Baltimore County GIS Strategic Business Plan

Volume 1

Enterprise Summary and Recommendations

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1 Executive Summary

Baltimore County recognized a need to conduct an independent assessment of the enterprise geographic information system (GIS) for the purpose of understanding the costs and benefits of the technology, along with opportunities for expansion and improvement based on industry best practices. The GIS Strategic Business Plan examined the use of GIS technology throughout the County and determined additional areas that can be supported with GIS in the future. A cost/benefit analysis will assist the County in understanding how agencies within the County are benefiting from incorporating GIS into business processes and how this relates to the cost of supporting the enterprise system. This business process assessment reveals areas within agencies that can be strengthened by incorporating GIS, leading to a set of recommendations detailed in the GIS Strategic Business Plan that provides the foundation for an operational and technological path for the near- to mid-term.

This Strategic Business Plan includes a discussion of many components of the Baltimore County enterprise GIS. Several sections have been allocated to review the enterprise GIS utilization, enterprise GIS architecture, public access programs, and an outside industry comparison research. The following key items were identified as over-arching themes applying across most of the agencies within the County:

- GIS is currently realizing a significant annual benefit of 4.65 million dollars for Baltimore County.
- Baltimore County is currently expending over 2.1 million dollars annually for GIS applications, database maintenance, hardware, supplies, and training necessary to support the enterprise GIS.
- The cost/benefit analysis for GIS yielded a net benefit of over 2.5 million dollars being realized annually. This provides evidence that the existing system is viable and worth the continued annual investment by the County.
- The Office of Information Technology (OIT) supports and maintains an enterprise architecture consisting of spatial databases, GIS applications, and network hardware that is providing flexible and stable GIS services to users across the County.
- Baltimore County has invested significantly in the development and maintenance of enterprise GIS datasets that are utilized for a wide variety of business programs and activities.
- GIS is a mandated technology required to support the Sanitary Sewer Consent Decree and 911 Phase II Wireless requirements.
- GIS has been introduced within most of the agencies working with geographic phenomena. The GIS is utilized to perform tasks such as map compilation, geocoding addresses, spatial queries, and simple geographic analysis.
- Although the enterprise GIS is supported and provided by the County, several datasets and applications that are critical to improving the efficiency and effectiveness of business processes have not been implemented.
- In terms of GIS utilization, GIS has been introduced into many agencies however, it has not been heavily integrated into business processes. GIS is used to assist business processes, either by providing information that would not be available without the system or by providing information more efficiently than would be the case without GIS. However, business processes generally have not changed with the introduction of GIS, applications have not been

customized to meet the specific needs of activities, and links between GIS systems have been minimal.

- Industry research of similar county GIS implementations revealed that Baltimore County generally follows best practices and occasionally serves as a model organization for GIS services and use. However, there are many GIS applications that the County has not implemented and that could serve as areas of focus for additional opportunities.

Baltimore County Agency Analysis

The GIS Strategic Business Plan contains a detailed look at each of the agencies' costs for operations, capital expenditures, personnel, training, supplies, and quantitative and qualitative benefits being realized due to the utilization of GIS. For each agency, the Plan also discusses the current GIS utilization, a needs assessment and associated recommendations for database creation, application development, staffing and training requirements, and business process reengineering. A chapter has been dedicated to each of the agencies reviewed; the findings of these chapters are summarized below:

The **Department of Public Works (DPW)** is one of the most significant users of GIS in the County. The cost for supporting the DPW GIS activities is relatively high, but benefits outweigh the costs and correlate to the extensive use of applications and data. The Sanitary Sewer Consent Decree requires the County to utilize GIS technology and develop specific datasets and applications to support the infrastructure management. Personnel utilize GIS for engineering design, asset management, public complaints, and many other activities

Permits and Development Management (PDM) has a major responsibility of managing geographically based information for permits, code enforcement, and development management. This agency has only recently introduced GIS into business processes and does not have enough support dedicated to maintaining GIS internally. As a result, there have been relatively few benefits realized, leaving more room for improvement than any other agency reviewed.

The **Department of Environmental Protection and Management (DEPRM)** is a significant user of GIS in supporting a wide variety of environmental activities. The agency has invested significantly in custom data and application development, and these have provided substantial benefits for the agency. DEPRM is bound by several mandates requiring the use of GIS.

The **911 Center** is directed by the Phase II E911 mandates to provide geographic data in support of emergency response activities. The agency has significant software and data development expenditures for this effort, which have not currently returned significant quantitative financial benefits for the County. However, the Facilities geodatabase currently in development will be widely used in the 911 Center and throughout the County, providing significant benefits to the agency.

The **Department of Health** is responsible for many activities that could benefit from GIS and produce additional benefits for the County. However, the agency has only minimally incorporated GIS into business processes and has seen few benefits as a result. This agency is considered a primary target for further GIS incorporation.

The **Department of Recreation and Parks (DRP)** has incorporated GIS into business processes supporting park maintenance, planning, and design. This agency could benefit significantly from further support in asset management and complaint services.

The **Fire Department** has recently ramped up GIS use to support requirements of the Emergency Operation Center, but still has relatively few GIS users in relation to the number of personnel within the agency. Personnel could benefit greatly from mobile technology, including AVL, GPS, and field laptops with mapping, in support of emergency response.

The **Department of Economic Development (DED)** has seen the greatest return on investment from GIS of all the agencies in the County. This agency is using GIS significantly for a small number of business processes, including business development and commercial revitalization by utilizing only County-provided data and applications to minimize costs. There are, however, many areas that could be supported by custom applications and data.

The **Office of Community Conservation (OCC)** is not a significant user or contributor of GIS services in the County. Although GIS is used to support several community conservation activities, it provides minimal benefits to the agency.

The **Office of Information Technology (OIT)** hosts the enterprise GIS system for the County, providing the enterprise geodatabase and GIS applications, public web mapping applications, mapping assistance, and application development support. OIT acts as a support agency for other agencies, incurring most of the enterprise costs and receiving little benefits as a result.

The **Police Department** is using GIS to support divisions throughout the agency in a variety of mapping and spatial analysis needs. These GIS-related activities often involve complex modeling, investigation, and analysis that have positioned the agency as one of the most sophisticated and competent users within the County and have gained the agency recognition across the country. Many addresses are geocoded to add a spatial component to agency datasets.

The **Office of Planning (OP)** has taken a leading role in incorporating GIS into the agency to serve the varied geographic needs, including community planning, land use zoning, and historic preservation. The agency supports a great deal of data development costs for the land use layer inside the cadastral dataset, a critical component of the enterprise GIS.

Several **Miscellaneous agencies** were reviewed that have little to no involvement with geographic information and phenomena. These agencies generally rely on OIT to produce maps with GIS to support their minimal needs and have seen little benefits as a result. Several of these agencies, including the Department of Social Services (DSS) and the Local Management Board (LMB), could benefit from increased support from GIS data and applications.

Baltimore County has implemented an enterprise GIS providing a comprehensive and robust set of services to a large number of users within the County. Although GIS utilization varies in magnitude and type for each agency, it is generally widespread across the County and is providing significant benefits to the County. There are, however, some areas that could be improved based on a needs

assessment and best practices, which have led to a series of recommendations to improve GIS service and use across the County.

2 Introduction

Baltimore County's Office of Information Technology (OIT), in conjunction with the Office of Budget and Finance, contracted with Dewberry to conduct a countywide Geographic Information System (GIS) Strategic Business Plan that analyzes the utilization of GIS technology in Baltimore County. This study has been conducted by analyzing the current annual costs and benefits of GIS technology utilization in Baltimore County, rather than the historical costs or benefits. The study was accomplished during an eight month timeframe, from September 2006 through May 2007.

The purpose of this study is to:

- Provide a definition of existing layers, identifying the key users(s) and their use(s);
- Identify current benefits, including cost avoidance, revenue, productivity gains;
- Identify current costs, including software, hardware, support, and maintenance; and
- Deliver a Strategic Business Plan, complete with a set of short- and mid-term recommendations of the key areas for Baltimore County to focus on as we move forward with this program.

The Strategic Business Plan outlined in this document serves as a review of the existing GIS system in addition to recommendations for the short- and mid-term. This document should be reviewed annually, proposing addendums as necessary. In addition, Baltimore County should implement an update to this document every three years, providing a cycle review of each of the business processes and needs for GIS within the County. This structured review process will ensure that the Strategic Business Plan is addressing current GIS needs of Baltimore County.

The project sponsor for the GIS Strategic Business Plan is Rich Sterba, a Budget Analyst in the Office of Budget and Finance. The Project Board consists of key stakeholders from the Office of Information Technology and the Office of Budget and Finance, including:

- Rich Sterba, Budget Analyst, Office of Budget and Finance
- Rob Stradling, Director, Office of Information Technology
- Lynne White, Executive Business Analyst, Office of Information Technology.

The Dewberry project team that has executed the GIS Strategic Business Plan, includes:

- Jeffrey R. Poplin, Senior Project Manager and Senior Business Analyst
- Phil Thiel, Principal-In-Charge, Business Process Advisor
- Sue Hoegberg, Senior Business Analyst
- Shane Engel, Business Analyst
- Rob Hayward, GIS Analyst
- Emily Walker, GIS Analyst

The Baltimore County project team executing the GIS Strategic Business Plan includes an extended team of staff from the Office of Information Technology and the Office of Budget and Finance, along with representatives from all the participating agencies in Baltimore County.

The team worked together to define a set of activities that utilized GIS or geographic information for each agency within the County. The team also compiled a list of individuals to gather information about these activities, which led to a series of interviews where questions were asked to uncover specific business processes and applications for data uses. This information was used to compile reports for each of the agencies. In addition to the interviews, several other information sources were used to compile information about the GIS infrastructure, comparable industry practices, and public access programs within the County.

Each of the findings uncovered and presented in the GIS Strategic Business Plan point to the fact that the current enterprise GIS implementation is a viable technology that is providing a significant return on investment and important qualitative and quantitative benefits to users in each of the County agencies reviewed. However, many business processes were uncovered that could further benefit from additional GIS integration. As a result, the Plan sets forth a series of enterprise recommendations that prioritize these findings and suggest a course of action for their implementation. These recommendations should focus future GIS efforts of the County and be implemented over the near- and mid-term to help realize additional benefits for the County.

The GIS Strategic Business Plan report is divided into three volumes. Volume I provides an assessment for management, focusing on the enterprise-wide existing GIS cost/benefit analysis and recommendations for future GIS implementation. Volume II provides a detailed documentation of the enterprise architecture and costs, study methodology, industry research, public access programs, and enterprise GIS utilization information. Volume III includes chapters for each of the agencies reviewed, covering information about each agency's costs / benefits, GIS utilization, needs assessment, short- and mid-term recommendations, and information for each of the GIS-specific activities.

3 GIS Utilization Summary

In general, GIS is used effectively by most of the Baltimore County agencies, with two notable exceptions: PDM and Health. The agencies are generally maximizing the utilization of the GIS databases currently supported and maintained, with approximately 98% utilization for all of the agencies reviewed. Baltimore County agencies are maximizing the utilization of the primary ESRI software suite and the custom Data Query application provided by OIT for enterprise users. However, for the most part, GIS is still used most frequently for looking up address locations, viewing data, and making maps. While these are valuable activities and GIS clearly improves the speed and accuracy with which these functions can be done, they do not take full advantage of the power of GIS to perform more complex spatial analyses.

4 Cost/Benefit Summary

Many agencies within the County participated in the GIS Strategic Plan, and their GIS use was analyzed with information gathering techniques including surveys and interviews. This information was used to compile a set of costs and benefits associated with GIS activities and programs within the County. Costs are defined as any expenditure required to support GIS activities within the County, including the personnel salaries for resources dedicated to database maintenance and administration, hardware and software costs, training and conference costs, capital expenditures, and miscellaneous supply and administrative costs. Benefits are defined as any assistance or advantages realized from use of the GIS system. These benefits were categorized as either quantitative, with measurable savings in time and money, or qualitative, with benefits that could be social or political in nature. These costs and benefits of the system provide an audit of the current GIS, helping to determine whether the various components of the system are being provisioned and used efficiently.

The table below presents the result of the cost/benefit analysis for each agency. These costs and benefits are further broken down in the following sections and individual agency chapters.

Total Annual GIS Cost/Benefits Summary			
Agency	**Annual Cost**	**Annual Benefits**	**Net Benefit**
911	$255,950.48	$140,026.78	-$115,923.70
DED	$11,009.18	$158,088.18	+$147,079.00
DEPRM	$292,628.26	$1,739,076.27	+$1,446,448.01
DPW	$671,242.69	$820,284.63	+$149,041.94
DRP	$33,834.13	$148,115.17	+$114,281.04
Fire	$52,003.48	$159,463.16	+$107,459.68
Health	$12,039.83	$75,097.40	+$63,057.57
OCC	$21,091.97	$24,342.17	+$3,250.20
OIT	$66,271.73	$124,186.00	+$57,914.27
OP	$295,576.63	$672,294.00	+$376,717.37
PDM	$208,174.76	$276,170.26	+$67,995.50
Police	$101,584.81	$278,797.70	+$177,212.89
Miscellaneous	$86,663.03	$43,579.18	-$43,083.85
Total:	**$2,108,070.98**	**$4,659,520.90**	**+$2,551,449.92**

Table 1 – Total Annual GIS Cost/Benefits Summary

Each of the costs for providing the enterprise GIS have been totaled for the County and distributed among each of the County agencies relative to the number of users in each agency. Please see the Enterprise Architecture and Cost chapter for more details. These costs documented above include the enterprise GIS costs, as well as expenditures specific to each agency.

4.1 Costs

The costs associated with providing GIS within the County have been divided into two components:

- The costs incurred by OIT for the enterprise GIS, and
- The costs incurred by individual agencies for more agency-specific GIS activities.

4.1.1 Annual Enterprise GIS Costs

The annual operating and capital costs for supporting the enterprise GIS are summarized in the table below.

Annual Enterprise GIS Costs	
Total Operating Costs:	$859,717.21
Total Capital Costs:	$272,000.00
Total GIS Enterprise Costs:	$1,131,717.21

Table 2 – Annual Enterprise GIS Costs

The annual operating costs identified and documented for the GIS enterprise include hardware, software, OIT enterprise GIS personnel, OIT support personnel, training, and supply costs. The annual capital costs identified and documented for the GIS enterprise include: scheduled database maintenance expenditures for orthophotography, Light Detection and Ranging (LiDAR), and planimetric/topographic datasets. The costs in this section have also been distributed across each agency using GIS, based on the number of GIS users, and have been captured in the individual agency chapters. These costs are discussed further in the Enterprise Architecture and Cost chapter.

4.1.2 Annual Agency GIS Costs

The annual costs associated with each agency are summarized in the table below.

Annual Agency GIS Costs				
Agency	**Annual Agency Operational Costs**	**Annual Agency Resources Costs**	**Enterprise Costs Applied to the Agency**	**Total Cost for Agency**
911	$132,450.00	$108,207.00	$15,293.48	$255,950.48
DED	$2,342.35	$3,569.00	$5,097.83	$11,009.18
DEPRM	$2,733.00	$35,004.00	$254,891.26	$292,628.26
DPW	$7,025.00	$363,446.00	$300,771.69	$671,242.69
DRP	$1,155.00	$7,190.00	$25,489.13	$33,834.13
Fire	$4,410.00	$32,300.00	$15,293.48	$52,003.48
Health	$2,500.00	$4,442.00	$5,097.83	$12,039.83
OCC	$700.67	$0.00	$20,391.30	$21,091.97
OIT	$0.00	$0.00	$66,271.73	$66,271.73
OP	$3,666.00	$164,464.00	$127,446.63	$295,576.63
PDM	$200.00	$55,040.00	$152,934.76	$208,174.76
Police	$6,085.73	$39,423.00	$56,076.08	$101,584.81
Miscellaneous	$0.00	$0.00	$86,663.03	$86,663.03
Total	**$163,267.75**	**$813,085.00**	**$1,131,718.23**	**$2,108,070.98**

Table 3 – Annual Agency GIS Costs

The annual operational costs identified and documented in each agency chapter represent the costs for training personnel, conference registration fees, and miscellaneous supplies. The annual resource costs represent the cost of any personnel's salary associated with GIS database maintenance. The enterprise costs applied to the agency represent the enterprise costs (summarized above) distributed to each agency based on the number of GIS users within each agency. These costs are detailed in each agency chapter.

Please note that all of the operation and resource costs for OIT have been included in the enterprise costs, and as a result have not been included in the individual agency costs for OIT. The miscellaneous agencies have no operational and resource costs, since they have no allocated personnel for database and software maintenance activities, along with no hardware and software costs. Most of these services are provided by OIT and other agencies, thereby deferring these costs to supporting agencies. The 911 Center operational costs are much higher than the other agencies due to annual maintenance costs associated with the microDATA GIS application, which provides GIS functionality to the 911 end users.

4.2 Benefits

The existing benefits realized by the County have been determined for each activity within internal agencies by analyzing the effort needed to perform a task with GIS in comparison to the effort required to perform the same task without GIS technology. Reductions in effort can be a result of a decrease in repetitive tasks, elimination of redundant tasks, decreased travel and field visits, decreased mistakes as a result of increased accuracy of information, and increased efficiency and time savings from new services and capabilities. These benefits do not include external benefits that may be seen from public or private industry uses of the County enterprise GIS and do not include qualitative, unquantifiable benefits.

This examination allows each activity to be measured in terms of time and then recomputed to dollars realized annually. The existing benefits that are currently being realized have been summarized by agency and have been aggregated to give an annual dollar figure. These benefits are discussed in more detail in each agency chapter.

Annual Agency GIS Benefits				
Agency	**Annual Hours Saved**	**Annual Time Benefits**	**Other Benefits**	**Total Annual Benefits**
911	4,124.50	$140,026.78	$0.00	$140,026.78
DED	4,656.50	$158,088.18	$0.00	$158,088.18
DEPRM	39,442.60	$1,339,076.27	$400,000.00	$1,739,076.27
DPW	23,380.00	$793,744.88	$26,539.75	$820,284.63
DRP	2,763.33	$93,815.17	$54,300.00	$148,115.17
Fire	4,697.00	$159,463.16	$0.00	$159,463.16
Health	2,212.00	$75,097.40	$0.00	$75,097.40
OCC	717.00	$24,342.17	$0.00	$24,342.17
OIT	0.00	$0.00	$124,186.00	$124,186.00
OP	19,802.45	$672,294.00	$0.00	$672,294.00
PDM	8,134.00	$276,170.26	$0.00	$276,170.26
Police	8,212.00	$278,797.70	$0.00	$278,797.70
Miscellaneous	1,236.50	$41,979.18	$1,600.00	$43,579.18
Total	**119,377.88**	**$4,052,895.15**	**$606,625.75**	**$4,659,520.90**

Table 4 – Annual Agency GIS Benefits

The annual hours saved are the total hours for each agency that were saved using GIS for associated activities. These "Annual Time Benefit" hours have been multiplied by a flat rate of $33.95, to give the total annual time benefits for each agency. Other benefits include quantifiable monetary savings that have been provided in means other than a reduction in effort and include items such as penalties for not abiding by mandates; fees collected for data and maps, and cost avoidance for consultant assistance. These benefits are detailed in each agency chapter.

Please note, due to the nature of OIT as a County support agency, OIT has not realized direct benefit savings through the use of GIS technology. Most of the GIS support activities OIT is involved with would not be done without GIS, since the responsibilities are directly related to supporting and maintaining the GIS Enterprise. OIT has documented a $124,186 benefit in the "other benefits" category, which represents the public access program revenue.

4.2.1 Qualitative Benefits

In addition to the quantitative benefits that are derived from cost savings and reduction in effort, there are many qualitative benefits that are being realized throughout the County. Some general conclusions regarding these benefits are discussed below:

- GIS provides tools necessary to perform analysis that is not capable without the software. This allows for better decisions to be made from increased information and awareness of geographic phenomena.
- Web mapping applications and distributed data give the public access to geographic information. Public consumption of this information can decrease reliance on County employees to answer inquiries, thus giving these employees opportunities to focus on other issues in the County.
- Geographic data is provided by the County to private developers, saving these developers time and money that would normally be spent compiling this information.
- GIS allows for emergency responders to quickly determine the location of an incident and determine important landscape characteristics of accident or disaster areas. This can improve response time and decision-making, potentially increasing the health of individuals and saving lives.
- Spatial and geostatistical analyses are used by the Police Department to analyze crime patterns spatially. This information helps to focus crime prevention and response strategies, potentially decreasing crime within the County and resulting in better standards of living and saved lives.
- Maps produced from GIS can provide evidence for criminal trials that would not be possible without the tool, resulting in more accurate information being introduced in criminal trails.
- Demographic and geographic data can be used to map and analyze economic and social issues of communities. This information can be used to focus economic development at the community level to potentially increase standards of living and tax revenues for the County.
- The County can use GIS to map the location of complaints received from citizens. This can decrease response times and increase service to these citizens, providing better overall service.
- Digital maps are produced with GIS and used as a communication tool between stakeholders and the public during development planning. These maps can give an idea of how developments will affect the land use and land cover of a community. This can improve decision making, which could improve the aesthetics of a community. The public can also participate more effectively, since issues are easily communicated through the maps.
- Web Mapping Services can provide geographic information over the internet, thus providing a mechanism to distribute real-time data in the event of a disaster. This can increase the security of citizens by allowing faster information gathering and responses.

Many more qualitative benefits that are being realized are discussed in the individual agency chapters.

4.3 Cost/Benefit Analysis

A cost/benefit analysis allows for an understanding of the relationship between costs and benefits that are being realized each year. This analysis can provide a justification for initiatives currently in place as well as help determine which areas may not be utilizing GIS technology to expectations, thus helping to focus future efforts.

4.3.1 Raw Cost Benefits

The raw costs and benefits for each agency give a general overview of where expenditures are occurring and where benefits are being realized within the County. A graphical depiction of the raw cost/ benefit values by agency is provided in the chart below.

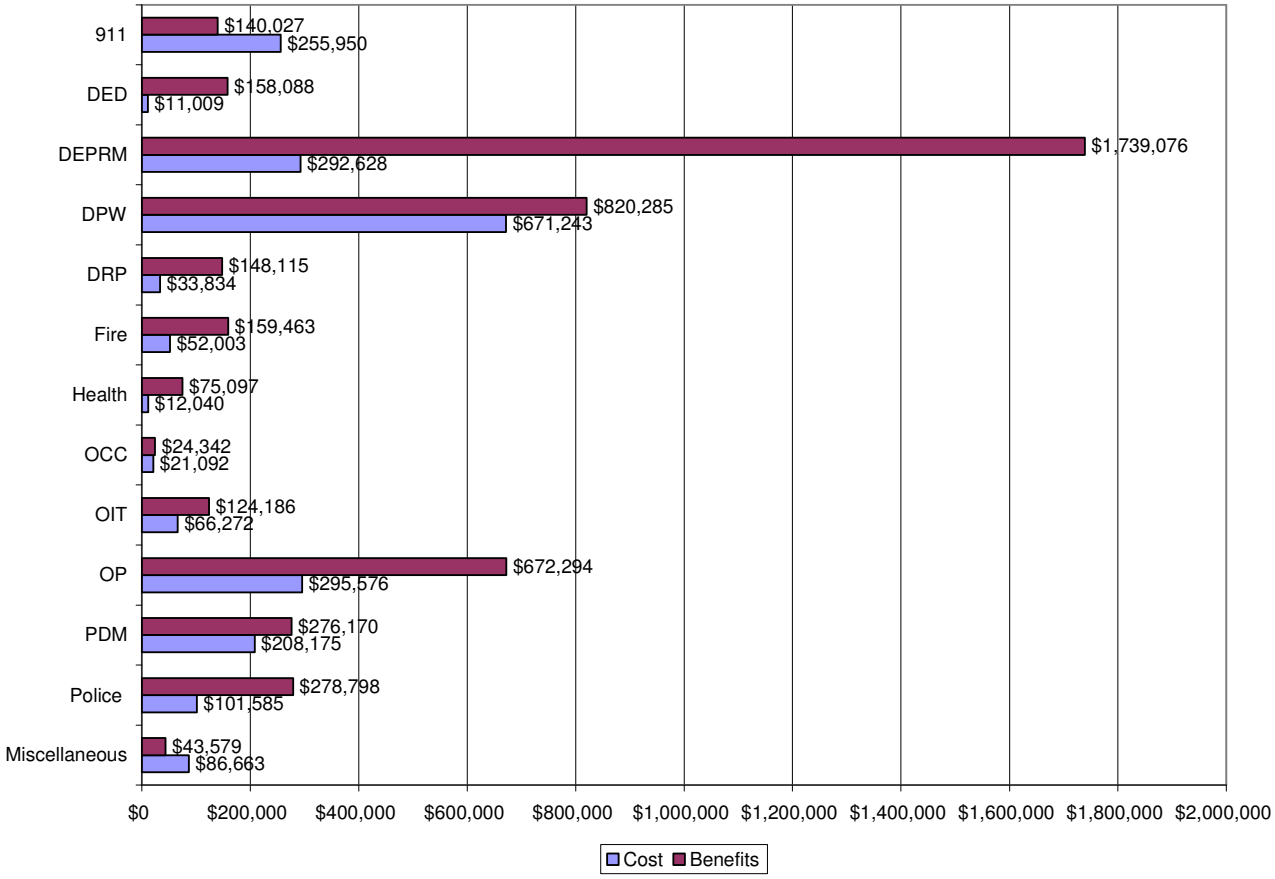

Figure 1 - GIS Annual Cost/Benefit by Agency

As is obvious from Figure 1, DEPRM, DPW, and OP, three of the County's largest users of GIS are receiving substantial benefits from GIS and account for about 75% of the total benefits being realized by the County. However, the picture changes slightly when this is compared to the costs associated with each agency. At a quick glance, DEPRM is receiving much more value from the expenditures within the agency than DPW and OP. A Return on Investment (ROI) measurement allows for a better understanding of these occurrences.

4.3.2 Return on Investment (ROI)

A Return on Investment measurement allows for an analysis of the relationship between the costs and benefits associated with the Enterprise GIS. This measurement is represented as a ratio of the annual benefits of GIS use divided by the annual costs of providing the system. An ROI is given for each agency and totaled for the County below.

Agency	Annual Cost	Annual Benefits	Annual Return on Investment Percentage
911	$255,950.48	$140,026.78	55%
DED	$11,009.18	$158,088.18	1,436%
DEPRM	$292,628.26	$1,739,076.27	594%
DPW	$671,242.69	$820,284.63	122%
DRP	$33,834.13	$148,115.17	438%
Fire	$52,003.48	$159,463.16	307%
Health	$12,039.83	$75,097.40	624%
OCC	$21,091.97	$24,342.17	115%
OIT	$66,271.73	$124,186.00	187%
OP	$295,576.63	$672,294.00	227%
PDM	$208,174.76	$276,170.26	133%
Police	$101,584.81	$278,797.70	274%
Miscellaneous	$86,663.03	$43,579.18	50%
County	**$2,108,070.98**	**$4,659,520.90**	**221%**

Table 5 – Annual Return on Investment

Note that because these measurements are based on a snapshot of the costs and benefits averaged for a year, the return on investment measurements listed above do not accumulate over time. Unlike ROI measurements that include the total cost of an initiative in the ratio, these ratios have a continual cost per year. This means that any ratio under 100% is seeing a net loss and anything over 100% is realizing a net benefit.

As seen in Table 5, the County overall is seeing about a 221% ROI per year. This means that of each dollar currently expended for GIS services, over two dollars are saved and realized as benefits. The total numbers show that the County is receiving a substantial return on the investment put into the GIS for maintenance each year. One important item to note is that these costs do not include initial investments, so the actual return on investment from development costs may be much lower. However, if the County moves forward as currently structured and supported, there should continue to be savings realized from providing the service to the enterprise, financially justifying further support for these activities.

At the agency level, the ROI measurements can be understood in a more microscopic fashion and help uncover variations in cost/benefits across the County. The ROI measurements that are graphically depicted in the chart below help show these variations.

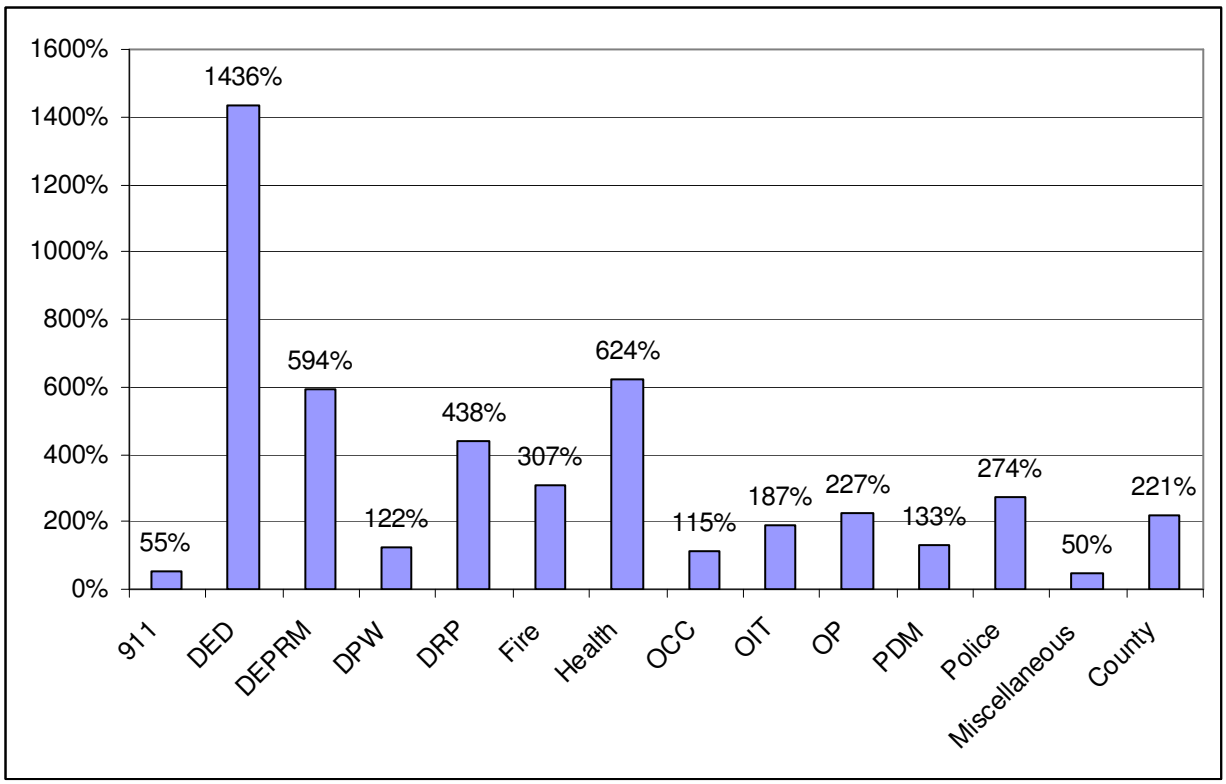

Figure 2 - Return on Investment

Figure 2 illustrates that although the County is realizing moderately high overall returns on GIS investments, there are clearly some extraordinary returns, as well as underperformers. DED, having very low overall costs, sees a very large ROI, even though the total benefits realized are only average. Health, DEPRM, and DRP are also realizing high benefits in relation to expenditures. The 911 Center and the miscellaneous agencies are not seeing the same type of return, with negative ROIs for these agencies.

There are several reasons that these ROI measurements differ by agency. First, there is occasionally support given from one agency to another for GIS efforts, increasing the costs for one agency while increasing the benefits for another. There is constant collaboration between agencies, since multiple agencies may participate and coordinate work to complete certain activities. Costs may also increase for an agency relative to benefits when the agency is responsible for developing a dataset that could be used more heavily externally. There are also instances when the enterprise costs have not been properly distributed. Since the enterprise costs have been allocated based on users, not on *usage*, there could be agencies that get more costs allocated than the benefits being realized. For example, if two agencies were performing the same task, one with ten people at 10% of their time and the other with one person at 100% of his or her time, the first agency would see ten times the cost of the other agency, but theoretically see the same benefits. Finally, there may be actual differences in the

efficiency, utilization, and business processes between agencies, leaving some agencies underperforming and others overperforming, resulting in a lower ROI.

4.3.3 Cost/Benefit by Agency

Further analysis helps uncover the differences in costs and benefits recognized by each agency. As shown in Figure 3, there are differences in the distributions of costs across the agencies. The 911 Center, which has a negative return on investment value, has a larger share of operational costs, accounting for the relatively large overall costs of the agency in comparison to realized benefits. Interestingly, the miscellaneous agencies, which also showed a negative return on investment, have only enterprise costs associated with these agencies. These agencies are most likely not able to support a full-time GIS user, signified by the low benefits realized in relation to the costs distributed to the agencies by GIS users.

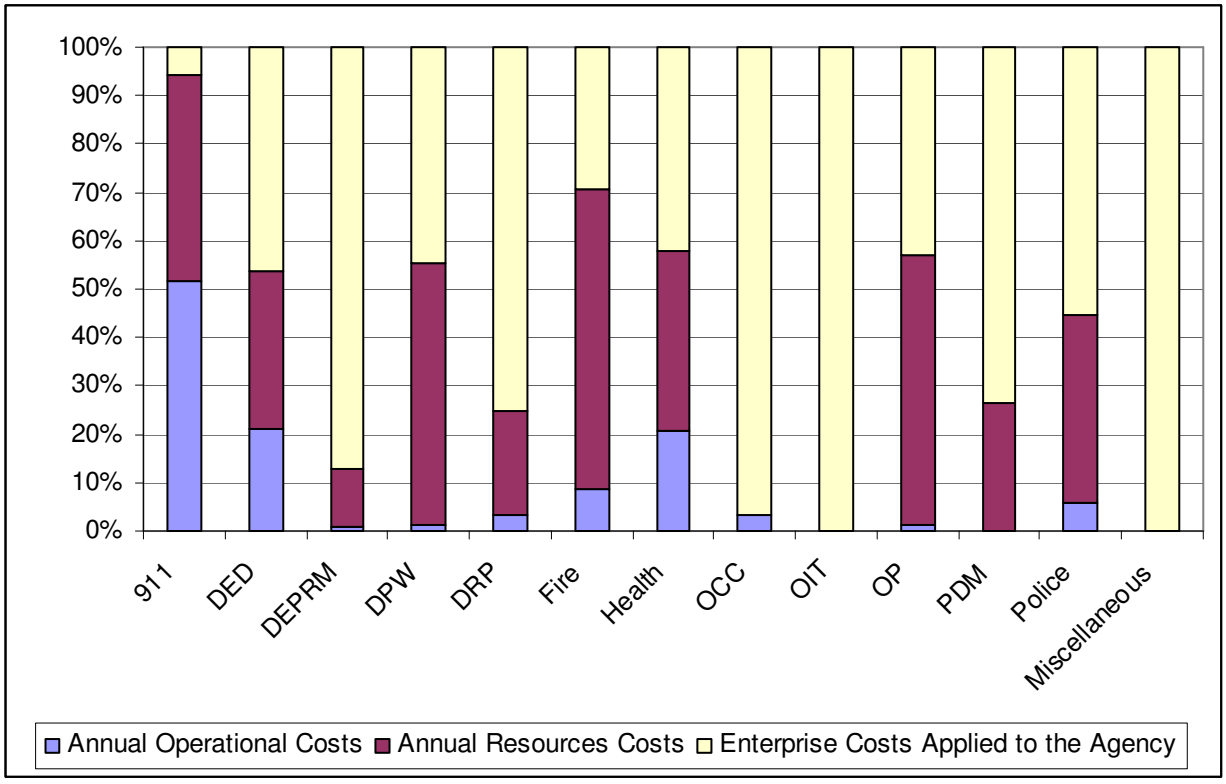

Figure 3 - Annual Cost by Type and Agency

Looking further at the benefits, we can see in Figure 4 that most of the benefits are being realized by a few agencies, namely OP, DPW, and DEPRM. These benefits correspond with the large usage of GIS within these agencies. There are several agencies that are medium users of GIS, including the Police Department and PDM, which are providing moderate financial benefits to the County. These agencies have significant staff and geographic information requirements, but either they are not using GIS to its full potential (PDM) or they are not relatively heavy GIS users (Police). The remaining agencies have much lower GIS use and associated benefits, corresponding to the size of these agencies, underutilization of GIS, or lower need for geographic information.

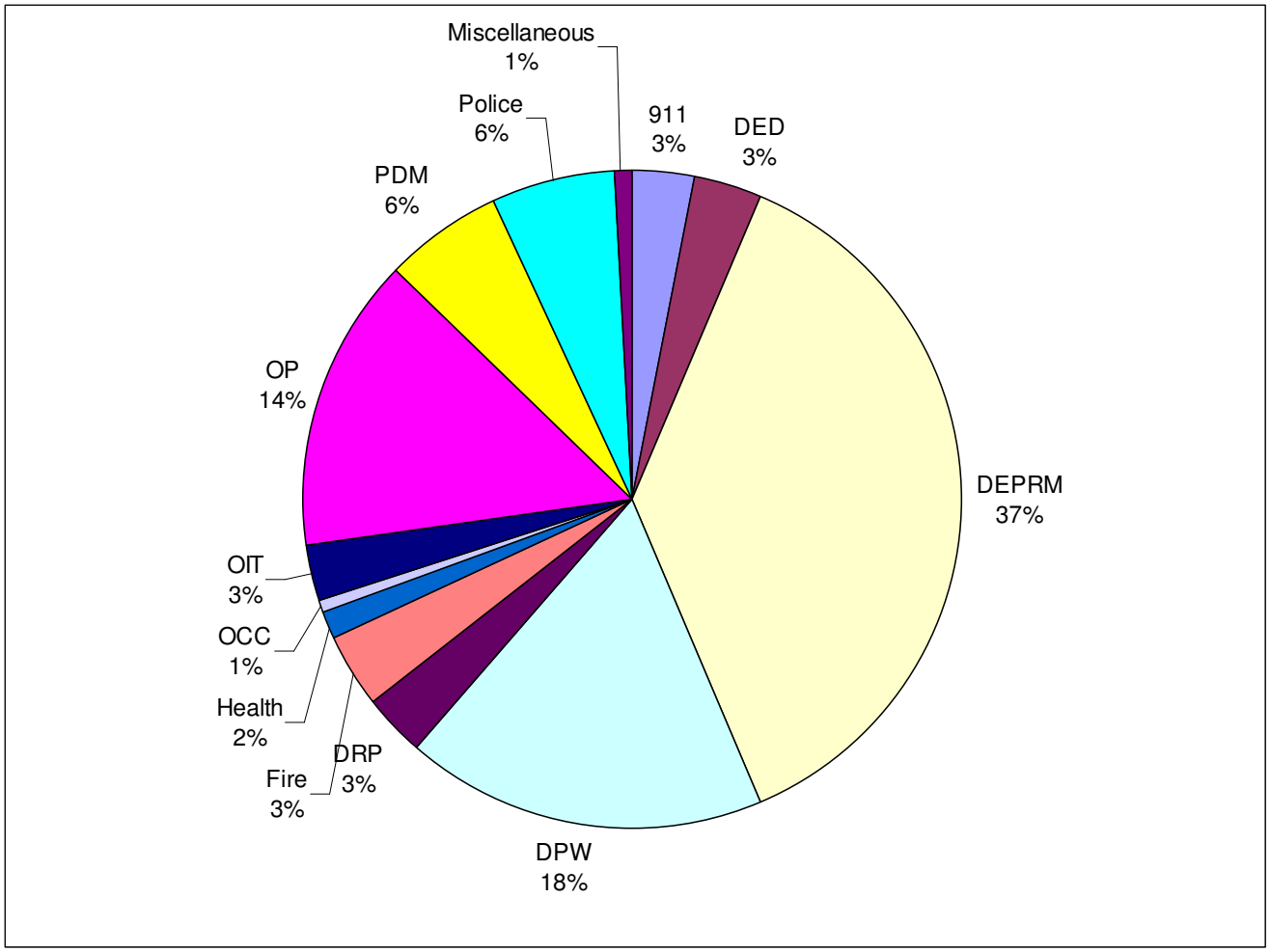

Figure 4 - Annual Benefits by Agency

4.3.4 Overall Cost/Benefit Assessment

Overall, the County is seeing particularly good returns on the investments associated with the enterprise GIS, making it a viable technology investment for the County. The costs of providing this service are much lower than the benefits overall for the County. There are differences in these returns by agency, which could point out areas that could serve as good models for the rest of the County, as well as uncover agencies that are in need of adjustments to increase returns. Variances such as these could also be caused by factors such as disproportionate responsibilities and misallocated expenditures. This can cause difficulties in generalizing for the County and comparing business processes between agencies. However, as we shall see in the next section, individual needs and business processes, in addition to some general enterprise operations, can integrate GIS more fully into each agency, providing greater returns to the County.

5 GIS Recommendations

Each agency chapter included in the Strategic GIS Business Plan includes a set of agency-specific recommendations, as well as a more detailed look at additional methods to introduce GIS into particular business processes. These recommendations were designed to focus efforts of OIT and specific agencies on areas of GIS improvement that could provide the most benefit to the County. Each recommendation was classified with a timeframe of either short-term (1 – 3 years) or mid-term (4 – 5 years).

In order to effectively exploit these recommendations, several general tactics should be employed by the stakeholders. These are:

- County Management should follow up with a formal business plan for each of the recommendations, in order to more fully understand the impact that the recommendations will have on the County.
- County Management should gauge agency cooperation with the recommendations and provide incentives or directives where agencies do not feel the need to participate.
- County Management should continually monitor the progress of the recommendations over time, in order to ensure that the recommendations are being implemented effectively.
- In areas where recommendations require additional resources, County Management should allocate resources for future investment opportunities with the understanding that the County will receive a return on these investments.

There are also recommendations outlined in each agency chapter that could specifically benefit those agencies, often with little to no cost. County and agency management should also review these recommendations, in order to prioritize specific recommendations for which a business plan can be designed and implemented.

5.1 Organization Recommendations

Examination of the organization of the enterprise reveals that additional roles and organizational restructuring could improve productivity of the County, provide the opportunity to incorporate GIS further into business processes, and increase communication and collaboration between agencies.

Currently, the County relies on a Business Analyst to coordinate with personnel within agencies to prioritize GIS project requests. This Business Analyst does not have the capacity to perform in-depth research into the business processes of each agency, leaving some agencies without knowledge of how they could improve their activities with GIS. This analyst also does not have the capacity to proactively expand the GIS technology to agencies that have not requested additional support, leaving OIT unaware of how GIS could be integrated into the business processes within each agency.

The GIS-user agencies do not necessarily have a designated liaison to serve as a point of contact for personnel within and outside of the agency for GIS needs. This causes problems in coordinating with these agencies. In instances where there is a GIS liaison, they are typically inundated with requests for simple maps or data maintenance tasks, leaving little time to provide solutions to more complex geographic problems. In general, the skills of the GIS Analysts and liaisons in the agencies are being under utilized, which is impacting realized benefits for the agency and the County.

In addition, several database maintenance activities are spread across agencies, creating complications with data synchronization and increasing the effort required to maintain the datasets. OIT, as a manager of the database, confronts difficulties in ensuring that the integrity of the database is maintained, since editors within the various agencies often have different priorities and are not under constant supervision and direction. This results in additional effort for quality control, editing, and conflict resolution during database reconciliation. There are also instances where editors are capturing information from the same source documentation, resulting in additional effort required for database maintenance activities.

The OIT Steering Committee, composed of representatives from the Executive's Office, Office of Budget and Finance, as well as senior management from various agencies, is currently responsible for reviewing and accepting proposals for GIS initiatives. The OIT Project Review Committee, which consists of the County Administrative Officer, the Director of Budget and Finance, and the Director of Office of Information Technology, reviews and approves budgets for any new initiatives. Agencies are required to submit a business case for GIS support, occasionally working with OIT, outlining the initiatives proposed to be implemented. This bottom-up approach to new projects does not effectively promote GIS for agencies or programs that do not see the need to change business processes, as seen in Health, PDM, and several other smaller agencies.

Several modifications to the organizational structure have been proposed to alleviate these issues, as depicted in Figure 5.

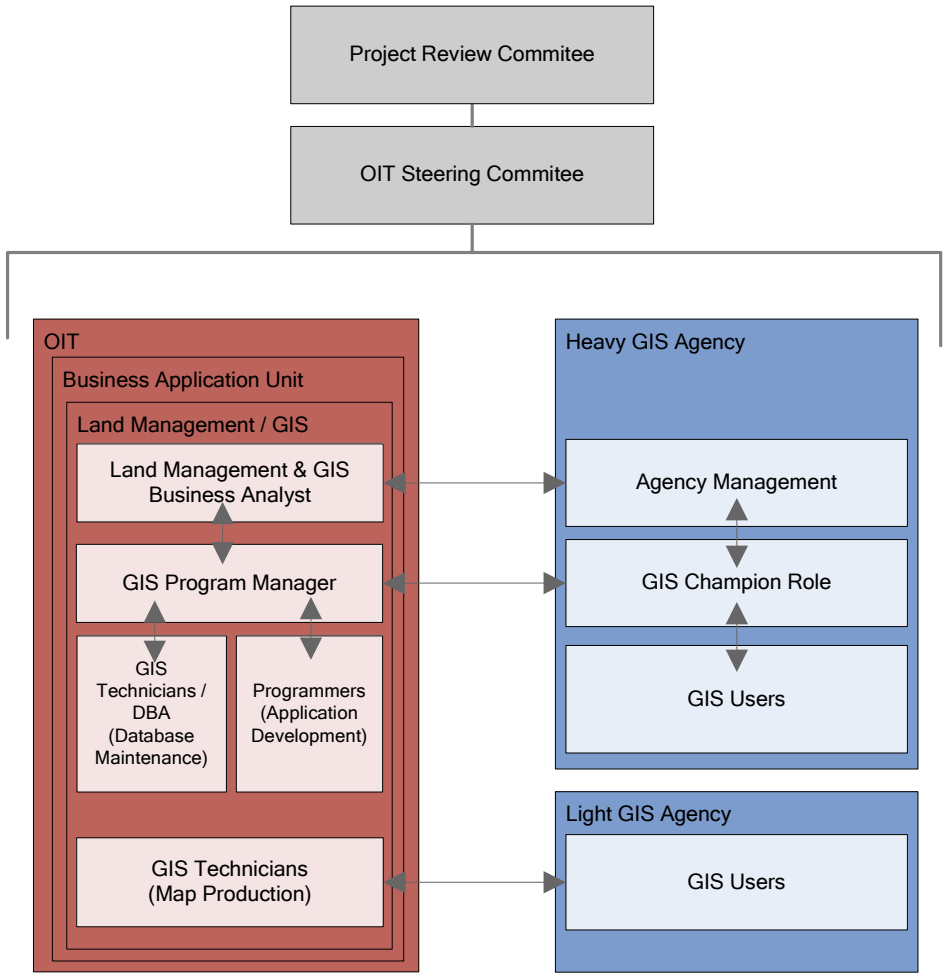

Figure 5 - Recommended Enterprise Organization

A GIS Program Manager would be responsible for coordinating with agencies that have a need for GIS. This program manager would coordinate with a GIS Champion in larger agencies to understand the agency's business processes and be able to offer recommendations as to how GIS might be able to support those activities. The GIS Program Manager would have the support of GIS programmers and technicians within the GIS unit to develop applications and datasets for the individual agencies.

The GIS Champion within larger agencies would serve as a liaison for all GIS matters in the agency. This person would be responsible for understanding the business processes in the agency, communicating these needs to the GIS Program Manager, and offering services for spatial analytical tasks. GIS users within the larger agencies should be able to handle simple GIS tasks, such as creating maps, in order to free up GIS specialists and analysts for more complex tasks. GIS users within smaller agencies can rely on the GIS Technicians in OIT to offer mapping and spatial analysis support.

The GIS Program Manager could be a non-voting, adjunct member of the OIT Steering Committee, detailing needs of the enterprise and individual agencies, as well as recommendations for meeting these needs. The committee could use this information to provide incentives or directives to agencies for implementation of these recommendations, providing a top-down approach for initiating new GIS projects in the County.

Several important initiatives need to be introduced to facilitate this new organization. These are discussed in detail below.

5.1.1 Hire a GIS Program Manager

Description

A GIS Program Manager would help support GIS activities within agencies throughout the County. This GIS Program Manager would be responsible primarily for coordinating with agencies within the County to determine what business processes could benefit from GIS. Based on the information gathered, the GIS Program Manager would determine which applications, data, personnel, and business processes were needed to support the effort. The GIS Technicians and Programmers within OIT would provide support for the GIS Program Manager in these efforts, helping to implement customized data and applications.

Implementation

A GIS Program Manager would need to be hired. This person would be responsible for meeting with GIS Champions within individual agencies in order to understand specific business processes. The GIS Program Manager would also coordinate countywide GIS efforts and implement the GIS Strategic Business Plan.

The GIS Program Manager would need to have program management skills with at least 10 years of experience within the GIS industry, three of which should have been involved with coordinating or managing GIS activities. This person should be knowledgeable in GIS system design/ integration/ implementation, advanced spatial analysis, database design and development, and application design and development.

The primary responsibilities of this individual would be to:

- Provide program management for all enterprise and agency GIS projects, as well as overall County GIS operations.
- Support GIS utilization for activities within County agencies and departments by providing technical assistance on design, development, maintenance, application development, etc.
- Participate on the OIT Steering Committee as a non-voting, adjunct member to represent the GIS program, GIS-user agencies and all associated business, including execution and maintenance of the GIS Strategic Business plan.
- Lead and coordinates the GIS Committee to support decision making on the future direction of GIS and to promote information sharing.
- Manage the development of product specifications, technical procedures, standing operating procedures and related systems development life cycle documentation for GIS activities and databases.
- Be responsible for contract administration associated with data conversion, data development, and applications development projects funded through the Information Technology Enterprise Fund or other sources.
- Participate in the integration of GIS in application development projects.

There may be other responsibilities that the GIS Program Manager would take on, depending on the amount of effort required from the efforts listed above.

Cost

The salary for this staff member should be consistent with the existing classification for a Systems Analyst or Information Technology Senior Project Manager.

Benefits

A GIS Program Manager could increase collaboration between agencies, further integrate GIS into business processes, and formalize communication between OIT and each individual agency within the County. Knowledge of business processes of agencies would help the GIS group focus their application development and database maintenance on activities that would provide the greatest return on investment and benefit to the County.

Timeframe: Short-term (1 – 3 years)

Best Practices

Baltimore County should consider implementing this recommendation as a best practice based on similar industry organizations. In general, most GIS organizations within larger municipal governments have designated a role for a GIS Manager or Program Manager. As noted in the Industry Research chapter of this document, both Mecklenburg County, NC, and King County, WA, have at least one GIS Manager role. These persons have similar responsibilities to those listed above.

5.1.2 Designate a GIS Champion

Description

Each large GIS agency should designate a GIS Champion that would serve as a primary GIS specialist with subject-matter expertise, helping to coordinate efforts between the OIT and the agency, solve complex spatial problems using GIS, and understand the geographic business processes within the agency.

Implementation

The GIS Champion would work with individuals within the agency to constantly evaluate the business processes within the agency, in order to determine how GIS could be used to support these activities. This person would coordinate with the GIS Program Manager to determine the best course of action and implement methods to introduce GIS into these processes.

Management within each agency would need to fully support the GIS Champion. Management would need to be committed to giving the GIS Champion the authority, under the direction of the Department Head, to meet and confer with management throughout the agency, in order to investigate business processes and work to integrate GIS technology, in conjunction with the GIS Program Manager.

This person should be selected from existing resources when possible. This person should be trained on complex GIS tasks, such as geocoding, spatial analyst tools, database design and creation, network analysis, and raster analysis. This person should initially coordinate with each business group within the agency, outlining their responsibility and getting a preliminary understanding of their business processes. In addition, the GIS Champion should be the primary resource within the agency for increasing GIS-user competency with both applications and data. The GIS Champions should participate in the GIS Oversight Committee meetings in order to increase collaboration and communication between agencies.

The heavy-use GIS Agencies within the County include:

- DPW
- PDM
- DEPRM
- Police Department
- Fire Department
- 911 Department
- Department of Aging
- Department of Corrections
- DED
- OCC
- DSS
- Health Department
- DRP
- OP
- Board of Elections

Timeframe: Short-term (1 – 3 years)

Benefits

This would help integrate GIS more fully into business processes and potentially increase the benefits seen from using GIS. The GIS champion would also act as a resource for the agency to handle more complex spatial analysis, leaving easier map compilation to the GIS users. This would help integrate GIS more fully into the agency, since more complex analysis would be available as a service to each agency.

5.1.3 Resource Consolidation

Description

Select personnel resources and GIS databases currently deployed across multiple agencies for database maintenance should be consolidated into the OIT, Business Applications Unit, Land Management/GIS group. A Service Level Agreement (SLA) with the County agencies participating in the resource consolidation should be established detailing the level of database maintenance services that OIT would provide to the agency. Under this agreement with each agency, OIT would use these individuals to focus effort on GIS data needs of each agency and the prioritized needs from the perspective of Baltimore County.

Although an agency would lose a resource, potentially significant benefits would be gained, since some database maintenance responsibilities would be removed. Instead, these responsibilities would be allocated to OIT personnel for specific identified databases that would be maintained in a standardized environment with consistent training and focused leadership, resulting in more efficient and accurate data compilation. The remaining GIS users within each agency would be able to focus on mapping and analytical tasks with GIS, providing additional time-saving benefits to the agency.

Implementation

The information provided below is a draft concept proposal that would need to be logistically evaluated and finalized with OIT, the GIS Program Manager, and County Management before being designed and implemented.

Several agencies could provide the resources to be consolidated within OIT. These are given in the table below, along with the number of current database maintenance resources and the number that are proposed for reallocation:

Agency	Number Current of Database Resources	Number of Proposed Resources to be Allocated to OIT
PDM	2	1
DEPRM	2	1
OP	6	1
911	1	1
DPW	5	1

Table 6 – Potential Resources for Consolidation

Five editors should be centralized into OIT Enterprise with specific database maintenance responsibilities to support the development and maintenance of pre-determined layers via a Service Level Agreement established with the Agencies. The Service Level Agreement should be based on the GIS Strategic Business Plan and agency requirements. One of these database resources could be redistributed from each of the five agencies listed in the table above. This will leave resources available within each of the agencies to serve as GIS Champions without being encumbered with database maintenance responsibilities that will be transferred to OIT.

During the first year of consolidation, the five proposed staff members should be moved into OIT to join the existing team of five GIS Technicians. After year one, the total enterprise GIS Technician team (10 staff) will make major progress towards the compilation and maintenance of the database layers. The workload of GIS should be evaluated by OIT during this time to determine if the staff is needed to perform additional tasks outlined within the GIS Strategic Business Plan. By the third year after consolidation, it may be possible to remove one or more staff members from the operating budget through natural attrition (as a result of streamlined operations and resource consolidation), if there are not increases in workload during this time.

As resources are moved from individual agencies into OIT, select database maintenance responsibilities should be transferred as well. The following databases should be considered for maintenance within OIT with the proposed resource consolidation recommendation:

- Facilities Geodatabase (from 911)
- Administrative Geodatabase (from OP)
- Historic Property Layer (from OP)
- Community Conservation Layer Support (from OP)
- Cadastral Geodatabase – Land Use (from OP)
- Cadastral Geodatabase – Restriction (from DEPRM)
- Environmental – Forest Conservation (from DEPRM)
- Cadastral Geodatabase – Encumbrance (from PDM)
- Refuse Recycling Routes (from DPW)

Timeframe: Short-term (1 – 3 years)

Benefits

This consolidation would provide the following benefits:

- Consistency in training and additional skill development leveraged through mentoring and peer development.
- Editing could be standardized more easily and be more effective by pooling resources, resulting in better and more efficient database maintenance.
- Removing the "GIS Technician" type of resource from the agency will force the low-end user to adopt some of the basic map-making functionality tasks.
- The remaining GIS Champion would not be required to perform database maintenance as a primary role and could focus more on analysis and extending the system further into business processes.
- Consolidating editing resources will allow GIS knowledge and expertise to be spread between the editors, increasing the competency of each personnel.
- Centralized GIS leadership and project management available in the OIT Enterprise will minimize database development and maintenance timeframes.

Best Practices:

Baltimore County should consider implementing this recommendation as a best practice based on similar industry organization. In general, most GIS organizations within larger municipal governments have designated teams dedicated to application development, database development, and miscellaneous mapping/ spatial analysis requests. As noted in the Industry Research chapter of this document, both Mecklenburg County, NC, and King County, WA, have a team of personnel centralized within a GIS group that are either a consolidation of resources from other agencies or fall under the direction of the GIS group.

5.2 Data Recommendations

Several critical datasets could be developed that would significantly impact the business processes of one of more agencies, providing additional benefits for the enterprise GIS. These datasets have been categorized as COMAR- County Code, Property, and Enterprise datasets. Each of these categories of data is discussed below.

5.2.1 COMAR - County Code

Several datasets should be developed to comply with the COMAR Title 26, County Code, and County Regulations mapping and data requirements. These datasets are discussed below.

5.2.1.1 Master Plans

Description

A Master Plans geodatabase should be developed to support the activities that DPW performs to meet the requirements of COMAR Title 26, County Code, and County Regulations for the development of maps that show the water, sewer, and transportation infrastructure in the County. The laws and regulations provide specific language for representation, attribution, and symbology for these maps.

Implementation

The Master Plans geodatabase should include master plans, cycle amendments, basic services maps, and the Metropolitian District boundary. The data should be represented as polygons taken from the County's Cadastral geodatabase. The Master Plans geodatabase will provide improved spatial representation of these features that are legally authoratative and suitable for integration and display with other County GIS features.

These data should be recompiled from the original source material to enable the integration of the maps with the County's large-scale geodatabases.

Timeframe: Short-term (1 – 3 years)

Preliminary Cost/Benefit Analysis

The total costs and benefits associated for this data development activity are provided in Table 7 below. This includes the cost to develop the data in the first year, as well as the costs for maintaining the dataset for two years. The benefits that should be realized over the following two years have also been provided. These associated costs are not a quote and should be used as an estimate only. Further formal analysis should be done to formulate an accurate cost/benefit assessment and an appropriate business case. Please review the DPW chapter for more detailed cost/benefit information.

Potential Cost/Benefit for Master Plans Geodatabase Development				
Development Costs	**Maintenance Cost (2 Years)**	**Total Cost**	**Benefits (2 years)**	**Cost/Benefit Difference**
$284,037.27	$10,026.12	$294,063.39	$179,595.50	-$114,467.89

Table 7 – Cost/ Benefit for Master Plans Geodatabase Development

There are other programs within DPW that could benefit from having the Master Plans geodatabase available, significantly increasing the return on the development expenditure. These programs are provided in Table 8 below, along with the potential number of annual iterations of the activity that could benefit from access to the Master Plans geodatabase. This gives an idea of the significance of the data and the impact that its development could have on DPW.

Potential Programs Realizing Additional Benefits from Master Plans Geodatabase	
Program	**Number of Iterations**
Complaint Tracking and Response (Research)	439
Engineering Management	509
Highways (Roads) Management	300
Inquiries – Citizens	600
MDE/EPA Consent Decree Requirements / Deliverables	36
MDE/EPA Utilities Maintenance Applications/Program management (CASS WORKS)	5,500
Miscellaneous Map and Display Creation – Department Wide	90
Total	**7,474**

Table 8 – Potential Programs Realizing Additional Benefits from Master Plans Geodatabase

In addition to DPW, the Master Plans geodatabase will support users in the following agencies:

- DEPRM
- PDM
- Office of Planning
- County Planning Board
- County Council

Recommendation

The Master Plans geodatabase will save significant effort within DPW across several programs and activities, justifying its creation. The geodatabase should also provide benefits to other activities throughout the County, providing an additional reason to develop the dataset. However, the development costs will not be offset within the first two years. The Master Plans geodatabase is still a good investment, even if the financial aspects of the cost recovery are not evident in this high-level analysis. The estimated return on investment, with full payback and cost recovery, would be approximately 40 months. Baltimore County should conduct a complete full business case to identify all estimated benefits within additional programs and across all agencies.

The elements of the Master Plans geodatabase are required by State and local law, and use of GIS is the appropriate and most cost-effective way to accomplish this task. If the County does not deliver a timely and adequate report of its review of its County plan, the State of Maryland could have the power to suspend development in the County. This is interpreted from the Environmental Article of Annotated Code of Maryland, section 9-509(c) (2) (ii). A violation of either an inadequate delivery or not timely delivery could result in the State not issuing any permit to install or alter a water supply system, sewage system, or solid waste disposal system in that County under the Environmental Article of Annotated Code of Maryland, section 9-204.

The political disincentives for not developing the Master Plans geodatabase noted above could far outweigh the relatively small negative financial benefit to developing this dataset.

5.2.1.2 Chesapeake Bay Critical Area

Description

The Chesapeake Bay Critical Area (CBCA) is a set of mapping products used to delineate and enforce development constraints proximal to the Chesapeake Bay. Baltimore County is mandated and authorized by COMAR to manage activities and constrain development within the CBCA.

Implementation

The CBCA geodatabase should map the three areas (polygons), including the critical areas (intense development areas, limited development areas, resource conservation areas), buffer management areas, and tidal wetlands. In addition to DEPRM, the CBCA geodatabase will support internal County users in the following agencies:

- DPW
- PDM
- Office of Planning

Timeframe: Short-term (1 – 3 years)

Preliminary Cost/Benefit Analysis

A preliminary estimate of the costs and anticipated benefits in one year, resulting from creation of a CBCA dataset is summarized in the table below. This includes the cost to develop the data, as well as the costs for maintaining the dataset for two years. The benefits that are expected to be realized over the following two years are also included. These associated costs are not a quote and should be used as an estimate only. Further formal analysis should be done to formulate an accurate cost/benefit assessment and an appropriate business case. Baltimore County should conduct a complete full business case to identify all estimated benefits within additional programs and across all agencies. Please review the DEPRM chapter for more detailed cost/benefit information.

Preliminary Cost/Benefit for CBCA Feature Classes Development				
Development Costs	**Maintenance Cost (2 Years)**	**Total Cost**	**Benefits (2 years)**	**Cost/Benefit Difference**
$182,575	$7,469	$190,044	$204,720	$14,676

Table 9 – Preliminary Cost/Benefit for CBCA Feature Classes Development

Other benefits resulting from a CBCA layer are:

- Improved service to citizens and Government Officials resulting from increased availability of information.
- Permanent retention and increased accuracy of mapped information mandated by State CBCA law.
- Improve effectiveness of State-mandated CBCA law by increasing public awareness of regulatory requirements on their properties.

- Improved service to citizens and Government Officials resulting from increased availability of information.
- Improved communication with State regulatory agencies.

There are other activities that would likely benefit from having the CBCA layers available, increasing the return significantly on the development expenditure. These activities are listed in Table 10 below. This gives an idea of the significance of the data layers and the impact that their development could have on County activities.

Potential Programs Realizing Additional Benefits from CBCA Feature Classes	
Agency	**Activity**
Public Works	• Bridge Management • Building Permit Review • Engineering Management • Floodplain Management • Master Plan Development • Metropolitan District Financing and Petitions
Recreation and Parks	• Capital Improvement Project (CIP) Project Planning • Mapping required for permits and approval process
Permits and Development	• Development Plans Review • Development Management • Permit and Licensing Processing • Zoning Review
Office of Planning	• Adequate Public Facilities • Community Planning • Development Review • Historic Preservation • Land Use Analysis / Vacant Land Analysis • Master Planning • Rezoning
Community Conservation	• Community Planning and Development, Revitalization Projects • Urban Design Assistance Team (UDAT) Project Management
Economic Development	• Decreased Time in Determining Property Status

Table 10 – Potential Programs Realizing Providing Additional Benefits from the CBCA Feature Classes

Recommendation

The CBCA data layers will save significant effort within DEPRM, justifying the creation of these layers. The development costs should be easily offset in less than two years, giving a comfortable rate of return in the potential investment. These layers should also provide benefits to other activities throughout the County, providing an additional reason and justification to develop the dataset. In addition, the recompilation of the layer will improve the accuracy of a layer required by COMAR.

5.2.1.3 Zoning History

Description

A Zoning Case History feature class should be developed to support the research and analysis performed by the zoning group and other agencies. This feature class will allow for spatial information that is currently available only in hardcopy format within the Zoning section to be provided to other County agencies and the public in digital format. This layer will reduce the amount of time and money spent researching hardcopy maps.

Implementation

The Zoning Case History feature class should represent the 60,000 zoning public hearings held on particular properties from the establishment of the Baltimore County Zoning Regulations on January 2, 1945, to the present date. Each feature should be represented as a point and should have the information associated as attributes and/or linked from an existing database, as shown in Table 11.

Zoning Case History – Attributes		
Case Number	Filing Date	Requested Relief
Case Type	Attorney	Acreage
Election and Councilmanic Districts	Hearing Date	Granted or Denied
Property Owner	Street Address	Map Reference
Zoning Classification	Order Date	Restrictions
Contract Purchaser	Property Description	Existing/Proposed Uses

Table 11 – Zoning Case History Attributes

This layer should also be linked to the zoning variance case files by case number where necessary.

Timeframe: Short-term (1 – 3 years)

Preliminary Cost/Benefit Analysis

The total costs and benefits associated for this data development activity are provided in Table 12 below. This includes the cost to develop the data, as well as the costs for maintaining the dataset for two years. The benefits that should be realized over the following two years have also been provided. These associated costs are not a quote and should be used as an estimate only. Further formal analysis should be done to formulate an accurate cost/benefit assessment and an appropriate business case. Baltimore County should conduct a complete full business case to identify all estimated benefits within additional programs and across all agencies.

Potential Cost/Benefit for Zoning Case History Feature Class Development				
Development Costs (1 Year)	**Maintenance Cost (2 Years)**	**Total Cost (3 Years)**	**Benefits (2 years)**	**Cost/Benefit Difference**
$231,760.93	$13,325.36	$245,086.29	$429,638.60	$184,552.31

Table 12 – Potential Cost/Benefit for Zoning Case History Feature Class Development

There are other activities within PDM that could benefit from having the zoning case history layer available, increasing the return significantly on the development expenditure. These activities are provided in Table 13 below, along with the potential number of annual iterations of the activity that could benefit from access to the zoning case history layer. This gives an idea of the significance of the data layer and the impact that its development could have on PDM.

Potential Activities Realizing Additional Benefits from Zoning Case History Feature Class	
Activity	**Number of Iterations**
Permit & License Processing – Miscellaneous Permit & License Processing	65,000
Real Estate Services – Appraisals	546
Real Estate Services – Contact & Negotiations/ Records Management	802
Real Estate Services – Land Acquisition Property Inquiry	2,236
Real Estate Services – Surplus Property	250
Real Estate Services – Title Examination/Property Settlement/Plat Review	75

Table 13 – Potential Activities Realizing Additional Benefits from Zoning History Feature Class

In addition to PDM, the Zoning History geodatabase would benefit the following agencies:

- People's Counsel
- Office of Planning
- Department of Public Works

Recommendation

The Zoning Case History layer will save significant effort within the Zoning Program, justifying the creation of this layer. The development costs should be offset after approximately two (2) years, giving a very comfortable rate of return in the potential investment. The layer should also provide benefits to other activities throughout the County, providing an additional reason to develop the dataset.

An additional layer could also be created that represents the zoning variance area as polygons. This layer would allow for more complex analysis to be performed on these features that is currently not available in the zoning layer. This feature class could also save additional time required to pull up and interpret legislative documents. The costs for developing and maintaining this layer have been included in Table 14 and Table 15 below.

Zoning Case History Polygon Development Costs			
Task	**Number of Instances**	**Time Per Instance (In Hours)**	**Cost**
Develop Zoning Polygons	20,000	1	$679,000

Table 14 – Zoning Case History Polygon Development Costs

Zoning Case History Polygon Maintenance Costs			
Task	**Number of Instances**	**Time Per Instance (In Hours)**	**Cost**
Develop Zoning Polygons	650	1	$ 22,067.50

Table 15 – Zoning Case History Polygon Maintenance Costs

It is recommended that this layer be introduced during a second phase that would be completed after all of the zoning documents and maps have been scanned and referenced.

5.2.2 Property Database

5.2.2.1 County-owned Property

Description

A county-owned property feature class should be developed that identifies all of the property owned by the County as a polygon, as well as the responsible agency. The Recreation and Parks agency previously developed a static version of this dataset; however, it is not necessarily accurate and is not available to the GIS enterprise.

The County-Owned Property layer will save time spent researching material to find out information about a property, including the location, ownership, and responsible agency. This would also reduce an agency's dependency on PDM providing this information, since the data could be hosted by the Enterprise. Each of these benefits would help reduce the turnaround time for a request. As an added benefit, the development of this layer would help to identify small parcels that are not easily readable on the State Tax Maps and would result in an increased quality and accuracy of the Tax Parcel layer.

Implementation

A detailed needs assessment should be performed in order to determine the detailed requirements and to determine the initial design concept to integrate this layer into the Cadastral geodatabase. This needs assessment should lead to a data model design and implementation.

A potential approach to developing the feature class should include extracting information already contained in the cadastral dataset and improving the attribute information based on source materials and information available in PDM. The owner attribute within the parcel layer could be queried for County agencies. Each of these features would be transferred to a new dataset and populated with the name of the responsible agency.

Timeframe: Mid-term (4 – 5 years)

Preliminary Cost/Benefit Analysis

The total costs and benefits associated for this data development activity have not been provided, since this layer can be implemented with relatively little effort and the detailed requirements have not completely been identified. However, the County should conduct a detailed business case to formally assess the estimated cost/benefits of the opportunity and determine the financial viability of the data development project.

5.2.2.2 Easements

Overview

An easement feature class should be developed to support the research and analysis performed by programs within agencies such as DPW, PDM, and DEPRM. This feature class should show drainage and utility easements, as well as forest buffers, conservation areas, and any other declarations granted to the County. The layer should be a polygon feature class that will include relevant information linked to the Land Acquisition Database. There should also be a URL to link to a scanned image of the easement deed and drawing if available.

The easement feature class will reduce the amount of time currently spent by personnel looking at hardcopy and digital tax parcel maps to research ownership and easement locations. The types of research that will see benefits from the development of this feature class include:

- DPW can use the layer to locate existing easements for new construction projects and investigating customer complaints to determine if the County is responsible for a problem.
- DEPRM could use the layer for storm drain easements location.
- Office of Planning could use the layer for new projects, such as streetscapes.
- Police Department can use the layer to settle civil disputes.

Timeframe: Mid-term (4 – 5 years)

Preliminary Cost/Benefit Analysis

The total costs and benefits associated for this data development activity are provided in Table 16 below. This includes the cost to develop the data, as well as the costs for maintaining the dataset for two years. The benefits that should be realized over the following two years have also been provided. These associated costs are not a quote and should be used as an estimate only. Further formal analysis should be done to formulate an accurate cost/benefit assessment and an appropriate business case. Baltimore County should conduct a complete full business case to identify all estimated benefits within additional programs and across all agencies. Please review the PDM chapter for more detailed cost/benefit information.

Potential Cost/Benefit for Easement Feature Class Development				
Development Costs	**Maintenance Cost (2 Years)**	**Total Cost**	**Benefits (2 years)**	**Cost/Benefit Difference**
$314,820	$35,100	$349,920	$201,485.48	$- 148,434.52

Table 16 – Potential Cost/Benefit for Easement Feature Class Development

There are other activities that could benefit from having the easement layer available, increasing the return significantly on the development expenditure. These activities are provided in Table 17 below, along with the potential number of annual iterations of the activity that could benefit from access to the easement layer. This gives an idea of the significance of the data layer and the impact that its development could have on PDM.

Potential Activities Realizing Additional Benefits from Easement Feature Class	
Activity	**Number of Iterations**
Building Plans Review – Building/ Fire	520
Code Inspection and Enforcement – Building, Plumbing, and Electrical Inspections	130,000
Development Management – Public Works Agreements	52
Development Management – Utility & Right of Way Agreements	52
Development Management – Water & Sewer House Connections	52
Development Management – Concept Plans	104
Development Management – Development Plans	52
Development Plans Review – Minor Subdivision Plans	200
Development Plans Review – Record Plats	150
Real Estate Services – Appraisals	546
Real Estate Services – Contact & Negotiations/ Records Management	802
Real Estate Services – Road Openings and Closings	10
Real Estate Services – Surplus Property	250
Real Estate Services – Title Examination/Property Settlement/Plat Review	75

Table 17 – Potential Activities Realizing Additional Benefits from Easement Feature Class

In addition to PDM, the Easement geodatabase would benefit the following agencies:

- Office of Planning
- Department of Public Works
- Department of Environmental Protection and Resource Management

Recommendation

The Easement feature class requires significant development costs, which do not provide the return necessary from the one activity analyzed. The estimated return on investment, with full payback and cost recovery, would be approximately 4 years. However, there should be additional benefits realized in a multitude of other activities that could potentially provide the necessary return on investment. Based on the needs assessment performed, the data layer would certainly be useful; however, Baltimore County should complete a full business case to determine if the dataset is a good investment.

5.2.2.3 Encumbrance Rights-of-Way

Overview

An Encumbrance Rights-of-Way (ROW) dataset is currently being developed by PDM to support the needs of agencies such as PDM, DPW, DRP, and OP. More resources should be allocated to this effort in order to complete the dataset in a reasonable time. These resources could be allocated internally if available (potentially from the resource consolidation recommendation referenced above), or contracted to a consultant with available resources. This dataset consists of a point dataset that shows the location of ROW features held by the County, as well as a polygon feature class that shows the boundaries of these features. This dataset holds a strong topological relationship with the cadastral database, since the boundaries of these features are generally shared with parcel and easement boundaries.

Timeframe: Short-term (1 – 3 years)

Preliminary Cost Analysis

The total costs associated for this data development activity are provided in Table 18 below. This includes the cost to develop the data, as well as the costs for maintaining the dataset for two (2) years.

Potential Cost for ROW Feature Class Development		
Development Costs	**Maintenance Cost (2 Years)**	**Total Cost**
$108,450	$43,380	$151,830

Table 18 – Potential Cost for ROW Feature Class Development

The development costs for the ROW layer have included the costs of supporting 2.5 resources at a salary of $43,380 over one year. Maintenance costs assume ½ of a fulltime employee (FTE) salary of $43,380 for two years.

The Encumbrance ROW layer is 42% complete, and it is estimated that it will be finished with existing resources approximately four years from the date of this report. This layer is currently being updated with approximately one FTE equivalent. By increasing the resources allocated to this development, this layer could be completed in one to two years, allowing for the benefits provided from this layer to be realized much earlier.

This layer will provide benefits to the activities in several agencies, including PDM, OP, DRP, and DPW. Currently, users of this information are required to research these features within an incomplete dataset. If the information is not found, additional research of hardcopy plats is required, increasing the amount of research time required to retrieve this information. Completing this dataset will reduce the amount of time researching these source documents and provide a central location where all of the information about these features can be stored and retrieved.

Recommendation

There has already been a commitment by PDM to develop the ROW dataset. This commitment should be extended, prioritized, and supported by the consolidated GIS enterprise resources in order to complete this dataset within a reasonable time. The presence of an incomplete dataset does not provide much benefit to users, since they are forced to work with two different data sources, one of which is time consuming. By completing this dataset earlier, users will have access to a single source of information for these features that will reduce the amount of time spent performing research.

5.2.3 Enterprise Databases

Overview

The enterprise layers provided by OIT are the most widely used datasets within each of the agencies reviewed in the County. These datasets are either generic enough to be used for a multitude of varying business processes or represent features that are an integral part of the business that the County conducts. In addition, these datasets are often used as source information for creating additional datasets, used to check the accuracy of other datasets, or used to support other datasets with spatial information through database links.

The County should commit to continually support the enterprise layers currently maintained by OIT.

Description

Several key enterprise datasets, which require capital investments for maintenance and updating, are provided below with a description and a brief discussion of their general use.

Orthophotography

The orthophotography dataset is a remotely sensed multi-spectral raster dataset, or digital photography, that has been orthorectified to the ground. This dataset shows features of the County from an aerial perspective. This dataset is important for understanding the location of cultural and physical features of the landscape in Baltimore County. Orthophotography is used for many activities within Baltimore County, generally for location reference and as a source dataset in data compilation.

Planimetric

The planimetric dataset is a set of feature classes created to represent buildings, roads, and hydrology within Baltimore County. These features have been captured from elevation data and orthophotography, and are generally used for cartographic purposes and as a basemap for other data.

Topographic

The topographic data include elevation data captured as contours and LiDAR mass points. These data allow for a three-dimensional representation of the surface of the County. They are used to determine elevation heights for specific features, model surfaces in three-dimensions, and analyze slope and aspect of the landscape. They are also used to correctly position orthophotography and planimetric data, increasing the accuracy of these data.

Timeframe: Long-term (10 years of continued support)

Cost Analysis

The total costs associated for these data-development activities are provided by dataset in Table 19 below. These development costs are based on the current costs associated with creation of these datasets and have been factored to an annual cost based on the current update frequency. Please note that these capital costs have already been factored into the enterprise costs utilized in the Cost/Benefit Analysis.

Costs for Enterprise Dataset Development			
Dataset	**Development Cost**	**Update Frequency**	**Annual Cost**
Orthophotography	$375,000	3 Years	$125,000
Planimetrics	$351,000	3 Years	$117,000
Topographic	$300,000	10 Years	$30,000
		Total Annual Enterprise Capital:	**$272,000**

Table 19 – Cost for Enterprise Dataset Development

Recommendation

A commitment has been made in the past to develop these data layers, with updates performed periodically. However, there is currently no long-term commitment from the County to continually update and support these databases. Since these datasets support so many of the activities that have proven benefits to the County, a continued long-term commitment should be made by the County to update and maintain these datasets.

Best Practices

Baltimore County should consider implementing this recommendation as a best practice based on similar industry-provided data. In general, most GIS organizations within larger municipal governments provide the enterprise layers listed above. These layers are critical to the GIS-business practices in any County and are necessary for the most basic GIS practices. As noted in the Industry Research chapter of this document, both Mecklenburg County, NC, and King County, WA, have each of the enterprise layers listed above available to the public and County agencies. The County should also investigate the benefits of updating the orthophotography more frequently, since both counties reviewed have an update cycle of two years.

5.3 Infrastructure Database

There are several infrastructure datasets that were analyzed and determined not to be a critical need for the County, although the datasets could potentially provide significant value to the County. During the industry research, it was determined that many similarly sized counties support their infrastructure asset management systems with the datasets identified in Table 20 below. These datasets could be used within CASS WORKS to support infrastructure management and asset management business processes within DPW. Each dataset is discussed in Table 20.

Infrastructure Datasets	
Dataset	**Overview**
Water	The County should consider partnering with Baltimore City to develop a water dataset that can integrate into the CASS WORKS application and business processes within DPW.
Storm Drains / Stormwater	Baltimore County should perform a preliminary business case to evaluate the needs of a Stormwater dataset and determine if the costs and benefits associated with this data make the development viable. A geodatabase design already exists for this dataset, which would deflect some of the costs for this development. DPW has identified that the Stormwater dataset would be used in CASS WORKS to track asset maintenance repairs and asset inventory, and to improve strategic decisions for overall Stormwater asset management.

Table 20 – Infrastructure Datasets

Timeframe: Mid-term (4 – 5 years)

Preliminary Cost/Benefit Analysis

The total costs and benefits associated for this data development activity have not been provided due to limited and complex requirements information. The County should conduct a detailed business case to formally assess the estimated cost/benefits of the opportunity and determine the financial viability of the data development project.

5.4 Business Processes Recommendations

5.4.1 Land Management System

Overview

A Land Management System should be developed to support the activities and interests of agencies with County land. These activities are primarily conducted by PDM, DPW, OP, DEPRM, and DRP, and should include the components identified in Table 21.

Land Management Activity	Process Opportunities
Development Plan Management	A database and database interface should be incorporated that allows users to track development plans throughout a project's lifecycle and effectively distributes these plans to agencies for review.
Development Plan Review	Tools should be provided to aid in reviewing development plans in digital format.
Code Enforcement	GIS should help personnel understand where code complaints are. Inspections can be allocated effectively to personnel and managed as they are performed.
Building Plan Management	A database and database interface should be incorporated that allows users to track building plans throughout a project's lifecycle and effectively distribute these plans for review.
Building Plan Review	Tools should be provided to aid in reviewing building plans in digital format.
Permit Management	A database and database interface should be incorporated that allows for users to track permits through their life cycle.
Permit Review	A GIS component should be developed that allows for the locations applying for permits to be reviewed.
Zoning Review	A GIS component should be incorporated that allows for the zoning of a property to be determined, including its zoning history. New zoning requests should be able to be reviewed within the interface.
Flood Management Cases	A GIS component should be incorporated that allows users to make determinations about whether a building is within a floodplain.

Table 21 – Land Management System Components

Implementation

Baltimore County should develop a business plan to determine what business processes are in need of components of a Land Management System. This business plan should focus on the needs of PDM, OP, DEPRM, and DPW. This plan should outline the ways in which business processes can be improved and determine what applications and data are necessary to complement these new business processes. A consultant with experience in these types of implementations would be extremely helpful in detailing these needs and making appropriate recommendations.

The County should use this plan to select a Land Management System vendor that offers an enterprise system that includes each of the necessary components outlined in the business plan.

Several datasets that were recommended for development earlier in this document are necessary for this system to operate effectively. These are:

- Right of Ways
- Easements
- Zoning History

In addition, the permits database, which contains a tax account identifier (primary key), should be joined to the cadastral property database, giving a spatial property to these data. The development plans should also be required to be submitted digitally, as recommended in the business process section of this document.

Timeframe: Mid-term (4 – 5 years)

Preliminary Cost/Benefit Analysis

The total associated costs and benefits for this application implementation have not been provided in this report. The County should conduct a detailed business case to formally assess the estimated cost and benefits of the opportunity and determine the financial viability of the project.

There are many programs within agencies that would benefit from this system. These are:

- PDM – Building Plans Review
- PDM – Code Inspection and Enforcement
- PDM – Development Plans Review
- PDM – Development Management
- PDM – Permit & Licensing Processing
- PDM – Real Estate Services
- PDM – Zoning Review
- DEPRM – Agricultural Preservation
- DEPRM – Community Reforestation Program
- DEPRM – Development Coordination and Permit Processing
- DEPRM – Environmental Impact Review Program
- DEPRM – Stormwater Management
- OP – Charrette and UDAT Project Management
- OP – Community Planning
- OP – Development Review
- OP – Historic Preservation
- OP – Rezoning
- DRP – Mapping Required for Permit or Approval Processes
- DPW – Building Permit Review (Residential)
- DPW – Floodplain Management

Recommendation

Baltimore County should conduct a business plan to determine what the needs are within the County that can be served by a Land Management System. The design of the system should meet these needs and include steps to integrate existing databases, migrate databases to new formats, develop new datasets, acquire software, customize software, and train individuals on the new system. This design should lead the implementation effort. This strategy will provide a comprehensive solution that meets the needs of individual County agencies, while ensuring that all work is performed on a platform that allows for communication and collaboration between agencies.

5.4.2 Digital Plan Submission

Overview

Development plans are submitted to PDM for concept plans and development plans of new land developments within the County. These plans are reviewed by approximately 20 agencies within the County, in order to determine if they meet standards and codes of the County. PDM is responsible for distributing hardcopy documents to these agencies, collecting any comments from the review, and distributing these back to the developer. Currently, these concept and development plans are scanned and archived by OIT for integration into the cadastral database.

A mandate or incentive could be developed that requires or allows developers to submit concept and development plans in digital format with the hardcopies that are currently provided to PDM. This would reduce the amount of time that is spent by OIT to digitize these data. This would also allow for these plans to be submitted in digital format to agencies that review the plans. Plans could also be georeferenced so that reviews could be performed within a GIS, saving time and money spent during the review process.

A website could be developed for digital submittals, providing an incentive to developers to submit the plans digitally, since they could avoid travel to the PDM office. These digital development plans could be used to print hardcopy plans when still needed as the process matures.

Implementation

A preliminary review should be conducted to understand the level of acceptance that developers will have to a digital plan submission process. Depending on this acceptance, a plan could be developed based on either mandates or incentives that need to be developed to implement the process. The implementation plan should include:

- The digital plan submission format, including the image file format, and whether the image should be georeferenced.
- An acceptance process, which could be web based, or located on site, which allows for digital data to be submitted, accepted, stored, and logged.
- The plan should also include a distribution process, which allows for the plans to be easily distributed to agencies across the County network. This process should track the plans as they are distributed, in order to understand the status of a given plan.
- A pilot implementation, which could be optional to developers, in order to ensure that the process is viable. Revisions should be allowed based on the outcome of this pilot.

A database would need to be developed to aid with tracking the plans through the submission, distribution, review, and acceptance processes. This database would record the dates that each plan has moved through the various stages, as well as information about the related County and developer parties. This database could be tied to a spatial representation of the development, such as a point showing where the development is or a polygon outlining the boundary of the development.

Additional tools could be developed within ArcGIS that allow for the reviewers to comment on the review plans in digital format, eliminating the need to comment on hardcopy plans.

Timeframe: Mid-term (4 – 5 years)

Preliminary Cost/Benefit Analysis

The total costs associated for this implementation are provided in Table 22 below. These associated costs are not a quote and should be used as an estimate only. Further formal analysis should be done to formulate an accurate cost/benefit assessment and an appropriate business case.

Potential Cost for Digital Plan Submission Implementation	
Task	**Development Costs**
Requirements/ Design/ Testing	$27,000
Develop Plan Submission/ Tracking System or Website	$48,000
Develop Digital Plan Tracking Database	$51,000
ArcGIS Plan Review Tool Development	$20,000
Training on New Business Processes	$10,000
Total Costs	**$156,000**

Table 22 – Potential Cost for Digital Plan Submission Implementation

The development costs include $27,000 allocated for designing the application, determining functionality requirements, and testing each version of the developed software. Development of a plan submission and tracking system website is estimated at 1,000 hours at $48.00 per hour, totaling $48,000. The digital plan tracking database will involve approximately 1,500 hours of data compilation effort at $33.95 per hour, totaling approximately $51,000. The ArcGIS Plan Review Tool Development will involve approximately 420 hours of development time at $48.00 per hour, which results in about $20,000 cost for this task. Training of users will cost approximately $10,000.

The following qualitative benefits could be realized as a result of implementing the digital plans submission:

- OIT would save time and money spent converting these datasets.
- Developers would not have to travel to the PDM office to submit plans.
- PDM would save time and money spent accepting digital plans, since information would be already available from the database.
- Distribution of plans would be easier, since PDM would not have to constantly move each of the plans to a bin and would be able to determine if agencies have received their plans.
- Acceptance of plans would be easier, since the database could track the review process within the database.

Recommendation

Developers should be contacted to ensure that there is general acceptance of the process. A plan should be developed to roll out a digital plan submission and review process. This plan should include methods for receiving and storing digital files, as well as distributing and accepting these plans. Methods can include systems supported by databases, which allow for the plans to be managed and tracked throughout their lifespan.

5.4.3 Data in Public Domain

Overview

Baltimore County provides public access to the County's GIS maps, data, and services. This fee-based program is designed to provide printed copies of published maps, access to the digital data, and services for the creation of custom products based on customer specifications. Digital data is available in several standard GIS and computer-aided drafting and design (CADD) export formats to support multiple uses, including shapefiles, .e00, and .dxf. Services are available to create custom products using the County's available data. All customers obtaining products are required to sign a License Agreement for GIS Data. GIS maps and data are given to consultants at no cost for use in design projects if the projects are County projects.

These data should be provided to the public without use constraints and for free. This would increase collaborations between the County and other agencies, increase public geographic awareness, decrease costs for filling data requests, and reduce the liability of the County for data errors.

Implementation

An interactive web mapping application should be developed that would allow users to view the data and then download it. Large datasets such as orthophotography or LiDAR data would be downloadable by tile. Smaller datasets could be made downloadable as countywide data layers.

Web mapping services, included as part of the MyNeighborhood suite, could also be developed to help serve data to customers. These web services could include feature-mapping services, which allow for data to be streamed into thick or thin clients for viewing and analysis. An image map service could also be developed that allowed a user to choose an area of interest and download data for the particular area. Finally, a metadata cataloging service could be developed that allows users to search the metadata information based on geographic extent, keyword, description, etc., which provides an easy-to-use interface for finding geographic data.

Timeframe: Mid-term (4 – 5 years)

Preliminary Cost/Benefit Analysis

The total costs associated with this implementation have been provided in Table 23 below. These associated costs are not a quote and should be used as an estimate only. Further formal analysis should be done to formulate an accurate cost/benefit assessment and an appropriate business case.

Potential Cost for Putting Data in Public Domain	
Task	**Development Costs**
Develop Data Download Website	$50,000

Table 23 – Potential Cost for Putting Data in Public Domain

In addition, there will be a loss of revenue from putting the data in public domain, which is given in Table 24 below.

Annual Loss of Revenue for Putting Data in Public Domain	
Task	**Loss of Revenue**
Average Annual Fee Collected for Data from 2000-2006 (Revenue Deduction, Not Cost)	$99,295

Table 24 – Annual Loss of Revenue for Putting Data in Public Domain

It should be noted that the trend in data requests has been decreasing in the last few years, perhaps due to the fact that larger requesters may have received all of the data they will need until the next County update of the orthophotography, elevation data, or planimetric data. As a result, the average fee collected for data could be reduced in the future. In addition, approximately 92% of the data provided to the public is given at no cost, with revenue-generating transactions being performed for only a very small amount of data.

Time spent filling data requests would be reduced and reallocated to other projects and database maintenance activities. Currently this amounts to one FTE in OIT plus additional hours spent in individual agencies. These benefits have been captured in Table 25 below:

Annual Benefits for Putting Data in Public Domain	
Task	**Resource Reallocation Savings**
Resource Savings Associated with Not Processing Orders (Ability to assign the resource to other tasks)	$43,380

Table 25 – Annual Benefits for Putting Data in Public Domain

Other advantages to putting the data in the public domain would be as follows:

- The County's liability for data quality would be limited.
- The County would increase its ability to participate in more partnerships for data sharing and cooperative efforts. Some of the partnership opportunities include the following:
    - The statewide orthophotography program, whereby the County could reduce its costs for countywide imagery. The County has already agreed to share its LiDAR data for use in rectifying the State's imagery.
    - The proposed statewide road centerline project, whereby the County might be able to share its data in exchange for regional datasets that would benefit many agencies.
    - The Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Map (DFIRM) Cooperating Technical Program (CTP), whereby the County already provided its base map data for use on FEMA's floodplain maps in exchange for GIS data of the floodplains.
- There are some arguments currently being made in GIS publications and journals that if licensing restrictions are removed, more data will be developed that fits a County's base map, which will ultimately benefit the County. It is unclear if this would be the case for Baltimore County.
- The public would have more access to data to perform their own analysis and create maps. This could make the public more informed about geographic phenomena in the County.

Best Practices:

The practice of putting data into the public domain is mixed among municipal governments. Of the two counties reviewed in the Industry Research chapter of this document, both charged for GIS data and did not put it in the public domain. However, as shown in Tables 26 and 27 below, there were significant differences in the cost structures of these counties and other proximate Maryland counties in relation to Baltimore County.

Baltimore County Countywide Digital Dataset Costs					
Dataset	**Tiles**	**Cost Per Tile**	**Subtotal**	**20% Discount for Countywide**	**Total Cost**
Planimetric/ Topographic	836	$90	$75,240	- $15,048	$60,192
Orthophotography	836	$80	$66,880	- $13,376	$53,504
Cadastral (Property)	117	$140	$16,380	- $3,276	$13,104
				Total Cost for Three Digital Datasets	**$126,800**

Table 26 – Baltimore County Countywide Digital Dataset Costs

GIS Data Cost Comparisons						
Dataset	**Baltimore County Cost**	**Harford County Cost**	**Howard County Cost**	**King County, WA Cost**	**M-NCPPC Montgomery County**	**Mecklenburg, NC Cost**
Planimetric/ Topographic	$60,192	$0	$100	$110	$118,800	$300
Orthophotography	$53,504	$0	$200	$260	Not for sale	$200
Cadastral (Property)	$13,104	$0	$100	$110	$59,400	$250
All Three Datasets	**$126,800**	**$0**	**$400**	**$480**	**$178,200**	**$750**

Table 27 – GIS Digital Data Cost Comparisons

With the exception of Montgomery County (data provided through the Maryland-National Capital Park and Planning Commission), each of the critical enterprise datasets provided by Baltimore County are sold at a rate far and above the rates charged by reviewed counties for the equivalent countywide datasets. Although our industry research does not suggest putting data in the public realm, Baltimore County, as a best practice, should at least consider charging fees for data that are within the reach of the general public, as other counties have done.

Recommendation

Baltimore County should provide data for free to the public through an interactive web application. This application should allow the user to select an area of interest and specific dataset and download data for this area or type of data. This could reduce costs that the County incurs from currently

charging for the data, as well as reduce the liability of the County and increase collaboration with partners. The public would also benefit from greater access to information.

In addition, the existing MyNeighborhood websites could be redesigned and redeveloped in coordination with this effort. This would allow the data access functionality to be incorporated with other mapping functionality and would save money spent upgrading the web mapping applications.

5.4.4 Introduce GIS to Additional Agencies / Activities

Overview

The Health Department, PDM, and DSS appear to have a vast potential for further use of GIS throughout the business processes in these agencies. Although there are other areas within the County that can benefit from the introduction of GIS, particular focus should be given to these agencies, in order to provide significant immediate benefits to the County. Introduction of GIS into business processes within PDM should be coupled with introduction of the Land Management System and associated data and applications.

Implementation

Through a controlled process of implementation, each agency should introduce GIS to each of its programs. This controlled implementation process should include the following steps:

- Identify the "GIS Champion" within each agency as noted above.
- Evaluate the business processes and security concerns.
- Document a roll-out plan with agency management and OIT.
- Implement the business process, with mentoring and skill development, monitoring success and adoption of the technology.

As part of the rollout process, each program within the agencies should obtain at least one copy of the Data Query application and associated personnel should receive training on the use of this software. Additionally, each program should have a formal introduction to data layers that could be of relevance to their activities. There is evidence from interviews conducted that personnel are not fully aware of all of the data layers that are provided by the enterprise GIS. This should be conducted as a training session, with summary documentation (which has already been developed by OIT) to reference in daily GIS use.

These training sessions should be specific to each program, focusing on data layers that could be of value to the associated activities. This would allow the agency to better utilize existing datasets, producing more benefits from existing resources.

Timeframe: Short-term (1 – 3 years)

Preliminary Cost/Benefit Analysis

Costs for introducing GIS to these agencies should be relatively insignificant and were not captured here.

The advantages to introducing GIS to each agency would be as follows:

- This will decentralize GIS support that is currently available, alleviating the dependency on the few resources available, both external and internal to the agency, and relax the level of effort expended by existing resources.

- Introducing this program will also increase the general awareness of GIS potential and reveal additional ways that GIS can support business processes.
- Redundancy of data compilation efforts would also be reduced, saving the County time and money.
- GIS will also provide time and money savings to the County by providing tools to decrease effort for map production and analysis.
- Additional spatial analysis will be available to personnel, allowing them to understand geographic phenomena not possible without GIS.

Recommendation

Agency management should designate a GIS Champion within each agency to coordinate GIS efforts with OIT and the agency management. This person should become familiar with the business processes within the agency and help management and OIT formulate an implementation plan for rolling out GIS to the agency. Training should be specific to the data and application needs of each activity.

5.5 Application Recommendations

5.5.1 Business Intelligence / Statistical Reporting

Overview

Currently, the County provides a custom application called Data Query that allows for basic GIS functionality, such as map compilation, data viewing, and basic querying, while simplifying the user interface for novice users. This application has served the basic needs of users throughout the County. However, there is a general need for an application that allows users to analyze data specific to their organization, in order to answer simple geographic questions.

An application should be developed to complement the existing Data Query application and allow users to query data specific to their business processes. This querying capability should include both spatial and attribute queries, so that users can ask questions such as:

- What councilmanic district is an address in?
- How many voters are within a precinct?
- How many developments have been built in the past ten years?
- How many robberies have occurred within five blocks of a house?
- How many picnic tables are there within a specific park facility?
- How many seniors are outside walking distance of mass transportation routes?

An interface should be developed that asks the user what type of data they are interested in and what type of question they would like to ask. This allows the tool to be robust, allowing for customization to questions specific to business processes, without significant upfront development costs.

This application would allow access to any centralized databases with a spatial component (i.e., addresses), including the Enterprise ArcSDE databases, CASS WORKS infrastructure management system, the Land Management System, and a Customer Relationship Management System.

Implementation

OIT should dedicate a full-time application developer to creating an application within ArcGIS or ArcGIS server that is user-friendly like the existing Data Query tools, is easily portable from one machine to another, and allows for customized queries to be developed on County data. This application should have the following components:

- A map display area where data can be viewed for the County.
- Easy to understand data referenced, i.e., Parcels as opposed to SimConFirstDiv.
- Ability to add external data sources and web services not provided by the County.
- A geocoding tool that allows a user to enter an address and create a point within the map at the location of the address.
- A simplified user interface, removing any superfluous tools from the map display.
- A query button, which starts the query tool.
- A reporting tool, which formats the outputs of queries for reports.

- A query tool, with drop-down menus that allow for a query to be easily created from existing data and associated attributes.
- A select tool that allows a user to select data and query information about this selection set
- Database linkages would have to be developed between enterprise spatial data and databases within the various management systems.

This application requires robust functionality to support translating information provided by a user interface into either SQL, an ESRI spatial query, or as a GML request. The application would then pass this standard information to a database management system or web service and then retrieve and display the information.

A training class should be offered for users to become accustomed to the application. Support should be offered by OIT for questions related to use of the application. OIT should work with the GIS Champions to determine the personnel that would benefit from the application, and agency management should promote training for the application and integration of the application into business processes.

Timeframe: Short-term (1 – 3 years)

Preliminary Cost/Benefit Analysis

The associated total costs for this implementation have been provided in Table 28 below. These associated costs are not a quote and should be used as an estimate only. Further formal analysis should be done to formulate an accurate cost/benefit assessment and an appropriate business case. Baltimore County should conduct a complete full business case to identify all estimated benefits within additional programs and across all agencies.

Potential Cost for Business Intelligence/ Statistical Query Tool	
Task	**Development Costs**
Requirements/ Design/ Testing	$27,000
Develop Application	$48,000
Total Costs	**$75,000**

Table 28 – Potential Cost for Business Intelligence/ Statistical Query Tool

The development costs include $27,000 allocated for designing the application, determining functionality requirements, and testing each version of the developed software. Development is estimated at 1,000 hours at $48.00 per hour, totaling $48,000 for all development costs and $75,000 for the entire application cost.

Benefits for developing and introducing this application include:

- Decreased training costs for users, since the simplified interface will allow for many processes to be implemented with only one tool.
- Greater integration of GIS in business processes, since tool will allow users to answer questions specific to business processes.
- The County will save time and money spent researching answers to questions that currently are investigated through a set of complex GIS queries or hardcopy maps.

Recommendation

A GIS tool to help with spatial queries would help users easily find solutions to problems specific to business processes, without having to introduce a custom application for each business process. This application should be developed by OIT. Agency management and the GIS Champions should work with OIT to have personnel trained on the application.

5.5.2 Activity Specific Applications

Overview

In general, GIS has been introduced into County agencies to handle ancillary issues of business processes, such as creating maps or to answer simple geographic questions such as geocoding; however, GIS has not been fully incorporated into business processes to handle more complex issues including providing spatial components to existing databases and offering solutions to unique spatial problems that cannot be met with Commercial Off The Shelf (COTS) GIS applications.

The County should work to develop small, activity- or program-specific applications that focus on the needs of individuals that cannot be met with COTS GIS applications. The functionality of these applications can vary, but a few examples include (see the individual agency chapters for a full list):

- **Disease Tracking and Reporting Tools** – A process could be developed whereby hospital emergency centers could provide their daily report on diseases in an electronic format and a tool could be created to automatically geocode the locations of the affected patients so spatial and epidemiological analyses would be easier, trends would be more evident, and any required reports would be easier to prepare.
- **Emergency Management Tools –** An emergency management toolset could be developed to show the locations of flood prone areas, topography, hospitals, other facilities, critical infrastructure, and evacuation routes, and help users locate the best sites for temporary shelters based on selected criteria, allow users to identify areas affected by an event, note locations of blocked or impassable roads, and identify areas in need of emergency water, ice, and other critical supplies.
- **GIS-Based Business Marketing Tools** – DED could make use of more sophisticated GIS-based marketing tools, including such features as fly-throughs and 3-D visualizations.
- **Automated Drainage Area Calculations** – Drainage area calculations could be automated in GIS through the use of ESRI's Spatial Analyst extension and/or use of the free statewide GIS Hydro application.
- **Parkland Accessibility** – An application could be developed to determine the accessibility that residents have to various types of park facilities, which could be used to assess what areas are in greater need of certain types of park services.
- **Trail Route Calculation** – An application could be developed that determines a best set of routes for a new trail to be located.
- **Emergency Operations Center Application** – An application could be developed to support Emergency Operations Center activities. This application could offer tools to perform geocoding; analyze properties impacted by flooding; model various bomb blast scenarios including number of buildings impacted and debris amounts; calculate estimated debris quantities for flood, hurricane, and tornado events; and help manage post-event activities by providing tools to allow the user to note the locations of obstacles, note which roads have been cleared of debris, etc.
- **Customized Emergency Vehicle GIS Tools** – For future consideration, when GIS- and GPS-enabled computers are placed in Emergency Vehicles, customized tools akin to Data Query but

specific to emergency management could be developed to make GIS use by emergency personnel easier.

- **Advanced Geostatistical Package –** An application could be provided that allows for advanced spatial analysis and statistical reporting that are needed by several of the agencies focusing on social issues with a geographic nature.
- **Redistricting Software –** An application could be incorporated that automatically creates new boundaries based on some input data, decreasing the amount of time spent manually updating these district features.
- **School Capacity Analysis Support** – Develop a customized application to automate the retrieval of current data regarding school capacity.
- **Create a Comprehensive Zoning Map Process (CZMP) Toolbar –** A toolbar could be developed to help OP with the CZMP process.
- **Footprint change detection** – An application could be developed that points out buildings that have been modified without the appropriate building permits, reducing PDM's reliance on public complaints.
- **Address range calculation** – An algorithm could be developed within GIS to assign address ranges to new streets based on the location of new streets in relation to existing streets.
- **Address Verification and Correction Software** – An address verification and correction software package could find and correct many of these errors associated with geocoding, reducing the time spent performing these geocoding activities.

Implementation

OIT should dedicate resources for application development, either by utilizing existing developer resources or by using contracted vendors for programming support. OIT should work with agency management and GIS Champions to prioritize application to be developed based on an understanding of business processes and potential benefits. A detailed cost/benefit analysis should be performed for each prioritized application and should be used to determine the feasibility and priority of development within OIT. This should be followed by the compilation of a business plan outlining the steps necessary to implement the application. This business plan should include:

- A detailed functionality requirements list.
- Implementation steps necessary to develop the tool.
- Data requirements.
- A versioning structure for a prototype application, as well as a beta version.
- Testing methodology to ensure that the application meets the functionality requirements.
- Training for the software.

Development should follow the implementation plan, with versions released according to the versioning structure. The GIS Champion and an OIT representative should be involved in application testing in order to build consensus that the application meets the needs of the business process.

Timeframe: Mid-term (4 – 5 years)

Preliminary Cost/Benefit Analysis

The cost associated with developing these applications will vary and have not been included. Baltimore County should conduct a complete full business case to identify all estimated benefits within additional programs and across all agencies.

Some general benefits from developing these applications can include:

- Integration of GIS with business processes, so that GIS helps tackle problems that current COTS applications cannot solve.
- The County could save time and money by reducing the amount of effort spent on repetitive tasks.
- Access to information not currently produced with COTS applications.

Recommendation

OIT should work with each agency to determine the software needs of individual business processes. Resources should be allocated to work on these applications in a prioritized manner. A formal business and implementation plan should be developed with application and training requirements, which should dictate the schedule in which applications are released and how individuals are educated on the new software.

5.5.3 Routing Application

Overview

There are currently many individuals within County agencies that perform field work or spend significant time traveling. These personnel would benefit greatly from having a routing application that would help determine directions to a location, optimally route vehicles to multiple destinations, and optimally assign routes to multiple vehicles.

Implementation

The street centerline dataset being developed by the 911 Center should be converted to a network representation, in order to allow for network calculations and routing algorithms to use this dataset. A data model will have to be developed that allows an address to be associated with a street segment and for an efficient network representation. Street network information from neighboring jurisdictions would need to be gathered and incorporated into the database.

A routing application would have to be acquired that can perform Traveling Salesperson Problems, Vehicle Routing Problems, and origin-destination route calculations. This application should be able to use custom data provided by the County, and preferably connects to ArcSDE databases. Future needs may require an application that can be placed on Personal Digital Assistants.

Timeframe: Mid-term (4 – 5 years)

Preliminary Cost/Benefit Analysis

The associated total costs for this implementation are provided in Table 29 below. These associated costs are not a quote and should be used as an estimate only. Further formal analysis should be done to formulate an accurate cost/benefit assessment and an appropriate business case.

Potential Cost for Routing System	
Task	**Development Costs**
Acquire Application	$50,000
Data Model Development	$25,000
Total Costs	**$75,000**

Table 29 – Potential Cost for Routing System

Routing applications can have a price range from $2,500 to $22,000 per site license. The total application cost will vary depending on the total number of licenses acquired. The cost above is only an estimate, based on an average cost of $10,000 per license for five (5) users.

Some general benefits from incorporating this application and data model can include:

- Savings in time and money spent traveling to destinations.
- Improved response times for emergency and other time-sensitive services.

Recommendation

The County should support an Enterprise routing system by incorporating a street network data model and acquiring a portable routing application. This system will decrease expenditures associated with travel and increase response times for time-sensitive services.

5.6 Technology Recommendations

5.6.1 Increase Network Speed

Overview

The wide area network used to connect the Public Safety Building to the enterprise ArcSDE database provided by OIT is cumbersome, preventing data from being used effectively. This connection should be increased to allow for faster communication between the Fire and Police Departments and OIT. This will allow for personnel to use the data services provided by the County (instead of performing data dumps periodically), as well as more easily edit and post data that has been created within the department.

Implementation

OIT should investigate the network speed and work with the agencies to develop an implementation plan and improve the connectivity.

Timeframe: Short-term (1 – 3 years)

Preliminary Cost/Benefit Analysis

Costs associated with this recommendation were not included.

The benefits of increasing the network speed include:

- Time spent managing data dumps will be saved.
- Increase in the accuracy of the data by providing Fire Department users up-to-date data.
- Improved collaboration between County agencies.