City of Guelph

Volume II: GIS Strategic Plan

Geographic Technologies Group
UNDERSTANDING LOCAL GOVERNMENT

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2014

Governance Model

City of Guelph, Ontario

Geographic Technologies Group

Governance Model

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Definitions and Concepts

Geographic Information Systems (GIS) technology provides a framework for organization-wide cooperation by using location as a common frame of reference, allowing individuals and departments to share information about locations. An enterprise GIS promotes interoperable technologies, standards, and methods, thus facilitating a more efficient and effective use of the technology. Coordinating efforts helps organizations better use the analytical capabilities of GIS technology and results in less staff time spent searching for, compiling, and integrating GIS data.

GIS Technology Principles

GIS is unique within information technology because of the relatively high start-up costs, data integration expenses, and longer pay-back periods. Therefore, the challenges associated with governing a GIS are unique and require governance principles and rules, in addition to the information technology principles and specific local government principles. For a government to maximize the return on investment while improving business productivity, GIS best practices and principles need to be recognized in the following ways:

GIS information is highly valuable and as such it must be integrated with technology initiatives.

The goal is to develop the data once and to re-use it multiple times and for many different purposes. By pooling resources and reducing expenses, sharing the base information lowers the overall start-up and maintenance costs. The organization becomes more productive because working collaboratively is less expensive than working as individual business units. In contrast, it is particularly expensive if each business unit or business system attempts to develop GIS information independently.

There is a longer payback and return on investment because it takes multiple years to implement a GIS. Extensive data acquisition efforts are required to build a GIS. Initial data gathering is typically conducted using aerial photography known as "a fly-over". The government issues a Request for Proposals (RFP) and contracts with an aerial photography company to fly the area and capture photographic images that are then geo-referenced to known ground control points. The film or data is processed and used to digitize the land base features. The fly-over process and data creation process can last from 1 to 3 years depending on the area's geographic size and the technology deployed. Parcel and tax map layers require an additional 1 to 3 years of field work, deed research and boundary compilation. Networks for water, sewer, and storm water could require additional physical surveys and extensive site and construction plan research. These surveys can take an additional 1 to 3 years. Each listed process could cost several million dollars, in addition to the cost of specialized GIS software. As a result, the government may invest heavily in a GIS implementation even before the first map is produced. The longer timeframe for return on investment (ROI) can make it difficult to maintain momentum and encourage participation during implementation efforts.

Special software and modules are required for GIS integration. The need for specialized software that bridges the gap between file databases and dynamic geospatial information results in higher integration costs for GIS. For example, the software allows Utility Engineers to visualize which water network segments are at risk for breakage by overlaying the water distribution network layer with a layer that depicts increases in water usage. To perform this analysis, the GIS needs to communicate with the water billing system. GIS software bridges the communication gap, but it has a higher cost of ownership than a billing system alone. The return on this investment results from preventing a water main break, wasted release of treated drinking water, customers being out of service, and avoiding the risk of flood damage to adjoining property.

GIS information is critical to the enterprise, and as such, it is universal and complete and enables the public decision making process.

GIS is often used to enable strategic decision and policy making and in providing information for regulatory compliance. GIS supports engineering modeling functions, planning, analysis and operations. GIS is used to dispatch emergency services and to enhance public safety. Each outcome is very important to the organization's mission and greatly enhances service. GIS enables an organization to save time, money and lives. To support these outcomes, GIS must be easy to integrate with existing and future information systems

and made available to the entire enterprise. Regardless of ownership, GIS operational functions must be aligned with appropriate resources and implemented by professional and dedicated GIS staff. Timely, high-quality GIS information is necessary to support desired GIS outcomes.

GIS information is largely public information (information that can be collected from the public right-of-way or from the public airways). This information is used for determining public policy, and appropriate information should be openly accessible and used to facilitate public knowledge and meet public expectations for service.

Public information and its spatial components should be made available to citizens to increase awareness about the government decision making process. GIS can identify potential hazards, indicate where services are located, and promote economic vitality opportunities. GIS information supports economic development and tourism opportunities by providing location data in relationship to desired amenities. Demographic analysis enables businesses to relocate or to target advertising to a particular market. Information about the locations of public bus routes, schools, and municipal buildings are important to the public, particularly for newer residents and visitors. Mapping health hazards, flood zones, evacuation zones, zoning, and public easements are very valuable, especially when selecting properties for homes, sites for buildings or emergency shelters. GIS analysis and maps are often used to support decision making and to develop policy. Providing repeatable analysis and information helps citizens understand the decision making process and enables them to provide informed input. The public has the right to inspect public records. Citizens should have open access to examine how their real estate properties are being assessed in comparison to similar properties in the jurisdiction. Open inspection of records can detect clerical or process errors quickly. They should be informed of new construction projects and re-zonings or zoning variances to help maintain a quality physical environment. Access should be provided universally in a format that promotes accessibility with little to moderate costs. Dissemination strategies should balance the public's right to know with the public's right to privacy. GIS applications should meet the same standards and expectations as other public-access applications. They should be fast, attractive and easy to use. GIS applications should be an integral part of government services and information provided via the Internet, enabling citizens to gather information from work or at home and to minimize the need to visit government offices or call 311.

GIS Initiatives are aligned with business processes and functions.

A well designed GIS product universally enables the business process. GIS applications, like other information technologies, are implemented to improve organizational productivity. The ultimate GIS system is a system that is universal and seamless. People with little or no experience can utilize the technology without training. The technology itself is transparent to the end-user. GIS improves productivity because it enables people to locate resources, assets, and features that otherwise are hidden deep within the complex layers of corporate databases. GIS information must be available and current so that it can be used within the business process to support business decisions.

GIS provides the core functionality and basic map interfaces needed to locate and identify global positions. GIS data can be integrated with any database, regardless of format, as long as a common link such, as address or property number, exists in both systems. Once the link is established, users can easily join database tables to generate extended information about locations. GIS spatial analysis tools and the ability to visualize information on maps enable the end-user to identify spatial relationships that are otherwise obscured by overwhelming amounts of tabular data. However, in order to support spatial analysis, data integrity rules are required to ensure that the linkages between databases are maintained. Metadata ("data about data") is very important to GIS because it documents database properties and lets the end-user know what information is available for analysis. It should contain documentation of the workflows and procedures used to create data. In addition to providing users with valuable information, end-users can review the metadata to help maintain data integrity and to prevent programming errors, bugs, and flawed logic. Metadata also enables developers to focus on solutions that improve business processes so they can develop appropriate solutions that meet business needs. A good system development life cycle starts with understanding end-user needs and then soliciting their input throughout the entire planning and implementation period. Consent agreements with GIS end-users reduce costs and improve data sharing at a universal level. GIS is not an island unto itself but, rather, a bridge that spans the gap between traditional information processing and real world spatial business process need.

A **GIS Governance Model** is an organizational structure and process that facilitates GIS technology growth and use. Governance model implementation can be complex and problematic, but the right governance model is critical for effective technology diffusion. If the aim of implementing geo-spatial technologies is to improve organizational effectiveness and efficiency, then selecting a governance strategy is a critical key to success. The appropriate governance model is even more important when considering multi-departmental/shared GIS resources.

Collective organization experiences prove that achieving an operational GIS application does not guarantee its use. Implementation is largely a social and political process which has to be nurtured and cajoled rather than imposed and controlled. The selection, therefore, and implementation of the right governance model (one that follows the GIS implementation principles) could give rise to positive and beneficial characteristics. Alternatively, the selection and/or implementation of a poorly suited governance model (one that does not follow the implementation principles) can have negative consequences. The following table contrasts the results of good GIS governance against that of misguided GIS governance.

Good GIS Governance Results:	Misguided or Lack of GIS Governance Results:
• Effective strategic decision making • Organization-wide resource planning • Seeing GIS information as a public resource • Project and process management • Prioritized resource control • Clear lines of roles, responsibility and accountability • Easy geographic information exchange • Timely response to internal and citizen GIS requests and questions • End-user participation • Stakeholder consent building • Increased productivity • Accurate information, map data, and statistical reports • Working as a team	• Assumption based decision making • Empire building • Misinformed public • Data and process duplication • Variations in priorities • Constant internal competition over funding projects and resources • Information hording or missing information • Inability to locate critical or timely information • Insensitivity to users' needs • Insufficient prevention and response • Inefficient decision making • Poor training and education • Poorly maintained, misplaced and stale information • Everyone going their own way

As the City of Guelph's GIS technology has evolved, it has historically shifted between multiple, but informal, governance strategies. Like most cities, GIS in Guelph in the early 1990s was being utilized in pockets on an as needed basis and was largely project based (i.e. purchased for use for a specific project). MapInfo software was utilized and Engineering, Water Works, and Planning were the heaviest users. City staff realized that GIS was an important resource for the organization as a whole. In that regard, a Technology Plan and GIS Strategic Plan were created that outlined the vision, goals, and objectives for moving GIS to the enterprise. In 2003, the Information Technology (IT) Department hired a Business Systems Analyst (BSA) for GIS. At this point, the focus was on data creation and dissemination. Key data layers were acquired and developed and a central database to house this data was implemented. Software from Esri was implemented for the enterprise GIS efforts. Other departments such as Planning, Engineering, and Water Works have contributed to the GIS effort through data creation and developing staff as power users. In 2005, ArcSDE from Esri was implemented in an effort to centralize all GIS data into a common database. ArcIMS was procured and used as a portal for staff to access data enterprise-wide. In 2006, a reorganization took place that realigned GIS and much of IT. IT management changed and GIS was not touted as a corporate asset. GIS was relegated to a technology that was provisioned like any other software/hardware solution. GIS staff was directed to act accordingly. Their focus was on ensuring that the software and hardware were functional but they were not allowed to spearhead GIS as an enterprise-wide program. A GIS intranet application was acquired to give access to the entire organization. This application, OnPoint, has served as the primary method of GIS dissemination to the enterprise for a number of years. During 2008 – 2009 the GIS was upgraded to Esri's ArcGIS 9.3 and OnPoint version 6. The underlying technology was migrated from ArcIMS to ArcGIS Server. In 2010-2011 changes again occurred in IT. New leadership recognized the enterprise-wide value of GIS and as such has elevated GIS within the organization. A second GIS staff person was hired in 2009 with staff turnover in 2011 (current staff person). GIS is now recognized as a corporate-wide

program and actions are being taken to reinvigorate the GIS. The importance of GIS has been recognized as important to the Corporation under the Council approved IT Strategy.

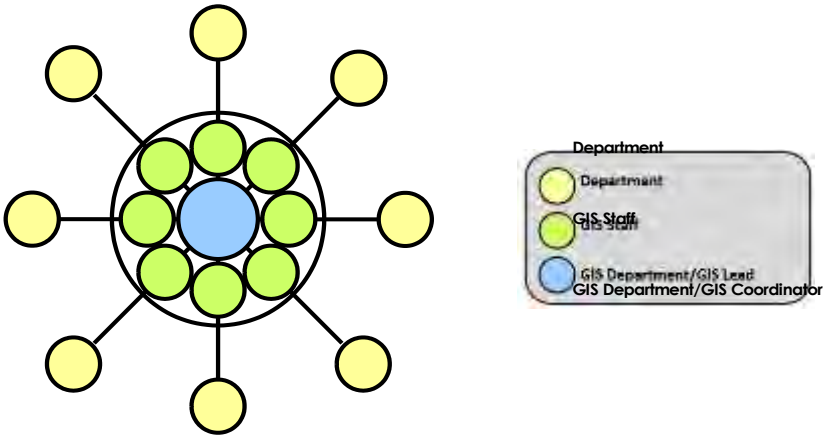
Newer GIS technologies including GIS web applications, back-office databases, and open architectures have allowed the GIS technology pendulum to swing back towards a more enterprise model. GIS information can be more easily integrated with other information systems. The City realized that a centralized GIS Group is indispensable to support the technology on an enterprise-wide basis. To guide the enterprise effort, two GIS Business Systems Analysts (BSAs) within the Information Technology Department are tasked with spearheading GIS implementation for the City. However, these GIS positions have been looked upon as technology centric positions. Historically, the GIS BSAs were tasked with implementing software and hardware, as well as, creating and updating core data layers. Although these items are important to GIS success, they are only some of the technical components of GIS. As importantly, are the non-technical components such as educating the organization, setting data standards, selling the benefits of the technology to each department, and setting organization-wide goals and standards. GIS is not a traditional technology. With a traditional technology, hardware and software are acquired and installed, end-users are given training, and then IT ensures that the hardware and software maintain their operability. GIS is a multi-faceted program made up of many technologies. GIS should become the window into all of the other applications in which the City has invested. At an enterprise-wide level, GIS becomes the conduit for centralized information and decision making. If effects how each department does their job. It alters many long-standing processes. A program that is this far reaching requires a well-defined and officially adopted governance strategy. If it is seen as just another technology, then it will fail to achieve the desired results.

The ultimate success of an enterprise-wide GIS will depend on the ability to govern and manage GIS in this evolving and complex multi-departmental environment. There are two primary organizational structures or governance models used to implement GIS in organizations. A third structure can be argued but is essentially a combination of the two primary models.

Enterprise-wide Organizational Models

There are two primary organizational structures used to implement enterprise-wide GIS within organizations throughout North America. The first type is a **centralized** structure. A centralized organizational structure maintains a central department or division that is responsible for all GIS services. In this type of structure, GIS often has its own dedicated department or is a division of an Information Technology (IT) or Technology Services department. The GIS department/division employs a cadre of management, analysts, technicians, and programmers tasked with hardware, software, application development, planning, and training. Data are created and maintained by this group, or outsourced to contractors. All other participants are characterized as end-users, with primarily the capability to view, query, and analyze spatial data. However, with the advent

of a new set of easy-to-use data collection tools and applications, end-users in some cases will be contributing to data creation and data maintenance.



Centralized GIS Organizational Structure

Business units use the data for day-to-day operations or detailed analysis. Feedback is channeled through the chain-of-command to the lead GIS staff person/s GIS information officer with oversight coming from a steering committee and end-user groups. Bureaucracy and duplication of effort are minimized since there is a central command and control and a single budget source. GIS functions are split into teams that are responsible for each function and requests for services.

This model can be compared to the military model or the water works model. The end-user of the service relies on the central GIS business unit to provide clean GIS information. The end-user just has to turn on the faucet and out flows the GIS information. The end user does not need to be aware of the effort or processes that produce the information; similarly, a person at the end of the water faucet does not have to worry about the infrastructure and management process required to provide clean drinking water. The centralized model is very efficient, and as such, is typically utilized by single departments, large government agencies, the military, and business corporations.

When a well-planned centralized GIS organizational structure is implemented, the government can expect:

- Clearly defined roles from a central chain and command
- Standard software and maintenance procedures
- Shared overhead costs
- Decisive and straight forward direction
- Solutions to operational problems that are implemented from the top down
- Greater operational efficiency for staff throughout the organization
- Reduction in data duplication
- Many integration opportunities with other business systems
- Central access point for data sharing
- Team based processes in which critical functions are beyond one person deep

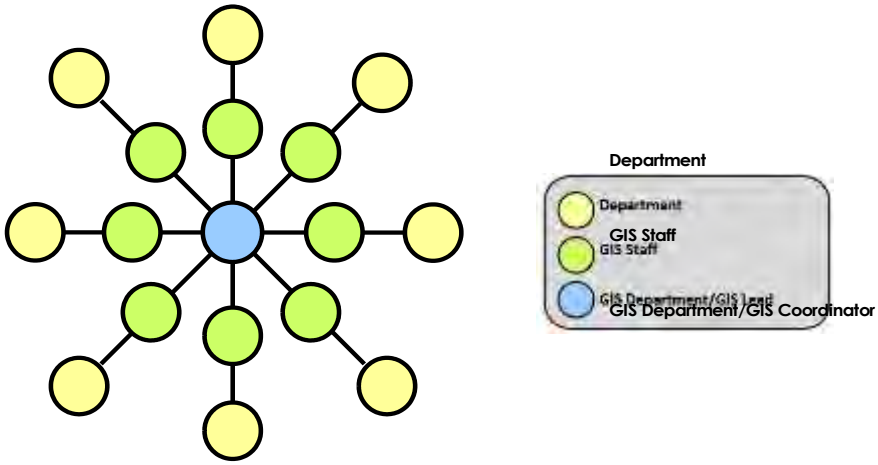
- Increased support for business areas through a pool of team based resources
- Mitigation of GIS service disruption from staff turn-over through a pool of team based resources
- Spatial information maintenance that improves because users are well trained and devoted to specialized tasks.

If the Centralized model is applied, then the governance authority must be aware of and avoid issues such as:

- Inflexible decision making
- Maintenance procedures and standards becoming too rigid
- Poorly funded implementations or budget cuts disrupting the whole system (all the eggs are in one basket)
- Lack of end-user input and design in the planning process
- Smaller agency may not know what to ask for from the central agency since they don't have any GIS experience
- Poor centralized leadership or direction, with the top down design, could lead to undesired results.

The major strength of the centralized model is a well-structured and defined universal GIS system that is highly efficient and effective for the entire enterprise. The weakness of this model is that it can become too rigid or inflexible for stakeholders. If this model is used, the City of Guelph would benefit from a well-run efficient machine with few redundant processes, but the City must be careful not to isolate stakeholders. Many cities usually shy away from the centralized model, since it has a comparatively higher start-up cost than the other models.

The second type of model for GIS governance is a **decentralized** structure. A decentralized organizational structure divides GIS responsibilities throughout various departments. Decentralized organizational structures may still have a GIS section/division, operating independently or under the jurisdiction of another department. This approach divides system and data maintenance between the GIS section/division and departmental end-users. During their course of daily business, users update an enterprise database (e.g., using ArcEditor to edit data). All users share responsibility for maintaining the GIS, and users within each department maintain specific data according to their thematic disciplines and specialties. This type of organizational structure enables the GIS section/division to focus on hardware and software maintenance, data exchange and distribution, application/data design and development, user training and support, community extension, and technology innovation, instead of devoting time to the creation and maintenance of data.



Decentralized GIS Organizational Structure

When a Decentralized GIS organizational structure is implemented properly, benefits include:

- Ability for departments to guide GIS activity independently from organizational initiatives
- Bottom-up decision making
- Line departments that are more sensitive to user needs since they are in close proximity to the developers
- Clear lines of responsibility within the department
- Facilitation of Multi-tasking
- Multiple funding sources for large projects and initiatives
- Shared resources and costs between two departments or sub-divisions
- Willingness for staff to help each other.

When not implemented properly, the difficulties associated with a decentralized model include:

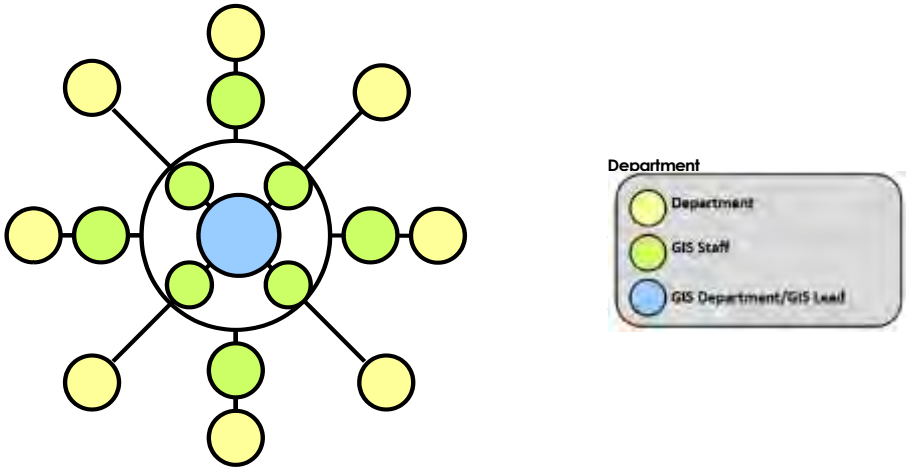
- Requires strong communications, paper work and bureaucracy to forge agreements between multiple departments
- Redundant roles and functions existing between departments
- Guided by individuals rather than by teams
- Multiple GIS and applications
- Databases and skills that are often fragmented throughout the enterprise
- Overhead costs that are not shared and often much higher
    - redundant effort in multiple departments
    - multiple copies of data being edited and stored in several locations
- Difficulty in standardizing software
- Poor data sharing and isolated databases

- Staff wearing multiple hats and sacrificing GIS competency to day-to-day departmental operations or tasks unrelated to the GIS field
- Staff competing with each other for funding or recognition instead of working together.

This model is often used in governments that do not have a strong GIS competency in a central location, especially smaller governments and those that initially begin using GIS. Small jurisdictions or single departments that have a low volume of GIS work depend on this model, especially when workers have to multi-task with departmental operational duties (i.e. wearing multiple hats). It also has a lower start-up cost for the departments and smaller jurisdictions that make it more attractive for first-time users.

This decentralized model could be used in the City of Guelph. The benefit is a defined structure where stakeholders pool their resources and work together to build a GIS. The model is flexible and ensures that stakeholder needs are addressed. However, the risk is that it can become difficult to coordinate and negotiate. It requires strong communications and leadership to hold the system together. Redundant data capture, staff, funding, and initiatives often occur in this model. The City would need to be aware and implement many teams and committees to serve as a check and balance to the divergent needs.

Many local governments utilize a **hybrid** GIS organizational structure, based on centralized and decentralized organizational models. This type of structure provides the benefits of both organizational models in scenarios where full implementation of either organizational structure cannot be readily attained.



Hybrid or Matrix GIS Organizational Structure

A Hybrid/Matrix model uses dual accountability along functional lines. Each particular GIS function is listed in a matrix. The matrix is divided among the stakeholders who are grouped into functional teams. The teams can exist either in a single department or serve multiple departments. Each stakeholder team is assigned a role that is closely related to their business function. Over time the individual team members become very

competent at managing their smaller implementation piece. If a team member leaves or is on extended leave, then the function continues because the other team members in the matrix pick up the slack. The Hybrid model works very well in large organizations that can devote the time and money to fund the teams and to coordinate from a central group or business unit responsible for overseeing GIS while stakeholders focus on GIS related business requirements. The hybrid model is also being used by the City to implement the IT Strategy.

When successfully implemented, the Hybrid model can benefit organizations in many ways, such as through:

- Shared costs
    - database management and maintenance
    - network and server resources
    - highly specialized GIS staff
- Improved efficiency
    - integrated multi-departmental solutions can be implemented
    - central data warehouse
    - team based processes (critical functions are no longer one person deep)
    - improved data quality
    - departmental ownership of relevant datasets is maintained
    - automated validation routines
    - real-time distribution of data
    - improved end-user support (Feedback from users is immediate since each team sits in close proximity to the work. They can hear and see firsthand what needs to be fixed.)

If not implemented successfully, the Hybrid model can be difficult for several reasons:

- Roles are not clearly defined, making expectations unclear.
- Unnecessary bureaucracy from too many standards or too many agreements and negotiations.
- No clear direction from leadership. Stakeholders end-up setting their own priorities and looking out for their own needs.
- Insufficient funding. Critical functions could be cut by a single department, hurting the remainder of the enterprise.
- Smaller departments with small staffs may be left out of the planning process and miss out on opportunities to participate.

The major benefit from the Hybrid model is its flexibility. Stakeholders actively participate in the design and project planning stages. Stakeholders work together while dividing and sharing the GIS functions. The GIS central body is responsible for overall GIS system architecture, applications, and license pools. The intra-departmental stakeholder teams are responsible for data capture, data edits, quality control and cartographic

output. Stakeholders pool resources and cross-train team members from different departments. Redundancy is reduced, since there is a central command structure made up of a GIS Lead and key GIS technical staff. Flexibility and departmental expertise are ensured, since the stakeholder teams work within the departmental structure on specific end-user functions. If funding or leadership is lacking in a single department then the other departments compensate. Smaller departments are involved since they have equal share in the decision making process and they are supported by intra-departmental teams.

The Hybrid model risk is that if there is no clear direction and agreement among participants concerning roles and responsibilities, it may devolve into the decentralized model and redundant processes will emerge. There is a risk that too many formal agreements and formal meetings will make decision making confusing and hamper productivity. People may not understand the system and may make up their own systems just to be functional. Strong communications, GIS knowledge, and leadership are required to make it run. The City of Guelph would benefit from the Hybrid model since it is a mature system with competent and well educated professional GIS staff. The City of Guelph would see an immediate return if this model was adopted.

Definitions Summary of Organizational Structures

Centralized Organizational Structure:
All GIS tasks, except data viewing and analysis, are handled by a central GIS department or division. All GIS staff are located within the central GIS department or division.

Decentralized Organizational Structure:
GIS data updating and maintenance responsibilities are assigned to individual GIS-participating departments. Departments have their own GIS staff members.

Hybrid Organizational Structure:
GIS tasks may be handled centrally or at the department level, depending on the needs and available GIS staff at individual departments.

On behalf of City of Guelph, GTG interviewed nine similar city and town based GIS initiatives to get an understanding of how they are governing and managing their GIS. The cities and towns were chosen based on similar characteristics. City staff was asked to provide a list of candidate cities to interview and a few additional cities outside of this list were included. Phone interviews and questionnaires were employed to garner the needed information. The table on the following pages summarizes the findings of nine case studies.

Industry Best Practices

GTG interviewed nine comparable cities and towns in regards to their governance and best practices. From the interviews of the nine comparable city GIS implementations, it is possible to get a sense of what implementation practices lead to success. Additionally, experience with cities and counties of all sizes has allowed for the identification of best practices that lead to successful enterprise-wide GIS success. The following items are considered to be best practices that lead to GIS success:

- **Steering Committee** – Almost all of the communities surveyed utilized a Steering Committee in the formative period of GIS implementation. The Steering Committee typically shapes the funding for and the direction and policy of the initial project. While in some cases the Steering Committee would disband after the initial implementation, it was also noted that the Steering Committee was reformed when a second or updated Strategic Plan was undertaken.

- **Internal GIS Data Access** – A component that was consistently important to each of the communities interviewed, was providing a reliable portal for staff to access GIS data internally. For one community, it was the kick start that was needed for the GIS to take off within the organization. For another community, providing GIS data to staff enabled them to create their own maps and generate their own reports, allowing GIS staff to focus on other areas of need. A common theme amongst all of the interviews is the need for this type of portal – a portal that users can rely on and is easy to use no matter the skill level of the end user.

- **Awareness, Training, and Access** – During the survey it was noted that successful implementations did a good job of making the user community aware of the GIS through the Steering Committee and/or User Groups. A greater measure of success was also noted where communities were able to provide access to their departments and the general public to the developed data.

On the flip side are those organizations that, while having some success with their GIS implementation, have been unable to fully integrate GIS into the enterprise and the daily workflow of their departments.

One example of this is a community where GIS is decentralized in its implementation. While the community has a functioning GIS, there is no one focused on the overall GIS vision and how it fits into the corporate goals for the community as a whole. There are challenges in getting staff outside of the central GIS group to take on new roles that have more GIS based skills tied to them. For the interviewed cities, the status of the above key elements is summarized in the chart below.

	City of Burlington	Sault Ste. Marie	City of Kitchener	City of Cambridge
How long has the GIS department been established for your agency?	The City started using GIS technology in the late 1980's and has been in its current service format for 20 years.	The agency has been utilizing GIS since 2000.	The City has been utilizing GIS for nearly 18 years. GIS started in Planning as a capital project and then, in 2000, became a section under IT. The City has had a corporate GIS group since 2000.	GIS was originally established around 1988 within the Technology Services Department (TS). It remains a division within TS and has undergone several transformations in technology and governance over the past 15 years.
Did you have a steering committee at formation of the GIS department?	Yes, there was a GIS steering committee in place at the formation of the GIS group.	Yes, there was a GIS steering committee in place at the formation of the GIS group.	Yes, there was a GIS steering committee in place at the formation of the GIS group.	Yes, there was a GIS steering committee in place at the formation of the GIS group.
Do you currently have a steering committee?	No, there is not currently a GIS steering committee in place.	Yes, there is currently a GIS steering committee in place.	No, there is not currently a GIS steering committee in place.	No, there is not currently a GIS steering committee in place.
Who is on the committee? High level department head types or more junior types?	The ITS department is currently changing the governance structure in the organizations. The City previously had an overall steering committee consisting of directors and senior managers. The City is moving towards the creation of separate steering committees, one of which will likely be focused on GIS.	Department heads and executive directors of all shared service solution agencies are a part of the GIS steering committee.	The City is looking at the possibility of starting a committee this year, but more of an influence group instead of a steering committee. The City needs a group of high level staff to help with meeting their needs.	A GIS Strategic Plan was done in and around 2008 and was done through a Steering Committee made up of representatives from each department with varying knowledge of GIS
How often does the steering committee meet?	Once the committee is formed, it is anticipated that meetings will occur every 2 months.	The GIS steering committee only meets once every five years.	N/A	There is no longer a steering committee, but they have established a good working relationship with the GIS Division.
Is there a user's group in place?	No, there is not currently a GIS user's group in place.	No, there is not currently a GIS user's group in place.	Yes, there is a GIS user's group in place.	No, there is not currently a GIS user's group in place.
How often does the user's group meet?	The City previously had a LRIS (Land Records Information Systems) group. That group has been abandoned in favor of creating a GIS User Group. When the corporate steering committees are put in place, the user group will begin meeting. Frequency will likely be every 2 months.	N/A	N/A	N/A
Is there a central GIS department or central GIS group?	No, there is not a central GIS department or central GIS group currently. The City does not have a centralized GIS department. They operate based on a distributed (departmental) model. Most staff are concentrated in the Engineering Department, Operations, and ITS.	Yes, there is a central GIS group.	Yes, there is a central GIS group.	Yes, there is a central GIS group.

	City of Burlington	Sault Ste. Marie	City of Kitchener	City of Cambridge
In what department/division is GIS housed?	Primarily in Public Works.	The Sault Ste. Marie Innovation Centre is a not for profit that runs the GIS for the City of Sault Ste. Marie and many other agencies as a shared solution.	The central GIS group is housed under Finance and Corporate Services – IT Division. The City feels this is a good location as they are a service group.	In Technology Services (part of Corporate Services). However, infrastructure related GIS data is maintained on the corporate GIS by Asset Management within the operating department (transportation and public works). Other departments do not have any GIS support and rely on those provided by TS.
How many full-time employees are in the central GIS group?	There is not a central GIS group within the City. A breakdown of where GIS staff reside is included in the next question.	There are a total of 18 full time employees within the central GIS group, but a total of 6 work fully or partially with the City of Sault Ste. Marie.	There are 9 full time employees in the central GIS group including the manager.	There are 2 that reside in TS.
How many full-time GIS employees are in other departments? Which department and what is their job title?	Engineering - 1 manager + 4 staff Operations - 2 staff ITS – 2 GIS Applications Analysts	There are not any other full time GIS employees in other departments.	There are not any other full time GIS employees in other departments.	There are 6 staff who are heavy GIS users with 1.5 FTE for GIS data maintenance, analysis, mapping and reporting. They are in transportation and public works. Asset Management Technologists, Asset Management Manager, Asset Management Director.
Who are your heavy using departments?	Engineering, Operations (Roads& Parks, Transit), Planning, Transportation, Parks & Recreation	Engineering, Public Works, and Planning	Only GIS staff edit GIS data for the organization. The City does have CAD people in Planning, Engineering, Utilities and Parks that may send drawings to the central GIS group, but after that the GIS team takes over. There are some users of ArcView in the organization, about 10, but they are casual users. If they create a layer it can be moved into GIS – SDE, but the ownership then moves to the GIS team. This approach took a while to get working, but is the preferred method now.	Planning, Community Services, Transportation & Public Works, and Fire
How aware of the GIS is staff? 1 – not at all 10 – pervasive knowledge	7	8	7	9
How aware of the GIS is the general public? 1 – not at all 10 – pervasive knowledge	5	3	6	5
Is the GIS centralized, decentralized or hybrid?	The GIS for the City is decentralized.	The GIS for the agency is centralized.	The GIS for the agency is centralized.	The GIS for the agency is centralized.
What is working in regards to the GIS for your agency? What are the top 3 successes for your agency in regards to GIS?		Data Sharing, Data Maintenance, Power of the GIS Data and Tools	1. Concept of a core Corporate Database that GIS is part of that feeds information in and out of to the satellite applications. For example: Cityworks, AMANDA, CIS, Crysis, etc. This approach allows for the Corporate Database (GIS) or any of the Satellite software's to go off line, but not affect the others. 2. Hard line in the sand as to what is done by the GIS team, DBA team and other system administrators. Everyone knows where the line is, so there is no confusion or stepping on toes. The City has a DBA that understands their SDE environment and they feel that this is key. This	GIS is the City's Asset Registry for all infrastructure assets and is a core part of their technology. GIS is also well deployed for all staff in the corporation with direct links to all major business systems (Maintenance Management (water, roads, storm, sewer, parking, signage, etc.), Building, Planning, Taxation, etc.)

	City of Burlington	Sault Ste. Marie	City of Kitchener	City of Cambridge
			DBA, and the previous one understood that when GIS needs a change users need it now to continue to deliver services effectively. 3. The GIS team is flexible and eager to assist others in finding solutions. They take the time to understand their business and enjoy working out solutions to help them. The GIS team very much look at their service delivery as "Service First".	
What is not working in regards to the GIS for your agency? What 3 things would you change if you could in regards to your agency's GIS?		Currently, everything is working about as well as it could be.	The City has no issues at this time. That said, a lot of work went into making their Centralized GIS work. They stated that they have the support of the organization.	Asset Management is generally more knowledgeable in GIS and processes then the Corporate GIS Division and they drive much of the GIS implementation and technology. However, they have established a good working relationship. It would be nice to have a lot more technical support in terms of spatial analytics, data integrity and automation which is lacking.
What are some of the biggest challenges your organization faces, and do you see GIS addressing these challenges?		No big challenges at this time. There have been some issues with dealing with the varying IT setups of the different agencies in the multi-agency shared solution.	One of the City's biggest challenges is getting departments to use the GIS team in specialized projects. For example, the GIS team could help out Economic Development, but can't seem to catch their attention and, then to be fair, the GIS team is busy and find it hard being proactive when a group is not knocking at their door. Another one of the new challenges is the Asset Management area and the GIS team also feels they can help them out. A challenge may be keeping historic data in GIS, this is not the team's preference due to complexity but they might not get a choice now that Asset Management is on board.	Infrastructure management, liability management (i.e. proof of inspections). GIS is a very key element in this and the City is continually implementing GIS and Maintenance Management Systems to deeper levels in the organization.
What are some project milestones that have been reached? ROI?		Improved Public Works Operations, Improved Planning Processes, Much Better Emergency Management Data, Improved Social Service Delivery	1. Digital automation of Engineering As Built drawings directly into GIS - SDE layers. Consultants are filling out attribute information for 32 layers of data in Civic 3D and then exporting to Kitchener, reviewed through Standard Checkers, Topology and Attribute Checkers in FME and then loaded into each of the 32 layers in GIS. Sanitary, Storm, Water and Gas are all following this format now. 2. Implementation of Cityworks - GIS data is updated nightly to CW and any edited changes in CW for assets, currently set up, are returned to GIS at end of day. 3. Completion of the Draft Official Plan and many other Planning Projects which are massive in nature (or always seem to be). 4. Review of Data needs for all Infrastructure layers and now working on other Asset Management needs. 5. Implemented an impervious layer for Storm Water Rate project. All building footprints were redrawn to 2009 imagery if not picked up through building surveys or site plans. Digitized all parking lots, roadways and sidewalks for non-residential properties and then Used FME to set up the nightly export of new, demolished or altered buildings to the CIS team for rate changes for billing.	Corporate GIS portal established about 2007. GIS and maintenance management system integration established in 2008. Centralized GeoDatabase about 2009. Corporate GIS portal fully integrated with other business systems about 2010

	City of Burlington	Sault Ste. Marie	City of Kitchener	City of Cambridge
Who currently maintains the GIS data?	Service owners (departments) assume ownership of their data and are responsible for maintaining that data if they have a GIS editor. Otherwise, arrangements are made for GIS Technologists in Engineering to maintain the data. This depends heavily on the data owners creating a process/flow of information.	The Sault Ste. Marie Innovation Centre maintains most data layers for the City and other shared service partners.	The whole GIS team is involved in maintaining data as part of ongoing work. 3 Technologists run large projects as well as maintaining specific layers or setting up new processes for a team of 4 GIS technicians. Most of the maintenance is done by the technicians. The City also has an Application Specialist that maintains the internal and external mapping tool as well as mobile applications, Cityworks needs, etc. It is a heavy workload but is manageable most times.	Asset management Division (in TPW) maintains all infrastructure data (road parameters, water system, drainage, sanitary, sidewalks, signs, walkways, etc...) TS GIS Division maintains parcel and roads along with datasets for other departments (i.e. parks, trails, zoning, etc...)
How up to date is your GIS data? 1 – much of the data is out of date 10 – all of the data is up to date all of the time	7	10	9	8
What would you consider the level of data integrity to be? 1 – not good 10 – perfect	6	10	9	9
Do you integrate GIS with other systems?	Yes, the City integrates the GIS with AMANDA (property data), ImageSite (document management system), and AVANTIS (work order management system) to varying degrees.	No direct integration, but unique GIS ID's match asset ID's in all other systems.	Have developed what is called the Corporate Database for the organization which GIS is integrated into. From this centralized database they send data back and forth to satellite applications, for example, Cityworks, CIS, Amanda, Class, etc. This design allows the City to take down any of the satellites application or even the Corporate Database without affecting any of the other systems. It also allows for clarity of who does what and where the data comes from i.e. the owners of the data. If another system requires data it will be integrated through interfaces to the Corporate Database. They truly believe this is what makes GIS work so very well at Kitchener.	Yes - Many. Building Permits, taxation, water billing, maintenance management, planning applications, etc...
Do you have a GIS strategic plan to guide your operations?	Yes, a GIS Strategic Review was carried out in 2010 – 2011.	No, there is not a GIS strategic plan in place.	Not really, but they have remained true to the original concept to keep the GIS central to everything else in the corporation. They negotiate and educate when users bring other applications on board and make sure they will work with their model and so far this has not been an issue. The City recently had new software for Transportation Planning added and are exporting layers from GIS to them and are now in the process of working on setting up a process to have them add in certain attributes that will flow through the backend from this new application back into the GIS (Corporate Database). At one point one of the staff asked if they could enter new addresses and the team nicely said no since only the Address Analyst in Building through Amanda does that task. This is a surprise to many staff new to the organization from other cities but this is how the City keeps data integrity in check.	Yes, there was a GIS strategic plan created, but there is not a lot of it being utilized currently.
Do you have a GIS vision? If so, what is it?	There is not a specific, defined vision for GIS. There are high-level corporate objectives in place, which focus on the identification of GIS opportunities, leveraging investments in GIS	"To continue a well-established and functioning shared solution GIS system."	There is no formal vision other than saying they stay true to the original approach to how GIS (Corporate Database) was set up at Kitchener. The concept is easy to understand and they	"GIS is a real-time representation of all business transactions to support day-to-day operations and decision support."

	City of Burlington	Sault Ste. Marie	City of Kitchener	City of Cambridge
	and GIS data, identifying cost effective and efficient methods for the way GIS is utilized, supported, and managed.		find new staff instantly get behind it. It also helps that they are part of IT and their DBA team agrees with the approach. The City have many long term employees that are willing to keep the vision going.	
How is the GIS funded?	The City has an operating budget in Engineering for five staff and minor capital equipment (software maintenance, equipment maintenance, external services, etc.). Other departments may follow the same format, but to a smaller scale. Larger capital expenses require submission into the corporate annual capital budget for consideration. An example of this would be the purchase of digital Ortho Imagery every 2-3 years.	Shared service solution is funded by many agencies through core funding in 5 year contracts.	The City has a capital budget, but otherwise they are set up like any other operating section in the City. Generally GIS picks up the tab for GIS needs for the organization (example Ortho Imagery, printing costs for mapping needs, etc.) but occasionally they work with departments to pay for extra needs. For example, the two checkers for the As Built automation process last year.	Taxation, water rates, sewer rates
On average, what is your approximate annual budget for GIS?	The Geomatics section in Engineering is tied into a larger group (Infrastructure and Data Mgmt.), which has an operating budget of approximately $750,000. Approximately 50-60% of this amount would likely be utilized by Geomatics, but much of the funding is available for use by non-Geomatics staff. Other departments would have funding as well, but the total is difficult to ascertain due to the distributed GIS model used at the City.	For the City of Sault Ste. Marie: $425,000	The overall budget is $1 million for GIS. The corporation was very supportive of GIS when it came on board.	
What is your current environment in regards to Hardware and IT infrastructure (i.e. iPad, iPhone, Android, Servers, and Network) and software?	The city uses Esri software almost exclusively, with the exception of OnPoint for external web mapping, and GeoCortex for their internal web mapping. GIS implementations use a client server model for delivering GIS data and functions to users. Via ArcIMS and ArcGIS server, there exists a centralized service for GIS at the City. The City migrated to ArcGIS Server 10 in 2012. There is a corporate strategy under review that would allow users to access and edit data utilizing mobile devices. At this time, field work is disconnected, without direct access to the GIS server. This will likely change in 2014.	ArcGIS 10.1 with Esri ELA delivered through Citrix to desktop and remote devices from Sault Ste. Marie Innovation Centre Servers.	Kitchener has just finished its Mobile Strategy and are just at the point of making decisions about mobile needs. GIS has set up Road Patrol, Sidewalker, Tree Inventory and shortly the newest mobile for Storm Water Facilities and Stream Reaches and mostly use Motion Tablets and ArcPad as the software.	Oracle DB server, Esri SDE, Esri ArcMap, Esri Server 10, OnPoint GIS Portal for all users, OnPoint GIS Mobile for mobile users on Blackberry and iPads, ArcPad (limited)
What is your workflow for editing GIS data?	Engineering data editing follows a specific workflow based on the design, construction and/or renewal of assets in their road right of ways. The City's design and construction section, as well as site development areas, forward planned and as-built drawings (hard or softcopies) to GIS Technologists who use this information to update features in the GIS. Other service areas (departments) have their own workflows, but staff in Engineering often provide input relating to best practices for editing, etc.	Sault Ste. Marie Innovation Centre performs all editing for shared service partners, this is mostly work order driven. Work orders, building permits, subdivision plans, etc. all flow to the Innovation Centre daily and they perform the updates.		Complex - starts with drawings as part of development or construction activity, then input, then validation and valuation and comparison to capital re-investment plan (development plan or re-construction plan) and valuation comparison to ensure nothing was missed. Tied into financial and project sign-off.
Do you have an SOP for data maintenance and QA/QC?	There is not a formal QA/QC procedure in place at this time, however it is in development. Engineering has developed SOPs for specific data sets (i.e. Storm Sewers, roads, structures) which are updated annually by the editors and Coordinator.	Yes, there is an SOP in place for data maintenance and QA/QC.	The City has documentation for most of their data maintenance and also a few SLAs in place though very rarely reviewed. "Does not seem to be a need since the City takes data maintenance very seriously in my group". There is no formal QA/QC but they do use integrity reports to keep errors in check. When possible they look for ways to automate processes using	No, but there is a documented process. Significant back-end QA/QC processes and cross-check reports.

	City of Burlington	Sault Ste. Marie	City of Kitchener	City of Cambridge
			FME in order to keep from making mistakes.	
What is your process for capturing GIS data in the field with GPS devices?	City staff currently utilize a Trimble unit for carrying out field data capture. Engineering staff operate and manage this equipment and utilize it approximately 150 hours per year for carrying out small scale assignments. There is no formal process in place, but staff utilize ArcPad and all editing (at this time) is disconnected. Data is uploaded at the end of each day.	The agency utilize tablets and laptops in the field with Citrix, including complete access to the corporate GIS database(s).	Currently ArcPad on Motion Tablets. Going forward, when possible, using Cityworks mobile once it is implemented and tested.	Mix of mobile devices and AVL systems. The City relies heavily on GPS tracking for many inspection processes and use it regularly in claims mitigation.
Do you have a structured training plan in place for GIS users?	Yes, the City has a structured training plan in place for GIS users. The City has a corporate training course open to all new employees to provide a general overview of their GIS services and data. For staff who are responsible for editing, the City utilize Esri training courses, seminars and promote participation in online workshops.	No, there is not a structured training plan in place for GIS users.	No, the City has a very sharing team that all the members try to keep each other up to date. During staff meetings they discuss what people have found that is new. The Application Specialist generally uses training more than the rest of the team but during the bi-yearly one on one discussion training needs are discussed and when necessary acted on. The City also takes advantage of free webinars and the group can sign up for if interested. The team can also attend Esri User conferences, URISA-OC sessions and all but 3 staff have attended the San Diego conference over the years.	No, there is not currently a training plan in place, but there is one currently being developed.
Are you utilizing cloud based solutions?	No, IT is currently reviewing the possibility of utilizing cloud based solutions for online maps.	No, the agency is not utilizing cloud based solutions at this time.	No, at this time that is not an approved option at Kitchener.	No, the City needs the data in-house as they connect to many different data sets including real-time transactional data for reporting and alerting. This is something that the City does not feel is easily accomplishable through cloud solutions.
Do you take advantage of crowdsourcing?	No, the City is not taking advantage of crowdsourcing at this time.	No, the agency is not utilizing crowdsourcing at this time.	No, this could change as they move towards open data this year.	No, the City does not currently utilize crowdsourcing.
Do you share or receive GIS data with external entities? If so, who?	Yes, the City shares or receives GIS data with the Region of Halton, Conservation of Halton, Niagara Escarpment Commission, and the City of Hamilton.	Yes, the agency shares or receives GIS data with approximately 50 agencies.	Yes, the City shares some data with the Region of Waterloo as part of data sharing agreements as well as KW Hydro, the 2 universities, 1 school board and GRCA. The City is hoping soon to share data with Esri Canada for the Community Maps program. The City receives data from Teranet and MPAC.	Yes, the City shares or receives GIS data from University research, other levels of government, developers, consultants, etc.

	City of Peterborough	Town of Oakville	City of Barrie	City of London	Town of Whitby
How long has the GIS department been established for your agency?	The GIS has been established at the City for 10 years.	There was a GIS focused section in IS+S until around 2008. It was made up of 4 people. That group was disbanded and the resources divided up between Apps Support and Projects and Development. There is not currently a GIS department at the Town.	The GIS function was formerly started in 2001 through the hire of the first GIS Analyst position.	The GIS was built in the mid 1990's for the City.	The GIS has been established at the Town for 12 years.
Did you have a steering committee at formation of the GIS department?	Yes, there was a GIS steering committee in place at the formation of the GIS group.	No, there was not a GIS steering committee in place at the formation of the GIS group.	No, there was not a GIS steering committee in place at the formation of the GIS group.	No, there was not a GIS steering committee in place at the formation of the GIS group.	Yes, there was a GIS steering committee in place at the formation of the GIS group.
Do you currently have a steering committee?	No, there is not currently a GIS steering committee in place.	No, there is not currently a GIS steering committee in place.	Yes, there is currently a GIS steering committee in place.	Yes, there is currently a GIS steering committee in place.	No, there is not currently a GIS steering committee in place.
Who is on the committee? High level department head types or more junior types?	N/A	N/A	The steering committee was formed to lead the completion of a corporate GIS Strategy. There are currently senior management staff on the committee, but that may change in the future.	High level department heads are part of a GIS Governance Committee representing business groups. Representatives from Police, Fire, Planning, and other key business groups are a part of the committee. The committee members do not necessarily understand the technology or technical issues and this could pose a problem long-term for the committee.	There was a steering committee and a working committee during the startup phase. The Town still has a working committee. The working committee is a mixture of departments with mostly junior types and a few supervisors.
How often does the steering committee meet?	N/A	N/A	The steering committee meets monthly to bi-monthly.	The steering committee meets bi-monthly.	The working committee met monthly in the beginning, but now it is more like twice per year or when needed.
Is there a user's group in place?	Yes, there is a GIS user's group in place.	Yes, there is a GIS user's group in place made up of mostly power users.	Yes, there is a GIS user's group in place.	Yes, there is a GIS user's group in place.	Yes, there is a GIS user's group in place.
How often does the user's group meet?	The GIS user's group meets monthly.	The GIS user's group meets quarterly.	The GIS user's group meets quarterly.	The user's group is made up of the data stewards. The group typically meets on a monthly basis, but is more on an as needed basis.	The user's group is the GIS Lead and the data stewards that are in different departments. They only meet when there is a need. For example, they will be meeting in the near future to discuss accessible mapping.
Is there a central GIS department or central GIS group?	Yes, there is a central GIS group.	No, there is not a central GIS group in place.	No, there is not a central GIS group in place.	No, there is not a central GIS group in place.	No, there is not a central GIS group in place.

	City of Peterborough	Town of Oakville	City of Barrie	City of London	Town of Whitby
In what department/division is GIS housed?	GIS is housed in Planning and Development, but is a corporate service.	Strategic Business Services within the Planning Commission does have 4 GIS resources. They have power users and data editors within many departments throughout the Town.	GIS is housed primarily in IT, Planning, and Asset Management.	Due to there not being a central GIS group, GIS is spread throughout the organization.	The GIS Lead is part of the IT department. There are several data stewards in the Planning, Engineering and CMS departments.
How many full-time employees are in the central GIS group?	There are 6 full-time employees in the central GIS group.	There is no central GIS group at the Town.	There are 3 in IT, 3 in Planning, and 5 in Asset Management.	N/A	There is 1 GIS Lead and 5 data stewards.
How many full-time GIS employees are in other departments? Which department and what is their job title?	There is one other full-time GIS employee located in Infrastructure Management. This person is a Spatial Data Analyst.	In IS+S they have 1 dedicated support person who has a primary focus on GIS in IS+S. There is also 1 additional person for secondary support. There is a DBA assigned to the GIS databases, but they are not dedicated solely to GIS related tasks. There is a developer in projects and development who is focused on GIS development and integrations. Projects and Development also has a BA who has GIS project experience, but is not dedicated solely to GIS projects. IS+S has a data architect who is involved in the meta data and Open Data Projects which includes GIS data. IS+S has a platform coordinator who ensures that the GIS environment is designed to support the solution and works with the network group to ensure high availability and redundancy, but they are not exclusive to GIS, but support all application platforms.	N/A	There are 3 GIS employees in IT and 6 data stewards in other departments. There are a lot of GIS users throughout the City that use the internally created City Map.	There are 2 in Planning (Planning Technologist), 2 in Public Works (Operations Services Technologist), and 1 in Community and Marketing Services (Landscape Technician).
Who are your heavy using departments?	The heavy using departments include Utility Services: Transportation, Public Works, Engineering; Community Services: Fire, Culture and Heritage, Social Services, Police; Planning and Development: Planning	The heavy using GIS departments include Forestry, Planning, Buildings, Fire, Parks and Recreation, Environmental Policy, Roads and Works, Engineering and Construction.	The heavy using GIS departments include Asset Management, Fire, Planning, Engineering, Operations, and Facilities.	Environmental Engineering Services, Parks and Operations Facilities, Police, Fire, Planning, Public Works, and Regional Healthy Facility.	The heavy using departments are Planning and Public Works.
How aware of the GIS is staff? 1 – not at all 10 – pervasive knowledge	9	7	6	10	6
How aware of the GIS is the general public? 1 – not at all 10 – pervasive knowledge	7	7	6	6	4
Is the GIS centralized, decentralized or hybrid?	The GIS for the City is Centralized.	The GIS for the City is Decentralized.	The GIS for the City is Decentralized.	The GIS for the City is Decentralized.	The GIS for the City is Hybrid.

	City of Peterborough	Town of Oakville	City of Barrie	City of London	Town of Whitby
What is working in regards to the GIS for your agency? What are the top 3 successes for your agency in regards to GIS?	1 – Recognized as a corporate service, demand for services is increasing; 2 – Switched to Esri from Intergraph two years ago; 3 – Hiring the right staff.	The Town has the latest technologies and are able to develop solutions and integrations between corporate applications to meet some of the business need. Leveraging Geocortex, the Town has been able to update the GIS application for the public so that it is easier to use. The Town is equipping field workers with tablets and technologies so that they can access GIS information for their work order completion in JD Edwards and Cityworks.	Great department coordination to maintain the internal and external GIS web portals; Awareness among senior leaders that more can be done with GIS at the City; Great integration of GIS with the Fire dispatching system and Cityworks.	1. City Map - Number one application built on home grown technology. Was world leading at the time of creation. Ability to provide information to users quickly and easily. Averaged 30,000 hits per day prior to Google Maps release. Now it is averaging around 3,000 - 5,000 hits per day. 2. Mailing label program - Built this to send citizens surveys and is automated through GIS. 3 - Linear Assets (streets, sewer, water) - Have created all of this in GIS. Have water and sewer modeling that comes from GIS. Electronic access to GIS data in the field. 4 - CMMS - Cityworks for hydrant and various hard asset maintenance items	Having all of the data in one central location (Esri SDE Oracle Database); Using a web browser to view all of the GIS data (OnPoint); Capturing data in the field; AVL in the vehicles at the Operations Center.
What is not working in regards to the GIS for your agency? What 3 things would you change if you could in regards to your agency's GIS?	The Geomatics/Mapping Division should be in the Corporate Services Department. Too political to change at this time. There is a disconnect with IT. If Geomatics was in Corporate Services there would be a closer connection.	There is no one focused on the overall GIS vision and how it fits into the corporate goals for the Town. There are challenges in getting staff outside of IS+S in taking on new roles that have more GIS based skills tied to them. It would be nice to see the business units leverage GIS analytics and be able to handle their own mapping needs.	There is not a corporate approach to GIS activities, departments tend to work in silos; GIS staff in IT are overwhelmed with the GIS workload, insufficient balancing of GIS resources across the corporation; They have taken GIS as far as they can with the current approach, need to consolidate GIS services to better advance GIS and integrate into more systems.	The City feels like they are on the right track, although they are not comfortable with the current governance model. The GIS manager is no longer with them - he was a strong asset and made sure that everything was running smoothly and that new staff knew their commitment and role. Committees are not as strong as a GIS manager at enterprise decisions and keeping things going. Technology is not an issue - using Esri and moving forward. The command and control over data and ensuring it is well maintained and that metadata is kept current is the challenge.	While the Town is now capturing some data in the field, they are not maintaining that data through a work order system. For example, they did an inventory of their signs, but the sign data is not being updated when a sign is being replaced, so they will have to do another sign inventory in a few years. The Town would like to use their work order system to its full potential and have field staff updating GIS data. Having their AVL system in house instead of being hosted by an external agency. The Town would like to see routing software being used to optimize the routes for Waste Collection and Winter Control.
What are some of the biggest challenges your organization faces, and do you see GIS addressing these challenges?	Staffing resources are thin and hard to justify. GIS iPad apps are helping streamline workflows.	The Town has just kicked off a GIS Services review with an external company. Through the discovery sessions they hope to identify the challenges.	Insufficient integration of common system functionalities and data; Need to enhance system reporting and move to data warehousing/BI; GIS will be a definite enabler in addressing some of these issues.	Leveraging the data in CMMS, CAM, and PSAP is going to be key. It will be important to ensure that GIS is providing all of the necessary information to these systems and vice versa. Bidirectional functionality between GIS and these systems will be important.	
What are some project milestones that have been reached? ROI?	The switch to Esri will save the City $250,000 over the next 5 years.	In 2013 the Town upgraded all of the servers, databases and Esri applications and incorporated Geocortex to their solution set.	It is hard to say at this point. Once the City completes the GIS strategy they will have a better opportunity to report on some ROI case studies. There are a number of GIS products/systems that the City has benefitted from already.	The major ROI for the City is the implementation of City Map – the home grown GIS viewer application deployed to all staff. This application is reaching the end of its life at the City, but has been a large asset for deploying GIS to all users.	Easy access to corporate GIS data. Information is readily available to staff. The staff are able to find answers and print off their own maps.
Who currently maintains the GIS data?	The Geomatics/Mapping division maintain the GIS data.	Data is decentralized and maintained by the business groups. Some data has not been maintained. This is going to be addressed as part of the meta data and open data initiative.	Distributed – Corporate Asset Management and Planning departments for the most part. Some of it is maintained in IT.	The 6 data stewards throughout the City are responsible for data maintenance.	The data stewards in the departments mentioned above are responsible for data maintenance.

	City of Peterborough	Town of Oakville	City of Barrie	City of London	Town of Whitby
How up to date is your GIS data? 1 – much of the data is out of date 10 – all of the data is up to date all of the time	9	8	7	9	7
What would you consider the level of data integrity to be? 1 – not good 10 – perfect	9	8	7	8	7
Do you integrate GIS with other systems?	Yes, the GIS is integrated with Fire Dispatch, AMANDA, and will soon be integrated with the financial system.	Yes, the Town integrates the GIS with other systems.	Yes, the City integrates with Fire dispatch and Cityworks currently.	Yes, the City integrates with CMMS, CAM, and PSAP. This is a new initiative and is currently underway.	Yes, the Town integrates the GIS with their property software (AMANDA) and their CRM software (Cityworks).
Do you have a GIS strategic plan to guide your operations?	There is somewhat of a GIS strategic plan in place, but nothing formal.	No, but there is one in the works.	No, but there is one in the works.	No, there is not a GIS strategic plan to guide operations.	No, there is not a GIS strategic plan to guide operations.
Do you have a GIS vision? If so, what is it?	The five year plan includes complete integration with all existing corporate systems/apps. All corporate users have the ability to maintain their own data and create custom maps through a web interface complete integration between Engineering Cad and GIS.	No, but there is one in the works.	No, but there is one in the works.	No, but it is a desire to have one created in the future.	No, not at this time.
How is the GIS funded?	The GIS is funded through the budget process of operating and capital accounts. The GIS group does not charge internally for their services.	IS+S funds the technology and acquisition of data such as the orthophotos. IS+S funds the ELA for Esri and pay for the annual maintenance for all applications. Capital projects with a technology focus are funded out of IS+S.	Distributed funding through various departments.	The departments fund their own GIS data maintenance operations. IT is responsible for providing technical and hardware support as well as funding the ELA.	It is part of the overall Town budget.
On average, what is your approximate annual budget for GIS?	$250,000 - $300,000 / year		Unknown due to the distribution of service at this time.	Unknown due to the distribution of service at this time.	
What is your current environment in regards to Hardware and IT infrastructure (i.e. iPad, iPhone, Android, Servers, and Network) and software?	iPad, iPhone, Virtual servers, Unix servers for DB - Oracle, Novel, Esri	Oracle 11G is on a RAC, and they have high availability and redundancy. They are on the latest version of ArcServer. The Town is a Microsoft shop and use Windows 8.1 in the field using Motion tablets that access the network using Direct Access, not Citrix.	Esri products, Autodesk products, Web Portals, Multiple Servers, Desktops, Laptops, and Tablets	Staff are using Toughbook's in the field currently in a connected environment through wireless cards. Toughbook's are expensive and the City is looking to move to tablets. The old technology did not support tablets, but newer technology will. The ability to edit data in the field is coming as well. ArcGIS for Desktop is used in the office for data maintenance.	The Town currently has a database server to host the GIS database. They also have a server that hosts the web solution. There are a few license servers for both Esri and AutoCad products. The ArcGIS and AutoCad software is stored locally on end users machines. For data collection, Yuma tablets are utilized.
What is your workflow for editing GIS data?	Edits are forwarded to the technologist that is responsible for the maintenance of the specific dataset.	Editors are given rights to edit and maintain their data. New layers are created within IS+S. New layers are created by SBS in a non-production database and are promoted by IS+S.	Edits are performed by departments, including some edits by IT. The data is heavily siloed and there is not a central data repository for all edits to end up.	Data stewards in each department edit data with ArcGIS Desktop in File Geodatabases. This data is posted to the corporate system. The data steward must then email IT to ask them to publish the data into the main data warehouse. There are scripts in place to extract the data from the main warehouse and put it into shape files for the City Map system to be able to access it. The new interface will allow editors to publish and a QA person to view the data and publish to the central repository. The new interface will pull the data from the central repository without conversion	Certain departments are owners of certain data. Some layers they edit using Esri versioning and other layers they have local geodatabases that get posted to the SDE when required. It is up to the data owner to ensure data quality.

	City of Peterborough	Town of Oakville	City of Barrie	City of London	Town of Whitby
Do you have an SOP for data maintenance and QA/QC?	Because the GIS group maintains all of their own data, including parcels, all maintenance is well documented with policies and procedures. The technologist who is responsible for maintaining specific data sets can change the procedure document once the change is reviewed by the Coordinator or Manager.	No, not at this time. The data architect will be creating this in the future.	No, there is not an established SOP for data maintenance and QA/QC at this time.	Yes, the GIS manager or other individual work with data stewards from the start to ensure compliance with their data maintenance and QA/QC procedures.	No, there is not an established SOP for data maintenance and QA/QC at this time.
What is your process for capturing GIS data in the field with GPS devices?	On an as-needed basis. Most of the data that is required has already been captured.	For Forestry they are using motion tablets with Cityworks (integrated to GIS) and some users are using ArcPad. The Town is going to be developing a solution in Geocortex that will provide them with some of the features of ArcPad so that they can limit the number of licenses needed of ArcPad.	There is not any GPS collection performed by this particular department currently.	There is not any GPS collection being performed in the field currently. The City considers GIS as a representation of the data, not exact.	The Asset Management division hires students to capture data as well as a consulting firm.
Do you have a structured training plan in place for GIS users?	Yes, there is a prioritized training plan in place for the next five years.	Yes, the Town offers training for the use of the in-house developed solutions and provide training specific to Esri tools.	No, there is not a structured training plan in place at this time.	Yes, the GIS manager or other individual provide training to users as needed.	No, there is not a structure training plan in place at this time.
Are you utilizing cloud based solutions?	Yes, the City is using Esri's community maps for external web mapping purposes.	No, the Town is not utilizing cloud based solutions.	No, the City is not utilizing cloud based solutions.	No, the City is not utilizing cloud based solutions.	No, the Town is not utilizing cloud based solutions.
Do you take advantage of crowdsourcing?	Yes, the City is beginning to engage the public through web apps and provide data through web forms.	No, the Town is not utilizing Crowdsourcing at this time.	No, the City is not utilizing Crowdsourcing at this time.	No, the City is not utilizing cloud based solutions.	No, the Town is not utilizing Crowdsourcing at this time.
Do you share or receive GIS data with external entities? If so, who?	Yes, the City shares or receives GIS data with Peterborough Utilities and the County of Peterborough.	Teranet, Halton, Conservation Halton, MPAC, Census, DMTI, Environics, Burlington Fire. The Town provides data to consultants working with the Town. They also provide data to students doing projects. The Town is in the middle of an Open Data project.	Yes, the City shares and/or receives GIS data from external entities.	Yes, the City shares or receives GIS data from the Regional Health group, London Hydro, and the Public.	The Town is a lower tier municipality. They share data with the Region of Durham.

The table below ranks the potential benefits for each governance model. Additionally, it ranks the typical challenges that are faced when implementing a governance structure. Thumbs up and thumbs down icons are used to represent how each model performs for each element.

City of Guelph, Canada Governance Model Comparison Chart			
Potential Benefits to the Organization:	**Centralized Model**	**Decentralized Model**	**Hybrid Model**
• Clearly Defined Roles Reducing Conflicts or Confusion About Service • Enterprise Level Direction and Goals • Central Chain of Command (Top-Down Solutions) • Clear and Straight Forward (I need a map) • Quick and Fully Informed Decision Making • Predictable Format			
• Shared Costs Reduced • Database Management and Maintenance • Network and Server Resources • Highly Specialized GIS Staff			
• Achieving Stakeholder Needs • Departments Contribute GIS Input and Resources • Sensitive to Department and User Needs			
• Reduction Duplication • Data (Multiple Copies of Data) • Effort (Data Creation and Maintenance) • Project Initiatives and Expenses			
• Improved Data Sharing/Integration with Other Business Systems • Enterprise Systems • Multi-Departmental Solutions • Central Access Point			
• Institutional Legacy • Team-Based Processes • Cross-training of Employees • Fail-Safe Critical GIS Functions and Tasks (beyond one person deep)			
• Clear Departmental Expectations • Responsibilities • Participation • End-user knowledge			
Expected Challenges to the Organization	**Centralized Model**	**Decentralized Model**	**Hybrid Model**
• Potential for Too Many Standards (formal agreements proliferate) • Too many meetings and committees • May Require Extensive Negotiations • Difficult to understand			
• Potential for too Rigid Standards (more time is devoted to following standards and the letter of the law and less to the original purpose of the program)			
• Funding Risks (if funding is suddenly cut) • All the eggs are in one basket			
• Exclusion of Smaller Departments (if everyone is not equal) • Funding • Service • Technology			
• Risk for Departmental System Isolation (everyone does their own thing) • Solo Initiatives • Lack Enterprise Cooperation • Risk of pull outs or refusals to participate			

City of Guelph GIS Organizational Structure

A majority of the City of Guelph departments/divisions will utilize GIS in various capacities. The utilization of GIS will vary from consistent daily use to sporadic use every few weeks or months. In addition, the knowledge and understanding of GIS technology is also variable within and among these departments, such that there are GIS users from each functionality tier (i.e., Flagship user, Analytical user, and/or Browser user).

The heaviest GIS use, as identified in this document, will continue to be in the following departments: Engineering, IT, Planning, Water Works, and Public Works. However, all departments will have access to GIS applications and data. The table on the next page illustrates the current utilization of GIS at the City of Guelph. It illustrates the current utilization of GIS by some departments and the overall lack of current utilization by other departments. Each department has identified the need for a holistic coordination effort aimed at managing an integrated enterprise GIS. Assessment and evaluation of the existing GIS organizational structure and staffing is critical for establishing a viable and successful GIS Coordination effort.

Based on departmental interviews and information gathering, GTG has determined that the City currently has a loosely defined **hybrid** GIS organizational structure with decentralized tendencies. This hybrid structure is based on a considerable amount of enterprise GIS work being performed by the GIS Team in IT and few dedicated departmental personnel in multiple departments. However, due to the lack of a concerted game-plan for enterprise-wide GIS the current structure has many decentralized tendencies. No governance authority has been established and/or formalized. The current GIS Team in IT is tasked as technologists and not program directors. Therefore, standards, decision making, and other key elements are still being decided through a decentralized method. Implementing a fully enterprise-wide GIS at the City will occur by defining and adopting a formal organizational structure.

Existing City of Guelph GIS User Profiles							
City Departments	**Usage Profile**						
Building Services	0	**1**	2	3	4	5	
Business Services	0	**1**	2	3	4	5	
By-law Compliance, Security, and Licensing	0	**1**	2	3	4	5	
City Clerk	0	**1**	2	3	4	5	
Community Energy	0	**1**	2	3	4	5	
Community Engagement	**0**	1	2	3	4	5	
Corporate Communications	**0**	1	2	3	4	5	
Culture and Tourism	0	1	**2**	3	4	5	
Downtown Renewal	0	**1**	2	3	4	5	
Economic Development	0	**1**	2	3	4	5	
Emergency Services	0	1	2	**3**	4	5	
Engineering	0	1	2	3	4	**5**	
Finance	0	**1**	2	3	4	5	
Information Technology	0	1	2	3	4	**5**	
Legal Realty	0	**1**	2	3	4	5	
Parks and Open Space	0	**1**	2	3	4	5	
Planning	0	1	2	3	4	**5**	
Public Works	0	1	2	**3**	4	5	
Service Guelph	**0**	1	2	3	4	5	
Solid Waste Resources	0	1	2	**3**	4	5	
Guelph Transit	0	1	**2**	3	4	5	
Wastewater	0	**1**	2	3	4	5	
Water Services	0	1	2	**3**	4	5	
0 No/Little GIS Use - **5** Maximum Utilization of GIS Technology							

Departmental Responsibilities

Departments throughout the City use GIS to support their daily tasks and operations. Historically, departments have used a variety of GIS technologies to satisfy project-specific or ongoing needs. In some cases these departments voluntarily solicited input from GIS staff, especially when integration with other enterprise systems was obvious. For planning GIS projects, the expectations and responsibilities of departments are not clearly defined. To ensure optimal return on investment, the City should clearly define the roles and responsibilities of departments.

Definitions

The term **Role** refers to the typical expected or required behavior of individuals or departments. Roles include daily tasks and are often associated with departmental workflow, business operations, or citizen services.

The term **Responsibility** is often more nebulous than Role and refers to the duty or obligation of individuals or departments.

The term **Dual Accountability** describes the roles of individuals in the organization. Dual accountability means departments should adhere to overall corporate goals while satisfying the goals of their department. In an organization such as the City of Guelph, staff is required to meet departmental operational goals but should also adhere to the overall needs of the organization's GIS goals. The term **Dual Accountability** refers to the idea that GIS users should have accountability at two levels:

1. **Team accountability**. The individuals have responsibilities to a specific function set which exists within a specific department or a consortium of departments. Team members participate in departmental work flows while performing daily tasks dictated by requests from end-users, customers or departmental staff. For GIS staff, this may include creating maps, editing data, gathering information or conducting analysis. The needs of the department are imperative and can often obscure the needs of anything beyond the task at hand, but in the long term, focusing only on the immediate needs of the department may not be meeting organizational objectives. If an organization focuses too much on departmental needs, organizational efforts suffer, which in turn, begin to affect the department's ability to meet its own needs.
2. **Enterprise accountability**. Individuals also have a responsibility to the enterprise-wide GIS effort to conduct daily business tasks in accordance with the goals set forth for the GIS. For departmental staff, this should include an understanding of the desired centralized structure of the database, the software that should be used, acceptable data formats and other organizational standards. Enterprise accountability includes formal and informal goals. It will be critical for the GIS Team in IT to communicate and train staff on goals and expectations. Communication mechanisms can include user group meetings, official city mandates, GIS communiqués and

personal communication between central GIS Team in IT and end-user departments. **It should be the responsibility of the GIS Steering Committee to ensure that there is an appropriate balancing and alignment between departmental and corporate GIS directions and priorities.**

Achieving a balance between these two levels of accountability is critical to enterprise GIS success and continued adoption. It will be incumbent upon the central GIS Team in IT (under the leadership and guidance of the GIS Steering Committee) to balance these objectives. The City of Wilson, North Carolina implemented annual anonymous user surveys to elicit input on how well the technology was being implemented and the initiative's overall effectiveness. Implementing this type of initiative at the City of Guelph would ensure that the GIS Team in IT understands the needs of the departments while maintaining overall organizational standards and goals. Other organizations implementing a hybrid model with dual accountability utilize job descriptions, joint work planning and review, and adoption of the strategic plan as a way to avoid conflict between the GIS Lead and departmental supervisors.

Desired Outcomes

A majority of City departments and soon the public will use GIS technology on a daily or weekly basis. Although the roles of the departments are well defined, the responsibilities are not as clearly defined, especially with regard to enterprise GIS responsibilities and expectations. Although departments typically work together and have achieved success with a variety of GIS initiatives, the lack of clearly defined responsibilities can create difficulties and inefficiencies. There is a strong desire at the administrative level to implement GIS technology responsibly and to maximize the enterprise-wide return on investment. Important issues include:

- Meeting the needs of the departments and citizens
- Maintaining data quality, security, and accessibility
- Improving efficiency and communication between departments
- Reducing redundancy and expenditures for overhead, data maintenance, and data storage
- Facilitating integrated and interoperable enterprise-wide systems
- Improving service to the citizens.

Earlier in this chapter, GIS governance models were defined and discussed. To facilitate the definition and implementation of an effective governance model and to help achieve the enterprise-level goals, there is a need to evaluate the current GIS departmental responsibilities and to determine how defining or modifying these roles may better facilitate responsible GIS growth.

Current Reality

Departments and divisions throughout the City typically have broad conceptual roles and mission statements. Often they define departmental roles and services in the context of larger organizational-wide initiatives with the overriding goal of providing the best possible services to citizens. The current roles of each department are discussed in the departmental needs assessment section of this study. This section addresses specifically the responsibilities that each department has or should have with respect to enterprise GIS governance. To facilitate and manage the current GIS initiatives, the City of Guelph has established the GIS Team within the Department of Information Technology with defined roles and responsibilities.

Information Technology

The City of Guelph's Information Technology Department is responsible for a wide array of functions that encompass technological issues for the City. IT has four functional groups – Corporate Applications, Client Services, Technology Services and Projects and Business Services. GIS currently resides within Project and Business Services.

GIS Team in IT

The GIS Team in IT (two staff) manages core GIS services for the City of Guelph. Their primary role is to support the City's GIS operations and spatial information needs. GIS is a common technology needed throughout the organization. A core responsibility of the GIS Team is to manage centralized GIS layers and enterprise GIS services. While there are some stated and implied responsibilities of the GIS Team to support departmental efforts, the departments currently have no official responsibility to the GIS Team or to an enterprise GIS initiative. The following is some of the skills, roles/responsibilities required of the GIS Team in IT:

- Liaison to other municipalities and external agencies
- Work with Corporate Communications Team on GIS communications
- Provides overall corporate direction for GIS use and growth
- Provide project implementation services
- Provide GIS technical support services
- Has ownership and manages ArcSDE and geodatabase schema objects
- Setup and Manage versioned GIS editing environment
- Manages ArcSDE service
- Works with DBA to configure and maintain the geodatabase
- Configures ArcGIS Server and OnPoint
- Provides Web services application and system performance tuning
- Data validation and quality control – topology and domains

- Spatial data management – data loading, spatial index tuning, database management system statistics
- Maintains and provides leadership concerning corporate web based GIS OnPoint
- Maintain corporate map base – property, address and streets
- Version management
- Provides Web service development and maintenance for internal and external web sites
- Coordinate project work for service areas and outside agencies
- Provide user training services
- Troubleshooting on custom application problems
- Provide interdepartmental services for data and mapping requests
- Provide technical leadership to GIS users
- Provide overall management for all contracted work
- Data model design – works with GIS analysts to develop logical data structures for applications, and creates logical and physical models
- Provide planning and direction for GIS growth to serve corporation needs
- Provide overall management for all GIS implementation tasks
- Manage priority setting for GIS database and application development
- Create and maintain metadata and pertinent documentation

GIS Staff within Engineering and Planning

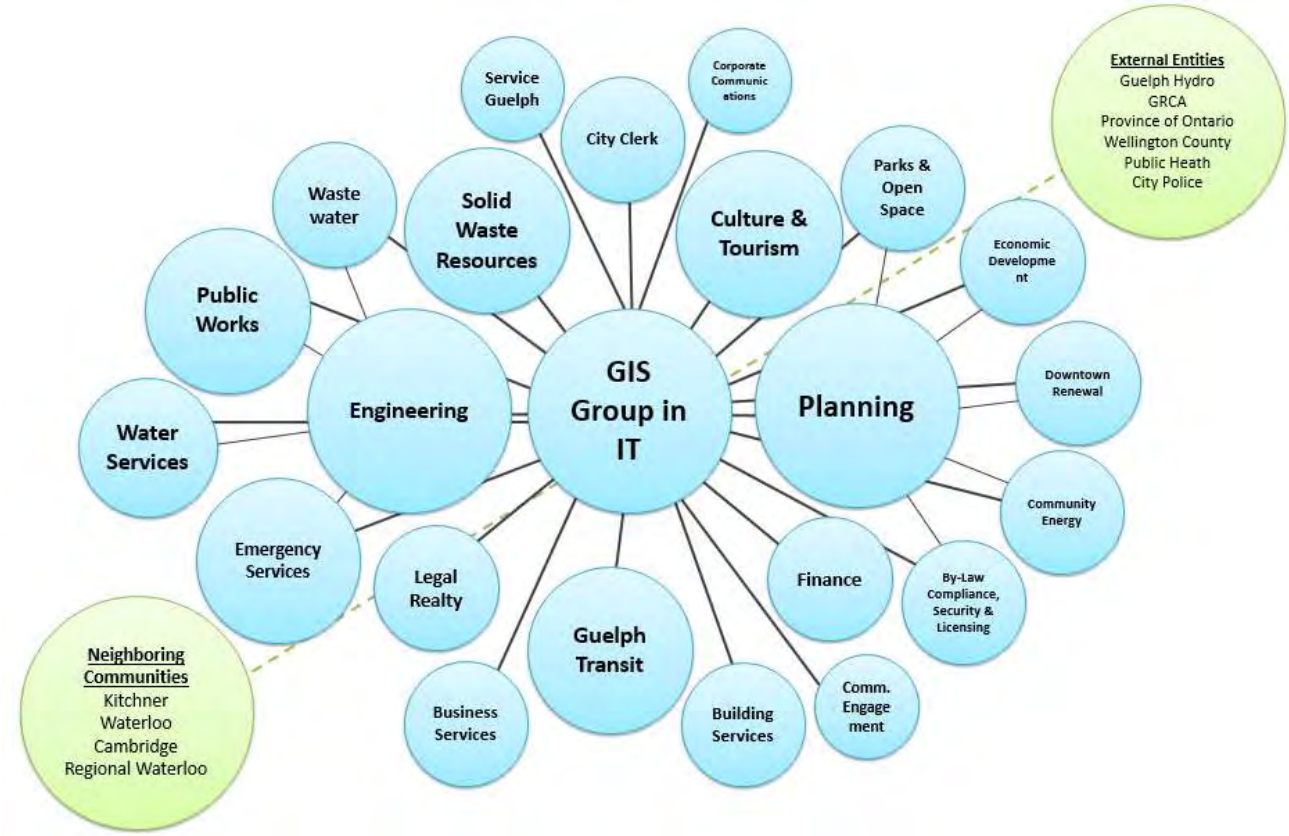
The Engineering and Planning Departments are the two heaviest users of GIS at the City. Both Departments have GIS staff responsible for the editing and maintenance of GIS data. Both departments support other departments in regards to their GIS needs. This is an informal arrangement and should be reviewed and formalized through the governance structure. These departments work closely with the GIS Team in IT but not in a defined capacity. If additional staff resources are established within the GIS Team in IT many of the services provided by these departments can be provided under the guidance of the GIS Team in IT.

GIS Expertise within Other Departments

Other departments have realized the critical nature of GIS for their tasks. As such, they have developed pockets of GIS expertise among existing staff (power users). Most of these staff members do not have GIS titles but are relied upon to provide GIS services to their department. Water Works is an example of a department that has advanced users, who utilize GIS client software for data manipulation, data creation, and analyses. When there is a need for more advanced use of GIS software, either the GIS Team in IT, the Planning GIS staff, or the Engineering GIS staff is called upon the provide advice and/or service to deliver the desired product.

City of Guelph Current Governance Model

Although not officially defined, the current governance model at the City of Guelph is a hybrid with characteristics of a de-centralized model. The GIS Team in IT supports the entire organization in regards to GIS hardware and software, as well as data modeling, spatial analysis, data maintenance and expert advice. Engineering and Planning have developed as departments with advanced GIS knowledge through employing dedicated staff for data maintenance and analysis. Other departments rely on these three departments for GIS services. What has moved the City from a centralized GIS to a hybrid GIS is the growth of the aforementioned GIS power users in other departments, and the implementation of the Intranet GIS portal (OnPoint) that was intended to enable each department to do many of their GIS tasks on their own. However, due to a variety of issues the deployment of OnPoint has not been successful. The following graphic illustrates the current governance model at the City of Guelph. It illustrates graphically that the GIS Team in IT is at the hub of GIS for the City, and that Engineering and Planning are the largest users and operate in support of other departments as well as their own department. Additionally, the relationship to other external entities is represented on the diagram.



City of Guelph Existing Governance Model Diagram

The following are some of the key **existing conditions** in regards to the City of Guelph GIS effort:

- No official governance model
- Hybrid and de-centralized characteristics
- GIS Team in IT serve as data warehouse custodians and technologists
- Planning and Engineering have GIS staff and act as the go-to GIS resources for some departments
- Heavy departmental users – IT, Engineering, Water Services, and Planning
- Moderate departmental users – Culture and Tourism, Public Works, Emergency Services, and Solid Waste Resources
- Other GIS using groups (mainly OnPoint) – Building Services, Business Services, By-Law, Community Energy, Corporate Communications, Downtown Renewal, Economic Development, Finance, Legal/Reality, Parks and Open Space, and Wastewater
- The City works with Wellington County, Grand River Conservation Authority (GRCA), consultants conducting work for the City and the various Ministry's within the Province of Ontario to acquire key data sets.

Gap Analysis

GIS is a common need distributed across the City and GIS has been integrated into numerous departmental workflows. Departments have become dependent on the technology and, in many cases, were not guided by corporate goals. Increased GIS use has created a very real need for departments to share what initially was considered to be department-specific data. Variations in software, data format, and data quality can make this difficult.

The GIS Team in IT has a responsibility to manage core GIS technology services. Sharing data among departments is critical to these core services. While IT clearly understands the need to define and maintain standards, current directives have not included standards for GIS technology, or clearly defined the role of the GIS Team in creating and maintaining the standards. Some of the standards that should be under the auspices of the GIS Team are:

- Naming conventions
- Data schema
- Data editing methodology (in collaboration with business area)
- QA/QC standards
- Training standards
- Work flow processes/procedures for GIS
- Mobile/Field GIS standards
- Application standards
- Data collection standards

- Data storage (i.e. what should be in a central database and what could be stored locally/shared network location like project specific data)

Varied GIS departmental implementations and the lack of GIS standards force the organization to take a **reactionary approach to enterprise integration**. This is inefficient for several reasons:

- Difficulties may prompt departments to:
  - Support duplicate efforts
  - Establish standards and procedures on their own which may not be GIS best practices
- Processes are often not real-time, which degrades the temporal quality of data
- Efficiency of communication and data sharing between departments are reduced
- System integration is more difficult and sometimes impossible due to varying standards
- Understanding of service areas is overlooked

The following are some of the core **existing challenges** that are evident in regards to an enterprise-wide GIS:

- No Official Strategic Direction – no goals and objectives in place
- Need Improved Digital GIS Data Layers – see data analysis chapter
- Need Additional Data Layers – see data analysis chapter
- Need Data in Extended Areas – service areas for various departments extend beyond the city limits
- Have Un-Met Needs (Increased Opportunity) – some department's needs are not being met
- Need for Temporally Accurate Data – many data layers are not updated as needed
- Technical Hurdles – application speed, functionality, technical support, and data access
- No Annual Training Plan – many users feel they are not being afforded adequate training

Recommended Actions

To better meet the organizational GIS needs and to facilitate the desired outcome of an enterprise-wide GIS, the following actions should be taken:

- **A GIS Steering Committee (Management Team) must direct the enterprise-wide GIS**
- **Formalize a Hybrid Model and staff accordingly**
- **Functional GIS Teams should be established**
- **Formal Directives should be given**
- **GIS Users Group should be a priority**

Each of these recommended actions is discussed in more detail in the next sections:

A GIS Steering Committee (Management Team) Must Direct the Enterprise-wide GIS

The city has created a GIS Steering Committee to guide the enterprise GIS effort. GIS should model some of the best practices being followed by IT. IT involves City management through an IT Governance Committee. This group contributes leadership and oversight to the City in regards to the direction of IT via the Corporate Technology Strategic Plan. This group provides the following key elements for the IT direction of the City:

IT Governance Committee Mandate:

- The ITGC is responsible for defining strategic directions for corporate technology based on corporate and Council priorities. A member of ET that is part of the ITCG will chair the Committee.
- The Committee will guide IT funding and evaluation, and make decisions regarding large scale investments within the context of the enterprise IT applications and infrastructure services portfolio.
- The Committee is designed to promote a collaborative and transparent approach to delivering on the technology strategy, recognizing the shared responsibility for successfully leveraging technology.
- The Committee will be responsible for setting expectations and monitoring IT service delivery regarding its role in supporting the City's Corporate Strategic Plan, Corporate Technology Strategic Plan, and Departmental Business Plans.

IT Governance Committee Duties and Responsibilities:

- Defines the corporate IT guiding principles
- Owns and manages Corporate technology strategy
- Agrees and endorses the criteria for evaluation of technology projects
- Accountable for developing annual IT capital priorities
- Provides oversight for the IT Portfolio (projects, assets, resources)
- Approves IT annual work plan and approves significant changes to the work plan throughout the year
- Approves new IT investments
- IT policy review, approval and endorsement
- Technical standards review and ratification – from Technical Standards Board
- Approval of multi-year strategic work programs from Steering Committees (individual projects within the plans will be routed through the IT Portfolio Evaluation Committee).
- Monitoring strategic IT KPI's
- Endorse the IT Annual report to Council

Ultimately, the City should use this committee as a model for GIS. In that regard, the City has created a GIS Steering Committee that should be relied upon to guide GIS implementation at a management level. The City must ensure that the GIS Steering Committee consists of upper management. A management-level employee, preferably the department head, should be on the Steering Committee. This Committee's main function is to ensure that GIS is implemented effectively throughout the organization and that enterprise-wide

goals and objectives are being met. The Committee **should provide critical, high-level commitment to investment in GIS**. Each member of the Committee will gain an understanding of the technology and feel some ownership in the GIS Implementation. These high-level participants will be indispensable during budgeting, and **each member will serve as a champion for GIS** within his or her own department.

The GIS Steering Committee **should**:

- Initially meet monthly or quarterly to guide the further implementation of GIS at the City
- Focus on the high level GIS direction of the organization
- Include the IT GM and the recommended GIS Lead
- Be comprised of high level department staff (preferably department heads)
- Receive formal presentations from the GIS Team in IT as to the direction and needs in regards to GIS
- Decide priorities founded on available funding and overall needs of the organization based on the identified needs of the up-to-date GIS Strategic Plan
- Make recommendations as to GIS priorities
- Understand and nurture GIS within their departments and the organization as a whole

The GIS Steering Committee **should not**:

- Meet at a frequency that is burdensome and unproductive
- Discuss the nuances of the GIS implementation such as hardware, software, etc.
- Be turned over to junior staff, which would defeat the purpose of the Committee
- Become a venue to advancing the individual goals of a department over the overall goals of the enterprise-wide needs

A GIS that fully benefits all departments and the public will not be realized unless a GIS Steering Committee guides the GIS.

Formalize a Hybrid Model and Staff Accordingly

The Hybrid model discussed earlier in this chapter is being recommended as the model of choice for this enterprise-wide effort. This model alters how the organization operates and requires departmental staff to adhere to the strategic direction of the City and specific best management practices established by the GIS Team in IT. The City of Guelph has evolved into somewhat of a hybrid model for GIS but needs an official adoption of this governance model. Additionally, the City needs to create a GIS Lead position to lead the GIS effort. The master plan serves as the rudder of the ship. However, the ship also needs a knowledgeable captain on board. All of the most successful GIS programs have a full-time program leader. Having this person is the most important component to GIS success because leadership can make or break the program and its associated projects.

The program leader is often referred to as the GIS Manager, GIS Coordinator, GIS Lead, or GIS Director. Whatever the position is called, you must have a person with the technical savvy to run diverse operating

systems, networks, and GIS software and the people skills to coordinate, sell, champion, teach and referee the implementation of this revolutionizing technology. This position must be seen as a corporate asset and as such needs to serve the entire organization with autonomy.

Why a Full-Time Lead?

There are many questions asked when creating a new position. Do we really need a new position to run our GIS? Can't we just use our existing staff? In which department should we put our GIS Lead? How much should we pay? These questions are not to be answered lightly. Organizations have spent millions of dollars on GIS just to see the project fail because these questions were not addressed properly.

GIS programs, as well as projects, are inherently complex. Decisions have to be made about hardware, software, networking, data standards, data sharing, data security, database design, data maintenance, data creation, priorities of data layers, training, programming, workflow processes, communication, documentation, etc. Managing these tasks is the role of the GIS Lead and it is a full time job.

Where to Locate the GIS Lead?

It seems natural to put the GIS Lead in the department that seems to need GIS technology the most. In many city governments, this is the Planning or Engineering departments. However, if the City of Guelph is going to have a successful enterprise-wide GIS, the GIS Lead should not be in a department that is a major user of the technology.

When the GIS Lead is in a user department, that department invariably gets much better treatment than other departments. The GIS Lead is faced with a dilemma: "Do I work on the project that will please my boss, or do I spend my time helping other departments?" More often than not, the GIS Lead will satisfy the boss. For example, a GIS Lead in the Planning Department will develop a comfort level with planning issues and will tend to gravitate to GIS activities that further planning goals. Other departments will soon feel isolated, grow resentful, and begin to lose interest in the GIS program. Support for the program, as a whole will begin to erode. Instead of breaking down traditional barriers, this mode tends to erect new ones.

For these reasons, the GIS Lead should be independent. Depending on the organization, the GIS Lead should be in one of three places:

- A division of IT
- An independent department
- A position directly under the supervision of the city manager.

These options allow the GIS Lead to look at the organization as a whole and set priorities without feeling the need to put the desires of one department above another. As aforementioned, the setting of corporate

priorities needs to be a collaborative process under the guidance of the GIS Steering Committee to ensure that corporate priorities and departmental priorities can be appropriately balanced and aligned. It is recommended that this position be on-par with a Corporate Manager. For example, a Corporate Manager works within Corporate Communications. This Corporate Manager is not focused on the needs of one department but the needs of the entire organization and is held accountable at an organization-wide level. The GIS Lead should likewise have an organization-wide focus. Also, the GIS Lead should be in IT directly reporting to the General Manager of IT. The precedent has been set and the infrastructure created for IT to support GIS at an enterprise-wide level. Therefore, there is a compelling reason for the GIS program to remain in IT.

Characteristics of an Effective GIS Lead

Hiring the right GIS Lead can be tricky. The ultimate success of an organization's corporate GIS will rest squarely on the shoulders of the GIS Lead, who must be several things:

Technically proficient but not intimidating. Today's GIS Lead must understand a diverse range of technological issues-computer networking, database design, integration with other IT systems, various GIS software, mobile computing, data conversion, etc. If the GIS Lead does not have a tight grasp on the technology, the GIS will languish.

It is important that the position not only know the technology but also be able to share this knowledge with staff. They must determine each user's level of expertise and relate the technology in terms that each user can understand. The GIS Lead must also avoid confusing and frustrating users, or antagonizing them by engaging in technical one-upmanship.

A geographer. It is said that 95 percent of everything done in local government has a geographic component. The GIS Lead must understand geography and be familiar with proper mapping techniques and geographic constructs. A formal background in geography is desirable. An extremely competent computer person may fail as a GIS Lead because he or she does not understand geography. Guelph should test the geographical knowledge of your potential coordinator before hiring. If he or she does not understand projections, coordinate systems, cartographic concepts, etc., look for another candidate.

A salesman. "Be everywhere, do everything, and never fail to astonish the users." This spin-off of the Macy's department store motto makes a good motto for the GIS Lead. The GIS Lead has to become the champion of GIS in the organization. Whenever new technology is advanced, there will be skeptics. It is up to this person to quiet the skeptics and tout the benefits of GIS to the organization. They should make sure that every department knows what GIS can do, and more importantly what it can do for them. Newsletters, presentations, informal conversations, and magazine articles should be used to educate users about the

technology. It is important that the position have people skills and ability to articulate the benefits of GIS. A good GIS salesman can quiet even the harshest of critics.

A diplomat. Diplomacy has been defined as the art of letting someone else have your own way. GIS will change the way Guelph operates. Whenever a revolutionary technology such as GIS is adopted, change will occur. Old, inefficient ways of doing business have to be evaluated and sometimes jettisoned. Often, this will not go over well with some staff. It is critical to be diplomatic in these situations. The GIS Lead needs to make sure that no one feels alienated. If possible, it is best to prompt users into coming up with ideas on how to change their operations using a GIS instead of coming in and trying to force change.

To build a fully functional GIS, the position will have to ensure that all departments get involved and that data are shared between departments. Inevitably, departments will disagree on how a GIS should be implemented. Such issues can drive a wedge between departments, and many organizations never get through this stage. It is up to the diplomatic GIS Lead to see that disagreements are resolved in a manner acceptable to all parties. In Wilson, North Carolina, potentially divisive issues relating to accuracy and cost of data to the public arose between departments. These important issues were met head-on and resolved by gathering all involved parties before problems could occur. With the help of their coordinator, the users came up with a mutually acceptable solution.

The right person for the lead position may be an existing staff person. A technically competent in-house hire can make sense for a number of reasons. First, the in-house person already knows the nuances of the organization. It may take an external hire months to understand how the organization functions. Second, you know the candidate, what kind of worker you are getting, and whether he or she can work well within your organization-something no resume can tell you. If a qualified person exists within the organization, don't hesitate to make him or her the GIS Lead. However, it is worth mentioning again that an in-house person cannot be the new GIS Lead while maintaining another full-time position. The GIS Lead position is a full-time job. The GIS Lead should be the direct supervisor of the GIS staff in IT. This hybrid model adoption and staff expansion should clearly define roles and responsibilities to include the following:

Central GIS Staff Authority and Responsibilities - It is important to reiterate here that under the Hybrid Model, the GIS lead should have a dual accountability to the Steering Committee in the sense that the Steering Committee should have an oversight role with respect to corporate GIS initiatives to ensure that as the lead carries out the noted responsibilities there is full departmental buy-in and consensus. The whole "hybrid" concept requires a collaborative and consensus-based approach. The following is a list of responsibilities on the GIS Team in IT:

- Set software and hardware standards for all geospatial technology
- Work closely with the power users in other departments (Engineering, Planning)
- Approve the acquisition of all geospatial software and hardware (GIS, GPS, AVL, others)

- Set database standards for all GIS data
- Implement geodatabase standards and designs for key data sets
- Enforce quality assurance and quality control standards for all GIS data
- Provide and approve corporate GIS educational opportunities for the organization
- Facilitate the ability for departments to maintain their own GIS layers where appropriate
- Select and provide enterprise-wide tools for departmental staff to conduct geospatial analysis and browsing
- Select or approve public facing geo-spatial portals
- Provide mechanisms to geo-enable existing non-GIS databases
- Oversee and administer a communications plan for GIS
- Maintain and enforce the use of a GIS help desk
- Conduct an annual user satisfaction survey
- Conduct an annual return on investment analysis (new GIS investments) of GIS at the City
- Oversee the use of functional teams which will include power using departments who will be instrumental in leadership
- Provide technical expertise for the creation of specialized GIS products or analysis
- Provide oversight as to the use of GIS at the departmental level
- Ensure that departmental level staff is adhering to corporate-wide standards. If not, rectify the situation through departmental staff supervisors and/or the GIS Steering Committee

Departmental Responsibilities

- Maintain staffing levels to support departmental GIS need – having a formal central GIS group does not abrogate departmental authority for providing resources for their own needs
- Utilize enterprise-wide data viewers and tools to create maps and reports as needed
- Maintain departmental specific data layers as appropriate
- Participate in the use and growth of geospatial tools
- Ensure that staff attend the internal training classes on GIS where appropriate
- Utilize the GIS help desk
- Participate in functional teams as needed. Current workload and capacity will need to be considered as functional teams progress.
- Give candid feedback to the central GIS staff as to how GIS is meeting their needs
- Establish department-specific GIS work plans, aligned, as appropriate with corporate GIS work plan

GIS Departmental Staff Supervisor Responsibility

- Understand city-wide GIS standards
- Ensure that staff adhere to organization-wide GIS standards and methods

- Ensure that staff are storing GIS data in the central GIS repository
- Ensure that staff are working towards the common GIS goals established by the GIS Team in IT and the GIS Steering Committee
- Communicate with the GIS Lead in IT to make sure GIS staff are functioning in such a way as to ensure that the organization-wide GIS goals and standards are being met
- Consult with the GIS Lead in IT as to job performance as a part of annual reviews

Additionally, staff working on GIS projects should be accountable to their own department but also to the GIS Lead. This dual accountability can only work if this model is officially adopted by the organization and the GIS Steering Committee. It is important that departmental staff are accountable to ensure adherence to established corporate standards, procedures, etc.., but the GIS lead has no responsibility/authority for overseeing departmental staff from a human resource/staff management perspective – this must remain solely the responsibility of their direct manager. The direct manager should consult with the GIS Lead in regard to a staff person's performance and contributions to the overall GIS.

The Hybrid model can be modified to accommodate current mission critical and department based GIS operations, as well as lay the foundation for enterprise level ownership and corporate oversight of many current and future GIS processes.

Model GIS Job Descriptions

The following are model job descriptions for the GIS Lead and GIS Analyst:

GIS Lead

Nature of Position: This position requires a broad range of management, business, and technical skills to guide the successful implementation of an enterprise GIS within the City. The GIS Lead has overall responsibility for ensuring that key GIS work elements – hardware, software, networks, databases, and staff resources within the central body – are managed, maintained, and enhanced to meet agreed-upon City requirements.

Oversee all corporate-level GIS operations including database management and administration, data structure and metadata development, system administration, GIS software selection, implementation and user support, corporate GIS project management, budgeting, marketing, education, user group oversight, functional team oversight and training. The GIS Lead should be expected to spend 40% of their available time focused on tactical and operational implementation of GIS components for City-wide and department initiatives (e.g. analysis, mapping, application configuration and deployment, geodatabase development). Sixty per cent (60%) of their available time should be spent on strategic and program management ensuring the enterprise GIS goals and implementation schedule is

maintained (e.g. project management, guiding internal resources, education, managing external consultants).

Education: Bachelor's Degree required in Geography, Computer Science, Earth Science, Engineering, Planning, or related discipline and minimum 5 years experience in GIS project management for local governments and 3 years experience GIS development and maintenance, or an equivalent combination of education and experience.

Skills: Experience with government GIS applications, especially in business areas such as planning, public utilities, transportation, fire, EMS, and City base map creation and maintenance. Experience developing schedules and managing complex information technology projects. Familiarity with business process analysis as it relates to GIS. Active participation in professional GIS, mapping, and/or surveying organizations and activities. Excellent verbal, written, and interpersonal communication skills. Ability to communicate technical information in a non-technical manner. Ability to lead and motivate work teams.

Computer Skills: Experience with Esri's ArcGIS suite of products in a Windows environment. Experience in database administration, relational database design, development, and implementation. Working knowledge of ArcSDE, ArcGIS Server, and ArcGIS modeling and analysis is required.

Nature of Contact with Other People: The GIS Lead will act as the geographic information expert for the City. The GIS Lead provides oral and written progress reports and updates to superiors and oversight committees. The position requires an extensive amount of communication at all levels of the City government and external organizations.

Salary: TBD, commensurate with experience and based on City HR policies.

GIS Business Systems Analyst

Nature of Position: GIS application support and project oversight, spatial data layer creation and conversion, geodatabase management and administration, data analysis, map production, GPS data collection, user support, and specific GIS project management.

Education: Bachelor's Degree in Geography, GIS, Computer Science, Earth Sciences, or related discipline.

Skills: This position is highly technical in nature and requires a candidate with existing GIS and GPS knowledge and skills in order to perform tasks efficiently; software design and development skills are required as well. Familiarity with geodatabase design, implementation, maintenance, and management. Familiarity with geographic projections and cartographic principles, as demonstrated through coursework or work experience. Working knowledge of how to edit GIS data, including geodatabases, shapefiles, and CAD files, and knowledge of how to perform logical queries of the database. Proficiency with spreadsheets and tabular data desirable. Understanding of GIS in City/local governments is highly desirable.

Computer Skills: Proficiency with ESRI software, particularly ArcGIS, is essential. Additional skills include object-oriented GIS application development, customization, and database programming, as well as GIS data conversion and GPS data collection skills. Detailed understanding of enterprise-wide GIS applications and environments is desirable.

Relevant Experience: Two years of experience with GIS and GPS concepts; two years of experience with GIS applications, specifically with ESRI software. One year of experience with enterprise geodatabases, preferably with ArcSDE and SQL Server.

Salary: TBD, commensurate with experience and based on City HR policies

Functional GIS Teams Should be Established

Historically, the GIS within local government has evolved into a regimented structure. Staff within a department focused almost solely on those tasks that were specific to their department while not being concerned with other departments with similar needs or overall organizational goals. Additionally, a core group of GIS staff were hired to implement GIS for the entire organization. However, central GIS staff often lack the authority to change processes outside of their domain. Therefore, central GIS staff often find that the traditional, local government model of departmental "stovepipes" is at odds with GIS implementation at an enterprise-wide level. Typically, departmental staff understand that the only person they have to answer to is their department supervisor. More often than not, that supervisor is not focused on the overall organizational goals and, instead, is focused only on departmental goals. This results in inefficiencies, duplication of effort, lost opportunities, and overall, works against the big picture of optimal GIS use within the entire organization.

San Luis Obispo, California found that they had three different departments creating street centerline files for their own purposes. Virginia Beach, Virginia found that each department was acquiring their own GIS tools and software which was in some cases incompatible with other departments.

One solution adopted by local governments was to centralize all GIS staff. However, this solution tends to alienate departments because they are losing key personnel. Additionally, the departments lose the expertise they need to conduct the very specific day-to-day GIS functions of their department.

The Hybrid model, as recommended previously, preserves the departmental needs while ensuring staff are working toward the overall enterprise-wide organizational goals. Implementing this model will require departmental staff to work together to achieve goals that occasionally involve needs external to their department. To that end, functional teams of GIS staff are being recommended. A **functional team** is a group of staff that works towards organizational goals that relate to their specific department. Each functional team can be comprised of knowledgeable GIS staff within departments, non-GIS staff within departments, the GIS Lead, and other GIS staff from the GIS Team in IT. A GIS staff person from the central GIS Team in IT and/or the GIS Lead will work as the GIS expert with a focus on the specific needs of that functional team. This GIS Analyst, under the guidance of the GIS Lead, or the GIS Lead will direct the team's efforts. The lead GIS staff person (GIS BSA or GIS Lead) assigned to a team should become an expert within the team's functions. For example, a GIS staff person assigned to the Operational Team would become intimately familiar with details as to how each department operates and how GIS can benefit that department. Team members will be required to contribute to the overall goals of the team while satisfying the needs of their department. The recommended functional teams are as follows:

- **Operational GIS Team** – this team will focus on needs that pertain to departments whose primary focus is the infrastructure of the city such as those services typically delivered through traditional Utilities and engineering functions. It is recommended that this team be comprised of the following minimum representatives:
    - Engineering Services
    - Parks and Open Space
    - Public Works
    - Solid Waste Resources
    - Guelph Transit
    - Wastewater Services
    - Water Services
    - Planning Services
    - Representative from central GIS group

- **Planning and Land Management GIS Team** - this team will focus on needs that pertain to departments whose primary focus is planning and land management related issues. It is recommended that this team be comprised of the following minimum representatives:
    - Building Services
    - By-Law and Compliance
    - Community Energy
    - Downtown Renewal
    - Economic Development
    - Legal and Realty Services
    - Parks and Open Space
    - Planning Services
    - Representative from central GIS group

- **Human Services GIS Team** - this team will focus on needs that pertain to departments whose primary focus is the delivery of human services and public interaction. It is recommended that this team be comprised of the following minimum representatives:
    - Business Services
    - City Clerk
    - Community Engagement
    - Corporate Communications
    - Culture and Tourism
    - Emergency Services
    - Finance
    - Service Guelph
    - Representative from central GIS group

Each functional team should meet at set intervals to discuss how best to carry out the overall GIS needs of their team while meeting the needs of their departments. These teams should be empowered to discuss and evaluate annual corporate work plan priorities and resource assignment to achieve priorities and make recommendations to the GIS Steering Committee. The Steering Committee should be responsible for confirming such priorities and resources: as GM's they have the authority and knowledge to make such resource commitments. GIS staff from the GIS Team in IT should oversee these meetings and set the agenda based on the goals approved by the GIS Steering Committee. As such, the attendance of some team members will be mandatory while others will be optional, depending on the nature of the prioritized projects. The meetings should be defined in advance via an agenda sent out from the GIS Functional Team Lead to the from the GIS Group members of the functional team. Where appropriate, functional team members should work toward common goals such as developing and maintaining needed data layers, special projects,

launching applications, and other needs. Members of the functional teams should still conduct the duties specific to their department but would also contribute to the overall enterprise or corporate GIS mission as appropriate. This team work mentality will only function if supported by management. The following are expectations of functional team members and their supervisors.

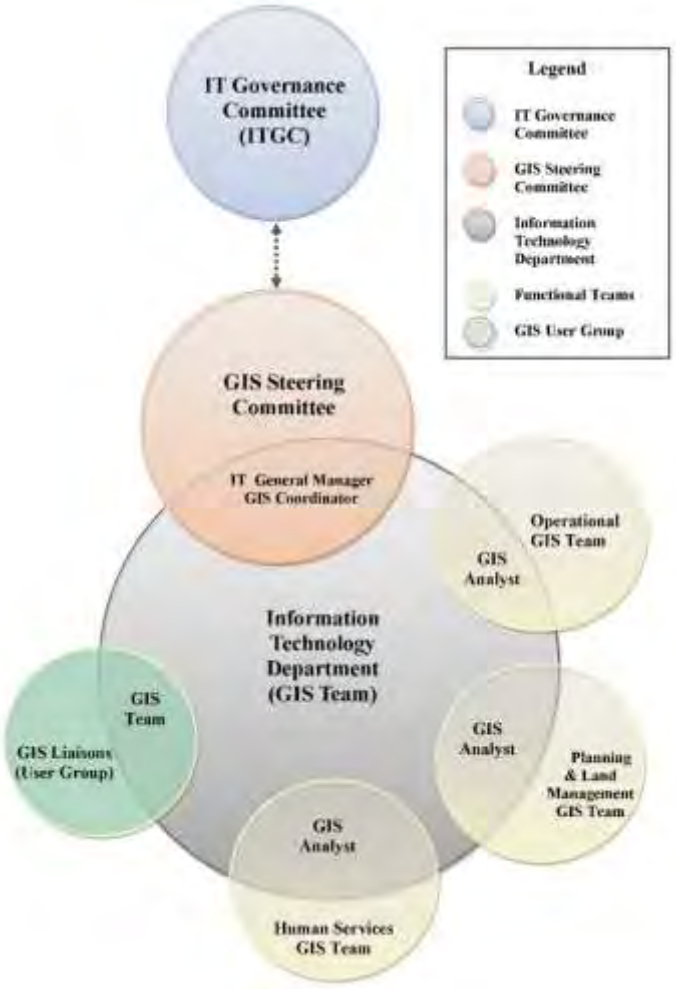
Expectations - Departmental Functional Team Members

- Attend functional team meetings
- Contribute to functional team with ideas
- Contribute to functional team in regards to shared goals and projects
- Inform immediate supervisor of functional teams goals and projects
- Communicate with functional team lead in regards to level of contribution based on other commitments
- Communicate with functional team lead in regards to changes in ability to contribute

Expectations – Supervisor of Functional Team Members

- Understand the purpose of the functional team and its collaborative nature
- Allow staff to contribute to functional teams within the constraints of other projects/tasks
- Communicate with staff in regards to functional team goals and projects
- Assist staff in identifying departmental needs in relation to the purpose of the functional team – project ideas that can be brought to the functional team
- Ask functional team lead for input as to job performance of participating staff

For the concept of functional teams to work, the City needs additional GIS resources. Currently the GIS Team in IT has two staff (GIS Business Systems Analysts). Cities of comparable size have more GIS staff than Guelph. The two current staff do not have the time to move the GIS to the enterprise due to the volume of immediate GIS needs. They often focus their time creating GIS products, with insufficient time for providing end user solutions, training and education of staff. It is recommended that a GIS Lead position be added to the GIS Team in IT. A GIS Business Systems Analyst or the GIS Lead would be assigned to lead a GIS functional team and focus their energies on the needs of this group. Additionally, an additional GIS Analyst should be added as budgets permit. The following graphic illustrates the recommended GIS functional structure for the City of Guelph:



Proposed GIS Functional Team Organization

Formal Directives Should be Given

The GIS Steering Committee will need to clearly define and effectively communicate the responsibilities of departments, issuing directives that give IT and GIS staff within IT the authority to set enterprise-wide GIS standards. Departments should then work within this framework to complete their specific GIS tasks. To effectively and efficiently move forward, GIS staff within IT should continue to support and integrate existing GIS initiatives while working towards enterprise standardization and creating a comprehensive list of accepted standards.

A GIS Users Group Should be a Priority

A GIS Users Group has been established. In the absence of a GIS Lead the GIS Users Group has been tasked with making decisions and recommendations in regards to GIS management as follows:

Current GIS User Group Mandate

"The GIS User Group will work to identify GIS functionality standards, guidelines, procedures and best practices for all existing and future implementations and use of corporate GIS. This group will provide coordinated leadership to all GIS Users and champion the expansion and enhancements of ESRI ArcGIS as a key corporate geographical information system for the City of Guelph."

Current Duties and Responsibilities

- Work collaboratively with the GIS Steering Committee to identify and prioritize GIS enhancements and upgrades
- Recommend GIS enhancement strategies to the Steering Committee
- Provide input to the Steering Committee in developing a five-year strategy, including resource plans
- Working with the Steering Committee and all GIS Users on the development and refinement of usage and maintenance Procedures and Policies
- Provide support to Communications for development and implementation of communications plan
- Lead Change Management to champion the proper use of GIS. The Steering Committee will set out the plans for the Change Management and the User Group will support the implementation of the plans
- Liaise with the IT Project Manager(s) and the Project Team for the review of all new projects and initiatives related to GIS, including the extension of the GIS platform for the provision of GIS field/mobile usage
- Provide input to the development of GIS Implementation Guiding Principles
- Identify Training Requirements for GIS
- Keep informed of Technology Advancements with GIS and ESRI ArcGIS
- Recommend to Steering Committee data maintenance policies, standards and guide lines including meta data
- Liaise with departmental peers to bring forward concerns and pass on information on changes coming in the GIS
- Monitoring continual improvement in user satisfaction within department

Most of these duties should be accomplished by the recommended GIS Lead. Until the GIS Lead is hired, the User's Group should continue to function in its current capacity. Once the GIS Lead is hired, the GIS User's Group should no longer function as it does. The User's Group should become a group focused on education and idea sharing. The group should include GIS-utilizing staff from all departments with identified GIS needs

and be led by the GIS Lead. A GIS Users Group meeting provides an excellent opportunity for communication between all GIS users and is a good venue for the group to share their successes and failures. Duplication of efforts will be minimized and sharing of ideas and data will be optimized. A GIS Users Group is also a great platform for internal training initiatives and is the venue where initiatives and successes of each functional GIS team can be shared.

Recommended Functions of a GIS User's Group

- The group should meet at least once per quarter and discuss the following items
    - Current GIS projects
        - Each department/division should share details on current GIS projects, including showing maps and data
    - Upcoming GIS projects
        - Ideas on how best to accomplish the projects should be shared
    - Industry trends
        - New software releases, new hardware, and networking issues should be discussed
    - New databases or changes to existing databases
    - Upcoming GIS conferences and/or training/webinars
    - Organizational and staffing issues
    - Joint project initiatives
    - New funding sources
- Have a way to communicate effectively with all members of the users group (e.g. email, Twitter, Facebook, Meetup.com, webpage)
- Maintain an internal Blog and/or discussion forum
- The quarterly meeting should also contain a brief technical session
    - A user should be able to conduct a how-to seminar on some aspect of the GIS
    - New functionality within Esri tools (version 10.2) could be an item for discussion
        - Improved Security
        - Geodata – support for new workspaces, ability to modify field properties on supported DBMSs
        - New Analytical Tools – 16 new geoprocessing tools
        - Improve Mapping and Reporting
        - 3D GIS
        - New Imagery Tools
        - Improved Publishing Abilities
        - Optimized Hot Spot Analysis
- Use survey methods such as SurveyMonkey.com to gauge presentation interests of the user group members

- Participate and an annual user satisfaction survey
- Members should be GIS liaisons and ambassadors for their respective departments
- Participate in GIS Day
    - Leverage the press
    - Reach out to elected officials
    - Reach out to the public
- Provide mentorship to local schools and universities

Things a GIS User's Group Should Avoid

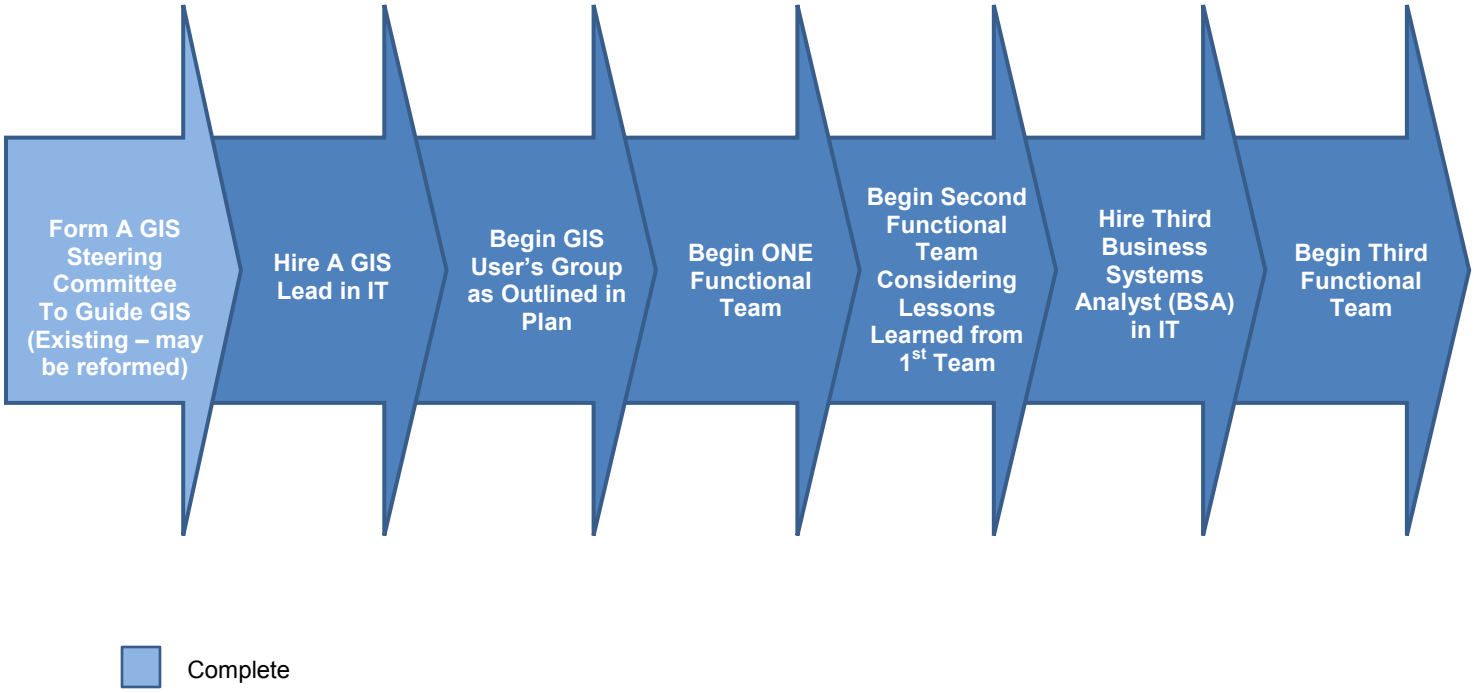
- A GIS users group should not force users to present or speak unless they are willing
- Do not spend a lot of time on one particular topic – a general rule is 10 minutes per topic
- Avoid bashing each other's technology choices or methods – the meeting should be a friendly environment with constructive criticism provided when needed
- Be dominated by one or two strong personalities
- Be central GIS staff pontificating and always delivering the material

Transforming the Organization (GIS Transition)

This chapter has proposed a significant deviation from the current business process at the City of Guelph. Positive change will not occur if the recommendations in this chapter are not formerly adopted. A governance transition checklist should be followed. Below is a recap of keys items that should occur to transition GIS from its current state to a true enterprise-wide hybrid governance model. The checklist below is not necessary linear but an effort has been made to list them in a logical sequence:

- ✓ Form a GIS steering committee – complete
- □ Finalize the strategic plan – in progress
- □ Finalize GIS mobility plan
- □ Officially adopt the strategic plan
- □ Create the GIS Lead position
- □ Hire the GIS Lead
- □ Begin a GIS User's Group as outlined in this chapter
- □ Implement education plan
- □ Implement training plan
- □ Establish functional teams
- □ Implement or re-launch intranet data browser
- □ Implement annual user satisfaction surveys
- □ Hire an additional GIS Analyst
- □ Create new data layers
- □ Implement end-user GIS tools as per the software chapter

The following chart illustrates the incremental transition into the governance model:



SWOT Analysis

A SWOT Analysis is a strategic planning method used to evaluate the strengths, weaknesses, opportunities, and threats as they relate to a topic. A GIS SWOT analysis was performed on-site at the City of Guelph in February of 2014. This was conducted after the on-site needs assessment interviews and the completion of the needs assessment document. This allowed all staff to understand the purpose of the strategic planning process and to have taken the time to think through how they anticipate utilizing GIS in the future. Staff SWOT teams were grouped by functional areas. The following were the functional areas that met to perform the GIS SWOT analysis:

- Community Information and Communications – staff who focus on public interaction and sharing of data with the public
- GIS Editors – staff who are responsible for the creation and editing of GIS data with advanced GIS tools
- GIS User Group – the existing GIS User's Group
- Mobile and Field – staff representing departments/divisions that have a pressing need to use GIS in the field
- Property and Address – staff who focus on managing property and address related data
- Public Safety – staff whose primary job duty is public safety and welfare
- Steering Committee – the existing GIS Steering Committee
- Utilities – staff from departments focusing on infrastructure and utilities

The results of the SWOT analysis were utilized to make recommendations in regards to advancing an enterprise-wide GIS. The entirety of the identified items is provided on the next few pages. A summary of findings are as follows:

Strengths - characteristics that place the City of Guelph at an advantage for implementing an enterprise-wide GIS

- Enthusiasm, desire, and identified needs all serve to make this a great time to advance GIS enterprise-wide.
- A number of existing successes have laid the groundwork for future successes.
    - Implementation of Esri Software
    - Culture Map
    - Integration with Existing Systems
    - Field collection (ArcPad) for trees, road patrol, and environmental items
    - Mobile and WAM Pilot
    - Intranet based GIS viewer
- Expert level staff exists at the city. A number of departments have adept GIS staff who are ready to lead the city in advancing GIS.

- Leadership – the city has formed a GIS Steering Committee and User's Group in an effort to direct GIS efforts
- A wealth of existing data

Weaknesses - challenges which may arise for the City when implementing an enterprise-wide GIS

- Lack of a clearly defined GIS governance structure
- Financial constraints
- Competing priorities – the city has many large projects on-going
- Lack of training and education
- Data inaccuracies – attribution, position, and temporal
- No uniform mobile solution
- Speed and performance of existing tools

Opportunities – items that will improve organizational effectiveness and efficiency as the City implements an enterprise-wide GIS – Return on Investment (ROI)

- Public access and public involvement
- Formalized governance that enables all users (internal and external)
- GIS integration with existing systems (adding value to those systems)
- Return on Investment impact (ice storm, green initiative)
- Easy-to-use tools
- Using GIS in the field (mobility)

Threats - issues that the City may encounter that could threaten the further implementation of an enterprise-wide GIS

- Provincial and federal mandates that slow data dissemination
- Reluctance to change – culture shift
- Budgeting – must justify spending via return-on-investment possibilities
- Not implementing an enterprise-wide GIS governance structure
- Too technical/complex - getting the right tools into the hands of the users
- Focusing too much on other initiatives at the expense of GIS
- Erroneous data undermining the validity of GIS
- Lack of integration with other systems (stovepipes)

STRENGTHS							
Community Information and Communications	**GIS Editors**	**GIS User Group**	**Mobile and Field**	**Property and Address**	**Public Safety**	**Steering Committee**	**Utilities**

• Open records for all Canadian organizations
• AODA Must address
• Open to 'any' GIS
• On-line Browser Accessibility - Software as a Service
• Culture Map
  ○ Example
• Desire
• Class software/data
• Integration with GIS
	• Software (Esri)
	• Training
		• Integration (Asset Mgmt Work Order)
		• Data (Abundance)
		• Enterprise Use
		• Good IT Dept
		• Development of Relationships
		  ○ Strategic Project Successes
		  ○ External Organizations
		• Enthusiasm from all levels
		• Recognition of Value GIS (ROI)
			• Existing ArcPad Solutions
			• Data [Mobile Ready]
			• Species Collection Success Story
			• Automated Data to GIS for Strom Water field staff
			• Identifying Road issues in the field - Pot holes
			• Governance – Available and User friendly GIS staff in IT
			• Have some Hardware
			  ○ Connection Citrix
			  ○ Amada in field
			  ○ Inspections in field
				• Political/Admin will support
				• Data Layers (abundance)
				• On-point (Citizen and Departments)
				• Business Solutions
				• Willingness to Try New Technology - ArcGIS Online
				• Ground Swell of support from staff
				• Steering Committee in Place – Recognize need for more governance
				• Positive Change-Staff (Competence of Staff)
				  ○ Training
					• EMS Open to GIS
					• Many Needs and desires
					• Request for funds for Analysis location of station – understands real ROI possibilities
					• CAD used GIS on a daily basis
					• Improve response times because of GIS
					• Good Data (City)
					• Good GIS Staff
						• Recognize value of Education, Training, and Knowledge
						• Good City Products and Services
						• History of Success
						• Existing Governance
						• Drive to use Technology
						  ○ Mayor-Council Down
						  ○ Mandate to work Better, Smarter, Faster
						• Plans-Existing Strategies From Council – GIS can assist with these – e.g. IOR
						• Have an existing Steering Committee
						• Skilled GIS Staff for Corporate Style GIS
						• Existing Investment in Technology (Esri)
						• Stable High-Speed Network
						• Business – Have a Corporate Mindset
						• Desire Best Solutions – Great Attitude
						• Willingness to Change
							• Dedicated staff in Utilities (Water/Engineering)
							• Accurate Data
							  ○ Up-to-date
							  ○ Utilities, Roads, Sidewalks
							• Infrastructure Asset Management System
							• Other systems use GIS ID's
							• Cross section of data layers
							  ○ Lots of Data layers
							  ○ Corporate Asset
							• Responsible Use of GIS
							• GIS Trained
							• Understand the Value of Shared GIS Data
							• Integration-Existing & Historic Models
							• Have Ownership | Custodianship
							• Willingness and desire to work with External entities – some in place now

WEAKNESSES							
Community Information and Communications	**GIS Editors**	**GIS User Group**	**Mobile and Field**	**Property and Address**	**Public Safety**	**Steering Committee**	**Utilities**

• Lack of Governance
• Resources
• Communication
• Training
• Education
• Data
  ○ Accuracy
  ○ Not exist
  ○ Not useable
  ○ Understandable
  ○ What type of data
• Staff Capacity
• Budget
• Structured Dedicated
• No GIS Program
• Sustainability
	• Data Standards
	• No formal governance structure
	• Vulnerable to staff leaving
	• SOP
	• If Staff leaves? Pickle
	  ○ Infrastructure
	• IT Network Speed
	• Duplication of Data layers
	• Lack of Training (Departmental)
	• Not Centralized in regards to data
	• Budget-Communication
	• Lack of AutoCAD standards
	• Corporate Reliance on GIS Technical Editors on large Data sets
	• Need Digital Data Submission
	• 90% of Data Layers Not Maintained
	• Availability of Data
	• Access to Data Layers
	• Understanding of Data layers
	• Not Accurate/Incomplete Data
	• No Formal Governance Structure
		• Lack of Mobile GIS
		• Funding
		• Lack of Education and Training
		• Data Lack of Centralization
		• No MetaData
		• Lack of Understanding
		• Integration-Enterprise
		• Documentation (SOP)
		• Technical Support | Governance
		• Lack of Resources
			• Need a Mobile Specialist in IT to understand
			  ○ IT Infrastructure
			  ○ Coverage of Cell Phones
			• Governance
			  ○ 5 Groups using Mobile now - not Uniform
			• No Uniform Strategy
			  ○ GPS Tools Sustainability
			• Accuracy of Data
			• Meta Data
			• Communication of Technology (Cell Coverage)
			• Missed Opportunity
			• Citrix is weak-not good
			• Duplication
			• Connectivity
			• Corporate 'Style' database
			• Understanding-Need Education
			• Maintenance and Upkeep
			• Aerial Photos need to be up-to-date
			• No live data connection
				• Funding
				• Duplication of Effort
				• No Clear Understanding – Department Specific
				• The Explanation of ROI
				  ○ Ongoing Education
				• Corporate Structure
				  ○ Save Cost-Not Funded
				  ▪ Culture?
				  ▪ Buy-in
				• Data Accuracy
				• Data Maintenance Issues
				• Clear lines of Responsibility
				• Support for GIS
				• Lack of SOP, documentation, Metadata
				• Lack of Job descriptions with GIS skills defined
					• No skill set or training
					• Dependent upon GIS staff
					• Access to GIS
					• Reliant on Provence and City (IT Infrastructure)
					• Lack of Uniform System
					• No Optimal Reserves (Funding)
					• Operational Weakness?
					  ○ Where are vehicles
					  ○ ICE storm-no staff able to use GIS for a common operational picture
						• Training and Education Funding
						• Problems with Multiple Initiatives
						• Lack of Corporate View of Systems
						  ○ Integration WAM Amanda
						• Need Expert GIS Knowledge (WAM)
						• Dedicated Funding
						• Lack of Corporate GIS Knowledge – what can GIS do for me and my staff
						• No GIS Lead
						• Lack of formal Governance Structure
						• Lack of Meta Data
						• Lack of Standards
							• Need Local Government Information Model
							• Data accuracy Gaps (Easement Layer)
							• Attitude towards GIS - History of Personnel who did not support
							• Lack of Accuracy - Positionally
							• Lack of Field Access
							• Lack of SOP for Data Entry/Collection
							• Lack of Governance
							• IT Infrastructure – too slow (10MBPS pipe)
							• Not Uniformly Engaged
							  ○ DPT|Divisions different places in GIS expertise
							• Lack of Geometric Models - Intelligent Networks
							• Need Relationship Classes
							• Staff (limited)
							• Lack of Accessibility to Data
							• Lack of Corporate Training
							• Lack of Access for Consultants
							• Awareness - Other Departments Education
							• Need Inventory of private infrastructure
							▪ Access to Private Infrastructure

OPPORTUNITIES							
Community Information and Communications	**GIS Editors**	**GIS User Group**	**Mobile and Field**	**Property and Address**	**Public Safety**	**Steering Committee**	**Utilities**

• Public Involvement
• Citizen Engagement
• GIS Centric Tool
  ○ Visual Techniques
• Business Analytical Tool
  ○ Build Case-GIS tool kit
• Open Data Team
• Open Data 'Day'
• Open Transparent Government, Open Government
• Internal Coordination
	• Corporate Style GIS
	  ○ Centralized of Data
	  ○ Data Standards
	• Formalize Governance
	• Documentation of data and process
	• Data Warehouse
	• Define Roles and Responsibilities
	• Formal Business Process (SOP)
	  ○ Work Flow
	  ○ Integration with systems
	• Technology- Have a common Corporate Solution and Uniform Strategy
	• Integration Disparate Systems
	• New Technology – ex ArcGIS Online
		• Routing-Road Closures
		• Applications of GIS
		• Data Proactive Citizen Notification
		• Collaboration
		• Open Government-Transparent Government
		• Citizen GIS 'How can we help' 311
		• Location based GIS
		• Excitement and Enthusiasm
			• Improved Efficiency
			• Field Use - better Decisions
			• Paperless City
			• Willingness to use Tools
			• Response to Events (Ice Storm)
			• Understanding Digital Data
			• Citizen Involvement
			  ○ 311
			• Better Analysis When Needed
			• Uniform Solution
			  ○ Support Structure
			  ○ Reduce Litigation Issues
			• Applications- Arc GIS Online – utilize ESRI Infrastructure
			• GIS for Risk Management
			• Inspections Time Stamp capability
			• Ease of Use
			• Quick to Ascertain whether something is City Owned vs. Private
				• Mobility of GIS
				• Corporate Collaboration
				• Additional Digital Layers
				• Training/Education
				• Improve IT/Speed
				• Confidence in Data
				• Public/Citizen Engagement
				• Increase in staff productivity
					• Access to data
					• In-house Study – station location study
					• New AVL system
					• RFP to replace GREY Island
					• Mobility of GIS
					• Education
					• Training
					• Knowledge
					• Common Operational Picture (COP) GIS
					• More Data
					• Geo Enabled Systems
					• Geo references
						• Political Opportunities
						  ○ Ice Storm
						  ○ Green Initiative (Need Education)
						• Build on Existing Plans
						  ○ Water
						  ○ Energy
						  ○ IOR
						  ○ Forestry
						  ○ Open Government
						  ○ Storm water
						  ○ Community
						  ○ Parks
						  ○ Source Water
						• Perfect time to 'Embrace' GIS other Initiatives
						• Public Awareness
						• Public Participation 311
						• Open Governance
						• Crowd Sourcing-Example
						• Push Notification
							• Need Software Integration-Speak to each other
							  ○ Key software Package WAM & AMANDA
							• Need GIS Centric Asset Management & Work Order Solution
							• Use GIS for Sewer
							  ○ All uses- it's not used
							• Visually see work & Financial data
							• Public Communications
							• Health and Safety Lone Worker uses
							• Educate and Training 'Knowledge Gap'
							• Tools for on-going infrastructure Asset Management
							• Emergency Response
							  ○ Ice storm etc.

THREATS							
Community Information and Communications	**GIS Editors**	**GIS User Group**	**Mobile and Field**	**Property and Address**	**Public Safety**	**Steering Committee**	**Utilities**

• AODA Compliance
• Staff Capacity
• Corporate Culture-Reluctance to Change
  ○ Compliance
  ○ Freedom of Info
  ○ Shared Data
  ○ Open Legislation
• Privacy (Accessibility to Data)
  ○ Must understand "off limits" data
• Election
• Buy-in
• ROI Business case
• Budget-How much will it Cost vs ROI
• Exclusion of Citizen
• Technology
	• Lack of Understanding
	• Budget
	• Governance
	• Training
	• Staff Turnover
	• Lack of Communication
	• Staff Time
	  ○ Zero time for metadata
	• Citizen Expectations
	• More Data = Slower IT
		• Resistance to Change
		• Corporate Support (Buy-in)
		• Too Technical or Complex
		• Organizational Capacity (Skills, time)
		• Competing Projects
		• Heavy Reliance on IT
		• Tractors for Ethiopians – Need to learn how to use GIS – need the right tools
			• Budget
			• Governance
			• Connectivity and IT Infrastructure
			• Environmental Issues (Cold, Rain, etc.)
			• Implement Wrong Hardware
			• Fatigue-Multiple Initiatives going on
			• Integration Problems
			• Buy-in
			• Staff Turn over
				• Funding
				• End-user experience
				• Competing Projects
				• Lack of Buy-in from Decision Makers
				• Loss of Key Staff
				• Documentation
					• Funding
					• Resources
					• Legal Threats - Liability
					• Data QA/QC
					• Infrastructure to access Data
						• Funding
						• Knowledge
						• Staffing
						• Resources
						• Criticism (Public)
						• Inefficiency (GIS)
						• Political Commitment
						• Political Instability
						• Changing Priorities
							• Lack of Funding
							• Departure of Key Staff
							• Buy-in-Competition for funds
							• Data quality (Esp Public)
							• Not a Corporate Centralized System
							• Infrastructure - No Integration

2014

GIS Vision, Goals, and Objectives

City of Guelph, Ontario Canada

Geographic Technologies Group

Vision, Goals, and Objectives

Chapter Outline

Introduction 3-2
GIS Mission and Vision 3-2
GIS Goals and Objectives 3-6
Enterprise-wide Goals and Objectives 3-6
Departmental/Division Goals and Objectives 3-8

Introduction

The City of Guelph has identified and utilized technology as a means for improving its business processes, infrastructure, services, information and decision-making. City staff has recognized the value and importance of an enterprise GIS, thereby taking the necessary action to ensure that its implementation of GIS is efficient, effective, and viable.

As the acquisition, management, and dissemination of information continue to become increasingly valuable functions within local governments, so too has GIS proven to be increasingly valuable. The City is no exception to this observation, as they too have benefited from a multi-year implementation of GIS. GIS and related output (e.g. maps and analysis) has already contributed to improve business processes, information exchange, and decision-making.

Positive, yet pragmatic, vision, mission, and goals will prove to be critical as the city proceeds with its GIS implementation. The benefits of GIS, especially an optimal return on investment (ROI) and improved efficiency and effectiveness, can only be realized if GIS is adopted and integrated on a shared city-wide basis.

GIS Mission and Vision

It is important to articulate the overall mission and vision of GIS at the city. These statements help define the purpose of a GIS and give it its identity. Many other cities have created a mission statement for their GIS. It is instructive to review other cities statements as a means of gaining insight and ideas for the City of Guelph. The following are some GIS mission statements from other organizations:

City of Suffolk, Virginia:

> "The mission of the City of Suffolk GIS staff is to support the activities of the City of Suffolk and its citizens by providing and maintaining accurate, current and complete geospatial data. This support

will be provided through leveraging the knowledge contained in this information by using a set of procedures and techniques collectively referred to as a Geographic Information System. Using the Geographic Information System (GIS), the staff will enable the managers and citizens to make decisions impacting the future of the City of Suffolk in an informed and logical manner."

City of Alexandria, Virginia:

"Enable the City to improve communication and decision-making to ultimately better serve the public through the efficient use of geographic information."

City of Irving, Texas:

"Our mission is to provide timely, responsive, and accurate support for our customers so that they can operate at a higher efficiency level through Information Technology's leadership, technical assistance and project coordination."

County of Essex, Ontario:

"The mission of the County of Essex GIS Department is to promote, and develop a geographic information system resource for local decision makers and the general public."

City of Kitchener, Ontario:

"Provide current, complete and accurate representation of the corporation's business in a geographical context."

A suggested vision and mission statement was created for the City of Guelph as follows:

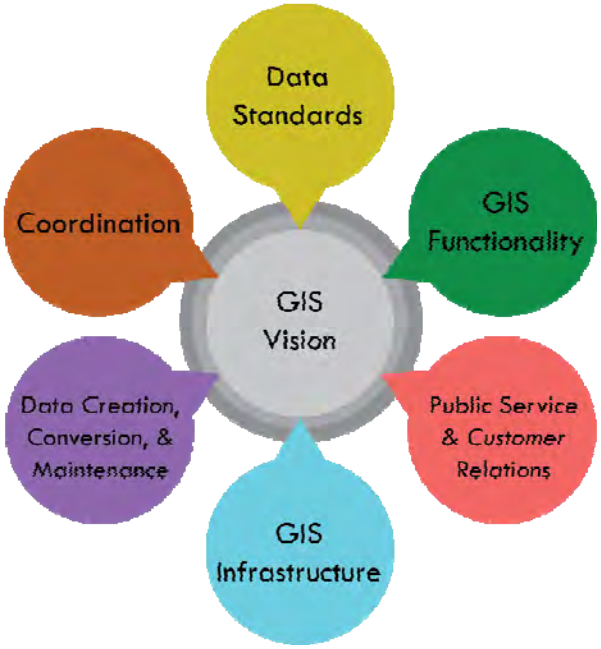
Mission Statement:

"To provide professional geospatial services to City of Guelph staff and citizens in order to enhance public service, improve operations, and to better disseminate information."

Vision Statement:

"The City of Guelph geospatial initiative is envisioned to govern, coordinate and implement an integrated enterprise-wide Geographic Information System (GIS) to support the effective, practical, and innovative use of GIS. At the core of this will be the development and management of a centralized, integrated and corporate style GIS that will serve all City of Guelph departments and citizens."

To accomplish this vision, six functional areas are outlined below to guide the City of Guelph in enterprise-wide adoption:



Implementation of the City of Guelph GIS Vision

1. **Coordination**
    - Promote Enterprise-Wide GIS
    - Foster Leadership and Management Support
    - Insure Necessary Skills in Spatial Data Handling
    - Implement GIS for a Wide Variety of Public Service Needs
    - Insure Strategic and Tactical Support for Projects and Programs
2. **Data Standards**
    - Enforce Accurate, Reliable and Consistent Digital GIS Data
        - o Create Metadata Standards/Procedures
    - Maintain Documentation, Archiving, and Indexing of Geo-Spatial Data Standards
3. **GIS Functionality**
    - Support Effective Use of GIS
    - Implement Three-Tiers of GIS Functionality
        - o Power/Flagship Users (e.g. GIS Administrator and GIS Editors)
        - o Analytical Users (e.g. GIS Technicians and Analytical Users)
        - o Browser Users (e.g. Department level GIS Users)
    - Make Accessible Internal and External (Public) Access
        - o Intranet

- Internet
- Mobile

4. **Data Creation and Maintenance**
    - Utilize Spatial Data Handling to Acquire, Process, Store, and Distribute Geospatial Data
    - Capitalize on existing GIS/CAD data from all departments
    - Create Scalable, Centralized Data Storage with Enterprise-Wide Accessibility
    - Maintain Documentation and Archiving of Geospatial Data Processing Methodologies and Workflows
5. **GIS Infrastructure**
    - Provide Needed Tools
        - Technology
        - Hardware
        - Software
        - Networks
    - Facilitate Knowledge
        - Training
        - Education
        - Documentation
        - GIS Users Group
    - Define Processes
        - Methodologies
        - Procedures
        - Protocols
6. **Public Service and Customer Relations**
    - Improve Efficiency, Increase Productivity and Enhance Public Service
    - Expand and Improve Public Access to GIS

GIS Goals and Objectives

The City of Guelph GIS should focus on providing proactive support and assistance, in terms of both technology and staff, to acquire, convert, integrate, maintain, document, analyze, coordinate, and distribute geographic information for a variety of organizational/departmental needs. The City of Guelph GIS mission, in a greater context, is to utilize GIS and GIS-based technologies to improve analysis, and subsequent decisions, aimed at improving internal and public services and products.

Enterprise-Wide Goals and Objectives

After extensive interviews with department staff, GTG has categorized six primary goals for the City of Guelph enterprise-wide implementation of GIS:

Goal #1 - Build and Maintain Reliable GIS Data: The GIS initiative should focus on building and maintaining accurate, consistent, and reliable geographic data.

Goal #2 - Make GIS Data Accessible: The enterprise-wide GIS initiative should make data accessibility simple and easy for all departments and citizens.

Goal #3 - Integrate GIS Functionality with Existing Systems: The integration and interoperability of GIS with existing business processes and systems is critical.

Goal #4 -Train, Educate and Inform Staff: The GIS initiative should improve the GIS knowledge base.

Goal #5 -Implement an Optimum GIS Governance Model: The GIS plan should have a clear and understandable strategy for the management and effective utilization of GIS.

Goal #6 - Build and Maintain Enterprise Infrastructure: Implement infrastructure for an enterprise GIS initiative that will sustain growth and change.

The following table summarizes the Enterprise-wide GIS Vision, Goals and Objectives for the City of Guelph:

Vision					
The City of Guelph geospatial initiative is envisioned to govern, coordinate and implement an integrated enterprise-wide Geographic Information System (GIS) to support the effective, practical, and innovative use of GIS. At the core of this will be the development and management of a centralized, integrated and corporate style GIS that will serve all City of Guelph departments and citizens.					
Goals					
Goal #1 **Build and Maintain Reliable GIS Data** Focus on building and maintaining accurate, consistent, and reliable geographic data.	**Goal #2** **Make GIS Data Accessible** Make data accessibility simple and easy for departments and citizens.	**Goal #3** **Integrate GIS Functionality with Existing Systems** Ensure that existing IT investments are leveraged and that the technology is integrated and interoperable with existing business processes and systems	**Goal #4** **Train, Educate and Inform Staff** Continue to improve the GIS knowledge base within departments.	**Goal #5** **Implement an Optimum GIS Governance Model** Institute a clear and understandable strategy for the management and effective utilization of GIS.	**Goal #6** **Build and Maintain Enterprise IT Infrastructure** Implement infrastructure for an enterprise GIS initiative that will sustain growth and change.
Objectives					
Objective: Enforce a **centrally managed geographic database.** *Objective:* Establish, implement, and maintain a **system design** for enterprise GIS architecture. *Objective:* Establish **standards and procedures** for the development and maintenance of data. *Objective:* Establish **standardized methods** and procedures for application acquisition and deployment.	*Objective:* Establish effective **organization-wide access** to geospatial data. *Objective:* Guide the **implementation of applications** that facilitate access by citizens and departments. *Objective:* **Improve public access to online services and data.** *Objective:* Use GIS as a tool to **provide timely and accurate data to** elected officials and decision makers**.**	*Objective:* I**ntegrate GIS** with existing business systems. *Objective:* Use **state of the art technologies** in order to ensure more seamless technology integration. *Objective:* **Integrate GIS as fully as possible** and apply it in a simple but effective way.	*Objective:* **Implement a total governance model** for sharing ideas, discussions, and information about GIS and related topics like GPS, AVL, and Mobile Solutions. *Objective:* Provide GIS **training and educational opportunities** to all staff to empower them to fully utilize GIS knowledge. *Objective:* Establish a **GIS user group network** within the organization to help facilitate growth.	*Objective:* Establish a governance structure **for review and coordination for all GIS initiatives.** *Objective:* Establish a **GIS Executive Steering Committee** within the organizations to help facilitate growth. *Objective:* Develop an **on-going GIS program** to ensure efficient use of enterprise GIS resources. *Objective:* Develop **inter-governmental agreements** to facilitate data sharing and cooperation among the County, Cities, Province, and Private Interests.	*Objective:* **Implement the most optimum network and hardware for the GIS initiative.** *Objective:* **Implement networking infrastructure** that creates an efficient technological teamwork environment for the GIS initiative. *Objective:* Ensure **network connectivity and system architecture** can handle all department needs. *Objective:* Develop **data storage and distribution strategies** that make effective use of current resources.

Departmental/Division Goals and Objectives

The previous section described the overall goals for the GIS initiative. However, taken by themselves, these goals are not specific enough to ensure that the needs of the individual departments are fully met. The next several pages review the goals and objectives identified by staff during on-site interviews and subsequent feedback on the Needs Assessment. These goals will be utilized to prioritize projects through the multi-year implementation of the recommendations. Therefore, it is imperative that staff review, understand, and agree with the goals for their department and the set forth prioritization of these goals.

Priority

Each goal has been given a priority based on departmental feedback. The priority ranking is threefold: low, medium, or high.

Priority	*Definition*
Low	A low priority is one that will make a department more efficient and effective but is not as critical to the department and can wait for implementation later in the project
Medium	A medium priority is important but one in which an immediate adverse effect on the department is not occurring due to its absence
High	A high priority is one that is critical for the department to function effectively and efficiently

Level of Effort

Additionally, each goal has been given a level of effort to accomplish the task. The level of effort ranking is threefold: low, medium, or high.

Level of Effort	*Definition*
Low	A low level of effort indicates that the project can be put into place without significant data constraints, without significantly altering workflows, and has few technological hurdles
Medium	A medium level of effort indicates that the project has a moderate non-existing data component, requires the alteration of some workflows, and/or has a few technological hurdles
High	A high level of effort indicates that the project requires a large non-existing data component, requires the alteration of multiple existing workflows, and/or is technologically difficult to implement

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Building Services		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Enable existing databases (Amanda)	High	Medium
Field based access to data to include routing	High	Medium
Access to new and additional data	High	High
Access to more robust intranet application	High	High
Public access and citizen engagement	Medium	Medium
GIS Training and Education	Medium	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Business Services		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Creation of new data sets	Medium	Medium
Expanded intranet functionality and access	Medium	Medium
Sharing data with the public/public access	Medium	Medium
GIS based complaint tracking	Medium	Medium
GIS training and education	Medium	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
By-law Compliance, Security, and Licensing		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Geo-enable existing databases	Medium	Medium
Creation of additional data layers	Medium	Medium
Access to an improved intranet application	Medium	Medium
Use of GIS for complaint tracking	Medium	Low
Mobile computing including AVL	Medium	Medium
GIS training and education	Medium	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
City Clerk		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Access to GIS via the intranet	Medium	Low
Citizen voter look up	Low	Medium
Use GIS for ward, polling site, and voter identification	Medium	Medium
GIS training and education	Low	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Community Energy		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Creation of new data sets	High	Medium
Expanded intranet functionality and access	High	Medium
Geodatabase Design	Medium	Medium
GIS Training and Education	Medium	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Community Engagement		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Creation of new data sets	Medium	Medium
Geo-enable existing data (Class)	High	Medium
Expanded intranet functionality and access	Medium	Medium
Sharing data with the public/public access	Medium	Medium
GIS Training and Education	Medium	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Corporate Communications		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Creation of new data sets	Medium	Medium
Expanded intranet functionality and access	Medium	Medium
Sharing data with the public/public access	Medium	Medium
GIS based complaint tracking	Medium	Medium
Live GIS on television	Low	High
GIS Training and Education	Medium	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Culture and Tourism		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Mapping and spatial analysis of culture and tourism data	Medium	Low
GIS Training and Education	Low	Low

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Downtown Renewal		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Additional GIS software (community analyst)	High	Low
Field based access to data	High	Medium
Access to new and additional data	High	High
Access to more robust intranet application	High	High
Public access and citizen engagement (Parking Portal)	Medium	Medium
Pedestrian traffic mapping	Medium	Medium
GIS training and education	High	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Economic Development		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Data development	High	High
Intranet data access	Medium	Medium
Economic development web portal	High	High
GIS training and education	High	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Emergency Services		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Mapping and spatial analysis of fire and EMS incidents and inspections	High	Medium
Geospatial data creation and maintenance	High	High
Field access to geospatial data	High	High
EOC GIS	High	High
Access to digital pre-plans and hazardous materials data	High	High
Predictive occurrence software	Low	High
Public access to public safety data	High	Medium
Automated vehicle location (AVL)	Medium	Medium
GIS training and education	High	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Engineering		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Data layer design, creation and completion	High	High
Department-wide access to GIS data	Medium	Medium
Use of GIS to track projects	High	Medium
GIS for a stormwater utility	Medium	High
GIS based work order system	High	High
Digital data submissions and standards	Medium	Low
Access to spatially enabled as-builts, CAD drawings, and videos	High	High
Field access to geospatial data	High	High
Public access to data and service requests	Medium	Medium
GIS training and education	High	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Finance		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Additional GIS data	Medium	High
Mapping of tangible capital assets	Medium	High
Tools for data viewing and analysis	Medium	Medium
Use of GIS to track projects	High	Medium
GIS training and education	Medium	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Information Technology		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Formalize new governance structure	High	Low
Provide GIS user support	High	High
Centralize GIS environment	High	Low
Oversee GIS data development	High	Medium
Identify and implement corporate field GIS access	High	High
Identify and implement corporate field GIS data updates	High	High
Provide city-wide training	High	High
Improve city-wide access to GIS data	High	High
Facilitate public access to GIS data	High	High
Implement metadata and GIS update notification	High	High

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Legal Realty		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Creation of additional data layers	Medium	High
Access to an improved intranet application	High	Medium
Use of GIS for Court Case Support	Medium	Low
GIS Training and Education	Medium	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Parks and Open Space		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Creation and augmentation of GIS data	High	High
Expanded mapping and spatial analysis	High	Medium
Geo-enable existing databases	High	High
Public access to GIS data	High	Medium
GIS enable the heritage and natural heritage inventory	High	Medium
Field access to GIS data	High	Medium
Field data collection	High	Medium
Use GIS for park and trail planning	High	Medium
Additional GIS staff	High	Low
GIS training and education	High	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Planning		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Creation and augmentation of GIS data	High	High
Expanded mapping and spatial analysis	High	Medium
Geo-enable existing databases	High	High
Automated neighborhood and vicinity mapping	Medium	Medium
Integration and utilization of imaging data – linking documents to GIS	High	High
Public access to GIS data	High	Medium
GIS enable the heritage and natural heritage inventory	High	Medium
Use GIS for public meetings	Medium	Medium
Field access to GIS data	High	Medium
Field data collection	High	Medium
Implementation of advanced analysis tools – I-tree, Spatial Analyst, and 3D Analyst	Medium	Low
Implement metadata tracking and notification	High	Medium
GIS training and education	High	Medium

City of Guelph:
DEPARTMENTAL GOALS AND OBJECTIVES

Public Works

GOALS AND OBJECTIVES:	*Priority*	*Level of Effort*
Integration with existing IT systems	High	High
Mapping and spatial analysis in support of forestry, traffic, parking and other city infrastructure	High	High
Data layer creation	High	High
Access to spatially enabled as-builts, CAD drawings, and videos	High	High
Field access to geospatial data	High	High
Field data collection	High	High
Automated vehicle location (AVL)	Medium	Medium
GIS training and education	High	Medium

City of Guelph:
DEPARTMENTAL GOALS AND OBJECTIVES

Service Guelph

GOALS AND OBJECTIVES:	*Priority*	*Level of Effort*
Access to an intuitive intranet application	High	Medium
Implementation of a customer request portal	High	Medium
GIS training and education	Low	Low

City of Guelph:
DEPARTMENTAL GOALS AND OBJECTIVES

Solid Waste Resources

GOALS AND OBJECTIVES:	*Priority*	*Level of Effort*
GIS data creation	Medium	Medium
GIS training and education	Medium	Medium

City of Guelph:
DEPARTMENTAL GOALS AND OBJECTIVES

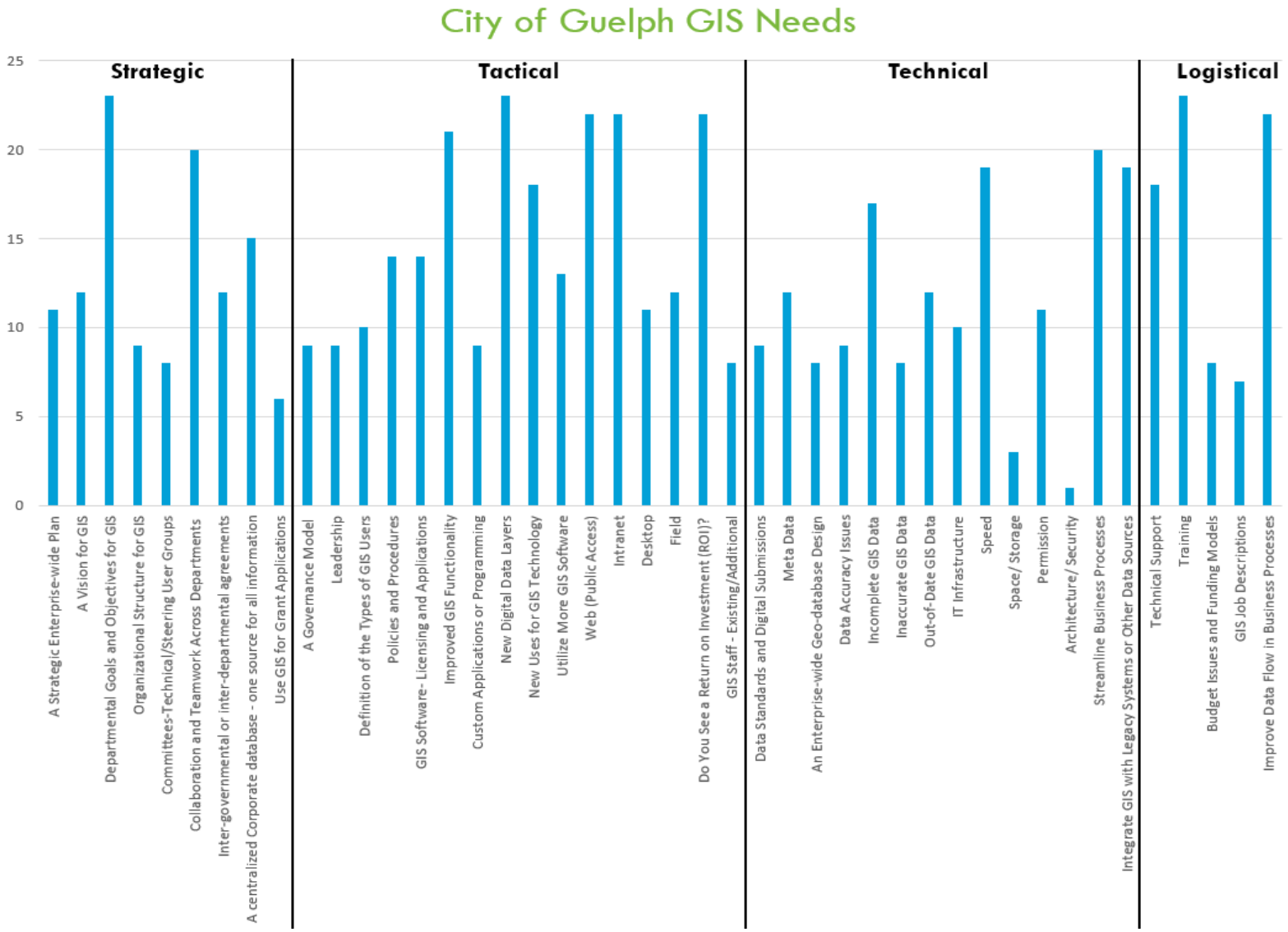
Guelph Transit

GOALS AND OBJECTIVES:	*Priority*	*Level of Effort*
Data layer creation	High	High
Use GIS for tracking projects	Medium	Medium
Provide public access to Transit data	High	High
Automated vehicle location (AVL)	Medium	Medium
GIS training and education	Medium	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Wastewater		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Data layer design, creation and completion	High	High
Geo-enable existing databases	High	High
Department-wide access to GIS data	Medium	Medium
GIS based work order system	High	High
Access to spatially enabled as-builts, CAD drawings, and videos	High	High
Field access to geospatial data	High	High
Field data collection	Medium	Medium
Automated vehicle location (AVL)	Medium	Medium
GIS training and education	High	Medium

City of Guelph: DEPARTMENTAL GOALS AND OBJECTIVES		
Water Services		
GOALS AND OBJECTIVES:	***Priority***	***Level of Effort***
Data layer design, creation and completion	High	High
Department-wide access to GIS data	Medium	Medium
Use of GIS to track projects	High	Medium
Mapping and spatial analysis in support of water operations	High	High
GIS based work order system	High	High
Access to spatially enabled as-builts, CAD drawings, and videos	High	High
Field access to geospatial data	High	High
Field data collection	Medium	Medium
Automated vehicle location (AVL)	Medium	Medium
Public access to data and service requests	Medium	Medium
GIS training and education	High	Medium

The following graphics depict a priority matrix of key issues derived from the Needs Assessment:



The following table identifies the return on investment opportunities identified for each department. Sixteen local government return-on-investment categories run down the x-axis and city departments down the y-axis.

Return on Investment (ROI) Opportunities	Departments																						
	Community Engagement	Parks and Open Space	Business Services	Culture and Tourism	City Clerk	Legal Realty	Corporate Communications	Information Technology	Community Energy	Downtown Renewal	Economic Development	Finance	Bylaw Compliance, Security, and Licensing	Emergency Services	Public Works	Guelph Transit	Building Services	Engineering Services	Planning Services	Service Guelph	Solid Waste Resources	Wastewater	Water
Automate Workflow Procedures		●	●					●		●	●				●		●	●	●		●	●	●
Comply with Provincial and Federal Mandates						●			●			●			●			●	●			●	●
Effective Management of Assets and Resources		●							●	●	●				●	●		●	●		●	●	●
Improve Citizen Access to Government	●	●	●		●		●	●		●	●		●	●	●	●	●		●	●			
Improve Communication, Coordination, and Collaboration		●					●	●		●	●		●		●			●	●	●		●	●
Improve Data Accuracy		●						●	●	●	●				●		●	●	●		●	●	●
Improve Efficiency		●	●				●	●	●	●	●			●	●	●	●	●	●		●	●	●
Improve Information Processing	●						●	●		●	●		●	●	●		●		●	●		●	●
Increase Productivity	●	●	●					●		●	●			●	●		●		●	●	●	●	●
Make Better Quality, and more Effective Decisions	●	●	●				●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
Protect Your Community		●												●	●							●	●
Provide Data to Regulators, Developers, and Other Interested Parties						●		●	●		●				●			●	●			●	●
Respond More Quickly to Citizen Requests	●	●	●	●			●			●	●		●	●	●		●		●	●	●	●	●
Save Lives														●									●
Save Money										●	●			●	●				●		●	●	●
Save Time	●	●	●	●			●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●

2014

GIS Software Solutions

City of Guelph, Ontario

GIS Software Solutions

Chapter Outline

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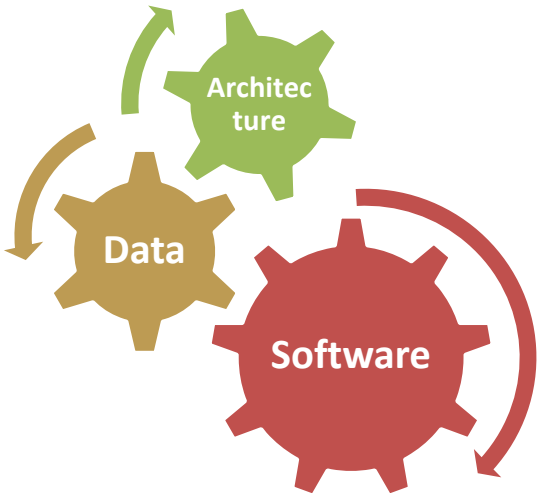
GIS Software - Deploying Enterprise GIS Solutions

Components of GIS

Local governments no longer need a sales pitch on the benefits of enterprise GIS. Overwhelmingly, government agencies at all levels continue to invest in GIS. Typically, the goal for most of these implementations involves enabling the entire organization to utilize GIS for various purposes. However, very few enterprise GIS implementations projects complete successfully. The causes of failure are numerous and varying, but they are generally related to a misunderstanding of the different components of GIS and the interrelationship between system architecture, data, and software. When these areas are understood in their proper context and relationship, organizations can plan for cost, resources, integration, priorities, time, and outcomes. Then organizations can successfully invest in GIS to provide their users with an intuitive tool that meets their unique needs. Once accomplished, the organization will achieve the objectives of GIS by maximizing the efficiency of decision making and planning, providing efficient means for data distribution and handling, eradication of duplicate data, integration of information from many sources, analysis of queries involving geographical reference data for generation of new information, and update data quickly while minimizing cost.



While the focus of this chapter is primarily related to GIS software solutions, the other components of GIS require a brief explanation since each component relies and is interrelated to the others. Like a series of gears, no one component can stand alone to create a successful GIS implementation. Therefore, no one component is more important than another; hence, software cannot be deployed in a vacuum. For example, an organization can have enormous amounts of highly accurate and current data, but without the skill of people or the software to analyze, the data is worthless. The following briefly describes the different components of GIS.

People

People make GIS work. They include positions/roles like GIS managers, database administrators, application specialists, systems analysts, and programmers. They are responsible for the maintenance of the geographic database and provide technical support. People are also the subject matter experts within the various departments that perform GIS queries, create maps, collect and update data, and make decisions from the GIS analysis. People associated with a GIS can be categorized into: viewers, general users, and GIS specialists. GIS continues to permeate all levels of organizations from executives to field operation personnel.

Procedures

Procedures include defining the retrieval, input, storage, management, transformation, analysis and final presentation output of data. Procedures also include the steps taken in answering question needing resolution. The ability of a GIS to perform spatial analysis and answer these questions is what differentiates this type of system from any other information system.

Hardware

Hardware consists of the technical equipment needed to run a GIS including computers with enough processing power to run the software, enough memory to store large amounts of data, and input and output devices such as scanners, tablets, digitizers, GPS data collectors, and printers.

Software

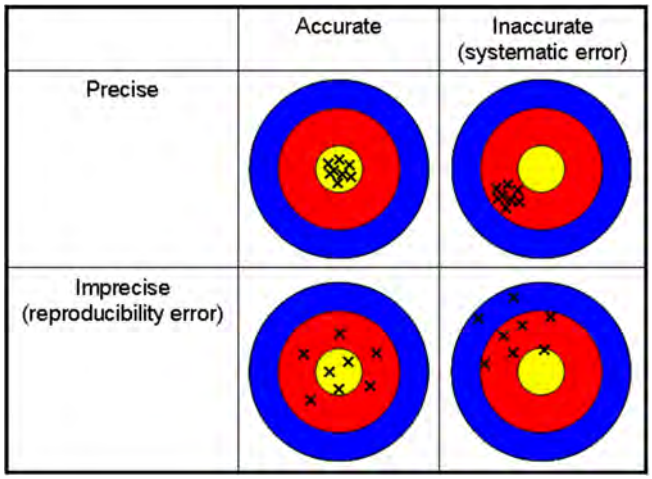
There are many different GIS software packages available today. All packages must be capable of data input, storage, management, transformation, analysis, and output; however, the appearance, methods, resources, and ease of use of the various systems differ. Today, organizations must also consider software for an ever increasing mobile workforce and consumer base. In addition, software includes applications that allow for interfacing and integrating between systems. In recent years web services like SOAP and REST have greatly expanded the reach of GIS software and allowed for integrating GIS with a large spectrum of other business systems.

Data

Generally speaking, the most expensive and time consuming aspect of initiating a GIS involves the collection and creation of data. Several things require consideration before acquiring geographic data. Data quality is vitally important and requires verification before obtaining any data. Errors in the data set will most likely add countless unpleasant and costly hours to implementing a GIS. Furthermore, the results and conclusions of the GIS analysis will propagate the errors and result in bad solutions. Several guidelines to look at include:

- **Lineage** – provides a description of the source material from which the data originates. Lineage should include dates of the source material and all updates and changes made.
- **Positional Accuracy and Precision** – *Accuracy* refers to how close a measured value is to the true or accepted value. For example, if an object known to have a known mass of 100 g was placed on a balance with a reading of 80 g, the measurement would be considered inaccurate.

  Precision refers more to repeatability. In other words, how close a group of measurements are to each other. For example, if the same 100 g object was measured five (5) times with results of 80, 80.1, 79.8, 80.2, 79.9, the measurements are considered precise (however, not accurate).

  The diagram at right illustrates the differences between accuracy and precision. In order to have confidence in spatial data, results need both accuracy and precision.
- **Attribute Accuracy** – An attribute provides detail about some location, set of locations, or features. Often, this information includes measureable data like size, population, height, age or elevation. It may also include more descriptive information like a place name, owner, or address. For GIS analysis, reporting, and mapping purposes, accuracy of these details is vitally important.
- **Completeness** – Frequently, GIS features and attribute data omit relevant details. Typically, this is caused by incomplete source data and/or deficient data maintenance processes. Incomplete data can involve completely missing features such as building, streets, and assets. It may also include missing attributes needed for analysis. Performing checks and implementing robust maintenance processes help to provide complete data.

Network

The network pertains to the connectedness of the different hardware and software. Networks vary in capacity, scope, and speed. Networks allow for rapid communication and data sharing. They can include scopes of Local Area, Wide Area, and the internet. In essence, the network comprises the “backbone” infrastructure that allows a multitude of hardware and software to communicate.

As the above summary indicates, each component of GIS is vital. Therefore, when considering the selection and deployment of GIS software, Guelph must consider all the different components. For example, selection criteria must consider questions like:

People

1. Who are the users?
2. What is their experience with GIS tools?
3. How will the software being evaluated assist them in their daily work?
4. How will our users access the software (office, field, internet)?

Procedures

1. What workflows will need modified?
2. Which workflows/business processes will be streamlined?
3. How does the software manage change?
4. Does the output of the software provide useful information?

Hardware

1. What are the specifications of the hardware needs?
2. Will we have to acquire new hardware or can we use existing?

Data

1. Does the software make full use of our current data?
2. What data will we need to acquire or update to utilize this software effectively?
3. Does the software assist in managing our data?

Network

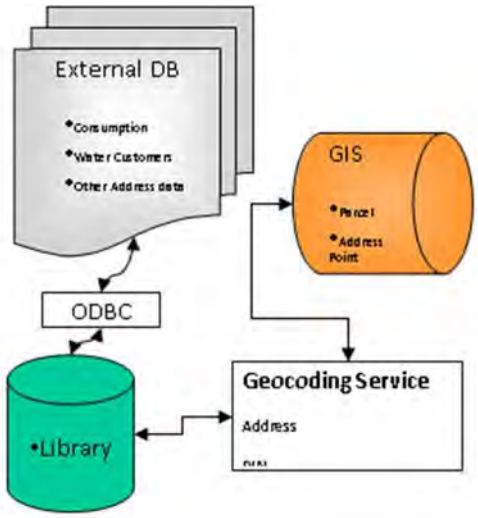
1. Is our network sufficient to handle the load of the software?
2. What network protocols are required?
3. Are their security issues that require considering?

Of course this is not an exhaustive list of questions that need consideration, but simply illustrates that when planning for the selection and deployment of GIS software, Guelph needs a process to follow. The process doesn’t and shouldn’t be overly complicated, but needs to consider the relationships between the different GIS components to help ensure a successful project.

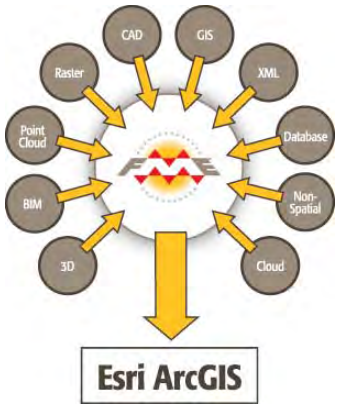
Software Solutions

There are many different GIS software solutions and methods for implementation of GIS. Based on the needs assessments, similar needs and a desire to share information were requested throughout the City. The ideal solution for the City of Guelph would be to continue the development of an Enterprise GIS and expand the usage of GIS technology. An Enterprise GIS integrates an entire organization so that users can maintain, share and utilize spatial data for various needs to address data development, modification and analysis. This would provide the City the ability to share information within the organization and with the public effectively. The similar needs for integration of non-spatial data (Access, Excel, hardcopy records, etc.), development of an intranet application (either correcting OnPoint issues or launching a new application), the creation of internet applications, and the desire to deploy mobile/field solutions can be addressed with an Enterprise GIS. The following provides details related these GIS needs.

Data Mining / Geo-Enablement



Integration with non-spatial data is one component of creating an Enterprise GIS and a need expressed by several divisions/departments within the City. Data mining can be used to extract data from existing databases by geo-coding addresses or mapping coordinates and placing the results into a relational database (SQL Server). The extracted data can then be stored and managed within the database. The resulting tables can be made available for IT professionals and analyzed using application software. The analyzed data can then be presented in a useful format such as a graph or table. An Enterprise GIS system should then be used as a front end to the analyzed data and relationships can be determined to link the analyzed data spatially. The graphic at left demonstrates, in a generic sense, the process of using data mining middleware to extract data.

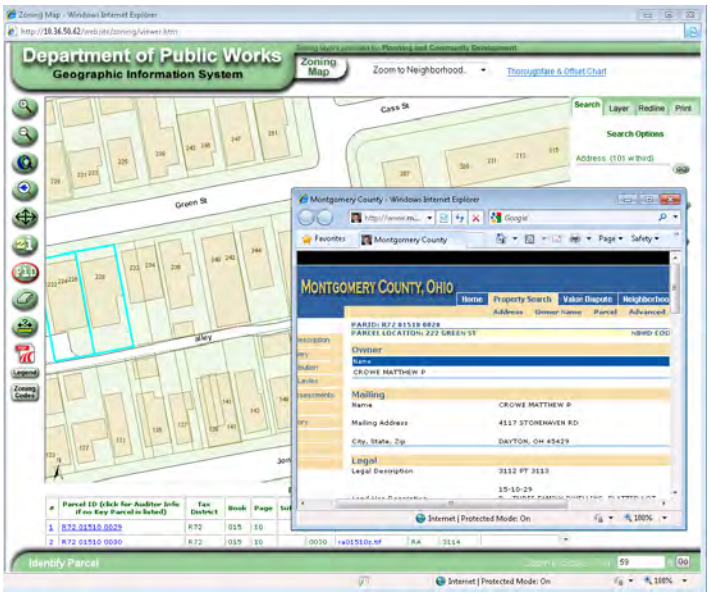


Several companies have developed application software, for example FME by Safe Software, capable of overcoming format and data model barriers to move data into various formats so that the City can leverage the use of depicting data spatially. In addition to FME, Esri offers a similar solution called ArcGIS Data Interoperability. Some examples of existing applications/databases currently being used by the City which should be linked spatially are Amanda, WAM, Microsoft Access and Excel, EMS, Class, and a host of other databases.

Once the above information is maintained as digital data, it can be spatially enabled for use in the City's GIS and used like any other GIS layer.

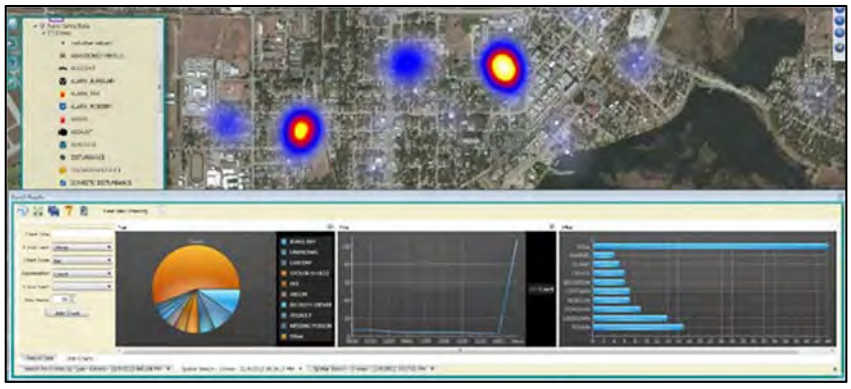
Web GIS (Intranet and Internet)

Another need listed by several divisions/departments was the desire to develop both an Intranet and Internet Application(s). One intranet application with a common feature set which can be utilized by the entire City would best be developed utilizing an enterprise solution.



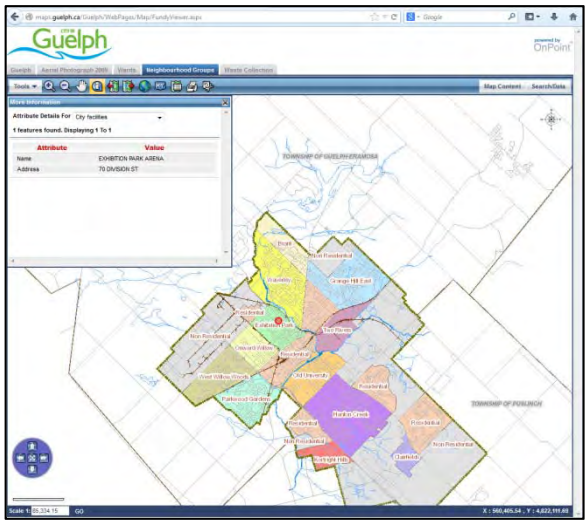
Division/Department Specific Intranet Application

Currently, OnPoint is used by some of the City, however, City staff reported data available through the application doesn't meet their needs and that the application is missing key functionality. An enterprise intranet application would provide a robust tool that allows specific configurations for the various departments/divisions while also providing the ability to share data. Each user group would be able to develop unique queries, reports and maptips specific to their needs. An added benefit would be the elimination of redundant identity stores by utilizing Windows Integrated Security which would be a benefit of switching to an Enterprise GIS intranet solution. Rather than multiple intranet solutions for each department, one enterprise-wide intranet solution would eliminate multiple directories, security identity stores (i.e. user names and passwords) and data platforms. Windows Integrated Security would enable single sign on (SSO) capability between applications resulting in less user confusion, increased productivity, and a decrease in IT support and administrative costs. An Enterprise GIS intranet application would reduce the amount of setup Citywide, require less refresher training and would allow the City to push the envelope in advancing intranet application usage throughout all departments/divisions.



One option is for the City to re-launch the latest version of the OnPoint software. Currently city staff have an unfavorable view of OnPoint. Therefore, getting users to embrace the latest version will present challenges.

For this to be successful the new application must overcome speed, ease-of-use, and functionality concerns. Other options include purchasing a different third-party application like VantagePoints, Web-GIS Solutions, or Geocortex. This clean break with existing technology would give the city a fresh start with this critical component of a successful enterprise-wide GIS. Additionally, the City should make sure the intranet application incorporates items such as an executive dashboard, hotspots, and social media integration. Regardless of the intranet application deployed, the City should also deploy easy-to-use single purpose applications from ArcGIS Online as intranet solutions for some of the department's internal needs.



Much like a GIS Enterprise solution for intranet applications, various departments/divisions expressed the need for Internet applications. Internet applications make sharing data with the public possible. Some examples of Internet applications requested during the Needs Assessments include web portals to share historical places (possibly accomplished though ArcGIS Story Maps), the ability to show emergency and disaster data, up-to-date maps that indicate road closures, capital projects, maps to show parking lot locations and the ability to share event maps. All of these requests could benefit citizens and visitors within the City. The City currently has a public facing GIS application on its website. This application provides a host of useful information. However, the trend in the industry is to move away from the multi-purpose Internet site to much more targeted single purpose applications. Additionally, there is a push to move to more user-friendly and intuitive applications.

There are many options to fulfill the need for internal and external consumption of GIS. The City of Guelph could employ ArcGIS Online for their intranet, internet, and mobile solution needs. One benefit of using ArcGIS Online is the ability to harness pre-developed applications and maps. ArcGIS Online could also be utilized for field mobility including data collection. Since ArcGIS Online is an integral part of the ArcGIS system, organizations can use it to extend the capabilities of ArcGIS for Desktop, ArcGIS for Server and other ArcGIS based applications.

ArcGIS Online

According to Esri, ArcGIS Online is a collaborative, cloud-based platform that allows members of an organization to use, create, and share maps, apps, and data, including authoritative base maps published by Esri. Through ArcGIS Online, organizations get access to Esri's secure cloud, where they can manage, create, store, and access data as published web layers, and because ArcGIS Online is an integral part of the ArcGIS system, organizations can use it to extend the capabilities of ArcGIS for Desktop, ArcGIS for Server, ArcGIS apps, and ArcGIS Web APIs and ArcGIS Runtime SDKs. ArcGIS Online is also a great solution for organizing and distributing GIS resources. This provides users with a one-stop shop for all data, maps, apps, documents, and anything GIS related.

ArcGIS Online implementation is a three-step process including planning, design, and deployment. Planning of agency logistics needs to be done carefully, with understanding of how multiple departments/divisions within ArcGIS Online will work together. Careful consideration of GIS data incorporation, groups, users, and applications will all need to be considered. The development process of ArcGIS Online begins with configuration of general settings, and then branches into setting up groups, web maps, the gallery, and much more.

Now, with ArcGIS Online for Organizations and ArcGIS Solutions, municipalities can begin implementation of ArcGIS Online using preconfigured models. According to Esri, these model organizations are a guide for industries to begin to leverage ArcGIS Online quickly. Specific configurations will vary depending on the functional responsibilities of the local government and the maturity of their ArcGIS implementation. In addition, Guelph should configure their organization's home page and other aspects of the ArcGIS Online subscription to match their City's brand.

The ArcGIS Online/Solutions (see ArcGIS Solutions section below) platform provides numerous ready to deploy applications. These applications can provide a powerful way to utilize GIS and should be configured during the development process. Users are added to the account and assigned appropriate permissions and access to the content they need. Using ArcGIS Online, Guelph can choose how to deploy maps and applications to management, office staff and field operations to reduce the need for printed maps and extend the of GIS throughout the organization.

Mobile applications for iOS, Andriod, and Windows are available to download and configure (see ArcGIS Solutions section below). For example, ArcGIS for Android can quickly be deployed to Android tablets and

smartphones to display and navigate maps, find addresses, identify GIS features, measure, find and share maps from ArcGIS Online, and collect data. The application can use either map layers hosted on ArcGIS Online or from the organizations corporate ArcGIS server. Similar functionality is available using the ArcGIS for iOS and ArcGIS for Windows.

Portal for ArcGIS Server Extension

Either in conjunction with or as an alternative to ArcGIS Online, Guelph should investigate implementing Portal for ArcGIS Server. Portal allows organizations to extend their ArcGIS Server infrastructure and provides a map-centric collaborative content management system duplicating the capabilities of ArcGIS Online securely behind their corporate firewalls. Portal provides the resources for organizations to create, organize, secure, and manage their GIS. Portal is highly customizable and becomes the central repository for an organization's GIS content.

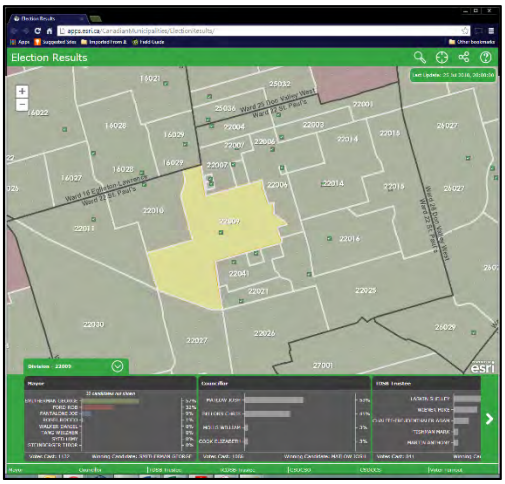
With Portal organizations can:

- Manage their organization's geospatial content
- Access a set of common base maps, tools, and web services
- Create maps and apps
- Share maps and apps with others inside or outside the organization
- Register existing ArcGIS services
- Form groups to collaborate on projects or common activities
- Extend the reach of their geospatial information products in the organization
- Promote collaboration of graphic data content in their organization

Deploying Portal offers increased security allowing any sensitive or confidential content to remain safely and securely on corporate servers. Portal has an identity store that provides credentials for authentication and security that can be integrated with existing identity stores in the organization that offers an extra layer of protection.

ArcGIS for Canadian Municipalities

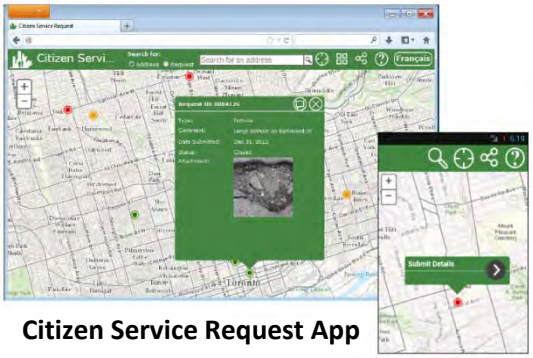
Specifically tailored for Canadian users, Esri has released ArcGIS for Canadian Municipalities. As part of this offering, there are several applications perfectly suited for the City of Guelph. Applications currently available from ArcGIS for Canadian Municipalities include a Citizen Service Request, Election Results, Government Services, and a Polling Place Locator.



Election Results Web App

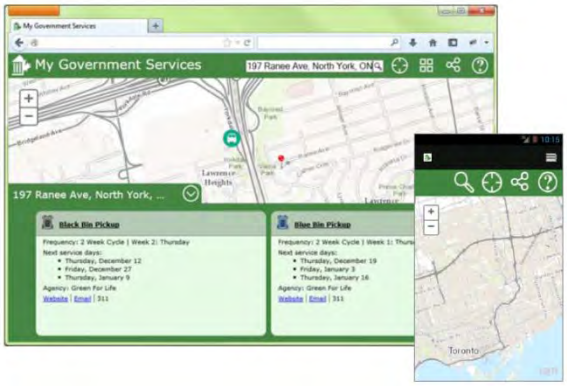
These templates can quickly be deployed using ArcGIS Online or by using existing ArcGIS for Server software. Deploying these apps becomes easier when combined with the adoption of the Canadian Municipal Data Model. The data model can be configured to support specific needs of the organization and all the templates are configured to work with the data model. With elections upcoming this Fall, Guelph could quickly provide value to citizens by deploying the Polling Place Locator and the Election Results web applications.

The **Polling Place Locator** allows users to search for an address or click a location on the map to receive information related to polling locations, including driving directions, details, and contact information. Users can also see who the candidates are. Then once election results are submitted, citizens can use the **Election Results** web application to view results based on geographic location. Both applications offer easy to use, intuitive interfaces that provide quick access to information.



Citizen Service Request App

The **Citizen Service Request** application allows citizens to submit requests for service in their municipality using a map-based interface. Users have the option of typing in an address or simply clicking a location on the map. Once the user has selected the location, a Service Request Details form appears for the user to complete, make attachments if desired, and submit. It can be used on a desktop browser, mobile phone, or tablet device. This application provides 24x7 access to the municipality and typically supplements customer service phone numbers.

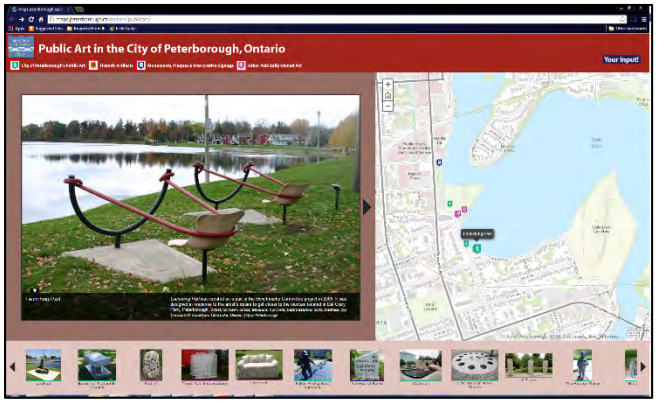


My Municipal Government Services App

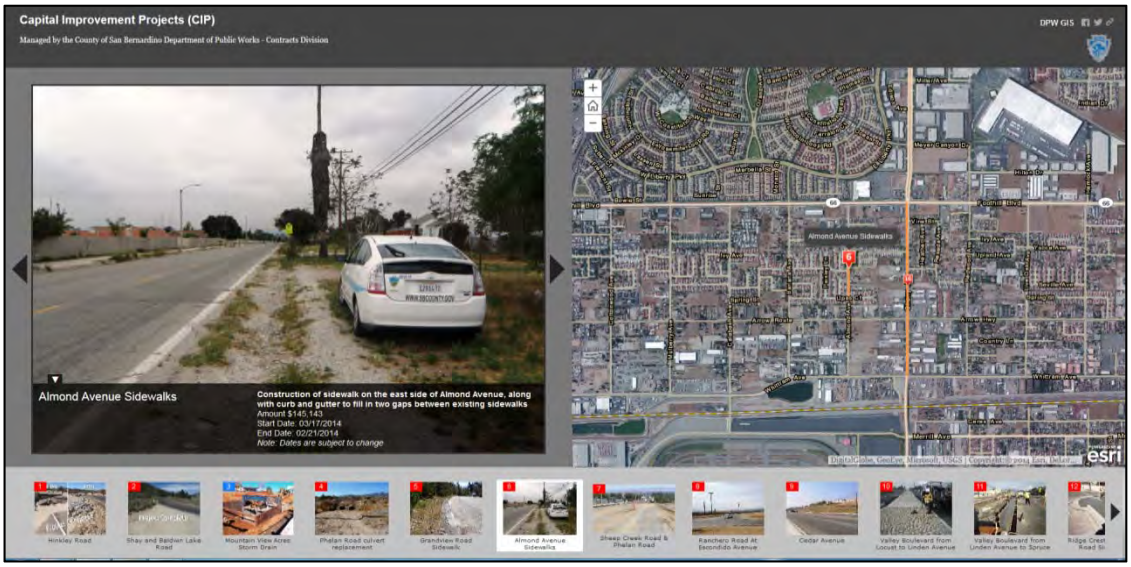
My Municipal Government Services is a configuration of ArcGIS and JavaScript that assist residents locate a municipal facility and obtain information about services

provided using a map-based view. It is typically used by residents or visitors to locate a library, post office or other facility near them. It may also be used for non-municipal facilities such as points of interest. My Municipal Government Services can be deployed by municipalities and used on desktops, smartphones, and tablet devices.

Esri Story Maps



Esri offers the ability to create Story Maps. These digital maps tell a unique story in a very intuitive and user friendly context. These maps would allow Guelph to present and organize information geographically about places, events, issues, trends, or patterns. Story maps offer and interactive map with rich content including text, videos, and audio to enhance the user's experience. The City of Peterborough, Ontario has created a Story Map of Public Art. Users can view pictures of the art and its location on a map. For Guelph, Story Maps would be an excellent way to display the Heritage Inventory and the Natural Heritage Inventory, and provide information related to parks and trails. Story maps lend themselves to presenting information that is cross departmental such as city projects and capital improvement projects (See below).



ArcGIS Solutions

Other solutions and applications currently not included in the ArcGIS for Canadian Municipalities are available through ArcGIS Solutions and the ArcGIS Marketplace. These applications are tailored for a variety of delivery methods including desktop, web, and mobile and are tightly coupled with ArcGIS Online. This section will focus on the desktop and mobile options. They may require some minor configuration changes to work with the Canadian Municipal Data Model, but the level of effort will be well worth the value added.

Esri's ArcGIS Solutions portal offers focused maps and apps for a variety of industries including local government, emergency management, and utilities. For Guelph, this translates into a host of deployable solutions to meet the needs of the entire organization. The following applications can assist Guelph in extending GIS usage throughout the organization and to their citizens and visitors.

Mobile/Field

Several departments mentioned the desire and need to have mobile/field GIS capabilities. Through ArcGIS Solutions there are a number of applications that can provide these departments with a solution. Perhaps the new "flag ship" of Esri mobile, **Collector for ArcGIS** provides robust and intuitive tools for viewing maps, collecting and updating data, getting driving directions, and tracking and reporting areas visited. Collector operates through ArcGIS Online and with the newest release allows the ability for working offline. Collector is designed to work with iPhone and Android smartphones, but can also be used on tablets running iOS or Android. Collector is a simple way to expedite a mobile GIS solution that allows users from across the organization to have the power of GIS in their hands. Similarly, Esri also has two other Apps for smartphones and tablets: ArcGIS App and Windows 8 App.

For Windows devices, Esri provides ArcGIS for Windows Mobile and Windows Tablet. This application is a task-driven mobile solution that offers many of the same functions as Collector. ArcGIS for Windows Mobile offers a central management, configuration, and deployment strategy and allows for synchronization of GIS information from server and desktop clients. It also includes an SDK for building custom applications. One example of an ArcGIS for Windows Mobile application is the **Water Utility Mobile Map**. The Water Utility Mobile Map can be used by field operations and maintenance staff to gain access to utility information. According to Esri, This application will help organizations deploy the Mobile Map in a disconnected or connected network environment. It is used for viewing detailed information about water, sewer and storm water assets in the field and allows field staff to locate a specific asset or area of interest and enter field notes. The mobile map also provides a series of

information pop-ups in which map-centric content can be visualized and used to update the status of work activities in the field.

There are also a number of inspection type applications available that can be used as is or configured to meet the specific needs of Guelph. Inspection applications include fire hydrant flow, manhole, hydrant, inlet, and code violations. These applications can assist Guelph in capturing critical infrastructure data to make better decisions regarding capital improvement planning and more efficient and effective maintenance.

Desktop

There are several applications available for ArcGIS for Desktop that can prove useful that are available through ArcGIS Solutions. The following highlights some of the options.

Address Data Management –

Address Data Management is an ArcGIS for Desktop editing map and a set of editing workflows for collecting and managing road centerlines with address ranges, facilities, site addresses, and related mailing address data. It is an editing map that can be used by mapping technicians in planning, public safety or land records organizations to streamline the collection, maintenance and use of authoritative address information.

The editing map also includes two add-ins. The Address Management add-in and address construction tools contain a series of custom editing tools that improve the editing experience for ArcGIS users working with roads and address information. For example, there are tools that:

- Add new road segments and allocate existing address ranges to the new segments
- Flip road segments so the direction of the line and address ranges are in sync
- Add new site address points and compute the proposed address from a location along the road centerline

The second add-in is called the Attribute Assistant. This add-in is an editor extension that uses a series of pre-defined methods to automatically populate attributes when updating and/or adding new features to the geodatabase. For example, one method will populate the full road name on each road centerline and site address feature from a valid list of road names contained in a master street name table. Other methods will help maintain the integrity of your address data by populating a unique identifier, last editor and last update date on each feature.

Data Reviewer for Addresses –

Data Reviewer for Addresses is a pre-configured set of ArcGIS Data Reviewer batch jobs (.rbj) for performing quality control on site address and road centerline data. It enhances Address Data Management and is configured to work with the Local Government geodatabase, which should in turn allow it to be used with the Canadian Municipal Data Model. This may require some configuration by defining "custom checks" for use with the CMDM.

ArcGIS Data Reviewer is an extension to ArcGIS Desktop that provides a set of quality control (QC) tools to simplify many aspects of automated and visual spatial data quality control. ArcGIS Data Reviewer offers over 40 out-of-the-box checks. Guelph can leverage these quality control checks to implement an efficient and consistent review process by automating spatial data quality control tasks. ArcGIS Data Reviewer checks may be run one at a time or can be grouped into a batch job. A batch job can also be scheduled to run once at a specific date and time or to run repeatedly at regular intervals.

Special Event Planning –

Special Event Planning is an ArcGIS 10 editing map and a set of editing workflows for collecting and managing special events data. It is an editor that can be used by mapping technicians in a public safety or emergency management agency to streamline the development of special event data and maps.

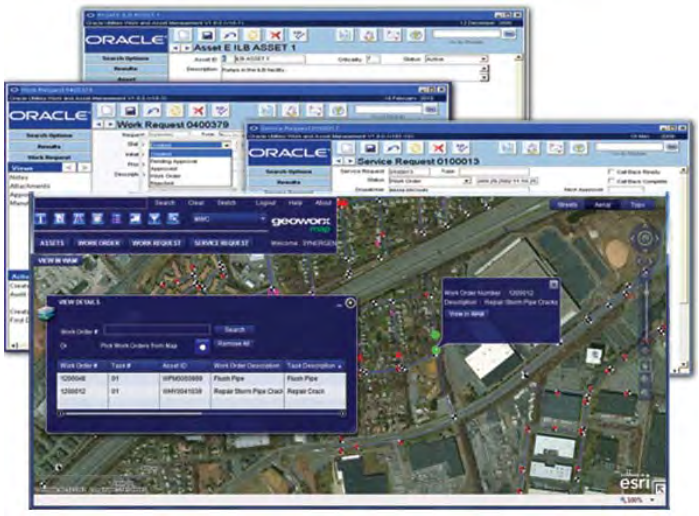
Water Utility Capital Improvement Planning –

The Water Utility Capital Improvement Planning (CIP) is an ArcGIS for Desktop editing map and a set of editing workflows used by water, sewer, and stormwater engineers to rate the condition of infrastructure networks and estimate the cost of Capital Improvement Projects. This editing map includes:

- A flexible set of geoprocessing models to evaluate the condition of your infrastructure network
- An interactive toolset to estimate the cost of capital improvement projects

Guelph can configure the Water Utility Capital Improvement Planning map for their organization and, in doing so, learn how to rate the condition of your infrastructure network and develop their Capital Improvement Plan using ArcGIS and their organization's data.

GIS Based Work Order Management



Beyond the need for web (both intranet and internet), several departments have a need for a GIS based work order management application. Engineering, Wastewater, Water Services and Public Works all have a need for a mechanism to create, view, update, and manage work orders via GIS. The City had utilized Oracle's GIS link for WAM in the past, however it has been unused for many years. There is currently a WAM assessment occurring where WAM is being reviewed based on user functionality needs and what solution can provide the desired needs. As part of the assessment, it has been further identified the need to have an easy to use GIS interface. There are three possible solutions for Oracle's WAM GIS interface: 1) retry the Oracle GIS link for WAM, 2) acquire the GeoWorx for Oracle Work & Asset Management solution from GeoNexus, or 3) replace Oracle WAM with one of the many options (see Water Services' Needs Assessment, pg. 1-211, for more details). Of these options, the GeoNexus solution seems most appropriate. GeoWorx is a suite of products that allow organizations to manage asset-related information including maintenance, operations, customer care, dispatch, and a mobile workforce. Deploying GeoWorx could greatly improve all these areas for the City of Guelph.

Overview of Existing and Desired GIS Software

Integration of non-spatial data, development of intranet applications and the creation of internet applications was echoed by nearly every division/department throughout the City of Guelph. An Enterprise GIS solution would best solve these needs and several divisions/departments have already implemented parts of Esri's Enterprise GIS solution. ArcGIS for Desktop is currently being used by Planning, Building Services, Engineering, Water, Traffic, Transit, Emergency Services, Solid Waste, and IT. It is recommended that the City expand on their current investments in Esri's Enterprise Solution. Esri offers several products that would address the software needs requested throughout the City. Since Esri products already exist within several divisions/departments, an Enterprise Solution through Esri would require less implementation and training. Given the need to expand ArcGIS applications and to acquire additional software (particularly ArcGIS Desktop Standard and ArcGIS Desktop Advanced), the City of Guelph should consider obtaining an Esri Enterprise License Agreement (ELA). Doing so may save cost, and would provide great flexibility for GIS growth.

Each department that was interviewed during the needs assessment utilizes GIS or GIS products or has expressed an interest in using GIS tools. Additionally, each of the departments expressed the desire to expand their use of the technology. The following is a department by department overview of existing and desired GIS software. **The details of each of the needs can be found in the Needs Assessment chapter.** In some cases, a specific product is named because that is the known solution (i.e. ArcGIS for Desktop Basic). In other cases, a more general reference is used because multiple possible solutions exist (i.e. Intranet Data Browser). The following icons are utilized to denote the current status of an application as follows:


Existing – This application has already been acquired by the City of Guelph


Desired – This application is desired and has not yet been acquired


Desktop – This application is available to the user via their desktop computer.


Embedded – This application is embedded in another application.


Intranet – This application is available via the Intranet.


Internet – This is an Internet application.


Software Suite – This application is part of a software suite


Shared Need – This application has been requested by more than one department


Unique Need – This application is unique to this department

The following are the applications identified within the needs assessment by department. There are software costs associated with most of these applications. This presumes the acquisition of an off-the-shelf application. However, many of the applications can be satisfied by using ArcGIS Online, Story Maps, and the other tools described above. Also, it is acknowledged that an intranet application already exists but assumed that another application will replace the current application or a re-launch will occur.

Building Services

- Data Mining Application – 
    - Description - Use to GIS enable data from AMANDA and other databases. Application will be housed and managed by the GIS Team in IT in conjunction with the Corporate Application Analyst for AMANADA and be transparent to the end users.
    - Number of Users – 2 (Within IT)
    - Software Cost - $9,500 This is a shared cost between many departments
    - Additional Cost - $7,000 SQL statements and setup of automation routines
- Intranet GIS Data Browser – 
    - Description - Primary portal for all staff. ArcGIS Server based with a Building Services configuration allowing for mapping and spatial analysis. Should also include Vehicle Routing Analysis capabilities.
    - Number of Users – 20
    - Software Cost - $15,000 shared cost with other departments
    - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments
- Internet GIS Application - 
    - Description – Provides a public facing GIS portal for sharing data with the public
    - Number of Users – unlimited
    - Software Costs - $15,000 shared cost with other departments
    - Additional Costs - $3,000 setup and training
- Mobile Data Browser – 
    - Description – Field access to GIS mapping and data collection for inspections, routing and interactive data query and analysis.
    - Number of Users – ~12
    - Software Cost – $5,000 each
    - Additional Cost – $5,000 for each hardware, plus $2,000 for setup and training

Business Services

- Intranet GIS Data Browser – 
    - Description - Primary portal for all staff. ArcGIS Server based with a Business Services configuration allowing for mapping and spatial analysis.
    - Number of Users – 17
    - Software Cost - $15,000 shared cost with other departments

- Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

- Internet GIS Application - 
  - Description – Provides a public facing GIS portal for sharing data with the public
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training

- Mobile Data Browser – 
  - Description – Field access to GIS mapping and data collection for inspections, routing and interactive data query and analysis.
  - Number of Users – ~12
  - Software Cost – $5,000 each
  - Additional Cost – $5,000 for each hardware, plus $2,000 for setup and training

- GIS Based Complaint Tracking – 
  - Description – Allows for all customer calls to be tracked. 311 type application. Some will spawn work orders.
  - Number of Users – 17
  - Software Costs - $15,000 shared with other departments
  - Additional Costs - $3,000 for setup and training

By-law Compliance, Security, and Licensing

- Data Mining/Geo-Enablement Tool/Application – 
  - Description - Used to GIS enable data from various databases. Application will be housed and managed by GIS Team in IT and be transparent to the end users.
  - Number of Users – 1 (Within IT)
  - Software Cost - $9,500 This is a shared cost between many departments
  - Additional Cost - $7,000 SQL statements and setup of automation routines

- Intranet GIS Data Browser – 
  - Description - Primary portal for all staff. ArcGIS Server based with a By-law configuration allowing for mapping and spatial analysis. Should also include Vehicle Routing Analysis capabilities.
  - Number of Users – 22
  - Software Cost - $15,000 shared cost with other departments

- Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

- Mobile Data Browser – 
  - Description – Field access to GIS mapping, vehicle routing analysis and Automated Vehicle Location.
  - Number of Users – ~6
  - Software Cost – $5,000 each
  - Additional Cost – $5,000 for each hardware, plus $2,000 for setup and training

- GIS Based Complaint Tracking – 
  - Description – Allows for all customer calls to be tracked. 311 type application. Some will spawn work orders.
  - Number of Users – 22
  - Software Costs - $15,000 shared with other departments
  - Additional Costs - $3,000 for setup and training

City Clerk

- Intranet GIS Data Browser – 
  - Description - Primary portal for all staff. ArcGIS Server based with a City Clerk configuration that provides Division-Wide Access to Geospatial Data including: Ward, Polling Site, and Voter Identification.
  - Number of Users – 9
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

- Internet GIS Application - 
  - Description – Provides a public facing GIS portal for Public Access to Geo-Spatial Data - Citizen District Voter Look-Up
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training

Community Energy

- ArcGIS for Desktop (Basic or Standard) – 

- Description – Will enable Community Energy the ability to assist with the development and design of the geodatabase. In addition, it will allow CED to update G-IEMS maps and data.
- Number of Users – 1
- Software Cost - $7,000 for new Standard license (Basic would be less costly)
- Additional Cost – $1,500 maintenance per year

- Intranet Application – 
  - Description - Primary portal for all staff. ArcGIS Server based with a Community Energy configuration. Recommended to include current, but also expanded, functionality of OnPoint. Application should include access to all required GIS layers, and allow for energy related analysis including commercial real estate, building and energy sources, building information, greenhouse emissions, renewable energy generators, and solar energy/panel installations.
  - Number of Users – 3
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

Community Engagement

- Intranet GIS Data Browser - 
  - Description - Primary portal for all staff. ArcGIS Server based with a configuration that incorporates Community Engagement needs. Application should include access to all required GIS layers and integration to CLASS data.
  - Number of Users – 25
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

- Internet GIS Data Browser/Portal - 
  - Description – Provides a public facing GIS portal for sharing data with the public. For Community Engagement this can provide information to the public regarding social service agency location, transportation, public meeting locations, and citizen collaboration. Application should be available for PC, tablets, and smartphones.
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training

Corporate Communications

- Intranet Data Browser - 
    - Description - Primary portal for all staff. Of specific importance to Corporate Communications is the ability to view city events, road closures, construction areas, development projects, snow removal routes, transit routes, waste pickup areas and schedule, water emergencies, floods, spills, power outgores, trails, trail signs, citizen complaints (from 311 application), and critical Water Department customers. The application should also allow staff to view social media like Twitter.
    - Number of Users – 9
    - Software Cost - $15,000 shared cost with other departments
    - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments
- Internet GIS Data Browser – 
    - Description – Internet based web site configured for public consumption.
    - Number of Users – unlimited
    - Software Costs - $15,000 shared cost with other departments
    - Additional Costs - $3,000 setup and training
- GIS Based Complaint Tracking – 
    - Description – Allows for all customer calls to be tracked. 311 type application. Some will spawn work orders.
    - Number of Users – 25
    - Software Costs - $15,000 shared with other departments
    - Additional Costs - $3,000 for setup and training
- Maps on TV (Viz Curious Maps) – 
    - Description – high quality maps for television production
    - Number of users – 1
    - Software cost - $9,000
    - Additional cost - $4,000 setup and training

Culture and Tourism

- Intranet GIS Data Browser - 
    - Description - Primary portal for all staff to visualize demographic and tourism related data.
    - Number of Users – 5
    - Software Cost - $15,000 shared cost with other departments

- Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

Downtown Renewal

- ArcGIS for Desktop (Basic or Standard) – 
  - Description – will allow staff to perform mapping and spatial analysis using various City-wide layers, along with creating and maintaining department specific data layers.
  - Number of Users – 2
  - Software Cost - $7,000 for new Standard license (Basic would be less costly)
  - Additional Cost – $1,500 maintenance per year
- Intranet Data Browser - 
  - Description - Primary portal for all staff to visualize GIS data along with the desired Pedestrian Traffic Mapping.
  - Number of Users – 2
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments
- Internet GIS Data Browser/Portal - 
  - Description – Provides a public facing GIS portal for sharing data with the public. For Downtown Renewal this can provide information to the public regarding variances, special use permits, and current and planned projects. A portal/App could also provide visitors and residents with Public Access Parking information.
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training
- Mobile Data Browser – 
  - Description – Field access to GIS mapping, retail visual inspection and useable during meetings to communicate strategies and plans.
  - Number of Users – 2
  - Software Cost – $5,000 each
  - Additional Cost – $5,000 for each hardware, plus $2,000 for setup and training
- Community Analyst (Canadian Subscription)– 
  - Description – A subscription service from Esri providing analysis tools and data related to demographics, census, health, crime, and business data.

- Number of Users – 2
- Software Cost – $5,000

Economic Development

- Intranet GIS Data Browser - 
  - Description - Primary portal for all staff to have access to numerous City data including businesses, consumer data, demographic, transportation, and utilities. ArcGIS Server based that incorporates other departments data.
  - Number of Users – 4
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments.

Emergency Services

- Intranet GIS Data Browser - 
  - Description - Primary portal for all staff to have access to numerous City data and Emergency Services specific data to provide mapping and spatial analysis of incidents and inspections. The configuration should also include layers from the Predictive Occurrence Software and Disaster Recovery and Damage information.
  - Number of Users – 100
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments
- Data Mining Application – 
  - Description - Used to GIS enable data for fire and EMS incidents, as well as, fire inspections. Application will be housed and managed by the central GIS group and be transparent to the end users.
  - Number of Users – 1 (Within IT)
  - Software Cost - $9,500 This is a shared cost between many departments
  - Additional Cost - $7,000 SQL statements and setup of automation routines
- Mobile Data Browser – 
  - Description – Field access to GIS mapping including address searches, display and query schools, hazardous materials, digital building pre-plans, and routing.
  - Number of Users – ~80
  - Software Cost – $5,000 each

- Additional Cost – $5,000 for each hardware, plus $2,000 for setup and training

- Internet GIS Data Browser - 
  - Description – Provides a public facing GIS portal for sharing data with the public. For Emergency Services this can provide information to the public regarding shelter locations, station locations, road closures, power outages, bridge closures, and flooded roads.
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training

Engineering

- ArcGIS for Desktop (Standard 10.x) – 
  - Description – Needed for creation, editing and management of GIS data, data layer design, tracking projects, managing storm water utility, linking digital drawings and videos, and part of a GIS based work order system.
  - Number of Users – 3
  - Software Cost - $7,000 for 1 new license (2 already owned by Engineering)
  - Additional Cost –$1,500 for annual maintenance costs (new license only)

- Intranet GIS Data Browser - 
  - Description - Primary portal for all staff and should include advanced search, mailing lists/labels, advanced graphic design capabilities. Application should have access to data including projects, utilities, AMANDA data, etc.
  - Number of Users – 25
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

- Internet GIS Data Browser - 
  - Description – Provides a public facing GIS portal for sharing geospatial data with the public. For Engineering, data should include data for service requests, bike lanes, and other department specific data.
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training

- GIS Based Work Order System - 

- Description – A system, process, or integration of GIS with WAM or other Work Order Management System.
- Number of Users – ~25
- Software Costs – TBD
- Additional Costs – TBD

- ArcGIS Online - 
  - Description – an Esri subscription and turnkey solution for providing GIS data and applications via the internet. Can be utilized both in the office and to provide field access.
  - Number of Users – ~25
  - Software Costs – $10,000 for 100 users, shared with other departments
  - Additional Costs – $2,500 training

Finance

- Intranet GIS Data Browser - 
  - Description - Primary portal for all staff for analysis of property and tax data, mapping of tangible capital assets, and for tracking of projects.
  - Number of Users – 10
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

- ArcGIS for Desktop (Basic or Standard) – 
  - Description – Needed for creation, editing and management of GIS data, data layer design, and tracking projects.
  - Number of Users – 1
  - Software Cost - $7,000 for new Standard license (Basic would be less costly)
  - Additional Cost – $1,500 maintenance per year

Information Technology

- ArcGIS for Desktop (Standard or Advanced) – 
  - Description – Will allow staff ability to provide data development and management of pertinent data including metadata.
  - Number of Users – 3
  - Software Cost - $7,000 for a new Standard license for new position
  - Additional Cost – $1,500

- Intranet Application - 
    - Description - Primary portal for all staff. A re-launched ArcGIS Server based application to overcome many current issues.
    - Number of Users – All City departments
    - Software Cost - $15,000 shared cost with other departments
    - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments
- Polling Place Locator – 
    - Description – Allows users to search for an address or click a location on the map to receive information related to polling locations, including driving directions, details, and contact information.
    - Number of Users – unlimited
    - Software Costs - $0
    - Additional Costs - $0
- Citizen Service Request – 
    - Description – Allows citizens to submit requests for service in their municipality using a map-based interface.
    - Number of Users – unlimited
    - Software Costs - $0
    - Additional Costs - $0
- My Municipal Government Services – 
    - Description – Assist residents locate a municipal facility and obtain information about services provided using a map-based view.
    - Number of Users – unlimited
    - Software Costs - $0
    - Additional Costs - $0
- Esri Story Maps – 
    - Description – Digital maps developed by organizations to present and organize information geographically about places, events, issues, trends, or patterns.
    - Number of Users – unlimited
    - Software Costs - $0
    - Additional Costs - $0
- Internet Application – 

- Description – Public facing web site permitting anyone to seek answers to relevant questions and self-fulfill requests for information.
- Number of Users – unlimited
- Software Costs - $7,000 for specialized parking application
- Additional Costs - $3,000 setup and training

- Data Reviewer for Addresses – 
  - Description – Public facing web site permitting anyone to seek answers to relevant questions and self-fulfill requests for information.
  - Number of Users – unlimited
  - Software Costs - $0
  - Additional Costs - $0

- ArcGIS for Server – 
  - Description – A server based product that provides scalable framework for distributing GIS services and data.
  - Number of Users – unlimited
  - Software Cost - $0 Already acquired by the City (additional cost if scaled to more servers which may justify an ELA)
  - Additional Cost – none

- Automated Geocoding/Data Mining Application – 
  - Description – An application that creates GIS data layers from non-spatial relational or tabular databases.
  - Number of Users – 2
  - Software Cost - $9,500 This is a shared cost between many departments
  - Additional Cost - $7,000 SQL statements and setup of automation routines

Legal and Realty Services

- Intranet GIS Application - 
  - Description - Primary portal for all staff. ArcGIS Server based with a configuration that incorporates Legal and Realty Service's needs. Specifically for mapping and spatial analysis of property and court case support.
  - Number of Users – 5
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

Parks and Open Space

- ArcGIS for Desktop (Standard) – 
    - Description – Parks and Open Space could see value in expanding on current uses of ArcGIS and have the ability to develop and manage data related to their assets. Also will provide mapping of Ad Hoc events, park and trail planning, and tracking projects.
    - Number of Users – 4
    - Software Cost - $7,000 for new license
    - Additional Cost – $1,500 maintenance per year
- Intranet Application - 
    - Description - Primary portal for all staff. ArcGIS for Server based with a configuration that incorporates Parks and Open Space needs. Parks and Open Space needs the ability to perform mapping and spatial analysis on interdepartmental data.
    - Number of Users – ~50
    - Software Cost - $15,000 shared cost with other departments
    - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments
- Internet Data Browser - 
    - Description – Provides a public facing GIS portal for sharing data with the public. For Parks and Open Spaces online maps should focus on facilities and amenities including information, directions, way-finding for hiking trails, park locations, and a host of other key data.
    - Number of Users – unlimited
    - Software Costs - $15,000 shared cost with other departments
    - Additional Costs - $3,000 setup and training
- Automated Geocoding/Data Mining Application – 
    - Description – An application that creates GIS data layers from non-spatial relational or tabular databases. For Parks and Open Space this would include data from Class and Amanda.
    - Number of Users – 2
    - Software Cost - $9,500 This is a shared cost between many departments
    - Additional Cost - $7,000 SQL statements and setup of automation routines.
- ArcGIS Online - 

- Description – An Esri subscription and turnkey solution for providing GIS data and applications via the internet. Can be utilized both in the office and to provide field access for field data collection and to provide specialized online mapping themes.
- Number of Users – ~50
- Software Costs – $10,000 for 100 users, shared with other departments
- Additional Costs – $2,500 training

Planning

- ArcGIS for Desktop (Standard) – 
  - Description – Needed for creation, editing, and analysis of GIS data including metadata.
  - Number of Users – 7
  - Software Cost - $14,000 for 2 additional Standard licenses (concurrent)
  - Additional Cost – $3,000 per year maintenance cost
- Intranet GIS Data Browser - 
  - Description - Primary portal for all staff. ArcGIS Server based with a configuration that incorporates the needs of the Planning department including an automated neighborhood and vicinity map, links to document management system, access to the Heritage Inventory and Natural Heritage Inventory, and Public Forum Mapping.
  - Number of Users – ~30
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments
- ArcGIS Online - 
  - Description – An Esri subscription and turnkey solution for providing GIS data and applications via the internet. Can be utilized both in the office and to provide field access for field data collection and to provide specialized online mapping themes for maps like the Heritage Inventory.
  - Number of Users – ~30
  - Software Costs – $10,000 for 100 users, shared with other departments
  - Additional Costs – $2,500 training
- Internet Data Browser - 
  - Description – Provides a public facing GIS portal for sharing data with the public. For Planning, online maps should consist of Reverse Lookup capability to allow citizens, businesses, and developers the ability to determine what they can do and where. They would also be able to determine any variances or special use permits that would be required based

on a property. Lastly, citizens, businesses, and developers could determine where development and/or major projects will occur for planning and participation.

  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training

- Spatial Analyst - 
  - Description – An advanced extension to ArcGIS that provides a range of spatial modeling and analysis tools to create, query, map, and analyze cell-based raster data, perform integrated raster/vector analysis, derive new information and much more.
  - Number of Users – 5
  - Software Costs - $8,000
  - Additional Costs - $3,000 training
- 3D Analyst - 
  - Description – An advanced extension to ArcGIS that allows for the use of existing 2D GIS datasets to create 3D scenarios.
  - Number of Users – 5
  - Software Costs - $8,000
  - Additional Costs - $3,000 training
  - Data Costs – Additional time required to model vector data to be used within a 3D environment (z-values)
- I-Tree - 
  - Description – An advanced set of tools to help users assess and manage the structure, function, and value of urban tree populations regardless of community size or technical capacity. i-Tree allows you to promote effective urban forest management and sound arboricultural practices by providing information for advocacy, planning, informed decision-making, and standardization for comparisons with other communities. It promotes a better understanding of the ecosystem services provided by community trees, and helps justify investment in stewardship, operations, and maintenance.
  - Number of Users – 5
  - Software Costs - free

Public Works

- ArcGIS for Desktop (Standard)– 

- Description – Public Works could perform more complete mapping and spatial analysis in support of Forestry, Traffic, Parking and other City infrastructure. It would allow them to create data layers, as-builts, CAD drawings, and digital documents.
- Number of Users – 2
- Software Cost - $7,000 for new license
- Additional Cost – $1,500 maintenance per year

- ArcGIS Online - 
  - Description – An Esri subscription and turnkey solution for providing GIS data and applications via the internet. Can be utilized both in the office and to provide field access for field data collection and to provide specialized online mapping themes. One major need for Public Works is access to Work Orders, inventories, site visits, and routing capabilities.
  - Number of Users – ~150
  - Software Costs – $10,000 for 100 users, shared with other departments
  - Additional Costs – $2,500 training

- Intranet Application - 
  - Description - Primary portal for all staff. ArcGIS Server based with a configuration that incorporates the needs of the Public Works department.
  - Number of Users – ~150
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

Service Guelph

- Intranet GIS Application - 
  - Description - Primary portal for all staff. ArcGIS Server based with a configuration that incorporates the needs of Service Guelph including wards, garbage collection schedules, termite zones, construction projects, and road closures. The application should also show data from databases like Amanda, Class and Oracle WAM.
  - Number of Users – 5
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

- Internet GIS Application - 
  - Description – Provides a public facing GIS portal for sharing data with the public. For Service Guelph, information should include wards, garbage collection schedules, termite zones,

construction projects, and road closures. The application should also show data from databases like Amanda, Class and Oracle WAM.

- Number of Users – unlimited
- Software Costs - $15,000 shared cost with other departments
- Additional Costs - $3,000 setup and training

- 311 GIS Based Application (Customer Care Portal) - 
  - Description – Provides both an internal and external application for reporting, tracking and responding to citizen needs and complaints. Application should be usable on a PC, tablet, or smartphone.
  - Number of Users – unlimited
  - Software Costs - $20,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training

Solid Waste Resources

- ArcGIS for Desktop (Standard) – 
  - Description – Solid Waste Resources could see value in creating data layers in ArcGIS, including waste collection routes, waste collection schedule, location of garbage cans and primarily a layer for the newly deployed carts and have the need to maintain these layers. Solid Waste could also assist in correcting address issues.
  - Number of Users – 2
  - Software Cost - $0 already owned by Solid Waste
  - Additional Cost - $1,500 annual maintenance

- Intranet Application - 
  - Description - Primary portal for all staff. ArcGIS Server based with a configuration that incorporates the needs of Solid Waste Resources for querying data, analysis and preparing reports. This could be used to show information related to carts and service delivery.
  - Number of Users – 30
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

- Internet Application - 
  - Description – Provides a public facing GIS portal for sharing data with the public. For Solid Waste Resources this could be used to share garbage collection dates and information related to service delivery.
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments

- Additional Costs - $3,000 setup and training

Guelph Transit

- ArcGIS for Desktop (Standard) – 
  - Description – Guelph Transit has the need to create and maintain numerous data layers including bus routes, stops, projects, and traffic by time of day. Transit also needs access to many interdepartmental data sets and demographic data.
  - Number of Users – 2
  - Software Cost - $7,000 for new license
  - Additional Cost - $1,500 annual maintenance
- Intranet Application - 
  - Description - Primary portal for all staff. ArcGIS Server based with a configuration that incorporates the needs of Guelph Transit for querying data, analysis and preparing reports.
  - Number of Users – 10
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments
- Internet Application / Bus Tracking App (NextBus/Google Transit) - 
  - Description – Provides a public facing GIS portal for sharing data with the public. For Transit this includes sharing information related to bus stops, and routes. Further, the application offers a “Where’s My Bus” application useable on smart phones and tablets to improve customer service (must be Trapeze compliant).
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training

Wastewater Services

- ArcGIS for Desktop (Standard) – 
  - Description – Needed for creation, editing and management of GIS data, data layer design, tracking projects, managing infrastructure, linking digital drawings, and part of a GIS based work order system, among other items.
  - Number of Users – 4

- Software Cost - $14,000 for 2 Standard licenses (concurrent)
- Additional Cost –$3,000 annual maintenance

- Data Mining Application/Automated Geocoding – 
  - Description – An application that creates GIS data layers from non-spatial relational or tabular databases. For Wastewater Services this would include data from spreadsheets, InfoWater, SCADA and other business databases.
  - Number of Users – 1
  - Software Cost - $9,500 This is a shared cost between many departments
  - Additional Cost - $7,000 SQL statements and setup of automation routines.
- Intranet GIS Data Browser - 
  - Description - Primary portal for all staff and should include advanced search, analysis, and digital CAD/as-built drawings. Application should have access to data including projects, utilities, WAM, etc.
  - Number of Users – ~45
  - Software Cost - $15,000 shared cost with other departments
  - Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments
- Internet GIS Data Browser - 
  - Description – Provides a public facing GIS portal for sharing geospatial data with the public.
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training
- GIS Based Work Order System - 
  - Description – A system, process, or integration of GIS with WAM or other Work Order Management System.
  - Number of Users – ~30
  - Software Costs – TBD
  - Additional Costs – TBD
- Mobile Data Browser – 
  - Description – Field access to GIS mapping including address searches, display and query utilities, edit features and attributes, and capturing photos, digital pre-plans, and routing.
  - Number of Users – ~30
  - Software Cost – $5,000 each
  - Additional Cost – $5,000 for each hardware, plus $2,000 for setup and training

- Automated Vehicle Location (AVL) - 
    - Description – A system to track and report vehicle locations for improved response to customer needs, perform task planning, and dispatching.
    - Number of Users – ~45
    - Software Cost – TBD - varies between vendors and functional needs
    - Additional Cost – TBD – varies between vendors and functional needs
- Water Utility Capital Improvement Planning – 
    - Description – an ArcGIS for Desktop editing map and a set of editing workflows used by water, sewer, and stormwater engineers to rate the condition of infrastructure networks and estimate the cost of Capital Improvement Projects.
    - Number of Users – 4
    - Software Cost – $0
    - Additional Cost – $0

Water Services

- ArcGIS for Desktop (Standard) – 
    - Description – Needed for creation, editing and management of GIS data, data layer design, tracking projects, managing infrastructure, linking digital drawings, and part of a GIS based work order system, among other items.
    - Number of Users – 7
    - Software Cost - $21,000 for 3 Standard licenses (concurrent)
    - Additional Cost –$5,000 annual maintenance
- Data Mining Application/Automated Geocoding – 
    - Description – An application that creates GIS data layers from non-spatial relational or tabular databases. For Wastewater Services this would include data from spreadsheets, SCADA and other business databases.
    - Number of Users – 1
    - Software Cost - $9,500 This is a shared cost between many departments
    - Additional Cost - $7,000 SQL statements and setup of automation routines.
- Intranet GIS Data Browser - 
    - Description - Primary portal for all staff and should include advanced search, analysis, and digital CAD/as-built drawings. Application should have access to data including projects, utilities, WAM, etc.
    - Number of Users – ~56
    - Software Cost - $15,000 shared cost with other departments

- Additional Cost - $5,000 Software functionality upgrades and setup shared with other departments

- Internet GIS Data Browser - 
  - Description – Provides a public facing GIS portal for sharing geospatial data with the public displaying pertinent data and service request.
  - Number of Users – unlimited
  - Software Costs - $15,000 shared cost with other departments
  - Additional Costs - $3,000 setup and training

- GIS Based Work Order System - 
  - Description – A system, process, or integration of GIS with WAM or other Work Order Management System.
  - Number of Users – ~60
  - Software Costs – TBD
  - Additional Costs – TBD

- Mobile Data Browser – 
  - Description – Field access to GIS mapping including address searches, display and query utilities, edit features and attributes, and capturing photos, digital pre-plans, and routing.
  - Number of Users – ~45
  - Software Cost – $5,000 each
  - Additional Cost – $5,000 for each hardware, plus $2,000 for setup and training

- Water Utility Capital Improvement Planning – 
  - Description – an ArcGIS for Desktop editing map and a set of editing workflows used by water, sewer, and stormwater engineers to rate the condition of infrastructure networks and estimate the cost of Capital Improvement Projects.
  - Number of Users – 4
  - Software Cost – $0
  - Additional Cost – $0

- Automated Vehicle Location (AVL) - 
  - Description – A system to track and report vehicle locations for improved response to customer needs, perform task planning, and dispatching.
  - Number of Users – ~50
  - Software Cost – TBD - varies between vendors and functional needs
  - Additional Cost – TBD – varies between vendors and functional needs

- ArcGIS Online - 

- Description – An Esri subscription and turnkey solution for providing GIS data and applications via the internet. Can be utilized both in the office and to provide field access for field data collection and to provide specialized online mapping themes.
- Number of Users – ~60
- Software Costs – $10,000 for 100 users, shared with other departments
- Additional Costs – $2,500 training

Required GIS Functionality

The following functionality matrix is based on the data compiled from the Needs Assessment. Each department/division's GIS functionality is identified and ranked by priority and complexity. Priority identifies the mission critical nature of the functionality. Complexity identifies how difficult a function is to achieve. This will serve as a guideline for the priority of proposed software solutions to meet each department/division's needs.

● High ■ Medium/Moderate ◆ Low P = Priority C = Complexity	Building Services		Business Services		By-law Compliance, Security, and Licensing		City Clerk		Community Energy		Community Engagement		Corporate Communications		Culture and Tourism		Downtown Renewal		Economic Development		Emergency Services	
Mapping Functionality Parameter	P	C	P	C	P	C	P	C	P	C	P	C	P	C	P	C	P	C	P	C	P	C
Pan and Zoom	●	◆	●	◆	●	◆	●	◆	◆	◆	●	◆	●	◆	●	◆	●	◆	●	◆	◆	◆
Map Layer Display	●	◆	●	◆	●	◆	■	◆	●	◆	●	◆	●	◆	■	◆	●	◆	●	◆	■	◆
Hard-copy Map Generation	●	■	●	■	●	■	◆	■	◆	■	●	■	●	■	◆	■	◆	■	◆	◆	◆	◆
Report Generation	■	■	◆	◆	◆	●	■	●	■	●	●	●	●	●	■	●	◆	◆	■	■	◆	◆
Graphic and Attribute Query & Browser	■	■	■	■	●	■	●	■	■	■	●	■	●	■	■	■	■	■	◆	■	◆	■
Buffer Generation – Overlay Techniques	■	●	◆	●	■	●	■	●	●	●	●	●	●	●	◆	●	◆	●	◆	●	■	●
Latitude/Longitude/Geo-reference Generator	◆	■	◆	■	◆	■	◆	■	◆	■	●	■	●	■	◆	■	◆	■	◆	■	◆	■
Coordinate/Area/Volume/Length Calculations	◆	●	◆	●	■	●	■	●	●	●	●	●	●	●	◆	●	◆	●	◆	●	◆	●
Feature Overlay	●	■	◆	■	●	■	●	■	■	■	●	■	●	■	◆	■	◆	■	◆	■	◆	■
Hyper-linking Objects	●	■	●	■	●	■	◆	■	◆	■	●	■	●	■	◆	■	◆	■	◆	◆	◆	◆
Text and Graphics Placement	◆	●	◆	●	◆	●	■	●	■	●	●	●	●	●	◆	●	◆	●	◆	●	◆	●
Address/Street/Intersection Search	■	■	◆	■	■	■	●	■	●	■	●	■	■	■	■	■	◆	■	◆	■	■	■
Tabular and Graphic Data Import/Export	◆	■	◆	■	■	■	●	■	●	■	●	■	●	■	◆	■	◆	■	◆	■	◆	■

● High ■ Medium/Moderate ◆ Low P = Priority C = Complexity	Engineering		Finance		Information Technology		Legal and Realty Services		Parks and Open Space		Planning		Public Works		Service Guelph		Solid Waste Resources		Guelph Transit		Wastewater	
Mapping Functionality Parameter	P	C	P	C	P	C	P	C	P	C	P	C	P	C	P	C	P	C	P	C	P	C
Pan and Zoom	●	◆	●	◆	●	◆	■	◆	●	◆	■	◆	■	◆	●	◆	●	◆	●	◆	●	◆
Map Layer Display	●	◆	●	◆	●	◆	■	◆	●	◆	◆	◆	■	◆	●	◆	●	◆	●	◆	■	◆
Hard-copy Map Generation	●	■	◆	■	◆	■	◆	■	●	■	◆	■	◆	■	●	■	●	■	●	■	◆	■
Report Generation	◆	◆	■	■	■	●	■	●	■	●	◆	●	●	●	■	■	◆	◆	◆	●	■	●
Graphic and Attribute Query & Browser	●	■	●	■	●	■	●	■	●	■	■	■	●	■	■	■	■	■	●	■	●	■
Buffer Generation – Overlay Techniques	■	●	●	●	●	●	■	●	●	●	◆	●	●	●	■	●	◆	●	■	●	■	●
Latitude/Longitude/Geo-reference Generator	■	■	■	■	●	■	■	■	●	■	◆	■	■	■	◆	■	◆	■	◆	■	◆	■
Coordinate/Area/Volume/Length Calculations	■	●	■	●	●	●	■	●	■	●	◆	●	■	●	◆	●	◆	●	■	●	■	●
Feature Overlay	●	■	●	■	■	■	●	■	●	■	●	■	■	■	●	■	◆	■	●	■	●	■
Hyper-linking Objects	●	■	◆	■	◆	■	◆	■	●	■	◆	■	◆	■	●	■	●	■	●	■	◆	■
Text and Graphics Placement	■	●	●	●	●	●	■	●	●	●	◆	●	■	●	◆	●	◆	●	◆	●	■	●
Address/Street/Intersection Search	●	■	●	■	●	■	■	■	●	■	◆	■	■	■	■	■	◆	■	■	■	●	■
Tabular and Graphic Data Import/Export	■	■	●	■	●	■	■	■	●	■	◆	■	◆	■	◆	■	◆	■	■	■	●	■

Business Processes

The following table identifies existing business processes within the City along with the corresponding departments that potentially could benefit from use of the information.

The circle, in the table, indicates that the Department has an interest in the business process. Note that the business processes often cross departmental lines, thus multiple departments need to be involved when evaluating the particular business process.

Business Processes Involving GIS																						
Business Processes	**Building Services**	**Business Services**	**By-law Compliance, Security, and Licensing**	**City Clerk's Office**	**Community Energy**	**Community Engagement**	**Corporate Communications**	**Culture and Tourism**	**Downtown Renewal**	**Economic Development**	**Emergency Services**	**Engineering Services**	**Finance**	**Information Technology**	**Legal and Realty Services**	**Parks and Open Space**	**Planning Services**	**Public Works**	**Service Guelph**	**Solid Waste Resources**	**Guelph Transit**	**Wastewater Services**	**Water Services**
Infrastructure																						
Address System	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Critical Private Utility & Other Agency Utilities (ROW Management)	●	●	●		●				●	●	●	●	●		●		●	●				●	●
Drawing/Document Mgmt.	●		●	●	●					●		●		●		●	●	●				●	●
Facilities/Asset Mgmt.	●				●			●	●	●	●	●	●			●	●	●		●	●	●	●
Parks Mgmt.		●								●	●	●				●	●	●		●		●	●
Pavement Mgmt.									●			●						●				●	●

Business Processes Involving GIS																						
Business Processes	**Building Services**	**Business Services**	**By-law Compliance, Security, and Licensing**	**City Clerk's Office**	**Community Energy**	**Community Engagement**	**Corporate Communications**	**Culture and Tourism**	**Downtown Renewal**	**Economic Development**	**Emergency Services**	**Engineering Services**	**Finance**	**Information Technology**	**Legal and Realty Services**	**Parks and Open Space**	**Planning Services**	**Public Works**	**Service Guelph**	**Solid Waste Resources**	**Guelph Transit**	**Wastewater Services**	**Water Services**
Traffic System		✓	✓			✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓
Utility Mgmt. (water, sanitary, sewer, etc.)	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓				✓	✓
Planning																							
Demographics / Business Geographics		✓		✓	✓	✓		✓	✓	✓	✓						✓				✓		
Zoning/Land Use Planning	✓	✓	✓		✓	✓	✓		✓	✓		✓			✓	✓	✓	✓	✓			✓	✓
Permitting / Development Review	✓	✓	✓	✓	✓	✓			✓	✓		✓			✓		✓	✓	✓			✓	✓
Transportation System Plan		✓	✓			✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓
Environmental																							
Environmental Mapping	✓		✓		✓	✓			✓	✓	✓	✓			✓	✓	✓	✓				✓	✓
Services																							
Community Groups		✓		✓		✓	✓	✓	✓	✓							✓		✓				
Crime Analysis									✓		✓				✓	✓	✓						
Crime Prevention									✓		✓				✓	✓	✓						

Business Processes Involving GIS																						
Business Processes	**Building Services**	**Business Services**	**By-law Compliance, Security, and Licensing**	**City Clerk's Office**	**Community Energy**	**Community Engagement**	**Corporate Communications**	**Culture and Tourism**	**Downtown Renewal**	**Economic Development**	**Emergency Services**	**Engineering Services**	**Finance**	**Information Technology**	**Legal and Realty Services**	**Parks and Open Space**	**Planning Services**	**Public Works**	**Service Guelph**	**Solid Waste Resources**	**Guelph Transit**	**Wastewater Services**	**Water Services**
Disaster/Emergency Planning & Response	●				●		●				●	●		●				●	●		●	●	●
Waste Collection																			●	●			
Public Safety				●		●					●								●		●		
Traffic Accident Monitoring						●					●	●						●					
Urban Forestry					●	●										●	●	●					
Administration																							
Finance/Utility Billing					●							●	●							●		●	●
GIS Data Management												●		●			●						●
GIS System Administration														●									

Priority Matrix

A successful GIS is measured not by the amount of money spent, the volume of data, or the GIS software utilized but by the applications made available to staff and the public. The following is a matrix that analyzes each application and its priority ranking.

The categories analyzed and weighted were:

- *Existing* – Has the application already been acquired? If so, has it been fully implemented for the department's needs? The values are weighted as follows:
    - Existing, fully implemented, and in use = 5
    - Existing, nearly implemented, and/or used infrequently = 4
    - Existing, partially implemented, and/or used rarely = 3
    - Implementation just beginning = 2
    - Implementation planned = 1
    - Non-existing = 0
- *Cost Savings* – Potential of monetary savings to the organization or to the public
- *Improved Efficiency* – Does the application improve staff ability to do their job
- *Potential Life Savings* – The potential of the application to assist in preventing loss of life
- *Improved Decision Making* – Does the application enable staff to more quickly and accurately make decisions?
- *Enterprise Usage* – How widely will the application be utilized in the organization
- *Improve Customer Service* – Does the application improve the customers' ability to access needed data and information?
- *Cost of the Application* – The cost to deploy the application was given a weight as follows:
    - $0 = 5
    - $1 - $10,000 = 4
    - $10,001 - $15,000 = 3
    - $15,001 - $20,000 = 2
    - $20,000+ = 1
- *Generate Revenue* – Will the application potentially generate revenue for the City?

The maximum amount of points for any category was 5. Generally, the higher the total score, the higher the application priority.

Existing and Desired Software	Existing	Cost Savings	Improved Efficiency	Potential Life Savings	Improved Decision Making	Enterprise Usage	Improve Customer Service	Cost of the Application	Generate Revenue	Total
Building Services										
Data Mining Application	0	4	4	0	5	5	3	4	0	**25**
Intranet GIS Data Browser	5	4	5	0	5	5	4	3	0	**31**
Internet GIS Application	0	5	4	0	3	5	5	3	1	**26**
Mobile Data Browser	0	3	4	0	4	4	3	4	0	**22**
Business Services										
Intranet GIS Data Browser	3	4	5	0	5	5	3	3	0	**28**
Internet GIS Application	0	5	4	0	3	5	5	3	1	**26**
Mobile Data Browser	0	3	4	0	4	4	3	4	0	**22**
GIS Based Complaint Tracking	0	2	4	0	3	4	5	3	0	**21**
By-law Compliance, Security, and Licensing										
Data Mining/Geo-Enablement Tool/Application	0	4	4	0	5	5	3	4	0	**25**
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Mobile Data Browser	0	3	4	0	4	4	3	4	0	**22**
GIS Based Complaint Tracking	0	2	4	0	3	4	5	3	0	**21**

Existing and Desired Software	Existing	Cost Savings	Improved Efficiency	Potential Life Savings	Improved Decision Making	Enterprise Usage	Improve Customer Service	Cost of the Application	Generate Revenue	Total
City Clerk's Office										
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Internet GIS Data Browser	0	5	4	0	3	5	5	3	1	**26**
Community Energy										
ArcGIS for Desktop	0	2	5	0	5	5	4	4	0	**25**
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Community Engagement										
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Intranet GIS Data Browser	0	4	1	1	5	5	2	4	1	**23**
Corporate Communications										
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Internet GIS Data Browser	0	5	4	0	3	5	5	3	1	**26**
GIS Based Complaint Tracking	0	2	4	0	3	4	5	3	0	**21**
Maps on TV	0	1	3	1	2	2	4	4	0	**17**
Culture and Tourism										
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**

Existing and Desired Software	Existing	Cost Savings	Improved Efficiency	Potential Life Savings	Improved Decision Making	Enterprise Usage	Improve Customer Service	Cost of the Application	Generate Revenue	Total
Downtown Renewal										
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
ArcGIS for Desktop	0	2	5	0	5	5	4	4	0	**25**
Internet GIS Data Browser	0	5	4	0	3	5	5	3	1	**26**
Mobile Data Browser	0	3	4	0	4	4	3	4	0	**22**
Community Analyst	0	2	5	0	5	4	5	4	0	**25**
Emergency Services										
Data Mining Application	0	4	4	0	5	5	3	4	0	**25**
Mobile Data Browser	0	3	4	0	4	4	3	4	0	**22**
Internet GIS Data Browser	3	5	4	0	3	5	5	3	1	**29**
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Engineering Services										
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
ArcGIS for Desktop	5	2	5	0	5	5	4	4	0	**30**
Internet GIS Data Browser	0	5	4	0	3	5	5	3	1	**26**
GIS Based Work Order System	0	3	5	1	4	4	4	1	0	**22**
ArcGIS Online	0	3	5	0	4	5	4	4	0	**25**

Existing and Desired Software	Existing	Cost Savings	Improved Efficiency	Potential Life Savings	Improved Decision Making	Enterprise Usage	Improve Customer Service	Cost of the Application	Generate Revenue	Total
Finance										
ArcGIS for Desktop	0	2	5	0	5	5	4	4	0	**25**
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Information Technology										
ArcGIS for Desktop	5	2	5	0	5	5	4	4	0	**30**
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Internet GIS Data Browser	3	5	4	0	3	5	5	3	1	**29**
ArcGIS for Server	5	4	5	1	5	5	5	5	1	**36**
Data Mining/Geo-Enablement Tool/Application	0	4	4	0	5	5	3	4	0	**25**
Polling Place Locator	0	2	3	0	2	1	4	5	0	**17**
Citizen Service Request	0	3	5	0	5	5	5	5	0	**28**
My Municipal Government Services	0	2	4	0	2	5	5	5	0	**23**
Esri Story Maps	0	2	4	0	2	4	5	5	0	**22**
Data Reviewer for Addresses	0	4	4	1	3	5	4	5	0	**26**
ArcGIS Online	0	3	5	0	4	5	4	4	0	**25**
Legal and Realty Services										

Existing and Desired Software	Existing	Cost Savings	Improved Efficiency	Potential Life Savings	Improved Decision Making	Enterprise Usage	Improve Customer Service	Cost of the Application	Generate Revenue	Total
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Parks and Open Space										
Data Mining/Geo-Enablement Tool/Application	0	4	4	0	5	5	3	4	0	**25**
ArcGIS for Desktop	3	2	5	0	5	5	4	4	0	**28**
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Internet GIS Data Browser	0	5	4	0	3	5	5	3	1	**26**
ArcGIS Online	0	3	5	0	4	5	4	4	0	**25**
Mobile/Field GIS	0	3	4	0	4	4	3	4	0	**22**
Planning Services										
ArcGIS for Desktop	5	2	5	0	5	5	4	3	0	**29**
ArcPad (Mobile/Field GIS)	3	3	4	0	3	2	2	4	0	**21**
Intranet GIS Data Browser	4	4	5	0	5	5	4	3	0	**30**
ArcGIS Online	0	3	5	0	4	5	4	4	0	**25**
Internet GIS Data Browser	0	5	4	0	3	5	5	3	1	**26**
Spatial Analyst	1	3	4	0	5	1	4	4	0	**22**
3D Analyst	1	3	4	0	3	1	3	4	0	**19**
I-Tree	0	4	4	0	4	0	4	5	0	**21**

Existing and Desired Software	Existing	Cost Savings	Improved Efficiency	Potential Life Savings	Improved Decision Making	Enterprise Usage	Improve Customer Service	Cost of the Application	Generate Revenue	Total
Public Works										
ArcGIS for Desktop	4	2	5	0	5	5	4	4	0	**29**
ArcPad (Field GIS)	5	3	4	0	3	2	2	4	0	**23**
ArcGIS for Server	3	2	5	0	4	2	4	4	0	**24**
ArcGIS Online	0	3	5	0	4	5	4	4	0	**25**
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Internet GIS Data Browser	5	5	4	0	3	5	5	3	1	**31**
311 GIS Based Application	0	4	5	1	4	4	5	2	1	**26**
Services Guelph										
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Internet GIS Data Browser	0	5	4	0	3	5	5	3	1	**26**
311 GIS Based Application	0	4	5	1	4	4	5	2	1	**26**
Solid Waste Resources										
ArcGIS for Desktop	4	2	5	0	5	5	4	5	0	**30**
Internet GIS Data Browser	4	5	4	0	3	5	5	3	1	**30**
Intranet GIS Data Browser	4	4	5	0	5	5	4	3	0	**30**
Guelph Transit										

Existing and Desired Software	Existing	Cost Savings	Improved Efficiency	Potential Life Savings	Improved Decision Making	Enterprise Usage	Improve Customer Service	Cost of the Application	Generate Revenue	Total
ArcGIS for Desktop	3	2	5	0	5	5	4	4	0	**28**
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Internet GIS Data Browser / Bus Tracking App	3	5	4	0	3	5	5	3	1	**29**
Wastewater Services										
ArcGIS for Desktop	1	2	5	0	5	5	4	3	0	**25**
Data Mining/Geo-Enablement Tool/Application	0	4	4	0	5	5	3	4	0	**25**
Intranet GIS Data Browser	3	4	5	0	5	5	4	3	0	**29**
Internet GIS Data Browser	0	5	4	0	3	5	5	3	1	**26**
GIS Based Work Order System	2	3	5	1	4	4	4	1	0	**24**
Mobile Data Browser	0	3	4	0	4	4	3	4	0	**22**
Water Utility Capital Improvement Planning	0	3	4	0	4	2	3	5	0	**21**
Automated Vehicle Location (AVL)	1	3	4	3	4	3	4	1	0	**23**
Water Services										
ArcGIS for Desktop	4	2	5	0	5	5	4	2	0	**27**

Existing and Desired Software	Existing	Cost Savings	Improved Efficiency	Potential Life Savings	Improved Decision Making	Enterprise Usage	Improve Customer Service	Cost of the Application	Generate Revenue	Total
Data Mining/Geo-Enablement Tool/Application	0	4	4	0	5	5	3	4	0	**25**
Intranet GIS Data Browser	5	4	5	0	5	5	4	3	0	**31**
Internet GIS Data Browser	0	5	4	0	3	5	5	3	1	**26**
GIS Based Work Order System	2	3	5	1	4	4	4	1	0	**24**
Mobile Data Browser	0	3	4	0	4	4	3	4	0	**22**
Automated Vehicle Location (AVL)	1	3	4	3	4	3	4	1	0	**23**
ArcGIS Online	0	3	5	0	4	5	4	4	0	**25**
Water Utility Capital Improvement Planning	0	3	4	0	4	2	3	5	0	**21**

The following tables help highlight the most critical and highest priorities of the entire organization. Using the information above, these tables summarize the total score received for an application/solution and the number of times an application/solution is requested. Using this information can assist Guelph in prioritizing the planning, acquisition, and deployment of these solutions.

Applications	Num. Times Requested
Intranet GIS Data Browser	23
Internet GIS Data Browser	15
ArcGIS for Desktop	12
Mobile Data Browser	8
Data Mining/Geo-Enablement Tool/Application	7
ArcGIS Online	6
GIS Based Complaint Tracking	3
GIS Based Work Order System	3
311 GIS Based Application	2
ArcGIS for Server	2
ArcPad (Mobile/Field GIS)	2
Automated Vehicle Location (AVL)	2
Water Utility Capital Improvement Planning	2
3D Analyst	1
Citizen Service Request	1
Community Analyst	1
Data Reviewer for Addresses	1
Esri Story Maps	1
Internet GIS Data Browser / Bus Tracking App	1
I-Tree	1
Maps on TV	1
My Municipal Government Services	1
Polling Place Locator	1
Spatial Analyst	1

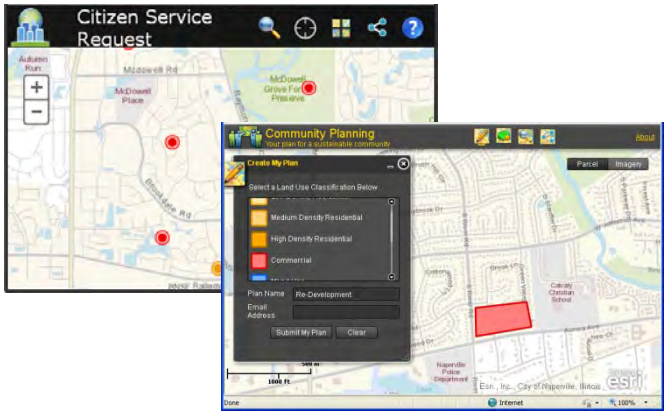
Applications	Total Sum of Scoring
Intranet GIS Data Browser	666
Internet GIS Data Browser	405
ArcGIS for Desktop	331
Mobile Data Browser	176
Data Mining/Geo-Enablement Tool/Application	175
ArcGIS Online	150
GIS Based Work Order System	70
GIS Based Complaint Tracking	63
ArcGIS for Server	60
311 GIS Based Application	52
Automated Vehicle Location (AVL)	46
ArcPad (Mobile/Field GIS)	44
Water Utility Capital Improvement Planning	42
Internet GIS Data Browser / Bus Tracking App	29
Citizen Service Request	28
Data Reviewer for Addresses	26
Community Analyst	25
My Municipal Government Services	23
Esri Story Maps	22
Spatial Analyst	22
I-Tree	21
3D Analyst	19
Maps on TV	17
Polling Place Locator	17

Final Software Considerations - Conclusion

As discussed in the first section of this chapter, the City of Guelph must consider each of the components of GIS while evaluating, selecting, planning and deploying GIS software. Following a process helps ensure successful deployment of ready to use applications that will have positive impacts across the organization.

Until recently it was difficult to acquire applications that met the needs of local governments. However, that has changed dramatically over the past few years. Now local governments can acquire the tools they need from software vendors. Creating and maintaining applications in-house can still be accomplished. However, doing so generally requires the employment of a highly skilled programming team to maintain and improve these applications. Organizations run the risk of developing highly customized applications only to lose the in-house expertise to maintain and expand the application moving forward. This leaves the organization vulnerable. Therefore, it is **recommended that the City of Guelph strive to implement only off-the-shelf applications**. In cases where these applications need to be augmented, the City should pay the vendor to add this functionality to the application.

This plan has recommended the extensive use of intranet and Internet applications. It is important that the City ensure that these solutions are all-inclusive and do not create stove pipes. In many cases, these applications serve as data viewers and provide some analytical capabilities. However, many of these solutions fall short of true enterprise-wide functionality. A true enterprise-wide solution will not only offer viewing and analytical capabilities but will allow the City to add a host of other tools via modules to the application. This includes; AVL, routing, reverse dialing, minor editing of data, plume generation, and other tools. If not, then separate applications have to be implemented for each of these needs thus creating application stove pipes and requiring customers to go to various applications to get what they need. At a minimum, the City should strive to make all GIS applications maintain continuity in the user interface and the database source.



Such application deployments are achievable. For example, utilizing Esri's ArcGIS for Local Government (AG4LG) or ArcGIS for Canadian Municipalities includes a host of resources that allow local governments to rapidly deploy GIS technologies. The City of Guelph can immediately take advantage of tools for inspections, dashboards, capital projects, community planning, citizen service request, emergency management maps, and many others. More information about these resources is available at: http://resources.arcgis.com/en/communities/local-government/index.html

http://www.esri.ca/en/content/arcgis-canadian-municipalities.

The City of Guelph is well positioned to quickly advance their GIS capabilities. By carefully considering and selecting the right software solutions and planning for deployment, the City will realize gains in efficiency, better decision making, cost savings, and increased customer service through expanded enterprise usage. Applications can be seen as the ultimate culmination of a successful enterprise-wide GIS. However, successful application deployment will be difficult if not impossible without changes to governance (discussed in detail in the Governance Chapter). The City must have the proper human resources to select, deploy, and maintain GIS applications. Staff resources at the City of Guelph today are insufficient to deploy the software solutions described within this chapter and should be strongly considered.

2014

GIS Training Model

City of Guelph, Ontario

Geographic Technologies Group

GIS Training Model

Chapter Outline

GIS Training Model 6-2

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GIS Training Model

Training will be an integral part of the City's continuing GIS implementation strategy and should revolve around a model that includes external training, internal training, and continuing education offerings. The training model should follow the same tiers of GIS users as outlined in previous chapters:

- A Tier 1 user is a Flagship GIS user who has access to a fully functioning GIS toolset including editing and complex analysis. Tier 1 users are those that use the entire ArcGIS suite, GIS data managers, and/or career GIS professionals.

- A Tier 2 Analytical user focuses on data analysis, in addition to general browsing capabilities. Tier 2 users conduct analytical tasks above and beyond what is offered at the Tier 3 level. They need a tool that allows for robust flexibility and a host of analytical tools such as provided by ArcGIS Desktop Basic.

- A Tier 3 Browser user requires only general browsing, simple cartographic output and basic GIS data query functions. Generally, Tier 3 users can have the majority of their GIS needs met by Internet and/or Intranet browser based map applications.

The recommended GIS Lead and technical staff will play a prominent role in the training model. In addition to bettering their own technical skills, it is recommended that the GIS Team in IT are proficient in GIS training to a degree that they are able to carry on training with other City employees. Discussed later in this chapter, the GIS Team in IT should use a "train the trainer" model to propagate their GIS skills to other City GIS users.

GIS Certification

Certifications are an effective way to ensure that staff is knowledgeable and proficient in their abilities. One recognized professional certification in the geospatial arena is the Geographic Information Systems Professional (GISP) credential. A GISP is a certified geographic information systems (GIS) professional who has met the minimum standards for ethical conduct and professional practice, as established by the GIS Certification Institute (GISCI). Information regarding the GISP professional certification can be found at www.gisci.org.

In addition to the GISP certification, Esri has introduced a new Esri Technical Certification Program that started in 2011. The Esri Technical Certification Program is designed to recognize those skilled in desktop, developer, and enterprise use of Esri technology. The certification is meant to distinguish individuals that possess a high level of technical expertise in the use of Esri software. It is recommended that the GIS Team in IT become certified in various areas of the Esri Technical Certification Program.

During their careers, other City of Guelph staff members may wish to become certified at various levels of GIS expertise and should be encouraged to do so as part of their professional development. This is a new program from Esri and as such will mature over the next few years. These certifications insure that staff is at an acceptable level of proficiency that is necessary to carry out their duties.

Currently there are eight different Esri certifications available; two more certifications are currently in development.

Current Certifications available include:

1. ArcGIS Desktop Associate*
2. ArcGIS Desktop Professional
3. ArcGIS Desktop Developer Associate
4. Web Application Developer Associate
5. Enterprise Geodatabase Management Associate
6. Enterprise Geodatabase Management Professional
7. Enterprise System Design Associate
8. Enterprise Administration Associate

*Note: All Professional level certifications must meet the ArcGIS Desktop Associate's level of requirements.

Additional information can be found at the following web location:

http://training.esri.com/certification/become.cfm

The following matrix shows the Esri certifications and levels of certification that are available or in the process of being developed:

Esri Certification Matrix

The following certification table shows the certification level, required qualifications and recommendations for staff levels that should consider acquiring the certification.

Certification	Qualifications	Recommended Staff
Geographic Information Systems Professional (GISP)	• Education – a bachelor's degree, or equivalent higher education, in addition to some specialized GIS education • Professional Experience – a minimum of 4 years professional GIS experience • Contributions to the Profession – substantial contributions to the GIS profession, such as volunteer service, presentations or publications • Professional Ethics – affirmed compliance with GISCI's Code of Ethics and Rules of Conduct	GIS Analyst, GIS Lead
ArcGIS Desktop Associate	• Construct a map using available datasets • Select the datasets necessary to publish a map or perform a specific analysis • Create new map datasets from analysis of existing datasets • Perform basic data editing • Select and perform spatial data analysis using standard tools	Tier II users GIS Analyst, GIS Technician

	• Apply basic map visualization and cartography skills • Use ArcGIS Explorer, ArcGIS Online, and desktop extensions	
ArcGIS Desktop Professional	• Utilize advanced modeling techniques including branching, iteration, scripting, etc. • Apply fundamental spatial statistics • Perform advanced vector and raster analysis including map algebra • Perform surface modeling and analysis • Understand and apply Python scripting • Perform fundamentals of spatial database design • Determine and define an appropriate coordinate system • Apply advanced visualization techniques • Understand and apply fundamental network analysis concepts • Build complex data sets • Author and publish a map service and image service • Have experience using ArcGIS Explorer, ArcGIS Online, and core ArcGIS Desktop extensions	Tier I GIS Analyst, Associate Analyst, GIS Lead
Enterprise Geodatabase Management Associate	• Understand basic ArcGIS concepts • Understand the system requirements for Relational Database Management System (RDBMS) • Design, install, and configure a geodatabase at a general level • Understand GIS workflows and their impact on the geodatabase • Manage data within the geodatabase at a general level • Perform geodatabase maintenance and troubleshooting • Use geoprocessing tools, command line, and performance monitoring and tuning tools	GIS Analyst, GIS Lead
Enterprise Geodatabase Management Professional	• Esri Certified Enterprise Geodatabase Management Professionals understand the components and architecture of the geodatabase and are skilled in developing and maintaining an ArcGIS multi-user enterprise. • This certification is for individuals with 5-7 years' experience as a database or GIS administrator and has managed an enterprise geodatabase for at least 3 years with advanced experience in a multi-user environment.	Tier I GIS Analyst, GIS Lead

ArcGIS Desktop Developer Associate	• Esri Certified ArcGIS Desktop Developer Associates are familiar with ArcGIS for Desktop application development. The candidate is a developer who is sufficiently familiar with ArcGIS technologies to use, configure, and deploy the software and build desktop GIS applications. • This certification is targeted for ArcGIS Desktop Developers who have a good context for ArcGIS for Desktop application development through familiarity with ArcGIS end-user tasks such as data analysis, data editing, data creation and data quality, map visualization, and map output.	Tier I GIS Analyst, GIS Lead
Enterprise Administration Associate	• Deploy and maintain a given solution based on a provided solution/system design • Make configuration changes to system architecture to meet production needs • Perform continuous monitoring and maintenance • Install and configure Esri and supporting software according to Esri best practices • Troubleshoot common Esri technology issues, including distinguishing between Esri and supported systems issues such as RDBMS and Web servers • Efficiently use Esri's licensing model • Determine appropriate GIS services to host in-house or delegate to ArcGIS Online • Determine efficient settings of pooled and non-pooled services • Diagnose and improve the performance of map services • Identify performance bottlenecks and recommend improvements • Setup map caching • Monitor the health of different components of the system and take appropriate action, if required • Utilize tools such as LDAP, Active Directory, IIS, J2EE Applications Servers, and Load Balancer/Balancing Software	GIS Analyst, Associate Analyst, GIS Lead
Web Application Developer Associate	A qualified candidate for the Esri Web Application Developer Associate Certification will be familiar with ArcGIS concepts and be aware of performance considerations for building Web applications. The candidate should be familiar with using object-oriented programming, as well as application documentation, maintenance, troubleshooting, and support. <u>A qualified candidate should be able to:</u> • Identify ArcGIS geometry types, relationships,	Tier I GIS Analyst, Associate Analyst, GIS Lead

	and operations • Define map and layer concepts and their applications in development • Understand relevant performance implications • Understand service configuration for out of the box services • Use services via REST and SOAP • Work with maps and layers, and other visualization elements • Use Web API tools • Work with secured services • Troubleshoot Web applications • Deploy Web applications	

Each certification requires the applicant to pass a certification examination, which will take about two hours to complete and includes a 90–95 multiple-choice question examination. Each certification exam costs $225 per certification type and level and are through Esri's testing partner, Pearson VUE.

ArcGIS Training Recommendations

It is important to note that the following recommendations do not account for existing expertise. For example, staff with a GIS Diploma or equivalent knowledge may not need some of these courses. Additionally, staff may have already taken classes or achieved a level of expertise on certain software products or functions precluding their need for certain classes. However, the following is a holistic look at what is needed. If a person already has the needed expertise they do not need to take the class unless they desire a refresher.

Tier 1 users – those GIS users responsible for the creation/maintenance of GIS databases – should take ArcGIS classes (ArcGIS II and ArcGIS III). These ArcGIS classes teach functionality, tools, workflows, and analysis for ArcGIS Desktop (Advanced, Standard, and Basic editions). ArcGIS II and ArcGIS III classes can be provided on-site by Esri or Esri Authorized Instructors. In addition to the ArcGIS class, Tier 1 GIS users that will have technical responsibilities with ArcGIS Server should also take the ArcGIS for Server "Sharing GIS Content on the Web" and "Building Geodatabases" classes. The GIS Lead and/or IT staff that are in a database administrator role should also take "Configuring and Managing the Multiuser Geodatabase" and "ArcGIS for Server: Site Configuration and Administration" to understand the use and storage of data in the ArcSDE environment.

Tier 2 users should be provided, at a minimum, with the multi-day ArcGIS II training class. This will include an introduction to the base functionality and tools of the software, from data management to desktop level analysis. Additionally, Tier 2 users should also take the ArcGIS III class. Students can either travel to an Esri office for this training, or hire an Esri Authorized Instructor to teach ArcGIS II on-site, or utilize a City staff member (recommended – more cost efficient).

Tier 3 users will receive customized training sessions on each individual end-user application that is developed. These applications are generally very intuitive and user-friendly with integrated contextual help. Half-day training sessions on each application will be sufficient. This training can be delivered through existing staff in an effort to achieve cost savings.

City of Guelph Training Alternatives

GIS training is mission-critical to the success of GIS within the City and there are many alternatives for GIS training. Esri offers a host of GIS classes and has a training center in nearby Toronto and numerous low-cost and free self-paced courses available on-line. Additionally, there are other vendors who provide certified Esri product training. Certified Esri trainers can be found at: http://www.esri.com/training/atp/locator/index.html. There are numerous local colleges that offer courses as well as books and other media forms of training. Esri courses are changed on a yearly or bi-yearly basis, depending on versioning, and offerings should be reevaluated regularly.

In appraising the City of Guelph's long term training needs, it would be very beneficial and cost effective to have the City of Guelph's GIS staff conduct the City's GIS basic training. To accomplish this, GTG recommends that the GIS Team in IT staff become in-house Esri trainers.

In the past Esri has offered an Authorized Trainer Program (ATP). This allowed non-Esri employees to become certified Esri trainers and would give them access to Esri training materials and order training books. However, in 2011 Esri discontinued to their Certified Training Professional (CTP) program. Due to the cost of training programs, combined with the increasing volume of training needed by City of Guelph, it is recommended that two staff become trainers (non-Esri certified) for the City of Guelph.

One GIS staff person should focus on topics relating to ArcGIS desktop and the other on geodatabase design, implementation, maintenance, as well as data management. These staff persons should take the Esri courses pertinent to the classes for which they will teach. They then should tailor a course to the City's GIS end-users. Esri courses cover a wide range of topics, some of which are not pertinent to City of Guelph's GIS users. Therefore, the GIS Team in IT trainers should customize each in-house course to focus on relevant topics tailored to the needs of the City of Guelph's GIS end-user community. These classes need not be the same duration as the Esri courses as the City's training material should be more concise and targeted.

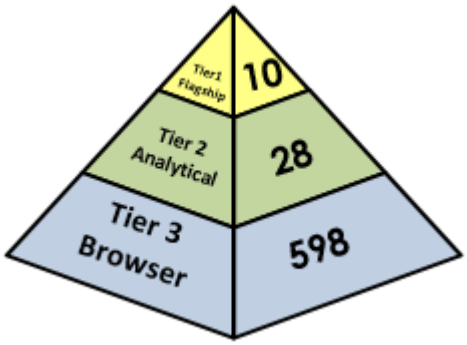
Projected GIS Software Tier-Level Users by Department

The following table summarizes the recommended GIS Software Tier-Level Users by Department. This table provides a snapshot of the level of training that will be necessary per each Department.

Projected GIS Software Tier-Level Users by Department				
City of Guelph Departments	Tier 1 Flagship Users	Tier 2 Analytical Users	Tier 3 Browser Users	Total Projected GIS Users
Building Services	0	0	20	20
Business Services	0	0	17	17
By-Law Compliance, Security & Licensing	0	0	22	22
City Clerk's Office	0	0	3	3
Community Engagement	0	0	7	7
Community Energy	0	0	3	3
Corporate Communication	0	0	9	9
Culture & Tourism	0	0	5	5
Downtown Renewal	0	2	2	4
Economic Development	0	0	4	4
Emergency Services	0	0	100	100
Engineering Services	2	4	20	26
Finance and Enterprise Services	0	0	10	10
Information Technology	2	0	0	2
Legal and Realty Services	0	0	5	5
Parks and Open Space	1	3	50	54
Planning Services	1	6	25	32
Public Works	1	1	150	152
Service Guelph	0	0	5	5
Solid Waste Resources	0	2	30	32
Guelph Transit	2	0	10	12
Wastewater Services	1	3	45	49
Water Services	0	7	56	63
Total:	**10**	**28**	**598**	**636**

Tier-Level Training Summary:

The following pyramid summarizes the total number of users needing training based on tiers of GIS use. The table on the right describes typical GIS activities by level of user.



Tiers of GIS Users

Group	Activity
Tier 1 Flagship	☑ GIS Administration ☑ Data maintenance ☑ Data conversion, creation ☑ Spatial Data Management ☑ Technical support ☑ Coordination
Tier 2 Analytical	☑ Data Maintenance ☑ Analytical functions/Geoprocessing ☑ Complex queries ☑ Modeling ☑ Use of desktop extensions ☑ High quality map production
Tier 3 Browser	☑ Browsing/Look-up ☑ Standard reports ☑ Simple query ☑ Map production

GIS Training Matrix

Several Esri courses have been identified which would be of benefit to continued GIS growth and professional development.

The following table summarizes the recommended training class regimen for the City. The table includes the class, trainer, course length, recommended participants, and initial offering plan year.

Class	Site	Trainer	Days	Year of Training – Based on this five year plan	Recommended Participants	Cost
ArcGIS I: Introduction to GIS (10.1)	On	Esri	2	1	Tier Two GIS Users	$980
ArcGIS II: Essential Workflows	On	Esri Authorized Trainer	3	1,2	Tier One and Two GIS Users	$5,000
ArcGIS III: Performing Analysis (10.1)	On	Esri Authorized Trainer	2	1,2	Tier One and select Tier Two GIS Users	$5,000
Building Geodatabases	Off	Esri	3	1	Tier One and Two GIS Users	$1,515
Creating and Maintaining Metadata Using ArcGIS Desktop	On	Web Course	3 Modules Self-Paced	1,2	Tier One and Two GIS Users	$96

Configuring and Managing the Multiuser Geodatabase	Off	Esri	3	1	Tier One and select Tier Two GIS Users	$1515
System Architecture Design Strategies	Off	Esri	3	1	GIS Lead and GIS Analysts	$1,515
Introduction to ArcGIS Server	Off	Esri	2	1	GIS Lead	$1,515
ArcGIS for Server: Site Configuration and Administration	Off	Esri	3	1,2	GIS Lead and GIS Analysts	$1,515
ArcGIS for Server Sharing GIS Content on the Web	Off	Esri	2	1	GIS Lead	$1010
Tier 3 Applications	On	Internal	1	1,2,3,4,5	Various	Various

GIS Training Offerings per Plan Year

The following table lists the recommended training class and recommended number of classes per plan year.

Class	FYI	FY2	FY3	FY4	FY5
ArcGIS Training Classes					
ArcGIS I: Introduction to GIS (10.1)	1	0	1	0	1
ArcGIS II: Essential Workflows	1	1	0	0	0
ArcGIS III: Performing Analysis (10.1)	1	1	0	0	0
Building Geodatabases	1	0	0	0	0
Creating and Maintaining Metadata Using ArcGIS	1	0	0	0	0
Configuring and Managing the Multiuser Geodatabase	1	0	0	0	0
System Architecture Design Strategies	1	0	0	0	0
Introduction to ArcGIS Server	1	0	0	0	0
ArcGIS for Server: Site Configuration and Administration	1	1	0	0	0

Class	FYI	FY2	FY3	FY4	FY5
ArcGIS for Server Sharing GIS Content on the Web	1	1	0	0	0
Tier 3 Applications					
Tier 3 Applications	4	4	4	1	1

Additional Training

One of the considerations for the city is to enter an Enterprise Licensing Agreement (ELA) with Esri. An ELA would give Guelph unlimited access to ArcGIS software. The ELA contains course credits that can be used for Esri online training. Following are additional training courses which would be of benefit to continued GIS growth and professional development to the City's GIS users.

Class	Site	Trainer	Days	Years of Training – based on this five year plan	Participants	Cost
Intro to Python Scripting Introduction to Geoprocessing Scripts Using Python	On	Esri	3	1	Various	$1,515
Implementing Versioned Workflows in a Multiuser Geodatabase (10.1)	Off	Esri	3	1	Various	$1,515
ArcGIS API for JavaScript	On	Esri	7 Modules	1	Various	Free
Sharing GIS Content Using an ArcGIS Online Subscription	Off	Esri	1 Module	1	Various	Free
Creating a Common Operational Picture with ArcGIS management (EOC)	Off	Esri and Internal	Training Seminar	1	Various	Free
GIS for Managers	Off	Internal	Training Seminar	1	Various	Free

The following table lists all of the recommended training courses along with user tier and prerequisites. Comments are provided that give a brief description of course contents. Detailed course descriptions can be found after this table. The courses are listed in a logical flow and recommended sequence.

Class	GIS Administrators	Tier 1	Tier 2	Tier 3	Suggested Prerequisites	Comments
ArcGIS I: Introduction to GIS		●	●	●	None	Basic level ArcGIS course teaching how to create maps, analyze data, and how to use various tools.
ArcGIS II: Essential Workflows		●	●		ArcGIS I: Introduction to GIS	Builds on content learned in ArcGIS I and adds training on how to author, share, and use geographic information in ArcGIS.
ArcGIS III: Performing Analysis		●	●		ArcGIS II: Essential Workflows	Building on ArcGIS I & II, learn how to efficiently solve spatial problems using various ArcGIS tools and vector, raster, and temporal data.
Building Geodatabases		●	●		ArcGIS I: Introduction to GIS	Learn how to build geodatabases, add data, and model real world relationships.
Creating and Maintaining Metadata Using ArcGIS		●	●		ArcGIS I: Introduction to GIS	Learn how to properly create and maintain metadata.
Configuring and Managing the Multiuser Geodatabase	●				ArcGIS II: Essential Workflows	Course prepares you to successfully deploy a multiuser geodatabase to manage critical geographic assets.
System Architecture Design Strategies	●				Review: www.esri.com/system design	Covers GIS system architecture design strategies. Learn how to plan and select the right system architecture for your organization.
Introduction to ArcGIS Server	●				ArcGIS II: Essential Workflows	Obtain skills to share GIS content on the web or across the enterprise.
ArcGIS for Server: Site Configuration and Administration	●				Introduction to ArcGIS Server	Learn how to install, configure, and manage an ArcGIS for Server system.
ArcGIS for Server: Sharing GIS Content on the Web	●				Introduction to ArcGIS Server	Learn how to publish professional map services that will provide spatial data to colleagues and non-GIS audiences.
Tier 3 Applications		●	●	●	None	Learn the basic capabilities and tools of the intranet/Internet/mobile applications.

Training Classes – Tier 1 and Tier 2

The following are the classes recommended for City of Guelph staff. Some classes in the Tier 1 level may coincide with classes recommended for staff classified in the Tier 2 level. These classes are noted.

ArcGIS I: Introduction to GIS (10.1)

Recommended Attendees

All Tier 1 and 2 users

Overview

This course teaches what a GIS is and what you can do with it. Working with various components of the ArcGIS system, you will create GIS maps, explore and analyze the data behind the maps, and apply methods to easily share your maps. By the end of the course, you will have a solid understanding of how GIS maps and ArcGIS tools are used to visualize real-world features, discover patterns, obtain information, and communicate that information to others.

Audience:

Individuals who do not have any prior GIS education or workplace experience with GIS.

Goals:

- Quickly create and share a GIS map using ArcGIS web-based tools and content.
- Find and organize geographic data and other GIS resources for a mapping project.
- Accurately display features on a GIS map and efficiently access information about them.
- Analyze a GIS map to identify where features that meet specific criteria are located.
- Share GIS maps and analysis results so they can be viewed using desktop applications, websites, and mobile devices.

Course Length

Two Days

Course Cost

$1,010 per student. Reduced rates may apply for onsite training.

Recommended Instructor\Location

City of Guelph Trainer, On-site

ArcGIS II: Essential Workflows

Recommended Attendees

All Tier 1 and select Tier 2 users

Overview

In this course, you will acquire fundamental skills needed to author, share, and use geographic

information and maps across the ArcGIS system. You will learn how to efficiently find, explore, manage, and analyze geographic data and create informative maps that showcase your work. The course covers a variety of techniques to effectively share GIS maps and resources with decision makers, stakeholders, and the public.

Audience:
GIS professionals and others who have an introductory-level knowledge of GIS concepts and limited ArcGIS experience.

Goals:

- Use ArcGIS software and content to create high-quality maps that combine data from different sources.
- Organize, create, and edit geographic data so that it is accurate and up to date.
- Manage, symbolize, and label map layers to support visualization and data exploration.
- Design an attractive page layout for maps that will be printed.
- Apply a standard workflow to analyze GIS data and solve spatial problems.
- Deliver maps and analysis results to multiple platforms so they are accessible to other ArcGIS users and to non-GIS users.
- Create presentation-quality maps and graphs.

Course Length
Three Days

Course Cost
$1,515 per student. Reduced rates may apply for onsite training.

Recommended Instructor\Location
City of Guelph Trainer, On-site

ArcGIS III: Performing Analysis (10.1)

Recommended Attendees
All Tier 1 Users and select Tier 2 Users doing day-to-day data editing

Overview:
Advance your foundational ArcGIS skills by learning how to obtain reliable results from different types of GIS analysis. You will apply a standard workflow to efficiently solve spatial problems using a variety of ArcGIS tools and vector, raster, and temporal data. Techniques to effectively share your analysis workflows and results are covered. This course is taught using ArcGIS for Desktop Advanced and some course exercises use tools provided in the ArcGIS Spatial Analyst extension.

Audience:
GIS analysts, specialists, and others who manage or conduct GIS analysis projects.

Goals:

- Choose appropriate data, methods, and tools to plan, execute, and document a given analysis project.
- Automate analysis tasks using geoprocessing models.
- Create a weighted suitability model to select the optimal location for a new site.
- Apply spatial statistics to examine distribution patterns and identify hot spots.
- Model temporal data to analyze and visualize change over time.
- Share analysis results so they are accessible and repeatable.

Course Length
Two Days

Course Cost
$1,010 per student. Reduced rates may apply for onsite training.

Prerequisites
ArcGIS II: Performing Analysis

Recommended Instructor\Location
City of Guelph Trainer, On-site

Building Geodatabases

Recommended Attendees
Select Tier 1 and select Tier 2 users

Overview:
This course teaches the essential concepts and skills needed to efficiently create a geodatabase, add data to it, and realistically model the real-world spatial relationships inherent to your data. You will learn about unique geodatabase features that help ensure data integrity over time and why the geodatabase is the preferred format for storing and managing geographic data. Course concepts apply to file-based and multiuser ArcSDE geodatabases. This course is taught using ArcGIS for Desktop Advanced.

Audience:
This course is for spatial data Coordinators who have a basic understanding of ArcGIS desktop applications and are ready to use the geodatabase. New and existing data Coordinators waiting to migrate to the geodatabase will benefit from this course.

Goals:

- Load data into the geodatabase from a variety of formats
- Set spatial reference and spatial domain
- Build a topology in the geodatabase

- Apply the appropriate topological rules for data
- Use the appropriate attribute rules for data with subtypes and domains
- Edit topological data
- Generate relationship classes
- Create and use rules for relationship classes and attribute data entry
- Produce and edit annotation

Course Length
Three Days

Course Cost
$1,515 per student. Reduced rates may apply for onsite training.

Recommended Instructor\Location
City of Guelph Trainer, On-site

Creating and Maintaining Metadata Using ArcGIS

Recommended Attendees
GIS Team in IT Staff who then train internal staff

Overview:
Metadata, the key information that documents a dataset, has emerged as a powerful tool for safeguarding an organization's investment in spatial data. Documenting datasets allows people to efficiently find them, evaluate their usefulness for a particular project, and share them with others. This course shows how metadata supports efficient management and use of spatial data and teaches practical strategies for creating and maintaining metadata using ArcGIS Desktop software. Students learn how to write proper metadata using tools in ArcCatalog and how to automate metadata workflows using templates.

Audience:
This course is designed for experienced ArcGIS users who work with, create, edit, or manage spatial data.

Goals:
- Describe the benefits of creating and maintaining metadata.
- Explain the advantages of adhering to a metadata standard.
- Implement an appropriate metadata standard.
- Search metadata to find datasets.
- Evaluate datasets using metadata.

- Plan metadata content.
- Write proper metadata.
- Create templates and use sample code to streamline metadata production.
- Identify various ways to share metadata.

Course Length
3 Modules

Course Cost
$96 per student.
Recommended Instructor\Location
Web Course

Configuring and Managing the Multiuser Geodatabase

Recommended Attendees
GIS Administrators

Overview:
This course prepares you to successfully deploy a multiuser geodatabase to manage your organization's critical geographic data assets. You will learn about the multiuser geodatabase architecture and installation options, and how to configure the geodatabase for efficient data storage and delivery of data access and editing capabilities to many users. Although course exercises use the enterprise geodatabase, many course concepts also apply to workgroup geodatabases.

Audience:
Spatial database administrators and GIS data managers who need to create, configure, and manage a multiuser ArcSDE geodatabase.

Goals:
- Install ArcSDE technology and configure it for your relational database management system.
- Create and connect to a multiuser geodatabase.
- Efficiently load and update data in a multiuser geodatabase.
- Configure storage settings to support your organization's data management workflows.
- Set up user roles and permissions to provide secure data access.
- Apply best practices to optimize geodatabase performance.

Course Length

Three Days

Course Cost
$1,515 per student. Reduced rates may apply for onsite training.

Recommended Instructor\Location
City of Guelph Trainer, On-site

System Architecture Design Strategies

Recommended Attendees
GIS Lead

Overview:
This course covers GIS system architecture design strategies and infrastructure architecture alternatives that support successful enterprise operations. You will learn comprehensive guidelines for planning and selecting the right system solution to meet your organization's needs. This course also covers performance validation and system capacity planning techniques for enterprise GIS deployments.

Audience:
This course is designed for senior staff including Senior Architecture and Software Architects, IT and System Administrators, GIS Coordinators, and Software Developers who need to understand enterprise system design, system architecture, hardware capacity planning and to troubleshoot performance problems.

Goals:

- Identify and collect user workflow requirements for an enterprise GIS system.
- Describe architecture alternatives for each identified user workflow.
- Recognize factors that impact GIS software performance and scalability.
- Identify network bandwidth requirements.
- Apply best practices for incorporating security throughout system design and deployment.
- Understand how platform technology affects ArcGIS performance and capacity.
- Develop a target enterprise hardware design to support capacity-planning needs.

Course Length
Three Days

Course Cost
$1,515 per student. Reduced rates may apply for onsite training.

Recommended Instructor\Location -Esri, Off-site

Introduction to ArcGIS Server

Recommended Attendees
GIS Lead, GIS Team in IT Staff

Overview:
ArcGIS Server provides a complete server-based GIS system that supports the use of centrally managed spatial data for mapping and analysis. This course introduces ArcGIS Server and teaches how to install, configure, and use the product as administrators and consumers of GIS services. Students learn how to publish maps, globes, and geoprocessing models that are optimized for performance. Students also create out-of-the-box Web applications using Coordinator and learn how to use GIS services in both Web applications and ArcGIS Explorer.

Audience:
This course is designed for those new to ArcGIS Server who want to learn about its architecture, capabilities, and client applications.

Goals:

- Understand the client and server components of the ArcGIS Server architecture.
- Configure the ArcGIS Server system.
- Administer the GIS Server and GIS services.
- Optimize the performance of GIS services.
- Build Web applications that consume GIS services.
- Utilize ArcGIS Explorer to work with GIS services.

Course Length
Two Days

Course Cost
$980 per student. Reduced rates may apply for onsite training.

Recommended Instructor\Location
Esri, Off-site

ArcGIS for Server: Site Configuration and Administration

Recommended Attendees
GIS Lead

Overview
In this course students will learn how to successfully install, configure, and manage an ArcGIS Server system that enables the sharing of GIS content across the enterprise. The ArcGIS Server architecture will be learned and recommended workflows will be taught for the configuration of ArcGIS Server sites. Best practices for system performance and security are emphasized.

Audience:
IT administrators, system administrators, GIS administrators, and others responsible for

installing, managing, or supporting an ArcGIS for Server system.

Goals:

- Successfully install ArcGIS for Server and create an ArcGIS Server site.
- Configure the Web Adaptor component to integrate your ArcGIS server with a web server.
- Publish services that have the capabilities required for your applications.
- Plan, create, and update a cache for high-performing map and image services.
- Tune and monitor services to ensure high performance.
- Implement security for your site and services that meets the needs of your organization.

Course Length
Three Days

Course Cost
$1,515 per student. Reduced rates may apply for onsite training.

Recommended Instructor\Location
Esri, Off-site

ArcGIS for Server Sharing GIS Content on the Web

Recommended Attendees
GIS Lead, Select GIS/IT Staff

Overview:
This course teaches how to deliver geographic information so that it can be effectively used by colleagues, decision-makers, and non-GIS audiences. You will learn how to share your professional maps, data, and workflows by creating and publishing high-performing GIS services that can be accessed from desktop computers, web browsers, and mobile devices.

Audience:

- GIS analysts, specialists, and other experienced ArcGIS users who want to share GIS resources in web maps and web-mapping applications.
- Developers who want to incorporate GIS services and web maps into custom applications.

Goals:

- Author and publish map services to share your authoritative GIS data.
- Create and publish image services to provide fast access to imagery.
- Design and build a map cache to maximize map service performance.
- Publish a geoprocessing service to share your GIS models and analysis results.

- Publish a feature service to enable data editing in a web application.
- Share GIS resources as stand-alone services and in web maps and web-mapping applications.

Course Length
Two Days

Course Cost
$1,010 per student. Reduced rates may apply for onsite training.

Recommended Instructor\Location
Esri, Off-site

Training Classes – Tier 3

Tier 3 users will need training specific to the GIS Intranet Data Browser, Mobile and/or Field applications, Work Order management, Routing, and other browser and analytical based applications. These training classes can be handled on-site on an as needed basis by the GIS Lead, GIS Analysts, and/or selected consultants.

The cost of all Tier 3 applications includes training for selected personnel. Enterprise-wide training of Tier 3 applications can be conducted by GIS Analysts or other technical staff person.

Tier 3 application training should cover the following topics/functionality:

- Brief overview of GIS
- Zoom and pan functionality
- Map extents
- Feature identification
- Map production/printing
- Reports (as needed)
- Spatial queries (as needed)
- Exporting maps
- Saving projects

In addition to the aforementioned topics/functionality, Tier 3 users should receive additional training specific to individual workflows or modules, such as work order request mapping and tracking or public notification via mapping module.

Continuing Education

An important part of professional GIS education is not only formal training classes, but also attending GIS conferences, being active in professional organizations, and joining area or regional user groups.

In addition to their regional and national users' conferences, GIS professional associations offer important peer-to-peer connections, professional journals and technical publications, training and other learning forums, and opportunities to form local, regional and national policy by serving on select committees and special interest groups. The two largest and best known professional GIS associations are:

- **Geospatial Information Technology Association** (GITA) – is the professional association and leading advocate for anyone using geospatial technology to help operate, maintain, and protect the infrastructure, which includes organizations such as utilities, telecommunication companies, and the public sector. Through industry-leading conferences—along with research initiatives, chapters, membership, and other programs—GITA provides education and professional best practices. (See www.gita.org for more information.)

- **Urban and Regional Information Systems Association** (URISA) – is a multidisciplinary association where professionals from all parts of the spatial data community come together to share concerns and ideas. URISA strives to provide exceptional educational experiences, a vibrant and connected community, and the essential resources needed for a successful career. (See www.usrisa.org for more information.)

GIS conferences allow registrants to attend workshops and seminars (some free, some at additional cost), and to interact with other GIS professionals from around the region, state, country, and world. The City of Guelph should budget every year for conference attendance. The International Esri User Conference is the premier Esri GIS learning experience and should be attended if at all possible.

Important conferences that should be attended by City of Guelph staff (at the GIS Lead's discretion, and within budgetary limitations) include:

Esri International User Conference

San Diego, California

http://www.esri.com/events/index.html

Who Should Attend?

The Esri User Conference is open to all Esri software users including:

• **New Users**	• **Experienced Users**
• **User Group Members**	• Coordinators
• **Programmers**	• Specialists
• **Analysts**	• Technicians
• **Local, Regional, National, and International Committee Members**	• Management Information Services and Industry Solutions Coordinators
• **Project Coordinators**	• Department Heads
• **Division Chiefs**	• Executive Directors
• **Faculty**	• Elected Officials
• **Board Members**	• Chairpersons
• **NGO Representatives**	• First Responders

Why Attend

- Find out everything you need to know about ArcGIS 10, from productivity and sharing to spatial analysis and imagery.
- See how to best leverage your current GIS investments.
- Learn from people like you who are tackling challenges similar to your own.
- Get updates and direction that will help your organization make better decisions.
- Gain tips, tricks, and tools to launch, update, and enhance your GIS projects.
- Connect with Esri staff including product and industry specialists, instructors, and the technical support experts.
- Hear straight from Jack Dangermond, Esri President.
- Be part of an inspired global community striving to design a better world.

Additionally, Esri Canada offers a series of conferences around the country. There are two conferences in close proximity – Toronto User's Conference (large event) and London's regional GIS conference. More information on these can be found at: http://www.esri.ca/en/content/esri-canada-user-conferences.

Urban and Regional Information Systems Association (URISA)

http://www.urisa.org/education-events/gis-pro-annual-conference/

The URISA Annual Conference offers a unique multidisciplinary approach, with sessions led by industry leaders, powerful keynote presentations, panels, roundtable discussions and networking meetings you won't find anywhere else.

This conference is vital to professionals concerned with the effective application of Management Information Services in all state and local government agencies, including:

- Community & Economic Development
- Emergency Services/Public Safety
- Environmental Management
- Land Records
- Public Works
- Tax Assessment
- Transportation Planning
- Urban Planning & Design
- Utilities

Some staff, including the GIS Team in IT, are members of URISA (Ontario Chapter). Therefore, all of the requisite notifications, newsletters, and conference/training information notices. This year the annual Be Spatial event is being help in Guelph (April 28th).

Municipal Information Systems Association (MISA) – Ontario Chapter

http://www.misa-asim.ca/?page=MA_CH_Ontario

MISA is a professional IT group. As per their website their goal is as follows: "Through the appropriate use of information technology and as a member of MISA, you will join a growing number of dedicated professionals working towards more effective government. Members and Patrons will have access to discounts on a variety of computer hardware and software products and services." MISA is working closely with URISA and the organizations are hosting joint events.

Communication Plan

Education is as important as formal training. GIS must be understood and the organization must be educated as to the benefits and uses of GIS technology. This can be accomplished through a number of methods. The City of Guelph must make a conscious effort to continually educate the organization. Therefore, it is important to have a communication/education plan. The purpose of a communication plan is to help an organization communicate with internal and external audiences. One of the weaknesses noted in the SWOT analysis (See

Chapter 3) was the lack of understanding of GIS and communication as to what GIS can do to assist the corporation. Therefore, it is critical that GIS is communicated in an organized and deliberate fashion at the city. Some of the reasons for the City of Guelph to communicate regarding GIS are as follows:

- Keep stakeholders informed about City GIS activities
- Provide ongoing project updates
- Distribute major reports and findings
- Educate GIS users as to approved standards
- Educate people about the benefits of GIS
- Make people aware of the City's GIS activities and the impact they are having
- Solicit and acquire input related to City GIS activities
- Understand the needs of the GIS user community
- Provide sound policy advice to decision makers
- Promote programs that the City thinks are critical to sound GIS development
- Promote the use of GIS in meeting objectives of key stakeholders

This communication plan is meant as a guide for the City's GIS development efforts. It describes the audiences that should be hearing from the City and ways to reach them. Additionally, it talks about ways for getting feedback as well as receiving communication from key audiences. The City should incorporate numerous ways to communicate with its audience. Following are the audiences that would typically be included in the communications plan:

- GIS Users Group –users that need to be kept in the loop on pertinent City directed GIS activities
- City Leaders – decision makers need to understand GIS and why it is being used
- General Public – typically peripherally aware of technology; need events and stories in the media to better inform
- Local and Regional Governments – potential users of the City's GIS; need to educate on what the City has to offer
- Surveyors – could support improving accuracy standards and modernization of land records

Communication Methods

Various methods exist that will allow the City to communicate its GIS message both internally and externally. Some methods, like email, brochures, newsletters, City web site, and council meetings, are always available and easily accessible. Other methods require significant effort and cost to create and distribute. These include publication articles, annual reports, participation at GIS conferences, and developing or updating strategic plans. The City will need to review the various communication methods available and decide which methods would best suit its needs. The following is a bulleted list of suggested communication methods, their frequency and costs:

- GIS Steering Committee

    - Already in place
    - Should meet quarterly at a minimum
    - Serves to keep decision makers informed and guide GIS implementation and priorities
    - No cost
- GIS User's Group
    - Should meet quarterly at a minimum
    - Serves to keep GIS users apprised of technology changes, city standards, and GIS direction
    - No cost
- GIS Day
    - November of every year
    - Opportunity to share GIS successes with the organization and public
    - Nominal cost – booth and various displays
    - Should participate and promote each year
- Annual User Satisfaction Survey and Report
    - January of each year
    - Users should be given an anonymous survey that allows them to give candid feedback as to how well GIS is meeting their needs
    - Data should be compiled in a report and shared with the corporation
    - No cost
- Annual Strategic Plan Update
    - March of each year
    - The strategic plan should be a living document. It should identify successes, changes in technology, and reprioritize GIS needs/expenditures each year.
    - Cost - $10,000 annually
- One-on-one Meetings
    - Monthly
    - The GIS Lead should meet one-on-one with key decision makers each month to apprize them on how GIS is progressing to meet their needs. Also, this is a great way to educate decision makers on other ways their department can use the technology.
    - Cost - $0
- Presentations to City Council
    - Annually
    - High level presentation to Council detailing how GIS is improving the City and expanding services
    - Cost - $0
- Blogs, email, and social media
    - As pertinent

    - GIS staff should establish a number of conduits for disseminating pertinent information, sharing ideas, and making announcement. Various digital mediums should be leveraged for this. Internal and external customers should be provided with various information conduits.
    - Cost - $0
- Newspapers and television
    - As pertinent but at least once a year
    - GIS staff should leverage the press. As exciting projects are completed, the story should be shared with media outlets. In most cases, they are looking for interesting stories and will gladly work with the City to publicize GIS successes.
    - Cost - $0
- Brochures, newsletters, and other marketing efforts
    - Throughout the year
    - GIS staff should make an effort to market successes and services. Brochures describing what GIS services, newsletters, the City web site, and other methods should be used to promote GIS throughout the City
    - Cost - $0 unless a profession firm is used to create an identity or brochure
- Seminars
    - Throughout the year
    - Formal software training is needed. However, these should be augmented with seminars that discuss GIS in a broader context. Seminars such as a GIS Manager's Workshop or Return-on-Investment with GIS are great ways to share how GIS can benefit an organization. These can be conducted by internal staff. However, a budget should exist to bring in outside speakers for key topics.
    - Cost - $5,000 annually

As the City continues to develop and grow its enterprise GIS, it is becoming increasingly necessary that strong and consistent communications are maintained with all GIS stakeholders internally and externally. The implementation of a pervasive communication plan will help to establish and formalize those lines of communications which in the long run, will help the City further improve the enterprise GIS while providing maximum value to its stakeholders.

2014

System Architectural Design

City of Guelph, Ontario

Geographic Technologies Group

System Architectural Design

Chapter Outline

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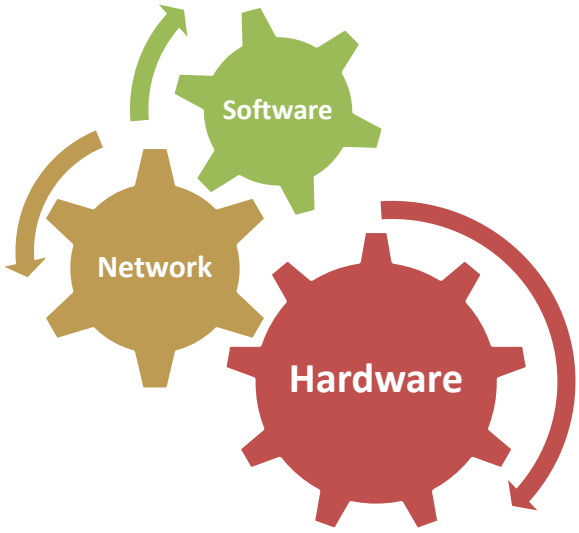
Introduction

Phase I of this project took an exhaustive look at the needs of each participating department/division in the City of Guelph. Other sections of this plan detail key elements such as a training plan and how the GIS should be governed. This section of the Strategic Plan will focus on the system architecture (hardware, software, and networking) of a system design and how they interact with each other, their place in an enterprise GIS, and how these components come together within the context of the current and future city organization model in regards to a full GIS enterprise implementation. As is discussed in the GIS Software Solutions chapter, the components of hardware, software and networking must be considered together. Using the same illustration, a series of gears, each component works with the others to operate effectively.



System Architectural Design Overview

The City of Guelph has a central group of GIS staff in their Information Technology Department – the GIS Team in IT. This GIS staff organizes and maintains GIS data and provides GIS services and products to the user community (see Governance Model chapter for more information). GIS architecture has significant impact on this recommendation and interrelates to the software deployment suggestions. For example, expansion of easy to use data browsers and Internet applications has been recommended that rely on a central GIS server. The City of Guelph houses their core GIS data via Esri's SDE version 9.3.1 and is the process of being upgraded to version 10.2.2. The City of Guelph GIS software of choice is from Esri. Esri licensing is under one customer number and are all managed centrally. This simplifies license management and insures that the City is getting the most use out of there GIS software. For instance, a user in a specific department may utilize an Esri license on a given day. Once the user is done using that license, it is moved back to the central pool of GIS licenses, then it becomes available to all users. In effect, this allows the City to maintain fewer copies of the software as the software is available in a pool on an as needed basis. The City should consider migrating its ArcView licenses to the concurrent use license model. The City has the following Esri licensing available in its centralized software pool:

Product	Product Type	License	Total Authorization
ArcView	Core	Single Use	23
ArcEditor	Core	Concurrent Use	5
Maplex	Extension	Concurrent Use	1
AGS Standard Enterprise	Core	Server	2
AGS Basic Enterprise	Core	Server	1
ArcGIS Data Interoperability	Extension	Concurrent Use	1

The GIS Team in IT has to be very cognizant of license availability and make sure that the departments who are accessing GIS software do not experience times when software licensing is not available. Therefore, software usage has to be monitored to ensure that ample software is available. If software usage is high for a particular software product then additional seats should be acquired. Conversely, if software usage is low for a product then eliminating seats should be considered. This optimization could save the City many thousands of dollars over time.

As discussed in the governance chapter, GIS is currently being run as a hybrid model with decentralized tendencies. The IT Department houses the central GIS authority but challenges exist to a full enterprise-wide implementation. Easy to use data browsers have been implemented that allow non-GIS users to quickly access GIS data, create their own reports, and create their own maps. This allows the casual user to have quick and user friendly access to GIS. Moving to this more distributive model in which end users can do a

majority of their own GIS tasks while relying on a central group of GIS experts for assistance with high level tasks is optimal.

Under this model, GIS users access data from a central server and are further enabled with easy-to-use GIS applications that allow them to conduct their spatial tasks without the assistance of other divisions. The following sections will detail the recommended architecture needed to advance this model.

End User Applications

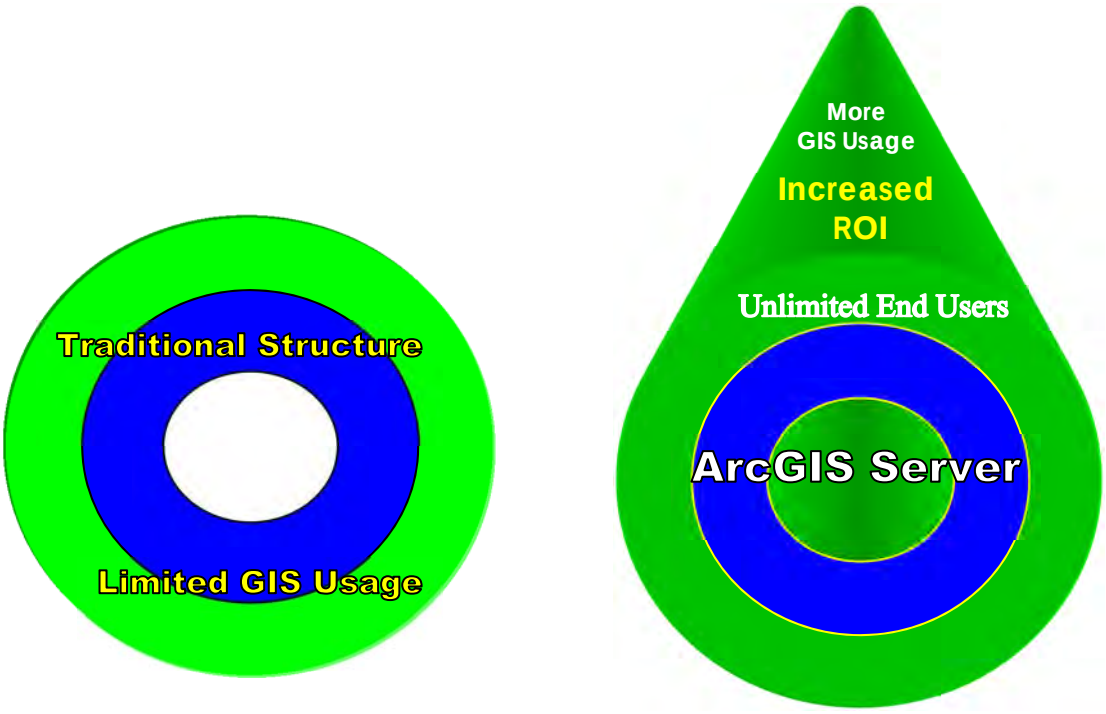
The needs assessment details each need identified and the appropriate method to meet those needs. The overall recommendation is to acquire or create end-user applications that utilize the central Esri compliant database. Some of these applications will be targeted to specific departments while others meet the needs of many departments. A detailed list of the end-user applications can be found in the software solutions chapter of this plan.

Desktop vs. Web Applications

Traditionally, GIS professionals have concentrated primarily on data compilation and focused application projects, investing time in creating GIS databases and authoring geographic knowledge. Desktop-based GIS applications have been used by end-users for connecting to geographic datasets via shared databases, building workflows for data compilation and quality control, authoring maps and analytical models and documentation. This was all based on selected licensing structure within the organization. Organizations commonly took advantage of the Esri Single Use or Concurrent licensing structures. The Single Use license is dedicated for each computer or network access point that has use rights for software, data or documentation. The concurrent license permitted execution of the software on any computer on the network and was controlled by a license manager application. This traditional distribution structure limits GIS application usage based on budgeted number of licenses.

ArcGIS Server Architecture

Progressively, an increased number of GIS professionals have begun to use and exploit their results in numerous GIS applications and settings. The work of authoring and serving geographic data will largely remain within the domain of GIS professionals. However, these professionals will also increasingly create server-based applications that allow common users, both internal and external to the organization, to have access to the power of GIS. The influence of GIS is still growing rapidly and will provide a powerful medium for managing, visualizing and communicating information between GIS professionals and the end-users. ArcGIS Server offers enterprise level functionality, which directly addresses Single Use and Concurrent Use license limitations by offering unlimited GIS application usage.



The implication for Guelph is that end users will more actively utilize GIS enterprise-wide, become more proficient users, and can perform more complex GIS tasks. By incorporating this level of end-user into an organization, Guelph will realize an increased return on investment (ROI) based on steady increases of internal and external GIS usage, utilizing server based applications and eliminating cost for single use licenses; making GIS widely available through custom application development via ArcGIS Server intranet/internet capabilities. Guelph should expand its use of ArcGIS Server and further enable users with a variety of user-friendly intranet and Internet based applications.

Licensing Overview

Most Esri products are licensed under the "click-wrap" license agreement included with the product. Esri generally requires signed licenses for server products, developer products, and web service products. A signed Master License Agreement (MLA) is required for some Esri products. The signature page is provided by Esri or its distributor and will incorporate the MLA Terms and Conditions. There are many different types of license agreements which Esri has placed on its software distribution to consumers. Listed below are the different types of license agreements and a description about each.

License Type	Description
Single Use License	A license dedicated for each computer or network access point that has use rights for software, data, or documentation. The licensee may make a second copy for his or her exclusive use on a portable computer so long as only one copy of the software, data, and documentation is in use at any one time.
Concurrent Use License	A license that permits execution of the software on any computer on the network. The number of simultaneous/concurrent users may be controlled by a License Manager to access and use the software, data, or documentation.
Server License	A license for server-side software that resides on a server computer and provides services to multiple users in a client/server distributed computer agreement.
Stand-alone Redistribution / Deployment License	A license which grants the licensee the right to redistribute a stand-alone application to end users provided the application is installed on each computer on which the application is run. This license requires payment of redistribution or deployment fees.
Server Deployment / Internet Redistribution License	A license which grants the right to redistribute an application via a network, the Internet, or Intranet to end users of the application. This license does not require a payment of additional deployment or redistribution fees.
Dual Use License	A license in which the software may be installed on a desktop computer and may be used simultaneously with either a PDA or handheld mobile device provided that the software is only used by a single individual at any one time.
Development and Testing Server License	A license which is specifically intended for a specific server/CPU which includes the right to develop, test, and deploy applications to end users. All developer licenses are single use licenses. This license is not intended for deployment of applications for production by end users. Licensees may use the Server software to test and deploy applications on the Internet provided the source and object code are not accessible to users of the application. Except for ArcGIS Server, the Server software administration tools may be copied and redistributed throughout the licensee's organization.

The two most common types of Esri licensing are single use and concurrent use licenses. A single use license is installed on and dedicated to a particular Personal Computer (PC). A concurrent use license permits execution of the GIS software from any PC on the network and allows multiple users to gain access at the same time. In this case there is a shared pool of "floating" licenses administered by a central license manager.

ArcGIS Product License Information

ArcGIS is an integrated collection of GIS software products for building a complete GIS. ArcGIS enables users to deploy GIS functionality wherever it is needed; on desktops, via servers, or custom applications, over the Web, or in the field. It introduces a new workflow that allows organizations to be more productive. As a complete geographic information system (GIS), ArcGIS allows agencies to author data, maps, globes, and models on the desktop, serve them to a GIS server for many others to access, and use them through web, desktop, and mobile clients. The diagram on the right highlights the interconnectivity between each of these realms within ArcGIS and their respective products.

Desktop GIS:

ArcGIS for Desktop is the primary platform for GIS professionals to compile, author, and use geographic information and knowledge. It provides a collection of software products that create, edit, import, map, query, analyze, and publish geographic information. Beginning at ArcGIS 10.1, Esri has changed the naming of their products. Previously the different licensing levels of ArcMap were: ArcView, ArcEditor, ArcInfo. Now, those products are called Basic, Standard, Advanced, respectively. ArcGIS desktop products also include ArcReader and ArcGIS Desktop Extensions. Although licensed separately, these products share the same core applications, user interface, and development environment. Each product provides additional GIS functionality, which is enabled as organizations move from ArcReader to Basic to Standard to Advanced.

ArcGIS desktop products share the same core applications (ArcMap and ArcCatalog), user interface, and development environment so users can share their work with others. Maps, data, symbology, map layers, geoprocessing models, custom tools and interfaces, reports, and metadata can be accessed interchangeably. A wide-ranging suite of optional extensions expands the functional capabilities of these products with specialized GIS tools.

- **Basic:**

  ArcGIS for Desktop Basic (previously ArcView) allows users to visualize, explore, and analyze geographic data, revealing underlying patterns, relationships, and trends. Organizations can use Basic to create maps, manage data, and perform spatial Assessment. Also, users can create and edit simple feature geometry like shapefiles, execute conversion of CAD and raster formats, and create charts and reports. Basic can be distributed by single use license or by concurrent use licenses.

- **Standard:**

  ArcGIS for Desktop Standard (previously ArcEditor) offers all the functionality of Basic and provides

advanced editing, data validation, and workflow management tools to maintain the integrity of an organization's data. With Standard, users can author quality maps and perform sophisticated spatial assessment. Additionally, organizations can use Standard to manage complex information, automate the editing workflow, and allow multiple users to update the same data simultaneously. It is preferred that editing on an enterprise GIS is done within a versioned environment which would require at least the Standard level license. Standard can be distributed by single use license or by concurrent use licenses.

- **Advanced:**

  ArcGIS for Desktop Advanced (previously ArcInfo) is the complete GIS product to build a comprehensive desktop GIS. The de facto standard for GIS professionals, Advanced provides additional tools for data integration and management, visualization, spatial modeling and assessment, and high-end cartography. It supports single-user and multi-user editing and automates complex workflows. Organizations can use Advanced to gather, build, and manage data, analyze geographic relationships, discover new information, and produce publication-quality maps. Advanced and its workstation extensions can be distributed by single use license or by concurrent use licenses.

- **ArcGIS Desktop Extensions:**

  ArcGIS Desktop Extensions allow organizations to perform additional tasks such as raster geoprocessing, three-dimensional visualization, manage workflows and geostatistical assessment. They can be distributed by single use license or by concurrent use licenses. Following is a list of the more common ArcGIS Desktop Extensions:

  - 3D Analyst – analyze data in a realistic 3D perspective
  - Geostatistical Analyst – use advanced statistical tools to analyze your data
  - Network Analyst – perform routing, closed facility, and service area analysis
  - Schematics – represent and understand your networks to shorten decision cycles
  - Spatial Analyst – use advanced spatial analysis to extract information from your data
  - Tracking Analyst – reveal and analyze time based patterns and trends in your data
  - Data Interoperability – improve data exchange and eliminate barriers to data use and distribution
  - Data Reviewer – improve data quality control management
  - Publisher – freely share maps and data with a broad range of users
  - Workflow Manager – better manage GIS tasks and resources
  - ArcScan – raster to vector data conversion
  - Maplex – improve ability to better position text and labels on maps

Server GIS:

ArcGIS for Server allows organizations to share GIS resources throughout the enterprise using web services — delivering GIS capabilities to large numbers of users over networks. Server empowers organizations to extend GIS beyond the desktop to other client applications, intranet and internet, and to mobile devices. This capability gives users interactive access to the GIS from anywhere. Server products allow GIS and data services to be hosted in a server-based environment. Centralized data management and application support, combined with adherence to GIS and information technology standards, make server GIS software products the key to broad use of geospatial technology with enterprise information systems.

Basically, Server GIS enables organizations to distribute their maps, models, and tools out to others in the organization in a way that fits well into business workflows. Staff in other departments and out in the field can query accurate, up-to-date data without a significant amount of training. This increases users' productivity as well as the enterprise as a whole. Server GIS complements ArcGIS Desktop by allowing GIS analysts to cost-effectively author maps, globes, and geoprocessing tasks on a desktop and publish them via a server using integrated tools. GIS functions can then be delivered as services throughout the enterprise. Server GIS allows GIS desktop applications and capabilities to be available to large numbers of users over IT networks without incurring costs associated with purchasing single use or concurrent licensing. Enterprise GIS users connect to central GIS servers using traditional desktop GIS as well as Web browsers, and mobile computing devices (Smart phones, tablets, etc.). ArcGIS for Server is IT-compliant and interoperates well with other enterprise software such as customer resource management (CRM), enterprise resource planning (ERP) systems, work order and asset management systems, AVL, etc. It offers support for interoperability standards in both the GIS domain (Open Geospatial Consortium) as well as the broader IT domains including World Wide Web Consortium (W3C), Representational State Transfer (REST), and Simple Object Access Protocol (SOAP).

ArcGIS for Server is a complete and integrated server-based GIS. It comes with out-of-the-box ready to deploy end user applications and services for spatial data management, visualization, and spatial assessment. Listed below are three tables which outline each of the available ArcGIS for Server editions and levels, and a list of available Extensions. Due to its full feature set and having all possible server capabilities, it is recommended that the City use the ArcGIS Server Advanced Enterprise version of Server. This version, though expensive, will allow the most room for growth and better serve the needs of the City's enterprise GIS. Server extensions would need to be evaluated by GIS staff to determine potential viability on a case-by-case basis.

ArcGIS Server Editions	
Basic	This edition of ArcGIS for Server is essentially ArcSDE bundled together with database replication functionality. Basic does allow for deploying GIS web services and simple web mapping, smartphone and tablet applications.
Standard	This edition of ArcGIS for Server includes all of the functionalities associated with the Basic edition, standard map publishing, Globe Server for 3D map rendering, standard geoprocessing, and web editing capabilities.
Advanced	This edition of ArcGIS for Server includes all of the functionalities associated with the Standard edition, plus advanced geoproccessing, along with several extensions. These extensions include ArcGIS Spatial Analyst for Server, 3D Analyst for Server, Geostatistical Analyst for Server, and Network Analyst for Server.

ArcGIS Server Levels	
Workgroup	This level of ArcGIS for Server includes a version of ArcSDE compatible with SQL Server Express 2008 R2 and is **limited to ten** simultaneous users and 10 GB of data storage.
Enterprise	This level of ArcGIS for Server allows for unlimited users and SDE database size, but requires the use of a Database Management Service (DBMS), such as SQL Server or Oracle. It also allows for a distributed installation of components.

ArcGIS for Server Extensions	Basic	Standard	Advanced
ArcGIS Schematics for Server		Yes	Yes
ArcGIS 3D Analyst for Server			Yes
ArcGIS Spatial Analyst for Server			Yes
ArcGIS Geostatistical Analyst for Server			Yes
ArcGIS Network Analyst for Server		Optional	Yes
ArcGIS GeoEvent Processor for Server		Optional	Optional
ArcGIS Data Interoperability for Server		Optional*	Optional*
ArcGIS Data Reviewer for Server		Optional*	Optional*
ArcGIS Workflow Manager for Server		Optional*	Optional*

ArcGIS for Server Extensions	Basic	Standard	Advanced
ArcGIS Image Extension for Server		Optional	Optional
ArcGIS for INSPIRE		Optional	Optional
ArcGIS ArcPad Extension for Server			Optional*
Portal for ArcGIS			Optional

* Windows Only

Mobile GIS:

ArcGIS for Mobile enables field-based personnel to capture, store, update, manipulate, analyze, and display geographic information with easy to use and intuitive applications. ArcGIS technology can be deployed on a range of mobile systems including Smartphones, iOS and Android Tablets, Windows laptops and tablets, and GPS devices.

- **Smartphones and tablets:**
  Esri and many business partners have developed numerous apps available to extend GIS to a broad audience. These apps allow field personnel to interact with an organization's GIS and perform a variety of tasks. Examples include collecting and updating spatial and tabular data, planning routes, capture video and pictures, and view a variety of maps. Several apps are available to download for free while others require purchasing. Currently, these apps work with Apple, Android, and Windows Mobile (depending on the app).

- **ArcGIS for Windows Mobile:**
  ArcGIS for Windows Mobile allows organizations to deploy easy to use applications to nearly any Windows device. These apps enable field personnel to view and navigate maps, collect, and edit and update GIS data. Any device running the following operating systems can utilize ArcGIS for Windows Mobile:
    - Windows Embedded Handheld 6.5 Professional and Classic editions
    - Windows Mobile 6.0, 6.1 and 6.5 Professional and Classic editions
    - Windows 8, Windows 7, Vista, and XP

- **ArcPad:**
  ArcPad is software for mobile GIS and field mapping applications. ArcPad provides mapping, GIS, and advanced GPS integration to field users via handheld and mobile devices. Data collection with ArcPad is fast and easy and improves field-based data validation and availability. ArcPad is distributed by single use license and dual use license. It is not licensed for navigational use.

The City has planning a mobile GIS pilot project. The project will include and analysis of:

- Integration of GIS automation capabilities in the field
- Improved access to GIS map and attribute queries in the field
- Testing of asset inventory tools, integrated photography, and laser rangefinders in the field
- Identification of efficient and automated workflows using standardized procedures, intelligent forms, and menu-driven attribution

Conceptual Enterprise GIS Architecture, Functions, and Standards

It is important to understand the conceptual flow of the GIS recommended for the City of Guelph. The graphic below diagrams the conceptual enterprise GIS architecture. In keeping with an enterprise architectural model, GIS has been placed within five separate architecture layers as follows: access channels, applications, middleware, data and information, and technology.

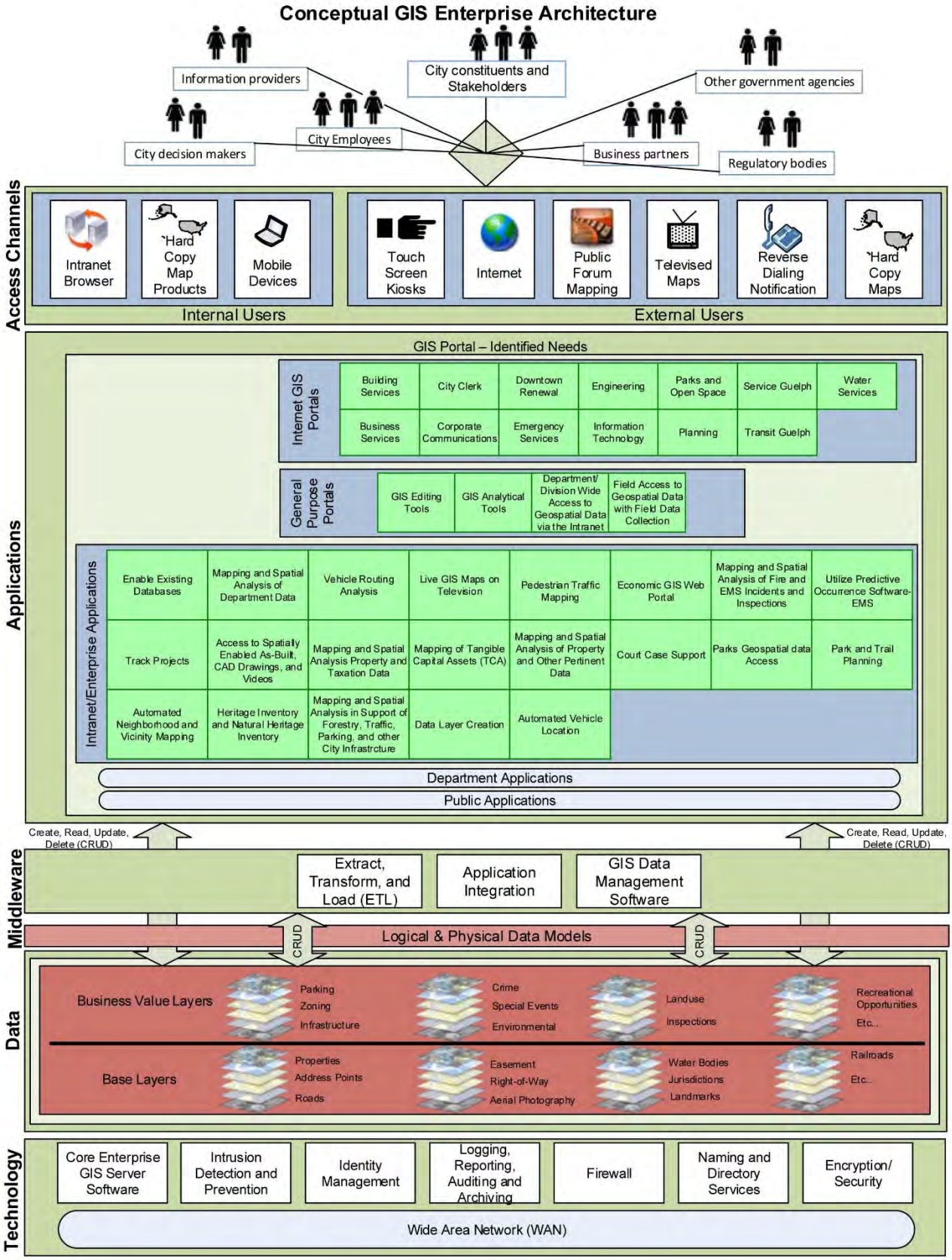
Access Layer - This layer contains the methods and technologies in which end-users will access the GIS data. Optimally the GIS will serve not only employees but be relied upon by the public, decision makers, private agencies, and other government agencies. There will be many ways that users will be able to access and utilize GIS data. Internal users will be able to access data via intranet portals, GIS editing software tools, analytical software tools, mobile tools, and hard copy map products. External users will have a host of access options including; Internet portals, public forum mapping presentations, and hard copy maps.

Applications Layer - Real GIS success is achieved when users are able to utilize GIS to solve their daily problems, automate a task – thus increasing efficiency, and/or do their job more effectively and efficiently. This is accomplished through the application layer. Guelph staff identified many GIS applications that would help them accomplish their tasks. The conceptual design identifies these as enterprise applications. Some of these applications will have utility for all departments, while others for just a few. Additionally, many departments identified that the public would benefit from Internet portals into the data and processes that their department manage. This eGovernment concept has taken root in the GIS world. Local governments are now offering specific GIS applications to the public. For instance, users could use a mapping interface to plot their address, their utilities, and their day of service or view crime statistics for their neighborhood. Additionally, general purpose portals will be available for users to access GIS data for many of their daily GIS tasks.

Middleware – This layer is managed by software tools. GIS and database management software will allow the appropriate users to access the files needed to perform their daily tasks. Appropriate users will be given access to edit and maintain certain datasets. Other users will be accessing data for viewing only.

Data and Information Layer - This layer addresses the need to manage data in a logical, orderly, and non-redundant fashion. GIS tools will manage data transactions including creating, reading, updating, and deleting. The system should be designed and implemented such that the ability to change data will only be granted to the appropriate staff. Additionally, viewing rights will only be granted to those department's staff that need access to specific data elements. Sensitive data sets will be GIS enabled such as some elements of crime data, customer data, and financial records. These sensitive data sets will only be accessible by approved personnel.

Technology Layer - This is the layer handled almost solely by the Information Technology group. This layer involves data security, networking, and a host of technical components that are critical to the GIS effort and data integrity.


Conceptual GIS Enterprise Architecture
Information providers
City constituents and Stakeholders
Other government agencies
City decision makers
City Employees
Business partners
Regulatory bodies
Access Channels
Intranet Browser
Hard Copy Map Products
Mobile Devices
Internal Users
Touch Screen Kiosks
Internet
Public Forum Mapping
Televised Maps
Reverse Dialing Notification
Hard Copy Maps
External Users
Applications
GIS Portal – Identified Needs
Internet GIS Portals
Building Services
City Clerk
Downtown Renewal
Engineering
Parks and Open Space
Service Guelph
Water Services
Business Services
Corporate Communications
Emergency Services
Information Technology
Planning
Transit Guelph
General Purpose Portals
GIS Editing Tools
GIS Analytical Tools
Department/ Division Wide Access to Geospatial Data via the Intranet
Field Access to Geospatial Data with Field Data Collection
Intranet/Enterprise Applications
Enable Existing Databases
Mapping and Spatial Analysis of Department Data
Vehicle Routing Analysis
Live GIS Maps on Television
Pedestrian Traffic Mapping
Economic GIS Web Portal
Mapping and Spatial Analysis of Fire and EMS Incidents and Inspections
Utilize Predictive Occurrence Software-EMS
Track Projects
Access to Spatially Enabled As-Built, CAD Drawings, and Videos
Mapping and Spatial Analysis Property and Taxation Data
Mapping of Tangible Capital Assets (TCA)
Mapping and Spatial Analysis of Property and Other Pertinent Data
Court Case Support
Parks Geospatial data Access
Park and Trail Planning
Automated Neighborhood and Vicinity Mapping
Heritage Inventory and Natural Heritage Inventory
Mapping and Spatial Analysis in Support of Forestry, Traffic, Parking, and other City Infrastrcture
Data Layer Creation
Automated Vehicle Location
Department Applications
Public Applications
Create, Read, Update, Delete (CRUD)
Create, Read, Update, Delete (CRUD)
Middleware
Extract, Transform, and Load (ETL)
Application Integration
GIS Data Management Software
CRUD
Logical & Physical Data Models
CRUD
Data
Business Value Layers
Parking
Zoning
Infrastructure
Crime
Special Events
Environmental
Landuse
Inspections
Recreational Opportunities
Etc..
Base Layers
Properties
Address Points
Roads
Easement
Right-of-Way
Aerial Photography
Water Bodies
Jurisdictions
Landmarks
Railroads
Etc..
Technology
Core Enterprise GIS Server Software
Intrusion Detection and Prevention
Identity Management
Logging, Reporting, Auditing and Archiving
Firewall
Naming and Directory Services
Encryption/ Security
Wide Area Network (WAN)

Existing Servers

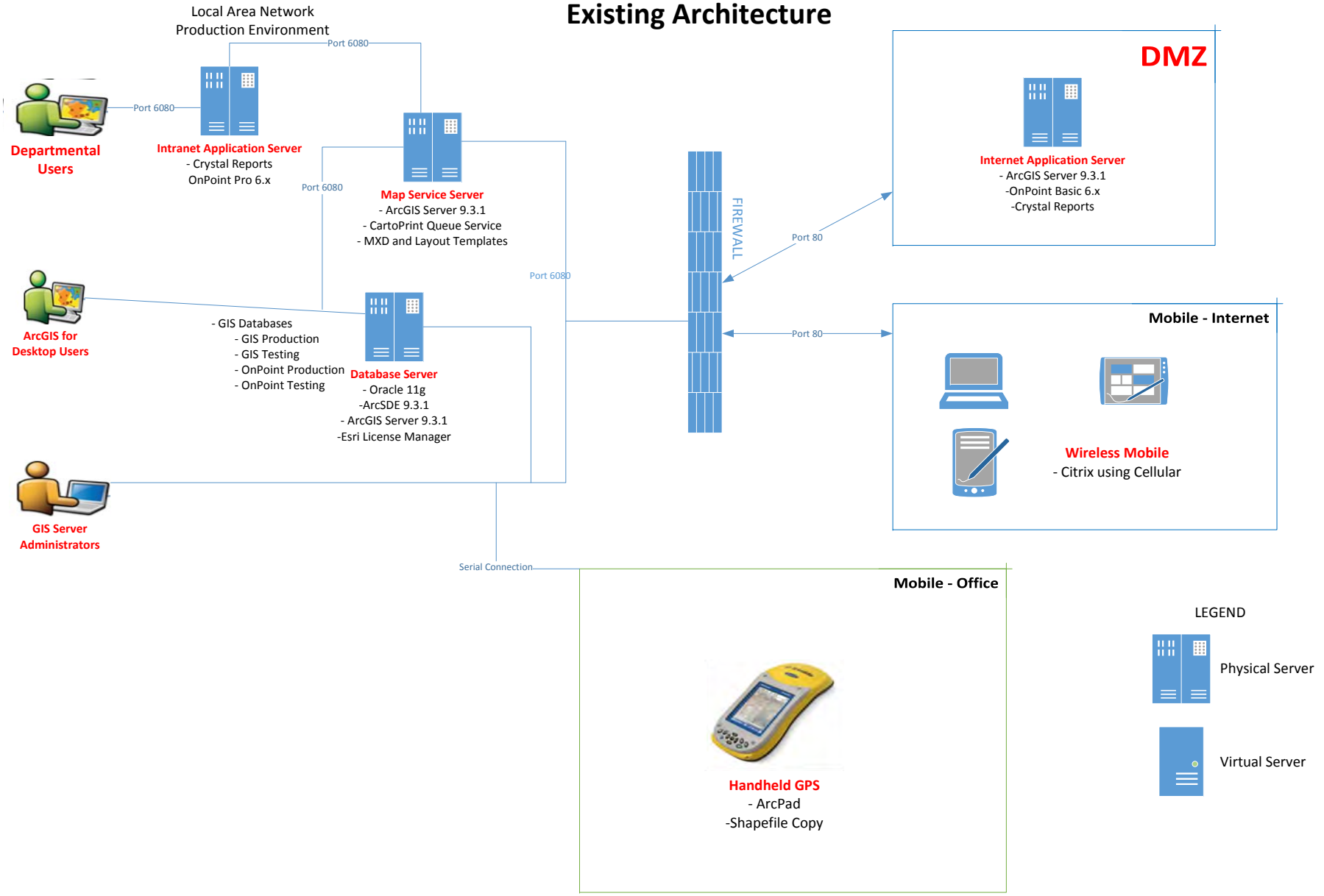
The City of Guelph has a number of servers for housing GIS data and applications. The following are the servers utilized by the enterprise GIS (prior to the GIS Upgrade project):

- Aap18gisw
    - System Specs
        - HP ProLiant DL360 G6
        - Window Server 2008 SP2
        - Intel Xeon 2.667GHz Quad core
        - 4GB RAM
    - Use
        - Intranet Application Server
- Aap19gisw
    - System Specs
        - HP ProLiant DL360 G6
        - Window Server 2008 SP2
        - Intel Xeon 2.667GHz Quad core
        - 4GB RAM
    - Use
        - Map Service Server
- Aap20gisw
    - System Specs
        - HP ProLiant DL360 G6
        - Window Server 2008 SP2
        - Intel Xeon 2.667GHz Quad core
        - 4GB RAM
    - Use
        - Internet Application Server
- Adb08gisw
    - System Specs
        - HP ProLiant DL360 G6
        - Window Server 2008 SP2
        - Intel Xeon 2.667GHz Quad core
        - 8GB RAM
    - Use
        - Oracle Database Server

Recommended System Architecture

The City of Guelph has implemented a client-server based GIS architecture that is centered on the geodatabase and ArcGIS for Server. As the graphic illustrates below this centrally managed system houses all GIS data and applications. In turn, data and applications specific to the needs of each department and user need will be made available to the end users through various applications and methods.

Enterprise GIS System
Existing Architecture

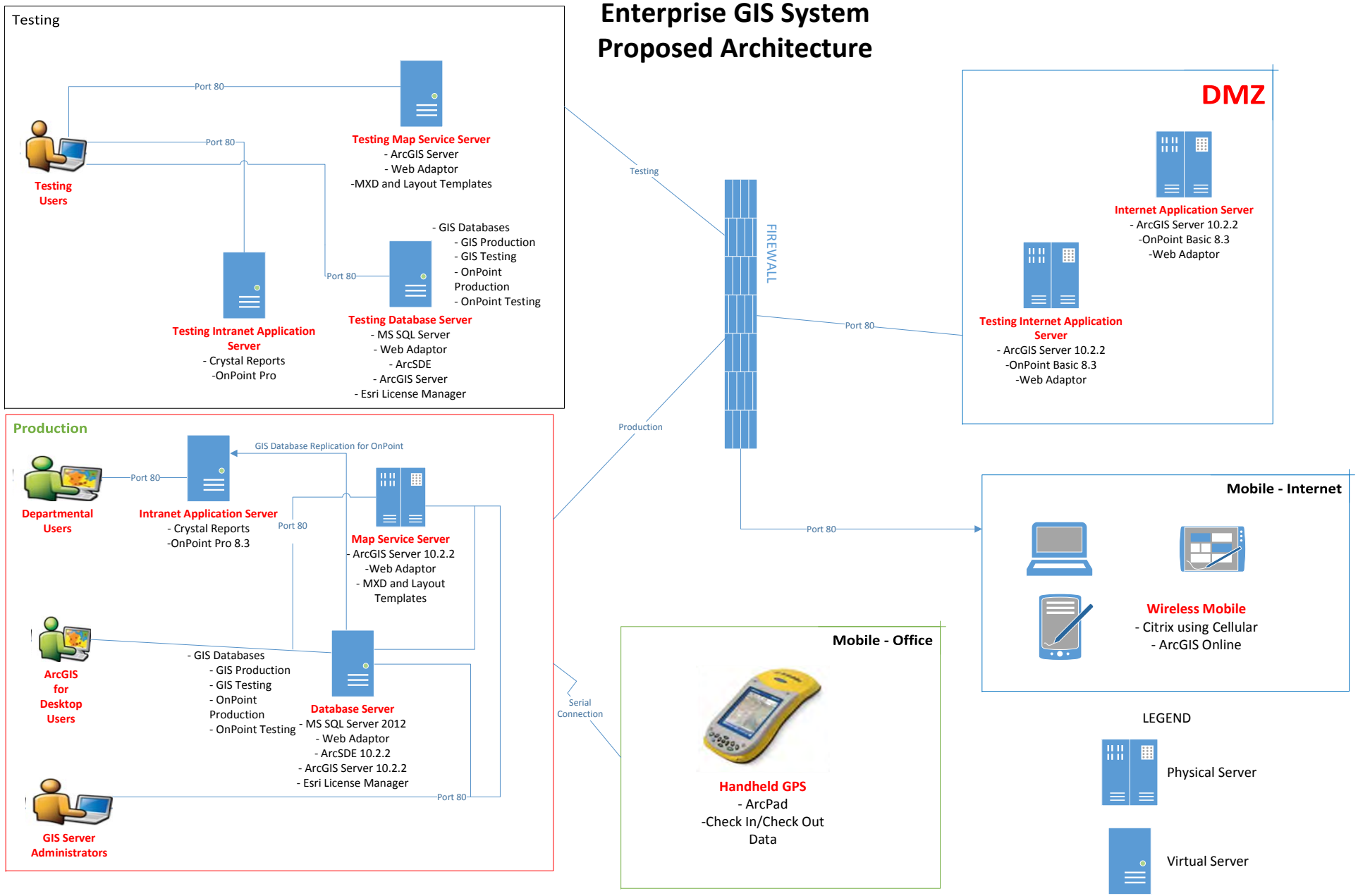


The existence of centrally-located enterprise geodatabase will continue to be the cornerstone component in Guelph's GIS program. The geodatabase is directly accessed through multiple desktop GIS applications, as well as various Esri ArcGIS Services.

The second major component of Guelph's recommended GIS architecture is the Esri ArcGIS for Server (AGS) suite. AGS consists of three major parts: GIS Server(s), Web Adaptor(s), and Web Server(s). See the Hardware section below for a summary of these components.

The following graphic illustrates the proposed architecture for the City's enterprise GIS. This architecture incorporates the following changes:

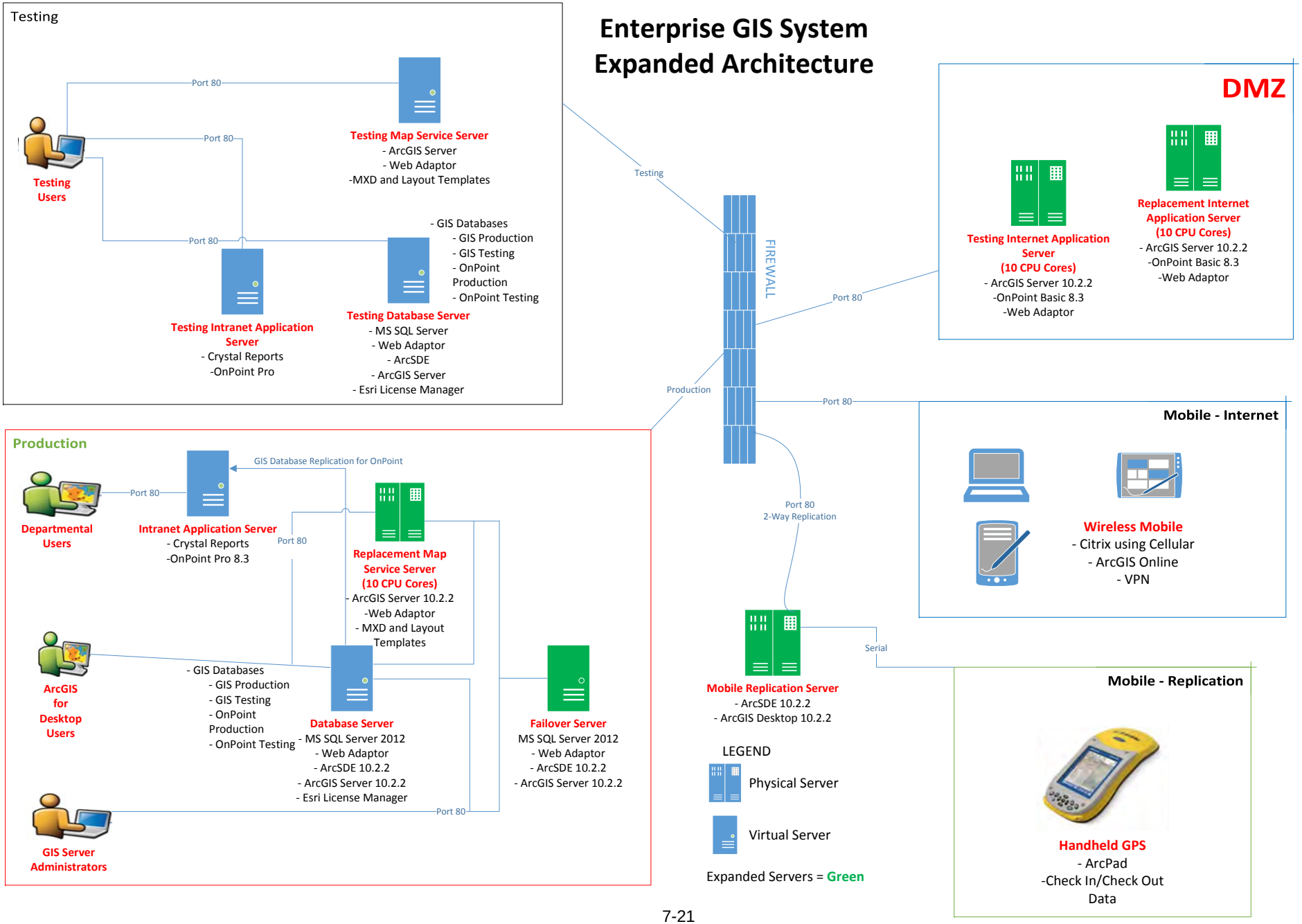
- the provision of a full testing environment including servers and applications
- changing ArcGIS Server connectivity from port 6080 to port 80 (web adaptor) to improve performance
- upgrading ArcGIS applications to version 10.2.2; upgrading OnPoint to version 8.3
- establish geodatabase replication between ArcGIS and OnPoint Production databases
- use ArcPad check-in/check-out procedures in the mobile GPS environment (Note: this will be tested and reviewed as part of the Mobile/Field GIS Pilot Project Study commencing in June 2014)


Enterprise GIS System
Proposed Architecture
Testing
Port 80
Port 80
Testing Users
Testing Map Service Server
- ArcGIS Server
- Web Adaptor
-MXD and Layout Templates
Port 80
- GIS Databases
- GIS Production
- GIS Testing
- OnPoint Production
- OnPoint Testing
Testing Intranet Application Server
- Crystal Reports
-OnPoint Pro
Testing Database Server
- MS SQL Server
- Web Adaptor
- ArcSDE
- ArcGIS Server
- Esri License Manager
Testing
FIREWALL
Port 80
DMZ
Internet Application Server
- ArcGIS Server 10.2.2
-OnPoint Basic 8.3
-Web Adaptor
Testing Internet Application Server
- ArcGIS Server 10.2.2
-OnPoint Basic 8.3
-Web Adaptor
Production
Production
GIS Database Replication for OnPoint
Port 80
Departmental Users
Intranet Application Server
- Crystal Reports
-OnPoint Pro 8.3
Port 80
Map Service Server
- ArcGIS Server 10.2.2
-Web Adaptor
- MXD and Layout Templates
Port 80
Mobile - Internet
Wireless Mobile
- Citrix using Cellular
- ArcGIS Online
ArcGIS for Desktop Users
- GIS Databases
- GIS Production
- GIS Testing
- OnPoint Production
- OnPoint Testing
Database Server
- MS SQL Server 2012
- Web Adaptor
- ArcSDE 10.2.2
- ArcGIS Server 10.2.2
- Esri License Manager
Port 80
GIS Server Administrators
Serial Connection
Mobile - Office
Handheld GPS
- ArcPad
-Check In/Check Out Data
LEGEND
Physical Server
Virtual Server

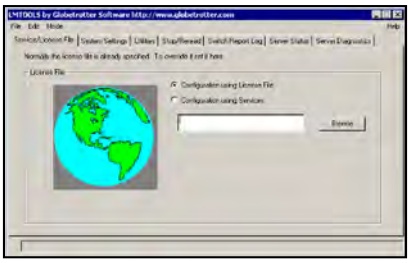
The proposed environment will improve the enterprise GIS for the existing user base by updating applications to current revisions, improve performance, and improve efficiency of procedures. The existence of a full test environment will allow GIS staff to perform comprehensive testing on future hardware/software solutions, software/hardware patches and upgrades, security access, etc. to ensure viability of those solutions prior to deployment in the production environment.

The following graphic illustrates the expanded architecture for the City's enterprise GIS. This architecture goes beyond the proposed architecture in order to add additional redundancy to the system and to support additional anticipated growth in the user base as well as adding additional security features. In addition to the previously mentioned proposed changes, this architecture incorporates the following changes:

- replacement of the Map Service Server in Production with a more robust server to support anticipated growth in the user base
- addition of a Failover Server in Production to add redundancy to the enterprise GIS
- replacement of the Internet Application Server with a more robust server to support anticipated growth in the user base
- addition of a Mobile Replication Server outside the Firewall to support all mobile data collection efforts by adding an extra layer of security and 2-way replication between the production database and the mobile database


Enterprise GIS System
Expanded Architecture
Testing
Port 80
Port 80
Port 80
Testing Users
Testing Map Service Server
- ArcGIS Server
- Web Adaptor
-MXD and Layout Templates
- GIS Databases
- GIS Production
- GIS Testing
- OnPoint Production
- OnPoint Testing
Testing Intranet Application Server
- Crystal Reports
-OnPoint Pro
Testing Database Server
- MS SQL Server
- Web Adaptor
- ArcSDE
- ArcGIS Server
- Esri License Manager
Testing
FIREWALL
Production
Port 80
DMZ
Testing Internet Application Server
(10 CPU Cores)
- ArcGIS Server 10.2.2
-OnPoint Basic 8.3
-Web Adaptor
Replacement Internet Application Server
(10 CPU Cores)
- ArcGIS Server 10.2.2
-OnPoint Basic 8.3
-Web Adaptor
Port 80
Mobile - Internet
Wireless Mobile
- Citrix using Cellular
- ArcGIS Online
- VPN
Production
Departmental Users
Port 80
Intranet Application Server
- Crystal Reports
-OnPoint Pro 8.3
GIS Database Replication for OnPoint
Port 80
Replacement Map Service Server
(10 CPU Cores)
- ArcGIS Server 10.2.2
-Web Adaptor
- MXD and Layout Templates
Port 80
2-Way Replication
ArcGIS for Desktop Users
- GIS Databases
- GIS Production
- GIS Testing
- OnPoint Production
- OnPoint Testing
Database Server
- MS SQL Server 2012
- Web Adaptor
- ArcSDE 10.2.2
- ArcGIS Server 10.2.2
- Esri License Manager
Failover Server
MS SQL Server 2012
- Web Adaptor
- ArcSDE 10.2.2
- ArcGIS Server 10.2.2
Port 80
GIS Server Administrators
Mobile Replication Server
- ArcSDE 10.2.2
- ArcGIS Desktop 10.2.2
Serial
Mobile - Replication
Handheld GPS
- ArcPad
-Check In/Check Out Data
LEGEND
Physical Server
Virtual Server
Expanded Servers = Green

The expanded environment will improve the enterprise GIS by expanding the architecture to support anticipated growth in the user base, providing additional performance to support those users, by adding redundancy to the production environment, and by providing a more secure environment for movement of data between the production and mobile environments.



Currently many departments are using GIS software. It is being recommended that all GIS software licensing continue to be managed and coordinated by the GIS Team in IT. The use of concurrent licensing expands the availability of desktop software; therefore, all Esri ArcGIS desktop and extension licenses should be managed through this centralized system.

Currently the City maintains a testing environment at the database level only. In order to have a comprehensive test environment that would allow staff to accurately test alternative technology solutions, it is recommended that the test environment also contain hardware and applications. This would be more representative of real world conditions and allow staff to make better informed technology decisions.

GIS is being used extensively throughout Guelph departments and it is anticipated that many more users will need varying access to the GIS in the near future. The following chart details the anticipated users of GIS within the City of Guelph agencies based on the needs assessment. Additionally, numerous public access portals have been recommended pushing the number of potential GIS users exponentially.

Projected GIS Software Tier-Level Users by Department				
City of Guelph Departments	Tier 1 Flagship Users	Tier 2 Analytical Users	Tier 3 Browser Users	Total Projected GIS Users
Building Services	0	0	20	20
Business Services	0	0	17	17
By-Law Compliance, Security & Licensing	0	0	22	22
City Clerk	0	0	3	3
Community Engagement	0	0	7	7
Community Energy	0	0	3	3
Corporate Communication	0	0	9	9
Culture & Tourism	0	0	5	5
Downtown Renewal	0	2	2	4
Economic Development	0	0	4	4
Emergency Services	0	0	100	100
Engineering Services	2	4	20	26
Finance	0	0	10	10
Information Technology	2	0	0	2

Legal Realty	0	0	5	5
Parks and Open Space	1	3	50	54
Planning	1	6	25	32
Public Works	1	1	150	152
Service Guelph	0	0	5	5
Solid Waste	0	2	30	32
Guelph Transit	2	0	10	12
Wastewater	1	3	45	49
Water	0	7	56	63
Total:	**10**	**28**	**598**	**636**

Hardware

Like many organizations, the City is continually upgrading hardware. New software packages often require new computer hardware. The City is also continually budgeting replacements for older PCs. The following sections document hardware specifications.

Server Recommendations

Optimal server configuration for ArcGIS for Server is complex and hinges on many factors. Some of the questions to be asked are as follows:

- What is the total number of simultaneous GIS Users (Internal and External)?
- When will these users come on-line?
- How will this user base scale up or down in the future?
- Are all of the users ArcGIS for Server users or are some of them ArcGIS for Desktop?
- Is the number of user's total user's or anticipated concurrent user's? If they are total users, how many concurrent users are expected?
- How many of the users are expected to be internal (using something like an Intranet Viewer) and how many are public? Most likely these different types of users will be treated differently in how many requests they make per minute.
- Is an Esri enterprise licensing agreement (ELA) available for the City? The cost of ArcGIS for Server is significant. Therefore, if no ELA exists then the number of users might have to be controlled based on limitations in funding for ArcGIS for Server.

The configuration of ArcGIS Server is complex. It is recommended that the City continue to deploy multiple GIS Servers. Servers will be utilized for different functions such as: database servers, container machines, and web application services. Esri provides classes on ArcGIS for Server scaling. The use of a virtualized server environment is a huge benefit when it comes to scaling. Virtualization allows administrators to easily "spin up" new servers or expand capabilities of existing servers very easily. Virtualization can create multiple virtual servers on top of an existing physical server. The virtual server

management software allows for quick and easy configuration of these servers. The bottom line is that as more users begin to use ArcGIS Server intranet and Internet products, the need for additional servers will arise. The GIS Team in IT will need to continually monitor performance of the GIS applications. If performance begins to degrade then additional resources should be acquired. Esri and various consultants offer a service that performs a detailed architectural design analysis that is beyond the scope of this report. This service from Esri is a comprehensive evaluation on-site, followed up by a detailed server/software document. The fee for this type of service averages $30,000.

Desktop Computers

Recommendations are given in this chapter that specify minimum and desired configuration of PCs needed to run GIS software applications. Following are the City's current desktop standard requirements: Hewlett Packard **–**

Desktops

- 6000 Pro Small form factor desktop
- 6200 Pro Small form factor desktop
- 6300 Pro Small form factor desktop

Workstations

- 8100 Elite CMT
- 8200 Elite CMT
- Z210 Workstation
- Z220 Workstation

All systems have at least 2GB of RAM. The OS used is both Windows XP Pro and Window 7 Pro 64 bit. All systems come hard drives with at least 120GB capacity.

The City of Guelph needs to refer to the following specifications to see if it will need to upgrade PCs to run specific GIS applications. Specifications will be looked at in two levels:

- **Level 1**: PCs to run robust GIS software such as Esri ArcGIS for Desktop 10.x (Basic, Standard or Advanced)
- **Level 2**: PCs to run ArcGIS for Server client applications, such as an Intranet GIS Data Browsers

There is a difference between a typical PC and a GIS workstation. A typical PC for word processing is not likely appropriately configured for GIS use. A GIS workstation demands, at a minimum, a high-end processor, large amounts of RAM (memory), and large disk space.

In the short-term, it is important that all Guelph personnel that will utilize Level 1 computers are capable of effectively supporting recommended GIS applications. In the long-term, as more personnel begin to use Level 1 and Level 2 GIS applications, they should have access to computers that can effectively support these applications.

Level 1 PC to Run Basic and Standard

Minimum Configuration

- 2.2 GHz Pentium PC or Greater
- 2 GB of RAM or Greater
- 17" or Greater High Resolution Monitor
- 24x CD-ROM drive or greater
- 80 Gigabyte hard drive or greater
- 100 MBPS Ethernet Card
- 64MB Video RAM or greater with 24-bit capable graphics accelerator

Recommended Configuration

- 2.8 GHz Intel Core Two Duo Processor or Greater
- 4 GB of RAM or Greater
- 19" or Greater High Resolution Monitor
- 8x DVD-ROM Drive or Greater
- 80 Gigabyte Hard Drive or Greater
- Gigabit Ethernet Card
- 256 MB Video RAM or Greater with 24-bit capable graphics accelerator

Level 2 PC to Run ArcGIS Server End User Applications

Minimum Configuration

- 1GB of Ram or Greater
- 17" Monitor
- 1.6 GHz Processor or Greater
- 100 MB of Unused Disk Space, or Greater
- 100 MBPS Ethernet Card
- 64 MB Video Ram or Greater

Recommended Configuration

- 1 GB of Ram or Greater
- 19" Monitor or Greater
- 2 GHz Processor or Greater

- 100 MB of Unused Disk Space, or Greater
- 100 MBPS Ethernet Card
- 128 MB Video RAM or Greater

Field Mobility

There are basically four (4) hardware options for accessing GIS data in the field: hand-held computers, notebook computers, tablets, and smartphones. Traditionally, the recommended solution for field access to spatial data has been the use of notebook computers. The primary advantage of hand-held computers has been their small size, which allows for greater portability. The primary disadvantages of hand-held computers are their small-screen size, and limited memory capacity. Notebook computers have much more memory capacity and processing speed than hand-held computers, and also have much larger screens. The advent of tablets and smartphones provides the best of both options: greater portability with increased memory capacity, processing speed and larger screen sizes.

Still, there are considerations that must be addressed when choosing devices for field operations. Ruggedized notebook computers are optimal for field personnel operating in conditions with exposure to weather, dust/dirt, water, and the like. Mounts for notebook computers should be installed in any vehicle that will contain a notebook computer. Mounting computers in vehicles makes them much easier to access and reduces wear on the machine. The mount should not be permanent, however, as notebook computers will need to be taken out of the vehicles by field personnel for special purposes and taken out of the field to IT periodically to update data/software. Ruggedized notebook computers are more expensive than regular notebook computers, but the cost of ruggedized notebook computers is offset by their longevity. A ruggedized notebook computer will outlast a regular notebook by three times. Analysis should be made on the continual cycle of repurchasing damaged or worn notebooks, vs. the initial purchase of a rugged version.

The City currently is using Citrix for remote access. This solution provides a secure back to the City's servers and is used for running applications that have been configured for Citrix. Use of a virtual private network (VPN) such as Microsoft or Cisco is another option for remote access. Both of these options provide connectivity to the corporate network but can be expensive and complex to implement and require login procedures by the end user. GIS users find remote desktop (Citrix) and VPN solutions to be cumbersome, slow, and insufficient for GIS. Therefore, organizations that try to use these solutions for GIS do not report success. A preferred alternative for mobile mapping applications is to use a wireless based connection with an internet based mapping application (e.g. ArcGIS Online Collector for ArcGIS). This solution does not require any complex connectivity solution. The user simply needs a wireless connection and goes to a URL address in their web browser to start the application. This solution provides the greatest "ease of use" to the end user.

The discussion of remote access described the methods for connecting to the corporate network when in the field. The applications for viewing and/or collecting GIS data in the field are another component of the mobile solution. The use of GPS equipment with ArcPad and the use of ArcGIS Online are both suitable mobile GIS mapping solutions with their own strengths and weaknesses. The following table compares the two mobile solutions:

Field Solution	Live Connection	Disconnected Editing	Horizontal Accuracy	Viewing	Red Lining	Editing
ArcGIS Online Native Application	Yes	No	Varies	Yes	Yes	Yes
Handheld GPS - ArcPad	No	Yes	Varies to High	Yes	Yes	Yes

It is common for all of these solutions to be deployed by organizations to meet differing needs of field staff and of the organizaiton. For example, a redlining application running on a tablet computer using ArcGIS Online could potentially meet the needs of one user while another user may need a handheld mapping grade GPS unit to collect large amounts of data in the field (e.g. utilities). The needs of individual users will need to be evaluated and the best mobile solution decided on an individual basis.

Following are the City's current standard configurations for mobile computers:

Hewlett Packard

Notebooks

- Probook 6550b
- Probook 6560b
- Probook 6570b
- Elitebook 2570p internal 4G air card available, with carrier GPS
- Elitebook 8470p
- Elitebook 8760w Mobile workstation
- Elitebook Revolve 810 G1 Tablet *internal 4G air card available, with carrier GPS

Panasonic

Rugged laptops

- CF19 Toughbook Tablet *internal 4G air card standard, with carrier GPS, Optional enhanced GPS
- CF52 Semi Toughbook* internal 3G air card available with carrier GPS
- CF53 Semi Toughbook * internal 4G air card available with carrier GPS
- CF30 Toughbook

Motion

- F5V Tablet *internal 4G air card standard, with carrier GPS
- F5T Tablet *internal 4G air card standard, with carrier GPS, Optional enhanced GPS

*Bell USB LTE air cards are available for any system. This has optional Carrier GPS.

*All Systems are at least dual core CPUs, workstations may have quad core CPUs and additional specialized graphics cards.

The following is the recommended configuration for notebook computers:

Notebook Computer – Approximate Cost = $4,500

- Ruggedized
- Weigh Less than 5 Pounds
- 1.6 GHz Processor or Greater
- 12 Inch or Greater Anti-glare Display
    - CD-ROM Drive
    - 2 GB RAM or Greater
    - 80 GB Hard Drive Space or Greater
    - 10/100/1000 MBPS Ethernet Card
    - Wireless Network Adapter

In contrast, when operating conditions are such that weather and the like are not a major concern, smartphones and tablets become a viable, economical, and user friendly option. As discussed in the software chapter, many applications are available for use on these devices and can assist in making field personnel more efficient by providing them access to GIS data and giving them the capabilities to capture and edit data in the field. Today, the market has many different brands and options available for purchase. However, in general, the options are Android, iOS, or Windows based systems. Each has positives and negatives, but all three can extend the use of GIS into the field. The primary factors driving the determination of which to use involve the application (some applications are only available on certain operating systems (OS)) and the end users (some users prefer smartphones over tablets or are more comfortable with a certain OS). As Guelph begins to plan for and deploy mobile GIS applications, they should compare the options available and make the selection based on their needs.

Data Capture Devices – Mapping Grade GPS Receivers

The City of Guelph should evaluate the use of mapping-grade GPS receivers for in-house GPS data collection of new or modified features. However, any data that takes longer than a year for in-house staff to collect

can usually be outsourced at a lower cost and the data can be used for analysis purposes sooner. This can save time and money vs. using in-house resources to collect data.

If the City of Guelph decides that new GPS receivers are needed, it is recommended, and will be evaluated as part of the upcoming Mobile GIS Pilot Project, that the City acquire the Trimble GeoXH as its mapping grade GPS receiver. The Trimble is ideal for use by utility companies and local government organizations managing assets or mapping critical infrastructure that requires spatial accuracy and data capture.

Trimble GeoXH 6000 Series – Approximate Cost = $6,000

H-Star technology for real-time sub-foot GPS accuracy

- Decimeter accuracy after post-processing
- TI OMAP 3503 processor with 256 MB RAM
- Microsoft Windows Mobile version 6.0 software, allowing maximum flexibility in software choice
- 2 GB onboard data storage plus SD slots for removable storage cards
- High-resolution VGA display
- Bluetooth, WiFi compatible
- GPRS/EDGE cellular modem connectivity
- Rugged handheld with all-day battery
- GNSS capable receiver board (220 channel for GLONASS constellation pickup)
- Field swappable batteries
- Floodlight Shadow Reduction Technology (for receiving satellite data better in urban environments)

Field-mounted GPS receivers will need to be configured and linked, as needed, to the City's computing resources, including computer systems (hand-held computers, notebook/tablet computers, workstations, and servers), networks, and enterprise-wide databases.

Output Devices

Printers

It is important that the City's GIS users have the means to print maps and documentation generated from these applications. Every GIS user should have access to a high-resolution color printer, to print 8"x11", 11"x17", or 8"x14" maps. In the short-term, each GIS user should have access to at least one networked color printer, even if it is not in their immediate work space. As output demand increases, additional color printers should be purchased for appropriate departments and users.

Plotters

It is important that Level 1 GIS Application users (Standard and Basic) have access to wide-format plotters. Many maps must be printed onto large sheets to be properly visualized. The following are recommend specifications for wide format plotters:

Plotters – Approximate Cost = $9,000

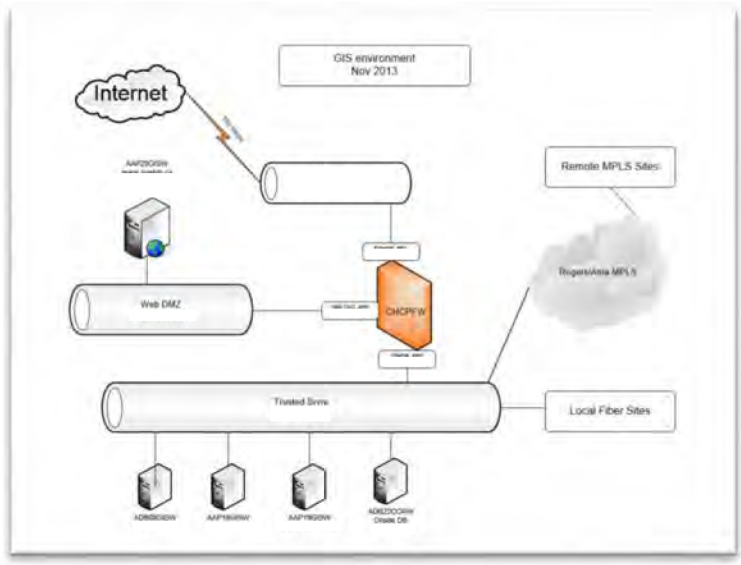
- 36" or Greater Paper Sheet Size
- 2 GB of Built-in RAM
- 100 GB Hard-drive
- 1200 dpi Addressable Resolution
- Adobe PostScript 3 Capability

HP Plotter

The City currently has the following plotters in use:

- HP Designjet 800 - Located at Waterworks
- HP Designjet T1200 - Located at City Hall in Planning Print Room
- HP Designjet T2300 - Located at City Hall in Engineering and Operations Annex
- HP Designjet T620 - Located at Riverrun
- OCETDS450 - Located at City Hall in Engineering

Networks



The IT Department will continue to administer the network in support of GIS and its related components. They should continually evaluate network infrastructure and configuration with staff as ArcGIS for Server does have a significant impact on the network. The City of Guelph has existing capacity to serve GIS data via the intranet and Internet, throughout the organization. IT staff along with GIS staff will need to administer GIS user permissions for each GIS user—users must have different levels of read or write access to GIS data, depending on their responsibilities.

Overall 1Gb+ speed connections are recommended for Tier 1 and 2 GIS users. Also, many departments have stated the desire to share data via the Internet. This will require that sufficient bandwidth is

available to support the public GIS users. Additionally, EVDO (3G or 4G) cellular based networking connections or a wide area network (WAN) is needed to sufficiently accommodate field GIS applications that need connectivity back to the City of Guelph's network (via Internet apps and/or via ArcGIS Server Advanced apps). Network connectivity and performance should be evaluated for all City offices that access the GIS to ensure that adequate bandwidth exists for the proper functioning of GIS applications.

Microsoft SQL Server and Oracle Comparison

Organizations that develop an enterprise GIS have various enterprise database management systems (DBMS) to choose from. The DBMS is the backbone of the GIS and is integrated tightly with the ArcSDE application and maintains large volumes of spatial and tabular data, controls access to the data, and provides tools for management of the data. The two most popular DBMS' in use by GIS users throughout North America are Microsoft SQL Server and Oracle. This section will provide a brief overview and comparison of these two products in order to provide the City with additional information it needs to choose a DBMS for its GIS. The City Corporate Data Architect has recommended the use of Enterprise SQL Server as the Standard Database Server for Data Warehousing and Business Intelligence initiatives. The City currently uses Oracle but is considering a move to SQL Server for GIS.

As a starting point, the following questions should be asked to help with the decision process:

- If your business unit is part of a large organization, has your organization already standardized on a DBMS vendor?
- Do you have staff that already have DBA experience with one of the DBMS vendors?
- How much staff resources can your organization devote to administering your DBMS?
- Do you have an OS preference (SQL Server of course only runs on Windows)?
- Do you have other applications that have DBMS dependencies that must be taken into consideration?
- Do your require fail-over to meet high availability requirements?
- Do you plan to scale your application out over a cluster of commodity servers or use blade server technology?
- Do you have specialized data access security requirements?

For many local governments, cost can be the deciding factor when selecting an enterprise database. SQL Server continues to be the much cheaper option as shown in the following list price comparison:

List Price Cost Comparison – 4 Core – x86 Processor

Edition	Oracle 11gR2 (USD)	SQL Server 2012 (USD)	SQL Server Saving%
Enterprise	$95,000	$27,496	SQL Server saves 71%
Standard	$17,500	$7,172	SQL Server saves 59%

Many other factors should also be considered when selecting an enterprise database and some are listed in the following table:

Category	SQL Server	Oracle
Operating System Support	MS Windows	MS Windows, Unix, Linux
Clustering Technology	Good	Better
Locking and Concurrency	Good	Better
Replication	Easy to use	Complicated
Administration	User Friendly	Not User Friendly
Integration with Active Directory	Easy	Very Difficult
Performance	Better < 100TB Database	Better > 100TB Database
Relative Cost of Ownership	Low	High
Integrates with ArcGIS	Yes	Yes
Spatial Data Option	Included with license for Enterprise SQL Server	Additional license cost

The City will need to consider and evaluate the aforementioned criteria when deciding on a DBMS for its enterprise GIS. Both are very capable products and if cost is the primary consideration, then the selection of SQL Server is the logical choice. Additionally, the **majority of City GIS implementations in North America are SQL Server based**. This is due to cost of ownership, ease-of-administration, and a more knowledgeable and pervasive user community. Because of the more widespread use of SQL Server, a much larger user community is available for advice and assistance when needed. Based on the provided information, GTG's experience, and the needs of the City of Guelph, GTG recommends that the City standardize on MS SQL Server for its enterprise GIS.

Database Security and Role Recommendations

When developing an enterprise geodatabase with ArcSDE in conjunction with a database management systems (DBMS) (e.g. Oracle or SQL Server), establishing proper user access to the enterprise geodatabase is critical to ensuring tight security. The DBMS provides capabilities for authenticating user logins and for establishing database roles that can be assigned to those users. Two types of authentication exist – operating system (OS) authentication and database authentication. Database authentication requires the creation of user logins within the DBMS, logins that may be redundant with the operating system. OS authentication allows the use of existing OS user accounts and user groups when logging into the DBMS. Possible benefits of OS authentication are:

- Multiple user names and passwords are not required; a single set of credentials can be used for both the OS and the DBMS
- The database administrator does not need to manage login credentials since they are managed at the OS level

Some possible drawbacks of OS authentication are:

- Less security if using certain database products that do not require digital certificates
- If an account password becomes compromised, then access to the DBMS is also compromised
- Additional configuration in the database may be required to support OS authentication

Since the City is considering migrating to a SQL Server DBMS for its GIS, the following information is provided specific to SQL Server.

SQL Server only runs on the Windows operating system so OS authentication for SQL Server is referred to as Windows authentication. By default, SQL Server is installed with Windows authentication for user logins. This can be changed to also allow for database authenticated logins which are accounts created in the database and are separate from the OS. The use of user groups (e.g. Windows Active Directory (AD) groups) can also greatly simplify the administration of user credentials between the OS and DBMS. Roles in SQL Server are similar in nature to AD groups and provide a bulk means to assign security credentials. By using and assigning AD groups to SQL Server roles, the management of user credentials can be further simplified. Windows authenticated users can only be used when the ArcSDE application is installed on the same server as the SQL Server instance. The basic process for adding AD groups to SQL Server is:

1. Create the AD group and add appropriate users
2. Add the AD group to the SQL Server instance
3. Add the AD group to each database that requires access
4. Map the login to the database(s)
5. For the AD group, a matching schema will be created the first time a user creates data in the geodatabase

Roles in SQL Server are used to group users based on their data access needs and assign privileges to the group. For example, in the enterprise geodatabase, you could have a role for “Viewer” and a role for “Editor”. An AD group containing all the view-only users could be added to SQL Server and assigned the “Viewer” role and the same done for users in the editing role. Lastly, these roles would then be referenced when assigning privileges to feature datasets in the geodatabase using ArcCatalog.

In conclusion, organizations with a large number of GIS users that currently use a Windows based network and Active Directory, would benefit greatly from using Windows authentication when accessing SQL Server. Specific AD groups could be assigned to specific database roles (e.g. Viewer, Landbase_Editor, Utilities_Editor, etc.) providing a logical way to group users and simplify management of user credentials.

Geospatial Content Management System

In light of the City's adoption of Open Data and Open Government initiatives, the implementation of a Geospatial Content Management System (GeoCMS) should be considered. A GeoCMS is defined by Wikipedia as follows:

"a content management system where objects (users, images, articles, blogs..) can have a latitude, longitude position to be displayed on an online interactive map. In addition the online maps link to informational pages (wiki pages essentially) on the data represented. Some GeoCMS do also allow users to edit spatial data (points, lines, polygons on maps) as part of content objects. Spatial data can be published by GeoCMS as part of their contents or using standardized interfaces such as WMS or WFS."

The City is currently in the process of standardizing on CKAN (Comprehensive Knowledge Archive Network) for the storage and distribution of data such as spreadsheets and the contents of databases. A logical next step would be to review existing GeoCMS packages and choose a system that will perform similar and management capabilities for spatial data in the enterprise GIS.

The ability of the GeoCMS to easily publish spatial data makes it ideal for the Open Data initiative. Various GeoCMS packages exist but one application worthy of note is GeoNode. GeoNode is an open source web-based application and platform for developing GIS and for deploying spatial data infrastructures (SDI). It is designed to be extended and modified and can be integrated into existing platforms such as ArcGIS.

2014

Five Year Tactical Plan

City of Guelph, Ontario

Geographic Technologies Group

Five Year Tactical Plan of Action

Section Outline

Introduction 8-2
Five Year Tactical Plan 8-2
GIS Sustainability 8-11
Tactical Plan of Action Schedule 8-18
Ten Year Forecast of Trends 8-19
Conclusion 8-22

Introduction

This chapter focuses on a tactical plan of action for implementing the key elements that have been identified and detailed throughout this plan. A tactical plan refers to a plan of action designed to identify a series of maneuvers or stratagems for obtaining a specific goal or result. In this case, the desired result is to utilize GIS as an enterprise-wide tool which enables staff to more effectively and efficiently serve the citizens of Guelph.

This chapter defines the necessary tasks and procedures for Guelph to plan and implement the recommendations outlined in this report. This five-year phased tactical plan, if implemented, will provide Guelph with a cost effective solution that allows the city to further utilize GIS in an enterprise-wide fashion.

Five Year Tactical Plan

The table beginning on page 7-10 documents all of the tactical elements needed to further implement enterprise-wide GIS over a five year period. Initially the efforts will be focused on governance and data normalization efforts. Next, the focus is on the expansion of the user base with Internet, Intranet, and targeted applications. An early primary objective is to gain several “quick successes” in terms of application implementation, data development and integration, data maintenance procedures, and education. It is important to note that these recommendations are predicated on the adoption of this plan and the adoption of the recommended governance strategy during the first year of this project.

Core enterprise data layers, such as streets, address points, and aerial photography, should be maintained by the centralized GIS Team in IT. Other data layers identified in the Needs Assessment are specific to the

various divisions/departments. The data layers should be created internally or through outsourcing as funding will accommodate.

Esri Enterprise License Agreement

Guelph's annual maintenance bill is approximately $41,000 a year from Esri. This project has identified the need for 17 additional copies of ArcGIS for Desktop Standard. Using the concurrent model (pool of shared licenses) it is anticipated that 10 concurrent copies will be needed. The cost of each of these is $11,400 apiece totaling $114,000. Once acquired, this will add an additional $21,600 to annual maintenance. Also, the expansion of GIS will necessitate more ArcGIS for Server licensing. Currently, this city has two four core licenses. The expansion plan has called for six more cores for the internal server and 6 more for the external. The price would be approximately $200,000 for the additional cores and the ArcGIS Server extensions and an additional $50,000 of annual maintenance. Additionally, this plan calls for extensive use of ArcGIS Online. The cost of the needed licensing would be $60,000 a year. Other expenses include desktop extension licensing and Esri training. The bullets below summarize the additional capital outlay and ongoing cost of the recommended enterprise GIS in regards to Esri:

Esri Additional Purchases Required

- ArcGIS for Desktop Standard 10 concurrent copies - $114,000
- ArcGIS for Server Additional Cores - $200,000
- ArcGIS Online Credits - $60,000 annually
- Desktop Extensions - $20,000
- Training - $10,000 annually

Total year one Esri cost - $404,000

Esri Ongoing Pricing

- Currently maintenance - $41,000
- Additional ArcGIS for Standard Maintenance - $21,600
- Additional ArcGIS for Server Core Maintenance - $50,000
- Annual ArcGIS Online Licensing - $60,000
- Additional Desktop Extension Maintenance - $4,000
- Annual Esri Training - $10,000

Total ongoing annual cost - $186,600

The above expense is onerous and would most likely necessitate a lesser implementation of enterprise-wide GIS. Fortunately, Esri has recognized that most agencies that desire an enterprise-wide GIS cannot afford full pricing of software and maintenance. Therefore, Esri has introduced an Enterprise Licensing Agreement (ELA). The ELA bundles unlimited instances of named software, large bundles of ArcGIS online licensing, and

online training for a flat annual fee. In the case of Guelph, the annual cost has been quoted from Esri at $83,000 a year. This ELA includes the following:

- Unlimited Software Access to the following Esri software for term of license:
  - ArcGIS Desktop Products - ArcGIS Desktop Advanced (formerly ArcInfo), ArcGIS Desktop Standard (formerly ArcEditor), ArcGIS Desktop Basic (formerly ArcView)
  - ArcGIS Desktop Extensions - 3D Analyst, Spatial Analyst, Geostatistical Analyst, Publisher, Network Analyst, Schematics, Workflow Manager Extension (formerly Job Tracking) and ArcGIS Data Reviewer
  - ArcGIS for Server - Advanced, Standard, Basic (Workgroup and Enterprise)
  - ArcGIS for Server Extensions - Network Analyst, Workflow Manager Extension (formerly Job Tracking), Image
  - ArcGIS Engine Standard Deployments
  - ArcGIS Engine Extensions - 3D Analyst, Spatial Analyst, Geodatabase Update, Network Analyst, Schematics
  - Esri Developer Network (EDN) Standard - One annual subscription to the Esri Developer Network (EDN) Standard for each year the ELA is in effect.
  - Esri CityEngine Advanced
  - Fixed number of credits for Esri Virtual Campus ($10,000 USD per year of course credits) - Applies to all Esri authored courses. Third-party authored courses not included.
  - Fixed number of callers for technical support - 4
  - One seat in the Working with Geometric Networks for Utilities class (Additional seats may be purchased at a 5 percent discount.)
  - Five percent discount on any scheduled class at Esri site
  - Ten percent for larger onsite classes at Guelph offices
  - ArcGIS online plan: 250 users and 37,500 credits per year included ($60,000 retail value)
  - 4 passes to Esri International user conference, San Diego, CA

It is recommended that Guelph utilizes the ELA licensing from Esri. This would mean that the initial capital outlay of $404,000 identified above and annual maintenance would not need to be expended. Year one cost savings would be $321,000 and the annual ongoing savings would be $103,600

Tactical Plan

Each Activity is divided into descriptive columns as follows:

Task – a descriptive title of the item

Department – the department that was identified to have a need for the item

Task Type

- OT = one-time non-repeating task
- MT = task that will be repeated multiple times
- OG = task that is on-going
- D = department/division task funded by the departments as needed

Funded By – the group that will be responsible for funding this item

Notes – comments and/or notes about the item

Year 1 – 5 Costs – cost approximation of the item. Some items have numbers that are exact. Others will depend heavily on what type of technology is used to implement them. Some will require an RFP to determine the actual cost.

Tactical Plan Tasks

The following are each of the tactical plan tasks by major category, a brief description, and any task dependencies. A  is used to denote a task with dependency. A  denotes an official decision point.

<u>Category 1 - Governance</u>

- **GIS Steering Committee Guidance** –  GIS Steering Committee will guide GIS priorities. See Governance Model Chapter pages 2-34 – 2-36
- **Official Adoption of Governance Strategy** – Adoption of the governance strategy by the GIS Steering Committee.  *GIS Steering Committee Quarterly Meetings*
- **Official Adoption of Implementation Plan** - Adoption of the implementation plan by the GIS Steering Committee.  *GIS Steering Committee Quarterly Meetings*
- **Official Adoption of Vision, Goals, and Objectives for GIS Team in IT** – Official adoption of the vision, mission, goals, and objectives of the GIS effort – See Vision, Goals, and Objectives Chapter.  *GIS Steering Committee Quarterly Meetings*
- **Adopt and Formalize a Hybrid/Matrix Model –** Formalize how the organization operates regarding GIS. Define roles and responsibilities of GIS Team in IT and the various divisions/departments.  *GIS Steering Committee Quarterly Meetings*
- **Hire a GIS Lead –** Lead GIS staff person in IT. See Governance Model Chapter pages 2-36 – 2-41  *Adoption of Hybrid/Matrix Model*

- **Identify Team Members for Functional Teams** – Identify GIS Business Systems Analyst in IT that will be the lead for the functional teams. Select departments and key individuals to serve on the teams. See Governance Chapter pages 2-43 – 2-46 *Adoption of governance strategy*
- **Begin Operational Functional Team** - Functional team to work on infrastructure GIS projects. See Governance Chapter pages 2-43 – 2-45 *Adoption of governance strategy*
- **Begin Planning and Land Management Functional Team** - Functional teams to work on planning and land management related GIS projects. See Governance Chapter pages 2-43 – 2-46 *Adoption of governance strategy*
- **Begin Human Services Functional Team** - Functional teams to work on human services and public interaction related GIS projects. See Governance Chapter pages 2-42 – 2-45 *Adoption of governance strategy*
- **Hire One Additional GIS Business Systems Analyst** – Third GIS Business Systems Analyst to lead functional teams and to expand GIS usage.
- **Annual User Survey** - Annual user satisfaction and input survey
- **Annual Return on Investment Analysis** - Annual analysis of work conducted and impact on organization *Data gathered during the annual user survey*
- **Implement GIS User Group Meetings** - Allows users to learn and share ideas. Builds GIS momentum.
- **Annual Update to the GIS Technology (Strategic) Plan** – Document successes, priorities, and budget.

Category 2 - Infrastructure

- **Production GIS Servers –** Provisioned by IT. Intranet application server, map service server, Internet application server, and database server is in place.
- **Testing GIS Servers –** Need a replica of production environment. Hardware will need to be acquired and testing environment needs to be established.
- **Public Facing GIS Servers –** Servers to provision GIS access for the various public facing applications.
- **Database Security and Roles Documented –** Identify user accounts, roles, and security for SQL Server deployment and transition.
- **Implementation of SQL Server Based Geodatabase –** Transition from Oracle to SQL geodatabase to include documented users accounts, roles, and security. *Need to identify accounts, roles, and security before implementation*

- **Identify Geospatial Content Management System (GeoCMS) Needs –** Fully document functions desired from a GeoCMS
- **Acquire and Implement GeoCMS –** Based on identified needs, select and implement GeoCMS system. *GeoCMS needs documentation*
- **Plotter –** Acquire plotter for use by GIS team in IT
- **Completion of the GIS Mobility Pilot Study** – Completion of study that will identify optimal implementation of mobile tools and software
- **GPS –** GIS Team in IT need a GPS device for testing and data collection. Departments will be responsible for acquiring their own GPS hardware as needed. *Completion of GIS mobility pilot study*
- **Mobile Hardware –** Tablets for testing and pre-deployment (iOS and Android). Departments will be responsible for acquiring their own as needed. *Completion of GIS mobility pilot study*

Category 3 – Maintenance

- **Esri Enterprise License Agreement –** Core GIS software for the enterprise.
- **Intranet and Internet Application –** Enterprise intranet and Internet applications.
- **3rd Party Applications as Identified in Software –** 21% maintenance based on acquisition of new software (See software section below) *Acquisition of third party products listed with Category 5 – Software*

Category 4 – Services and Data

- **GIS Consulting Services –** Annual fund to utilize outside expertise on an as needed basis – Projects that require outside expertise to include Esri, ROLTA Orion, and/or other technical experts.
- **Database Design, Development, and Cleanup –** It is recommended that Guelph will be implementing the Canadian Municipal Data Model, this will not be a wholesale replacement for the existing geodatabase. Staff will need to take the time to clean up and customize the existing data schema. Standardization is needed. A consultant can be used for this process.
- **Setup of Canadian Municipal Data Model (CMDM)** – The complimentary CMDM will allow for the use of free applications from Esri.
    - **Data Mapping –** Map feature class to feature class and field to field. Using categories defined in the Data Analysis chapter.
    - **Data Migration –** Moving data to CMDM
- **GIS Layer Development –** New and augmented layers were identified in the plan. Creation of all of these layers will be a multi-year endeavor. Work to be done in house. Priorities set through direction

from the GIS Team in IT and the GIS Steering Committee through feedback from functional teams. Use of interns should be considered for many of these layers.

- **Easement Layer –** This is a layer needed by many departments yet does not fit clearly under the auspices of any one department. Additionally, its creation is time intensive. It is recommended to utilize outside resources for the creation of this layer. Once complete, the layer can be updated in-house.
- **Core Data Layer Augmentation –** Based on the GIS Strategic Plan each of the core base layers have been reviewed and have action items
    - **Address Point Augmentation –** Implement NENA standards and data augmentation
    - **Property Data Augmentation –** Utilizing current processes and extending data into service areas
    - **Street Centerlines –** Cleanup of null values and connectivity issues
    - **Bi-Annual Aerial Photography –** Acquire data every two years
    - **Utility Geodatabase**
        - **Develop geometric networks –** Establish rules to ensure proper connectivity and attribution are maintained.
        - **Data cleanup and augmentation –** Using various internal and field techniques continue to improve existing datasets
- **Departmental Data Layers -** This strategic plan has identified hundreds of data layers. Some of which exist, some of which need augmentation, and some of which do not exist. The GIS Team in IT is responsible for maintaining some core GIS layers. However, departments will need to consider funding the creation and/or augmentation of other needed data. The recommended GIS Lead in IT will consult with departments annually to discuss needed GIS layers and methods for creation/augmentation.
- **Open Data Standards –** Continue implementation of open data initiative per the open data policy in support of open governance
- **Metadata**
    - **Metadata Policy and Standards –** Establish metadata template, data to be populated, and policies for update
    - **Implement and Populate Metadata –** Implement metadata as described in previous step.

      Template must be decided upon
- **Setup of Departmental Views using Intranet GIS Application –** Specific departmental setup of Intranet Data Browser
- **Setup of Internet Public Portals –** Various public portals for GIS data access

Category 5 – Software

- **Data Mining Application –** GIS layers from tabular databases. Recommend FME or Esri ArcGIS Data Interoperability.
- **Intranet Application –** Primary data viewing and analysis portal. More portals and additional functionality. Additional application if needed.
- **Provisioning of ArcGIS Online Licensing** – Additional ArcGIS Online credits. ELA credits should suffice for foreseeable future
- **Public Access Internet Applications –** Various public use portals identified by staff. This line item contains funds for various Internet applications. ArcGIS Online and StoryMaps.
- **Mobile Data Applications –** Tablets for testing and pre-deployment (iOS and Android). Departments will be responsible for acquiring their own as needed. Recommend budgeting money bi-annually for the every changing devices. More information will be detailed in the mobile project.  *Mobile Hardware and Completion of Mobile Pilot Project*
- **Department Applications -** This strategic plan has identified much desire for a variety of applications throughout the organization. The GIS Team in IT will provision enterprise-wide GIS applications. However, it will be incumbent upon a department to fund the acquisition of an application that is limited in scope to only the needs of their department. The recommended GIS Lead in IT will consult with departments annually to discuss needed GIS applications.
- **Departmental Mobile Hardware -** Departments will decide on the priority for deploying mobile computing for their staff. It will be incumbent upon departments to budget for this hardware. The recommended GIS Lead in IT will consult with each department annually to discuss and give advice on mobile technology needs/solutions.
- **Portal for ArcGIS Server Extension –** Map-centric content management system. Does not consume ArcGIS online credits. Should be negotiated as part of ELA  *Esri ELA*
- **ArcGIS for Canadian Municipalities –** Implementation of off-the-shelf applications to include Polling Place Locator, Election Results, Citizen Service Request, and My Municipal Government Services applications.
- **ArcGIS for Desktop Applications –** Implementation of off-the-shelf applications – Address Data Management, Data Reviewer for Addresses, Special Event Planning, Water Utility Capital Improvement Planning
- **GIS Based Work Order Management System –** Selection and implementation of a GIS based work order management system or GIS interface to existing system. This is a part of an ongoing initiative (WAM Assessment). No funds are included here but the GIS Team in IT should be consulted in regards to the GIS component for the work order system.
- **Additional Core Esri Licensing –** One more license for GIS Lead and GIS Business Systems Analyst. Additional Esri licenses for various departments. 17 ArcGIS Standard licenses were

requested. 8 concurrent licenses should suffice for these departments. Covered under Esri ELA. *Esri ELA*

- **Esri Extension Licensing –** Spatial Analyst and 3-D Analyst. 2 concurrent seats of each should suffice. Community Analyst for Downtown Renewal. Covered under ELA. *Esri ELA*
- **Third Party Applications –** a number of departments requested additional application functionality. Some of these needs can be met with some of the aforementioned ArcGIS Online applications. Others may require a competitive bid process. The following are the requested applications:
    - Mobile Data Viewer (Building Services, By-Law, Downtown Renewal, Emergency Services, Wastewater Services, Water Services)
    - Complaint Tracking/311 (Building Services, By-Law, Corporate Communications, Service Guelph) – Product needs to be compatible with work order solution. It is anticipated that this will be funded outside of the GIS budget
    - I-Tree (Planning, Public Works-Forestry) – Free software from http://www.itreetools.org/
    - 21% maintenance based on acquisition of new software

Category 6 – Training and Education – The Esri ELA comes with credits for on-line training. This should be the preferred method of training. However, it is recommended to budget $10,000 annually for training to be taken off-site, conferences, and for an external on-site trainer as needed.

- **ArcGIS Desktop 1 – Introduction to GIS**
- **ArcGIS Desktop 2 – Essential Workflows** *ArcGIS Desktop 1 or have commensurate skills*
- **ArcGIS Desktop 3 – Performing Analysis** *Students should have taken ArcGIS Desktop 1 and 2 or have commensurate skills*
- ***Building Geodatabases -*** *Students should have taken ArcGIS Desktop 1-3 or have commensurate skills*
- **Creating and Maintaining Metadata Using ArcGIS**
- **Configuring and Managing the Multiuser Geodatabase**
- **System Architecture Design Strategies**
- **Introduction to ArcGIS Server**
- **ArcGIS for Server Site Configuration and Administration**
- **ArcGIS Desktop for Server Sharing Content on the Web**
- **Tier 3 Classes –** conducted by GIS Team in IT
- **Intro to Python Scripting**
- **Implementing Versioned Workflows**
- **ArcGIS API for JavaScript**

- **Sharing GIS Content Using and ArcGIS Online Subscription**
- **Creating a Common Operation Picture with ArcGIS**
- **GIS for Managers**
- **ESRI Regional Conferences/Workshops**
- **MISA Ontario Chapter Conferences/Meetings**
- **URISA-OC Conferences/Meetings**
- **GIS Certification Institute – GIS Professional Certification**
- **ESRI ArcGIS Desktop Professional Certification**
- **ESRI Enterprise Geodatabase Management Associate Certification**
- **ESRI Enterprise Administration Associate Certification**
- **Communication Strategy** – The following are items not addressed in the previous sections:
    - **GIS Day –** November of every year
    - **Monthly Personal Meetings –** with key decision makers and department heads
    - **Marketing Efforts –** newspaper, television, brochures, newsletters
    - **Seminars –** throughout the year
    - **Implementation of Blogs, Email and Social Media –** for communications

GIS Sustainability

GIS is an enterprise asset that has become indispensable for departments and the organization. However, its indispensability does not guarantee its permanence and sustainability. Due to budget constraints, lack of visibility, lack of education, and/or other factors, some organizations have found their GIS budgets shrinking and in some extreme cases their GIS program has been eliminated. This strategic plan has identified the desire and need for expansion of GIS throughout the organization and to external customers. What can the City of Guelph do to safeguard their GIS investment and guarantee sustainability? One strategy is the diversification of funding. Some organizations have made the mistake of centralizing all GIS expenditures to include enterprise and departmental GIS needs. This results in a large budget line item that is more susceptible to budget cuts. Additionally, a centralized budget does not adequately reflect the diversified and pervasive needs that include department specific GIS uses. Therefore, it is recommended that the GIS is funded through various budgets. A baseline budget should exist for GIS. This should be a baseline number that ensures the propagation of the enterprise-wide GIS assets such as the core Esri software, base data layers, and enterprise-wide end user tools. IT should budget for traditional IT items such as servers and other hardware items. Lastly, individual departments should budget for department specific software, hardware, and data. Based on the budget identified on the following pages, a baseline budget of $150,000 should be considered for GIS (not including IT, departmental budget items, or personnel costs). There may be a need for funding above this in a given year. However, this figure should be considered as a baseline for the next five years. This diverse approach to funding is one method of assuring the sustainability of GIS.

Another key strategy in regards to sustainability is education. It is all too common that organizations have great success with GIS but don't educate the organization about these successes. Chapter 6 of this plan identifies a number of education items that are instrumental to the sustainability of GIS. This includes documentation and dissemination of return-on-investment examples, education opportunities for all staff, elected officials, and the public, as well as, leveraging internal and external media opportunities (television, newspaper, social media, etc.). Additionally, strong leadership and guidance from the GIS Steering Committee will ensure that GIS is aligned with the overall goals, priorities, and mission of the City of Guelph which in turn will be instrumental in ensuring continued GIS success.

It is important to note that the following tactical plan is not an all or nothing strategy. Depending on actual budget allocation, the plan can change and be reprioritized. It is important that the Steering Committee assist the GIS Lead in prioritizing tasks based on the actual budget each year. Each of the items in the tactical plan were prioritized based on the extensive staff interview process, analysis of the system design chapters, and the criticality of items that are necessary for the success of other items. This document and tactical plan should be updated annually based on funding available and changing priorities. The entire plan should be redone in totality after five years. The following tactical plan has a criticality ranking (Ranking column in the following chart). This will help the organization decide on priorities if there is a budget shortfall. The ranking is as follows:

- A – Mandatory item. Without this item other items cannot be accomplished and the project as a whole will be jeopardized.
- B – Important item. The program can still function in the near term if this item is delayed. However, the item is needed and should be considered a high priority.
- C – Desired item. This item is desired but if it is not implemented it will not adversely affect other items. In some cases, this is a departmental item and its importance is departmental.

					Five Year Tactical Plan					
Task	**Department/Division/Agency**	**Task Type**	**Funded By**	**Ranking**	**Notes**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
GOVERNANCE										
GIS Steering Committee Guidance	GIS Steering Committee	OG	NA	A	GIS Steering Committee will guide GIS priorities.	*	*	*	*	*
Official Adoption of Governance Strategy	GIS Steering Committee	OT	NA	A	Adoption of the governance strategy by the GIS Steering Committee.	*				
Official Adoption of Implementation Plan	GIS Steering Committee	OT	NA	A	Adoption of the Implementation Plan by the GIS Steering Committee.	*				
Official Adoption of Vision, Goals, and Objectives for GIS Team in IT	GIS Steering Committee		NA	B	Official adoption of the vision, mission, goals, and objectives of the GIS effort.	*				
Adopt and Formalize a Hybrid/Matrix Model	All	OT	NA	A	Formalize how the organization operates regarding GIS. Define roles and responsibilities of central GIS Staff and the various divisions/departments.	*				
Hire a GIS Lead	GIS Team in IT	OT	NA	A	Lead GIS staff person in IT. *Personnel costs are not included in this pricing summary.	*				
Identify Team Members for Functional Teams	GIS Team in IT and GIS Steering Committee	OT	NA	B	Identify GIS Analyst in IT that will be the lead for functional teams. Select departments and key individuals to serve on the teams.	*	*	*		
Begin Operational Functional Team	GIS Team in IT	OT/OG	NA	B	Functional team to work on infrastructure GIS projects.	*				
Begin Planning and Land Management Functional Team	GIS Team in IT	OT/OG	NA	B	Functional teams to work on planning and land management related GIS projects.		*			
Begin Human Services Functional Team	GIS Team in IT	OT/OG	NA	B	Functional teams to work on human services and public interaction related GIS projects.			*		
Hire One Additional GIS Business Systems Analyst	GIS Team in IT	OT	NA	B	Third GIS Business Systems Analyst to lead functional teams and to expand GIS usage.			*		
Annual User Survey	GIS Team in IT	OG	NA	B	Annual user satisfaction and input survey	*	*	*	*	*
Annual Return on Investment Analysis	GIS Team in IT	OG	NA	B	Annual analysis of work conducted and impact on organization	*	*	*	*	*
Implement GIS User Group Meetings	GIS Team in IT	OG	NA	A	Allows users to learn and share ideas. Builds GIS momentum.	*	*	*	*	*
Annual Update to the Strategic Plan	GIS Team in IT	OG	NA	A	Document successes, priorities, and budget.	*	*	*	*	*
INFRASTRUCTURE										
Production GIS Servers	GIS Team in IT	OT	IT	A	Provisioned by IT. Intranet application server, map service server, Internet application server, and database server is in place. Upgrade will be needed as GIS use expands			$25,000		
Testing GIS Servers	GIS Team in IT	OT	IT	B	Need a replica of production environment. Hardware will need to be acquired and testing environment needs to be established.		$25,000			
Public Facing GIS Servers	GIS Team in IT	OT	IT	A	Server upgrade for public access		$15,000			
Database Security and Roles Documented	GIS Team in IT	OT	NA	B	Identify user accounts, roles, and security for SQL Server deployment and transition.	*				
Implementation of SQL Server Based Geodatabase	GIS Team in IT	OT	NA	A	Transition from Oracle to SQL geodatabase to include documented users accounts, roles, and security. Currently ongoing	*				
Identify Geospatial Content Management System (GeoCMS) Needs	GIS Team in IT	OT	NA	C	Fully document functions desired from a GeoCMS	*				
Acquire and Implement GeoCMS	GIS Team in IT	OT	GIS	C	Based on identified needs, select and implement GeoCMS system. Prices vary depending on solution chosen. Some are free. Funds for software/implementation are an estimate	*	$25,000			
Plotter	GIS Team in IT	OT	GIS	B	Acquire plotter for use by GIS team in IT	$10,000				
Completion of the GIS Mobility Pilot Study	All	OT	NA	A	Completion of study that will identify optimal implementation of mobile tools and software. Already being funded	*				
GPS	GIS Team in IT	OT	GIS	B	GIS Team in IT need a GPS for testing and data collection. Departments will be responsible for acquiring their own GPS hardware as needed.	$8,000				
Mobile Hardware	GIS Team in IT	OG	GIS	B	Tablets for testing and pre-deployment (iOS and Android). Departments will be responsible for acquiring their own as needed. Recommend budgeting money bi-annually for the every changing devices. More information will be detailed in the mobile project.	$10,000		$5,000		$5,000
Departmental Mobile Hardware	Various	OG	Departmental	C	Engineering Department – 4 GIS field devices for Inspectors (Roughly $12,000) and 2 GIS field devices for Survey Crews (Roughly $18,000) - detail to be determined via GIS Mobile Pilot Project Study	$30,000				
					Parks and Open Space – 7 Microsoft Surface Tablets with protective cases (Roughly $7,000)	$7,000				
					Emergency Services – (identified through Mobile/Field Pilot Project Study ($1,000 every other year)	1,000		$1,000		$1,000
					Planning Services – 2 GIS field devices for Site Plan Inspections, Environmental and Landscaping Reviews and 4 larger monitors	$13,000				
					Water Services – TBD					
					Building Services					
					Community Engagement					
					Public Works					
					Solid Waste Resources					
					Transit Services					

					Waste Water Services – 5 GIS field devices for Collections and 5 field devices for Environmental Protection Officers (detail to be determined via GIS Mobile Pilot Project Study)	$30,000			$6,000	
					Financial Services – 1 GIS Field Device for Taxation and Assessment Management (detail to be determined via GIS Mobile Pilot Project Study) Year 4 cost associated to replacement of existing device (if needed) or to purchase additional device)	$3,000			$3,000	
MAINTENANCE										
Esri Enterprise License Agreement	All	OG	GIS	A	Core GIS software for the enterprise.	$83,000	$83,000	$83,000	$83,000	$83,000
Intranet and Internet Application	All	OG	GIS	A	Enterprise intranet and Internet applications	$10,000	$10,000	$10,000	$10,000	$10,000
3rd Party Applications as Identified in Software	Various Departments	D/OG	GIS	C	21% maintenance based on acquisition of new software (See software section below)	*	$7,203	$20,706	$23,709	$26,712
SERVICES AND DATA										
GIS Consulting Services	All	OG	GIS	B	Annual fund to utilize outside expertise on an as needed basis- Projects that require outside expertise to include Esri, Orion, and/or other technical experts.	$20,000	$20,000	$20,000	$20,000	$20,000
Database Design, Development, and Cleanup	GIS Team in IT/All	OG	NA	B	Although Guelph will be implementing the Canadian Municipal Data Model, this will not be a wholesale replacement for the existing geodatabase. Staff needs to take the time to clean up and customize the existing data schema. Standardization is needed. A consultant can be used for this process but it is anticipated that this work will be done in-house	*	*			
Setup of Canadian Municipal Data Model (CMDM)	GIS Team in IT/All	OT	NA	B	New off-the-shelf data model that allows for the use of free applications from Esri. • Data Mapping – map feature class to feature class and field to field. Using categories defined in the Data Analysis chapter. • Data Migration – moving data to CMDM	*	*			
GIS Layer Development	All	OG	GIS	C	New and augmented layers were identified in the plan. Creation of all of these layers will be a multi-year endeavor. Work to be done in house. Priorities set through direction from the GIS Team in IT and the GIS Steering Committee through feedback from functional teams. Use of interns should be considered for many of these layers.	$70,000	$70,000	$70,000	$70,000	$70,000
Easement Layer	All	OT	Departmental	C	This is a layer needed by many departments yet does not fit clearly under the auspices of any one department. Additionally, its creation is time intensive. It is recommended to utilize outside resources for the creation of this layer. Once complete, the layer can be updated in-house.	$50,000				

Core Data Layer Augmentation	All	OG	GIS for Aerial Photography	A	Based on the strategic plan each of the core base layers have been reviewed and have action items
					• Address Point Augmentation – Implement NENA standards and data augmentation
					• Property Data Augmentation – Utilizing current processes and extending data into service areas
					• Street Centerlines – Cleanup of null values and connectivity issues
					• Bi-Annual Aerial Photography – Acquire data every two years
					• Utility Geodatabase
					  • Develop geometric networks – establish rules to ensure proper connectivity and attribution are maintained.
					  • Data cleanup and augmentation – using various internal and field techniques continue to improve existing datasets
						*	*	$25,000	*	$25,000

Departmental Data Layers	All	OG	Departmental	B	This strategic plan has identified hundreds of data layers. Some of which exist, some of which need augmentation, and some of which do not exist. The GIS Team in IT is responsible for maintaining some core GIS layers. However, departments will need to consider funding the creation and/or augmentation of other needed data. The recommended GIS Lead in IT will consult with departments annually to discuss needed GIS layers and methods for creation/augmentation.					

					Engineering Department – • Data Design Review/Update (dedicated toward reviewing and updating existing data model to be more comprehensive, should be partially shared with Water Services so Engineering can review Sanitary, Storm and Water concurrently using the same methodology • Data Review/Capture/QA/QC (item is anticipating that a consultant may be needed to complete the desired work)	$200,000	$50,000			
					Parks – GIS Layer Development (i.e. Data Capture/Conversion)	$50,000	$25,000			
					Planning Services – TBD					
					Water Services – TBD					
Open Data Standards	All	OG	NA	B	Continue implementation of open data initiative per the open data policy in support of open governance	*	*	*	*	*
Metadata	GIS Team in IT/All	OG	NA	B	• Metadata Policy and Standards – Establish metadata template, data to be populated, and policies for update • Implement and Populate Metadata – Implement metadata as described in previous step.	*	*	*	*	*
Setup of Departmental Views using Intranet GIS Application	GIS Team in IT	OG	NA	B	Specific departmental setup of Intranet Data Browser	*	*	*	*	*
Setup of Internet Public Portals	GIS Team in IT/All	OG	NA	B	Various public portals for GIS data access	*	*	*	*	*
SOFTWARE										
Data Mining Application	All	OT	GIS	A	GIS layers from tabular databases. Recommend FME or Esri ArcGIS Data Interoperability. Price is for FME if ArcGIS Data Interoperability is not sufficient	$20,000				
Intranet Application	All	OT	GIS	B	Primary data viewing and analysis portal. More portals and additional functionality. Additional application if needed.		$25,000			
Provisioning of ArcGIS Online Licensing	All	OG	NA	A	Additional ArcGIS Online credits. ELA credits should suffice for foreseeable future	*	*	*	*	*
Public Access Internet Applications	Various Departments	D/OT	NA	A	Various public use portals identified by staff. This line item contains funds for various Internet applications. ArcGIS Online and StoryMaps are free.	*	*	*	*	*
Mobile Data Applications	GIS Team in IT	OT	GIS	A	Applications for field data access (software, install, and training). Collector for ArcGIS and Water Utility Mobile Map applications. **Pending results of GIS mobile study. Enterprise foundation software.		$25,000			
Department Applications (Office and/or Field)	Various Departments	OT	Departmental	B	This strategic plan has identified much desire for a variety of applications throughout the organization. The GIS Team in IT will provision enterprise-wide GIS applications. However, it will be incumbent upon a department to fund the acquisition of an application that is limited in scope to only the needs of their department. The recommended GIS Lead in IT will consult with departments annually to discuss needed GIS applications.					
					Community Engagement and Downtown Renewal – ($3,500 for 1 ArcGIS Online Subscription Account for up to 5 users + 8 for Community Analyst)	$4,300	$4,300	$4,300	$4,300	$4,300
Portal for ArcGIS Server Extension	GIS Team in IT	OT	NA	A	Map-centric content management system. Does not consume ArcGIS online credits. Should be negotiated as part of ELA	*				
ArcGIS for Canadian Municipalities	GIS Team in IT	OG	NA	B	Implementation of off-the-shelf applications to include Polling Place Locator, Election Results, Citizen Service Request, and My Municipal Government Services applications.	*	*	*	*	*
ArcGIS for Desktop Applications	GIS Team in IT/Various Departments	OG	NA	A	Implementation of off-the-shelf applications - Address Data Management, Data Reviewer for Addresses, Special Event Planning, Water Utility Capital Improvement Planning	*	*	*	*	*
GIS Based Work Order Management System	Various Departments	OT	NA	A	Selection and implementation of a GIS based work order management system or GIS interface to existing system. This is a part of an ongoing initiative (WAM). No funds are included here but the GIS Team in IT should be consulted in regards to the GIS component for the work order system.	*				
Additional Core Esri Licensing	Various Departments	OG	NA	A	One more license for GIS Lead and GIS Analyst. Additional Esri licenses for various departments. 17 ArcGIS Standard licenses were requested. 8 concurrent licenses should suffice for these departments. Covered under Esri ELA. Expand use as needed	*	*	*	*	*
Esri Extension Licensing	Various Departments	OG	NA	B	Spatial Analyst and 3-D Analyst. 2 concurrent seats of each should suffice. Community Analyst for Downtown Renewal. Covered under ELA.	*	*	*	*	*

Third Party Applications	Various Departments	D/OG	GIS	B	A number of departments requested additional application functionality. Some of these needs can be met with some of the aforementioned ArcGIS Online applications. Others may require a competitive bid process. The following are the requested applications: • Mobile Data Viewer (Building Services, By-Law, Downtown Renewal, Emergency Services, Wastewater Services, Water Services) • Complaint Tracking/311 (Building Services, By-Law, Corporate Communications, Service Guelph) – Product needs to be compatible with work order solution. It is anticipated that this will be funded outside of the GIS budget • I-Tree (Planning, Public Works-Forestry) – Free software from http://www.itreetools.org/ Pricing is estimated based on priorities and desire to pursue Enterprise software assets as needed and identified	$10,000	$10,000	$10,000	$10,000	$10,000
TRAINING AND EDUCATION										
ArcGIS Desktop 1 – Introduction to GIS	All Tier Two Users	D/OG	GIS	B	Taught every other year by Guelph's internal trainer. Guelph should strive for one person to create coursework and train on desktop product usage and another person to train on Geodatabase related topics. First year cost reflects the cost of the Guelph trainer taking the course. Once complete, the Guelph trainer should utilize the knowledge gained to create a similar course (maybe more streamlined) for other Guelph staff. Classes for other Guelph staff should be taught by this trainer every year (1, 3 & 5).	$1,000		*		*
ArcGIS Desktop 2 – Essential Workflows	Tier One and Tier Two Users	D/OG	GIS	B	Taught every other year by Guelph's internal trainer. Guelph should strive for one person to create coursework and train on desktop product usage and another person to train on Geodatabase related topics. First year cost reflects the cost of the Guelph trainer taking the course. Once complete the Guelph trainer should utilize the knowledge gained to create a similar course (maybe more streamlined) for other Guelph staff. Classes for other Guelph staff should be taught by this trainer every other year (1, 3 & 5).	$1,600		*		*
ArcGIS Desktop 3 - Performing Analysis	Tier One and Tier Two Users	D/OG	GIS	B	Taught every other year by Guelph's internal trainer. Guelph should strive for one person to create coursework and train on desktop product usage and another person to train on Geodatabase related topics. First year cost reflects the cost of the Guelph trainer taking the course. Once complete the Guelph trainer should utilize the knowledge gained to create a similar course (maybe more streamlined) for other Guelph staff. Classes for other Guelph staff should be taught by this trainer every other year (1, 3 & 5).	$1,600		*		*
Building Geodatabases	Tier One and Tier Two Users	OT	GIS	B	Teaches essential concepts and skills needed to efficiently create a geodatabase, add data to it, and realistically model the real-world spatial relationships inherent to your data. Guelph will learn about unique geodatabase features that help ensure data integrity over time and why the geodatabase is the preferred format for storing and managing geographic data.	$1,500				
Creating and Maintaining Metadata Using ArcGIS	Tier One and Tier Two Users	OT	GIS	B	Taught a variety of versioned editing workflows and examines how versioning decisions impact data accuracy and database performance.	$100				
Configuring and Managing the Multiuser Geodatabase	GIS Team in IT	OT	GIS	B	Guelph will learn to successfully deploy a multiuser geodatabase to manage the organization's critical geographic data assets. Guelph will learn about the multiuser geodatabase architecture and installation options, and how to configure the geodatabase for efficient data storage and delivery of data access and editing capabilities to many users.	$1,600				
System Architecture Design Strategies	GIS Team in IT	OT	GIS	C	Details on optimal system design	$1,600		$2,000		
Introduction to ArcGIS Server	GIS Team in IT	OT	GIS	B	Gain better understanding of ArcGIS Server	$1,600		$2,000		
ArcGIS for Server Site Configuration and Administration	GIS Team in IT	OT	GIS	B	Optimizing and configuring ArcGIS Server	$1,600	$2,000			
ArcGIS Desktop for Server Sharing Content on the Web	Tier One and Tier Two Users	OT	GIS	C	Taught in year one by Guelph's internal trainer. Guelph should strive for one person to create coursework and train on desktop product usage and another person to train on Geodatabase related topics. First year cost reflects the cost of the Guelph trainer taking the course. Once complete the Guelph trainer should utilize the knowledge gained to create a similar course (maybe more streamlined) for other Guelph staff. Classes for other Guelph staff should be taught by this trainer in year one.	$1,000	*			
Tier 3 Classes	Various	D/OG	GIS	A	End user training on ArcGIS Server Intranet Portal and Desktop conducted by GIS Team in IT	*	*	*	*	*
Intro to Python Scripting	GIS Team in IT	OT	GIS	B	Skills gained used for data automation and data mining	$1,600				
Implementing Versioned Workflows	GIS Team in IT	OT	GIS	B	For key GIS Team in IT staff	$1,600				

ArcGIS API for JavaScript	GIS Team in IT	OT	GIS	C	For key GIS Team in IT staff Free Online	0				
Sharing GIS Content Using and ArcGIS Online Subscription	GIS Team in IT	OT	GIS	B	For key GIS Team in IT staff Free Online	0				
Creating a Common Operation Picture with ArcGIS	GIS Team in IT	OT	GIS	B	For key GIS Team in IT staff Free Online	0				
GIS for Managers	GIS Team in IT	OT	GIS	C	For key GIS Team in IT staff Free Online	0				
ESRI Regional Conferences/Workshops	GIS Team in IT and other GIS Users	OG	GIS	B	Regional GIS Group	*	*	*	*	*
MISA Ontario Chapter Conferences/Meetings	GIS Team in IT and other GIS Users	OG	GIS	B	Regional GIS Group	*	*	*	*	*
URISA-OC Conferences/Meetings	GIS Team in IT and other GIS Users	OG	GIS	B	Regional GIS Group	*	*	*	*	*
GIS Certification Institute – GIS Professional Certification	GIS Team in IT and other GIS Power Users	OT	GIS	C	For key GIS Team in IT staff and GIS departmental staff. Certification required renewal every 5 years.	$275				$125
ESRI ArcGIS Desktop Professional Certification	GIS Team in IT	OT	GIS	C	For key GIS Team in IT staff	$1,000		$1,000		$1,000
ESRI Enterprise Geodatabase Management Associate Certification	GIS Team in IT	OT	GIS	C	For key GIS Team in IT staff	$1,000		$1,000		$1,000
ESRI Enterprise Administration Associate Certification	GIS Team in IT	OT	GIS	C	For key GIS Team in IT staff	$1,000		$1,000		$1,000
Communication Strategy	GIS Team in IT	OG	GIS	A	The following are items not addressed in the previous sections: • GIS Day – November of every year • Monthly Personal Meetings – with key decision makers and department heads • Marketing Efforts – newspaper, television, brochures, newsletters • Seminars – throughout the year • Implementation of Blogs, Email and Social Media – for communications	*	*	*	*	*
Annual Training Budget for As Needed Supplementary Classes	All	OG	GIS	B	For additional on-site and off-site classes	$5,000	$5,000	$5,000	$5,000	$5,000
					Yearly Total	$653,975	$396,400	$286,006	$235,006	$263,167

Tactical Plan of Action Schedule

This following project schedule lists each of the above tactical items by year.

Five Year Tactical Plan of Action Schedule

Tactical Item	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
GOVERNANCE																				
GIS Steering Committee Guidance																				
Official Adoption of Governance Strategy																				
Official Adoption of Implementation Plan																				
Official Adoption of Vision, Goals, and Objectives for GIS Team in IT																				
Adopt and Formalize a Hybrid/Matrix Model																				
Hire a GIS Lead																				
Identify Team Members for Functional Teams																				
Begin Operational Functional Team																				
Begin Planning and Land Management Functional Team																				
Begin Human Services Functional Team																				
Hire One Additional GIS Analyst																				
Annual User Survey																				
Annual Return on Investment Analysis																				
Implement GIS User Group Meetings																				
Annual Update to the Strategic Plan																				
INFRASTRUCTURE																				
Production GIS Servers																				
Testing GIS Servers																				
Public Facing GIS Servers																				
Database Security and Roles Documented																				
Implementation of SQL Server Based Geodatabase																				
Identify Geospatial Content Management System (GeoCMS) Needs																				
Acquire and Implement GeoCMS																				
Plotter																				
Completion of the GIS Mobility Pilot Study																				
GPS																				
Mobile Hardware																				
Departmental Mobile Hardware																				
MAINTENANCE																				
Esri Enterprise License Agreement																				
Intranet and Internet Application																				
3rd Party Applications as Identified in Software																				
SERVICES AND DATA																				
GIS Consulting Services																				
Database Design, Development, and Cleanup																				
Setup of Canadian Municipal Data Model (CMDM)																				
GIS Layer Development																				
Easement Layer																				
Core Data Layer Augmentation																				
Departmental Data Layers																				
Open Data Standards																				
Metadata																				
Setup of Departmental Views using Intranet GIS Application																				
Setup of Internet Public Portals																				
SOFTWARE																				
Data Mining Application																				
Intranet Application																				
Provisioning of ArcGIS Online Licensing																				
Public Access Internet Applications																				
Mobile Data Applications																				
Department Applications (Office and/or Field)																				
Portal for ArcGIS Server Extension																				
ArcGIS for Canadian Municipalities																				
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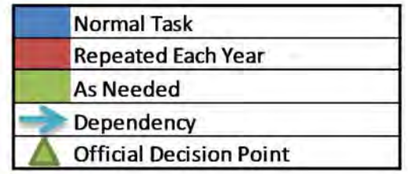
Communication Strategy																				
Annual Training Budget for As Needed Supplementary Classes																				

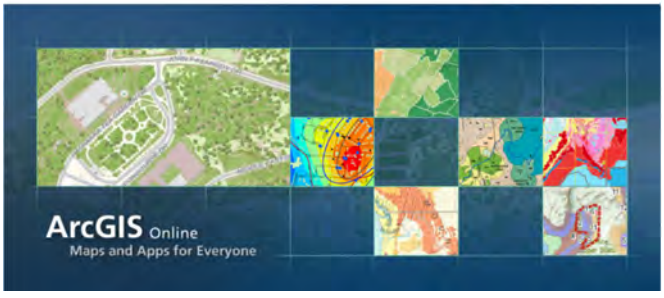


Ten Year Forecast of Trends

GIS has evolved significantly since its inception. Radical changes in software, databases, hardware, data creation methodologies, and end-user demands are frequent. Therefore, it is incumbent upon local governments to keep an eye on the future. Many local governments fail to do so and find that they are utilizing technology that is antiquated and not delivering expected services. These agencies find that because they have not stayed current with their technology, they do not have a readily available path to implement the latest tools. Often, the expense of having to jump from old GIS technology to new is too onerous, and they are forced to continue with their antiquated tools. In some cases, the organization almost has to start over in order to modernize their GIS. The City of Guelph should pay close attention to industry trends. The following are trends that are anticipated to become prevalent over the next decade:

- **GIS in the cloud and software as a service (SaaS)** - Oracle, Google, Amazon, Yahoo, and Salesforce.com have spearheaded the trend of enterprise grid computing using low cost hardware and software that enables virtualization and dynamic provisioning of resources. Google, for example, has shown that this infrastructure is excellent for building scalable, and highly available, geospatial services that provide a rich user experience. Esri has recently embraced this concept, having partnered with Amazon to make (the) ArcGIS Server available via Amazon's Compute Cloud (EC2). Instead of installing and maintaining local instances of ArcGIS Server on premises, customers can launch ArcGIS Server on EC2 instances with ArcGIS Server preconfigured for them. This is in its early adoption phase and has been slowed as Esri decides on how best to offer true SaaS solutions. It is anticipated that many organizations will move their GIS to the cloud over the next decade.

- **Web Services and Data Sharing** – Although already in existence, web services and data sharing are just in their infancy. The push in the GIS industry now is to make GIS data shareable and available. Esri's software currently allows users to consume data from external feeds. ArcGIS Online is a cloud-based geospatial content management system for storing and managing maps, data, and other geospatial information. Built on Esri's cloud



infrastructure, it gives users access to geographic content shared and registered by Esri and GIS users around the world. Other vendors, such as Microsoft, are providing similar tools. Over the next decade, GIS users will transparently be consuming data provided from any number of sources.

- **Enterprise Integration** – GIS, as the integration tool for local government, has been heralded for many years. The idea is that GIS becomes the portal into all databases within an organization (spatial and non-spatial). For instance, integration between GIS, work management, asset management, outage management, and customer information systems is a desire of local government. Another example is utilizing a GIS address layer as the de-facto address database serving all non-spatial applications. This has not been and will not be an overnight process. Strides have been made over the past few years. Local governments have begun to make integration a mandatory component of any new software system acquisition. Therefore, software vendors are upgrading their software to meet this demand. Over the next decade, this trend will continue. Local government will inch closer and closer to accessing all of their enterprise data through a GIS front-end.

- **Low cost spatial data collection tools and digital data** – The cost of data collection has plummeted over the past decade. Tools have advanced, giving the ability for local government to acquire or collect information. Data collection methods and data availability will continue to expand. Local government GIS staff will need to integrate the ever increasing volume of data to include: radio frequency identification (RFID), automated meter reading (AMR), digital imaging cameras, airborne and terrestrial LIDAR, and remote sensing satellites. An ever increasing volume of digital data will be consumed via the GIS.

- **Location based services and location tracking** – Public safety has led the way with regards to integrating customer location with the services provided. E-911 and Phase II regulations have allowed agencies to view the spatial location of any call for service (land line calls and cellular calls). Utilizing location based services (LBS) has become ubiquitous for smart phone users. Users can quickly locate their favorite restaurant, an ATM, or any desired services based on their current location and a GIS mapping application. Local governments are implementing automated vehicle location (AVL) to track their fleet. Over the next decade, this will become more prevalent for public and private use. Users will expect local governments to automatically provide LBS information on road closures, the location of the nearest park with desired amenities, the location of special events, parks and

recreation offerings, availability of a book at a local library, and the location of the garbage truck that will be picking up their trash. Additionally, users will expect this data to be pushed to their mobile devices. For instance, the trash truck is within an hour of a house for pickup and the customer gets a message letting them know so they can move their trash and/or recycling can(s) to the curb.

- **Citizen notification** – Akin to LBS, discussed in the last bullet, is citizen notification. Public safety has led the way of late in implementing applications that will notify citizens if a crime occurs within a certain distance of their houses, schools, places of worship, etc. Citizens are beginning to expect this type of information to be emailed, texted, or automatically phoned to them. GIS is utilized as the method of geo-enabling an existing database and comparing the event in the database with the citizen's location of concern. The demand for this type of information will continue to increase. It will be expected that a local government will notify citizens when a change of any type is occurring nearby. For example, Wayne County, North Carolina provides its citizens with geo-enabled crime, inspection, nuisance abatement, and school/restaurant sanitation grade information based on a user's geography.

- **Mobile GIS** – Mobile computing has exploded over the past few years. Tablets and smartphones like the iPad, iPhone and Android devices now have GIS applications available. The proliferation of smartphones will help increase the pressure on software companies to continue to produce mobile applications and as computing power and capability increases for such devices, so too will the number of software companies offering mobile solutions. Expect all GIS software companies to offer their core software on these mobile devices. Additionally, a majority of GIS end user applications will become untethered from the traditional personal computer.

Conclusion

It is clear that staff throughout the city need to and desire to continue to utilize GIS technology to conduct their daily tasks. GIS use in local government is going to become more pervasive. GIS will become the de-facto portal for managing and analyzing all data at the city (spatial and non-spatial). The spread of GIS tools has been significant over the past few years. Also, citizens are equipped with an ever increasing array of GIS based tools. They have location aware phones and an assortment of mobile devices. Over the next decade, this will become more prevalent. Users will expect local governments to automatically provide location based service (LBS) information on road closures, the location of the nearest park with desired amenities, the location of special events, parks and recreation offerings, availability of a book at a local library, and the location of projects throughout the city. Additionally, users will expect this data to be pushed to their mobile devices. For instance, the debris pickup truck is within an hour of a house for pickup and the customer gets a message letting them know so they can ensure they have moved their debris to the curb. This can only be accomplished through the use of GIS. The city has a very well-run GIS. The importance of GIS at the city will continue to increase. Therefore, it is critical to the success of the organization as a whole that the recommendations made in this report are adopted. This will ensure that the city's GIS investment will be viable and will be able to meet the ever increasing demand.

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City of Guelph