Enterprise Overview
Spotsylvania County is using Geographic Information System (GIS) technology to perform a variety of department specific tasks throughout the County.

The County has made a financial investment in the technology, which in turn has prompted the growth of use through the departments. Presently, three departments are using the technology as part of their every day workflow.

Over the past few years, advancements in software, hardware and network infrastructure have created the possibility of cost effective County-wide implementation of this technology, making GIS applications available to all County staff.

This section provides details about GIS applications that will be used county-wide by personnel in various departments, by the public, or by both County personnel and the public.

Enterprise GIS Personnel
As the number of employees using GIS in the County has grown, the tasks supported by this technology have also grown. However, for the purpose of this project the use/users of GIS can be categorized into three groups:

Tier 1 users typically use GIS on a daily basis. They are responsible for using high-end GIS software to create, edit, and maintain spatial datasets being used enterprise wide. They are knowledgeable with respect to spatial constrains, topology rules and data structure. Examples of Tier 1 datasets are street centerlines, parcel polygons and utility infrastructure.

Tier 2 users leverage GIS to conduct analysis, improve decision making, or display related data in a map environment. Tier 2 users leverage the availability of enterprise data to perform their jobs more efficiently. Although the analysis process may result in additional datasets, they are typically project or department specific. In addition, Tier 2 users may be tasked with creating high quality cartographic products that also tend to be project or department specific. Examples of Tier 2 datasets are crime analysis, emergency evacuation planning, and work order tracking.

Tier 3 users typically leverage GIS as an intuitive mechanism to retrieve information from a map interface. Often this is done through an enterprise level browser solution. Data and maps are retrieved using pre defined search routines. Cartographic products are typically limited and no data is being created or edited. Tier Examples include locating points of interest and retrieving property ownership information.

Please refer to specific department/division sections to determine the exact GIS tier use for each staff member.
The table below lists departments and divisions that represent the major GIS stakeholders within the Enterprise as well as the type and number of GIS users in each department:

<table>
<thead>
<tr>
<th>Major GIS Stakeholders</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Compliance</td>
<td></td>
<td></td>
<td>50+</td>
</tr>
<tr>
<td>Commissioner of Revenue</td>
<td></td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Economic Development</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Fire, Rescue, and Emergency Management</td>
<td>5</td>
<td></td>
<td>50+</td>
</tr>
<tr>
<td>Health Department</td>
<td>6</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>IS Department (GIS Division)</td>
<td>8</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Parks and Recreation</td>
<td>5</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Planning Department</td>
<td>7</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Schools</td>
<td>1</td>
<td>4</td>
<td>50+</td>
</tr>
<tr>
<td>Sheriff’s office</td>
<td>3</td>
<td></td>
<td>50+</td>
</tr>
<tr>
<td>Utilities Department</td>
<td>2</td>
<td>6</td>
<td>50+</td>
</tr>
<tr>
<td><strong>Conservative Enterprise Estimates</strong></td>
<td>11</td>
<td>39</td>
<td>342+</td>
</tr>
</tbody>
</table>
The following graphic depicts the recommended enterprise wide application configuration based on the three levels of application usage.
Enterprise GIS Applications

GIS applications are one of the key building blocks for Spotsylvania County’s enterprise-wide GIS implementation.

Desktop GIS Applications

ArcGIS 9.x

ArcGIS is a scalable system of software designed to meet all Tier 1 and Tier 2 needs. Three different levels of ArcGIS are available: 1) ArcInfo, 2) ArcEditor, and 3) ArcView. Although licensed separately, ArcGIS is a scalable set of software with the same underlying executables and user interface. ArcInfo, ArcEditor, and ArcView can all be customized using VB, C++, and many other popular programming languages within the ArcObjects object model.

Individual recommendations for utilization of ArcGIS are included in each department/division section in this chapter.

Tier 1—Flagship GIS

ArcEditor 9 for ArcGIS is the recommended Tier 1 application for Spotsylvania County. ArcEditor 9 includes all the functionality of ArcView 9 and allows users to access the power of ESRI’s Spatial Data Engine (ArcSDE). As described in Appendix I and Chapter 5 - Database Development and Design, the geodatabase is the primary data format used in ArcGIS. Two types of geodatabases are offered: 1) personal geodatabases, which store data within MS Access MDB files (regardless of whether the user has MS Access on their computer), and 2) enterprise geodatabases, which store data in a wide variety of commercial relational database management systems (RDBMS), including Oracle, SQL Server, Informix, and DB2. ArcSDE is required as a gateway between ArcGIS and the enterprise geodatabase stored in an RDBMS.

ArcEditor can store and edit data in enterprise-wide geodatabases and personal geodatabases. ArcView can only store data in personal geodatabases and has limited accessibility to data stored in ArcSDE. The primary advantage of using ArcSDE and enterprise-wide geodatabases is simultaneous, multi-user editing of geodatabases. For this reason, ArcEditor is recommended within a variety of Departments. Editing within the recommended County ArcSDE database is not available with the ArcView license.

The County currently has several concurrent use licenses of ArcGIS that range from the ArcInfo level (Utilities) to the ArcView level (Planning). It is recommended that all ArcView licenses be migrated to at least the ArcEditor level in phased progression. As departments develop sophisticated usage of the GIS system there will be a need for data editing and extensive participation with the recommended ArcSDE Enterprise
Geodatabase. All ArcView licenses should be upgraded by the end of the three year implementation plan.

ArcEditor 9 costs approximately $4,000 per license. Most users will not need access to the full functionality of ArcEditor 9 but will use the license to access editing within the recommended ArcSDE Enterprise Geodatabase.

Over the past few years the use of desktop GIS has increased dramatically, facilitated by advancements in computing power and improvements in operating systems. Desktop GIS includes many of the more popular functions of the flagship GIS products but omits some of the lesser-used functions. Desktop GIS is much less expensive than the flagship product. Desktop GIS can be purchased for an average price of $1,000 per license. Products such as ArcView have proliferated throughout local government and have allowed a new, larger group of employees to use the GIS. If 3 people are using the flagship package, perhaps 10 will be using the desktop version.

ESRI’s Tier 2 software application has recently migrated from ArcView 3 to ArcView 9, although ArcView 3 is still supported.ArcView 3 was much more user-friendly than ArcInfo Workstation, as it was all menu-driven, as opposed to ArcInfo Workstation’s command line interface. ArcView 9 is the least robust and least expensive of the ArcGIS suite. As an ArcGIS product, it uses the same interface as the Tier 1 one products, ArcInfo and ArcEditor. The primary differences (beside cost) between ArcView 9 and the Tier 1 products is that ArcView: 1) cannot edit coverages, 2) can only edit personal geodatabases, 3) has less geoprocessing tools, 4) and lacks many database schema customization tools.
Tier 2 desktop applications still offer more functionality than many users need, and their robust functionality often cause them to run slowly on machines not intended to operate memory intensive applications.

**Tier 2 – ArcView 3x**

**Tier 2 – ArcView 8x**

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**Tier 3 – Customized/Open GIS**

The majority of potential GIS users need easy-to-use, intuitive interfaces that perform well-defined tasks. Thus, the third tier of GIS software was born: customizable/open GIS. GIS software companies have moved GIS functionality to common, widely used programming languages such as C++ and Microsoft Visual Basic. The result is that application developers can create very user-friendly interfaces that have the look and feel of other personal computer applications. Only the GIS functionality needed for a specific program is used. Thus the overhead of non-used functionality is not slowing down the applications. Custom applications can be created and distributed throughout the organization. Typically the Tier 3 product has a price tag of a few hundred dollars per seat, which can include all the necessary programming software and deployment licenses. For each additional deployment, typically a $100 fee is paid to the software company.

Counties like Columbia County, Georgia, are deploying GIS using all three tiers and concentrating on custom applications. Columbia County will be deploying a "generic data browser."
“browser” that will allow citizens, elected officials, and anyone with a personal computer to access a wealth of information.

The open programming interface opens the GIS door for any application developer in any industry. No longer is GIS development the domain of an elite few GIS gurus. Now any programmer adept at a standard programming language can embed GIS functionality in applications to be used by anyone throughout the organization.

More information can be found at: [http://www.esri.com](http://www.esri.com)

### Example of a Custom GIS Data Browser

#### Internet/Intranet Departmental GIS Data Browsers

The ability to view data in a quick and easy format is important for local governments and is needed throughout an enterprise. Web-based data browsers allow quick viewing and printing of map data. Web-based data browsers can be configured either for use solely within County departments or as a web site available to the public. A potential application for a GIS browser would be for the visualization and query of property information, utility customers and service areas, zoning, and other pertinent layers; additionally, this application could serve as a tool for creating mailing labels for targeted areas.

#### Recommended Intranet Configuration

**Intranet**

Departmental Intranet GIS Data Browser Solutions are ArcIMS-based applications for data dissemination by departmental function across an Intranet. Intranet browser’s represent a step forward in enterprise-wide GIS technology as it offers just enough spatial analysis, geographical viewing and map production, as well as external database links. The browser should include:

- Advance Search Criteria
- Automated Mailing Labels
- Integration of Departmental Data
- Incorporation of enterprise Database records
- Customized Departmental Query Control
- On-Line Help and Tutorial
- Advanced Graphic Design
- Enhanced Text Placement
- Link to external web Databases
- Easy-to-Use interface

Each department is presented with pertinent GIS data and custom defined queries for easy end-user interaction and module development allows for the configuration or addition of module departments or functions to the browser based interface.

**Intranet GIS Data Browser**

The County currently has an existing application created by a consultant that runs on the ArcIMS platform. It is recommended that the County use its license of the latest version of ArcIMS (Version 9), so it can serve as the backbone for the Internet and Intranet GIS Data Browsers.

Upon consolidation, centralization and standardization of GIS data, the Intranet GIS data browser should be modified to provide department-specific data and functionality. Additional functionality should include the ability to view all base map data, department-specific queries, and standardized mapping templates. Additional departmental/divisional requirements are provided in specific department/division sections in this chapter.

The ArcIMS platform utilized for the Intranet GIS data browser can also be leveraged to implement other Intranet GIS applications in the future as well as an Internet GIS data browser.
Internet GIS Data Browser

A key issue identified in the County Administrator interviews was improved access to information through GIS technology. An internet GIS data browser will provide citizens with access to online maps and geo-spatial information via a web-based solution. The Internet browser application should include an intuitive interface, and should incorporate the use of a graphic outline. The interface should be developed to match the current County Web Site in color scheme, layout, logo etc.

Recommended Internet Configuration

Map Navigation Query Tools via Intranet Data Browser

The Intranet and Internet browsers should have a variety of navigation and query tools.
Navigation tools should include
- Pan
- Zoom in
- Zoom out
- Zoom to active layer
- Zoom previous
- Zoom to full extent
- Zoom to address
- Zoom to neighborhood

The simple query tools should include the following functions:
- Identify
- Ad-hoc query builder
- Find Address
- Spatial selection by box or polygon
- Buffer selection by layer

Multiple Interfaces or Services by Department or Function
The browsers should have a selection box for every major department or function in the organization. Once the department is selected then the interface, layers available, search mechanisms, and available reporting change to focus on the needs of that department. These associated layers and stored queries should be definable by staff and not require the use of outside consultants to edit or update.

Data Search Methods and Stored Queries
Various methods of finding information should be available. Each departmental interface will have a definable list of data search methods. These methods will be editable and storable by an administrative user and the shared out to the end user community. The following graphic depicts some more popular ways of searching for data in local government.
**Data Display and Hyper-linking**

The browser solutions should support hyper linking to web supportable file formats. Following are excellent examples of hyper-linking opportunities from the application datasets:

- Parcel deeds and plats
- Sexual Offenders link to the State
- Imagery of Community Facilities
- Pictures of individual structures
- Maps to community facilities

![Sample of Sexual Offender link](image-url)
**Printing and Reporting**

The browser solutions should provide the ability to generate quality prints to a local printer. The print should include the map, legend, title and scale bar for quick reference.
**Buffering for Notification or Mailing Label Generation**
The browser solutions should provide a method for staff to generate mailing labels for notification purposes. This should be accomplished by the server automatically producing a standard list using Crystal Reports or a similar reporting application.

A buffer interface (above) should provide the user with a simple method to produce buffers and select features based on that buffer. The resulting buffer and selected set should be displayed for the user (right). Generation of mailing labels should be supported by the application (below).

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**Sample Buffering and Mailing Label Generation**

**Mobile GIS Functionality**

**Mobile GIS Browser**
Multiple Departments have expressed a strong desire for mobile GIS access. There are two types of mobile access to GIS data. The first is “real time” access and the alternative is intermittent synchronization. The latter does not require a full-time wireless connection between the mobile computing device and the database.
Mobile GIS data browser

Field Editing Tool (annotation of current GIS data layers)

Change to System Valve
Please refer to specific department sections to determine the types of mobile browsers recommended for each department.

**Automatic Vehicle Location (AVL)**

Automatic Vehicle Location (AVL) provides up-to-date location information for emergency vehicles, delivery trucks, freight trucks, service vehicles etc. An AVL system consists of a GPS receiver in a vehicle, a communications link between the vehicle and the dispatcher, and pc-based tracking software for dispatch. The communication system is usually a cellular network similar to the one used for cellular phones. As an alternative communications link, a satellite communication network (not to be confused with the GPS satellite system) is available for areas where ground-based wireless communications is weak. The communication satellite receives position information from the AVL vehicle's satellite transmitter (uplinks) and forwards it (downlinks) to a tracking dispatch application. A typical GIS-based dispatch application displays vehicle locations as icons against specific local streets and intersections. The following graphic illustrates how AVL is displayed in a GIS browser application:

![AVL tracking overlay on GIS dispatch data browser](image)

County personnel identified the need for an AVL system for use in the Sheriff’s Office, the Fire, Rescue, and Emergency Management Department, and the Utilities Department. Several hardware/software investments will need to be made in order to outfit vehicles with GPS receivers and communications devices; an AVL mapping application will also need to be implemented.

The complete cost of implementing AVL can vary considerably depending on the type and quantity of equipment that is procured. In general, outfitting one vehicle for AVL
will cost approximately $2,000-$5,000, depending on the type and quality of hardware that is procured.

In addition to hardware costs for vehicles, communications equipment and services need to be factored into the cost. In general, communications infrastructure will cost anywhere from a few hundred dollars to thousands of dollars. Subscription to different types of communication services can also cost anywhere from less than one hundred dollars to several hundred dollars per month. Lastly, a GIS-based mapping application is required; these applications also vary in price. Several approximate costs are provided below to provide a general idea of associated costs.

**In-Vehicle Laptop**
- Fixed Mobile Terminal: $5,000
- Ruggedized Notebook PC: $3,500
- Standard Notebook PC: $1,250
- Display Terminal Only: $500

**In-Vehicle Modem**
- Public digital network: $200
- Public analog network: $1,000
- Wi-Fi Mesh Network: $300
- Private 800 MHz networks: $3,250
- Private VHF or UHF 19.2K: $2,500

**Communications Connection (per month)**
- Public digital network: $50
- Public analog network: $50
- Wi-Fi Mesh Network: $100

**Mapping/Dispatch Software**
- Basic mapping/tracking: $3,000
- Robust dispatch/mapping tracking: $5,500
- High-end software: $10,000 and up

The County should deploy AVL technology as a pilot project with the Sheriff’s Office, the Fire, Rescue, and Emergency Management Department, or the Utilities Department. A good candidate is the next department scheduled to receive a mobile computing hardware upgrade. A few vehicles should be fitted with the AVL equipment to start. The IS Department will need to determine which communications services and equipment are most compatible with existing infrastructure. Additionally, the IT Department may have long-term plans for wireless network connectivity and accessibility, which will play a role in the procurement and specification of wireless modems and communications protocols.