

Section 5.4

GIS For Municipalities

1.0 INTRODUCTION

1.1 Background

Service Nova Scotia and Municipal Relations (SNSMR), retained Geoplan Consultants Inc. to prepare a report on Geographic Information Systems (GIS) functional requirements relevant to municipalities. The project was carried out with the participation and assistance of staff of the Town of Bridgewater and the Municipality of the county of Pictou.. The findings brought to light were carried over into a generic “requirements template” document that may be used to assist other Nova Scotia municipalities in planning for the acquisition of GIS software and hardware.

This document is a summary of the full report prepared by Geoplan Consultants. The full document may be obtained from Service Nova Scotia and Municipal Relations.

1.2 Study Contents

The Geoplan Consultant report contains the following sections:

- **Section 1.0: Introduction**, provides a brief background and introduction;
- **Section 2.0: Implementation Planning**, contains specific recommendations for how the material can be used to guide a Nova Scotia municipality toward the successful implementation of a GIS;
- **Section 3.0: Municipal Business Functions**, describes the generic ‘business’ functions that various groups in the municipal corporation perform;
- **Section 4.0: GIS Application Requirements**, describes typical mapping and GIS applications activities that support the municipalities ‘business’ functions;
- **Section 5.0: GIS Data Requirements**, outlines the various map, spatial and attribute databases required to support the GIS functions; and
- **Section 6.0: GIS Technology Architecture**, describes in a general way several levels of GIS IT technology . Depending on the type and volume of mapped data needs of the various municipal departments, there is a range of GIS technologies that can be either integrated into existing corporate IT architectures or form the basis for the IT technology where the municipality is headed..

This report was organized to reflect the sequence generally followed in a GIS user requirements analysis following the order of Sections 3, 4, 5, 6.

The full study contains four Appendices

- **Appendix A: Glossary of Terms and Terminology**, contains a comprehensive list of acronyms plus an extended glossary of geographic information terms and terminology;
- **Appendix B: GIS Detailed Application Requirements**, contains an in-depth description of the municipal GIS functional requirements that were presented within Section 4.0;
- **Appendix C: GIS Detailed Data Requirements**, provides a comprehensive description of the various data requirements for municipal GIS that were presented within Section 5.0; and
- **Appendix D: Benchmark Evaluation Criteria**, contains a material that can be used as a guide for municipal staff in the preparation of evaluation criteria leading to a Request for Proposals (RFP) for GIS hardware and software.

This version contains two additional appendices- *Appendix E :Sample GIS User Needs Study Request for Proposals (RFP)*; and *Appendix F : Sample GIS Queries*

1.3 **Study Methodology**

The generic Nova Scotia municipal GIS requirements described within this document were developed through a consultative process including:

1. A review of relevant previous studies and background materials was undertaken in order to prepare an initial set of municipal GIS application requirements.
2. On-site workshops were conducted with municipal staff from the Municipality of Pictou County and the Town of Bridgewater.
3. Results from the municipal workshops were used to prepare an initial summary of business functions, GIS application and data requirements, and existing technology architecture within each municipality.
4. The individual requirements were consolidated into the generic requirements document and augmented with other municipal GIS studies (i.e Cape Breton Metro Planning Commission City of Fredericton).

5. The individual reports for Bridgewater and Pictou and the generic municipal requirements document were sent to SNSMR staff for review and comment.

1.4 Study Terminology and Concepts

While GIS is just one type of information technology it has specific language and terminology that should be understood. Appendix A of the full report contains a glossary that is widely used in Nova Scotia. A few key definitions have been produced for this summary report to help familiarize the reader with some background concepts.

Automated Mapping

The use of computer graphics systems to create, edit and manipulate cartographic data. The resulting graphic image files are a compilation of “primitive” drafted features with no information processing capabilities other than to generate displays of different combinations of map data, views, and scales.

Digital Mapping

Mapping that uses numerical coordinates to reference the location of its elements. Mathematical relationships can be used to describe points, lines and polygons in a way that computers can present graphic data.

GIS (Geographic Information System)

An organized collection of computer hardware, software and procedures designed to support the capture, editing, management, manipulation, analysis, modelling and display of spatially referenced data for solving complex planning and management problems.

GIS Attribute Data

Textual or numeric data describing spatial objects. For example the owner or sale price of a parcel of land.

GIS Database

A GIS database includes data about the spatial location and attributes of geographic features as well as sufficient data to produce a graphical representation of some or all of the data.

GIS Query Tool

A system which contains all of the capabilities of a GIS except for data capture and editing.

The relationship between GIS and an automated mapping system (for example, a CAD package) is that a GIS extends the functionality of automated mapping to include the construction of relationships among digital map features (commonly referred to as topology) such that this “intelligent map” can then be used to perform spatial analysis functions. Examples of spatial analysis include:

- finding an optimum path for routing a vehicle through a road network;
- determining how many land parcels are contained within a 500 metre radius of a specified location; and
- determining how many buildings are located within 50 metres of a specified road centreline.

A GIS is also capable of linking textual or numeric data (attributes) to the digital map files. It is then possible to use this information to generate both displays and reports about map features that meet certain user specified criteria. For example:

- click on a property parcel and display its ownership and assessment information;
- highlight all property parcels that are owned by a municipality;
- produce a colour coded map display of properties according to land use classification; and
- generate a report of property owner names and addresses for all properties within a one kilometer radius of a property that is being considered for rezoning.

For municipalities, it is this combination of spatial analysis and attribute presentation capabilities that make a GIS package especially attractive to use. For many municipal functions, where attribute databases can be directly related to lot parcels for example, digital property maps represent a key starting point. As digital property mapping is available for all land parcels within the province (from the N.S. Land Information Centres), municipalities can therefore implement GIS applications in a phased manner at a reasonable cost by leveraging this data. This summary and the full report have been prepared as a guide for Nova Scotia municipalities that are considering the implementation of GIS. For further information, please contact:

David Keefe
Project Coordinator
Land Information Services Division
Service Nova Scotia and Municipal Relations
PO Box 216
Halifax, NS B3J 2M4
Phone: 902-424-7923
Fax: 902-424-0639
Email: dkeefe@gov.ns.ca

John Mersereau
Senior Planner
Municipal Services Division
Service Nova Scotia and Municipal Relations
PO Box 216
Halifax, NS B3J 2M4
Phone: 902-424-7417
Fax: 902-424-0821
Email: merserjf@gov.ns.ca

2.0 GIS PROJECT IMPLEMENTATION PLANNING

2.1 Critical Success Factors for Implementation

It is important to recognize that GIS implementation within a municipality, whether large or small, represents a significant investment in staff resources and funding as an Information Technology (IT) project. The implementation must therefore be managed like any major IT project to achieve benefits.

Strong Project Management

It is important that a Project Manager be appointed by the municipality to oversee the GIS implementation. This individual will assume responsibility for deliverables, will develop and monitor the project schedule, and be the primary liaison between staff and management for communicating project results. It is not a requirement that this individual ultimately be responsible for the day-to-day administration of the implemented GIS system.

If the municipality does not have sufficient resources to allocate a full time project manager internally, an alternative solution is to contract out the project management as part of the consulting involved in system implementation, customizing and testing. However, there must be *some* municipal staff person responsible for overseeing the implementation and reporting to management on progress.

Active Project Steering Committee

GIS implementation will affect, and be of benefit to, many parts of the organization. It is important that the implementation be guided by a Steering Committee that represents key stakeholder groups. This group will establish priorities for the applications and databases that will be created.

Phased Implementation

It is important that the implementation take place according to a phased plan that provides for short term deliverables that are limited in scope. The plan should make provision for the up-front loading of databases and the development of applications that will have immediate benefit to the organization. (As an example, there are immediate and significant benefits that can be obtained by loading the provincial property mapping database and linking municipal information databases such as land use, permits and municipal facilities to it. Since the data is readily available from the NSGC, initial data loading time is minimized).

Appropriate Evaluation of Technologies

It is important that the technologies selected for GIS implementation are capable of being tightly integrated within the corporate IT environment of the municipality. As an example, if the municipality is currently using Oracle as a database management system, the GIS software must be capable of accessing Oracle databases. If the organization is currently running a Novell Local Area Network (LAN) with Windows 95 on individual workstations, the GIS software must be integrated into this environment.

Use of Data Standards

Standards for the GIS spatial and attribute databases are important. Municipal IT staff or the municipality's IT consultants should set out relevant data format standards in the early stages of the project. Wherever possible, the municipality should leverage existing provincial or municipal standards. The Province has digital geographic database standards in the following areas:

- topographic database (NSTDB) for both resource and urban digital mapping; and
- digital property mapping and associated attribute database content (NSPRD);

The Province is currently overseeing a contract for standards for a civic address database (NSCAF).

It has also published a more generic document entitled "*Geographic Information Nova Scotia - Standards Manual*" that provides considerable information on existing geographic database standards for Nova Scotia. Another study provides a manual for land use codes. These documents are available for viewing on the NSGC website (www.nsgc.gov.ns.ca). A copy of the final report from the NSCAF pilot project is also available on this site.

Leverage Provincial Digital Data Sources

It has been previously mentioned within this report that the Province of Nova Scotia has a number of "GIS ready" digital base map products that can be used to form the foundation for a municipal GIS implementation. It may also be possible to enter into a cost sharing arrangement with the Service Nova Scotia and Municipal Relations if large scale urban topographic base mapping is considered important for the implementation.

Development of Specific Functional Specifications

This document represents a generic template for Nova Scotia municipalities to use in the preparation of a GIS needs study and the application functional descriptions and data base

specifications included represent a *high level* set of requirements only. Municipalities that use this document as a starting point for GIS implementation must realize that functional specifications for their applications and databases will need to be developed specific to their needs.

Communication of Progress

The GIS implementation will impact on many parts of the municipal organization. It may therefore be seen as a high profile project, and departmental stakeholder expectations could be high. Care must be taken to ensure that proper communication of project results takes place, and that visible signs of progress are achieved early in the implementation plan.

2.2 Proposed Steps for Implementation

This section contains a summary of steps that are intended to guide Nova Scotia municipalities in studying the feasibility of implementation of GIS applications within their organizations.

1. Conduct an initial general needs assessment for your municipality prior to proceeding with a GIS implementation project. The assessment should commence with a review of the municipal ‘business’ functions (as outlined in Section 3).
2. Describe the mapping components (GIS application requirements) that support the business functions and activities of groups within the municipality. (as outlined in Sections 3 and 4 of this report).
3. Define the data (digital maps and attribute) needed for the GIS to extract information relevant to the functions and activities identified in the ‘business’ function analysis step (as outlined in Section 5).
4. Investigate the availability and currency of existing digital base mapping for the municipality. Prepare an initial estimate of the storage requirements and cost associated with these products.
5. Identify the general configurations of equipment, software and expertise (as outlined in Section 6) required to provide mapping support to the ‘business’ functions and make use of the digital mapping. Section 6 includes “order of magnitude” costs that can be used for initial budget preparation purposes, and a checklist of GIS hardware / software requirements for each municipal GIS application category.

6. Prepare a Request for Proposal that sets out the specific functions the GIS implementation requires and the software functionality expected. The RFP can specify additional deliverables as appropriate including - loading data, staff training, integration with other administrative applications or the development of customized GIS applications (permit tracking).

2.3 General Information Technology Implementation Issues

As part of the GIS implementation plan for each specific municipality, IT issues are likely to arise and the following section identifies a number that are common to all IT projects and have been part of prior GIS project experience.

Systems Administration

Systems administration includes troubleshooting network problems, installation of new computers and network connections, operating system maintenance, file backups and software upgrades to individual workstations. If the municipality currently has a number of production applications in place and a LAN in place to connect individual user workstations, there may already be an individual responsible for carrying out these functions.

The availability of in-house capability impacts on GIS implementation. In order to leverage the investment in GIS technology, access to the databases should be available across the organization.

Data Base Management Software

The attribute databases that support the GIS applications should be stored within a relational data base management system (RDBMS) environment. If the municipality currently does have a RDBMS product in place, the GIS software to be acquired must be capable of interfacing with this environment to access existing corporate databases for use within GIS applications.

Security

The GIS software should be capable of restricting access to individual layers and / or features. The primary use of security will be to limit update capabilities to those directly responsible for maintenance of map layers and associated attributes.

Organisation of GIS Function

It may not be clear at this time which department within the municipality should be responsible

for a GIS should a system be acquired. While there is no “magic” answer to this question, it may be advisable to place this responsibility within the IT group if the municipality currently has an IT group.

Physical Requirements

The GIS implementation may require that the municipality invest in some additional hardware and communications facilities if the following components do not currently exist:

- a LAN with sufficient “drops” to provide convenient access to the GIS throughout the organization, and a central patch panel to consolidate these drops;
- a central network server facility with sufficient disk storage, processor speed, RAM backup facilities to manage access to the GIS and backup power source (UPS) ;
- a printer and plotter to address output requirements; and
- optionally, a digitizing table or scanner to input points and lines and other graphics.

3.0 MUNICIPAL BUSINESS FUNCTIONS

This section presents a set of generic activities and services (referred to as ‘business functions’) that are felt to be broadly representative of those typically required within Nova Scotia municipalities. These functions have been developed based upon previous studies (i.e. Cape Breton Metro Planning, City of Fredericton), interviews conducted with the municipalities involved in this project, and related experience and documentation.

It should be noted that, while a reasonable attempt has been made to ensure that a comprehensive range of municipal business functions have been included, municipalities should recognize that their GIS implementation plans should reflect their specific activities and operations.

The report presents an overview of the range of activities included within each functional area, as a basis for the subsequent development of GIS functional, application and data requirements. It has been organized around clusters of activity typical of Nova Scotia municipalities.

3.1 Financial, Administrative and Legislative Services

Corporate Services within a municipality is generally considered to encompass those areas of responsibility that provide specific management services in the areas of finance/accounting, general administration, information management and council support.

3.1.1 Council Support

This function includes the following components:

- meeting coordination, agenda and reporting;
- councillor correspondence;
- Mayor, Warden and individual Councillor support (specific Ward/District issues);
- elections, enumeration, and electoral boundaries; and
- bylaw procedures and regulation.

3.1.2 Financial Services and Administration

This function includes the following components:

- tax base administration (assessment, Business Occupancy, Change-in-Use);
- tax rate determination;
- accounting, payroll, procurement, cash management;
- area rate determination, service charges, capital levies;

- billing, revenue collection, tax sales;
- capital budgeting, asset and debt management; and
- customer service / inquiry.

3.1.3 Corporate Services

This function includes the following components:

- systems administration (computer/network maintenance, installations, security)
- database management;
- applications development, maintenance ,support and training;
- human resources;
- labour relations; and
- legal services, contracts and litigation.

3.2 Protective Services

Protective services includes the police and fire departments and related public safety based operations of inspections and bylaw enforcement.

3.2.1 Law Enforcement Services

This function includes the following components:

- policing and law enforcement;
- central dispatch;
- parking meter enforcement and collection;
- investigations (property inquiry re ownership, etc.);
- RCMP liaison, including link to national police / crime databases;
- Motor Vehicle Act enforcement; traffic accident reporting;
- special event routing; and
- crime reporting / statistics.

3.2.2 Fire Protection Services

This function includes the following components:

- fire and accident management;
- building floor plan maintenance;
- emergency routing;
- hydrant management and flow mapping;
- sprinkler system inventory;

- hazardous sites / materials inventory; and
- key box administration.

3.2.3 Inspection Services

This function includes the following components:

- building inspection;
- fire inspection;
- plumbing inspection;
- electrical inspection; and
- subdivision inspection.

3.2.4 Bylaw Enforcement Services

This function includes the following components:

- animal control;
- dangerous and unsightly premise investigation / tracking;
- illegal dump site investigation / tracking; and
- mobile home park plan review / approval.

3.3 Transportation, Public Works and Engineering Services

This group of functions involves engineering related services of a municipality including roads, water, sewer and solid waste management. In some municipalities activities such as street designation, civic numbering and inter agency coordination of building permits are tasked to the engineering group.

3.3.1 Transportation Services

This function includes the following components:

- road, bridge, street lighting operations management;
- traffic engineering (pavement markings, signs, signals, parking studies,);
- snow removal; and
- transit.

3.3.2 Public Works

This function includes the following components:

- operation and maintenance of water distribution system infrastructure (supply / transmission / distribution / treatment / maintenance and water testing);
- watershed management;

- operation and maintenance of sanitary sewer system infrastructure (collection / treatment / disposal / maintenance);
- operation and maintenance of storm sewer system infrastructure;
- garbage collection and transfer;
- recycling, composting and landfill facilities management; and
- building maintenance.

3.2.3 Engineering Services

This function includes the following components:

- utility coordination (MT&T, NS Power, Sempra Gas, etc.);
- tree inventory;
- engineering design (utilities, road upgrades); and
- subdivision plan review.

3.2.4 Civic Addressing / E911

This function includes the following components:

- civic number assignment / database update;
- information exchange (N.S. E911, police, fire, ambulance, NSGC, EMO);
- street name assignment / changes; and
- maintenance of community boundaries; service area and emergency responder area boundaries.

3.2.5 Building Permits

This function includes the following components:

- permit processing, permit tracking;
- subdivision plan review;
- access approval (liaison with DOT&PW);
- environmental / municipal service approvals; and
- report preparation: Statistics Canada (monthly), CMHC (monthly), Council (monthly, year-end).

3.4 Planning and Development Services

This group of business functions relates to the regulation of development including both the preparation and administrative aspects of land use plans, strategies and bylaws.

3.4.1 Land Use Planning

This function includes the following components:

- municipal planning strategy preparation and amendment;
- land use by-law administration and regulation;
- letters of zoning confirmation;
- rezoning and variances;
- site plans;
- special projects; and
- mapping / reports, area profiles.

3.4.2 Development Services

This function includes the following components:

- subdivision applications;
- development permits;
- variances and special building permits; and
- development agreements.

3.5 Parks, Recreation and Heritage Services

This includes services provided by recreation departments as well as functions related to the administration of parks and open space, heritage and cultural resources.

3.5.1 Recreation Services

This function includes the following components:

- recreation master planning;
- site planning;
- community liaison;
- recreational land use planning;
- trail systems planning, use administration and permits;
- special event coordination; and
- recreation facilities management.

3.5.2 Parks Services

This function includes the following components:

- parks planning;
- natural system studies and interpretation;
- sports field permits / booking;

- parks and sports field maintenance ; and
- parks supervision.

3.5.3 Heritage and Cultural Services

This function includes the following components:

- museum and museum collection management;
- heritage sites supervision and inventory;
- heritage properties registration;
- heritage district planning; and
- heritage archeology studies.

The foregoing identification of the various ‘ business’ functions of departments of typical municipalities is for illustration purposes. In any information technology project including GIS feasibility analysis, it is important to have a focused vision of the operations performed by both respective departments and common activities across departments. Many of the business functions that have been assembled on this list do not have a significant mapping component. On the other hand, in other cases it is clear that information on maps is an important feature.

4.0 GIS APPLICATION REQUIREMENTS

This section describes the GIS application requirements for a typical municipal unit. The applications represent the tasks that the GIS will perform.

Geoplan Consultants divided these operations into three general categories based upon access characteristics:

- *corporate* applications that support multiple divisions within a municipality;
- *workgroup* applications are those that support operational requirements within a specific section of the organization (i.e. fire department); and
- *external* applications that are not directly municipal responsibility, but are highly interrelated (i.e. utility underground cabling).

Table 4.1 summarizes the GIS applications identified by category and the business functions which it supports. The consultants indicated that GIS implementation could be phased in, using the following ratings:

- (E) Essential** - those applications that should form the basic framework for a municipal GIS installation;
- (D) Desirable** - those applications that are an enhancement, but are of a lesser priority than the essential applications; and
- (O) Optional** - those applications that are lowest in priority but could be included if time and resources permit.

The intent of the above ranking of applications is to provide municipalities with the basis for the formulation of a phased GIS implementation plan that will ensure that those applications with the greatest impact on municipal operations are implemented first.

Details concerning each application are contained within Appendix B of the full report, including map and textual data requirements, supporting GIS functional requirements, and output requirements.

4.1 Corporate Applications

This section describes the corporate GIS application requirements for a generic municipal unit. While there may be departments that are dominant users, corporate applications are those that are used in support of business functions across most organizational units within a municipality.

4.1.1 Street and Civic Address Mapping / Inquiry

This application provides the update and maintenance of the two main municipal map databases-

the street file and the building location on the street with the civic address number. GIS has the ability not only to quickly locate and edit data related to the civic number but relate it to other mapped themes such as property ownership or voter enumeration. The Service Nova Scotia and Municipal Relations contract for a geo-referenced Nova Scotia Civic Address File (NSCAF) will identify procedures that can be used as a template for all municipalities.

4.1.2 Parcel Mapping, Inquiry/Reporting

This application includes the ability to locate land parcels by attribute query through one or a combination of civic address, PID, owner name, assessment account number (AAN). It also allows for land parcel selection by graphic inquiry through either pointing or area boundary definition. This application will also have the ability to select 'neighbours' of other selected parcel features. The Parcel Inquiry/Reporting application involves the use of the Nova Scotia Property Records Data Base (NSPRD) to display and report on property parcels.

4.1.3 Boundary Mapping

This applications will permit the update, display and inquiry of various administrative boundaries (ward and district boundaries, general service areas, area rate boundaries, community boundaries) within the municipal unit. The Boundary Maps application includes the ability to overlay and query property parcels and topographic mapping.

4.1.4 Service Infrastructure Inquiry

This application uses municipal utility infrastructure mapping for inquiry and analysis purposes. It includes the ability to display municipal service systems -water, storm and sanitary utility information -(main lines, manholes, valves, lift stations, hydrants, etc). This data takes on additional value when combined with other themes such as municipal street, civic address, property ownership and/or topographic base mapping.

4.1.5 Permit System Integration and Inquiry

This application encompasses the entire range of functions required to build and maintain a municipal permit tracking system. The Permit System links permits to property parcels and civic number. It includes the ability to track applications, inspections, approvals by type. The application further allows for the monitoring of subdivision activity by type. The permit system should be capable of maintaining variance and site analysis information. It could also allow for the input of building footprints and possibly scanned images (e.g. photographs).

4.1.6 Urban Topographic Mapping

In dense urban areas, this application includes the entry and updating of an urban topographic database from field survey, photography, design plans and scanned "as-built" drawings. Features typically collected during this process are curb lines, hydrants, signs, trees, manholes, catch basins, building footprints, utility poles and other relevant items. This application should include procedures for the upload of field survey data from GPS, monitoring stations and other field collection units. It can also allow for conversion of other map formats (raster to vector) and geo-referencing of existing maps and plans. Further information concerning urban topographic mapping is presented in Section 5.1.4.

4.1.7 Rural Topographic Mapping

In suburban and rural areas, this application displays the provincial 1:10 000 digital topographic mapping (Nova Scotia Topographic Data Base or NSTDB). This mapping includes the following features: transportation (roads/railroads), hydrography, major utilities, structures, buildings, designated areas, land cover, contours and delimiters. Section 5.1.1 gives a detailed description of the NSTDB. More detailed large scale (1:5000 and 1:2000) urban topographic mapping is described in Section 4.1.6 below.

4.2 Workgroup Applications

This section details the workgroup GIS application requirements for a generic municipal unit. Workgroup applications are considered to be those that are of primary interest to one business area.

4.2.1 Financial, Administrative and Legislative Support Services

Area Rate Calculations

The Area Rate Calculation application includes the ability to identify properties within 'service areas' for services such as fire protection, street lighting, sewer, fire hydrants and solid waste or garbage collection zones. This application will allow for the overlay of these zones with the property layer and determination of the parcels that fall within each zone.

Redistricting Analysis

This application consists of the ability to realign political and administrative boundaries based upon a supplied voters list and a road centerline network with civic address ranges. It provides functions needed to conduct an analysis of boundary changes for services areas, electoral districts, school districts, and other such areas based upon user specified criteria. This application often requires additional software that is specifically designed to perform this task.

Voter Enumeration List

The Voter Enumeration List application involves the maintenance of a municipal voter list that is tied to civic address. This data can be compared with Elections Canada or Nova Scotia Electoral Office information and used to generate municipal voter lists.

4.2.2 Protective Services

Emergency Service Areas

This application allows for the determination and revision of the response areas for fire, police and emergency services. The application provides the ability to allocate manpower and equipment based on map features such as area, buildings or street miles and to allow for reconfiguration (redistricting) during emergencies.

Incident Reporting

This application allows for the entering updating and analysis of traffic, crime and other emergency incident reporting using street or address information. This application provides monitoring and analysis capability for fire and police departments.

By-Law Infraction Reporting

This application includes the ability to display, update and maintain a by-law infraction inventory database. The key to this application is to link each by-law infraction to a parcel through the use of the PID. The By-Law Infraction Reporting application includes complaint logging, follow-up visit tracking and tracking of patterns over time (repeat infractions, etc).

4.2.3 Transportation, Public Works and Engineering Services

Utility Inventory Management

This application consists of the ability to enter, update and maintain utility maintenance attribute information for water, storm and sanitary sewer main lines and service laterals, valves, curb stops, manholes, catch basins, hydrants, etc. The typical information collected on utilities includes; pipe sizes and types, installation dates, contractor, inspection and maintenance records. This application will allow for the import of data from GPS receivers, total station units, and CAD files. The application will also allow for basic system network modeling (for example, modeling the flow through a water distribution system).

Road Infrastructure Management

This application involves the data entry, update, display, plotting and reporting of various road infrastructure data bases that are associated with a digital street centerline network. The Road Infrastructure Management application includes the ability to maintain a basic road network inventory (road name, civic address ranges, road class, length, jurisdiction, costs, etc), construction contracts, pavement management (including surface type / condition, distress ratings, etc.) and road link data, such as traffic counts and volume/capacity ratios. Other road infrastructure items that are considered part of this application include culvert inventory, sign inventory, bridge inventory and access control lines.

The Road Infrastructure Management application can also provide network routing capabilities to allow for the analysis of maintenance, solid waste pickup / recycling, street sweeping, and snow plowing. The routing functionality should be considered as a future enhancement to this application.

Street Signs/Signals Inventory

This application will permit the update, inquiry and display of traffic signs, traffic signals and street light inventory data. Items to be included include but is not limited to stop signs, crosswalks, no parking signs, speed limit signs, traffic signals and street lights.

Parking Inventory

This application maintains an inventory of municipal parking facilities, including parking lots, garages and on-street meters. Maintenance records may also be associated with this application. Functions are included to update, display, report and plot the parking inventory data.

4.2.4 Planning and Development Services

Zoning and Land Use Query

This application includes various functions to allow for the inquiry and reporting of land use categories. A key component of this application is to classify each parcel by its land use category. The Nova Scotia provincial assessment database (OASIS) does contain a field for land use; however, this is for assessment purposes and is often different from the land use categories for a municipal application. (Service Nova Scotia and Municipal Relations has produced a land use coding manual for municipalities.) The Land Use Planning application includes the ability to query zoning, setback regulations, and site planning conditions of properties. As the property layer is essential to this application, full display, inquiry and reporting of parcel information will be available.

Development Analysis

This application uses parcel layer data such as the date of lot creation, building permit information and land use data in order to monitor the direction and pace of development, the need for rezoning and plan amendment.

4.2.5 Parks, Recreation and Heritage Services

Recreational Facility Locations

This application includes the identification and update of recreational facility locations. The Recreational Facility Locations application includes facility classification, ownership and land use, facility inventory maintenance, inspection status and deficiency identification (for liability purposes). It is anticipated that this application would maintain a textual database that would be linked to property parcels through the PID.

Trails Inventory

This application includes functions to display, update and maintain a municipal trails inventory. Initially, this application would simply identify right of way parcels; however, detailed inventory of walking trails, resource roads and logging could also be added.

Heritage Properties

This application consists of the creation and maintenance of heritage property records that are linked to land parcels (PIDs). The ability to store scanned raster images (eg. photographs) is an optional component of this application.

4.3 External Application- Utility Integration

External applications are those for which the municipality is not directly responsible, but may wish to import data from in support of municipal business functions.

4.3.1 Power Utility Information Access

This application includes functions to import power utility infrastructure layers from Nova Scotia Power Inc and other power utilities. It also includes functions to display this information

overlaid with other municipal GIS layers.

4.3.2 Telephone Utility Information Access

This application includes functions to import telephone utility infrastructure layers from MT&T. It also includes functions to display this information overlaid with other municipal GIS layers.

4.3.3 Cable Utility Information Access

This application includes functions to import cable utility infrastructure layers from cable companies. It also includes functions to display this information overlaid with other municipal GIS layers.

4.3.4 Natural Gas Utility Information Access

This application includes functions to import natural gas utility infrastructure layers from gas pipeline utilities. It also includes functions to display this information overlaid with other municipal GIS layers.

**Table 4.1
Municipal GIS Applications by Category**

CATEGORY	APPLICATION	Financial Services	Administrative Services	Information System Services	Council Support	Public Works	Engineering Services	Inspection Services	Civic Addressing/E911	Building Permits	By-Law Enforcement	Land Use Planning	Development Services	Recreation Services	Parks Services	Heritage Services	Law Enforcement Services	Fire Protection Services	IMPLEMENTATION	
Corporate	Utility Infrastructure Inquiry	X			X	X	X					X	X		X			X	D	
	Parcel Inquiry / Reporting	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	E
	Boundary Maps	X	X		X	X		X	X	X		X	X				X	X	E	
	Civic Address Mapping / Inquiry	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	E
	Topographic Mapping				X	X	X	X	X	X		X	X	X	X	X	X	X	X	E
	Urban Topographic Mapping				X	X	X	X	X	X		X	X	X	X	X	X	X	X	D
	Permit System	X	X		X	X	X	X		X	X	X	X		X			X	E	
Workgroup	Utility Inventory Management					X	X	X											D	
	Land Use Planning		X			X	X					X	X	X					D	
	Road Infrastructure Management				X	X	X		X										D	
	Street Signs / Signals Inventory				X		X												D	
	Area Rate Calculations	X																	D	
	Redistricting Analysis		X		X							X	X				X	X	O	
	Heritage Properties Inventory											X				X			D	
	Voter Enumeration List		X		X														D	
	Bylaw Infraction Reporting		X		X						X							X	D	
	Civic Address Maintenance								X										E	
Trails Inventory				X							X		X				X	D		

CATEGORY	APPLICATION	Financial Services	Administrative Services	Information System Services	Council Support	Public Works	Engineering Services	Inspection Services	Civic Addressing/E911	Building Permits	By-Law Enforcement	Land Use Planning	Development Services	Recreation Services	Parks Services	Heritage Services	Law Enforcement Services	Fire Protection Services	IMPLEMENTATION
	Recreational Facility Inventory	X			X							X	X	X	X		X		D
	Parking Inventory	X			X		X				X	X					X		D
	Tree Inventory														X				O
	Cemetery Management											X							O
External*	Power Utility Information Access		X		X	X	X			X		X	X	X				X	O
	Telephone Utility Information Access		X		X	X	X			X		X	X						O
	Cable Utility Information Access		X		X	X	X			X		X	X						O
	Natural Gas Utility Information Access		X		X	X	X			X		X	X					X	D

E-Essential

D-Desirable

O-Optional

5.0 GIS DATA REQUIREMENTS

The foregoing section described typical information extraction functions that a municipality would perform. This section describes the GIS requirements for data - what information would it use and where is it available. The data requirements are broken down into three areas by availability and maintenance responsibility: provincial mapping, municipal mapping and utility mapping.

The GIS data requirements are summarized within tables for each of the above mentioned areas. Each table contains the following information:

- the name of the mapping database;
- the layers of information included;
- a list of major map features contained on each layer;
- the topology which represents the geographical sophistication and detail of geo-referencing; and
- the attribute or textual database files that are linked to each map layer.

More comprehensive descriptions of each map product are contained within Appendix C of the full report available from Service Nova Scotia and Municipal Relations.

5.1 Provincial Mapping Data

Databases within this category are available from the Province of Nova Scotia . For each of these, it is recommended that the municipality enter into an agreement with the Province for the ongoing maintenance of the mapping and any attribute data that is associated with it.

5.1.1 Rural Topographic Base Mapping

The provincial 1:10 000 digital topographic mapping (Nova Scotia Topographic Data Base, or NSTDB) should be used as a base map to which other layers and features are referenced. This mapping includes the following layers:

- transportation (roads, bridges and railroads);
- water features;
- utilities (major transmission lines, etc);
- structures (dams, wharves, etc);
- buildings;
- designated areas;
- land cover;

- delimiters (boundaries); and
- contours.

The 1:10,000 mapping has some data limitations with respect to certain detail, for example:

- individual utility poles are not shown;
- manholes are not shown;
- most buildings will appear as point symbols only; and
- roads will appear as centerlines only - pavement edges, sidewalks and curb lines are not shown.

5.1.2 Urban Topographic Base Mapping

The Province of Nova Scotia has entered into cost sharing agreements with some municipalities for the creation of large scale (1:5000 and 1:2000) urban topographic mapping. This mapping is a subset of the topographic mapping in that the same layers are present, but furthermore additional detail is included and some features may be represented differently due to the larger scale. For example:

- roads are represented as double lines instead as centerlines;
- utility poles are included;
- most buildings will be represented as outlines rather than as symbols; and
- trees and vegetation can be represented.

5.1.3 Property Mapping

Digital property mapping (Nova Scotia Property Records Data Base - NSPRD) is available from SNSMR. These maps contain all land parcels within the Province of Nova Scotia and are continuously updated as changes occur due to development activity and changes in ownership. Changes to the parcel fabric are normally reflected in the mapping within sixty to ninety days.

Two attribute data bases are associated with the NSPRD:

- the Parcel Index contains information on ownership, size and documents registered against each parcel; and
- Assessment data contains information on individual parcel assessment values, along with some associated data.

It is important to note that there is not in all cases a 1:1 match between property identification numbers (PID) and assessment numbers (AAN). It is therefore necessary to maintain a cross

reference file that relates land parcels to assessment parcels. The integration of these two files is being continuously improved.

5.1.3 Georeferenced Civic Address File

Service Nova Scotia and Municipal Relations (SNSMR) is overseeing the creation of a georeferenced Nova Scotia Civic Address File (NSCAF) that will contain two sets of civic address data:

- an updated road centerline file that will contain community boundaries, street names and address ranges for each road segment within the Province; and
- a civic address point file that will include a location for every civic address within the Province.

Municipalities will play a key role in the creation and ongoing maintenance of civic address data. This data will also be extremely useful to municipalities, in that it will provide a convenient location reference for indexing of additional data. Civic address points will be associated with buildings.

5.1.5 Other Provincial Mapping

It should be noted here that SNSMR and other provincial government agencies have other digital data that may be of use to municipalities. These thematic mapping products include drinking water supply watersheds, agricultural lands, forest cover, crown lands, parks, flood risk areas and other environmental and resource features. The Nova Scotia Catalogue of Geographic Information available from the Nova Scotia Geomatics Centre (NSGC) website (<http://www.nsgc.gov.ns.ca>) has more specific information regarding the status of provincial thematic mapping products.

5.1.6 Provincial Data Formats

Data maintained by DHMA and other Provincial Departments is available in several GIS formats, including CARIS and Arc Info. Other formats may be available upon request.

Table 5.1 summarizes each of these databases in terms of graphic layers and supporting attribute files.

**Table 5.1
Provincial GIS Mapping Requirements**

Mapping Database	Layer	Major Features	Topology	Attribute Files
Nova Scotia Topographic Data Base (NSTDB) and Urban Topographic Mapping	Transportation	Road and rail centerlines, bridges	Network	None
	Hydrology	Rivers, lakes	None	None
	Utilities	Power lines, substations	None	None
	Structures	Light houses, wharves, grandstands, etc.	None	None
	Buildings	Building symbols and outlines	None	None
	Designated Areas	Parks, reserves, game areas, etc.	None	None
	Land Cover	Treed areas	None	None
	Delimiters	Boundaries, neat lines	None	None
	Contours	Contours, spot heights	None	None
Nova Scotia Property Records Data Base (NSPRD)	Land Parcels	Land Parcels, PID labels	Polygon	Parcel Index File Assessment File
	Other Features	Text	None	None
Nova Scotia Civic Address File (NSCAF)	Civic Address Points	Civic address points	None	Civic address attributes
	Street Network File	Street centerlines, community boundaries	Network, polygon	Street attributes

5.2 Municipal Mapping Data

This section provides an overview of municipal mapping that is needed to support municipal GIS applications previously described within this document. These requirements are based upon feedback received during group workshops (in both Bridgewater and Pictou Municipality) and individual interviews conducted for this project, review of other municipal GIS studies and relevant background reports, and the prior experience of the Consultant.

Some of this information may currently exist in digital form; however, it would have to be determined on a case by case basis whether this data is suitable for use with a GIS system. It may be necessary to construct these layers as part of a municipal GIS implementation project.

Table 5.2 summarizes each of these databases in terms of graphic layers and supporting attribute files. Descriptions of each of these databases are contained within Appendix C of the full report.

**Table 5.2
Municipal GIS Mapping Requirements**

Mapping Database	Layer	Major Features	Topology	Attribute Files
Municipal Utilities	Water	Water mains, laterals, curb stops, manholes, pump stations	Network	Inventory records Maintenance records
	Sanitary Sewer	Sewer mains, laterals, manholes, lift stations, treatment facilities	Network	Inventory records Maintenance records
	Storm Sewer	Mains, laterals, catch basins	Network	Inventory records Maintenance records
Watersheds	Watersheds	Watershed polygons	Polygon	To be determined
Zoning	Zoning	Zoning polygons	Polygon	Zoning classification
Land Use	Land Use	Linked to PIDs	n/a	Land use classification
	Future Land Use	Future land use polygons	Polygon	Future land use classification
Setback Lines	Setback Lines	Setback lines	None	Setback regulations
Recreational Facilities	Recreational Properties	Linked to PIDs	n/a	Recreational facilities inventory
	Recreational Trails	Linked to PIDs	n/a	Recreational trails inventory
Electoral Boundaries	Electoral Boundaries	Ward boundary polygons	Polygon	Ward attributes
First Responder Zones	Fire Response Zones	Fire zone polygons	Polygon	Fire zone attributes
	Police Response Zones	Police zone polygons	Polygon	Police zone attributes
	Ambulance Response Zones	Ambulance zone polygons	Polygon	Ambulance zone attributes
	General Service Area	General Service Area polygons	Polygon	General Service Area polygons

Mapping Database	Layer	Major Features	Topology	Attribute Files
Tax Areas	Fire Protection	Area polygons	Polygon	Tax area attributes
	Fire Hydrants	Area polygons	Polygon	Tax area attributes
	Street Lighting	Area polygons	Polygon	Tax area attributes
	Sewer	Area polygons	Polygon	Tax area attributes
	Garbage Collection Zones	Area polygons	Polygon	Tax area attributes
Traffic Control	Signs	Sign locations	None	Sign inventory Maintenance records
	Signals	Signal locations	None	Signal inventory Maintenance records
Road Inventory	Culverts	Culvert locations	None	Culvert inventory Maintenance records
	Curbs	Linked to road centerline features	n/a	Curb inventory Maintenance records
	Sidewalks	Linked to road centerline features	n/a	Sidewalk inventory Maintenance records
	Guardrail	Guardrail locations	None	Guardrail inventory Maintenance records
Bridge Inventory	Bridges	Bridge locations	None	Bridge inventory Maintenance records
Access Control	Access Control	Linked to road centerline features	n/a	Access control inventory
Tree Inventory	Tree Inventory	Tree locations	None	Tree inventory Maintenance records
Heritage Sites	Heritage Sites	Linked to PIDs	n/a	Heritage site inventory Maintenance records

Mapping Database	Layer	Major Features	Topology	Attribute Files
Parking Inventory	Parking Lots	Linked to PIDs	n/a	Parking lot inventory Maintenance records Revenue records
	Parking Garages	Linked to PIDs	n/a	Parking garage inventory Maintenance records Revenue records
	Parking Meters	Meter locations	None	Parking meter inventory Maintenance records
Cemetery Lots*	Cemetery Lots	Cemetery lot polygons	Polygon	Cemetery lot inventory Maintenance records

*Note: This may not be common to each municipality but was identified in the Bridgewater study

5.3 External Mapping Data

This section provides an overview of additional mapping requirements. These are associated with the location of other utilities: power, telephone and gas. Some of this information may currently be available in digital form. Where it is not, discussions should be held with the appropriate agencies to determine whether it is possible to enter into a cost shared agreement for mapping these facilities.

Table 5-3 summarizes each of these databases in terms of graphic layers and supporting attribute files that are of interest to or shared with municipalities. Descriptions of each of these databases are contained within Appendix C of the full report.

Table 5.3 External GIS Mapping Requirements

Mapping Database	Layer	Major Features	Topology	Attribute Files
Power Utilities	Poles	Utility poles	None	To be determined
	Street Lights	Linked to poles	None	Street light inventory Maintenance records
	Facilities	Transformers, substations	None	To be determined
	Power lines	Power lines by phase	None	To be determined
	Underground Cable	Underground cable conduit locations	None	To be determined
Telephone Utilities	Poles	Utility poles	None	To be determined
	Telephone lines	Telephone lines	None	To be determined
	Underground Cable	Underground cable conduit locations	None	To be determined
Cable Utilities	Poles	Utility poles	None	To be determined
	Cable lines	Cable lines	None	To be determined
	Underground Cable	Underground cable conduit locations	None	To be determined
Gas Utilities	Main Lines	Main and lateral transmission lines	None	To be determined
	Distribution Lines	Distribution lines	None	To be determined

6.0 GIS TECHNOLOGY ARCHITECTURE

The foregoing sections attempted to identify what tasks and what information is required in a municipal GIS. This section involves description of the computer systems and technology involved. These requirements have been prepared following a review of the current information technology architecture present within the study municipalities (Pictou County, Bridgewater) and review of other municipal jurisdictions.

It is important to note that the hardware and software configurations described within this section should be considered as *initial guidelines only*. The cost figures provided are adequate for preliminary budget purposes in support of a typical municipal GIS implementation. However, the reader is cautioned that actual GIS implementation costs may vary significantly from the implementation scenarios presented within Section 6.3.

Finally, as a rough guide to assist municipalities in determining hardware and software requirements, a checklist is provided within Section 6.4 below.

6.1 Current Information Technology Architecture

Before implementing GIS technology in a municipal environment, several considerations must be taken into account. A complete review of the current information technology architecture must be undertaken. A review of each existing municipal database is needed to identify potential GIS linkages based on the fact that the most common links are the property identifier(PID), the assessment account (AAN) and the civic address. It will also be a requirement to identify up front the anticipated role and responsibility of each municipal staff person involved in or benefitting from the use of GIS technology.

The level of technical skills available among municipal staff may dramatically affect the success of GIS technology implementation in municipal governments. A GIS implementation that does not take into account existing municipal databases and the level of skills available becomes a request and delivery system rather than providing support for planning and decision making.

6.2 GIS Technology Requirements

This section describes the information technology architecture required for GIS implementation in terms of both hardware and software.

The technology requirements for each implementation vary depending upon the size of the municipality (small or large), the number of anticipated GIS users, and the complexity and requirements of the applications being developed.

A small municipality might start with one or two GIS viewers, plus the NSPRD property mapping database, and simply link attribute data from existing database records to it through a common link (e.g. PID). The next step may be to add a permit system that stores the PID as part of its attributes. Next a civic address file is created by creating a PID/Civic Address Index. Finally, the creation of map themes specific to the municipality such as wards or districts and administrative boundaries might be created through out-sourcing of these specific layers to private firms to digitize.

In a larger municipality, a large Network server could be utilized as a data repository and multiple GIS viewers installed on individual client PCs. The Network server would be accessible to specific GIS users by granting privileges at the operating system level.

6.2.1 Hardware Requirements

The information technology review conducted under Section 6.1 will determine whether GIS implementation can take advantage of the existing local area network, server configurations, workstations and printers. This would also include data storage and backup requirements.

Mainframe

Based upon the review of the information technology architecture in place within the municipality, it can be determined whether an existing mainframe computer meets the minimum system requirements of the GIS system proposed.

In many cases, it is preferable that GIS software reside on a network server or individual workstations to avoid interference with other mainframe applications such as accounting. If the system contains a database management system, consideration should be given to storing the textual databases associated with the GIS applications on the mainframe, and providing GIS access to existing databases that have location references (for example, water and sewer accounts that are linked to property parcels of civic address points).

Network Server

A Network Server is typically an integral part of GIS technology architecture for medium to large municipal implementations. It stores the GIS programs and system files, municipal graphic data and attribute data files. The amount of available memory on the server will vary depending upon the anticipated number of client workstations accessing the GIS data. A backup tape unit should be included in the configuration of the server.

Local Area Networks

Many municipalities have some computer network in place allowing some exchange of

information between workstations. These networks are most often wired with 10BaseT cabling. The speed of the standard network card in the workstation must be adequate (should be able to transport data at rates of 10Mbps and be upgradable to 100Mbps). The transport protocol of the network to exchange data must also be considered (GIS systems commonly support the TCP/IP network protocol).

Personal Workstations

The personal workstation configuration requirements varies with each GIS system and tasks performed on each workstation. A workstation which is routinely performing analysis functions such as area rate calculations or determination of parcels within municipal zoning polygons would typically require more system memory than a workstation inquiring on ownership information on individual parcels.

While technology requirements are constantly changing, a base workstation recommendation includes a Pentium II (350Mhz or better) computer, with 64 Mb of RAM and a 16Mb video card on. As querying mapping files tend to be intensive a 17" monitor should also be included as part of this standard configuration.

Digitizers and scanners

Where municipalities will be making their own maps, a large format (30"x30") digitizing table is often required for data entry of lines, points and polygons into a GIS system. Alternatively, these could be scanned and vectorized with a 'mouse' (heads-up digitizing).

Printers and plotters

It is essential that some form of hardcopy output capability is available from a GIS. A laser printer is typically suitable for reports and small format plots and screen dumps. A large format colour plotter is generally part of a GIS implementation solution when large format mapping output or plans are required.

6.2.2 Software Requirements

GIS Viewer

For the "front-office" workstations, access to full GIS functionality is not required. The "front-office" system configuration simply requires data display, inquiry and reporting capabilities. This configuration is generally capable of being handled by desktop GIS viewers .

GIS Analysis

The GIS system analysis requirements which have been identified for municipal applications

include:

- overlay analysis;
- corridor analysis; and
- point in polygon.

The ability to perform address geocoding (locating civic address points on a road centerline network that contains street names and address ranges) will be needed for most Nova Scotia municipalities. In addition to the above basic functions, more advanced municipal applications may require the ability to reference linear data and display results using dynamic segmentation. In more sophisticated operations a network routing function may also be desirable for vehicle dispatch and service area planning applications.

GIS Editor

Where a municipality is creating its own maps or editing or adding detail, software is required to edit the graphic files (administrative boundaries, zoning layers, or municipal utility infrastructure), more sophisticated software capable of producing accurate digital maps is required.

Several GIS systems have scaled down, low cost digital map-making capability that compliment their GIS viewers and analysis and enable network and polygon creation. Other systems have developed extensions for CAD based products which allow for GIS (topological) relationship to be created and exported to their GIS viewers.

Full GIS editing and topological functionality goes a step further and allows for, amongst other things, the ability to digitize, to clean undershoots and overshoots, and to remove duplicate features. There is often a requirement to have the ability to connect a digitizing table to a GIS editing workstation. This full GIS functionality enables the creation of linear networks and enable the appropriate intelligence to be imbedded in the points, lines and polygons(topology)to create the most complex maps.

GIS System

A fully featured GIS system includes all of the capabilities described above within the GIS Viewer, GIS Analysis, and GIS Editor packages. As well, it will typically include advanced map database library management and map file import and export functions.

The map editing and topology construction functions will be much more sophisticated than those found within the GIS Editor. Some of the functions that may only be available as additional modules to the GIS Analysis package (for example, linear referencing / dynamic segmentation, network routing) may be included within the basic GIS System package.

Database Management Software

A relational database management system (RDBMS) package is generally an integral part of a GIS implementation. This software is the type typically associated with any database management and includes Foxpro, Oracle, Microsoft Access, and Microsoft SQL Server. These database systems maintain the attributes associated with the graphics data that are non spatial. For instance, a user might know the PID or civic address of a parcel and want to know the owners name, assessment value and land use classification of that parcel. This would not require a GIS system to perform the task and only a query of the database. Current GIS systems integrate graphic databases (maps) with attribute data. As an example, the GIS system can identify all parcels within 100m of a specific property, once these PID's are identified, the relational database can produce a report of the mailing addresses of their owners..

Office Automation and Integration:Permit System

The integration of such functions as lot related approval and permit operations (subdivision, development, building) into the GIS database provide functionality to efficiently track these processes. Although this is not a necessity, the fact that this information is tied to a property parcel allows for a richer and more comprehensive analysis of development .

There are a number of commercial permit tracking systems available that would be suitable for use within Nova Scotia municipalities. Some of these packages are third party solutions and extensions of existing GIS systems. These systems enable you to view, query, analyze and manipulate data within a spatial environment.

6.3 Typical GIS Configurations

In order to give some perspective of the cost associated with GIS implementation three example scenarios are presented. Each of the outlined scenarios present basic GIS functional requirements and rough costs. The Nova Scotia property records database (NSPRD) and topographic database (NSTDB) which are the basic 'building blocks' for municipal GIS implementation and are available to municipalities at nominal costs, are not included in these figures. Municipalities may be able to implement GIS more cheaply should existing equipment meet GIS specifications.

6.3.1 Scenario 1 : Small Startup System

The first scenario represents a small startup system configuration that assumes that the GIS software can be loaded onto existing local area networks, servers and workstations. It also assumes that existing printers and plotters are available for use. This configuration is implemented with three GIS viewing stations linked to a desktop database. The CAD workstation, CAD system and topology automation tool configuration is a low cost means of creating digital data and network and polygon topology for the GIS viewing workstations.

Table 6.1
Small Startup System Costs

Category	Component	Unit Cost	Quantity	Total
Hardware	CAD Workstation	\$4,000	1	\$4,000
Software	GIS Viewer	\$2,000	3	\$6,000
	CAD System	\$5,000	1	\$5,000
	Topology Automation	\$1,800	1	\$1,800
	Desktop Database	\$900	3	\$2,700
TOTAL				\$19,500

6.3.2 Scenario 2 : Small to Medium Configuration

The second scenario represents a configuration suitable for a medium sized municipality. The configuration is implemented with four GIS viewing workstation and one CAD workstation with topology automation capabilities. A large format plotter and laser printer have been added . This configuration also includes the addition of an entry level relational database management system (RDBMS) in support of a permit tracking system with GIS viewing capabilities.

Table 6.2
Small to Medium Municipal System Costs

Category	Component	Unit Cost	Quantity	Total
Hardware	CAD Workstation	\$4,000	1	\$4,000
	Viewing Workstation	\$3,000	4	\$12,000
	Permit Workstation	\$3,000	1	\$3,000
	Laser Printer	\$1,500	1	\$1,500
	Large Format Plotter	\$10,000	1	\$10,000
Software	GIS Viewer	\$2,000	5	\$10,000
	CAD System	\$5,000	1	\$5,000
	Topology Automation	\$1,800	1	\$1,800
	Permit System	\$5,000	1	\$5,000
	RDBMS System	\$5,000	1	\$5,000
TOTAL				\$57,300

6.3.3 Scenario 3 : Medium to large Configuration

The third scenario represents a configuration suitable for a medium to large municipal implementation. It includes a RDBMS server with two editing workstations, ten analysis workstations and viewing workstations all connected on an organization wide LAN. This scenario also includes a RDBMS with an unlimited site license in support of a permit tracking system, a large format plotter and laser printer (see Table 6.3).

Table 6.3
Medium to Large Municipal System Costs

Category	Component	Unit Cost	Quantity	Total
Hardware	Network Server	\$20,000	1	\$20,000
	Editing Workstation	\$3,000	2	\$6,000
	Viewing Workstation	\$3,000	10	\$30,000
	Permit Workstation	\$3,000	1	\$3,000
	Laser Printer	\$1,500	2	\$3,000
	Large Format Plotter	\$10,000	1	\$10,000
	Digitizing Table	\$5,000	1	\$5,000
	Software	GIS Viewer	\$2,000	10
GIS System		\$20,000	2	\$40,000
Permit System		\$5,000	1	\$5,000
RDBMS Server Unlimited		\$20,000	1	\$20,000
TOTAL				\$162,000

6.4 Summary GIS Technology Checklist

This section provides municipal staff with a checklist that can be used to roughly determine GIS hardware and software requirements. Table 6.4 below provides, for each application described the GIS software functionality required to support the application in terms of the definitions provided. The reader can then use the cost figures provided (Section 6.3) to determine approximate hardware and software cost estimates.

- *GIS Application* - specifies the municipal GIS application as described within Section 4.0 and Appendix B;
- *Map Editing* - indicates whether GIS map editing and update functions are required;
- *Attribute Update* - indicates whether attribute data editing and update functions are required;
- *GIS Software* - specifies the GIS software required to support the application; and
- *Special Software* - identifies any additional application software that is required to support the application.

Note that Table 6.4 does not contain a column to indicate where a RDBMS package is needed. While this is a basic component of all GIS, the municipality may have a one in place to support other applications.

**Table 6.4
Software Requirements by Application**

Application	Map Editing	Attribute Update	GIS Software	Special Software	Notes
Utility Infrastructure Inquiry			Viewer		
Parcel Inquiry/Reporting			Viewer		
Boundary Maps	X		Editor		
Civic Address Mapping/Inquiry			Viewer		
NSTDB Topographic Mapping			Viewer		
Urban Topographic Mapping	X	X	Editor		
Permit System		X	Viewer	Permit Application	
Utility Inventory Mngt.	X	X	Editor	Network Modeling	1
Land Use Planning		X	Viewer		
Road Infrastructure Mngt.	X	X	Editor	Network Routing	1
Street Signs/Signals Inventory	X	X	Editor		2
Area Rate Calculations	X	X	Editor		
Redistricting Analysis		X	Analysis	Redistricting	
Heritage Properties Inventory		X	Viewer		
Voter Enumeration List		X	Viewer		
Bylaw Infrastructure Reporting		X	Viewer		
Civic Address Maintenance	X	X	Editor		
Trails Inventory		X	Viewer		
Recreational Facilities Inventory		X	Viewer		
Parking Inventory		X	Viewer		
Tree Inventory	X	X	Editor		
Cemetery Management	X	X	Editor		
Power Utility Info			Viewer		3
Telephone Utility Info Access			Viewer		3
Cable Utility Info Access			Viewer		3
Natural Gas Utility Info Access			Viewer		3

Notes:

1. *The special software specified is optional, and may be used to expand the functionality of the application.*
2. *The editing capability requirement for this application is for the addition of parking meters only. If the GIS Viewer or Analysis package chosen includes the ability to enter and edit print features, a GIS Editor package may not be needed.*
3. *The ability to import data layers from the external utility agency is required. If the GIS Viewer package does not fully support this function, a GIS Analysis or Editor package may be required.*

1.0 INTRODUCTION AND SCOPE

1.4 Introduction

This section of a Request for Proposal (RFP) will contain a brief description of what services are being requested. (For instance, the purpose of this RFP is to undertake Geographic Information System (GIS) User Needs Study for use by the municipality and its' respective departments including Engineering and Public Works, Planning, and Administrative Services).

1.5 Issuing Organization

This section of an RFP would indicate the committee, department or organization responsible for the issuance of the RFP.

1.6 Background Information

This section of an RFP would provide some general background information regarding the decision to pursue the use of GIS technology within the municipality to improve efficiency, effectiveness and enhanced decision support.

This section should also detail the present municipal business functions supported by mapping (i.e. - subdivision approval, area rare districts, location of pipes).

1.4 Purpose and Scope

This section of an RFP would provide details of the purpose and scope of the RFP document (in this case a GIS User Needs study).

1.5 Current Technology Architecture

This section of an RFP would provide details on current hardware and software configurations within the municipality. Existing hardware (computers, plotters, printers, scanners, etc.) should be identified and network configurations described. Existing software should be identified (operating systems, word processing, spreadsheets, databases, E-mail, CAD systems, etc.) in relation to the functions they support within the municipalities operations. Any desired system integration (i.e. proposed link of property database to building permit applications) should also be identified.

This section would provide sufficient detail to enable the bidder to determine how the GIS can be integrated into the current technology architecture.

1.6 Terms and Conditions

This section would contain a brief summary of the terms and conditions of the contract including some or all of the following:

1.6.1 Requirements

This would include sections such as the:

- Required Hardware and Installation of Software;
- Required Interfaces;
- Conversion and Creation of Digital GIS Layers;
- Training; and
- Support and Maintenance.

1.6.2 Payment and Invoice Provisions

This section of the RFP would provide details on payment provisions. For instance, the payment for the proposed GIS software will be due once the GIS installation, testing and training has been completed.

1.6.3 Acceptance of Proposal

This section sets out the basis and understanding of obligations as a result of the RFP. Typically this section would include a statement that suggests that the issuance of the RFP does not commit the municipality to award a contract to any bidder. If selected, the bidder would be required to enter into contract negotiations with the municipality to resolve any revisions to the original submission, as deemed necessary, prior to contract award.

1.6.4 Letter of Intent

This section of the RFP provides for a letter of intent being submitted as a covering letter to the proposal. The letter must clearly identify the prime bidder in the contract and identify any subcontractors involved. The letter must be signed by an authorized employee of the lead company. Failure to submit a letter of intent will disqualify the proposer from the evaluation process.

2.0 PROPOSAL PREPARATION AND SUBMISSION

This section of the RFP would contain the details on when, to whom and how the municipality wants the proposal formatted.

2.1 Closing Date and Other Important Dates

This section of an RFP would contain details on the submission of questions, the closing date, and the anticipated target date for the completion of proposal evaluations.

2.2 Review of Materials

This section of an RFP (optional) would allow for the opportunity of the Bidders to review any relevant materials and documentation deemed appropriate to the scope of the RFP document. A review of materials timetable is often outlined in the RFP for Bidders to meet with key personnel and allow an opportunity to ask questions. In some cases written questions can be submitted by interested bidders and

the responses distributed to all

2.3 Proponents Meeting

This section of an RFP (optional) would allow the municipality to setup a specific meeting time and place for Bidders to attend to review any relevant materials, documentation and to meet with key personnel.

2.4 Contracts

This section of an RFP would contain details with respect to the operation of this contract along with any specifics on procurement practices.

2.5 Submission of Proposal

This section would include details on how the proposals are to be submitted. This would include the number of copies to be submitted (i.e.- two bound, one unbound) and the complete address of the individual and location to submit the proposals. This section would also indicate whether the proposal can be submitted by fax or other form (E-mail).

2.6 Format and Content of Proposal

This section details the format and content of the proposal submitted by the bidders. The RFP should contain detailed descriptions and requirements for each of the following sections:

- Management Summary;
- GIS Application Software;
- Hardware Requirements;
- Security;
- Implementation;
- Data Conversion and Creation;
- Warranty and Support;
- Training;
- Financial Summary;
- Key Personnel and References; and
- Requirements Checklist.

2.7 Benchmark or Demonstration

This section of an RFP would provide details regarding the necessity for either a benchmark or a demonstration of the proposed GIS system.

2.8 Additional Information

This section of an RFP would encourage the bidder to include any additional information or implementation scenarios which may not have been addressed previously in the RFP.

3.0 TERMS AND CONDITIONS

3.1 Inquiries

All inquiries from Bidders related to the RFP are generally directed to one of the key personnel involved in the RFP evaluation process. This individuals address, phone/fax number and E-mail address would be supplied here. It is also typically identified that all inquiries reference specific sections of the RFP document for ease of response.

3.2 Information Session

An information or viewing session of materials may be provided by the municipality to provide the proposer(s) a sample of existing municipal information.

3.2 Presentation / Demonstration

The municipality may request a formal presentation and/or demonstration of the proposed GIS solution at a mutually agreeable time.

3.3 Proposal Evaluation

A brief statement on how the proposals are to be evaluated is generally included in an RFP document. This statement would typically detail the evaluation criteria along with a maximum score per item. Some of the criteria may include, but is not limited to, the following:

- Hardware and Software Costs;
- GIS Functionality;
- Support (Local);
- Reliability;
- References; and
- Warranties.

3.4 Subcontracting

Utilizing a subcontractor (who must be clearly identified) is acceptable; however, the lead bidder is ultimately responsible for the proposed GIS solution. Maintenance and support of software components may be provided directly from the software provider.

3.5 Proposal Closing

Proposals must be submitted (in a specified number) in a sealed envelope with the proposal title and closing date clearly identified. The proposals should be submitted to a specified key personnel on or before a clearly detailed closing date and time. It should indicate that late proposals will not be accepted.

3.6 Proposal Information

All information submitted in the proposals shall be considered the property of the municipality.

3.7 Proposal Costs

The Bidders will assume any and all costs incurred with preparing and presenting the proposal to the municipality.

3.9 Statement of Liability

The municipality shall not be deemed liable for any software/hardware delivered by the successful bidder until the complete GIS system has been accepted by the municipality.

3.10 Award Responsibility

This section of an RFP documents the key personnel or municipal department responsible for the review and evaluation of the submitted proposals.

3.11 Software Reliability

This section of the RFP would detail any software specific requirements. This would include a statement that the software is current and has been certified on the recommended GIS system.

3.12 Multiple Proposals

More than one proposal may be submitted by each Bidder; however, this must be clearly detailed on the proposals' title sheet.

3.13 Optional Products

This section of the RFP would provides the Bidder the opportunity to describe details on further system enhancements which may provide improved performance or additional capabilities.

3.14 Schedule of Events

This section of an RFP document contains a brief summary of all of the specific dates outlined in the RFP.

4.0 COSTS AND FEES

This section of the RFP would provide complete details on how the Bidders are to present costing information. This may include prepared forms or a format for the Bidders to submit along with their proposals detailing the following; GIS software and installation costs, hardware costs, data conversion costs, training and support costs, and other associated system implementation costs.

Appendix F - Sample GIS Queries

Sample 1: Locating a selected use, in this case, single family dwellings built after 1995.

The screenshot displays the ArcView GIS 3.1a interface. The main window shows a map of building permits with several single-family (SF) dwellings highlighted. The 'Building Permit Query' window is open, showing a query: `(([Bldgtype] = "SF") and ([Estval] >= 100000) and ([Dateapplic] >= (" 19931224"))`. The 'Attributes of Building Permits 1992-1999' window is also open, displaying a table of permit data.

Pid	Estval	Worktype	Femno	Dateapplic	Bldgt
15626823	121125	E	15158	19950818	SF
15531817	103125	E	15285	19950922	SF
15660079	206655	E	15177	19950824	SF
15590367	126525	E	15153	19950817	SF
15536253	134100	E	15273	19950920	SF
15188089	111750	E	15305	19950926	SF
15317761	128198	A	15395	19951023	SF
15216203	158775	E	15151	19950816	SF
15657216	107325	E	15401	19951024	SF
15639602	279975	E	15397	19951023	SF
15316078	140250	E	15366	19951011	SF
15663339	112950	E	15458	19951121	SF
15563901	153000	E	15472	19951127	SF
15364409	123225	E	15157	19950818	SF
15564768	115050	E	15570	19960209	SF
15625981	215025	E	14753	19950523	SF
15665508	100875	E	15672	19960401	SF
15607203	100950	E	15224	19950908	SF
15582281	182753	E	15383	19951019	SF
15586787	116250	E	15632	19960315	SF

Sample 2: Locating a selected use, in this case a convenience store.

The screenshot shows the ArcView GIS interface with the following components:

- Top Panel:** ArcView GIS Version 3.1 menu and toolbar. Status bar shows "8 of 5902 selected".
- Left Panel (Land use classification.shp):** Fields list (Shape, Code1-5, Describe) and Values list ("Georges River", "North Sydney", "Scotch Lake", "Sydney Mines", "Upper North Sydney"). A query is entered: "[Code1] = 'SACS'" and "[Community] = 'North Sydney'".
- Right Panel (Convenience Store Query - Community of North Sydney):** Legend showing various land use codes and their corresponding colors. A map view shows the selected polygons highlighted in yellow.
- Bottom Panel (Attributes of Land use classification.shp):** Attribute table showing the following data:

Shape	Code1	Code2	Code3	Code4	Code5	Describe	Initial	Source	Updated	Community	Units
Polygon	SACS					Convenience Store	jsw	Field Check	062800	North Sydney	com1
Polygon	SACS					Convenience Store	jsw	Field Check	062800	North Sydney	com1
Polygon	SACS					Convenience Store	jsw	Field Check	062600	North Sydney	com1
Polygon	SACS					Convenience Store	jsw	Field Check	062000	North Sydney	com1
Polygon	SACS					Convenience Store	jsw	Field Check	061500	North Sydney	com1
Polygon	SACS					Convenience Store	jsw	Field Check	061500	North Sydney	com1
Polygon	SACS					Convenience Store	jsw	Field Check	061600	North Sydney	com1
Polygon	SACS					Convenience Store	jsw	Field Check	062600	North Sydney	com1
Polygon	SEMVAB					Autobody Shop	jsw	Field Check	061500	North Sydney	com1
Polygon	RSSIDE					Single Unit Dwelling	jsw	Field Check	032200	Upper North Sydney	rs1
Polygon	RSSIDE					Single Unit Dwelling	jsw	Field Check	032200	Upper North Sydney	rs1
Polygon	RSSIDE					Single Unit Dwelling	jsw	Field Check	032200	Upper North Sydney	rs1
Polygon	RSSIDE					Single Unit Dwelling	jsw	Field Check	032200	Upper North Sydney	rs1
Polygon	RSSIDE					Single Unit Dwelling	jsw	Field Check	032200	Upper North Sydney	rs1
Polygon	RSSIDE					Single Unit Dwelling	jsw	Field Check	032200	Upper North Sydney	rs1
Polygon	RSSIDE					Single Unit Dwelling	jsw	Field Check	032200	Upper North Sydney	rs1
Polygon	SEMVAB	SEMVAB				Auto Repair/Auto Body	jsw	Field Check	032200	Upper North Sydney	com1
Polygon	RSSIDE					Single Unit Dwelling	jsw	Field Check	032200	Upper North Sydney	rs1
Polygon	RSSIDE					Single Unit Dwelling	jsw	Field Check	032200	Upper North Sydney	rs1
Polygon	RSSIDEM					Mobile Home	jsw	Field Check	032200	Upper North Sydney	rs1

Sample 3: Locating services, in this case, the location of water mains.

The screenshot shows the AutoCAD Map 2000 interface. The main window displays a street map with various streets labeled, including Queen Street, Post Office Street, Rink Street, and Centennial Street. Blue lines and labels indicate the location of water mains. A data table is visible at the bottom of the screen, showing details for the selected water main link.

INTERNAL_ID	USER_ID	MUN_UNIT	STREET_NAME	LOCATION_DETAIL	YEAR	DEPTH_M	VALVE	DIAMETER_MM	MODEL	NUT_SIZE_MM
1811	BT_WGV65	Town Limits	Post Office Street	Intersection of Granville Street	1949	1.2	Gate	150	Mueller	50 2
1812	BT_WGV66	Town Limits	Post Office Street	Corner of Rink St and Post Office						
1813	BT_WGV67	Town Limits	Post Office Street	Intersection of Rink Street - near c	1949	1.2	Gate	150	Mueller	50 2
1814	BT_WGV68	Town Limits	Rink Street	10' east Intersection post office	1949	1.2	Gate	100	Mueller	50 1 1/2
1815	BT_WGV69	Town Limits	Queen Street	Civic 56 south of bridge	1989	1.4	Gate	250	Mueller	50 3/4
1753	BT_WGV7	Town Limits	Faye Road	Corner of Centennial Dr and Faye						
1816	BT_WGV70	Town Limits	Queen Street	At bridge	1989	1.2	Gate	250	Mueller	50 3/4

GIS for Municipalities

Sample 4: Locating services, in this case, the condition of water mains

