities with adequate GIS workstations.

Technical Training

Technical training in the form of 3 to 5 day courses in specific software will be required. The courses may be provided to groups of 10 to 15 students and require training materials and access to GIS workstations at a ratio not larger than 1 to 2. The most common requirements will be Arc/Info courses and ORACLE training. Because of the large number of courses which will be required in these areas, the County should develop its own training program which all of the participating agencies can utilize.

Technical Training
System Mgmt / Operating System
Database Administration
ORACLE / RDBMS
Development/Programming
Arc/Info Courses

Since a single course may cost from $1,000 to $2,000 if provided by the software vendor, there is significant potential for cost savings if the County develops a training program. Sending 6 staff to a one week training course provided by a vendor could cost $6,000 to $12,000 plus any associated travel or lodging costs.

Annual Training Projections

Projections of the annual training requirement have been made for GIS user and technical staff training for all agencies. The estimates reflect training required during a typical year.

	Public Schools	Montgomery Colleg	County Executive	M-NCPPC	WSSC	TOTAL	
Days of Training						Days:	
Concepts Intro	5	4	100	43		152	offer inhouse with consulting support
Personal Trainer	10	4	105	115		234	provided by GIS support staff
ArcView	10	2	61	52	20	145	include in **Training Program**
Weeks of Training						Weeks:	
System/Operating			4	2	2	8	vendor course
GIS Database Admin.			2	2	2	6	vendor course
ORACLE/RDBMS	1		4	4	2	11	vendor course
Dev/Programming			6	4	2	12	vendor course
Advanced Arc/Info	1		8	4	3	16	include in **Training Program**
Introductory Arc/Info	1		8	6	6	21	include in **Training Program**
Introductory ORACLE	1		4	6	2	13	include in **Training Program**

Most of the user training is estimated based on numbers of days since this can vary from 1 day for introductory training to 15 days of personalized training per user. The personal training will not be offered as a "course" but scheduled according to user needs.

The technical training is based on the number of weeks of training which will be required among the pool of GIS support staff. Generally, each technical staff member, whether in a core group or user organization, will require one to two weeks of technical training per year. Even experienced staff may require training in new software, operating systems, or revised software.

Based on these projections, the scope and nature of the Training Program can be determined. The personal training time is not considered a course, so is not included in the Training Program. The projected 234 days of personal training will be allocated between users over the course of a year. The Introductory GIS courses should be provided by each agency and should be tailored to the needs of each group to be trained. Consultant services may be used to develop and/or provide these courses.

The courses with the highest projected attendance, ArcView, Arc/Info, and ORACLE should be offered through the Training Program. The other technical courses should be provided by the individual software vendors since each one will only be required by a small number of staff.

Training Program Content

There are four courses that are recommended to be part of the training program. A total of 12 two to three day courses and 10 one week courses should be offered each year. Over 100 agency staff could benefit from this program annually. The courses outlined could cost more than $25,000 if obtained from vendors.

Training	students per course	length of course	number of courses
ArcView	8	2/3 days	12
Introductory Arc/Info	8	5 days	4
Advanced Arc/Info	8	5 days	3
Introductory ORACLE	8	5 days	2

If the training program is developed in such a way that courses can be offered to participants outside of the MC:MAPS agencies, then the program can be expanded. Possible other participants include other public agency staff such as adjacent Counties or the cities.

The primary resources needed to support a training program are: instructors, training materials and curriculum, GIS data, and GIS workstations. The MC:MAPS Committee and the involved agencies should determine the total cost of developing the program and a cost recovery mechanism through course fees. If the program is jointly funded by all agencies, an equivalent savings in course costs should be realized.

If it is decided that Montgomery College should manage the Training Program and provide the instructional resources, the County and MCPS could potentially share in the development of a GIS Lab which would be local to the College as well.

Training Program Resources	
Training Materials and Curriculum	The curriculum for the courses should be developed based on use of the County's data. These resources may be developed by consulting services.
Instruction	Training instructors may be provided by consulting services, in-house staff, or the Montgomery College GIS program.
GIS Data	The data should include the County's GIS base layers, other overlays of application data, water and sewer facilities data, and the GBF/DIME file.
GIS Workstations	Ideally 6 GIS workstations should be available to support these classes. GIS labs are currently under development at WSSC and M-NCPPC, however additional software and possibly upgraded equipment is needed. A centrally located facility at Montgomery College or County offices is also required.

DATA DISTRIBUTION POLICIES

The GIS database represents the most significant investment of resources in the County's GIS Project. As the database becomes more complete, the opportunities to use the data for a wide variety of purposes by non-agency staff will increase.

The MC:MAPS and the GIS agencies must consider and adopt appropriate policies in several areas to govern distribution of and access to their resources. The resources which have been developed may be of interest to several classes of users:

- general public for nonprofit use
- public agencies for public/nonprofit use
- private entity in support of agency projects
- private entity for commercial use (profit)

The first three groups are acting in the public interest or working directly for County agencies. It is recognized by all MC:MAPS agencies that data for this class of projects will be provided to users at a minimal cost (the cost associated with the transaction). Clearly defined policies and procedures for data distribution to this class of user still need to be established. Key questions to be addressed include:

- What agencies will be responsible for distribution of data?
- What formats will data be provided in (Arc/Info, DXF, both)?
- What procedures will be used to track the distribution of data?
- What data will agencies be prohibited from providing?
- How will data be transmitted (Internet, tape, compact disc)
- Will special products or services also be provided (plots, reports, etc.)
- What fees will be charged for data/services provided.

Currently, data is being distributed in an ad-hoc manner on a case-by-case basis. *PlanGraphics recommends that the MC:MAPS Committee develop guidelines and procedures to address the issues above and other related issues associated with distribution of GIS data to these types of users.*

The second class of users would include those users who will use the data that they acquire for commercial purposes. As with the other class of users, the pressure and the opportunities to provide data for commercial purposes will increase as the database becomes complete and more and more users become aware of its quality and value. Providing this data for commercial purposes provides an opportunity for the County to generate revenues. An analysis of the market potential has not been completed, however it can be assumed that several hundred thousand dollars in revenue could be generated annually with a well structured and comprehensive data distribution program.

In addition to the issues described above, the key issue to be addressed is who will serve as the distributor of data. The distributor could include a County Office, or it could be a private organization. In order to sell the data in a comprehensive manner it is important that the distributor have a well developed marketing, sales, and distribution program. If a private vendor is used, it is possible that they could serve as the data distributor for the other class of users described above as well.

It will be necessary to develop a clearcut methodology for classifying potential users as nonprofit and commercial that will be defensible.

M-NCPPC has developed a draft RFP to solicit proposals from vendors that may serve as data providers or value-added resellers to commercial users. This RFP will serve to "test the market" for determining firms that are interested in selling data. *PlanGraphics recommends that as a first step in this process the RFP be finalized, and proposals from potential vendors solicited.* Following this process, decisions on the approach to pursue for data distribution can be made and a program can be implemented.

PUBLIC ACCESS TO GIS

Many applications and opportunities for providing important information to the public via the GIS were identified during completion of the agency plans. Examples include public school information, real estate information, zoning and planning data, parcel data, facilities locations, and general public information. Several options exist for providing access. The location for the access could be a variety of places depending on the type of information.

Several information counters are currently operated, such as the engineering records information counter at WSSC and the development information counter at M-NCPPC. GIS workstations available to the public at these counters could support queries and display of GIS data. Applications to support this were identified in the Application Requirements for each agency. These would be multi-media type user interfaces which would not require any knowledge of the GIS software or the windows operating system.

Where?	What?
Public Libraries	Kiosks
Information Counters	GIS Workstations
Public Schools	Multi-media
Health Centers	Web Site
Internet	

The other important location for public access would be more public areas such as libraries, schools, or service centers such as health facilities. These could be supported with GIS workstations and specialized applications or with Kiosks which could include touch screen, audio, and speech-recognition capabilities. This option would be appropriate for more general public information and access to County resources

Public access applications should be developed, and a commitment to provide access to GIS data for query and retrieval purposes by the public should be made. A public access application would serve to save existing agency resources, highlight the quality of agency services, and would also illustrate the benefits of GIS technology to the public and the County. The public access application should be implemented in various stages, depending on data availability and quality.

Internet Access

The Internet is becoming the preferred mode for disseminating technical information throughout the computer industry. Several of the MC:MAPS agencies have implemented home pages on the Internet. Others are looking into, or are in the process of developing individual home pages. Currently the GIS newsletter is being published in a special section of the M-NCPPC home page which has been dedicated to MC:MAPS.

The MC:MAPS home page should be expanded to serve at a minimum the following functions:

- Provides "news" on GIS activity within the agencies.
- Provides an overview of the GIS program underway
- Provides access to data dictionary or metadata information that exists in the database
- Provides for exchange of information on applications developed
- Provides clearinghouse for exchange of technical information
- Provides points of contact for GIS related information
- Serves as basis for articles and publications on the local GIS effort
- Publish samples of data for users

Ultimately the Internet could also be the mechanism by which data and applications are made available and distributed to users.

ORGANIZATIONAL ACTION ITEMS

The following tasks should be accomplished by the agencies and committees in the year indicated in the last column (beginning with Fiscal Year 1997).

	TASKS	DESCRIPTION	RESPONS-IBILITY	YEAR
1.	Establish/Enhance GIS Labs	Develop a GIS training lab at the College or County offices. Improve the existing training facilities at WSSC and M-NCPPC.	All	1
2.	Design Training Program	Determine the detailed requirements for the Training Program, identify funding sources, determine cost sharing arrangements, assign responsibilities.	MC:MAPS Agencies Consultant services	1
3.	Acquire Training Resources	Acquire resources including materials, curriculum, instruction.	Assigned Agencies	1
4.	Implement GIS Staffing	Establish GIS positions identified in the agency plans, phasing over the five year planning period.	Each Agency	1-5
5.	Establish Data Distribution Policy	Develop and adopt policies for distributing both the GIS base layers and other GIS data. Include distribution to the public and private entities.	MC:MAPS GeoMaP	1
6.	Implement Data Distribution Program	Investigate options for effectively distributing data and implement program(s).	Assigned Agencies	2
7.	Design and Implement Public Access Systems	Implement two types of public access systems: an information counter with a specific purpose and a public information site.	MC:MAPS Agencies	2

SECTION 7
IMPLEMENTATION COSTS AND PHASING

INTRODUCTION

The goal of the Montgomery County GIS implementation effort during the five year planning period is to expand the GIS user base such that the full benefits and efficiencies of GIS implementation will be realized. This requires that the agencies complete the GIS base layers, develop applications, expand the GIS communications networks, and implement an interagency training program which will support the development of GIS staff in all agencies. Achieving these objectives will ensure that the use of the GIS can be expanded significantly.

GIS implementation has been a multi-million dollar investment for the agencies over the past five years. It is anticipated that the expansion of the GIS during the five year planning period will require continued investment at this level.

This section of the report describes the cost factors related to some of the more major undertakings and relative phasing of activities. Cost estimates were not included within the scope of work to be completed by PlanGraphics for this project. The cost information presented here should be used for general planning purposes only and does not represent the full cost of GIS implementation.

Detailed cost projections for the WSSC GIS implementation were made in the GeoMaP Pilot Study Report, although full funding for the first two years of the planning period was not provided.

APPLICATION DEVELOPMENT

Over 200 distinct GIS applications were identified among the five agencies, including 30 utility and core applications which are the highest priority for development during the next three years. Agency responsibilities for development of the utility and core applications were allocated leaving the County, M-NCPPC, and WSSC with significant application development work both for these applications and the agencies' individual functional areas.

Effective design and development of applications and implementation of standards is dependent on commitment of significant staff resources. The MC:MAPS and GeoMaP Committees must also participate in application prioritization, scoping, standards development, and work assignment during this time period.

It is estimated that, at a minimum, the County and M-NCPPC, should each plan to spend $100,000 in consulting services to support the development of the core and utility applications each of the next two years. This is in addition to allocation of staff resources to support the

development effort. Beyond that time, the need for consulting services will depend on the level of agency resources which are established and available for continued application development.

DATABASE DEVELOPMENT

The highest database priorities, completion of the large-scale GIS base layers, have been budgeted by the agencies. Of the many requirements for additional database development and enhancement, a few have been identified as being the highest priority for all agencies.

Five database development efforts have significant costs associated with them and are required by all agencies. These five should be authorized as CIP projects and jointly funded by the agencies. General cost estimates for their development are provided. These estimates should be refined as preliminary stages of analysis and pilot projects are completed.

Zoning Conversion	$250,000	Year 1
Address Data Conversion	$250,000	Year 1
GBF/DIME Enhancement	$100,000	Year 1-2
Floodplains Layer	-	Year 2
Land Use/Land Cover Mapping	-	Year 2

Other high priority database development efforts are appropriate for in-house conversion. These may be longer term efforts which will be incorporated into daily operations or ongoing procedures. They include:

Preliminary Plan Boundaries	M-NCPPC
Record Plats	M-NCPPC
Natural Resources Inventory Data	M-NCPPC and County
Water and Sewer Service Areas	County
Planned Transportation ROW	M-NCPPC
Bridges Inventory	County
Sidewalks	County
Hazmat Sites	County
Traffic Signs	County
Septic System Locations	County
Water Wells	County

The design and development of the integrated parcel database using ORACLE should also be funded as a shared project. This project will require a combination of consulting services and involvement of County and M-NCPPC staff.

SYSTEM EXPANSION

The costs of system expansion will fall into four areas:

GIS workstations
Peripheral devices (printers, plotters, scanners)
LAN expansions
WAN expansion

The most common GIS workstation, the Pentium PC and its GIS software, will cost in the range of $5,000 to $7,000. A UNIX workstation or database server may cost from $10,000 to $25,000 depending on individual memory and storage requirements.

A long term consideration in system costs is that most equipment and software has accompanying license and maintenance fees of 10 to 20% per year. System costs will be an ongoing and significant part of each agencies GIS budgets.

TECHNICAL ASSISTANCE COSTS

Throughout the implementation process, technical assistance in addition to application development will be required. Support areas will include database design and enhancement procedures, assistance in evaluating and incorporating new technologies (SDE, Windows NT, GPS, EDMS, etc.), developing and implementing a data distribution program, and defining and establishing the Training Program. The necessary funding for these efforts should come from individual agencies budgets, as well as through shared projects between agencies.

ORGANIZATIONAL COSTS

The major organizational costs are in the areas of staffing and the training program. Each agency plan identifies the most critical positions to be established in the next year as well as the complete staffing resources for the five year period.

The costs for the training program will include:

GIS Labs
Instructional Costs
Materials/Curriculum

These costs should be determined in detail as part of determination of the approach to the Training Program, agency roles and responsibilities, and mechanisms for acquiring training instruction and materials.