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S T A T E OF M A I N E

GIS Needs Assessment
& Requirements Analysis

And

Strategic Plan to Develop
The Maine Public Library
of Geographic Information

Applied Geographics, Inc.

In association with

CDM

And

GIS Mapping & Analysis, Inc.

Table of Contents

1 Needs Assessment/Requirements Analysis 5
1.1 Summary Findings from Needs Assessment Interviews 5
1.1.1 Multiple Statewide GIS Initiatives 5
1.1.2 Education & Technical Assistance 5
1.1.3 Needs for New Data 6
1.1.4 Efficiency of MeGIS as a Statewide Repository 6
1.1.5 Software Licensing & Hardware Issues 7
1.1.6 Application Issues 8
1.1.7 Funding 8
1.1.8 Summary of Unmet Data Layer Needs 8
1.1.9 Summary of Unmet Application Needs 9
1.2 The Survey Database 10
1.2.1 The Survey Methods 10
1.2.2 The Survey Results 11
1.3 Interview Write-ups 14
1.3.1 Interview Itemization 15
1.3.2 Full Project Contacts 17

2 Coordination & Implementation Plan 18
2.1 The Context: Opportunities and Challenges 19
2.1.1 Opportunities 19
2.1.2 Challenges 20
2.2 Proposal to Create an Expanded Statewide GIS and the Maine Public Library of GI 20
2.2.1 Pillar #1: Development of Detailed Data Standards 21
2.2.2 Pillar #2: Data Warehousing Infrastructure Improvements 23
2.2.3 Pillar #3: Additional Investment in Statewide Data Development 25
2.2.4 Pillar #4: Targeted Application Development 33
2.2.5 Pillar #5: A Program for Expanded GIS Education, Outreach and Coordination 37
2.3 Implementation Issues 39
2.3.1 Governance and The Maine Public Library of Geographic Information Board 39
2.3.2 Protection of privacy 40

3 Development Tracking 43
3.1 Overview 43
3.1.1 Development Tracking is an Integrated Subset of the Statewide Plan 43
3.2 Data Sources 44
3.2.1 Development May Be Described by Different Data Types 44
3.3 Development Tracking Implementation 53
3.3.1 Point Based System 53
3.3.2 Human & Technical Resource Requirements of Development Tracking 55
3.3.3 Pilot Application / Proof of Concept 57
3.3.4 Integrating Regulatory, Environmental and Demographic…Data 57
3.4 Advanced Development Tracking Applications 58
3.4.1 Fiscal Impact Analysis Tools 59
3.4.2 Buildout Analysis Applications 59
3.4.3 Scenario Generators 60
3.4.4 Comprehensive Planning Map Support applications 60
3.4.5 Environmental Impact Analysis 60
3.4.6 Economic Development / Growth Zone Targeting 60
3.5 Recommendations 61

4 Benefit Analysis 63
4.1 Overview of Benefits 63
4.1.1 Types of Benefits 63
4.1.2 Costs versus Benefits 65
4.2 Benefits of GIS by Constituency 66
4.2.1 State Benefits of GIS 66
4.2.2 Local benefits of GIS 69
4.2.3 Regional benefits of GIS 74
4.2.4 Benefits of GIS to Non Profit Organizations 76
4.2.5 Benefits of GIS to Other Stakeholders 77
4.2.6 Collaborative Benefits of GIS 78
4.3 Description of Benefits by Recommendations Made in the Coordination 81
4.4 Business Justification for Development of The Maine Public Library of GI 85
4.5 Summary 89

5 Funding Approach 90
5.1 Enumeration of Funding Possibilities 91
5.1.1 Funding Options across the Country 91
5.1.2 Potential funding vehicles available in Maine 95
5.2 Description of a Funding Approach for Maine 102
5.2.1 General description 102
5.2.2 Funding options by Project Component 103
5.2.3 Project Components associated with Funding Options 105
5.2.4 Recommended Funding Scenario 106

GLOSSARY

ATTACHMENTS **Section Reference**
A. Requested DataLayers List 1.1.8
B. Requested Applications, Services List 1.1.9
C. Resolve 23 GIS User Survey Form 1.2.1
D. Project Contacts List 1.3.2
E. March 2001 Remote Sensing Landcover Classification 2.2.3.2
F. Maine Public Library of Geographic Information Act Draft and Draft Bond Legislation 2.3.1
G. Electrical Connection Certification Form 3.3.1
H. Inventory of Growth Indicator Data Layers 3.3.3

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1 Needs Assessment/Requirements Analysis

What is needed…

1.1 Summary Findings from Needs Assessment Interviews

In order to fully understand the requirements for GIS from a broad number of stakeholders, this study commenced with a thorough and structured needs assessment interview process. The stakeholders interviewed included members of Maine state government, regional and municipal governments as well as the private sector and academic community. In total, over 65 individual interviews were conducted. This interview process was necessary to fully understand current GIS developments in Maine as well as the context for further development of the state's system.

Below, key findings from these interviews are summarized. These findings are grouped by finding type and were used to inform the development of the Coordination and Implementation Plan found in Section 2. These summaries aim to call out:

- Issues and problems that must be addressed
- The most intense unmet needs
- Factors that impact the context for statewide GIS expansion

The precise list of entities interviewed as well as a reference to the hundreds of pages of on-line, agency-by-agency summaries of need are found in Section 1.3.

1.1.1 Multiple Statewide GIS Initiatives

- Several organizations observed that Maine has multiple, significant GIS programs that tackle statewide data. The most significant of these at the state agency level include MeGIS (formerly State Office of GIS, or OGIS), DEP, DOT, DMR, DOC, DIF&W and PUC. Each of these is a strong, independent program and there is a high level of sophistication.
- These multiple entities share data and participate in some coordinating activities including the Maine GIS Executive Council. However, there remain some significant duplications of effort and data.
- There is no single source in Maine where one can obtain all of the best statewide data sets.
- Multiple participants observed that the current service level agreement funding mechanism of MeGIS hinders its ability to act as a strong statewide organization. It is difficult for MeGIS to exert authority, or even encourage collaboration and cooperation, when it is beholden to those it is trying to coordinate for funding support.

1.1.2 Education & Technical Assistance

- GIS is a common buzzword but many of those who stand to benefit by the technology don't know what it is. Many organizations have pursued GIS without

having clear objectives and expectations. Many groups had started initiatives but weren't sure what to do next.

- Numerous municipalities have GIS/automated data sets they are not taking advantage of. Multiple communities described having a "parcel composite" created in the 1990's that wasn't being used due to lack of knowledge about how to proceed.
- There is a huge need for education and outreach to help people understand and get people ready to begin GIS deployment. Common topics of suggested educational outreach included: cost and benefit information; instruction in data types and accuracies; surveys of GIS application availability; and, basic software use.

1.1.3 Needs for New Data

- The need for parcel data was widespread across all constituencies that were interviewed. People either wanted to create parcel composites or they had parcel composites that they were unable to use due to format (e.g. CAD) or inability to link with assessor's attribute information.
- Interest in aerial photos/imagery was widespread.
- Numerous municipalities mentioned an interest in school district data sets. These people were unaware of MeGIS school district data sets (see section 1.1.4, first bullet below)
- Multiple municipalities raised concerns about parcel updating going forward, even/especially when parcels exist digitally.
- Multiple parties mentioned that uniform statewide standards would help address problems that they faced. There was widespread frustration with handling parcel composites from multiple towns due to overlap issues at political boundaries, or having the data stored in different formats (e.g. CAD vs. GIS, different coordinate system, etc.). Many parties - especially state agencies and regional entities - were interested in assembling multi-town parcel composites to perform regional mapping and analysis.

1.1.4 Efficiency of MeGIS as a Statewide Repository

- Lots of people were unaware of how much data is available from MeGIS. Multiple participants mentioned interest in data that was available from MeGIS. There should be further active outreach and education to help people understand the importance and value of this resource (see 1.1.3, third bullet above).
- People mentioned operational issues in terms of getting data from MeGIS efficiently, in spite of MeGIS data availability via the web. Issues included:
    - MeGIS tiling system is cumbersome to deal with and requires significant post processing by data recipients to create locally seamless data.

- MeGIS data often needed to have coordinate transformations performed to be useful with locally developed data sets (i.e. ME State Plane data vs. MeGIS UTM)
- Many parties had slow Internet connections that hindered their ability to download what they wanted/needed.
- People reported a major annoyance with the current overlap between ortho images. This issue could be eliminated with some basic post-processing of the ortho images by MeGIS.
- People reported a significant “download overwrite” problem. This problem emanates from the fact that multiple files covering different areas have the same name on the MeGIS site. Hence when two of these files are downloaded, one overwrites the other. This could easily be addressed with some basic file naming adjustments.

- Multiple parties raised concerns about the lack of a "one-stop" location for getting all state GIS data. Currently, one might have to make requests to MeGIS, DEP, DOT and several others to get all relevant data sets for a region. This uses the requesters time, and it also implies that multiple state personnel are performing a duplicative data distribution task (see above). Simply put, why should MeGIS and DEP both need to distribute data? Why should a COG need to get data from multiple state agencies?
- Multiple parties described their own operational issues with sharing GIS data sets. It was suggested that MeGIS could potentially sponsor an accessible Web or FTP site where individual communities and/or Regional Councils could post data for others to obtain.

1.1.5 Software Licensing & Hardware Issues

- Interviews identified very large quantities of ESRI® software licenses. At first glance, these quantities appear more than adequate, especially with the need for desktop access to GIS potentially diminishing with increased use of Internet Map Servers (IMS) and web applications. Issues of transitioning to new ESRI® technologies, and replacing old applications with new architectures (e.g. Citrix® vs. IMS) will be cause for further reevaluation of Maine's licensing structure.
- At the same time, many local and regional entities complained about lack of access to GIS software, especially some of ESRI®'s higher-end tools such as ArcInfo®/ArcGIS™. The State could consider creating a pool of licenses that could be shared with local governments on a check-in/check-out basis, potentially distributed via Citrix®.
- Multiple participants mentioned that group purchasing of hardware and software would be beneficial. The State should investigate creating a “state blanket” mechanism for ESRI® software purchases, and potentially for peripheral equipment.
- Lack of large format plotting often mentioned as an issue.

- Internet connectivity is not necessarily high-bandwidth. While slower bandwidth may be manageable for web-based applications, it can be fatal for tasks such as downloading multiple orthophoto images. Many towns mentioned difficulties downloading MeGIS data because of slow speeds. This issue should be tracked and if municipalities are unable to address it, the state could potentially consider a program to facilitate bandwidth improvements.

1.1.6 Application Issues

- There was strong support for web-based applications
- Given difficulties in obtaining software or securing adequate training to make good use of existing software, it was suggested that consideration be given to MeGIS providing a "packaged" web-based viewing application and/or a desktop GIS viewer. This application could be provided to communities to help jump start GIS activity. If MeGIS hosted an application with baseline GIS functionality (e.g. find an address, zoom and pan, basic layer manipulation, list basic attributes), multiple municipalities could be provided an affordable entry point into GIS. The minimal investment would be the cost of creating (or adapting an existing data set into) a standards compliant parcel composite.

1.1.7 Funding

- The Portland Water District mentioned that they could potentially support co-funding some data development projects. Project of interest to this type of utility might include new orthophoto imagery and parcel composites for its service territories. This type of collaborative funding could be explored more broadly with other utilities.

1.1.8 Summary of Unmet Data Layer Needs

As part of the interviews and surveys conducted in this study, GIS users of all levels were asked to identify data layers that would most benefit their operations, yet which were not immediately available to them. More than 100 such data layers were identified. A small number of these are in fact available currently through the MeGIS data distribution system, but users were unaware of this or unable to access them. Among the layers that are not presently available, the most requested were property parcels, roads combining class information with address ranges, land use/land cover that accurately describing land utilization types, water and sewer utilities, zoning, conservation lands, and contours.

The table on the following page presents this data layer prioritization, itemized by the types of organizations that requested the data layers. The table sorts individual layers by the number of times they were requested during the interview and survey process. This number is indicated in the column in the extreme right-hand column.

Maine SPO Resolve 23 REQUESTED DATALAYERS LIST 1/24/2002 Highest Priority Layers Priority Layers Layer Name and Description	Towns and Cities	Maine Counties, Regional Agencies, Tribal Councils and Land Trusts	Maine State Agencies	Utilities	Educators	Federal Agencies, National Organizations	Private Companies and Consultants	Rating
PARCELS with Attribute Data	11	5	5	3			1	25
ROADS E-911 and DOT Data from MeGIS as combined layer	10	6	4			1		21
LAND USE Coverage/Data	4	3	5		1	1		14
UTILITIES Data Layers (water and sewer systems)	5	2	1	2				10
ZONING data, with standardized attributes	2	2	4	1			1	10
MeGIS Base Data (available through periodic, dependable updates)	2		3	1		2		8
Shoreland Zoning Data and Overlays	3	2	2				1	8
CONSERVATION Lands, Protected Open Space	3		3					6
CONTOURS (10' or better, including surrounding communities)	4	1	1					6
WATER Distribution System Data	4	2						6
ORTHOPHOTOS (digital)	1	1	3					5
School District Boundaries	4		1					5
Sewer and Drainage System Data	2	1	2					5
Endangered Species Locations	2	1	1					4
Digital Elevation Model Statewide	1		2					3
Growth Areas		2	1					3
Hydrography (Enhanced Streams)	1		2					3
Soils			3					3
Watershed Boundaries			2	1				3
Wetlands (higher quality than NWI)		1	2					3
County & Municipal Boundaries (no shorelines)		1	1					2
Deer Habitats	2							2
Demographics Data (Census or other)		1	1					2
Fish and Wildlife Data		2						2
Floodplain/Flood Hazard Data			2					2
ROW for Planning & Analysis				2				2
Septic System Locations	1		1					2
Slopes	1		1					2
Transportation Networks	1		1					2

Table 1-1: MOST REQUESTED DATALAYERS

Please note that the Private Companies and Consultants responses are limited due to the relatively low number interviewed and the fact that several of those contacted are more active producers of spatial data than consumers of them.

The full list of these data requests is included as **Attachment A.**

1.1.9 Summary of Unmet Application Needs

The interview and survey process also included questions about desired GIS and GIS-related applications. These varied widely, and again, included some that are presently being delivered by MeGIS and other agencies.

Among the most desired, there was a strong correlation with the requested data layers list. These include a consolidated E911 and classed DOT roads viewer, parcel viewer with abutters identification and notification tool, and an application to land use and aerial photography data.

There were also frequent requests for tools to manage GIS data, including a standard, statewide metadata management application that would quickly bring data sets into

compliance with the MeGIS and Federal Geographic Data Committee (FGDC) requirements.

Applications were organized into the following categories:

- **Data Management Tools.** These included applications to be used for organizing and integrating spatial data with the overall Maine GIS environment. They would be utilized for validating the quality of spatial data, indexing and cataloging data that exists, and assisting in the creation of specifications for contracting GIS work.
- **Data Viewers.** Generally these correspond to layer-specific requests for access to data. Some viewers, such as a tool for viewing information about specific Maine lakes or visualizing public water supply data are already available to the general public over the Web (see Attachment B). Many others, ranging from statewide orthophoto and wetlands viewers to insect infestation monitoring tools will require enhancements to underlying data before they are actualized.
- **Simple Analytical Tools.** More sophisticated than simple data viewers, this category of tools involves proximity or multi-layered analysis of spatial data. They include such applications as Census data analysis and property parcel abutter notification tools.
- **Complex Analytical Tools.** More sophisticated still are applications bringing large numbers of data layers and other tabular information sources together to perform analysis on land use and complicated infrastructure systems. This category includes such applications as buildout analysis and impervious surface modeling tools.
- **Integrated Hardware and Software Solutions.** Applications that involve real time vehicle location tracking and full integration of global positioning system data were also identified.

The full list of these data requests is included as **Attachment B**.

1.2 The Survey Database

1.2.1 The Survey Methods

In close collaboration with the Steering Committee, an 83-question survey was prepared as a vehicle for quickly assembling information on GIS requirements from a wide group of Maine GIS stakeholders. Distribution of the survey to Maine GIS users began in October, 2001. The survey was designed as both an accompaniment and complement to the personal interviews conducted as part of this project. Almost all interviewees filled out the survey as did many other entities that were not interviewed personally or by telephone. The survey was handed out in hard copy format at the Maine Municipal Association annual meeting as a means of obtaining the most possible feedback from as many cities and towns as possible. The results from hard copies that were returned were entered into an MS-Access database by MeGIS staff. In addition, the survey was placed

on-line on the Internet through the MeGIS web-site. On-line entries were automatically entered into the database, which was configured so as to enable thematic mapping of its contents.

This database remains active and respondents continue to add data. It may be accessed through the MeGIS Website at: http://apollo.ogis.state.me.us/sc/survey/scsurvey.asp .

The following categories of questions were asked and answered in the survey:

- Section 1: **General contact information**. This includes email and mail addresses to potentially be used for future contact and GIS community building.
- Section 2: **Issues that could be better addressed** in the respondent's community. Asks the respondent to prioritize on a scale of 1 – 5 which general issues (that GIS is traditionally useful in addressing) they would like to be able to do better.
- Section 3: **Existing GIS activity.** Asks specific questions about GIS use and familiarity.
- Section 4. **Technology infrastructure.** Addresses the software and network environment of respondents' geographic information systems.
- Section 5. **Data sharing and exchange.** Determines how GIS and other digital data moves in and out of the organization.
- Section 6: **Potential for state/regional assistance in GIS development.** Determines what funding, training or support roles that state or regional organizations could play in facilitating future GIS growth.
- Section 7: **General comments and ideas.** Solicits free form input from respondents regarding their experiences with GIS and what they feel could be done better.

A complete version of the survey is included in this report as **Attachment C**.

1.2.2 The Survey Results

1.2.2.1 Relevant facts gleaned from the survey

Responses to the survey were both filled out online and submitted in hardcopy to the Maine Office of GIS where their contents were entered into the database. Summary findings are drawn from analysis of the 83 questions on that survey. While the survey remains online and active, totals tabulated for this report were collected through January 22, 2002.

Responses at the time of this final tally totaled 234. Respondents were predominantly municipal officials, although entries were generated from all levels of government and the private sector. Municipal entries arrived from town managers (n=37), assessors and assistant assessors (n=22), selectmen, code enforcement officers, and clerks. Entries from other sectors included land trust directors, environmental scientists, librarians, company presidents and IT managers, epidemiologists and educators.

- There was wide familiarity with GIS, but it was not universal.
- Almost all were operating within the Microsoft Windows environment, though more than a dozen reported using GIS under a UNIX operating system.
- ESRI® software was ubiquitous, but additional entries included Autodesk (n = 6) and MapInfo (n = 4).
- Of respondents answering questions about speed of access to the Internet,
    - 21 reported T1 (> 1 Mbit/second) access
    - 17 reported DSL
    - 8 reported ISDN
    - More than 35 reported 56K or slower Dial up.
- Answers to questions about pressing issues that GIS could be used to solve are summarized in the following table:

GIS is a useful tool in addressing all of the following issues. Which of these issues do you feel could be better addressed in your community?	RESPONSE (n = 234)
Create and reproduce maps, that include information on aerial photographic imagery, zoning, topography, sewer and water lines, wetlands, etc.	66.3%
Update and reproduce tax maps, zoning maps and land use maps	63.9%
Provide detailed planning for efficient and sound land development	59.0%
Select optimal sites for locating businesses and other facilities	57.9%
Advance economic development	57.5%
Map road conditions and maintenance priorities	57.5%
Track and model the quality of ground and surface water	52.1%
Auotmate identification of abutters and addressing of envelopes for abutter notifications	52.1%
Track and manage residential and commercial growth	51.7%
Provide citizens with remote access to local government information	51.1%
Provide property maps quickly to tax payers and real estate professionals	51.0%
Dispatch and route emergency vehicles	49.8%
Track active building and septic system permits to aid in inspections	48.7%
Optimize preservation of farmlands	45.8%
Track depletion and recovery patterns of fisheries, forests, and soil erosion	44.5%
Track and model the spread of pollutants or destructive biological agents	43.6%
Optimize delivery of rural health and medical services	43.3%
Locate sites for telecommunication towers and cell phone facilities	42.6%
Identify hazardous waste sites and map brownfields	42.6%
Track and map buildings with fire code violations	42.6%
Map and analyze crime patterns	42.4%
Graphically identify locations of properties with tax liens by year	42.0%
Map the territories of animal and plant species	41.7%
Evaluate sites for waste disposal	38.5%
Evenly distribute classload burdens among schools and increase efficiency of school bus routing	37.4%
Track down power outage locations	36.9%
Provide asset management that could address GASB-34 requirements	36.8%

Table 1-2: SURVEY RESULTS: ISSUES

- Similarly, aggregated responses to questions about funding and state or regional assistance questions are included below:

What types of "state and/or regional" sponsored GIS support would be most valuable to your community/agency?	RESPONSE (n = 234)
Free GIS software	62.2%
Technical assistance	62.0%
Training opportunities	62.0%
Educational events and seminars	60.8%
Facilitated data distribution/sharing	59.9%
Sharing resources to support GIS data distribution & applications	57.0%
Facilitated group/blanket purchasing of equipment/software	54.8%
Creation of regional GIS service centers	52.0%
Development/promulgation of GIS standards	51.8%
Web-site hosting	48.3%
Cash/matching support >$10,000/town	40.3%
Cash/matching support of $5,000 - $10,000/town	40.1%
Cash/matching support of <$5,000/town	35.2%

Table 1-2: SURVEY RESULTS: ASSISTANCE

The fact that these response data are collected in a digital database facilitates mapping of trends. A sample of this is included below:

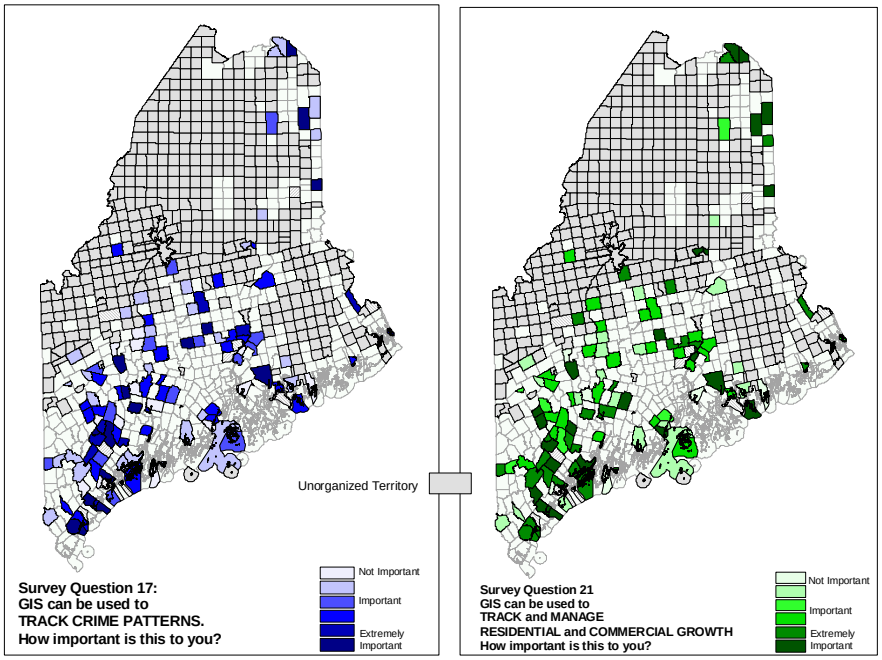

Figure 1-1: SURVEY RESULTS: CRIME & GROWTH

The complete database associated with this survey is included on a compact disk that will be made available through MeGIS. An ArcView® project file and necessary geographic data to graphically depict survey results are also included on this CD. Tabular data will be accessible with Microsoft Access, Excel or compliant software. Geographic data will require GIS software for viewing.

1.2.2.2 Maps showing entities in Maine that were contacted

The following pair of maps describes respondents' answers to questions relating to their familiarity and use of GIS. In the first it is apparent that the vast majority of municipal jurisdictions contacted had some familiarity with this technology. The second visually describes that far fewer are currently using this technology.

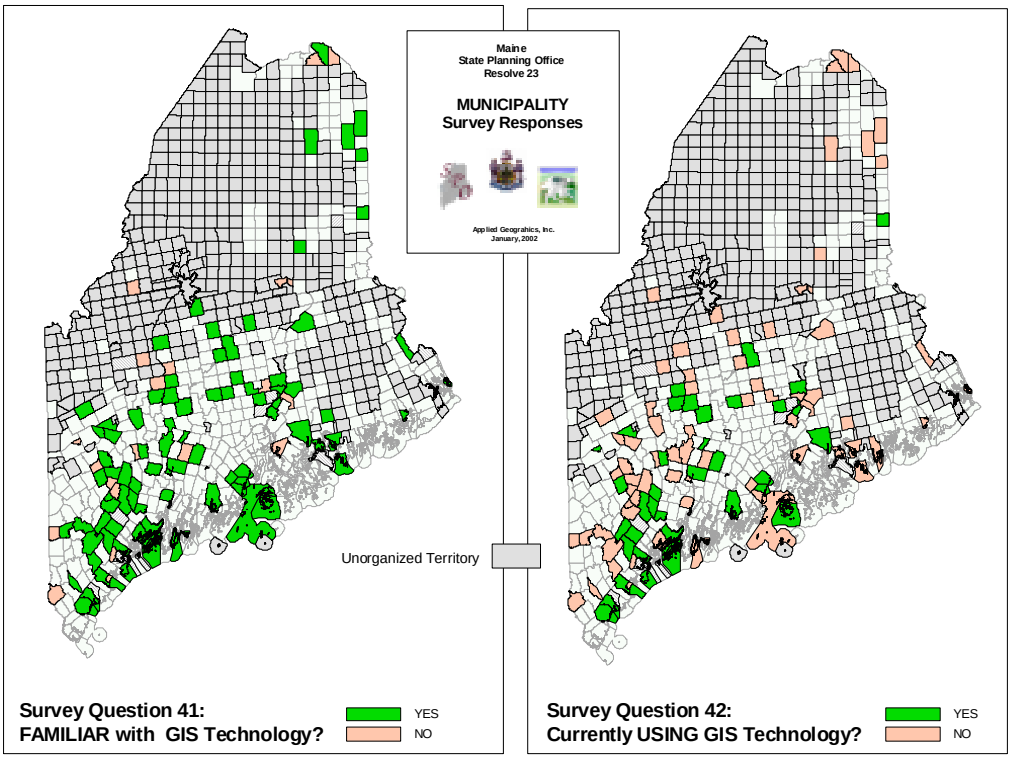

Figure 1-1: SURVEY RESULTS: GIS USE

1.3 Interview Write-ups

Nearly one hundred entities in seven different categories were interviewed either by phone or in person as part of the Maine Resolve 23 Needs Assessment. In most cases these involved site visits and observations of current working environments as well as demonstrations of applied technology. Duration of interviews typically lasted 1-3 hours, while some extended far longer and were even conducted over multiple days.

Detailed write-ups of these interviews typically include brief functional and GIS overviews, itemization of GIS data and resources, GIS applications currently being used or needed, planned GIS activities and most observable benefits of GIS within the organization or agency. Since the summaries of these interviews together total hundreds of pages of text, for purposes of economy these have been included in digital Adobe Portable Document Format (.pdf) as part of a compact disk that will be available from MeGIS. Additionally, they are available on-line at:

http://www.appgeo.com/clients/maine/

1.3.1 Interview Itemization

Interviews included the following:

Maine Towns and Cities

Arundel	Fort Fairfield	Saco
Bangor	Hampden	Sanford
Bar Harbor	Houlton	Skowhegan
Calais	Kennebunk	Waldoboro
Camden	Lewiston	Waterville
Carrabasset Valley	New Gloucester	Winthrop
Dover-Foxcroft	Oakland	
Ellsworth	Portland	

Maine Counties, Regional Agencies, Tribal Councils and Land Trusts

Androscoggin Valley Council of Governments
Eastern Maine Development Corporation
Land Trusts & Non-Profit Private Conservation Groups (focus group), including:
- Coastal Mountains Land Trust
- Freeport Conservation Trust
- Frenchman Bay Conservancy
- Lakes Environmenal Association
- Maine Audubon Society
- Maine Coast Heritage Trust
- Sheepscot Valley Conservation Association

Greater Portland Council of Governments
Hancock County Planning Commission
Island Institute
Kennebec Valley Council of Governments
Lincoln County Commissioner
Northern Maine Development Commission
Southern Maine Regional Planning Commission
Penobscot Indian Nation
York County EMA

Maine State Agencies
Department of Agriculture
Department of Conservation
Department of Defense, Veterans & Emergency Management
Department of Education
Department of Environmental Protection
Department of Human Services (Bureau of Health)
Department of Inland Fisheries and Wildlife
Department of Marine Resources
Department of Transportation
Economic Development (Focus Group), including:
- Department of Economic and Community Development
- Department of Labor
- Maine and Company
- Maine State Housing Authority
- Finance Authority of Maine
- Maine State Chamber of Commerce

Maine Historic Preservation Commission
Maine Office of Geographic Information Systems
Maine Public Utilities Commission
Maine State Archives
Maine State Chief Information Officer
Maine State Planning Office

Utilities
Portland Water District
Central Maine Power
Bangor Hydro
Utilities (Focus Group) including:
- Adelphia
- Maine Natural Gas
- Maine Public Service Company
- Portland Natural Gas Transmission Company
- Portland Pipe Line Corporation
- Verizon

Water Utilities & Sewer Districts (Focus Group), including:
- Augusta Water District
- Kennebunkport and Wells Water District
- Maine Rural Water Association
- Paris Utility District
- Portland Water District
- Winthrop Utilities District

Private Companies and Consultants
Engineers and Surveyors (focus group) including:

City of Portland Department of Public Works
Duke Engineering & Services
Maine Department of Transporation
Sebago Technics
Woodlot Alternatives

Realtors and Appraisers (focus group) including:
Central Maine Title Company
Verill & Dana LLP
Associated Builders & Contractors, Inc., Downeast Maine Chapter
Home Builders & Remodelers Association of Maine

James W. Sewall, Company
Plumb Creek Timber Company

Educators

Universities and Colleges (focus group) including:
Bates
Bowdoin
Unity College
University of Southern Maine
University of Maine at Farmington
Colby

University of Maine at Orono

Federal Agencies and National Organizations

Federal Emergency Management Agency
National Park Service: Acadia National Park
National Oceanic and Atmospheric Administration
US Fish and Wildlife Service
US Department of Agriculture, Natural Resources Conservation Services
US Geological Survey, National Mapping Program

1.3.2 Full Project Contacts

In addition to the formal interviews, a large amount of information was collected as part of conversations and electronic correspondence with GIS stakeholders elsewhere in the public and private sector. All told, input from more than 400 individuals was received during the course of data collection for this project. The complete list of contacts is included as **Attachment D.**

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2 Coordination & Implementation Plan

What is proposed to meet these needs…

2.1 The Context: Opportunities and Challenges

The Coordination and Implementation Planning approach was informed by examining the existing GIS conditions in Maine. Based on the research conducted in the GIS Needs Assessment and Requirements Analysis (see Section 1), several opportunities and challenges become apparent:

2.1.1 Opportunities

- **Robust GIS data sets exist for the state:** Maine has been pursuing GIS for over a decade and as a result there is a rich, basic infrastructure of existing statewide data sets. Due to these existing resources it will be possible to move Maine forward much more quickly than would otherwise be possible. In addition, these data sets have helped increase the general level of GIS literacy throughout state government, and beyond.
- **Wide state government use of GIS:** Numerous state agencies are effectively using GIS technology on a day-to-day basis. Again, this indicates a high degree of GIS literacy and implies that state government already has much of the expertise necessary to advance the GIS program "to the next level".
- **MeGIS provides an excellent baseline for a statewide GIS program:** The MeGIS program already functions to a large extent as a statewide GIS. While there are undoubtedly some flaws in the current operation and great opportunities for advancement, there is already a successful organization in place. Notably, MeGIS has been proactive and innovative in making its data sets available to the public on the World Wide Web. The fact that MeGIS exists and only needs some tuning, gives Maine a good head start at fulfilling its statewide GIS ambitions.
- **Extremely wide interest in GIS throughout Maine municipalities:** During the extensive interviewing conducted as part of this project there was extremely wide interest in municipalities gaining access to these technologies. It is clear, there is wide support in the field for this type of initiative, and particularly for state support of local/regional efforts.
- **Maine has shown a successful commitment to statewide technology investments:** Maine has a long history of supporting technology investments at the state level. It is clear that the state maintains an excellent foundation for undertaking this type of initiative through both the CIO and BIS offices. The state's innovative InforMe legislation and fine statewide web site are indicative of these efforts. Recently the Center for Digital Government ranked Maine 5th nationwide in effective use of information technology in government during their annual survey of the states.

2.1.2 Challenges

- **Unclear funding picture for going to the "next level":** The largest challenge that Maine currently faces is the lack of a clear long term funding picture for advancing the statewide GIS. Clearly, working with the Governor, the Cabinet and the Legislature to secure this funding will need to be a key priority.
- **Protection of privacy:** Many elements of the proposed plan will create and more widely disseminate very detailed information about Maine. This includes data on property ownership and land utilization. In light of general concerns about maintaining web privacy and further homeland security concerns, protection of privacy will need to be addressed without undermining the intent of freedom of information statutes. Privacy concerns are addressed specifically in the plan presented below.
- **Some inter-state agency duplication and lack of coordination:** Given that Maine has multiple, significant but only loosely coordinated GIS efforts there remains some duplication of effort and data redundancy. Given proprietary programmatic interests and long histories among these independent GIS programs issues of asserting increased coordination will need to be handled sensitively and with the goal of achieving consensus. This was recognized by the Legislature and has been partially addressed through the inclusion of two members of the state GIS Executive Council on the Steering Committee overseeing the creation of this report.
- **Wide divergence in sophistication of municipal government throughout Maine:** There is a wide continuum of sophistication and technical expertise among Maine's nearly 500 municipalities. This program cannot proscribe a "one-size-fits-all" program for providing technical assistance to these varied municipalities. As such, the program needs to be crafted carefully so that it provides assistance and benefit to GIS newcomers as well as to long-term GIS users, such as the City of Portland, alike.

2.2 Proposal to Create an Expanded Statewide GIS and the Maine Public Library of Geographic Information

Through Resolve 23, the Legislature requested that a plan for expanding the statewide GIS capability be put in place. To oversee this process the Legislature created a GIS Steering Committee (see frontispiece of this document for a listing of Steering Committee members and their affiliations). Working with state staff and outside consultants the Steering Committee has formulated a multi-element Coordination & Implementation Plan for achieving a higher degree statewide GIS activity, coordination, capability and efficiency. The following presents that plan. This plan aims to address the needs that were discovered and outlined in the Needs Assessment & Requirements Analysis (see Section 1) while considering the opportunities and challenges that are cataloged above.

This plan is anchored by taking action in five separate areas as illustrated by the figure below:

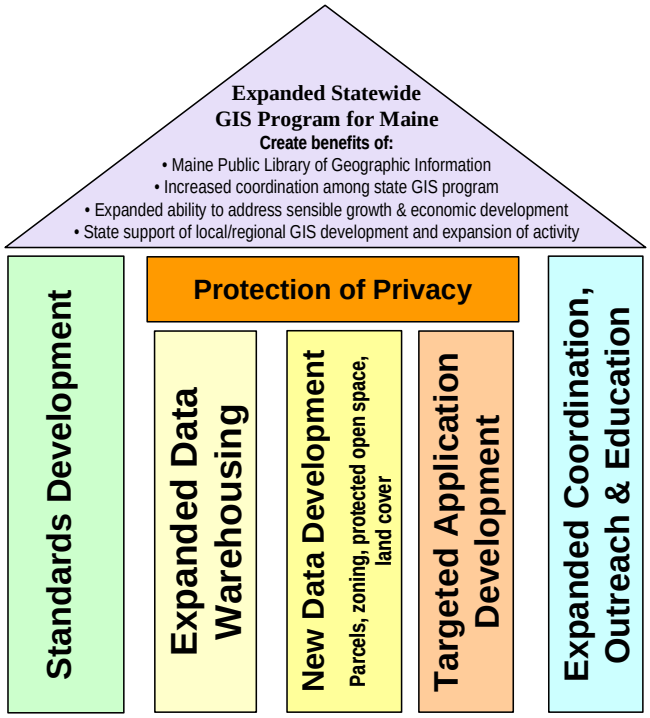

Figure 2-2: Maine Public Library of Geographic Information: Foundation Pillars

The hallmark of this plan is the creation of a new entity called the Maine Public Library of Geographic Information (hereafter, GeoLibrary). This new entity will be built on the foundation of advancements made in the five separate areas represented by the pillars of the diagram above. The following describes the proposed activities within each pillar in detail.

2.2.1 Pillar #1: Development of Detailed Data Standards

While individual departmental GIS programs as well as MeGIS currently implement GIS standards to varying degrees, additional overall standards development must proceed. The newer standards should expand on existing MeGIS standards and should include both the basic GIS technical specifications (e.g. topologies, clean linework, attributes, etc.) as well as detailed *data layer specific* content standards for important new data sets – such as parcels, open space and land use - that are proposed to be developed (see section 2.2.3 below). These types of expanded standards are absolutely essential of new statewide data layers are to be developed from the myriad efforts of multiple participants. For example, it is contemplated that a statewide parcel data layer will be created over time by the combined efforts all of Maine's individual municipalities. Standards can be

envisioned as the glue that holds these individual efforts together to make them useful at both regional and statewide levels.

Standards will not be nearly as valuable unless there is a firm commitment by the state to **enforce** them. Data created by municipalities must be *tested* to ensure that they conform to the new standards. Ultimately software tools should be created to execute these tests and validate data compliance with these standards. The initial standards document will provide the initial design specification for such validation tools.

Development of these new standards should be pursued as a distinct project under the direction of the proposed GeoLibrary Board (see section 2.3.1 below). It should not be necessary to initiate these activities "from scratch". As described above, Maine already has a start with data standards. In addition, there is a wide body of existing and emerging standards literature from both the federal government and other states involved in statewide GIS. Of particular note:

- **Federal Geographic Data Committee (FGDC):** The FGDC has developed and promoted standards work in a wide number of areas[1]. Of particular note is their widely adopted standard on metadata creation and management.
- **Spatial Data Standard for Facilities, Infrastructure & Environment (SDSFIE):** The National Committee for Information Technology Standards (NCITS) recently adopted this standard as NCITS 353. This standard is robust and comprehensive – including a section on cadastral information - and based on an existing military standard that is already deployed[2]. It is expected that in the wake of the September 11th events that this standard will see increased deployment as numerous entities recognize the importance of being able to "roll up" local data sets into regional views as a tool for addressing issues of homeland security. Maine should strongly consider adopting standards that are consistent with this federal standard.
- **Existing Parcel Data Standards:** Both Wisconsin[3] and Massachusetts[4] have existing parcel data standards that could provide useful reference and guidance for Maine. Similarly, other states may have parcel standards as well as standards for other key data sets such as protected open space or land use/cover.
- **Open GIS Consortium[5] (OGC) Standards:** OGC is actively engaged in creating and fostering both technical data format standards. This body of standards should be referenced prior to adoption Maine-specific standards. In addition, OCG has, or is developing relevant standards for application issues, including standards for geographic object modeling, web map rendering and web services.

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[1] See http://www.fgdc.gov/standards/standards.html for a summary of FGDC standards work.

[2] See http://tsc.wes.army.mil/products/TSSDS-TSFMS/tssds/html/ for further information on SDSFIE.

[3] See http://www.wlia.org/standards.html for further information on Wisconsin standards efforts

[4] See http://www.state.ma.us/mgis/muniparc.htm for further information.

[5] See http://www.opengis.org/ for further information.

2.2.2 Pillar #2: Data Warehousing Infrastructure Improvements

It is essential that Maine begin the exercise of collecting ***all*** of its best spatial digital information and then placing it in a location where it is readily available to all agencies as well as to important collaborators and even the general public. This is the essential notion behind the GeoLibrary. In addition, Maine is also hoping to reach out beyond state government and collect important digital spatial data – such as parcels and zoning - from municipalities and regional entities. Certainly those local data sets created with the use of state supplied funds ought to find their way into the central library.

MeGIS currently maintains the beginnings of such a library, also known as a spatial data warehouse. However, the existing data warehouse does **not** have all of the state's best data, much less all data from collaborators and/or fund recipients. In recognition of the fact that as Maine's statewide GIS capacity is expanded additional demands will be placed on the existing data warehousing infrastructure it is essential that Maine plan on improving this infrastructure and planning for staff to handle considerably more data transaction volume. These investments in 21st century "information infrastructure" mimic the 19th and 20th century investments in rail and road infrastructures. The following describes the key initiatives in this area:

2.2.2.1 MeGIS Data Warehousing Improvements

Creation of a stable, high-capacity data warehousing environment is essential for the broader statewide data and data serving initiatives implied by the GeoLibrary. Several areas that must be addressed, include:

- Adding a new staff position for addressing the increased technology of the infrastructure improvements outlined below as well as the increased volume of data transaction implied by increased activity. This new staff person is included in the overall budget presented in Section 5, and is discussed further in sub-section 2.2.5.1 below.
- Planning and consideration of whether the existing ArcSDE™ data warehouse environment should be supplemented by an RDBMS server such as Oracle® Spatial. Tools such as Oracle® Spatial could potentially increase performance and open alternative possibilities for application serving.
- Optimizing the configuration of the ESRI® ArcSDE™ environment. Data warehousing environments involve complex technology and the performance of that technology is the result of careful testing and tuning. It is critical that MeGIS plan on structured optimization and tuning of its data warehousing environment(s).
- In addition to decisions about the underlying technologies (i.e. ArcSDE™ and potentially Oracle® Spatial), MeGIS has choices on the data format(s) with which to warehouse its spatial data. For example, ArcSDE™ supports both generic "SDE layers" and a deployment of ESRI®'s Geodatabase (GeoDB). Development of a complete database design for the data warehouse environment must accompany the optimization and tuning described above. Innovative

existing work using these technologie, such as that being pursued by the DEP, may provide useful models for incorporating into the GeoLibrary.

- All existing MeGIS data sets should be loaded into the data warehousing environment with appropriate metadata. Unlike the present configuration, all data should be stored **seamlessly** on a statewide basis and in a uniform coordinate/projection scheme. In addition, MeGIS staff must ***actively*** work with other departmental GIS initiatives (e.g. DEP, DOT, PUC, IF&W, etc.) to ensure that all the best departmental data is also collected and stored in the GeoLibrary.
- Once the data warehouse is established, the MeGIS staff and the GeoLibrary Board must work on a set of policies and procedures for updating data within the data warehouse. These policies and procedures must cover both technical and administrative/political elements of updating activity, including but not limited to:
  - Assignment of responsible parties (i.e. which departments have responsibility for which layers)
  - Agreement on appropriate timetables for data update cycles
  - Determination of appropriate technologies (e.g. *in situ* updating vs. update outside of warehouse and re-load of updated information)
  - Data standards validation routines to ensure that only data meeting the statewide standards are loaded into the library

2.2.2.2 Evaluate Application Delivery Infrastructure

MeGIS, DEP and others have had extensive experience developing applications using a variety of ESRI®'s tools including ArcView® (Avenue), ArcInfo® (often delivered via Citrix® "terminal emulation") and ArcIMS™. These applications have been developed over time and with varying degrees of success. Many of these applications – particularly some of the older ones - might be more effectively delivered using other technologies (i.e. some Citrix® applications could be done more easily with ArcIMS™). As a result detailed analysis and potentially a plan of upgrade for application delivery should be considered. Key questions include:

- Once the GeoLibrary is in place some/many applications may need to be adjusted to point at the new data warehouse as the fundamental data source, that will deliver the must current, and standards conformant data sets.
- MeGIS and application sponsoring agencies should carefully evaluate existing application architectures to determine opportunities for improvement.
- The GeoLibrary should consider the development of a generic "web services framework" for enabling application development by third parties that can use the GeoLibrary as a data source (see section 2.2.4 below)
- New and existing applications must be carefully designed/optimized for stability and good performance in light of potential increased activity that may arise due to the development of the GeoLibrary. In short, creating the library and the outreach that will accompany the creation of the library may increase the utilization of applications requiring them to be more robust.

2.2.2.3 Internet Bandwidth Infrastructure Improvements

A key component of encouraging data warehousing is ensuring that the people who require access to the data warehouse can obtain that access with appropriate bandwidth. The GeoLibrary will not be successful unless people can get to it with good reliability and performance. MeGIS, BIS and the GeoLibrary Board should evaluate the overall networking environment between state agencies, and between the state and the Internet (where 3rd party collaborators such as municipalities will gain their access to the warehouse) to ensure that there is adequate capacity for the intended purposes. It should be noted that if ArcIMS™ and Citrix® architectures are pursued for application deployment, the need for very high-bandwidth may be lessened to a degree. Both the Citrix® and ArcIMS™ approaches are designed to be bandwidth efficient relative to trying to access full data sets across a wide area network (WAN). Based on the results of this evaluation, the state may consider some potential bandwidth improvements. Ideally, MeGIS should track availability of cost effective broadband Internet access throughout the state and make this information available to municipalities and state personnel planning applications. Currently, no bandwidth improvements are budgeted as part of this proposal, however, this study may indicate a need that would support separate investments in this area.

2.2.2.4 Reevaluation of Current ESRI® Licensing and an Expansion of Group Purchasing Options for GIS Software & Hardware

Statewide, hundreds of GIS software licenses are currently available for use. These are overwhelmingly ESRI® products. While many of these are being used efficiently, there are numerous cases where they are being underutilized. And despite the large number of licenses, there are GIS users who desperately need access to these products and services and can't afford to acquire them.

Maine should strive to optimize licensing with the large software vendors whose products it uses. There are numerous strategies for achieving this, but conceptually it involves pooling license resources so that the maximum number of working 'seats' are available at all times. To this end Maine should strengthen its blanket contract with ESRI®, using the full weight of its pool of licenses as bargaining strength.

The technical move to Citrix® distribution of licenses from a MeGIS central node will support this going forward. If GeoService centers and other GIS users are accessing ESRI® products through this system, more of the licenses in the overall system will be collected for both optimization of availability and bargaining leverage with software vendors.

2.2.3 Pillar #3: Additional Investment in Statewide Data Development

Historically, data development is the most costly element of a GIS program. This is amplified when pursuing a statewide project where the land area is very large. The proposed expansion of Maine's statewide GIS reflects this historic trend. Of the potential $14.4 million dollars worth of state and external funding sources proposed for this program, $9.6 million, or 67% is for data development. The following provides details on the data development that is proposed:

2.2.3.1 Creation of Detailed Statewide Orthophoto Base Map Through Continued Participation in USGS NAPP Program

The USGS maintains the National Aerial Photography Program (NAPP) and National Digital Orthophoto Program (NDOP) whereby significant matching funds are provided by USGS to create detailed digital aerial photography for the country. Maine has been a historic participant in this program through a 1997-1998 project[6] created 1 meter resolution, 1":1,000' (1:12,000 metric scale) scale, black and white digital orthophotos (also know as digital ortho quarter-quads, or DOQQs) for approximately 90% of the land area of Maine. Continuing and expanding this relationship is a cornerstone of the data development recommendations. The following outlines specific recommendations for further participation in NAPP/NDOP.

Completing the 1997-1998 Digital Ortho Quarter-Quadrangle (DOQQ) Project
Maine should invest in completing the 1997-1998 data set for the entire state. This will create an important, high-quality statewide data set of uniform scale and accuracy. The proposed budget includes payment of $180,000 to USGS that will result in completion of the state. The USGS has notified Maine that if these moneys are not available USGS will proceed with production of the remaining orthophotos on a low-priority basis using in-house resources. However, if the state wants any assurance on completion or control over the schedule of completion, funding will need to be provided.

Undertaking a New 2003-2004 NAPP Project with USGS
USGS is now amenable to working with states to create the imagery that will be of most use to the state. Unlike in the past, NAPP funded projects are **not** limited to creating 1":1,000', 1 meter resolution black and white products. The states and USGS can negotiate to specify the aerial photographic products that are deemed to be of most use to the state. There are several opportunities for improvements that Maine is interested in. First, improving the scale to 1":500' and the resolution to ½ meter, will greatly enhance the ability of this type of imagery to be used as a base map by local municipalities. Such a base map is a prerequisite for performing parcel compilations in a consistent, high-quality manner. Second, pursuing color imagery will increase the value of the orthophotos to many constituencies.

The state (likely through MeGIS, the GIS Executive Council and the new GeoLibrary Board) needs to determine specific requirements and work with USGS to craft a detailed proposal for new NAPP imagery that could be flown during the 2003-2004 timeframe (i.e. the next NAPP funding cycle that Maine qualifies for). Since the improvements in scale and resolution will increase the cost of this type of project, it is very unlikely that 100% of the state could be flown and produced for the same costs as the 1997-1998 project. As such, the state may need to consider completing higher resolution imagery for only a portion of the state.

[6] Maine provided funding for the DOQ production aspect of the 1997-1998 project as well as photography funding for a 1991 CIR project.

According to USGS, the state is eligible for up to $1.6 million of USGS matching funds[7] for a statewide project. If the state matches that sum, there is potential to perform a $3.2 million dollar statewide project. According to cost estimates[8] that were made as part of this project, it is possible that $3.2 million would be adequate to fund approximately 70%-100%[9] of Maine's land area for ½ meter color orthophotos at scale of 1":500' (see Figure 2-1 below). If Maine pursued a project where 100% of the state was not covered, then Maine would only qualify for a proportional share of USGS matching funds. For instance, if 75% of the state was covered by a new project, Maine would only qualify for 75% of the maximum USGS match, in this case $1.2 million (i.e. 75% of $1.6 million).

Since vast areas of Maine are unlikely to change significantly in the 1997-2002 time period, it may be possible to craft a program where the most environmentally sensitive and development-susceptible areas of Maine are identified to be flown at higher resolution through a new NAPP/NDOP project. In addition, there is no absolute limit to the funding for this project. Only the USGS contribution is limited. Hence, if Maine were able to raise funds from other sources (e.g. other federal sources, utilities), funding for 100% coverage of Maine under the more conservative cost estimate might be possible. This possibility was assumed in the funding scenario presented in Section 5.

The Steering Committee considered a program that broke Maine into three priority areas for receiving improved, color DOQQs. These priority areas were based on the Steering Committee's impression of the level of need for higher resolution orthophotos (see figure 2-1 below). Higher priority was assigned to areas experiencing higher-rates of change (i.e. development) and perceived increased risks of environmental degradation. As table 2-1 below indicates, based on current cost estimates and an assumed $3.2 million in combined Maine-USGS and potential third-party funding for a statewide project, it should be possible to craft a program that covers all of the "priority area 1 and 2" lands under even conservative cost estimates.

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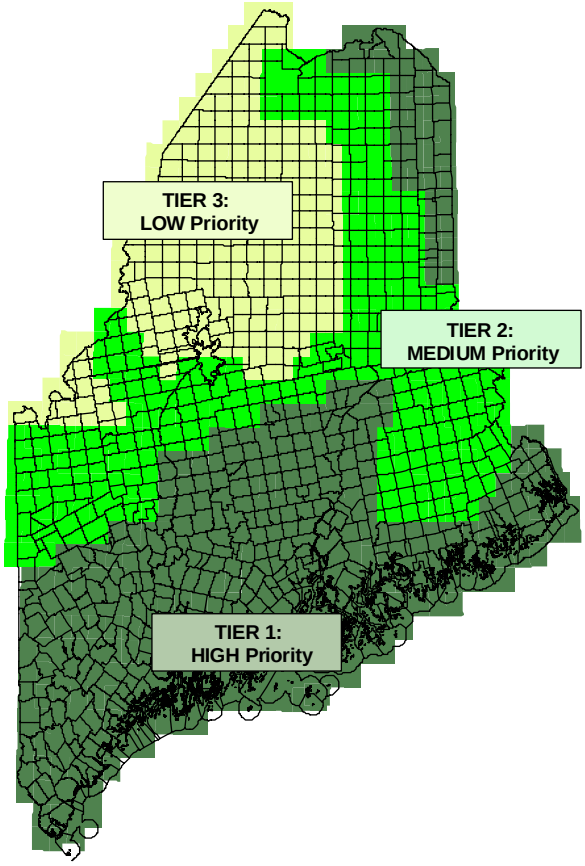
[7] This amount is an estimate only. The USGS can contribute an amount not to exceed one-half the government cost estimate for NAPP photography plus one-half the cost of statewide DOQ coverage based on the USGS fixed price of $800 per DOQ for the state. The number of cooperative partners and USGS funding availability at the time of the agreement will determine the actual contribution.

[8] Several private photogrammetry firms, including USGS NAPP contractors, were contacted and asked to provide price estimates for completing this type of project.

[9] Photogrammetry cost estimates are often presented as a bracket representing a low and high cost estimate. Precise estimates are difficult to obtain prior to detailed specification of a project and absent the competitive landscape of a procurement. In this case, the "low estimate" obtained would be adequate to complete 100% of Maine. The "high estimate" would not.



Priority Level	% of Maine	Low Est.	High Est.
1[10]	48.3%	$1,200,000	$2,000,000
2	29.3%	$727,950	$1,213,251
3	22.3%	$554,037	$923,395
Statewide	**100%**	**$2,481,988**	**$4,136,646**

Table 2-1: FLYOVER PRIORITIES COST

Figure 2-1: FLYOVER PRIORITIES

2.2.3.2 Statewide Landuse and/or Land Cover

Landuse and land cover data are closely related, however, they differ in a fundamental way. Land cover is simply an interpretation of what type of habitat or development is covering the earth. Most often **land cover** is generated based on satellite imagery and the classifications are limited to what distinctions can be made from the raw satellite sensor data. Typically, the built environment classifications are fairly limited and include land cover types such as urban or suburban. Also, land cover data can have very detailed natural environment classifications with distinctions made between many types of forest cover. **Land use** is most often photointerpreted by human beings. As such, there can be a much richer number of built environment classifications with distinctions between high-density residential, low density residential, commercial and industrial possible. Due to the human component of photointerpretation the cost of completing land use is generally much, much higher than land cover. The GIS Steering Committee reached consensus that, given resource limitations, the development of land cover would be more appropriate to meet current analytical needs on a statewide level. The following briefly describes what Maine might obtain through a land cover mapping initiative:

[10] Cost estimates were obtained only for priority level 1 areas (i.e. 48% of the state). These figures were then extrapolated across the other two priority areas. Table figures for percentage were rounded.

A statewide land cover layer would likely be made available in both raster and vector format. Data would be derived from appropriate satellite imagery and classified with an agreed to land cover classification scheme likely containing 20 -50 classifications. Most of these classifications would distinguish different types of natural or agricultural land cover types. In March, 2001, members of numerous Maine and federal agencies established a proposed land cover classification for the state. This comprises more than 100 classes in 4 levels, mostly of vegetation types. The top-level classes are Crops, Grass, Shrub, Forest, Open Water/Wetlands, Coastal, Developed, and Non-Vegetated Non-coastal Manmade. While the specificity of this classification would make it very expensive, the classes established by the committee are a valuable reference source. The contents of this classification are included in this document as **Attachment E**.

Resolution of land cover data that would meet acceptable utility and cost requirements would likely be in the 10-30 meter pixel range. Cost of a statewide land cover classification would vary widely depending primarily on the detail of the data required. As a reference, New Hampshire recently completed a statewide 23-class, primarily vegetation type product over the 9,375 square miles of the state. This took about one and a half years at a total cost of about $250,000.

Commercial off the shelf land cover data are available from vendors such as SPOT Image. SPOT reported that their LandClass 18-classification product could be delivered over the entirety of Maine for less than $90,000.

Maine has an excellent in-state resource for remote sensing data processing in the Maine Image Analysis Laboratory at the University of Maine at Orono. This lab was instrumental in constructing the sole existing statewide land cover layer, assembled in the mid-1990's as part of the Maine GAP Analysis Project. The GAP land cover layer used Landsat-Thematic Mapper (TM) imagery along with other GIS data such as a US Fish and Wildlife Service National Wetlands Inventory (NWI) maps, to delineate 37 different vegetation and land cover types.

2.2.3.3 Parcel Data Layer Development

Parcel data represents one of the most valuable and difficult to assemble data sets proposed to be undertaken by Maine. These data are valuable because cumulatively parcels unambiguously define land ownership across the state. In addition, all addresses in Maine can be associated with a parcel. Thus, parcels also represent a complete, unambiguous data layer of addresses. Since almost all transactions conducted with the state emanate from an address (i.e., of a business, of a tax payer, of a vendor, of a permit holder, of a state office building, etc.), parcels can be used to accurately map those locations. In addition, changes to the parcel fabric of the state are a key indicator of new development and are an important element of development tracking applications and pursuing sensible growth.

Parcel data are extremely difficult to assemble because each of the nearly 500 cities and towns within Maine is responsible for maintaining its own parcel maps. In addition, the parcels in the unorganized territories (UT) are mapped by the Department of Revenue

Services in collaboration with the Land Use Regulation Commission under the Department of Conservation. . Thus, to create a statewide parcel layer, one must assemble and standardize 500 component pieces, plus the information from the UT. Unlike other data sets such as roads, there are no commercial sources for statewide parcel data. Further, the quality and format of the parcel data varies widely from community to community. Last, parcel data are constantly changing since land is continually undergoing sub-division and ownership changes. Assembling and standardizing a statewide parcel data is not a *one-time activity*; it is an *ongoing process*.

As hinted at above, in light of the difficulties assembling a statewide parcel layer, a key component of assembling these data is the creation of clear and strong standards that can be followed by each of these independent entities. If such standards were in place, then it would be feasible for the state to provide grants or other financial support that would result in the creation of parcel data on a town-by-town basis. The standards would ensure that all data were of consistent quality and that they fit together spatially. In addition, the standards should address the collection of minimum set of attribute data pulled from the community's CAMA database (e.g. minimum set might include: owner name, address, land use, assessed value, etc.). It will be necessary to work with the CAMA vendor community so that commercial CAMA software can be tuned[11] to provide the types of CAMA "dumps" that are specified by the standards. The statewide resource would come together over a period of multiple years. The following briefly describes the proposed plan for creating a statewide parcel data layer:

- Proposed budget includes $2 million dollars that would be provided to cities and towns on a dollar-for-dollar matching basis. Cities and towns would pursue data development through their own efforts and contracting with the private sector. The grant program would be implemented under the auspices of the proposed GeoLibrary Board.
- Parcel data would be developed as polygon data layer with an explicit linkage to attribute information (e.g. owner name, assessed value, land use, etc.) available in Assessor's database (i.e. CAMA system).
- Cities and towns would be strongly encouraged to use the existing, or in the future improved resolution, digital orthophotos (DOQQs) as the minimum base map for parcel compilation and automation. Communities that have base maps that are of better quality than the DOQQs would be encouraged to use those base maps.
- Terms of the grant would mandate delivery of the data in conformity to a statewide parcel data standard (see section 2.2.1 above) and allow the inclusion of the parcel data in the publicly available GeoLibrary.
- Terms of the grant would mandate that updates of the parcel data be provided to the state on an ongoing basis.

[11] Tuning might involve adding a feature to the software or having the software prepare a standard report that would generate standards compliant CAMA attributes.

- The grant program would allow "pure" non-matching grants to cities and towns that have already invested in parcel data development. The grants would be used for improving the quality of existing parcel data sets and bringing those data into conformance with the statewide standard.

2.2.3.4 Zoning Data Layer Development

Like parcels, zoning data are maintained at the local level by individual communities. In addition, there are two types of zoning in Maine: 1) **shoreland zoning**, and 2) **general municipal zoning**. Shoreland zoning exists on a statewide basis in reaction to the statewide statute (38 M.R.S.A, Section 435-449) that created these land use restrictions. The application of minimum guidelines requires local discretion to select appropriate zoning designations and create accompanying shoreland zoning maps. In fact, while minimum requirements are uniform, individual communities differ widely in how they implement the minimum guidelines and create their maps. The Board of Environmental Protection imposes ordinance provisions in cases where a municipality has not, in the Board's judgment, met the minimum guidelines.

Even with a relatively uniform statewide program, there are challenges to overcome in developing a composite statewide data layer. Over time, different municipalities have used different wetlands source data. If, for instance, higher accuracy aerially derived wetlands or flagged survey data are used to enhance the accuracy of National Wetlands Inventory polygons, these adjustments aren't automatically adopted as technical delineations. Moving to a new data set requires a full ordinance revision process.

As recently as during the 1990's, DEP offered hand-drafted shoreland zoning mapping assistance to municipalities through a federally funded program. It is unfortunate that this work was not done within a GIS environment.

Conventional municipal zoning does not exist on a statewide basis. Many communities do not employ local zoning at all so "statewide" coverage of this layer is moot.

As with parcels, it is recommended that a strong set of standards be developed for zoning layers in Maine's statewide system. Further, it is recommended that a program for providing grant funding support to municipalities (or regional entities) to create and submit standards compliant zoning data be created. The following briefly describes what a program to develop statewide zoning data sets might look like:

- **Shoreland zoning:** Shoreland zoning areas/buffers would be represented as polygons with attributes describing the zoning classification. The shoreland zoning data from each individual community would be automated and submitted to the state for comparison to the standard and insertion into the GeoLibrary. The issues articulated above illustrate the challenges to be faced in creating a uniform layer using this methodology, but simply warehousing the individual shoreland zoning data sets in an accessible location and common format would constitute a significant step forward.

- **Municipal zoning:** Municipal zoning maps would be automated with zoning areas represented as polygons with attributes describing the municipal zoning classification. Municipal zoning does not have a uniform set of zoning codes from town to town. As such, it will be necessary to "normalize" codes to create a data set that is useful on a regional basis. This normalization would add a new field that rolls up local codes into a "state standard" that approximates the local definition. Implementing this normalized "state code" would **not** involve removing the local "official codes" from the data set. The final attribute table would include two fields: 1) municipal zoning code, and 2) state zoning code. Again, data from each individual community would be automated and submitted to the state for comparison to the standard and insertion into the data warehouse.
- The State Planning Office (SPO) would undertake complementary funding policies that would ensure that **existing** SPO funds used for land use mapping result in standards compliant data sets.
- Grants would be given to municipalities or regional entities such as a county or council of government. These entities would be responsible for developing the data through their own efforts or contracts with the private sector.
- Efforts should be expended to understand the relationship between parcel data sets and zoning. When parcel data exist, or are in the process of being created, zoning automation effort should **follow** parcel automation efforts.
- For the purposes of budgeting, the zoning grant program and the conservation land/protected open space grant program (described below in section 2.2.3.5) are combined as a single budget line item. The GeoLibrary Board working in conjunction with SPO would be responsible for determining the details of this combined grant program.

2.2.3.5 Conservation Land/Open Space Data Layer Development

Currently, MeGIS has a protected lands data set that covers only Federal and State owned protected open space. This layer has been enhanced throughout the past decade by Richard Kelly at the State Planning Office and is reasonably exhaustive regarding state and federal lands at state or regional scales. But gaining a complete picture of protected lands will involve obtaining data on land that is protected at the municipal level or via the very active private non-profit conservation community within Maine. Creating this data set poses many challenges. First, information on locally protected lands needs to be acquired from the multitude of individual communities. Second, there is a large amount of land that is protected via conservation restrictions placed on deeds and this information can be considered sensitive, if not private. Nevertheless, this information is critical and at least two other New England states – Connecticut and Massachusetts – are involved in creating this type of data resource.

The following briefly describes the proposed approach for creating an improved statewide open space data set for Maine:

- **Protected Open Space:** Each parcel of open space would exist as a discrete polygon with attributes describing the owner, type of protection and other key information.
- Grants would be given to municipalities or regional entities such as a county or council of government. These entities would be responsible for developing the data through their own efforts or contracts with the private sector.
- Efforts should be expended describing the relationship between parcel data sets and protected open space. When parcel data exist, or are in the process of being created, protected open space automation effort should **follow** parcel automation efforts. Ideally, the open space parcels would be a sub-set of the parcel representation from a municipal parcel data set. This will clearly be a long term goal given the expected duration of the parcel development initiative.
- As described above, the open space data layer grant program and the zoning grant program have been combined as a single budget line item.

In addition, there is active effort ongoing within multiple agencies interested in creating both Maine-specific and New England-wide open space data sets. The Muskie School of Public Service at the University of Southern Maine is currently undertaking a feasibility study defining the parameters of precisely this question. Other organizations, including the New England Forestry Foundation that secured the 762,000 acre Pingree Forest easement in 2001, are investigating means to achieve the same objective. Keeping abreast of the efforts that are being taken by multiple stakeholders on this front will be critical to avoid redundant development efforts and maximize available resources.

2.2.3.6 Road Centerline Enhancements:

Currently, the E911 road centerline data is the only data set that has comprehensive address information attributes. Similarly, the DOT data set has a rich set of road characteristic and condition attribute information not available on the E911 roads. This project would create a new "combined" data set that would have the best characteristics of each of these two road centerline data sets, while ensuring that the best possible line work representation of roads was used. DOT and MeGIS, working along with the GIS Executive Council have thoroughly examined the feasibility and approach for this project and have arrived at suitable technical approach[12]. This project is ready to go, pending funding availability.

2.2.4 Pillar #4: Targeted Application Development

GIS data sets by themselves provide little value. These data must be manipulated by human individuals using software to yield benefits. Often, GIS programs fail to adequately invest in tools for manipulating the data and thus very expensive data are underutilized. As such, it is appropriate for a program of this nature to contain a set of

[12] It should be noted that this technical approach involves the use of ESRI® dynamic segmentation. Currently, dynamic segmentation is not supported in ESRI®'s data warehousing environment, ArcSDE™ . This feature has been promised by ESRI® and DOT awaits its delivery, hopefully on a timetable consistent with completing the road centerline enhancement project.

investments in application tools. These applications will facilitate the use of the data in specific contexts, and to address specific problems. The proposed budget includes $500,000 of investment in applications, or approximately 3.5% of the total 5-year budget. The investment of these funds will help ensure that the other 96.5% of the investments are used early and often.

2.2.4.1 Standards Conformity Validation Applications

As described above in section 2.2.1, standards do not work well unless there is enforcement. Thus, MeGIS will need a set of tools that allows the state to quickly determine if data submitted by a community, or any other collaborating entity, meets the stated standard. If the data passes a "conformity test" then it can move forward in the process for eventual inclusion into the GeoLibrary. If the data does not pass, it should be quickly returned to the supplier, potentially with a report card, so that its deficiencies can be addressed. While automated tools will be important, there will also be a need for accompanying manual quality assurance/quality control procedures.

2.2.4.2 General Purpose Internet Browser-based Data Viewer and an Application Development Platform

With a commitment to creating a superior GeoLibrary with all of the state's digital data, the state should also invest in a set of tools that allows the general public to easily browse the data. This would be analogous to a city or town investing in the creation of a card catalog, or micro-fiche reader once their library was built. The viewer application would be designed to be extremely simple and aimed at the general public. It should not require any foreknowledge of GIS software in order to use it. This application would provide basic GIS viewing capabilities through a web-browser, including, but not necessarily limited to:

- Viewing GeoLibrary data layers
- Providing zoom and pan capabilities
- Providing ability to click on a feature to interrogate attribute data
- Providing an ability to locate an address
- Providing access to, and query of metadata for GeoLibrary layers

Potentially, this type of application could be deployed using a web-services architecture. In the simplest terms, a web service is a web site that generically provides *data to applications* rather than specific *browser content to people*. Hence, the "client-side" data viewer application described above would be designed get its mapping data from a "server-side" GeoLibrary web service. The GeoLibrary's web service(s) would be designed to deliver specific data layers, with specific symbology to the end-user's client viewer application. The client-side viewer application would be designed such that it requested the layers from the server according the specifications of the web service. If the web service was effectively deployed it would be generic and thus the **same web**

service could potentially deliver data to the GeoLibrary viewer application as well as to other client-side applications developed by third parties, be they other state agencies or the private sector. That is, *one* server-side web service can power *numerous* client-side applications.

Fueled in large part by E-Commerce, "web service" oriented approaches to computing have rapidly emerged as a topic of intense interest and development. Companies such as IBM®, Microsoft®, Oracle® and Sun Microsystems® have all launched ambitious web service initiatives. Industry initiatives such as Microsoft®'s .NET™ are aimed at facilitating web services development. Currently, there is a great deal of activity aimed at identifying, and agreeing to a common set of standards for web services delivery. The World Wide Web Consortium (W3C) has established an XML Protocols group to develop and codify a set of standards[13] for these services. In addition, GIS firms such as ESRI® have embraced this architecture and are actively improving their products to support these emerging standards. Web services make sense in a GIS context because they can simplify client-side application development significantly.

While detailed planning will remain to be done, it is recommended that the GeoLibrary consider the development of a suite of generic web services. These web services would be accompanied by published Application Programming Interfaces (API) that would allow third-party developers to use these services as a means of accessing data stored within the GeoLibrary. There are at least three critical, foundation GIS functions for which development of a web service may be appropriate:

- Map rendering service
- Geocoding service (i.e. address finding/matching)
- Data download service

Together, this suite of GIS web services would provide a robust application development platform for both the GeoLibrary and third-parties to work with. The proposed browser-based viewing application would be the first application to use these web services. The figure on the following page provides a high-level schematic representation of what the GeoLibrary's services architecture might look like:

[13] The most prominent and relevant of these standards are Simple Object Access Protocol (SOAP); Web Servcies Description Language (WSDL) and Universal Description, Discovery and Integration (UDDI).

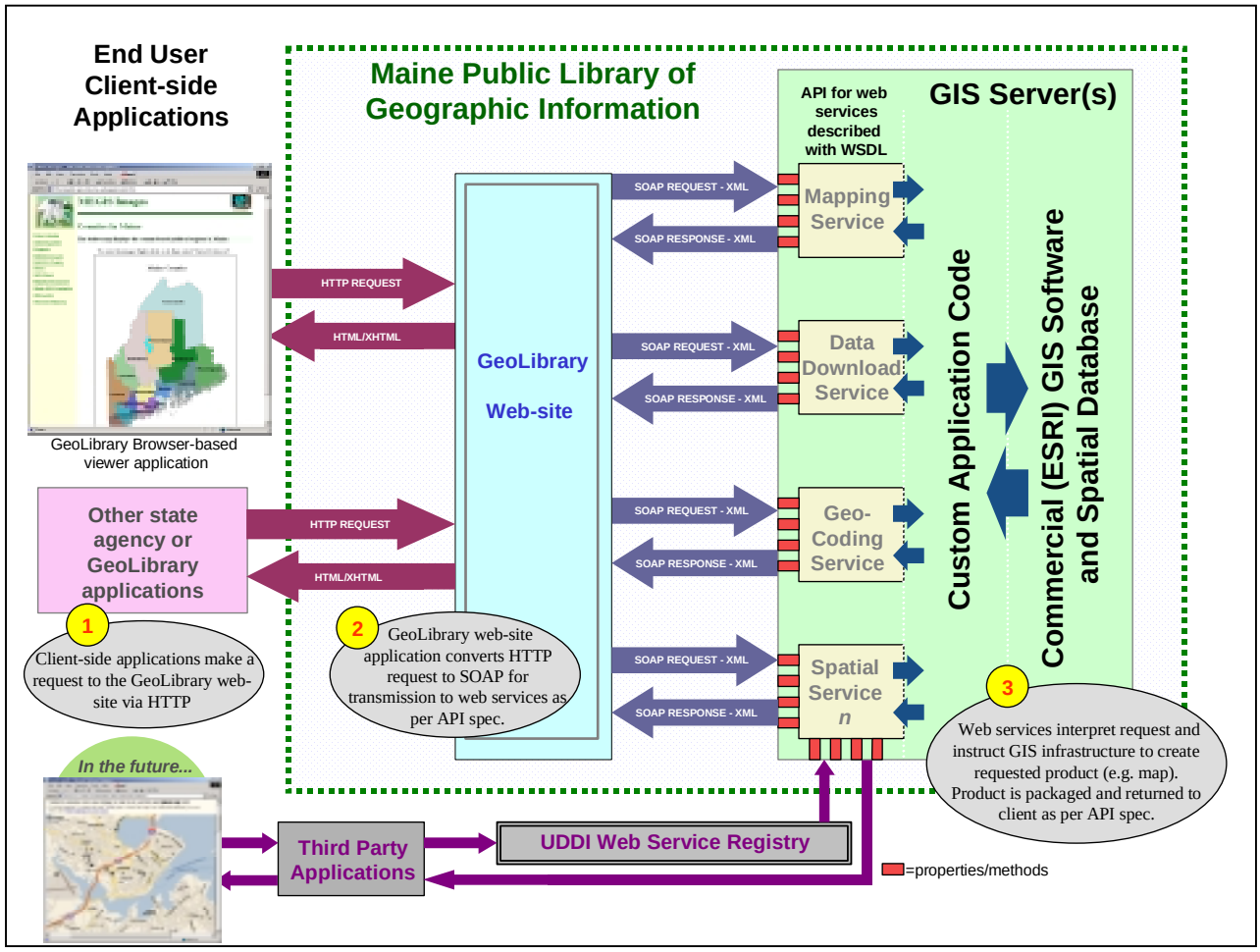


Figure 2-2: POTENTIAL MAINE GEOLIBRARY ARCHITECTURE

Additionally, a point rendering and manipulation service should be considered to serve in facilitating Development Tracking applications. This service is addressed in Section 3.

2.2.4.3 Development Tracking Tool Development Suite

Performing improved development tracking is a priority for SPO and of significant interest to the Legislature. There are multiple opportunities for using GIS technology to ***measure*** current development, ***extrapolate*** current trends to determine potential impacts, and ultimately to inform policy that will help ***optimize*** future decisions on encouraging growth and development within Maine. In this manner economic development can be fostered while appropriately protecting the environment and unique character of Maine. The details and form of these tools will emerge over time but they may include such things as: completion of zoning buildout analyses and the creation of growth targeting strategies. This initiative and associated applications are fully addressed in Section 3 of this report.

2.2.5 Pillar #5: A Program for Expanded GIS Education, Outreach and Coordination

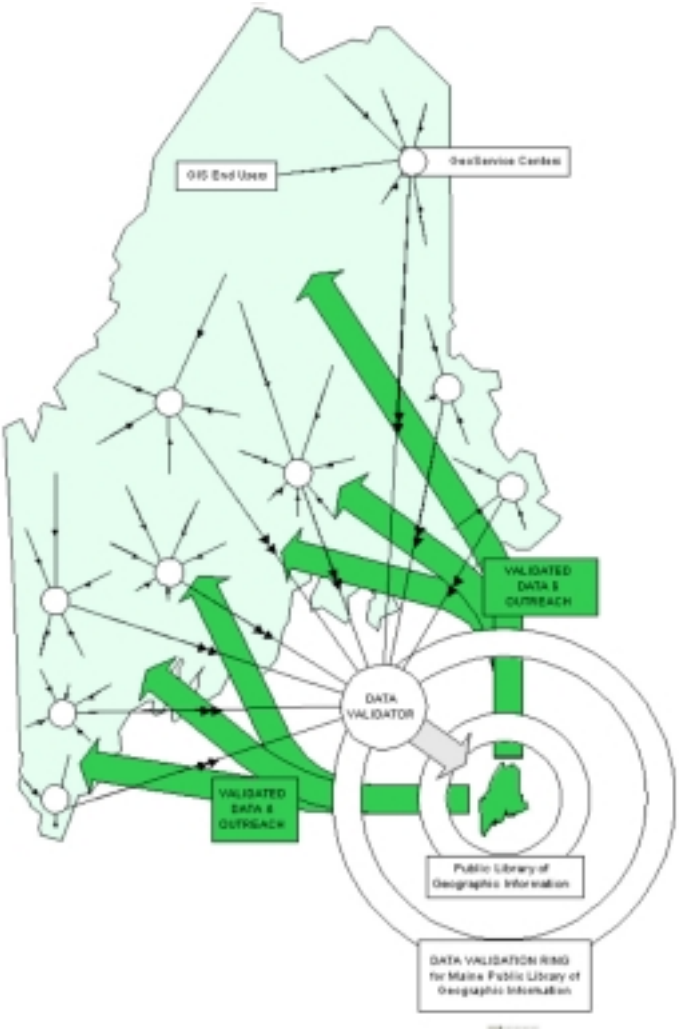
2.2.5.1 Creation of an Explicit Coordination Function within MeGIS:

Many of the initiatives described above involve coordination between the state and the myriad individual communities and regional entities that manage spatial data. Similarly, there are numerous state initiatives, some of which have overlapping data sets and business functions (i.e. the need to distribute data to 3rd parties). MeGIS needs staff resources aimed explicitly at fostering a coordinated approach to GIS development within Maine. The following three staff positions will cover the essential functions of the Maine Public Library of Geographic Information.

- GeoLibrary Content Specialist: manages increased flow of data into and out of the GeoLibrary. Works with current MeGIS DBA. This will be a highly technical position. The Content Specialist will control checkout and check-in of all GeoLibrary data. He/she will be responsible for ensuring that data submitted to the Library meets specifications and integrates fully with overall content. He will track and manage metadata compliance monitor currency and use of Library data. This position is also discussed above in section 2.2.2.1.
- GIS Outreach Coordinator: actively engaged in coordinating both state agency-to-agency and agency-to-municipality/regional GIS activity. The Outreach Coordinator will maintain the best overall sense of who in the state is doing what with GIS data and where particular strengths and most pressing needs are. He will trawl the GIS installations at all government levels and work to get pertinent layers added to the library. The Outreach Coordinator will me the main point of contact with GeoService Centers for technical assistance and training.
- GeoLibrary Contract Coordinator: acts as staff to the board. Looks for grant opportunities and does work of applying for grants. Does contracting for state supported GIS activity (i.e. getting land cover, ESRI® blanket contract, GeoService Center establishment and funding, etc.). The Contract Coordinator will administer the state grant program money, apportioning funding for development of parcel, zoning and open space grant money, for example.

2.2.5.2 Creation of Regional Geographic Service Centers (GeoService Centers):

Obtaining technical assistance frequently and on demand was the most widely reported unmet need during the Needs Assessment interview process. Providing this service, and expanding GIS literacy and utility among a growing user base in Maine will require a support structure distributed throughout the state. Because of the size of Maine and the different issues facing different areas, regional centers are a workable solution for assisting with the delivery of GIS services. Simply purchasing GIS software and data will not create a functioning body of users. To fully enable the use of this technology, regional centers should be established and encouraged. This will assist users with the tools, data and practices necessary to feed Maine's Public Library of Geographic Information (GeoLibrary). The Regional GIS Service Centers (GeoService Centers) will:



- Provide assistance to municipalities without GIS capabilities of their own. Many municipalities are years away from having the capacity to maintain GIS independently. Some will never achieve this capacity. But all should have access to one or more GeoService Centers to ensure that they may receive the full value of the growing Maine GIS infrastructure.
- Answer common technical questions (e.g. how can a data set be projected into the appropriate coordinate system?)
- Assist in Specifying requirements for GIS services and necessary budgets for accomplishing work.
- Execute contracts for GIS work with private sector.
- Understand the fundamentals of the Maine Public Library of Geographic Information. This will include validation requirements for data that has been enhanced or created with state funding in preparation for its inclusion into the GeoLibrary.
- Enforce the Maine geographic data standards as published by the GeoLibrary.
- Foster GIS education. This will include assistance in basic application development and be targeted to Maine issues and Maine data.

Initial GeoService Center activity will likely occur within the eleven existing Regional Councils. These vary considerably in their knowledge and capacities for managing GIS, but they understand the regional mapping needs of their constituent communities and many of the areas where GIS is most needed.

While the GeoLibrary Board will have ultimate discretion in determining what entities qualify as GeoService Centers, it is clear that Regional Councils are not the only candidate locations. Innovative public-private or quasi-private partnerships might be

encouraged as GeoService Centers. The GeoLibrary Board should encourage the creation, evaluation, and renewal of GeoService Centers that best help to meet the goals of this plan. GeoService Centers should be evaluated on their ability and capability to reach a broad range of public and private interests and in meeting the purposes of this plan and the GeoLibrary.

Land trusts or large municipalities with established GIS and excess technical capacity could serve in this role, especially in areas where regional councils are not technically qualified to provide these services.

Private companies might also be able to serve as GeoService Centers. Two of the primary contractual obligations of GeoService Centers will be enforcement of spatial data standards and providing technical support to GIS users. In many cases strong relationships already exist between private firms and client GIS users. Development and maintenance of these systems benefit significantly by strong, ongoing interpersonal relationships, and where these already exist the GeoLibrary should seek to strengthen them.

Private rates for performing GIS work will likely be higher than those charged by regional councils, but experience has shown that this will not price the private sector out of the market. The private sector has a much more nimble capacity to scale services to needs and adjust quickly to changing circumstances, and if initiatives in southern New England are any indication, it will be essential to have such excess capacity available in the GeoService Center community. A public-private partnership of this sort should foster a lively development environment for innovative approaches to problem solving.

2.3 Implementation Issues

2.3.1 Governance and The Maine Public Library of Geographic Information Board

Recognizing that an ongoing governance structure is vital to the successful implementation of the recommendations outlined in section 2.2, the Steering Committee collaboratively developed, and unanimously endorsed draft statutory language to establish the Maine Public Library of Geographic Information and a governing Board. (**See Attachment F** for a copy of the entire draft.) If enacted, the Library will be charged in statute to serve the needs of citizens, businesses and all levels of government, by providing a standardized, networked clearinghouse of all geographic information available for public use within Maine.

In overseeing the Library, the Board will work in partnership with municipal and county data custodians to provide electronic copies of all geographic information produced with State moneys to the Library. In addition, to reduce redundancies in the creation, verification and maintenance of public geographic information, State agency data custodians will provide the Library with electronic copies of geographic information funded by any source of public funds or grants. Federal agencies and private organizations may also volunteer data to the Library. The draft legislation

specifies that organizations, which submit information to the Library for public use, will not be held liable for any use of that information. While the Board may develop appropriate internal services to facilitate generalized access and use of Library data, the Board will not compete directly with services provided by private enterprise.

The Maine Public Library of Geographic Information Board's 15 members represent stakeholders from State agencies, counties, regional councils, municipalities, public utilities, and private sector GIS vendors. The University of Maine, environmental, real estate and development interests, and the public are also represented on the Board. The President of the Senate, the Speaker of the House and the Governor each appoint members to three-year terms. The Board will oversee Library operations; establish and maintain standards, rules and policies regarding data to be placed in the Library; coordinate public geographic information; set priorities; approve expenditures of funds; seek partnerships; resolve disputes; conduct studies; and report annually to the Legislature. With respect to standards and policies, the Board has broad powers. If the draft legislation is enacted without change, the Board will set standards and policies regarding:

- Methods of access and delivery of information held by the Library,
- Geographic Information System technical specifications,
- Data content, metadata, and security including guideline criteria for accepting third party data from data custodians or data volunteered by the private sector,
- Privacy and how it will be protected,
- Mechanisms to correct inaccuracies, and
- Data validation tools and processes.

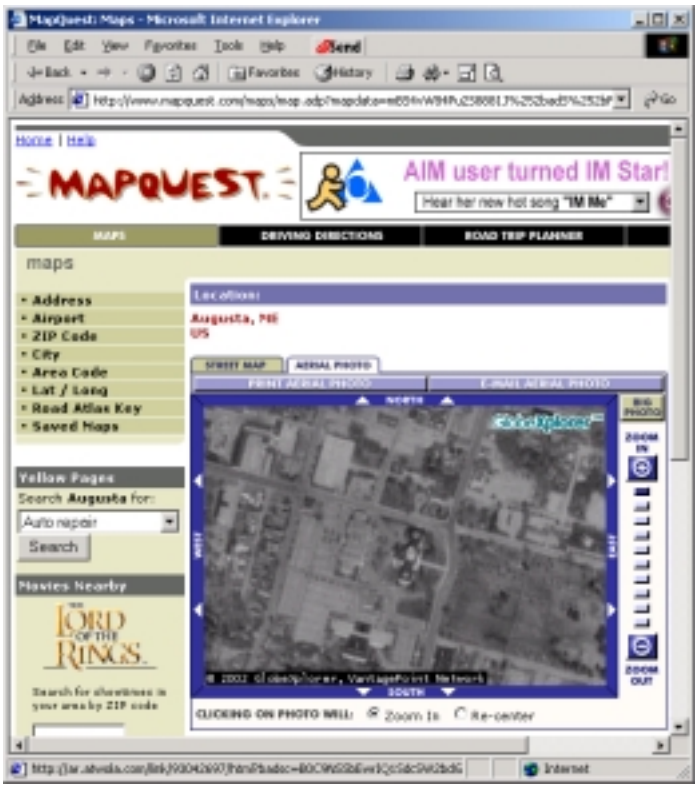
The draft legislation also authorizes the Board to establish fees for electronic copies of Library data that are not more than three times the actual cost of reproduction. Lastly, it specifies that the presence of data in the Library does not, by itself, make that information a public record.

Finally, it is important to recognize that the new Board is responsible for GIS on a statewide, inter-governmental level. It is anticipated that the new Board will work closely with existing coordinating bodies, such as the GIS Executive Council, which represents state government interests. The GIS Executive Council will be a key ally for helping to expand GIS in Maine and in helping the Board implement policies as they pertain to state government agencies.

2.3.2 Protection of privacy

With increasing adoption of the World Wide Web and in light of security concerns raised in the aftermath of September 11th there is legitimate, increased attention on preserving privacy in the digital age. More information is more readily available than ever before. Pursuing an expanded statewide GIS and the development of the GeoLibrary raises important questions of whether privacy is compromised by creating and facilitating the

distribution further spatial data layers. As such, the Steering Committee created a sub-committee to examine these issues and this report reflects the findings of that sub-committee.



It is clear that the state's spatial data, whether in digital or hard copy format, is part of the "public record". Hence, almost all[14] of the data sets under discussion are public documents that can be accessed by the general public. No new privacy issues are raised simply because the public records in question happen to be maps.

In addition, there is already wide spatial data availability through publicly available commercial sources. For example, the figure to the left shows an aerial photo image of the Maine State House complex taken from the publicly available, free MapQuest.Com site. While these types of data sources have different content and quality than what is being discussed for the GeoLibrary, the fact remains that it is already relatively easy to locate detailed spatial data for Maine via the web.

While agreeing these are public records, the sub-committee also discussed potential mechanisms that could be added to a web-based distribution of GeoLibrary content. These mechanisms include, but are not limited to things such as a request for "opt out" of one's records or the wholesale suppression of certain types of information such as property owner names. Web based technologies provide multiple options for instituting these types of privacy protections. In addition, web server technologies provide tools for assessing the computer connections that are looking at various data sets. For example, Maine's InforMe system tracks users of their system and can gain a general sense of "who's looking at what". Such tracking can help identify suspicious or inappropriate usage of the system while also allowing the serving organization to better understand what types of services are most in demand.

The burden of responsibility for determining privacy standards rests with the original data custodian and privacy will be one of the details contained within the Memorandum of Understanding governing the data transfer agreement between original custodians and the

[14] There are a limited number of data sets, such as the location of endangered species habitats or archaeological sites, which have statutory exemptions from Freedom of Information statutes.

GeoLibrary. The GeoLibrary, in turn, must ensure that only necessary and appropriate information is made available to the public. The concern is neither new nor unique to geographic data. In fact, the State has significant experience with suppressing certain fields of data within public records (e.g. taxpayer and sales tax records) and has already successfully addressed the privacy issue from a shared portal environment similar to the GeoLibrary through the InforMe Board.

Ultimately, the Steering Committee has confidence that appropriate safeguards on privacy can be instituted through the GeoLibrary. It is recommended that the newly formed GeoLibrary Board undertake the development of a specific privacy protection policy, and a plan for implementing that policy.

3 Development Tracking

3.1 Overview

Development tracking at its most basic is the measurement of change in land use brought about by human development. Quantifying this change is essential in order to assess evolving needs in infrastructure planning and evaluate environmental implications. The State of Maine currently has no uniform and consistent method of capturing this change.

Before any system can be developed, Maine needs to prioritize what data describing these impacts and changes are necessary to adequately inform analysis, planning and policymaking. What development is most necessary to track? Is it growth of public infrastructure? Is it the number of new houses with the fiscal and environmental impacts this creates? Is it land cover, or the measure of impervious surface (roads, structures, parking areas) vs. farmed or forested land with their respective influences on stormwater runoff and habitat disturbance? Is it the changing size and ownership pattern of land parcels? Is it the actual organization of the built environment within a developed area and the impacts this has on service delivery and community character? The answers to these questions have serious implications on the preferred system of development tracking to be implemented.

The challenge of this analysis is to determine Maine's most useful and cost-effective approach in pursuit of development tracking in the near-term future, informed by the strengths, limitations, challenges and costs of the various options.

The following objectives will guide this analysis:

1. Development tracking needs to be implemented statewide but must remain useful at municipal scales and accuracies.
2. The system should be operational in a short period of time (within 12 months).
3. The system must be economical to build, maintain and operate.
4. The system must integrate cleanly with higher accuracy data as such data becomes available.
5. The growth indication data must contain a temporal component. These must be compatible with a baseline going forward. Data from 2002 should be directly comparable with data from 2012 or 2020.
6. All data utilized in development tracking must be retained in the Maine Public Library of Geographic Information: There is to be zero data loss and no stranded investment where state funding is used to create these products.

3.1.1 Development Tracking is an Integrated Subset of the Statewide Plan

The overall Maine GIS data enhancement initiative outlined in this report is being designed to address many of the foundation requirements of creating effective

development tracking. If the recommended program is implemented, many general data improvements will occur: Roads, updated regularly and accurately and including information about type and condition as well as address information, will provide a network useful for geo-coding new development and quantifying impervious surface area. Land cover will be captured and classified using satellite imagery, producing useful information describing agriculture, forest types and developed areas at scales suitable to watershed or regional analysis. Zoning districts will be more thoroughly and consistently automated and made available in digital format. Highly accurate aerial photography will be completed for the whole of the state and distributed freely through the Public Library of Geographic Information.

Still, none of these data products will capture land use and development change in a manner satisfying multi-scale utility and accuracy or near-term statewide availability. Additional growth indicator data must be added to the Geographic Library to establish the baseline of developed area and measure change moving forward.

3.2 Data Sources

3.2.1 Development May Be Described by Different Data Types

The following comparison of the various data feature types will serve as a guide to the different classes of development indicators. The choices made between these will largely determine what analysis and presentation products will be feasible, and help define the specific data collection and maintenance challenges ahead.

The basic data types useful for development tracking can be grouped into line-based, point-based, polygon-based or image-derived strategies. These vary enormously in cost to implement as well as in analytic utility. Following is a brief description of each.

3.2.1.1 Line-based

The following set of three images is a sequence illustrating progressive development over time as measured by a line based system. These lines represent existing roads captured by the GIS at uniform intervals of time. The pattern is clear, though not extremely detailed or informative.

Figure 3-1: GROWTH INDICATED by LINES (ROADS)

Road centerline data figure importantly in current Maine GIS, and are not presently being fully utilized for their development tracking capabilities. Road lines may be buffered to approximate developed land, as has been undertaken in some areas by Inland Fisheries and Wildlife. They can be converted to polygonal data to produce a composite of undeveloped un-roaded areas or "eco-blocks," such as those currently being used by The Nature Conservancy or in a similar format by the Department of Conservation Natural Areas Program. They can be modeled according to their functional classes and other attributes from the rich data set maintained by the Department of Transportation. DOT's Travel Demand Model for forecasting statewide traffic growth may be called upon to augment the development tracking system. This is especially true to the extent it can be used to measure and model urban population and employment dispersal to non-urbanized areas in the state.

Some of the most useful line-based approaches to development tracking system follow.

Roads

New development can be captured as it is added to the E-911 road network. Development tracking can piggyback on the existing system as communities report new road development to MeGIS through the established addressing methodology. There is a fully developed process established for feeding data into this system that involves nearly every community in the state. Of the 492 organized townships in Maine, 323 have presently completed the MeGIS E-911 readdressing process, which involves globally positioning existing road centerlines and creating address ranges for structures along the roads. All but 16 organized municipalities are participating in the addressing system in some way. Approximately 125 of the 422 unorganized townships are also being readdressed for E-911. To maintain the system, municipal addressing officers are instructed to notify MeGIS when new roads are developed. MeGIS then sends a contractor to globally position the new road centerline to be added to the statewide network. The number of participants required to successfully operate the initiative provides some sense of the complexity in maintaining even this simple line-based development measurement layer.

DOT roads, to the extent that they are actively updated, provide similar capabilities and possess a rich set of attributes. The updating methodology for DOT is focused more on public road modeling, so it is not as desirable a source as the E-911 layer for monitoring growth at the fine capillaries of the transportation network where the much of the residential building occurs.

When these two roads layers are combined as is planned within the next year, a single source will be available providing the best qualities of each. Spatial accuracy will be assured by the constant updating efforts of the E-911 program, attached to the rich attribute set maintained by the DOT.

Private source roads can also provide data tracking of this variety. Vendors such as GDT, ETAK, and NavTech develop and sell accurate GIS road networks. These vendors purchase Maine DOT and MeGIS data, integrate it with other sources, package it

commercially, then charge $5,000 or more per year to re-license it as a statewide layer to end users. Most of the quality improvement is feature enhancement in densely populated areas to ensure proper road directionality, geometry and intersection integrity for navigational purposes. This data product succeeds in year-to-year consistency, but fails the requirement of statewide accuracy, especially in rural areas.

Linear Infrastructure

Public water and sewered areas as defined by physical infrastructure locations are another linear data source, and in certain cases far more useful to development tracking than street centerlines. This is true even if these features are only captured to planning level or schematic accuracy. Sewer extensions almost universally portend land subdivision and infill as soil percolation requirements or contaminant loading limits are eliminated with their construction. These data are digitally available for most sewered areas in Maine, at least as system-wide schematics, and could be quickly automated from existing hardcopy system maps elsewhere. Costs for maintaining these data could likely be at least partially offset by the utilities themselves. These data are obviously useless in non-sewered areas, or the overwhelming majority of the state.

Electrical, telephone or data distribution utilities are useful as predictive indicators of development as well as built environment. Accurate maps of communication capacities, including fiber networks, broadband cable and DSL access areas, are predictors of future developmental and demographic change as well as helpful components in characterizing the current state of development. Both Bangor Hydro and Central Maine Power maintain detailed GIS layers of their entire electrical transmission and distribution systems.

There are conflicting sentiments among Maine utilities regarding exchange and sharing of proprietary system data with state agencies or the public at large. Reasons for opposition include liability concerns associated with potential data inaccuracies, faulty analysis undertaken beyond the utility's control, and missed opportunities of capitalization by the utility on data that have in most cases been very expensive to acquire. Typically water and sewer utilities are more willing to freely exchange data than electrical and communications utilities.

3.2.1.2 Point-based

The next three images illustrate the same development sequence as above using points. The lines are retained for reference, as they will be available statewide and likely used as the addressmatching source data. The points represent approximate center locations (centroids) of a growing number of property parcels. By itself this picture does not quantify what manner of physical development is occurring. With these anchor points established though, other data sources such as municipal assessing records or county Registry of Deeds data could be attached to augment them. Visually this product would have a similar appearance whether collected using global positioning equipment or interpreted from aerial orthophotography.

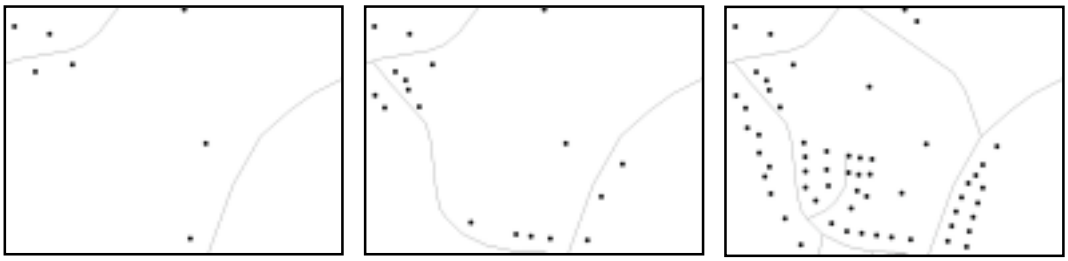


Figure 3-2: GROWTH INDICATED by POINTS (with Roads)

Geocoded Pemits

Assigning geo-located points to each individual property provides a more accurate means of tracking development than any linear features alone. This approach is used by New York State and elsewhere to track real estate parcels. The latitude and longitude coordinates of these properties are approximate, based on the size and location of the land parcels, but they are linked to assessing data and can be mapped thematically. In Maine the logical way to capture this type of feature set would be to geocode address records of one or more growth indicators.

Building permits are a good example of this, though in Maine these are not reported uniformly statewide and no aggregation point exists at which those that are reported can be summarized at a state level. New housing units authorized by building permits in 2000 numbered approximately 6,200.

Plumbing Permits are more universally available and presently aggregated in the DHS Wastewater and Plumbing Control Program. Approximately 40,000 plumbing permits are processed annually (generating $275,000 in dedicated revenue). It should be feasible to work with sewer districts to collect new and upgraded sewer connections to supplement the plumbing permit data and provide essentially full statewide coverage.

Utility Pole Permits. Maine utilities are required to get permits in cases where they are going to be adding poles to the network. In cases where areas are being electrified in anticipation of building, such permits constitute a useful advance indicator of development. When the poles have been set, their GPS'd locations with date installed are maintained by the utility. These data would be valuable from a development tracking perspective, but utilities are typically unwilling to share them. It is highly unlikely that CMP or Bangor Hydro will voluntarily share their pole location data with the State Planning Office or other state agencies to assist this initiative.

Electrical Connection Permits. The Subdivision Control Law and the Shoreland Zoning Law of Maine prohibit a public utility from installing services to a lot in a subdivision (Title 30, Subsection 4956.4), or a structure in a shoreland area (Title 38, Subsection 444) without appropriate municipal authorizations. The necessary authorization forms are provided by the electric utilities and processed by municipal code officers, inspectors and sometimes volunteer selectmen or planning board members. Once completed these are re-submitted to the utilities prior to physical electric hookups. Since these forms must

pass through town offices and city halls to have map/lot numbers and appropriate signatures added, the constitute a potential collection point for valuable growth indicator data.

Telephone Connection Data

Telephone connection data are maintained as a complete data set by Verizon, which is under contract with the state for maintaining the Enhanced 911 database. Like electrical utility connection data these present a potentially valuable resource for tracking growth: despite the cellular revolution, nearly every Maine structure contains phone service and the data require accurate address information for emergency response. But these are also private, proprietary data protected through complex negotiations for a single-use purpose, making them unlikely components of a development tracking system. Given the close working relationship between MeGIS and the E911 project, it might be possible to explore whether a subset of this database might be appropriately made available for development tracking purposes. If determined to be feasible, such a step may require statutory authorization.

Municipal Addressing Records

One of the changes made with the enactment of Maine's E911 system is that official physical addresses, which also serve as postal addresses, are assigned by municipalities. During development of the statewide system, 431 towns (330 organized and 98 unorganized territory townships) had points collected. These consist of locations corresponding to driveways and front doors of structures, and these points have been snapped to accurately geocoded address centerlines. Each point represents an existing structure and was assigned an address. Each point was also coded to indicate whether it was a residential, commercial, industrial, public use and of one or more units. Municipal addressing committees verified and corrected the field work to arrive at a very accurate rendering of existing structural development at the time the points were gathered. These points are now all geocoded by address and municipalities have been and will continue to assign addresses for all new structures as they are built. Physical addresses must be assigned by a municipality before mail can be delivered or utility service can be established. Therefore, in the vast majority of instances (other than remote seasonal cases), municipal addressing can be expected to occur.

This system is one which should be further explored to determine its feasibility for use for development tracking. At this time there is no plan or mechanism for centralized collection of new address points as the E911 system itself is fed through the Verizon telephone database described above. The large number of municipal officials that would need to participate in such a data gathering project is a clear hurdle for this approach but they are already established and networked through communication related to the E911 and road centerline file updating processes. On the plus side, the maps provided to the municipalities who engaged in the addressing process are extremely popular, used by fire departments and other officials, and represent an active routine exposure to GIS at the local level. During the process of verifying these maps, addressing committees gained an awareness of new development that had been occurring in their communities. A development tracking system that returned updated maps to municipalities would have

recognized local value for multiple purposes. In any event, the archived set of points from the date of collection sometime over the last 8 years provides a critical base dataset from which to calculate change.

3.2.1.2.1 Fine Tuning Locational Points

Slightly more accurate than addressmatched permit locations will be layers consisting of structures or other visible features that have been digitized to current orthophotography or captured in the field with GPS receivers.

An example of this would be using the E-911 lines layer to addressmatch permit locations, then manually adjusting these to correct locations over current orthophoto imagery. This presupposes the existence of current aerial or satellite photography containing all evidence of new development. Since statewide 1-meter digital ortho quadrangle data represents a funding outlay of well over $3 million using current technology, this would be an extremely expensive approach for capturing new growth at regular intervals.

But such imagery would still provide a valuable resource in the locational tuning process. The E-911 program has created accurate, addressmatched points for 431 towns (330 organized and 98 unorganized territory townships) and "snapped" these to locations on road centerlines like a string of pearls. These "pearls" consist of locations corresponding to driveways and front doors of structures and include attribute information describing which side of the road they belong on.

Since new development constitutes only a small percentage of all built structures, the vast majority of these points could be quickly and easily migrated to appropriate roof locations on the DOQQ photographs.

Satellite-captured 10 meter panchromatic SPOT imagery could provide a marginal basis for augmenting out of data photography, but it would need to be purchased frequently. MeGIS took delivery on statewide SPOT imagery in 2001 and this data is licensed for use by all government and educational users in the state. Current cost of this is approximately $15,000/year.

The level of effort involved in migrating large numbers of points this way would vary widely according to methodology used. Currently the process can be undertaken easily and effectively using out of the box ArcView 3.2 with data that currently can be downloaded from the MeGIS web site (except for the address points themselves). It is tedious work, but with an optimally configured operating environment productivity could easily exceed 250 points per hour. Attachment of crucial Map/Block/Lot attribute information would slow the process considerably but properly formatting and integrating existing assessing tables prior to the positioning process would increase productivity.

Approaches would vary depending on availability and condition of assessing data, but one hypothetical strategy would involve the following steps:

1. Select all assessing records taxed for containing structural improvements on the property
2. Match these assessing addresses to addresses derived from point locations on lines, and Link tables
3. Use linked tables to display address, owner name and Map/Block/Lot information to technician
4. Using these attribute hints, guide the point from the centerline to its appropriate rooftop location
5. With the points correctly places, generate a geographically-derived unique identifier and drop all fields except the Map/Block/Lot concatenation from the points attributes.

The result of this process would be a point set correctly positioned over structures with a unique identifier recognizable to MeGIS and the State Planning Office, that could be used by the municipality to visually display attributes of its entire assessing database.

With the foundation points in place this a similar process could be used to capture newly occurring development. Ideally the technology for doing so would be made accessible to a large group of collaborating data maintainers using Web-based point and attribute editing tools.

3.2.1.3 Polygon-based

3.2.1.3.1 Property Parcels

The next three images are a time sequence illustrating development of this same land as depicted with property parcels. These paint a much clearer and more accurate picture of property fragmentation, describing precisely how land is fractured into smaller and denser units of consumption. These data are typically maintained by individual municipal assessing departments, and represent a very expensive and complex data creation and maintenance challenge. Not only must the polygons be kept up to date, but the underlying attribute information with the many fields of information used to assess property values must maintain their precise linkage to them.

Figure 3-3: GROWTH INDICATED by POLYGONS (PARCELS)

Parcels are the standard of land use measurement for they represent the legal boundaries of ownership. As GIS features, parcels are extremely useful in that they can be graphically depicted using various colors or symbols that correspond to their underlying attribute values. For instance, a GIS user can ask a map which parcels are contained in a given zoning district and light these up, painting an accurate picture of the district as a whole. Or properties of a particular value range can be selected and displayed as a subset of the whole. The same queries using points provide no sense of the corresponding area of selected parcels.

Statewide property parcel–based development tracking will require participation of potentially hundreds of individual data maintainers. Numerous states have struggled with the creation and maintenance of parcel data over their entire land area, but none has succeeded yet. As an example, Tennessee is presently undertaking a statewide initiative, and is estimating a total cost of over $50 million to complete.

Ultimately parcels cannot be kept out of a statewide development tracking strategy. This is because they are maintained locally and contain the best technical information relating to geometric dimensions and property condition. As part of the Statewide GIS Implementation Plan, parcels will continue to be developed independently in different parts of the state according to available resources and need. Currently more than 75 communities maintain digital parcels or have them in process (including the entire Unorganized Territory under the jurisdiction of LURC and the Maine Revenue Service), though these are stored and updated according to a variety of scales, accuracies and formats, and can't be effectively integrated without more consistency of content and maintenance. It is essential to recognize that a point-based development tracking system that positions these points accurately will accelerate parcel development and utilization by serving as the automatic link to assessing databases. With such points in place, as soon as parcel lines are accurately drawn they can be lit up with the best available attribute information.

The statewide GIS implementation plan proposes creation of strict standards to guide future parcel development and maintenance. All data developed using state funding will be required to meet these standards and will reside in the Public Library of Geographic Information. With proper funding and technical incentives, parcel development will be fostered in areas experiencing or subject to the most serious growth pressures and their unified format will facilitate regional and watershed-wide analysis.

However, for at least the next five years parcels will remain a spotty and undependable data source for development tracking statewide.

3.2.1.3.2 Other parcel Uses

Parcel polygons can also be useful in development tracking as subsets of municipality-wide layers. Subdivision plans and land surveys undertaken as conveyance instruments in land ownership transactions could be collected and integrated. If every property

survey undertaken in the state every year could be acquired, geographically registered and digitized into the Library of Geographic Information, an invaluable development tracking source would be created. Unfortunately this is not data that is captured at Registries of Deeds or anywhere else. County Registries of Deeds are not map-centric, and the critical link between book/page → map/lot → parcel geometry is not made until individual assessors interpret deed references and make changes locally. Streamlining this process and facilitating clean communication between these intimately connected data sets could revolutionize land modeling and visualization.

Unfortunately, barring huge advances in coordination among surveyors and a well-staffed collection mechanism to draw these resources into the Library, this will not be a dependable source of statewide development tracking data for a number of years.

Another polygon-based development indicator consists of building footprints and other accurately digitized planimetric features. These are the ultimate resource for visually describing the state of development in a mapped environment. Such feature locations and shapes provide extremely accurate representations of not only where the buildings are but their precise geometric shapes, whether streets include sidewalks, the configuration of driveways and even locations of fire hydrants and public benches. The comparison of such a data product (at right) with the line-point composite is striking.

Figure 3-4: POINT and POLYGON DATA COMPARISON

The mechanism for capturing these features involves technical tracing of shapes from highly accurate aerial photographs and is extremely expensive, often costing hundreds of thousands of dollars for a single community. A few of the highly urbanized areas of the state have undertaken development of this high quality data, but it is outside the reach of most jurisdictions and will continue to be so for many years.

3.2.1.4 Imagery-Derived Tracking

A wide array of imagery sources exists that provide utility in development tracking. These include conventional aerial photography and orthophotography (images with their distortion corrected to allow them to layer correctly with other mapped features) to a growing array of satellite-acquired data that include varying color and resolution characteristics. These are commercially available at a wide range of prices.

For purposes of development tracking, higher resolution is generally better. Resolution describes the size on the ground of the pixels constituting the image (e.g., 1-meter imagery is a mosaic of individual shades, each measuring one square meter on the ground). The ability to discern individual roof shapes and other built features rather than vague shades and colors aids in feature detection, and is impossible using a product like 30-meter Landsat imagery and marginal using 10-meter SPOT. File size increases dramatically with resolution.

Cost also increases with resolution. Maine has recently taken delivery on statewide satellite (SPOT) imagery at 10-meter resolution for a cost of about $15,000. The City of Saco has just spent $30,000 for 6" resolution data for its relatively small municipal area.

Coarseness of imagery does not preclude it from being useful for development tracking. If it can be captured in a repeatable fashion year to year and is inexpensive it can provide a lot of utility for regional or statewide analysis. Remotely sensed (captured from cameras on satellites) data meets these criteria. The following table summarizes some of the more common satellite data sources currently used for development tracking and land cover classification over the continental United States.

SOURCE	Black and White	STATEWIDE COST (B&W)	Color	STATEWIDE COST (COLOR)	Comments
LandSat7	15 meter		30 meter	$6,500	Both bands are captured onboard simultaneously. Can be fused and co-registered. Satellite has only been up 2-3 years. Scenes are 180km/side. Should be rectified using best available DEMs. Captured (satellite flyover) ever two weeks. Should be obtai
SPOT	10 meter		10 meter	$15,000	Maine has purchased SPOT statewide as of 09/2001. Often used with 30meter Landsat for "colorization" Color is derived from fusing with LandSat7 imagery
IRS	5 meter	$250,000	20 meter	$250,000	(4) visible bands. B&W and color can be fused. Engineered like old LandSat.
Space Imaging IKONOS	4 meter	$2,500,000	1 meter	$3,800,000	(4) visible bands. Just announced a price reduction. Problems with cloud cover. Guarantees no better than 20% cloud cover. Prices will probably drop again by summer 2002.
SPOT5	2.5 meter		10 meter		(4) multispectral bands (3 color, 1 IR) Launches Q2 2002; will be used to upgrade 10meter offerings
EROS (Israeli)	1.5 meter	$1,800,000	N/A		"Guarantees" cloudless coverage in 6 satellite passes.
Digital Globe	61 cm		2.44 meter		Recently launched. Quickbird Satellite. Good data in 4-5 bands. Won't be commercially available until end of 2002
Aerial Orthophotography	.5 meter	$2,300,000	.5 meter	$2,900,000	Average vendor prices for statewide at uniform half meter resolution. Significant savings will be yielded by varialbe resolution capture over different areas of state.

Table 3-1: REMOTE SENSING (Satellite) IMAGERY DATA

3.3 Development Tracking Implementation

3.3.1 Point Based System

The most likely candidate data layer suitable for Maine development tracking will be **point**-based. Parcel polygons, linear features or data captured from repeated satellite or

aerial photography will be used collaterally and integrated going forward, but complications in standardized, statewide collection and cost prohibitions make points a better initial development indicator.

The point feature layer must provide a dependable anchor to attach underlying attribute data. It must be collected with good spatial accuracy and both physical, recorded address and Map/Block/Lot identification. This will permit forward and backward compatibility with data maintained on the property at municipal, regional and state levels. Map/Block/Lot will provide a link to most data maintained at Registries of Deeds and municipal offices such as Assessing. Accurate addresses will allow the data to link to most other data sources.

One of the attribute fields in the point layer will contain date information, corresponding to either a permitting event or the date of the feature's entry into the system. This date value will allow analysis of development patterns over time. The points should also contain attribute information defining them as commercial or residential and enumerating the number of units if residential.

Of the numerous data layers investigated, each offers potential benefits as a foundation growth indicator, although none is an obvious winner. For purposes of system illustration the points derived from the **Electrical Connection Certification** form may be considered as a promising candidate. Most of the essential components of a point-based growth indicator are covered by this layer, and there is an existing collection methodology for assembling and aggregating the points. The form used for data collection is standard among all electrified areas statewide. A copy of this form is included in this document as **Attachment G.**

The preliminary table structure below describes the basic data that would be collected to fulfill this layer's role as a development tracking growth indication layer.

FIELD	FIELD DESCRIPTION	TYPE and VALID VALUES
MPLGI_ID	Maine Public Library of Geographic Information Identification Number	STRING
MAP	Municipal Map Sheet Number	STRING
BLOCK	Municipal Block Number	STRING
LOT	Municipal Lot Number	STRING
ST_NUM	Street Address Number	STRING
ST_NAME	Street Name	STRING
ST_SUFFX	Street Name Suffix	STRING
ZIPCODE	Physical Zip Code	ZIP
COMRES	Commercial or Residential Flag	STRING < C/R >
CON_DATE	Connection Date	DATE
UNITS	Number of Units (If Residential)	FLOATING POINT

Table 3-2: Development Tracking POINTS DATA DEFINITION

The unique MPLGI_ID that is used to index these points will serve as a stable, dependable locator to which many other sources of data can be attached. It would likely

be a concatenated x,y pair in Maine's standard UTM Zone 19 meters projection. This would represent the physical structure location as closely as it could be ascertained either visually from orthophotos or via GPS. Using this strategy would guarantee uniqueness and eliminate the need to test the ID against the existing bank of already assigned numbers before committing it to the structure. The number could be two integers separated by an underscore, and would look like:

430200_4925620

This identifier could also be used to integrate the high quality geocoded data delivered as part of the E-911 project. While these are snapped to road centerlines and as such don't specifically represent structure locations, their accuracy on lines would facilitate efficient mass-relocating over orthophotos to positionally correct them. Existing points could be dragged into the roof area or footprint apparent on the photograph. In cases where parcels exist, Map/Block/Lot could be automatically assigned via a spatial join.

Newly constructed buildings wouldn't be locatable this way, but utilizing the existing capabilities of the E-911 municipal addressing officers these points could be added with a high degree of accuracy.

Ideally an online tool would be available to facilitate this data input. This would be a simple interface allowing the user to visually navigate to a location based on road centerlines and orthophotographs, then add a point with appropriate Map/Block/Lot identification and send this to the GeoLibrary for validation and incorporation into the overall data layer.

As the universe of mapped structure locations increases, the MPLGI_ID could become a de facto standard for home and business locations in the State of Maine. Any number of attributes could then be mapped to these with superior ease and confidence. Whether building or plumbing permits, telephone connection data, well contamination reports, epidemiological, noise or animal nuisance data, the presence of a MPLGI_ID will permit high accuracy mapping to a common point.

3.3.2 Human & Technical Resource Requirements of Development Tracking

Data Collection

The necessary data components to feed the system could be collected by municipal addressing officers or town code enforcement officers when assembling necessary information to fulfill electrical connection sign off. A mature system would include a Web application that allowed the point to be placed on a digital map including a combination of orthophotography, attributed roads and other reference features. Along with the point the officer would populate all appropriate data fields and submit the data to the Public GeoLibrary. An appropriate MPLGI_ID would be assigned. Additionally, the data could be transmitted to the electric utility company to fulfill the certification

requirement for the new structure. This would eliminate the need for conveyance of paper documents.

Because the ultimate objective of this system would be an exhaustive, statewide structures database, the large number of existing structure points would need to be repositioned from their current road centerlines to within the footprints of the buildings themselves.

Data Users

Ideally a development tracking system will be useful and accessible to all levels of government and the general public. At its most basic, the system must be useable by the State Planning Office to illustrate statewide growth patterns over successive intervals of time. The point data combined with rudimentary basemap layers (roads and political boundaries) will satisfy this need. These data may be accessed through an Internet application served from the Public Library of Geographic Information or another location, or viewed locally using ArcView.

Due to the inclusion of reference fields to the map, block and lot index, municipalities will be able to link these points to their assessing records or other community data keyed with these identifiers. They will also be able to relate them directly to parcel boundaries if these exist. In fact, in towns where parcel polygons are digital and up to date, it will be possible to harvest these for use in another system by referencing them through the map/block/lot identifier.

Regional Councils will be able to use the structural age data derived from Connection Date values or assessing information to uniformly assess all new construction within their jurisdictions. These could be used in conjunction with all other data layers in the Public GeoLibrary. Analyses based on proximity of new buildings to the approximately 200 mapped growth zones throughout the state would be a typical, easily executed query that could be satisfied with these data without adding value through manipulated repositioning.

Manually repositioning the address points to actual structure locations will enhance the analytical value of the data by allowing more accurate GIS queries relating to impact on sensitive areas such as wetlands and prime farmland soils. It might also be possible to characterize relative building size and/or impervious surface coverage (e.g. < .25 acre, .25-.49 acre, .5-1 acre, >1 acre) to assist in analyzing potential impacts. The cost-effectiveness of this strategy should be tested through the pilot initiative described below and integrated into the planned transition to a parcel-based system over time.

Technical Support

Regardless of which municipal official(s) is/are tapped to capture and report original data, technical support will be required. Initially, this will require field support within each municipal office, ideally provided through the regional GeoService Centers. For municipalities that requested more assistance, the GeoService Centers might actually perform the data gathering function on behalf of the municipality. Coordination for data

acquisition would be provided through the GIS Outreach Coordinator of the Maine Public Library of Geographic Information.

User support for applications would be provided by a combination of the Library Outreach Coordinator as well as support staff at the various Maine GeoService Centers.

3.3.3 Pilot Application / Proof of Concept

In order to test the feasibility and efficiency of a development tracking solution based on structure points, a pilot project should be implemented. This project would include a small number of municipalities and would test application of software, data management techniques and mobilization of human resources necessary to collaboratively capture and maintain this planning resource. The critical components necessary to develop this solution include:

- Creation of a Maine structures points file carrying a unique identifier and a link to the municipal database (establishment of file standards). This includes integrating current E-911 feature attributes and developing a roll-up mechanism to allow for local variation and statewide aggregation;
- Validation mechanism to ensure all changes comply with GeoLibrary standards;
- Training in the use of the point-manipulation application;
- Completing actual data capture;
- Determinining analytical value to all data users;
- Evaluating administrative, financial and utilitarian aspects of the program;
- Making recommendations for moving forward.

Recommended but not essential add-on components that would enhance the effectiveness of development tracking for resource impact analysis:

- Application (preferably Web-based) to facilitate manipulation of positional accuracy of these points and addition of new points as structures are erected;
- Training in the use of the point-manipulation application.

Estimated costs for this pilot are outlined in Section 3.5.

3.3.4 Integrating Regulatory, Environmental and Demographic & Economic Development Data

Along with the development tracking core growth indicators, the full suite of Public GeoLibrary data will be available for integration and analysis.

Regulatory Data include layers such as shoreland zoning, flood hazard areas and special use overlays. These are necessary for delineating legal boundaries and attributes of

physical land areas. Growth indicator information used in concert with regulatory data will describe whether or not structures are being erected in conformance with legally established boundaries.

Data sources used for modeling the natural environment that will be useful in development tracking applications include water features, wetlands, soils (might be worth mentioning prime farmland separately), slopes, aquifers, floodplains, conservation lands and landuse/landcover data derived from satellite or aerial photography. These layers will be essential for constructing buildout analysis scenarios and characterizing land as having development potential. Environmental constraints data such as these can be stacked to illustrate areas least favorable to development potential. Plotting these together with growth indicator points will reveal patterns where building is occurring at a potential environmental danger or expense.

Economic development data include such layers as Tax Increment Financing Districts, Business & Industrial parks and Mapped Growth Zones. Plotting development points against Mapped Growth Zones will very quickly reveal locations where growth is either responding well to growth area incentives or proliferating outside of planned boundaries. Such a system will provide invaluable support to policy evaluation efforts such as whether a Tax Increment Financing District actually attracted the desired development activity. Assessing attribute data would allow for ready analysis of investment comparisons within and outside targeted districts and data such as number of jobs could be easily related to geography.

An exhaustive list of data layers identified as suitable and applicable to development tracking is attached as **Attachment H.**

3.4 Advanced Development Tracking Applications

With the point-based growth indicator layer established, its maintenance and update regime in place, and full integration with other GeoLibrary data sources ensured, the foundation will be set to build a large number of high end planning and analysis applications.

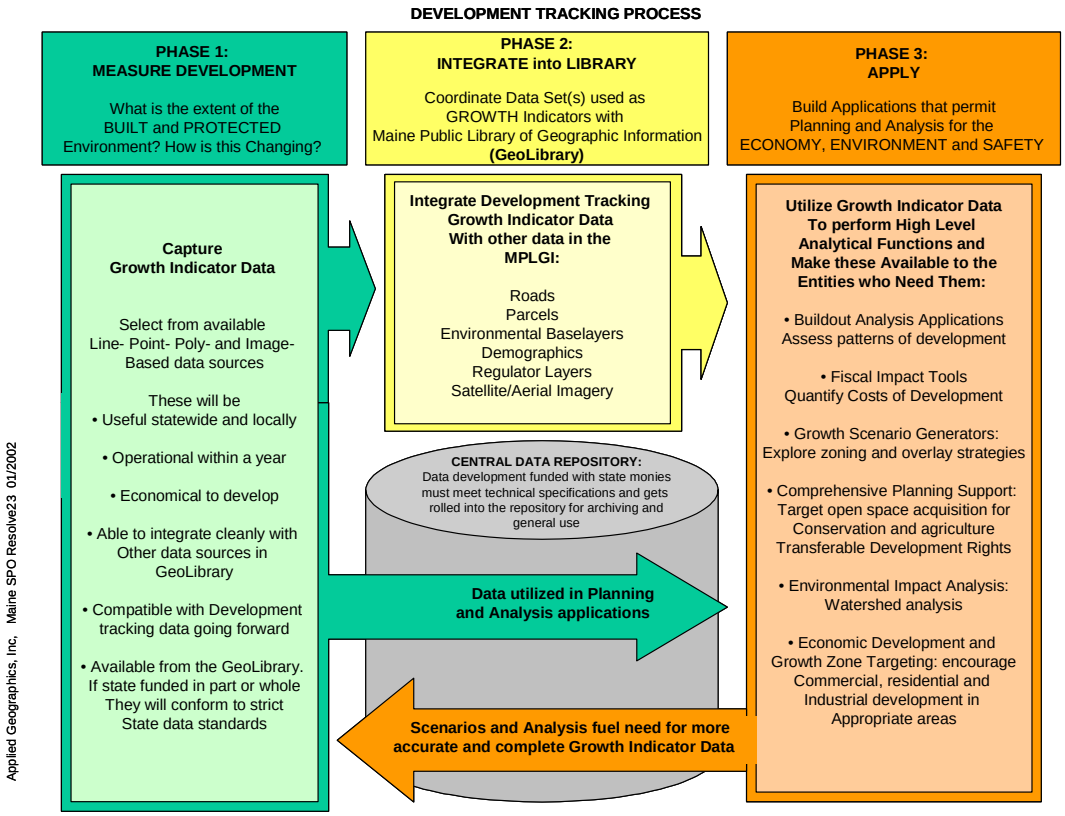


Figure 3-5: APPLICATIONS OVERVIEW

Combining this information with the many layers of regulatory, environmental, demographic and economic development data will permit development of a suite of tools that may be used to accurately and incisively track and manage development in the state. Descriptions of some of these follow.

3.4.1 Fiscal Impact Analysis Tools

An important, sophisticated application to permit Maine to analyze costs of recent development in order support more informed and better managed future development.

3.4.2 Buildout Analysis Applications

Utilizing many of the layers in the GeoLibrary, buildout analysis will examine all of the land resources of one or a collection of communities and assess the total amount of land within that area that may be legally or practically developed. Combined with exclusionary zoning data this sort of analysis can produce accurate totals of maximum allowable home and business construction, water consumption, waste production and population increase.

3.4.3 Scenario Generators

Either adding to the buildout analysis environment or starting from scratch, scenario generators permit users to test such inputs as additional zoning restrictions or special use overlays, changes to minimum lot sizes or setbacks from sensitive resources, and calculate the consequences of these changes. Assuming a town-wide minimum lot size of one acre, for instance, a town can apply a 5 acre minimum to a specified geographic area and generate numbers quantifying how this will diminish population and resource load totals. Integrating these data with information regarding school sizes, water distribution and sewage treatment capacities, or watershed phosphorus loading limitations will produce meaningful data that help to define sensible maximum growth targets.

3.4.4 Comprehensive Planning Map Support applications

Hundreds of communities throughout the state have completed comprehensive plans to guide their development. Most of the mapping and geographic data associated with these plans have not made it into GIS in such a way that it is accessible or useful going forward. Standardized mapping applications to support comprehensive planning should be developed to streamline the map-making process and ensure that data resources used in the plans do not get stranded in reports and orphaned from further use. Building these tools so that they use or favor data meeting statewide standards for the GeoLibrary will fuel the feedback loop of ever-increasing spatial data accuracy.

3.4.5 Environmental Impact Analysis

Using development tracking points and their attributes to describe new population growth, transportation analyses may be undertaken describing how movement will occur to and from these points or clusters. Air quality & fuel consumption from trip frequency & length may be calculated. Using DOT/MeGIS roads, comparative impervious surface calculations may be made between new and early development patterns.

3.4.6 Economic Development / Growth Zone Targeting

A final application type that will benefit enormously from current, accurate and accessible spatial data will be economic development tools. Encouraging robust economic development of desired types in appropriate locations is the Holy Grail of Smart Growth. GIS is indispensable in this exercise, and the better the data, the more likely such an application can be made reality.

An economic development application will know the environmentally suitable places to build, where regulations are favorable, what the neighborhood looks like, what the age, education and economics of the population are, what infrastructure (sewer, water, electric and transportation) systems are proximate and their carrying capacities, what properties are available for sale, and whom to contact to purchase one. It will be able to display this information clearly and quickly to anyone in the market with a computer and an Internet connection.

No statewide GIS can be considered mature until this type of application can be built and maintained and begins reaping genuine benefits for the State of Maine.

3.5 Recommendations for System Implementation

This analysis suggests that a point-based system utilizing one or more of the available indicators discussed above should be selected for short-term development tracking use. This layer should be augmented where feasible with parcel and/or fine-tuning based on air photo interpretation. It is also recommended that the multitude of data layers developed and incorporated into the Maine Public Library of Geographic Information be relied upon for analysis of the current and potential impacts of development.

To move this effort towards implementation, the following steps are recommended:

1. The State Planning Office should work with each of the parties responsible for management of the point indicators described in Section 3.2.1.2 to further document the mechanics of the collection of each of the point based indicators. Owners and maintainers of these data should be encouraged to participate in the data gathering elements of the development tracking system. Benefits to each party that would be asked to participate should be explored and marketed as a reward for transmitting data.

2. Following this analysis, the most meaningful and cost-effective method that meets the objectives laid out in Section 3.1 should be chosen for implementation. It is recommend that the State conduct a pilot level project as outlined in Section 3.3.3 to test one or more of the most promising approaches before implementing the system on a statewide basis.

3. A pilot area should be chosen to test and prove the concepts of point-based development tracking, and to uncover best procedures and establish costs for scaling the methodology to a statewide program. The pilot communities should end up with points that link cleanly to their respective assessing databases, are correctly positioned over existing structures, and are updated frequently and locally.

4. To the extent that the data collection serves a multitude of user needs, this project should be fully coordinated with the GeoLibrary and rely on the regional GeoService Centers for implementation assistance.

5. Data should be collected locally and validated centrally. Efforts should be taken to develop data input and maintenance software and procedures that permit input collaborators with deep local knowledge but little exposure to GIS to contribute meaningfully.

The following table contains a rough approximation of the costs associated with completing this initiative as both conservative and aggressive pilots and as a statewide project.

	Pilot: 5 Towns	Pilot: 50 Towns	Statewide
Points File Standards development and File Creation	$10,000	$10,000	$10,000
Application Creation: Point manipulation and tabular attribute editor	$50,000	$50,000	$75,000
GeoLibrary Data Validator Software writing and testing	$10,000	$10,000	$25,000
Training	$10,000	$30,000	$125,000
Data Capture and Maintenance Support	$20,000	$50,000	$240,000
Approximate Total Cost	$100,000	$150,000	$475,000

Table 3-3: APPROXIMATE PILOT COSTS

4 Benefit Analysis

What benefits will accrue by proceeding with this program?

4.1 Overview of Benefits

In order to make informed decisions about investing in a GIS program that meets the needs of a wide array of public and private organizations throughout Maine, it is necessary to look at how the application of GIS will affect specific business and decision-making processes and what the types of benefits will be.

4.1.1 Types of Benefits

There are five categories of benefits that can be realized through the application of GIS. These are:

- Task Efficiencies
- Cost Avoidance
- Improvements and Additions to Service
- Intangible Benefits
- Leveraged Investment

Task Efficiencies – Task efficiencies occur when the introduction of GIS into a business process results in time savings, or even elimination of tasks. One example of this is a local assessing department using parcel data to compile an abutters list. Another example is the use of GIS in siting public facilities such as schools. By compiling spatial and associated non-spatial data in GIS, multiple criteria associated with site selection can be evaluated much more quickly than is possible when data is dispersed and in different formats.

Cost Avoidance – Cost avoidance can be achieved when the application of GIS results in decisions or actions that enable an organization to save money it would otherwise have spent on business as usual. An example of cost avoidance is the application of GIS for vehicle routing. Using GIS for bus routing, for example, can result in a significant reduction of vehicle miles traveled and fuel used.

Without GIS, water models utilize approximations of the water distribution system that do not match with their true locations, and therefore both the inputs to and the outputs of the model are difficult to correlate with actual conditions. With GIS, model inputs can be calculated from mapped data, such as population density. In addition, model output can be mapped in meaningful ways, such as color coding pipes based on pressure against a basemap of topographic relief.

Improvements and Additions to Service – The application of GIS into an organization can be an enabler, providing a town or department with tools to provide services that would not be possible without the technology. Disaster preparedness and management is

an example of improved service capabilities. By having important infrastructure, environmental and demographic information compiled in GIS, officials can better respond when disasters occur, such as the 1998 ice storm in Maine.

Another example of improvements to service can be seen in the use of GIS for water modeling. Without GIS, models provide approximations of water flows and demands based on estimated information about the water network that are programmed into the model. With GIS the model can utilize specific information about the locations of water assets, providing more accurate results and improved ability to serve the public's demand for water and water quality.

Intangible Benefits - Intangible benefits can not be quantified in monetary terms, but are nonetheless important in the justification of a GIS. For example, many municipalities maintain paper data and plans that are old and are quickly deteriorating over time. By converting these data to GIS format historic information that only one or two staff may maintain in their heads is documented and made available to many more people to use and understand. This availability and accessibility of information may provide huge value by improving moral, inciting creativity and facilitating the sharing of ideas. Additional examples of intangible benefits include improved image of the public organization and improved customer service due to an improved ability to respond to information requests.

Improved decision-making is another type of intangible benefit. For example, if GIS is used for the analysis of land acquisition for open space, it is possible to consider spatial relationships between a variety of factors such as zoning, land ownership, accessibility via roads or public paths, cost of land, and potential use based on topography and land cover. By enabling the synthesis of multiple spatial issues into a single picture, GIS can optimize the decision making process.

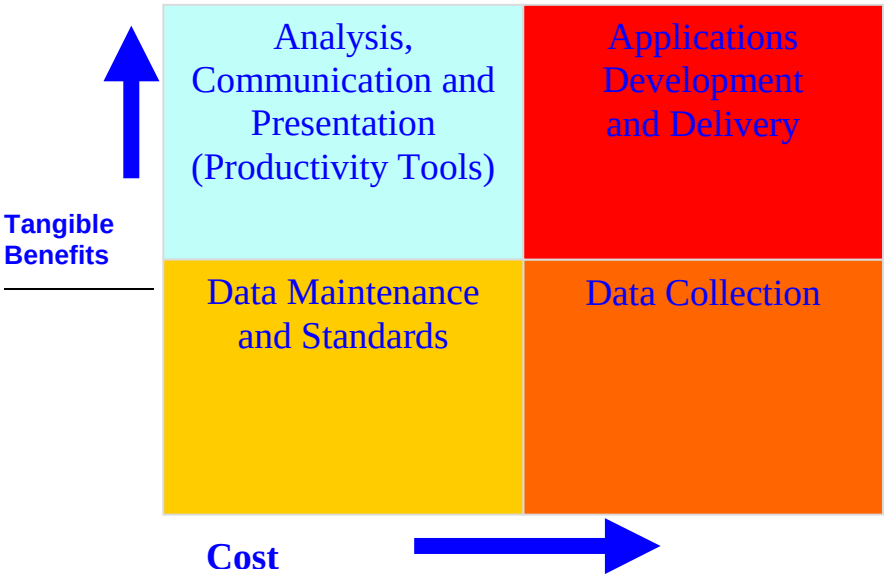
Leveraged Investment - This category relates to benefits that can be realized once an initial investment is made. For example, there are grant programs such as the United States Geological Survey (USGS) National Aerial Photo Program (NAPP) program that provide matching funds for local investments in GIS data development. By providing funding to support participation in this grant program, two dollars of product is realized for every $1 of money invested by Maine.

An additional example of this type of benefit occurs when access to an investment in GIS data and technology is given to additional end users. For example, an organization such as a utility may develop GIS data for a region that is relevant to towns, counties and state agencies. If all of those organizations are given access to the data they can utilize the data for analysis and decision-making, and will accrue benefits without incurring the cost of data development. This is an important benefit for collaborative GIS endeavors, and is the reason that partnerships can be a rewarding approach for GIS funding.

4.1.2 Costs versus Benefits

Four elements are required for a GIS program to exist in an organization: hardware, software, data and users. The specific benefits accrued will be dependent upon the data and software tools available, as well as the level of interest and education of GIS end users. While some task efficiencies can be achieved with basic GIS data and introductory knowledge of GIS by end users, other benefits may require more detailed data or customized analysis tools.

In order to realize the benefits of GIS it is necessary to invest in data collection. Software, hardware and staff are of minimal value on their own without the necessary data to support business needs. The value of the data is enhanced if the data is developed in accordance with an accepted set of standards. With wide acceptance of and use of standards a single investment in data development can provide benefits for multiple stakeholders. For existing data to retain its value it is necessary to invest in maintaining the data. If data are not maintained, not only are future benefits missed but the return on the initial investment in data collection is minimized. It is less expensive to manage and maintain data than it is to collect new data. Unfortunately, it is a frequent problem that resources are not allocated for data management and maintenance because the benefit is undervalued.



Once an investment is made in data collection some high value benefits can be accrued for a minimal relative investment by applying basic GIS functionality to support common needs such as query support and map production. While the quantitative benefit of these productivity tools may be low per use, they can provide significant value when summed over the number of uses. For example, GIS can save a planner an hour producing figures. If the planner makes 100 figures a year, this is 100 hours per year that the planner can use for other tasks.

By investing greater amounts of money in more sophisticated applications even greater benefits can be realized. For example the Maine Oil Spill Information System (MOSIS) is a special purpose application developed to enable multiple organizations to coordinate activities in the event of an oil spill. The value of GIS for such an application is that it can provide vital information such as infrastructure and plume modeling results to facilitate a rapid response to an oil spill event, resulting in the ability to better protect some of Maine's most valuable environmental and economic assets.

The benefit of geographic information technology is dynamic in nature. As additional efforts and resources are made available, additional benefits will accrue. With continued attention and support, benefits of GIS can continue and grow with the business needs of all levels of government. This report cites a number of initiatives and investments that have already been undertaken throughout the State. However, this does not imply that no further action should be taken. Rather, it is an indication that the State is ready to progress to the next level of GIS use, that of GIS collaboration and coordination.

4.2 Benefits of GIS by Constituency

4.2.1 State Benefits of GIS

GIS has a long tradition of use throughout Maine state government. In addition to MeGIS, many departments in Maine state government are heavy users. These include the Departments of Environmental Protection (DEP) and Transportation (DOT), Marine Resources (DMR), Emergency Management (MEMA), Conservation (DOC), Inland Fisheries and Wildlife (IF&W), the State Planning Office (SPO) and the Public Utilities Commission (PUC).

Many State GIS users develop and maintain independent data sets, in addition to obtaining data from MeGIS. By implementing a more coordinated state GIS program, synergies will exist enabling all departments to take greater advantage of the current level of investment in GIS by the State, and duplication of efforts can be reduced in data development and maintenance. To do this, standards need to be developed, and the infrastructure and policies for data sharing enhanced and formalized. In addition, staff are needed to manage and facilitate data sharing.

The following table lists state departments along with examples of general benefits from current and potential future deployment of GIS applications.

Department/Office	Application of GIS	Needs	Benefits
Transportation	Vehicle Routing	Roads and address data	Cost Avoidance - Reduced mileage, fuel usage and vehicle maintenance.
Environmental Protection	Permit review	Zoning, watershed, endangered species and natural resources data	Task Efficiencies – Reduced time to consider spatial criteria associated with permit approvals. Intangible – More complete consideration of multiple environmental criteria.
Economic Development	Site Selection, Marketing	Zoning, roads, utilities and parcel data and data standards	Task Efficiencies - Reduced time identifying appropriate locations for development. Intangible – Attract economic development by being proactive in presenting information.
Department of Education	School Redistricting	Schools locations and demographic data	Task Efficiencies – reduce time required to redistrict schools based upon population shifts. Cost Avoidance – prevent underutilization of schools. Intangible – Prevent school over-crowding.
Homeland Security and Emergency Management	Emergency Preparedness and Response	Infrastructure, state facilities, demographic data, data standards	Task Efficiencies – improve time to respond to emergencies such as power outages, floods. Intangible – better able to protect and serve residents during emergencies.
Safety/Police	Crime Tracking	Address data	Improved Service – by looking at the spatial distribution of crime, law enforcement can target policing efforts and protect most vulnerable members of the public such as school children and elderly.
Planning Office	Growth Management	Standards, technical assistance, data sharing policies	Cost Avoidance – minimize expenditures on grants that don't result in useable data. Improved Service – Can evaluate program efficiencies.

Historic Preservation	Tracking Properties	Locations of properties of archaeological and architectural significance.	Task Efficiencies – preparation of the Growth Management Architectural and Archaeological Sensitivity Areas maps would be reduced by automating map production in GIS. Intangible – Sharing information with communities and other planning and preservation organizations will help ensure inclusion of this information during the comprehensive planning process. This will improve the quality of these plans.
All Departments	Data Management Mapping Coordinate Licensing Communications	Data standards Standards Staff person responsible Data, staff, software, hardware	Cost Avoidance - Elimination of redundancy of data collection and maintenance by centralizing. Intangible - Standardize mapping and use of spatial data results in more confidence in information, and can improve decision-making. Cost Avoidance – reduce licenses purchased and under-utilized. Intangible – Improve ability to communicate issues and needs to stakeholders.
Insurance Industry	Flood Mapping	Flood Zone and parcel data	Cost Avoidance – by identifying areas of vulnerability, the industry can set its rates in the fairest way possible rather than spreading the cost across lower risk clients.

Some examples of specific state level benefits of GIS both in Maine and elsewhere are:

Maine Department of Health

The Maine Breast and Cervical Health Program (MBCHP) used state and federal GIS data to design and produce a set of maps to help MBCHP identify areas of unmet need for mammography and other women's health-related services. Address data from MBCHP was used to located and map existing care providers and community health coalitions. US Census Bureau population data were used to identify potential clients based on various age categories. The resulting maps were used by MBCHP to target future service locations and in proposals to procure federal funding. This work was completed for MBCHP by the local GIS consulting firm Northern Geomantics.

Maine Department of Transportation

By combining GIS enabled data from DOT and Inland Fisheries & Wildlife, DOT was able to map the incidents of animal crashes, particularly moose, across the state. This was valuable in demonstrating that the risk of being involved in an expensive, injurious crash in York County is as great as in the far off woods in the north. In addition DOT

finds GIS to be a valuable tool in communicating its resource and project needs to the Legislature, and for ensuring that all parts of the State receive an equitable distribution of funds.

Illinois State Police
GIS was used by the police department to examine traffic problems and develop more effective enforcement strategies that targeted specific areas and infractions. Implementation of a vigorous enforcement strategy dramatically reduced accidents by 42 percent compared to the previous year, and fatalities during the first half of the following year were down 29 percent.

North Carolina Department of Public Instruction
GIS was used for bus routing in the State's 107 school districts. Following a successful pilot program, the state mandated the use of GIS by all districts statewide in 1992 and provided state funding incentives. In the 1994-95 school year this resulted in the State's need for 500 fewer buses as well as a savings of 15,000,000 miles driven and 2,000,000 gallons of fuel over a six-year period of time.

4.2.2 Local benefits of GIS

GIS use at the local level usually begins with those departments that utilize maps as part of their regular business. The level of GIS use varies widely for those local governments in Maine that currently use the technology. Almost all towns with GIS find value in the ability to make maps to support traditional business needs, especially those that involve communicating with the public, governmental officials, and developers. However, there are local governments in Maine that have taken the use of GIS even further to the point where GIS is a fundamental tool in daily conduct of business.

There are a number of Maine municipalities that have made an investment in GIS including Freeport, York, Lewiston, Bath, Auburn and Portland. Many municipalities have linked GIS tax parcel maps with their assessing databases to further enhance the value of both sets of information, and others have implemented GIS across multiple departments. Auburn, for example, undertook a web-based implementation of GIS, providing departmental access to data and map-making tools on their Intranet. Implementations such as these provide the greatest benefit for the investment because the availability of maps and data eliminates the otherwise redundant efforts to create department or project specific versions of the same maps and data.

In these communities, the Assessing Departments, for example, have on-line access to the very same digital maps that the Engineering Department maintains. Assessing or Planning staff can quickly produce a map of abutters to a particular property, while engineering staff, using the same data, can produce a map for field crews to conduct home inspections for a neighborhood drainage improvement project. These examples demonstrate how GIS can become an invaluable tool for local government employees in managing and tracking information when given access to the information and appropriate training for its use.

Besides traditional GIS applications such as abutter lists, zoning maps and assessing applications, town-wide GIS implementations can provide access to information to support any business need that has a spatial component. For example, Lewiston is linking water quality monitoring information to their GIS in order to track the quality of water across the town. In Auburn, the Police department is applying GIS to crime analysis and mapping.

The following table shows examples of GIS applications from which different departments of local municipalities may benefit. The benefits are listed along with the data layers needed to support the applications described.

Department/Office	Application of GIS	Data Needed	Benefits
Public Works	Vehicle Routing	Roads, addresses	Cost Avoidance - Reduced mileage, reduced fuel usage, reduced vehicle maintenance
	Asset/Facility Management	Location of assets, asset characteristics	Task Efficiencies – Reduced time for planning large maintenance projects, timesaving in maintaining contract drawings and updating existing plans.
	Project Planning & Communications	Project specific data	Intangible – Assists in communicating project plans with municipal leaders and the public to obtain project support.
Assessor	Abutters lists	Parcels, ownership d+ata	Task Efficiencies - Reduced time in compiling abutters list
	Assessments	Parcels, attribute data on land and sales	Intangible – Greater equity in the distribution of tax assessments due to enhanced modeling and analysis capabilities.
Planning	Site Review	Zoning, roads, utilities, parcels	Task Efficiencies - Reduced time reviewing and approving plans submitted by developers.
	Map Preparation	All relevant layers	Task Efficiencies – Reduced time in preparing maps to support municipal boards and committees. Intangible – Assists in communicating issues and plans with municipal leaders and the public to obtain project support/issue resolution.
Economic Development	Site Assessment	Zoning, roads, utilities, parcels, environmental constraints	Task Efficiencies – Reduced time in selecting appropriate sites. Improved Service – Better able to respond to requests for new potential businesses and development. Intangible – Provides image of responsiveness to needs of business, which can attract economic development to appropriate areas.
Homeland Security and Emergency Management	Emergency Preparedness and Response	Infrastructure, state facilities, demographic data, data standards	Task Efficiencies – improve time to respond to emergencies such as power outages, floods. Intangible – better able to protect and serve residents during emergencies.

All Departments	Data Management	All relevant layers	Cost Avoidance - Elimination of redundancy of data collection and maintenance through centralization.
	Mapping	All relevant layers	Intangible - Standardize mapping and use of spatial data results in more confidence in information, and can improve decision-making.
	Data Query	All relevant layers	Task Efficiencies – Faster access to information since information is centrally located and accessible at the desktop. Cost Avoidance – Providing data to the public via the Internet can reduce the interruptions and time spent by town staff responding to requests for information.
	Decision Making	All relevant layers	Intangible – By applying thematic mapping and spatial analysis tools in GIS, a greater number of factors can be considered, leading to better informed decisions.

The total value of GIS to municipal government accrues through the cumulative value of many small benefits. A number of towns also realize intangible benefits such as improved decision making due to the ability to produce maps to support issues of concern. For example, the Town of Bath has noted a significant increase in the demand for GIS maps because these maps have added value, in fact have become invaluable, to the planning and decision making processes. Some other examples of specific local government benefits of GIS in municipalities in Maine and across the country are presented below. While some of these examples are anecdotal, they are representative of the variety of areas where the application of GIS provides value. They demonstrate that the investment in GIS can provide a net benefit from a variety of applications.

Westbrook, ME

By having sewer system data in GIS, the City of Westbrook was able to use GIS to access flow information. This resulted in an avoided cost of 16 person-hours of time for each trip to the field to collect flow data to open manhole covers and to observe direction of flow and pipe diameter. The sewer system has over 2,000 manholes. In addition, without GIS, staff needed to go to the original plans of the sewer system to obtain pipe information. These plans are difficult to locate in paper files, and sometimes the information on those plans is out of date or not legible. The GIS has more accurate data and frees up staff from fieldwork, allowing person-hours to be focused on other work.

The City also has a GIS layer of 2 ft. contours covering the entire city. This data layer, produced with a one-time capital outlay, continuously saves money on survey costs for construction projects, which are estimated to be between 5% and 10% of the total project costs. For example, if there is a $1 million project the survey cost on such a project is

usually between $50,000 and $100,000. This cost is avoided by using the GIS-based contour data instead of paying for additional survey work

Brunswick, ME

The Town of Brunswick is currently creating an open space plan and using GIS as part of this effort. There are approximately 100 volunteers working on this plan. These volunteers go out into the field to determine land use types. Approximately 3,000 person hours (about half the projected work time of the volunteers) was saved on this yearlong project by preparing for fieldwork through the analysis of land conditions and available open space using existing data sets in GIS.

There was also a survey of flora and fauna conducted as part of this project that required the use of a consultant to go into the field for identification. Approximately 50% of the estimated cost of the consultant was saved by using color aerial photographs with GIS software to determine this information and narrow down the area required for field effort.

Freeport, ME

The Town of Freeport has observed significant overall value in their use of GIS through an aggregation of a number of small benefits and efficiencies. For example, the Town receptionist has been given access to GIS tools and basic assessment data. As a result, the number of interruptions and the amount of time spent by the Assessor's office responding to requests for property information has been reduced. It is estimated that about a dozen requests for property data come in to the town each day. If there is a savings of 5 minutes per query by using GIS, this results in a savings of 5 hours a week, or 260 hours per year. While the town receptionist is performing new work more efficiently, the Assessor's office is freed to focus on their primary responsibilities. Additional savings have also been noted in the production of maps, in using GIS to reapportion voting districts, and in preparing mailing information to residents impacted by the Town's Browntail Moth Spray program. In aggregate, this results in months of savings per year.

Intangible benefits have also been noted by Freeport. Most notable are the new analysis capabilities that are added with GIS and the contribution of GIS to decision making. By improving the ability to communicate complex issues when a subject comes up for public debate, better decisions are made. Examples of GIS analysis functions that Freeport finds valuable include: plotting, viewing and basic visual analysis of property sales data; assessment of the factors that effect property values such as the proximity to specific natural (e.g. views, wetlands) and man-made assets (e.g. public sewers); and, providing the ability to measure the impact on property owners of proposed changes to zoning such as expansion of stream buffers.

Hampden, ME

The Town of Hampden recently completed a parcel map to help in planning projects. The parcel development allowed the planner to focus efforts on other projects rather than make maps for the planning commission meetings. The town estimates that the $10,000 spent to create the parcels was recovered in 2 years given timesavings based on the hours that the planner used to spend making maps for the planning commission alone.

St. Paul, MN
The City participated in the Local Update of Census Addresses (LUCA) program. This program allows communities to ensure that the Census Bureau has accurate information. The City used GIS and identified 1,099 housing units that the Census Bureau had not accounted for. The 2,900 people residing in the additional housing will result in the City receiving an additional estimated $5 million in federal funding over a ten-year period.

Marlborough, MA
The City of Marlborough estimates a cost savings of $50,000 per year by using it GIS data in lieu of survey contractors for public works projects.

City and County of Honolulu, HI
The city and county required maps and data to support facility maintenance management of the wastewater system. These maps were also required for master planning to support capital improvement program funding, planning, scheduling and tracking. GIS data sets were created of the sewer infrastructure facilities. These data support maintenance management, modeling and work order production. As a result of using the GIS data, the city and county avoided more than $6 million in federal fines. Additionally, more accurate assessments of capacity were created, a more efficient preventative maintenance management program was set up, and the city and county are able to take advantage of the GIS to more accurately forecast budgets for future projects.

4.2.3 Regional benefits of GIS

Regional use of GIS is valuable when it is necessary to compile information for multiple towns to facilitate planning, communications and decision-making. The application of GIS may be undertaken by an organization such as a regional utility, county government or council of governments, or informally by a group of towns deciding to work together on an initiative. Some examples of general benefits of GIS at the regional level are presented in the table below.

Department/Office	Application of GIS	Data Needed	Benefits
School Districts	Bus Routing School capacity planning	Roads, addresses School locations, student addresses, demographic data.	Cost Avoidance - Reduced mileage, reduced fuel usage, reduced vehicle maintenance Task Efficiencies – Reduced time for determining where students are located in relation to school capacities.
Councils of Government	Environmental Planning	Zoning, natural resources	Task Efficiencies - Reduced time to analyze multiple environmental criteria over a geographic region. Intangible – better planning and decision-making since environmental issues cross municipal boundaries.
Economic Development	Site Selection, Marketing	Zoning, roads, utilities, parcels, soils, environmental constraints	Task Efficiencies - Reduced time identifying appropriate locations for development Intangible – Able to attract economic development desired by a region by being proactive in presenting information.
All Departments	Data Management Mapping		Cost Avoidance - Elimination of redundancy of data collection and maintenance by centralizing. Intangible - Standardize mapping and use of spatial data results in more confidence in information, and can improve decision-making.

The following are examples of typical regional government benefits of GIS as experienced in Florida and California:

Santa Clara County, CA

Santa Clara County implemented a study to determine the possible cost savings that could be achieved by implementing a multi-participant GIS system where several municipal, utility, and county agencies share the cost of data development and system maintenance. This study indicated that staff in numerous agencies at each level of government spend approximately $960,000 worth of time each year when preparing and manipulating maps to exchange data with other agencies. If data were exchanged electronically the County estimated that staff time would be reduced by 75 percent, resulting in an annual savings of $720,000. In addition, it was estimated that if all

agencies and departments used the same base map and map updates were coordinated to eliminate duplication of effort approximately $684,000 in map maintenance costs could be saved annually.

Duval County, FL
The County School District Transportation Department required improved school bus routing throughout the county. A GIS-based automated routing solution was implemented, resulting in the elimination of 20 bus routes. The elimination of these routes will save the school district an estimated $700,000 annually.

4.2.4 Benefits of GIS to Non Profit Organizations

GIS is also a valuable tool for applications outside of government. A variety of non-profit organizations in Maine have applied GIS to their projects. There is currently a high level of data sharing and partnering for data development between non-profits, colleges and universities and municipalities. Much of the data developed and shared, however, is not created to any specifications or standards. This can often limit the value of the data to the specific purpose for which they were created. The benefits of GIS to non-profit organizations are as varied as the organizations themselves. The following table presents some examples of the application of GIS to non-profit organizations in Maine:

Department/Office	Application of GIS	Data Needed	Benefits
Maine Audubon	Tracking Sprawl	Parcel data, Zoning data	Intangible – Better able to understand development patterns and develop strategies to influence behavior.
	Identify Potential Conservation Land	Landuse and parcel data, data from municipal comprehensive plans	Task Efficiencies – Reduced time to identify land to be acquired or protected frees up more time for decision making and taking actions. Intangible – Better able to coordinate land conservation efforts with comprehensive planning efforts of municipalities.
Island Institute	Communications and Scientific analysis	Sampling data, contours, data on habitats, coastline, parcel data and data from DEP	Intangible – Able to analyze and clearly integrate scientific and planning data, and communicate this in a form that can guide municipal planning and decision making, thus minimizing adverse impacts on island communities.
Maine Lakes Environmental Association	Analysis of Phosphorus loading	Landuse, phosphorus loading data	Intangible – Able to identify critical areas to effectively target mitigation efforts.
All	Data Management		Cost Avoidance - Elimination of redundancy of data collection and maintenance through centralization.
	Mapping		Intangible – Better able to present project specific information to constituents, resulting in more productive communications.

4.2.5 Benefits of GIS to Other Stakeholders

In addition to the specific benefits discussed above, the availability of GIS tools and data can benefit other stakeholders in Maine, including the private sector and the public. GIS is heavily used by some segments of the private sector including **telecommunications** and **utilities**. Individual companies invest significant amounts of money – up to millions of dollars - in the development of data sets for their own business purposes. The availability of specific digital municipal data, such as parcel data, through the GeoLibrary would increase the value of the private sector's GIS by enabling more detailed analyses of their service areas. For **consulting engineers** and **scientists**, the existence of standards and a catalog of data available in the GeoLibrary would enhance their ability to provide value added services to their clients by reducing the duplication of effort for project specific data development.

Other private business areas that would benefit from GIS include **realtors** and **developers**. Both of these groups use parcel data and other spatial data regularly as a part of normal business operations. With GIS, realtors will be better able to serve their clients by having the data and tools necessary to evaluate the multiple criteria that need to be considered when looking to buy, sell or develop a property. Similarly, developers spend a significant amount of time identifying appropriate sites for specific business opportunities. Not only will the GeoLibrary assist in the site assessment process, but the simple fact that all stakeholders in a development project will have access to the same data will result in improved communications. This can result in significant *cost avoidance* through the reduction of lengthy battles between developers, municipalities and the public over sites chosen by relying on incomplete information.

GIS is also an extremely powerful educational tool for Maine's students. By introducing GIS into classrooms at the elementary and secondary school levels, students can be guided to synthesize knowledge gained through specific classes and educational experiences. For example, students may study history, earth sciences and social studies. With GIS, information about historic sites, natural resources and demographics can be analyzed together to demonstrate to students the importance of geography and environmental factors in historic settlement patterns. In addition, exposure to GIS software strengthens general computer literacy.

Individual members of the public will also benefit from the use of GIS. By providing access to information and simple data viewing tools via the Internet, individuals with access to a PC at home, school or the library will be able to access information about their town, region or state by going to the GeoLibrary. This will improve the public's ability to participate in public debate, and to influence decision making that affect their quality of life. Further, it saves individuals the time that would be associated with collecting this information from state agencies or public libraries.

4.2.6 Collaborative Benefits of GIS

GIS is used in Maine at the local, regional and state government levels, and at each level there are a series of benefits that can, and have been realized. However, some of the most valuable benefits of GIS are not realized within any one level of government. Collaborative GIS initiatives that involve a variety of participants provide a great deal of value through the coordinated development and use of GIS data. With collaboration it possible to avoid the duplication of effort that can occur when multiple organizations develop similar data independently. The primary benefits associated with collaborative GIS initiatives are those of leveraged investments.

GIS consists of a number of layers of data. Each layer of data has value of its own, but the value of multiple layers can be greater than the sum of the individual layers. This is true because of the powerful analysis and decision support capabilities of GIS. For example, data about the location of roads are widely used across all levels of government for setting the context of a geographic area or determining the best route from one point to another. Parcel data is useful for observing the distribution and ownership of land, and

zoning data identifies how land can be used. Any of these sets of data in GIS are useful for observing specific categories of information. However, when these three data layers are combined the information can be used by a number of different organizations and groups for many purposes. A transportation department may use the data to estimate the number of parcels that would be impacted by a new road project, an economic development agency can use the data to target the most appropriate parcels to market to new businesses, and a town can use the combined information to determine if zoning should be changed.

Site assessment and site selection for all purposes is a valuable application of GIS. In addition to economic development, GIS has been used to identify the most appropriate location of public and private facilities. By combining local information about parcels and zoning with regional utility data and the location of public services, GIS can dramatically decrease the time it takes to locate facilities such as new police and fire stations, libraries, health care centers and schools. In North Carolina, GIS was used to analyze potential locations for a new fire station. With the support of GIS the decision was made to relocate two existing stations rather than adding a new station. The result of this decision and action was a reduction in fire department response time from 7 minutes to 4 minutes, and a savings of an estimated $2,000,000 in building costs, equipment and salaries over 5 years.

Some specific examples of the benefits of collaborative GIS are presented below.

Homeland Security

The United States Federal Geographic Data Committee (FGDC) has determined that GIS is an invaluable tool for the handling, display, and analysis of information involved in every aspect of Homeland Security. It is not possible to address the issue of Homeland security without crossing geographic, governmental and professional boundaries. It is only by collaborating that public safety and assets can be adequately protected. The FGDC indicates that GIS is useful on many levels. For example:

- **Detection:** GIS information provides the spatial and temporal backdrop upon which effective and efficient threat analysis is accomplished. By linking and analyzing temporally and spatially associated information in real time, patterns may be detected that lead to timely identification of likely modalities and targets. This type of approach has been applied recently in the Greater Chicago area.
- **Preparedness:** Emergency planners and responders must often depend on geospatial information to accomplish their mission. Current, accurate information that is readily available is crucial to ensuring the readiness of teams to respond. GIS information access and interoperability standards are essential elements as they support the means for the local, state and federal response units to react to terrorist attacks, natural disasters, and other emergencies.
- **Prevention:** GIS information provides a means to detect and analyze patterns regarding terrorist threats and possible attacks. This information, coupled with

information about borders, waters, and airspace, in turn may lead to the disruption of their plans or the prevention or interdiction of their attacks.

- **Protection:** GIS information is a very important component in the analysis of critical infrastructure vulnerabilities and in the use of decision support technologies such as visualization and simulation to anticipate and protect against cascading effects of an attack on one system as it relates to other interdependent systems.
- **Response and Recovery:** GIS information has been used by many organizations in response to and recovery from natural disasters. Similarly, this information is invaluable for emergency response services of all kinds, as well as for carrying out long-term recovery operations. GIS has been applied extensively in New York City to support the response and recovery efforts following the attacks on the World Trade Center.

Maine's Beginning with Habitat Project

The Maine State Planning Office (SPO) in collaboration with the Maine Department of Inland Fisheries and Wildlife (MDIFW), Maine Natural Areas Program (MNAP), US Fish and Wildlife Service (USFWS), Maine Audubon Society (MAS), Wells National Estuarine Research Reserve, and the Southern Maine Regional Planning Council (SMRPC) are working together to develop and pilot a new approach toward town and regional open space planning.

In order for communities to grow in a manner that promotes conservation and protection of critical natural resources, towns need access to current resource information. The "Beginning with Habitat" project focuses on 10 -14 towns in Southern Coastal Maine to promote a greater local understanding of the need to conserve biological diversity and to provide useful tools to these towns which will help them chart their future growth. For each of the pilot towns a series of digital and hard copy maps, with supporting information, will be developed which identifies 1) habitats of management concern as identified by MDIFW, MNAP, and USFWS; 2) riparian, wetland and open water areas which need to be conserved to maintain habitat connectivity and integrity in a developing landscape; and 3) large undeveloped blocks of regional significance. Information on wetlands, watershed boundaries, conservation ownership, and landuse will also be provided. Technical assistance will also be provided to help towns analyze the data and incorporate it as appropriate into comprehensive and open space planning.

The result of this effort will be the enabling of local, regional, state and federal entities to adopt a proactive strategy of sharing information and technical expertise, and improving planning and decision-making. The response to this project from the natural resource community, the planning community, towns, land trusts, and others has been overwhelming. What has become enormously evident is that this work is extremely timely and important as towns face the pressure of increased growth and development and work to maintain the natural character of their communities.

Maine's E911 Project
The Maine Office of GIS is collaborating with the Department of Public Safety and municipalities throughout Maine to develop road centerline data as part of the E911 project. This project provides valuable data that can be used to associate addresses with spatial road data. The project has been funded through a combination of bond funds and a telephone surcharge, with participating towns providing in kind services to review, edit and update data. The resulting data has and will provide recognizable benefits to the majority of GIS users in Maine. This is a good example of a data development project that provides benefits through multiple levels of government as well as the private sector with one targeted application of resources.

The street centerline data has been used by municipalities such as Bath to map sidewalks and develop maps to facilitate decision-making about maintenance activities. Having access to this data has saved time in producing the maps needed to support this process, and has enabled Bath to present more maps for communication and review than would have been possible with a paper based system. Other uses of street centerline data from this project include (a) geocoding of lead information by Maine State Housing to target educational literature and service needs and (b) school bus routing by the Department of Education to improve the efficiency of miles traveled in school districts across the State.

Michigan
During the summer of 1996 the Michigan Departments of Transportation, Natural Resources, State, and Management and Budget voluntarily came together to pool their resources to create a single, up-to-date, accurate, statewide base map and associated applications. Michigan estimates that this approach saved the State over $15,000,000, or 50% of the cost, for the development of the basemap compared to the aggregated cost of data development by each department. In addition, the project has provided a focal point for establishing partnerships between federal, state, regional, county and local agencies and improving communication among agencies involved in geographic information management.

4.3 Description of Benefits by Recommendations Made in the Coordination & Implementation Plan

Pillar #1: Standards
Standards for the development of spatial and associated attribute data and metadata are necessary to ensure the highest return on investment in data creation and maintenance. A significant amount of resources are spent throughout the State on the development of digital spatial data, however there are no standards in place to ensure that the data will have value for purposes other than the specific use for which they are created.

The State Planning Office has awarded about 400 planning grants totaling $1.2 million for the development of GIS, including development of digital parcel data. In addition, $100,000 has been spent on 225 implementation grants to develop land use and zoning data. If statewide GIS standards are developed, these investments can be leveraged into

the core of a consistent, statewide land records mapping and analysis system that will accrue both economic and environmental benefits to the state. Similarly, standards will enable data produced by colleges and universities to be incorporated into the statewide data sets, enhancing the value of academic contributions to the state data reserves.

Similarly, when land surveys are done for public projects, the spatial data are developed in an assumed coordinate system rather than a standard coordinate system such as State Plane meters or UTM unless there is a specific requirement otherwise. This means that it is not possible to precisely associate these data with other spatial data sources. The existence of standards will enhance the return on investment in data development by ensuring that all spatial data that is created can be shared and combined with other data.

When municipalities hire a consultant for a transportation project, environmental assessment, or other projects, spatial data may be required for analysis of the issues. If existing spatial data do not have metadata, consultants will not have confidence that the existing data are appropriate for use, and will develop new data. This cost is incurred by each municipality. Costs of developing new data could be reduced if existing data were well documented and conformed to standards.

Pillar #2: Expanded Data Warehousing

A key goal Maine's statewide GIS expansion is to create the Maine Public Library for Geographic Information. By improving the State's GIS infrastructure all of the state's data can be collected and made available through the Library, providing one-stop shopping for access to Maine's spatial data. Making access easier and more efficient will lead to increased use of data for multiple purposes, and a greater return on investment.

In addition, the existence of the Library will save individual State agencies the time and effort required to respond to multiple requests for data. The Department of Transportation estimates that it requires 10% of a full time equivalent employee to service requests for road data from other state agencies, consultants, federal agencies, regional planning commissions, towns, utilities, and map companies. Aggregating requests for specific data sets across all State departments that use GIS can easily add up to a full time employee. If data requests to municipalities and regional organizations across the State are considered also, the time of multiple full time employees can be saved and used for more valuable tasks.

Perhaps the greatest benefit of the Library will be a reduction in the duplication of similar data sets across the State. It is often the case that data sets are developed from scratch because nobody is aware that a data set may exists elsewhere, or they cannot access an existing data set in a way that is easy for them to use. The Library will alleviate this. Some key data sets, for example, are maintained by multiple State agencies. Road centerline data are maintained by both DOT and the E911 program and hydrologic and drainage divides are kept by various state agencies. This is not only a duplication of effort, but it is also a burden to potential users who may become confused or frustrated in attempts to understand differences in data quality, content and availability. By

consolidating these data in the Library, the time spent on data maintenance is reduced to a fraction of the cost and data quality will improve.

An important intangible benefit of the GeoLibrary is its ability to provide common data for use by all stakeholders, including state and local decision makers, non-profit organizations, the private sector and the public. This will ensure that everyone involved in addressing an issue of public concern will have access to the same information to perform independent analyses and assessments, thus "*leveling the playing field*" with regard to data access. The value of this is that it empowers stakeholders to inform themselves, and can elevate the level of debate. This may ultimately assist in achieving consensus or in formulating compromises necessary to move projects forward.

Pillar #3: Statewide Data Development

The Needs Assessment indicated that there is wide need for several important data sets that are currently unavailable, including: parcels, zoning, protected open space and land cover. These data are necessary to provide efficiency benefits to all level of government, as well as to enhance current GIS capabilities.

Recognizing that developing high-quality local data sets requires access to consistent, high-quality base mapping. It would be beneficial for the State to actively work with the USGS by providing matching funds for the National Aerial Photo Program (NAPP). Maine's investment in new orthophotographs could leverage up to $1.6M of USGS funding to create an improved base map for the State. This would underpin much of the new parcel and zoning development that can provide value in the coming years.

The development of land cover data will contribute to the value of many types of GIS applications including growth management and watershed protection. Statewide land cover data will be valuable across all levels of government and the private sector for site assessment and site selection applications, as well as for tracking development and environmental impacts.

Zoning data is maintained by individual municipalities, many of which use town and city specific zoning codes. By providing grants to standardize the codes and aggregating these data in the Library, statewide zoning data will provide value to regional and state organizations for planning and environmental protection efforts, as well as for targeting and attracting economic development.

One of the most valuable data sets across all levels of government and the private sector is parcel data. Encouraging and supporting a standard approach to parcel development that is adoptable by each municipality will benefit State agencies, counties, utilities and the private sector. At this time, organizations such as the Department of Marine Resources, Portland Water District and regional Councils of Government needing parcel data for a region must contact individual municipalities, and then spend the time pasting data sets together for regional consideration. Not only does the pasting process yield inconsistencies and data gaps, but the total time required by each requesting organization

may be 60 hours per use, depending on the geographic extent of the area, adding up to a significant amount of time when the number of public and private organizations making requests is aggregated. Furthermore, after such an effort is made there is typically no means of keeping such a valuable data set updated so that it retains its utility going forward. In addition, digital parcel data does not exist for many towns, leading to incomplete analysis of some areas.

Statewide parcel data would provide value for a number of applications such as development tracking and economic development. In addition it can provide task efficiencies across all levels of government. At the local level, digital parcel data enables an Assessor to cut the time required to complete a single abutters list from hours to minutes. This savings can also be realized by State agencies needing to contact residents about a new road development project, or in the event of an emergency such as a gas explosion or environmental concern. Over a year this can add up to hundreds of hours.

Pillar #4: Application Development

There are a number of potential GIS applications that will have wide applicability for current and future GIS users in Maine. Priority public sector use areas identified in this study include development tracking, environmental protection, economic development and homeland security, but the greatest benefits will be realized through the establishment of statewide standards and coordination Once data are developed, the maximum value of the data is realized in its use for analysis and communications. For example, both homeland security and environmental protection applications for GIS that utilize up-to-date data in the Library would enable local, regional and federal public safety officials to respond in almost real time to emergency situations. In addition, it will assist in planning and preparing for events by providing the ability to model different scenarios and actions to be taken. All this will ultimately result in improved public safety and protection of Maine's environmental assets.

The creation of an economic development application can benefit local, state and private organizations by assisting in the assessment of sites for development. South Carolina has actively used GIS to market locations across the state for business development and has been highly successful in attracting new businesses and the tax dollars that they bring.

A development tracking application will measure the change in landuse brought about by human development. Quantifying this change is essential to assessing evolving needs in infrastructure planning and environmental management. The State of Maine currently has no uniform and consistent method of capturing these changes. The value of such an application is that it will enable towns, State agencies and utilities to proactively assess, plan for and coordinate future development.

Pillar #5: Outreach, Education and Coordination

Providing outreach and support to GIS users in Maine will ensure that they get the most of existing and future investments in GIS. Currently, some GIS users in the State do not

utilize software and data to which they have access because they are unable to overcome simple technical hurdles. For example, some towns do not know how to change the projection system of GIS data layers so they do not take advantage of some data sets that already exist.

Currently, most data collected as part of survey and engineering work done locally is not usable in GIS because of a lack of data development standards and the absence of simple requirements that data be submitted digitally. The development of boilerplate language and standards for data development should assist in growing municipal data sets over time.

By providing staff to educate GIS users about data development, standards and technical issues, municipalities can capitalize on investments made in GIS. Some municipalities have GIS software and have paid to have data developed, but the data are not being used. This represents a lost investment of thousands of dollars for some towns because of lack of staff and/or expertise. By establishing an outreach network and developing standards and some basic publications about GIS, stranded investments can be minimized.

4.4 Business Justification for Development of The Maine Public Library of Geographic Information

This report presents many examples of GIS use and benefits in Maine and in other states with relevant experience. The information in this report was compiled from a number of sources including direct experiences with organizations using GIS, published materials and interviews and personal conversations with GIS users in Maine. As presented in Section 4.1, there are five general categories of benefits that Maine could realize with an enhanced GIS program:

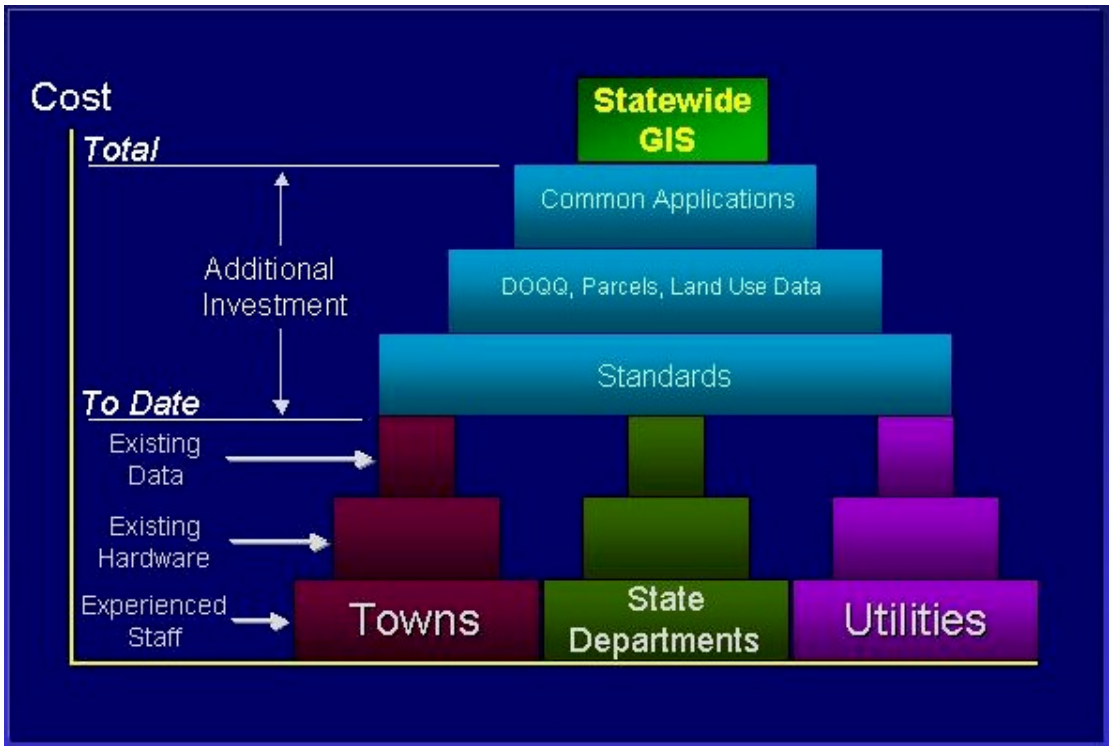
- Task Efficiencies
- Cost Avoidance
- Improvements and Additions to Service
- Intangible Benefits
- Leveraged Investment

Examples of all of these types of benefits have been presented in Section 4.2. Based upon these examples, the following table summarizes the benefits that Maine can expect from an investment in an enhanced statewide GIS program. The aggregation of the information in this table demonstrates that Maine can realize millions of dollars in benefits for state and local government, as well as for the public, by taking action on the recommendations in this report. Maine can expect some specific quantifiable benefits by implementing the recommendations in this report, these are described in the text following the table.

Benefit Type	Application of GIS	Magnitude of Benefit
Task Efficiencies		
	Site Assessment	Days of time per use by state, regional, local and private organizations.
	Abutters lists	Days of time per use for all municipalities in Maine.
	Production of graphics	Weeks of time per year for all municipalities and many state agencies.
	Permit review	Weeks of time per year for DEP.
	School redistricting	Weeks of time per project for DOE and school districts.
	Political redistricting	Weeks of time per project.
Cost Avoidance		
	Vehicle Routing	Potentially millions of vehicle miles traveled, at 36.5 cents per mile, by school districts, local DPWs, state DOT.
	Duplication of effort for data development and maintenance	Thousands of dollars a year for state agencies.
	Software licensing	Thousands of dollars per year for municipalities and state agencies.
	Support for data sharing	Weeks per year for DOT and DEP, days per year for municipalities with digital parcel data.
Improvements and additions to service		
	Targeted police efforts from crime analysis	Reduced crime resulting greater public safety.
	Faster emergency response times	Saves lives and protects valuable assets.
Intangible Benefits		
	Improved decision making	Better confidence in public and improved quality of life.
	Attraction of new business	Increased tax revenues and employment rates.
	Prevent loss of data	Potentially millions of dollars of paper records.
	Improve public health	Target health services and education based upon spatial distribution of population.
	Improved education of students	Introduction of GIS in schools provides tools for students to synthesize knowledge about geography, social studies, mathematics and computers, and to actively pursue knowledge about their state.
Leveraged Investment		
	Grant money for planning	$1.5 million over ten years of SPO grants.
	USGS NAPP funding	$1.6 million for development of ortho-photography.
	Local land survey data	Thousands of dollars for data development per town in Maine.
	Prevent loss of data	Potentially millions of dollars of paper records.
	Ability to make case for grant funding	Potentially thousands of dollars in grant funding.
	Future data development	Potentially millions of dollars for data development by municipalities and state agencies.

As discussed throughout this report, there are many successful applications of GIS in Maine at this time. Approximately $20 million dollars has been invested by the state in GIS data and application development since the early 1990's, and currently roughly $2 million is spent annually to maintain the current infrastructure. Additional millions more have been invested by local governments such as Lewiston, Auburn, York and Portland, with hundreds of thousands of dollars being spent by municipalities across the state to maintain GIS assets. The result is a solid foundation of GIS knowledge, data and tools.

The actions proposed in this report have been formulated to enable Maine to leverage this investment. The Maine Public Library of Geographic Information will provide the capacity and infrastructure to give broader access to Maine's existing state, regional and local GIS data. In addition, through the creation of standards, new data that is developed over time can be stored in the Library and made available and useful to a wider base of users. The benefits will therefore have a multiplying effect. The graphic below shows how the independent efforts of different entities when combined with strategic ***statewide investment*** can result in the efficient creation of a true statewide system.



For example, if a town hires an engineer to do a land survey of a specific area, and the new data standards are applied, these data can be brought into the Library. Then, if a utility is called in to do work on the site as a result of development, the cost of collecting new redundant data is saved. Without the standards and the Library it would be necessary to recreate these data because the utility would either not know of the existence of this data, or would not have confidence in its use because of lack of standards. Rather

than providing benefits only for the specific site assessment purpose for which the data set was collected, the life and value of the data is extended, resulting in a multiplication of benefits. If a single site survey cost $1,000, and a town has 5 surveys done a year, this is $5,000 per year, per town. This is a lost investment in spatial data development because of the lack of standards and a lack of an infrastructure such as the Library for sharing these data.

Similarly, as noted in Section 4.3 the State Planning Office (SPO) estimates that approximately $1.5 million in grant moneys given by the state over the last 10 years *could* have produced a higher return on investment if GIS data standards were in place. With standards and the Library, the grant moneys provided by SPO to assist communities in developing data for comprehensive planning would have provided additional value for current and future use at all levels of government. Since the comprehensive planning program will continue over time, there is an opportunity to capture this additional value for all *future* SPO grants.

The existence of the GeoLibrary will also save Maine the cost of duplicated efforts for data development and maintenance. For example, it is currently costing Maine double what it could to maintain street centerline data since this is done both by DOT and for the E-911 program. Similarly, multiple agencies spend time maintaining hydrologic and drainage divides data when it can be streamlined to a fraction of the effort by having the data located in a central repository. To accomplish this, a committee could be formed for each duplicated data set to determine which is of the highest quality and value to the most end users. This would then be designated as the master data set, and the responsibility for editing the data placed upon the individual or individuals that are most appropriate.

The GeoLibrary will also provide the benefit of avoided costs of sharing data. DOT estimates that it requires about 10% of a full time equivalent employee to respond to road data requests. By combining data requests to all state agencies and serving them with the Library, this staff time can be saved and used to support the Library and similar statewide GIS coordination and outreach endeavors instead. Similarly, towns and regional councils of governments (COGS) service a number of data requests and COGS also spend time compiling GIS data for municipalities in their jurisdiction. This staff time could also be redirected to support the needs of the Library, or can be spent on more worthwhile activities at the local level.

As part of the GeoLibrary, it is recommended that Maine work toward the development of digital parcel data statewide. These data would be valuable to all Maine organizations, public and private, that have GIS. For example, the collaborative Beginning with Habitat project discussed in Section 4.2.4 involves the compilation of many environmental data layers to aid towns in proactive planning. While these data are valuable in understanding environmental issues and threats, the availability of parcel data in combination with the Habitat data would bring the benefits of this program to a new level. This would give local regional, state and federal decision makers the ability to place environmental assets in context with existing property information, thus empowering them to make better-informed decisions.

The Town of Hampden estimated that the $10,000 cost of developing digital parcel data was paid back in 2 years based only on the time it saved the Town Planner to produce maps. If the benefits of this data for other town, regional, state and private uses were considered, the time to recover the cost of the investment would be even shorter. This benefit will be magnified further the more municipalities develop digital parcel data that conform to statewide standards, and place the data in the Library.

In addition to adding value to the existing foundation data, having statewide parcels in the Library will save time across all levels of government for data sharing. Many state and regional agencies require parcel data for regions of Maine. In order to compile this data it is now necessary to contact all towns in the target region and manipulate the data from each so that it can be spatially aggregated. In many cases updated digital data are not even available. This type of activity is undertaken many times each year by organizations all over Maine.

Finally, outreach and technical assistance is needed to support end users of the Library, especially those that are new to GIS, or that are unsure of how to take advantage of this asset. Municipalities in Maine have spent thousands of dollars over the last decade on GIS data and software that sit unused and un-maintained. This investment is wasted because of a lack of understanding about how the data can be used, as well as because staffs do not have the time to overcome simple technical issues associated with the application of GIS.

4.5 Summary

Use of GIS in the public sector will grow in Maine over the coming years as individual organizations make investments in data, training and GIS infrastructure. Now is the time for the state to invest in efforts to coordinate these activities before opportunities for maximizing the collective investment of public funds are missed. It is not a question of whether GIS will be used in Maine; it is a question of how effectively the resources will be applied. The programs presented in this report will provide the coordinating mechanisms to maximize the return on the States expenditures on GIS.

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5 Funding Approach

How will this initiative be funded?

5.1 Enumeration of Funding Possibilities

5.1.1 Funding Options across the Country

As Maine develops an approach for funding the Maine Public Library of Geographic Information it is instructive to study how other states fund their GIS programs. The information in this section of the report builds upon research conducted by Dr. Lisa Warnecke for the states of Maine and Ohio. Dr. Warnecke recommended States whose approaches were most transferable to the situation in Maine, and research was conducted through a number of phone calls and emails to other state GIS coordinators, as well as Internet based research.

There are a handful of approaches in place across the country to fund GIS. States typically employ more than one of these approaches to fund a suite of functions and services. These generally include the following:

- **Dedicated funding** – a specific source of revenue that provides a constant and guaranteed funding stream for some or all aspects if GIS, typically established by Legislative action. Examples include land transfer fees, lottery receipts, and bonds dedicated for GIS.
- **Mission driven funding** – funding to support a defined government function or a specific project for which GIS technology may be used as a resource or tool to support this mission through enhanced analysis capabilities or to perform a task more efficiently. The sources of funding can be of any kind used by government. These sources may include bond funds, CIO (Chief Information Officer) funds, cooperative funding partnerships and federal grants or matching funds.
- **Assessments on agencies** – a charge on some or all state agencies to support central and coordinating GIS functions. Examples include memoranda of understanding, service level agreements, and assessments.
- **Central and capital IT funding** – funds that are used for GIS, but are derived from a state's already established mechanisms to support central government functions, such as information technology (IT) operations or various administrative services. These types of funds are, in effect, a specific type of dedicated funds.
- **Cost recovery** – monies received from the sale of hard copy maps or other products. User fees are an example of cost recovery.

See Table 5.1 for a summary of the pros and cons of each type of funding. Various types of potential funding vehicles are discussed below in Section 5.1.2.

Table 5.1 – Funding Type Matrix

Type of Funding[15]	Explanation	Advantages	Disadvantages	States
Dedicated Funds (Includes options such as land transfer fees, license fees, permit charges)	A dedicated source of revenue that provides a constant funding stream. States may use a special tax or fee to produce funds	• Long term source of funding is guaranteed • GIS program becomes recognized as part of state government • Inspires confidence in GIS products and assurance that GIS resources will exist in the future • GIS staff can develop and implement long term strategy without having to continually secure funding support • Able to focus on development and maintenance of important data sets, rather than the data sets that are "funded" • Ability to provide GIS guidance and assistance over the long term	• Difficult to implement, especially in times of economic strain • Typically requires legislative action and political clout to implement • May be difficult to garner support for a statewide initiative from local, county and town level officials and other stakeholders	WI OR VT
Mission Driven Funding (Bond initiative and Federal grants would fall in this category)	Funding for a government function that provides support for GIS to assist in meeting this mission or a specific project	• Certain topics (public safety, conservation, land planning, economic development) are popular with voters and policy makers and good "drivers" for GIS, thus facilitating availability of funding to support data development to support these missions • Specific Legislative of Gubernatorial action not required for GIS if mission has broad funding support • Can be easier to justify, secure, and maintain funding over time than other approaches • Data and applications development can be funded to support specific missions • Can institutionalize GIS as a part of regular business processes and relationships (such as between state and local governments)	• Funding may not be available for ongoing system maintenance and management. • Risk of skewing statewide GIS development plans to meet a specific mission • Risk of focusing too much on a specific data sets to support a specific mission • Support for certain types of missions may be dependent on certain policies, programs or politicians, and when no longer supported, mission funding may cease • Declining economic conditions may lead to declining support for certain types of missions	ME (E911) OR (E911) VA (E911) AR MA (with Community Preservation) MI TN KS
Assessments on Agencies	Assessments on some or all state agencies to support central GIS functions, or collaboration of a few leading	• Can institutionalize and distribute support for statewide GIS coordination activities among several agencies • Distributes costs for statewide GIS activities	• May require support from key policy staff to institutionalize • Will require support of the Budget Director	KY MD ME (thru Service Level Agreements)

[15] This table is based upon the report "Final Best Practices Report for the Ohio Spatial Data Cost-Benefit Analysis" by Dr. Lisa Warnecke, GeoManagement Associates, Inc., and T. James Fries and Annie Metcalf, PlanGraphics, Inc., October 31, 2001

Type of Funding[15]	Explanation	Advantages	Disadvantages	States
	state agencies for specific multiagency GIS projects	among multiple agencies • Ensures supporting agencies have input to statewide GIS activities • Specific Legislative or Gubernatorial action not necessary if policy staff are supportive • Facilitates a coordinated GIS effort among state agencies • Provides an avenue for many statewide agencies to become familiar with GIS activities and products, which can lead to additional agencies' support and projects • Multiagency support can serve as an endorsement for statewide GIS activities and can lead to additional funding through other approaches	• May require cumbersome record keeping in order to satisfy the many state agencies involved • Will require complicated logistics to get many different state agencies to buy in • Requires annual or biennial budget review with risk of diminished funding and frequent changes in funding level • Agency competition may occur as agencies demand certain levels of service and may not contribute proportionate funding levels • Not clear who pays for the coordination activity itself	MI NC
Central and Capital IT Funding	Allocation from existing central government funding mechanism (such as information technology) as useful for GIS	• May only require support of a few policy staff (such as state CIO), and usually not Legislative of Gubernatorial action • Relatively east to implement logistically while often equitably distributing costs among multiple state agencies • May provide dedicated funding support that can be extended over more than one year • Once in place, funding levels should remain relatively stable over time	• Requires significant political and policy activities to garner support for funding • Requires the support of officials who may be voted out of office • Agencies may have limited formal input into GIS activities	MA AR TX KS
Cost Recovery	Funding received from contractual services or from the sale of hard copy maps or other products; Offer most data for no cost but charge for "premium services"	• May create public/private partnerships to operate web services (and data access services) at no cost to the state • Funds are applied specifically for services and products that have been agreed upon in advance • Funds can be carried over from one fiscal year into the next • May be used to fund specialized staff	• State laws may limit some states' ability to use some aspects of this approach • Organizations with the most funding receive the best services thus developed data may not meet statewide needs • May fragment GIS support and ability to meet statewide needs	AR MN NC UT

Type of Funding[15]	Explanation	Advantages	Disadvantages	States
		• Is not necessarily dependent on politics or policy	• Limits data development and data access to those organizations with funding • Reinforces the divide between the “haves” and “have-nots” based on financial resources • Funding may not be available for ongoing system maintenance and management • Risk of skewing statewide GIS development plans to fulfill funded rather that priority statewide data and needs	

- Long term funding support is necessary to support full time staff. Funding from bonds and/or grants is not an appropriate, or possible, solution to fund staff. Full time staff are necessary to ensure the GIS program has stability and longevity.
- For special projects such as specialized data set development, specific applications, and one-time investments in hardware and software, another potential funding source is grants from Federal Agencies or other sources. A more detailed list of Federal funding sources for GIS is included below in Section 5.1.2.
- To build up the library of digital data, it is advisable to encourage the use of GIS by municipalities and counties. A well-staffed statewide GIS organization could foster local GIS development by providing assistance, data, and other support to municipalities and counties to develop applications to meet local needs and help in pursuing external assistance such as from ESRI®, the National Association of Counties (NACo), local, and other sources to support data development and other local GIS needs.

5.1.2 Potential funding vehicles available in Maine

The following provides a catalog of the funding vehicles that are potentially available in Maine. Whenever possible, reference has been made to other states that use these particular funding vehicles. While these represent what is possible, it is important to note that this list does **not** imply that there was consensus among the Resolve 23 Steering Committee members on whether any of these vehicles is appropriate for Maine. Section 5.2.4 represents the Steering Committee's recommendation on a particular funding approach going forward.

- **Bond Funds** – Requests can be made to the State Legislature to authorize a bond initiative. The initiative then goes before the public who votes to approve or disapprove. Bond funding cannot be used to fund state employee salaries in Maine. However, it can be used to hire consultants, purchase hardware, software and data, and develop grant programs for municipalities.
- **CIO Funds** – This funding source is a type of central and capital funding. The CIO's Strategic Plan project (recently completed by Gartner Group) included GIS as "endeavor project" with statewide benefits. Two projects have been presented, "Making GIS more Accessible and Easier to Use", and "Developing Master Road Centerline GIS Database". The CIO will be going to the legislature to obtain funding for these initiatives as well as all other "endeavor projects". Although GIS is recognized as a priority, due to the importance and magnitude of other strategic IT needs, there may not be any funding available for GIS this year. Several other state CIOs provide some funding for GIS coordination. These states include ***Arkansas, Colorado, Idaho, Indiana, Kansas, Nebraska, North Dakota, Texas, Washington and Wyoming.***

- **General Funds** – General funds are appropriated by the State Legislature. This is a desirable source of funding for ongoing costs associated with a state wide GIS program to cover staff, software upgrades and fees, hardware maintenance and consumable items. It can be difficult and competitive to gain the support necessary to obtain general fund money since all state programs compete for these funds. These difficulties will be compounded during the current budget cycle where there will be statewide funding cutbacks. ***Minnesota*** uses general revenue funds to support the GIS activities of state agencies. This type of funding works well for ongoing programs but is difficult to obtain for new initiatives. ***Kentucky's*** statewide digital basemep development project was funded, in part, as a capital project from the general fund.

- **Fees and Surcharges** – Funds are raised by imposing an additional fee or surcharge on a service or license provided by the state. In order for this approach to be successful, the transaction costs associated with collecting and administering the funds must be less than the amount of funds collected, and the amount collected must contribute significantly to the financial needs for which it is collected. In addition, it is important to understand that there could be significant difficulty in gaining support from the sectors impacted by a particular fee increase. Examples of this approach are presented below:

    - Recording Fee for Land related documents – This is a fee charged on the official recording of land transfers. In ***Wisconsin,*** this fee is collected by each County's Registrar of Deeds in order to generate funding to assist in the development and maintenance of automated land records information systems. Authorized by the Legislature, Wisconsin has raised $70 million over the last decade to fund this modernization program. Most of the generated funds are retained by counties, while some of the receipts are transferred to the state to help fund local and statewide needs. This initiative has been deemed successful in modernizing land records, catalyzing local GIS activities and private sector GIS business, and lowering title insurance costs. The logic of this fee is that it imposes a cost on new property owners to help in modernizing land recordation systems, which is a key data resource for local government GIS. ***Illinois*** recently amended their Counties Code to allow the county board of a county that maintains a GIS to collect an additional $3 on filings. Funds collected under this code must be used to implement and maintain a GIS.

    - Real Estate Transfer Fee – This is a fee that is charged on all real estate transfers in the state. Potentially a surcharge could be added to this fee to provide a funding stream for GIS. ***Oregon*** charges a $1 per transfer to fund the development of statewide parcel data.

    - Surcharge on permits (building, plumbing, etc.) – This type of charge would impose an extra fee in addition to the cost of a permit. The logic of this fee is that it imposes a cost on activities such as new

development that appropriate local, regional and state departments and agencies can better track and manage with GIS.

  - Surcharge on licenses (real estate, professional engineers, etc.) – This type of charge would impose an extra fee in addition to the annual cost of maintaining a professional license in Maine. The logic of this charge is that it will impose a cost on those professions that will benefit from the existence of a statewide GIS program.
  - Utilities Surcharges Municipalities may franchise local utilities, such as Cable TV and charge a licensing fee as part of the franchise process. Funds from this fee could be used to support GIS activities.

- **Lottery Funds** – The State Legislature would need to approve the allocation of a certain percentage of lottery revenues, or a new lottery program, for GIS. For example, in ***Colorado***, a set percentage of lottery money is allocated to Great Outdoors Colorado, which can expend the money on GIS efforts and grant programs. ***Minnesota's*** Legislative Commission on Minnesota Resources (LCMR) has funded much data development through state lottery funds.

- **User fees** – User fees would be charged in return for some added service or value beyond the delivery of public information. For example, customized information delivery or access to application functionality could be charged for in order to cover the cost of developing and maintaining the service. The challenge with this approach is determining a fee level that does not discourage the use of the service, but that is high enough to recover costs. This approach works best if there is a high demand for the service, and the service is not too costly to deliver.

- **Service Level Agreements, Agency Assessments, and Contracts** – Agencies requiring GIS services are assessed an agreed upon amount in return for specific services and/or statewide coordination efforts. Some state GIS organizations work on a contract basis, supporting other state agencies or federal projects. Contracts are generally for specific projects and carry a specific budget.

  - Enterprise Network Services Rate – The Steering Committee has received preliminary approval for an increase in the assessment on state agencies for the Enterprise Network Services, most likely in the form of an increase to the per computer charge. The Enterprise Network Services Rate is a charge that covers many aspects of enterprise-wide planning and access to resources on the State's wide area network. The funding derived from this assessment could start in FY2003 at approximately $300,000 and would be adjusted from there. This funding would be used to support initial operations costs including standards development. The Steering Committee is examining the possibility of a two-year trial period for this proposed source of funding, with a review to be conducted at the end of the two years. At the end of the two-year period, it is anticipated that

additional funding may be obtained from non-state agency beneficiaries of the system.

- Contracts - ***North Carolina*** has had large, repeated contracts with state agencies and much of its current funding is supported by contract work. The State Department of Transportation has funded the North Carolina CGIA (Center for Geographic Information Analysis) to the tune of over $1million per year over the past decade. These funds are used to develop data sets and perform analysis to conduct environmental and cultural assessments for highway corridor planning. Contract work is also completed for federal agencies. North Carolina's largest GIS contract client today is FEMA. The CGIA is performing flood plain mapping services including updating Flood Insurance Rate Maps (FIRMs). CGIA has also developed a voluntary assessment program where each state agency pays a different amount based on GIS infrastructure and data use by agency. In FY01 this voluntary assessment program was funded for $850,000 derived from ten agencies.
- Assessments - ***Michigan*** has also successfully funded support and development of GIS data through voluntary levied assessments on several state agencies. Funds from assessments on eight state departments are placed into an account that totals $1.1 million and is renewed each year. Three of the eight agencies have their contribution amount in their vase budget to ensure that the funds are available each year. Michigan also works on a contract basis. GIS services are delivered to specific state agencies on a project by project basis. ***Kentucky*** funds its statewide GIS activities partially through assessments on state agencies. These assessments amount to approximately $520,000 in funds per year.

- **Federal grants or matching funds** – Specific GIS initiatives (state and/or local) would be presented to the appropriate federal agency for funding. For example the US Geological Survey's NAPP program provides matching funds to develop digital ortho quarter quads (DOQQ). US Department of Justice – Office of Domestic Preparedness grants should be explored as a possible source of funding. Additionally, the FGDC (Federal Geographic Data Committee) is strongly advocating the use of GIS technology in support of Homeland Security Efforts. While there are no specific grants available at present there may be funds in the future to support homeland security measures. The following is a summary of some federal grant programs.
  - USGS Innovative Partnerships - Offers cooperative agreements under which the agency provides support (financial or non-financial) for assistance in obtaining digital elevation, vector line, orthoimage, and similar data, in USGS or compatible formats, for the public domain from non-Federal producers. A specific program is underway in Maine. As part of the NAPP program. USGS will contribute up to $1.6 million for statewide imagery. This includes $1.3 for compilation of the digital data and $300,000 for the NAPP component, which is the photo itself.

- Federal Geographic Data Committee (FGDC)[16] offers three funding programs:
    1. Cooperative agreements for projects that will establish clearinghouses to find and access geospatial data, develop standards related to geographic data, implement educational programs to increase awareness and understanding of the National Spatial Data Infrastructure, and build or strengthen relationships among organizations to support digital geographic data coordination. For 2001 there were four categories:
        a. "Don't Duck Metadata": Metadata creation and implementation assistance. $6,000
        b. "Don't Duck Metadata": Metadata Trainer Assistance $20,000
        c. Clearinghouse Integration with Web Mapping provides funding to extend existing clearinghouse nodes with OpenGIS consortium. $20,000
        d. Canadian/US Framework Collaborative Project supports a projects between an organization in the US and Canada that have an interest in basic geospatial data over a common geography. $75,000 This may be worthwhile for Maine to look into further.
    2. Framework demonstration projects that support efforts to implement and test the data, technology, and organizational aspects of the framework. Consortia propose projects in which their members work together to produce, maintain, and disseminate framework data needed for national, regional, state, and local analyses.
    3. The National Spatial Data Infrastructure (NSDI) Benefits program funds cooperative projects that assess the impact of inter-organizational cooperation and data sharing to address important issues or solve problems over a particular geographic area. Projects may focus on environmental, economic, social, or cultural problems.

- National Institute of Justice Grant program to assist units of local government to identify, select, develop, modernize, and purchase new technologies for use by law enforcement. It may be appropriate to piggy-back on E-911 work that has already been completed.

[16] These references were compiled from information on the Internet (Indiana GIS, Ohio GIS, Federal sites)

- The National Science Foundation: Grants & Awards Provides funding for research and education in the sciences, mathematics, and engineering. This funding may be appropriate for a project that partners with a college or university.

- Telecommunications and Information Infrastructure Assistance Program (TIIAP) Provides matching grants for projects that improve the quality of, and the public's access to, education, health care, public safety, and other community-based services. Grants are used to purchase equipment for connection to networks, including computers, video conferencing systems, network routers, and telephones; to buy software for organizing and processing all kinds of information, including computer graphics and databases; to train staff, users, and others in the use of equipment and software; to purchase communications services, such as Internet access; to evaluate the projects; and to disseminate the project's findings.

- National Oceanic and Atmospheric Administration (NOAA) NOAA provides funding under several grant programs for projects related to understanding and predicting changes in the coastal ocean environment and the global environment. While programs are primarily research-based, state agencies and local governments are eligible to apply, and are encouraged to partner with academic researchers.

- Environmental Protection Agency EPA's State, Local and Tribal Projects section includes programs that provide support for open space preservation, parks creation, brownfields clean up, water quality improvement, environmental protection, and pollution prevention. The Agency also offers funding opportunities related to specific geographic regions, as well as environmental management, financing, and technology.

- Department of Housing and Urban Development (HUD) HUD provides support for projects related to housing and community development, economic empowerment, and targeted housing and homeless assistance. Information about all of HUD's grant support is provided via one annual Super Notice of Funding Availability (SuperNOFA). HUD also makes available for purchase Community 2020, a desktop GIS that includes an array of U.S. Bureau of the Census geographic and demographic data and HUD program data. In addition, the software can integrate data from a range of data sources provided by the user.

- U.S. Department of Commerce The US Department of Commerce has a matching grant program for state and local governments, and non-profit organizations, supporting those infrastructure projects focused specifically on networking/communications based initiatives. The Technology Opportunities Program (TOP) is managed by the Department’s National Telecommunications and Information Administration. TOP promotes

widespread use and availability of advanced telecommunications and information technologies in the public and non-profit sectors. The purpose is to help develop a nationwide, interactive, broadband information infrastructure that is accessible to all Americans in rural and urban areas.

- National Aeronautic and Space Administration (NASA) This program is focused on state, local and tribal governments. It is geared toward projects that are solution oriented and address one or more of the following application areas:

  - Resource Management
  - Environmental Assessment
  - Community Growth and Infrastructure
  - Disaster Management

NASA seeks organizations in the U.S. that will lead the use of NASA and commercially developed remote sensing capabilities in operational activities. This grant cannot be used to fund demonstration projects that do not have a plan to reach operational status, nor projects to fund existing, on-going operational programs. There is potential applicability to land cover development to support "community growth and infrastructure" issues.

- **Other grant sources** – Other grant sources also fall into the category of mission driven funding. Grants may provide funds as well as hardware, GIS software and training services. The ESRI®-NACo grant is an example of an alternate grant source. Environmental System Research Institute (ESRI®), the leading GIS software provider in Maine, offers many grants to local and state governments. Two such grants are administered by the National Association of Counties (NACo) and supply the recipient with thousands of dollars worth of software, data access and training. ***Kansas***' Data Access and Support Center (DASC) was the recipient of a $76,000 grant from a public-private partnership organization. This grant money will be used to enable Kansas' Egovernment data portal to have spatial capabilities.
- **Local Funds** – With educational, outreach and assistance efforts, local governments and regional entities could be encouraged to help utilize some of their own funding and the private sector could also be encouraged to participate in partnerships for GIS data development and maintenance. Funding could come from whatever source the local government, business, or organization felt was appropriate, but likely sources would include areas that would benefit from a coordinated statewide GIS effort. This may include departments of public works, consulting engineers, telecommunications and other utility companies. ***Kentucky*** is requesting funds for a Local Government GIS program (LGIP) for 2003-2004. The budget request of $600,000 would be used to cerate partnership incentives for Kentucky local governments currently developing GIS data to build the data to a

statewide standard, share the data, or a subset of the data, with the state after it is created, and build the data so that adjacent counties can use each other's data. ***Virginia*** established a Public Safety Division and new Wireless E-911 Board in 2002. This board is responsible for the disbursement of funds to local communities for the implementation of Wireless E-911. The Board has ruled that communities may apply for mapping funds related to the support of E-911.

- **Cooperative Funding Partnerships** – This type of funding falls under the category of mission driven funding. It would involve cooperation among state agencies, or between state and federal agencies, to fund ongoing program costs including staff costs. The project under which this report is being prepared is an example of a cooperative funding partnership undertaken by departments in ***Maine***. The State Planning Office, Department of Transportation and the CIO jointly funded this project to explore the best course of action for further developing Maine's statewide GIS under Resolve 23. The project supports a specific "mission" however three separate agencies pooled resources to fund the project. Four separate state agencies collaborate to collectively create, maintain and distribute GIS data sets in ***Maryland.*** The Department of Planning, Department of Natural Resources, the State Highway Administration, and the Department of Housing and Community Development have coordinated the development and release of statewide GIS data both via CD-ROM and on the internet. ***Kansas*** worked with the Natural Resource Conservation Service (NRCS) of the USDA to build GIS data about soils. During one particular project, the NRCS provided a staff person to create data. The state, working in conjunction with a local university, provided some funds that were used towards data processing. Note that some cooperative funding partnerships fall under the heading of assessments in the form of voluntary assessments. Examples of theses are discussed above.

5.2 Description of a Funding Approach for Maine

5.2.1 General description

As documented above, other states use a variety of funding mechanisms to fund statewide GIS efforts. In addition it is clear that there are numerous options for funding mechanisms. It is clear that Maine will need to use a *combination* of funding vehicles to pursue the recommendations set forth in the Coordination & Implementation Plan. The following provides an overview of a potentially feasible funding *approach* for Maine:

- Pursue a **bond-funding package** for major capital investments in data and taking the Maine GIS program "to the next level". This would be used to support activities such as standards development, library infrastructure, DOQQ creation, parcel grant program, development of basic viewing and dissemination applications, and an initial education/outreach initiative.

- Focused effort and attention to **generating funds from federal and other grant sources**. Maine should establish a committee/team to apply for Federal grants and to actively work with other third-party funding entities such as utilities.
- **Creative combination of other Maine funding sources** for ongoing operational expenditures. Ultimately, the Legislature must make the decision on appropriate long-term funding for GeoLibrary operations.

The following section (5.2.2) provides a description of how project components are divided among these three general categories of funding. The next section (5.2.3) lists each of these summary funding categories and provides a listing of each project component that may be funded by each category. Finally, section 5.2.4 provides a plausible funding scenario with which the entire Resolve 23 Steering Committee found consensus.

5.2.2 Funding options by Project Component

The following describes the major task components of the Coordination and Implementation Plan while providing a basic assessment of the funding vehicles that are most appropriate to each activity.

5.2.2.1 Hardware/Software

- Bonds would be appropriate for the purchase and implementation of hardware and software to expand MeGIS's data warehousing capacity.
- CIO funding, if it is available, is another possibility for purchasing hardware and software.
- Software could also be addressed by negotiating better licensing agreements to get the most value out of licensing dollars spent.
- Maintenance is best covered from dedicated funds. Alternatively, a use fee could be charged to cover expenses. This fee could be estimated based on some percentage of hardware/software expenditures divided by estimated numbers of users and/or "hits".

5.2.2.2 Digital Orthophotos (DOQQ)

- Bonds would be appropriate for the development of DOQQs. This funding would leverage availability of matching federal funds from USGS NAPP/NDOP program.
- Should pursue partnerships with other governmental organizations and utilities for cost sharing. May enable State to get better resolution for the same investment.
- Need a plan in place to update the ortho imagery over time and as appropriate.

5.2.2.3 Parcel Data Development

- A number of municipalities have already invested in automating parcel data and eventually most will migrate to GIS. Prior to the establishment of uniform

standards, there was some value in waiting. Once Maine establishes standards, the sooner all municipalities migrate to the standard, the sooner efficiencies can be realized and better decisions can be made due to enhanced analytical capability.

- To encourage this transition to occur in time to reap the rewards and effectively address the key public concerns expressed during the Needs Assessment, the investment through bonds would be appropriate. This would be used to establish a grant program for municipalities to develop digital parcel data to state standards, and support maintenance and sharing requirements.
- Consider partnership opportunities with non-governmental users of parcel data (realtors, utilities) for parcel data development projects.
- Possible subscription fee for receiving/accessing updated parcels to fund maintenance of parcel data. Fee would need to go to municipalities to provide resources to update data. Would need to provide service beyond supplying public information.

5.2.2.4 Standards and Metadata

- Bond funding could be used for initial standards development by a consultant, including stakeholder outreach and involvement.
- CIO funding, if it is available, is another option for funding initial standards development.
- Federal grants are available from FGDC for standards development and education about standards and meta-data.

5.2.2.5 Technical Assistance

- Bond funding is not an appropriate long-term strategy for technical assistance, but could be used to hire contractors to develop an initial training/consulting program.
- Dedicated funds are most appropriate option for long-term technical assistance. It is likely that at least to one person on the state payroll would be made available to oversee technical assistance services to ensure that needs are being met.

5.2.2.6 Application Development

- Bond funding is appropriate for initial application development
- Federal grants for specific applications that serve multiple state stakeholders, led by MeGIS/Executive Committee.
- Service level agreements as are in place now.
- Fee for use if a web based application is developed/hosted/maintained on state server/with state data for use by private sector.

5.2.2.7 Staff/Maintenance

- Dedicated funds are the best, most stable, option for supporting the staff necessary to oversee all elements of a statewide GIS program. Need coordination even if development work is contracted out.
- Could explore a staff sharing agreement with different state agencies. Have those departments that can benefit most from GIS contribute to fund up to several staff positions. The benefit would be coordination of data development efforts, technical coordination, and leverage for federal funding.

5.2.3 Project Components associated with Funding Options

The following describes the three general funding categories introduced in section 5.2.1 and lists the project components that would be most appropriately funded by each funding category:

5.2.3.1 New 2002 Bond Funding Package

Bonds are appropriate for funding the startup of a statewide program as well as major capital expenses such as data development. They could be used for:

- Hardware and software improvements for warehousing technology and infrastructure
- Consulting support for standards development
- Consulting support for outreach and training for municipalities, COGs, counties.
- Data development (matching funds for USGS NAPP DOQQ program)
- Grant program(s) to local government, COGS and GeoService Centers for the development of digital parcel, zoning and protected open space data.
- Application development

5.2.3.2 Federal Grants, Other Third-Party Funds and Local Matching Funds

Federal funding would be given based on the merits of proposals made by the state and or local or regional governmental organizations, and would need to be used for the specific purposes indicated in the proposal. Appropriate requests for Federal grant dollars are:

- Warehouse enhancements
- Standards Development that is consistent with Federal Geographic Data Committee (FGDC) Information Systems standards
- Metadata development
- Outreach and training
- Data development (e.g. USGS funding for DOQQs)
- Application development that would benefit the Federal Government agency to which the request is made (e.g. homeland security, US-EPA, etc.).

This funding would be acquired based on agreements with public and private organizations in Maine and could include:

- Agreements with utilities for co-funding of data sets of mutual interest (e.g. parcels)
- Local government matches of state dollars to provide local data sets such as parcels and zoning.
- Agreements for maintenance of data stored in the library by local governments.

5.2.3.3 Operational Funding

It is assumed that the GeoLibrary Board and Legislature will come up with a suitable combination of funding sources to provide operational staffing and management of the GeoLibrary. In addition to funding staff, this is the best funding mechanism for other routine expenditures such as maintenance of hardware, software and data.

5.2.3.4 User/Cost of Dissemination Fees

Ultimately, the GeoLibrary will contain suitable resources that may warrant the institution of user fees, or "cost of dissemination" fees for data as outlined in the draft legislation. This would not take place until the latter years of the Coordination & Implementation Plan's 5-year time horizon. Even then, it is unlikely that these types of fees would amount to significantly more than $100,000 per annum. Thus, these should be considered, at best, a minor funding source. User fees/dissemination would most likely be collected to contribute to the operational funding of the GeoLibrary.

5.2.4 Recommended Funding Scenario

The following presents the most plausible funding scenario for initiating the work described in the Coordination & Implementation Plan. The Resolve 23 Steering Committee has actively examined multiple funding options and there is **unanimous consensus** among Steering Committee members that the following reflects a supportable, realistic and achievable funding path for enhancing Maine's geographic information infrastructure going forward.

- **New 2002 Bond:** Pursue a $6 million bond-funding package for major capital investments in data and taking the Maine GIS program "to the next level". This would be used to support standards development, library infrastructure, DOQQ creation, parcel grant program, development of basic viewing and dissemination applications, and an initial education/outreach initiative.
- **Third-Party Funding Sources:** Focused effort and attention will be paid to generating funds from federal and other grant sources. This includes a program to capitalize on the $1.6 million potentially available through USGS's NAPP/NDOP program. Further, Maine should establish a committee/team to apply for other Federal grants and to harvest the maximum amount of available funding. This committee/team could also actively work with utilities in Maine to attempt to generate further collaborative funding for parcels and/or land base. Last, several

elements of the bond are considered "grant programs" to municipalities. Some of these grants would require matching funds from municipalities thus further leveraging the money from the bonds.

- **Use of Enterprise Network Services Rate (ENSR)** rate increase for initial funding of ongoing operational expenditures. The Department of Administration and Financial Services (DAFS) has given preliminary approval to raise the ENSR to create a funding stream for initial operating costs of establishing the GeoLibrary. Based on an increase to ENSR of $2/month/computer effective July 1, 2002, it is estimated by DAFS that potentially $300,000 would be raised during FY2003 and another $600,000 would be raised during FY2004. Approval for an increase in the ENSR was given for a probationary 2-year period. Following the 2-year period the GeoLibrary Board will need to work with DAFS and the Legislature on a longer-term funding strategy that may include an extension of the ENSR rate increase, the institution of user fees and/or alternative funding mechanisms.

The scenario described above is further illustrated in Tables 5-2 and 5-3, below. Table 5-2 presents the funding elements according to potential funding sources. Table 5-3 illustrates the proposed scenario over a 5-year period, showing estimated expenditures by fiscal year. The program components listed in the table are discussed in detail in Section 2.2 of this document.

Table 5-2

5-Year Budget for Expanded GIS in the State of Maine

Estimated Expenditures by Funding Type

ONE TIME CAPITAL EXPENDITURES:	TOTAL Cost	Bond	CIO (1)	USGS Matching Grant	Utility or Other Partnerships	Potential one-time grants	Potential Grant Sources
1. Standards							
Statewide data standards development	$200,000	$100,000				$100,000	FGDC for standards/metadata; and/or US-Canada framework
2. Data warehousing							
Infrastructure improvements	$200,000	$200,000					
3. Statewide data development							
Participation in **USGS NAPP program for new orthophotography**. Program would complete 1997-1998 mapping and initiate more detailed mapping for a 2003-2004 program (2).	$4,200,000	$1,800,000		$1,600,000		$800,000	Farm Service, NRCS, US-EPA
Development of statewide **land cover**	$750,000	$250,000				$500,000	NASA
Parcel automation grant program	$3,500,000	$2,000,000			$500,000	$1,000,000	Municipal match for parcel moneys. Assumes $1 to $1 match (3).
Zoning & conservation/open space automation grant program	$750,000	$750,000					
Road centerline improvements	$400,000	$400,000					
4. Facilitating application development							
Standards conformity validation tools/application	$100,000	$100,000					
On-line Internet-browser based access to Library and application development platform for delivery of Library data to third parties	$150,000	$150,000					
Development tracking application development	$250,000	$250,000					
GRAND TOTAL ONE-TIME EXPENDITURES	**$10,500,000**	**$6,000,000**	**$0**	**$1,600,000**	**$500,000**	**$2,400,000**	

Table 5-2 *continued*

ONGOING, RECURRING OPERATIONAL EXPENDITURES:	TOTAL 5-Year Cost	FY2003 (4)	FY2004 (4)	FY2005 (5)	FY2006 (5)	FY2007 (5)
2. Data warehousing (6)						
Ongoing infrastructure support: staff, H/S maintenance, disk storage (5)	$1,200,000	$100,000	$200,000	$300,000	$300,000	$300,000
5. Outreach, education, and coordination (6)						
Active, directed staff support for inter-governmental and intra-governmental coordination, education & outreach (6)	$1,200,000	$100,000	$200,000	$300,000	$300,000	$300,000
Coordination, technical assistance and outreach through funding of Regional Service Centers (eventually 10 Centers @ $40,000 per annum) (6)	$1,500,000	$100,000	$200,000	$400,000	$400,000	$400,000

5-YEAR GRAND TOTAL, all investments, all funding sources:	**$14,400,000**
Potential investments from grants or funding matches:	**$4,500,000**
TOTAL 5-YEAR INVESTMENTS BY STATE OF MAINE:	**$9,900,000**

(1) It is currently assumed that no CIO funding for GIS will be available, even though GIS is listed as an Endeavor Project. If funding is available it will be allocated across these expenses selectively.

(2) Cost to complete higher resolution flyover may exceed $3,200,000, to cover high resolution for a broad area.

(3) State will also provide some "pure" non-matching grants to organizations that already have parcel data that only needs conversion into the statewide standard format.

(4) FY2003 and FY2004 would be funded through **Enterprise Network Service Rate** and library dissemination fees.

(5) To be determined following 2-year program evaluation.

(6) Assumes that all operational support of expanded data warehousing and active coordination and outreach is funded through dedicated, non-bond sources. Early year investments could potentially be covered by bond funding through contracting.

Table 5-3

5-Year Budget for Expanded GIS in the State of Maine

Estimated Expenditures by Fiscal Year

ONE TIME CAPITAL EXPENDITURES:	TOTAL 5-Year Cost (1)	FY2003 (2)	FY2004 (2)	FY2005	FY2006	FY2007
1. Standards						
Statewide data standards development	$200,000	$100,000	$100,000			
2. Data warehousing						
Infrastructure improvements	$200,000	$25,000	$100,000	$50,000	$25,000	
3. Statewide data development						
Participation in **USGS NAPP program for new orthophotography**. Program would complete 1997-1998 mapping and initiate more detailed mapping for a 2003-2004 program.	$4,200,000		$2,100,000	$2,100,000		
Development of statewide **land cover**	$750,000	$50,000	$500,000	$200,000		
Parcel automation grant program	$3,500,000	$100,000	$500,000	$750,000	$1,150,000	$1,000,000
Zoning & conservation/open space automation grant program	$750,000		$100,000	$300,000	$200,000	$150,000
Road centerline improvements	$400,000		$400,000			
4. Facilitating application development						
Standards conformity validation tools/application	$100,000		$75,000	$25,000		
On-line Internet-browser based access to Library and application development platform for delivery of Library data to third parties	$150,000		$100,000	$50,000		
Development tracking application development	$250,000			$50,000	$75,000	$125,000
GRAND TOTAL ONE-TIME EXPENDITURES	**$10,500,000**	**$275,000**	**$3,975,000**	**$3,525,000**	**$1,450,000**	**$1,275,000**

Table 5-3 *continued*

ONGOING, RECURRING OPERATIONAL EXPENDITURES:	TOTAL 5-Year Cost	FY2003 (3)	FY2004 (3)	FY2005 (4)	FY2006 (4)	FY2007 (4)
2. Data warehousing						
Ongoing infrastructure support: staff, H/S maintenance, disk storage	$1,200,000	$100,000	$200,000	$300,000	$300,000	$300,000
5. Outreach, education, and coordination						
Active, directed staff support for inter-governmental and intra-governmental coordination, education & outreach	$1,200,000	$100,000	$200,000	$300,000	$300,000	$300,000
Coordination, technical assistance and outreach through funding of Regional Service Centers (eventually 10 Centers @ $40,000 per annum)	$1,500,000	$100,000	$200,000	$400,000	$400,000	$400,000

5-YEAR GRAND TOTAL, all investments, all funding sources:	**$14,400,000**
Potential investments from grants or funding matches:	**$4,500,000**
TOTAL 5-YEAR INVESTMENTS BY STATE OF MAINE:	**$9,900,000**

(1) Total expenditures from all potential funding sources, including state, federal govt., utility partnerships and local government matches.

(2) It is assumed that funding from a calendar year 2002 bond would not become available until the second half of fiscal year 2003 (i.e. Spring 2003). Hence, expenditures from the bond begin modestly at the tail-end of FY2003 (e.g. late-Spring 2003) and ramp up in earnest during FY2004.

(3) FY2003 and FY2004 would be funded through **Enterprise Network Service Rate** and library dissemination fees.

(4) To be determined following 2-year program evaluation.