FRANKLIN COUNTY REGIONAL GIS PROJECT

GIS NEEDS ASSESSMENT

PARTICIPATING COMMUNITIES:

VILLAGE OF MALONE
TOWN OF MALONE
TOWN OF BELLMONT
FRANKLIN COUNTY

PREPARED BY THE:

Development Authority of the North Country

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EXECUTIVE SUMMARY

Many municipalities responsible for providing safe drinking water, sanitary sewer, and other services to residents, businesses, and institutions struggle with maintaining their infrastructure. The community officials and employees that are responsible for making decisions about investing in improvements, budgeting reserves, and completing repairs, do not have comprehensive knowledge of the extent or condition of their community's infrastructure. Personnel responsible for operating and maintaining these critical systems may be unsure of the location of isolation valves and other components that are essential to locate quickly in an emergency. Comprehensive knowledge of municipal infrastructure can be difficult, simply because the infrastructure is buried, and often only outdated hardcopy records exist. Water and sewer systems are frequently shown on separate maps, and the construction of multiple districts or developments may mean that a single community has multiple sets of drawings and records. These records are sometimes difficult to access and inconvenient for employees to take into the field. Municipal employees are increasingly aware that utilizing Global Positioning System (GPS) and Geographic Information System (GIS) technology will allow them to tie together the information in hard copy records to the actual locations of that infrastructure in the ground, making planning, repairing, and emergency response more efficient.

The Village of Malone and the Towns Malone and Bellmont have recognized implementation of a GIS as a better way to manage water, wastewater, and other infrastructure assets. Franklin County currently utilizes GIS technology and recognizes that they can be more efficient in how they deliver GIS services to the public. These communities participated in this GIS Needs Assessment to identify GIS data and functions that will enhance each municipality's capability to manage their infrastructure, by converting hardcopy and electronic records to digital GIS format and integrating them into a GIS database. Implementing a GIS will help the communities increase awareness as to the extent, location, and condition of these assets so that proactive maintenance programs can be developed to repair and replace this infrastructure as needed.

Records inventories were conducted for each community to identify hardcopy and digital water, wastewater, and other engineering records to support GIS development through records conversion. A GIS incorporating a common web-based platform would provide the most benefit to the participating municipalities. The partner communities do not currently possess the resources to convert hardcopy records to GIS format or develop and host a web-based GIS. It is recommended that a consultant be hired to assist with records conversion and development and hosting of the web-based GIS. Costs to hire a consultant to covert hardcopy records and develop a web-based GIS are estimated at $__________ for all partners, based on budgetary estimates. On-going consultant costs to host the web-based GIS are estimated at $__________/annually per community.

A GIS will provide the communities with a valuable resource to better manage their infrastructure. This will ensure the municipalities will be able to provide safe, reliable, and affordable services to customers over the long term.

1.0 INTRODUCTION

The Village of Malone, the Towns of Malone and Bellmont, and Franklin County (hereafter referred to as 'partners'), see the application of GIS as a possible solution to better manage their infrastructure assets. These partners are in close proximity to each other and are part of a regional trend wherein communities with limited resources have partnered together to assess implementation of GIS as a solution for better management of their assets. Past partnerships in the North Country region have included communities in the following locations: Southern Franklin County and Hamilton County, Lewis County, Jefferson and Oswego Counties, Eastern St. Lawrence County, the St. Lawrence Seaway, the Western Adirondacks, Western Jefferson County, the Route 3 Corridor (Jefferson County), and communities surrounding Fort Drum in Jefferson County.

The Development Authority of the North Country (Authority), a New York State Public Benefit Corporation that provides GIS services for municipal customers, has been called on to assist this partnership and past community partners in evaluating and implementing a regional, shared GIS. The partners are aware of several uses of GIS for municipal government; however, they elected to concentrate on water and sewer infrastructure, since efficient management of these assets is a common problem shared by all participating communities. Franklin County does not own or maintain water/wastewater infrastructure, but they do maintain tax parcel boundaries and data related to special district boundaries for water and wastewater, agricultural districts, and other special districts.

Management of municipal infrastructure is a challenging task. As public water, wastewater, highway, and other infrastructure systems age, they require more maintenance. However, many communities do not have a proactive asset management plan in place for updating and maintaining their infrastructure. Instead, many municipal governments react to failures with quick fixes, without considering the long-term sustainability of these critical systems as a whole.

Proactive asset management is exacerbated by a lack of knowledge pertaining to the location, condition, and extent of a community's infrastructure systems by board members, municipal staff, and the general public. Generally, infrastructure details are only completely known by one or two individuals, typically the municipality's longest standing Department of Public Works (DPW) or Highway Department employee. Communities are increasingly at risk of losing this comprehensive intellectual knowledge as the existing municipal water and wastewater workforce retires or leaves public service for better employment opportunities[1]. All of the partners recognize the need to perpetuate infrastructure information and details in a way that can be reliably passed on to new employees.

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[1] Boepple-Swider, T.M. (2008). A regulator's perspective on workforce issues: Water and wastewater operators. *American Water Works Association.* August 2008, pp. 132 – 135.

Hardcopy engineering records and other maps and documents are usually the only alternative to a senior operator's intellectual knowledge. These records, including large-format engineering drawings and lateral tie sheets, can be highly technical and require careful study. Using these records for asset management is cumbersome. The original water/wastewater records for most communities are drawings issued by engineering firms and tie books drawn by operators, or sometimes provided by contractors for larger capital projects, encompassing whole system construction or major rehabilitations. As this infrastructure ages, it is upgraded in parts and new engineering drawings and tie sheets are issued superseding the original record. However, only that portion of the original record corresponding to the extent of the upgrade is superseded; the remainder of the original drawings or tie sheets, not corresponding to an upgrade, still contains the latest information. When a smaller community grows and adds infrastructure, they can often end up with several sets of drawings depicting only small, specific areas of their distribution system. It can be confusing to find the most up-to-date record, and all of these drawings can become cumbersome to store and reference.

If a community elects to have its staff perform updates to infrastructure (pipe upgrades, new service connections, etc.) new drawings are usually not issued, as most municipalities do not have the in-house resources to furnish new drawings. Instead, the infrastructure changes are simply not documented, or changes are captured by handwritten notes on the original engineering drawings and tie sheets, called redlining. Municipal staff must either remember the changes, or consult several sets of infrastructure records for redlines, to ascertain a comprehensive understanding of a community's water and wastewater system.

GIS is a mapping technology implemented by public and private utilities to better manage their water, wastewater, and other infrastructure assets. When deployed correctly, a GIS can integrate the infrastructure details contained in engineering drawings and lateral tie sheets with operator knowledge. The result is a sustainable, progressive asset management model that enhances access to information, provides the capability to update infrastructure details, and ensures the long-term integrity of water, wastewater, and other records.

The goals of this Needs Assessment are to:

A. Identify relevant municipal infrastructure records within each community
B. Identify any existing hardware or software to support GIS
C. Provide a master list of data required for communities
D. Identify GIS functions that communities require to utilize data
E. Recommend a sustainable GIS model for water/wastewater and other infrastructure asset management
F. Provide recommendations of a GIS conceptual design for deployment
G. Provide an implementation plan for GIS with budgetary estimates

2.0 METHODOLOGY

2.1 PROJECT INTRODUCTION

Project introduction meetings were conducted between Authority staff and representatives of the participating municipalities in December 2017. These meetings served as an opportunity for the Authority to introduce the project. The following items were covered at the meeting:

- Introduction of the Authority project team
- Overview of what a GIS is and its potential uses
- Discussion of the purpose of a GIS Needs Assessment

2.2 RECORDS INVENTORY & ASSESSMENT

In order to implement the recommended GIS framework, information contained on hardcopy records will need to be converted to a digital format suitable for use in a GIS. A thorough inventory of water and wastewater records was conducted for each participating municipality to determine the extent of records to be converted. The inventory included documenting the following details of engineering drawings:

- Title
- Number of Pages
- Design engineer's name & project number
- Revision number & date of revision
- Drawing type[2]
- Whether records exist as hardcopy, electronic, or both

Potential GIS datasets and functions were identified by municipal staff during project introduction meetings. Ancillary information was also recorded pertaining to records management issues and workflows. This information was gathered to ensure the GIS datasets (outlined in Appendix A) will be useable by the communities to replace existing hardcopy record workflows.

2.3 CONCEPTUAL DESIGN

A well-conceived conceptual design does not necessarily guarantee successful GIS implementation, but it does provide a framework that is sustainable for the long-term. The goal of a conceptual design is to provide the municipalities with a useful model accommodating the dynamic nature of municipal infrastructure by application of GIS technology. The design includes a framework for developing GIS data from hardcopy records, and importantly, a solution to keep data current. Converting hardcopy records to GIS is not very useful unless the conceptual design includes provisions to

[2] There are two types of engineer drawings: As-built and Contract drawings. Contract drawings are issued by design firms prior to construction. As-built drawings are issued after construction is complete. Distinguishing between different drawing types is important as details contained in Contract drawings may not necessarily be the infrastructure that was actually constructed.

accommodate infrastructure updates and ensures that the information is easily accessible to users. The following concepts are explored in the conceptual design:

- Components of a GIS
- Methodologies for converting hardcopy records to GIS format
- Structuring of GIS data
- Outline of GIS deployment platforms
- Recommended GIS deployment, taking into account the needs of the partnering communities, existing resources, and cost.

2.4 IMPLEMENTATION PLAN

Once the conceptual design is completed, an implementation plan can be developed. The implementation plan (Section 5 of this assessment) provides a recommended sequence of tasks to be completed in order to successfully deploy the conceptual design. The length of time to complete each task is variable based on each municipality's staff and budgetary resources. The Implementation Plan includes an estimated budget (Section 5.6) and breaks implementation into five phases:

- Phase 1 - Designate GIS Coordinator
- Phase 2 - Define Standards
- Phase 3 - Data Development & Web Deployment
- Phase 4 - System Maintenance & Backup
- Phase 5 - System Expansion

3.0 ASSESSMENT

Given the focus of municipal owned infrastructure, departments responsible for managing these assets were interviewed, which included Town Supervisors, Clerks, and Public Works and Water departments. The Town of Malone's water system is connected to the Village of Malone's system, and the Village operators maintain the infrastructure for the Town as part of an intermunicipal agreement. The Village of Malone also has wastewater infrastructure. The Town of Bellmont has water and wastewater infrastructure.

The Village of Malone has an electronic billing system that it manages for water/wastewater services for the Village and the Town of Malone. The Town of Bellmont water and sewer customers pay for the water and sewer services as part of their annual real property County and Town tax bill.

All of the partners have the same mission and responsibilities relative to management of water and wastewater and other infrastructure assets: provide safe, reliable services at an affordable cost to their customers. Therefore, the GIS needs for each community are similar. Sections 3.1 through 3.4 contain community profiles and discussion of the infrastructure records inventoried. The communities intend to maintain their partnership for GIS implementation. Therefore, existing hardware, software, and data resources to support the recommended conceptual design are discussed together in Section 3.5 and 3.6.

3.1 VILLAGE OF MALONE

The Village of Malone is located in Franklin County and has a population of 5,911, according to the 2010 census. The Village was incorporated in 1853 and is the County seat of Franklin County. The Village has many businesses and restaurants and is also home to a North Country Community College campus.

The Village's water and sewer infrastructure systems are critical to the safe delivery of water and sewer services, and the Village water system extends into the Town of Malone's two water districts. There are 2,006 water connections and 1,980 sewer connections in the Village. The Village DPW staff and water/sewer operators maintain the infrastructure in the Village and manage the water treatment plant and the wastewater treatment plant. The Village Treasurer handles all of the billing for water and sewer service in the Village and the Town. The Village relies heavily on tie books of notes, current employee knowledge, and engineering drawings to locate the infrastructure in the Village and the Town. The staff reference their records and drawings an average of fifteen to twenty times a month to help them locate buried infrastructure, like valves and curbstops.

The current DPW Superintended has worked for the Village for 27 years and is planning to retire in the next 5 years. The other DPW staff and water/sewer operators average about 15 years on the job. These operators have a large store of intellectual knowledge of the water and sewer systems that will potentially be lost if these people retire or leave their positions. In order to share data, the Village must loan out their drawings; the DPW foreman rarely shares his records because of the risk of losing them. In 2017, the Village contracted with an engineer to complete improvements to the wastewater distribution system and the wastewater treatment plant. The engineer has the Village wastewater system infrastructure in digital CAD format, but this data is not available or usable to the Village, since the Village does not have the software to view or use digital CAD or GIS data.

Engineering Drawings

The Village's actively used water and wastewater records are stored in a room in the DPW garage; additional copies of 75% of these records are stored in the records room in the Village Office. The records in the DPW garage are stored flat in a metal fireproof file cabinet. The room is not temperature controlled, but the records are safe from dust and moisture. The records are in fair condition and well-organized in the file cabinet, but experience significant wear and tear from frequent use. Many of the records have rips and tears on the edges and are stained and faded. The records stored in the Village Office records room are rolled up or folded on metal shelves. The Village Office records room is temperature controlled and very well-organized. The records in the Village Office do not experience as much wear and tear as the copies in the DPW garage, but they also do not get updated or marked with notes when the DPW copies are updated by the operators, which means the Village Office copies are out-of-sync with the copies that are most used. If the DPW copy is destroyed or lost, the updates made on them would also be lost. All of the drawings are on white paper and are 24” x 36” size. Engineering records for the Village of Malone are contained in Table 1 below.

TABLE 1 – VILLAGE OF MALONE WATER AND WASTEWATER RECORDS

Title	Pages	Date	Drawing Type	Engineer	Hardcopy	Digital
Malone NY Sewerage Development	13	04/1933	Contract	Henry Taylor	X	
Village of Malone West Side Interceptor Sewer	8	10/1959	Contract	Morrell Vrooman Engineers	X	
Village of Malone West Intercepting Sewers	6	04/1972	Contract	Tisdel Associates	X	
Village of Malone Water System Improvements	9	08/1988	Contract	Christie Engineering	X	
Malone Junction Water Distribution and Sanitary Sewer Improvements	7	11/1991	Contract	Sear-Brown Group	X	
State of NY DOT Rte. 30 N	9	08/1992	Contract	NYS DOT	X	
Village of Malone	22	01/1993	Asbuilt	Ralph Jesmer	X	
Village of Malone River Sanitary Sewer	4	05/1997	Contract	Christie Engineering	X	
Village of Malone Chasm Falls Water Main	12	07/1998	Contract	Christie Engineering	X	
Village of Malone Cady Rd Water Main - Prison Line	12	08/1998	Contract	Christie Engineering	X	
Park St Water Main Improvement	14	11/2001	Contract	Stearns and Wheler	X	
Water Transmission Main and PRVs	13	01/2006	Asbuilt	Burley-Guminiak	X	
Village of Malone Water System Upgrades Chasm Falls upgrade	32	02/2006	Asbuilt	Burley-Guminiak	X	
Duane St water main replacement Contract 2	14	04/2011	Contract	Barton & Loguidice	X	
Duane St water main replacement	11	07/2011	Asbuilt	Burley-Guminiak	X	
No title - Hand-drawn Sewer Map Village	57	none	Asbuilt	Village staff	X	
Sanitary Sewer Detail	28	unknown	Asbuilt	Malone Staff	X	

Lateral Tie Sheets

The DPW maintains tie sheets that are stored in the DPW building that have been sketched by Village operators over decades. The tie sheets are in 9” x 7” 3-ring binders and stored on top of the metal file cabinet or in the DPW staff vehicles. These sheets only have text; there are no sketches on most of these sheets. The tie sheets are referenced often in order to find residential shutoffs and other buried infrastructure. There is a box of 8 ½” x 11” copies of these tiesheets stored in the Village Office records room that were copied several years ago by Village staff. There are approximately 2,000 pages of tie sheets for Village and Town infrastructure.

3.2 TOWN OF MALONE

The Town of Malone in is Franklin County and includes the Village of Malone. The Town's population in the 2010 census was 8,634, not including the Village population. The southern boundary of the Town is on the edge of the Adirondack Park and the Town calls itself the "Foothills of the Adirondacks." The Town was established March 2, 1805, and today the Town of Malone is home to many businesses, a recreation park, and a regional airport.

The Town's two water districts are separated on the west and east sides of the Village of Malone and are connected to the Village's water infrastructure. The Village water operators and DPW staff maintain the infrastructure through an intermunicipal agreement with the Town; the Village Treasurer handles all of the water service billing for the Town. There are approximately 150 water customers in the Town that are not in an official special district, but are connected to the transmission water main from the water source in Chasm Falls to the Town's east water district. The Town has 494 water connections. There are also 66 customers in the Town that receive sewer services, but they are not in a sewer district and are considered "outside users" of the Village of Malone's sewer system.

The Town currently does not have any GIS software or digital data for its water infrastructure.

<u>Engineering Drawings</u>

The Town of Malone's hardcopy water records are stored in the Village of Malone's DPW garage with the Village's infrastructure records, and copies are stored in the Village Office records room. The records are in fair condition, with small tears and staining from age and use. All of the drawings are on white paper and are 24" x 36" size. Water drawings for the Town of Malone are included in Table 2 below.

TABLE 2 – TOWN OF MALONE WATER RECORDS

Title	Pages	Date	Drawing Type	Engineer	Hardcopy	Digital
Water Distribution System East Malone Water District	27	4/2000	Contract	Burley-Guminiak	X	
West Malone Water District	27	1/2001	Asbuilt	Burley-Guminiak	X	

<u>Lateral Tie sheets</u>

The Village of Malone's operators maintain tie sheets for water infrastructure in the Town with the Village tie sheets.

3.3 TOWN OF BELLMONT

The Town of Bellmont is located in Franklin County and is almost entirely within the Adirondack Park boundary. The Town was established in 1833 and has always had a small population of people dispersed in different hamlets and population centers around its lakes, but in the mid-1800's the area experienced a boom of summer resort visitors. At the 2010 census, the population was 1,434 people, and the Town today takes advantage of its many recreational opportunities and is a destination for hikers and kayakers.

The hamlet of Brainardsville is the only location in the Town that has municipal water and sewer infrastructure, and the systems serve 61 water customers and 64 sewer customers. There was an original water infrastructure system built by a private enterprise in 1904 in the Brainardsville hamlet. The Town built its own municipal water infrastructure in 1969 to serve the hamlet. Most of the hamlet is connected to the newer municipal system; however, there are a few residents that are still connected to the old private system and they are not considered municipal water customers. The wastewater infrastructure was installed in the mid-1980's and is a system of residential septic tanks that collect solids, and the remaining blackwater is gravity fed to the wastewater collection tank. Residents have their septic tanks pumped out once every three years. The Town's long-time water/wastewater operator died several years ago, and water/wastewater operator that took over left for a new position three years ago. The Highway Superintendent is now serving as the water/wastewater operator and has to rely heavily on the few existing engineering records to learn about the water and sewer infrastructure, since most of the institutional knowledge known by the previous operators was lost.

Engineering Drawings

The Town stores its infrastructure records in the Highway Superintendent's office. The drawings are stored folded in a metal filing cabinet and are well-organized and in good condition. There are 4 copies of the same set of engineering records, but 3 of the copies show a drilled well detail on the front page and 1 copy does not. All of the drawings are on white paper and are 24" x 36" size, except one record that is 11" x 17". The Town does not have GIS software or digital data related to water or wastewater infrastructure. The engineering drawings are listed in Table 3 below.

TABLE 3 – TOWN OF BELLMONT WATER AND WASTEWATER RECORDS

Title	Pages	Date	Drawing Type	Engineer	Hardcopy	Digital
Brainardsville Water District Water System Construction of Pipe Lines, Spring Houses, and Storage Tank	1	2/1968	Contract	Morrell Vrooman Engineers	X	
Brainardsville Water District Site Plan	3	1/1991	Contract	Architectural and Engineering Design Associates	X	
Town of Bellmont Brainardsville Water District	1	11/1992	Contract	Unknown	X	

Brainardsville Sewer District #1 Town of Bellmont Proposed District Boundary	1	11/1992	Contract	Design Engineering and Land Surveying P.C.	X	

Lateral Tie sheets

The Town has hand-drawn tie sheets in a 3-ring binder for the water laterals that were created by the operators over the years. The approximately 60 pages of 8 1/2" x 11" tie sheets are well used and very important to the Town. The binder is stored in the Highway Superintendent's office in the municipal building.

3.4 FRANKLIN COUNTY

Franklin County is located in the northern part of New York. At the 2010 census, the County population was 51,599. Much of the County is located within the Adirondack Park boundary and the park is one of the defining features of the County.

The County does not own or maintain water or wastewater infrastructure, but it does maintain water and sewer district data and information for real property tax purposes. Its needs pertaining to GIS and this project are different than the other partners. The County has an existing GIS database that includes tax parcel boundaries and agricultural districts. It has ESRI GIS software, a dedicated staff person to update tax parcel data, and it publishes the GIS data on a web-based mapping application maintained by a consultant. The County is looking to be more efficient in delivering GIS data to the public by partnering on this shared services project and publishing their data on a shared GIS platform, instead of keeping their own separate map viewer. The County does not have hardcopy records to convert to GIS, but their existing GIS data for tax parcels and agricultural districts would need to be moved onto a new shared services platform for public access. The County would retain their GIS software license and staff because they would still be responsible for maintaining their tax parcel and other data. The County also uses SDG Image Mate Online to give users additional access to real property information. The County will require a web-based application that can integrate their SDG Image Mate Online data.

3.5 HARDCOPY RECORDS SUMMARY

This section provides a summary of all the relevant municipal infrastructure hardcopy records managed and stored by the partnering communities that could be converted to GIS data. The hardcopy records are all printed on regular white paper and are in good to fair condition (some rips and tears on the edges and small stains).

TABLE 4 – HARDCOPY RECORDS DETAIL SUMMARY

Page Size	Condition	Fasteners	# of Pages
24" x 36" Large size Engineering	Good to Fair	3 Staples	331
8 ½" x 11" Letter	Good to Fair	3 Ring Binder	2,060
11" x 17" Ledger	Good	None	1

3.6 GIS RESOURCES

The Village of Malone has some digital data for their sewer system that was developed by an engineering contractor, but the Village does not have CAD or GIS software, or staff with CAD or GIS experience, to view, utilize, or share that data. Franklin County has GIS software and trained staff to maintain tax parcel data in GIS. All of the communities in the partnership have computers, high-speed internet service, and printers. Microsoft Office is used in each community for word processing and spreadsheets. Each community maintains a customer database for water and/or wastewater billing. Table 5 below is a list of the GIS Resources in this partnership.

TABLE 5 – GIS RESOURCES

Community	GIS Software and GIS-trained Staff	GPS/GIS Unit	Digital Water/Wastewater Data
Village of Malone	-	-	Limited Digital Data for Sewer
Town of Malone	-	-	-
Town of Bellmont	-	-	-
Franklin County	GIS Software and 1 Staff Person	-	Real Property Data

4.0 CONCEPTUAL DESIGN

The conceptual design provides a framework of how the partnership's GIS will be developed. Section 4.1 provides a general overview of the components of a GIS; this information is provided as a high-level overview. Section 4.2 discusses different GIS deployment platforms and Section 4.3 outlines recommendations for the conceptual design to support the partnership's GIS.

4.1 GIS COMPONENTS

4.1.1 Data

A GIS is a computerized system used to store, analyze, retrieve, and manipulate spatial data. Data are displayed in both a database and a map which are dynamically linked. Data are the driving force behind a GIS. Many state and federal datasets are available for free. These datasets are used by many different GIS applications and are termed 'basemap' datasets. In the case of the partnership, the New York State (NYS) GIS Clearinghouse and the Franklin County Real Property Offices can provide a significant amount of free basemap data including:

- Roads
- Town/Village Boundaries
- Parcels
- Special Districts (Voting, School, Agriculture, etc.)
- Lakes, Rivers & Streams
- State & Federal Wetlands

- Aerial Imagery

Water, wastewater, and other infrastructure data are not considered basemap datasets and will have to be developed by the partnership.

Some records contain information that cannot be easily converted into GIS data. Records that contain detail drawings which depict cross sections, profiles, or photographs may not be suitable for digitization, but the information is still important and needs to be accessible. These records can be scanned and associated with relevant GIS data using a process called hyperlinking. Hyperlinking allows users to see very specific details about a feature, such as a tie sheet and photograph of a curbstop, without having to leave the GIS framework. This is an important component from a records management standpoint; providing access to detail records that cannot be mapped.

Data development is an occasional procedure. However, data maintenance is ongoing and will be the responsibility of the partnership. It is important to note that GIS data depicting water, wastewater, and other infrastructure systems are subject to the same legal requirements as hardcopy records for retention and disposition under NYS Local Government Law mandates of the *Arts and Cultural Affairs Law* (Section 57.25) and the *Official Compilation of Codes, Rules, and Regulations of the State of New York* (Part 185, Title 8).

4.1.2 Software

GIS software provides the tools to manage, access, and store GIS data. Software packages vary in terms of how they provide access to data. There are a handful of companies offering GIS software solutions, however, ESRI is considered the industry standard. It is highly recommended that any GIS conceptual model standardize on ESRI products. There are three (3) software systems for deploying GIS:

1. Desktop systems
2. Web-based systems
3. Mobile systems

<u>Desktop</u> - are stand-alone systems wherein the GIS data and software reside on one computer. These systems are meant for highly technical users who manipulate data and perform advanced analyses.

<u>Web-based</u> - these systems provide data access to the masses through the internet without having to install software on each user's computer. A highly customized web interface provides GIS functionality in an environment with a low technical learning curve. Web-based systems access a centrally-managed database ensuring data consistency. However, web-based systems rely on expensive hosting servers and software customization.

Mobile - mobile systems encompass handheld or ruggedized laptop devices that integrate GIS with Global Positioning Systems (GPS). These devices support the dynamic nature of infrastructure data, allowing operators to update GIS data in the field. Since they are GPS enabled, operators can use them to locate buried infrastructure. Mobile platforms can also be configured to support specific projects such as manhole inspections. When infrastructure GIS data is edited with the mobile platform, it must be synced back to master copy of GIS data residing on either the desktop or web-based platform.

4.1.3 Hardware

Beyond meeting the minimum system requirements for GIS software, the most important considerations when determining hardware needs for a GIS are the capacities of the Hard Disk Drive (HDD) and Random Access Memory (RAM). The speeds of the Central Processing Unit (CPU) and graphics card are less important as the specifications of these components in the vast majority of PCs are more than adequate. Choosing the correct RAM and HDD size can mean the difference between optimal system performance, and slow, unreliable functioning and recurrent software crashes. As a general rule, GIS hardware should have a minimum of 1 gigabyte (GB) of RAM. HDD size is dependent on the type and volume of data being stored. For instance, imagery data are very large and can take up HDD space quickly, whereas points, lines, and polygons (referred to as vector data) are comparatively small and require minimal storage capacity. GIS applications that require large volumes of raster imagery, perhaps covering an entire county, will require lots of HDD space on the magnitude of hundreds of GBs.

4.1.4 People

For many organizations, GIS is a complex, multi-year program that requires careful planning and budget attention. These initiatives are best tasked to a GIS Committee comprised of stakeholders. Stakeholders develop procedures and provide oversight to the GIS program, including data development, budget planning, etc. The GIS Committee is headed by a Coordinator who acts as the primary point of contact for GIS in the organization. One thing successful GIS programs have in common is that the Coordinator is a staff member whose acts as the primary point of contact for the organization’s GIS.

GIS data development and management require a high degree of technical aptitude and typically a formal education from a two year or four year college program. The term “GIS professional” encompasses a wide range of titles including: GIS Supervisor, Coordinator, Analyst, Specialist, Technician, Developer, etc. Due to the high level of technical expertise and yearly salary required to staff a GIS professional, it is very common for smaller organizations to outsource GIS by hiring a consultant. If an organization outsources for a GIS Professional, they should still designate a GIS Coordinator to collaborate with the consultant to ensure their organization's interests are represented.

4.2 GIS DEPLOYMENT PLATFORMS

There are three possible GIS deployment models the partnership could use to implement its GIS program (mobile systems can integrate with any platform):

A. Decentralized desktop platform
B. Centralized desktop platform
C. Centralized web-based platform

4.2.1 Decentralized Desktop Platform

In a decentralized desktop platform, desktop GIS software would need to be installed on multiple computers at each of the partnering communities. All of these machines would need to meet the minimum system requirements for desktop GIS software. It should be noted that free or low cost GIS software is available from ESRI and other vendors; however, it is very limited in terms of functionality. Regardless of whether a low cost or full suite GIS software is used, the decentralized platform has many shortcomings, including a high technical learning curve, data redundancy and incongruous version of data.

A decentralized, desktop platform would require that necessary GIS data be stored at each of the partnering communities. This approach will be very costly, as each full suite GIS software license would cost approximately $5,000. Each community would either have to hire a GIS professional or obtain the training necessary to use ESRI desktop GIS software. This approach would require that each community store the same datasets on their computers, leading to multiple versions of the datasets as data are edited. This mimics the issue of multiple copies of hardcopy engineering drawings stored in separate offices.

4.2.2 Centralized Desktop Platform

A centralized desktop platform would still require that desktop GIS software be purchased and installed on one computer at each of the communities. However, GIS data would be stored in a shared server which would centralize all of the GIS data. This approach would require a networked intranet between all of the communities; an intranet does not currently exist. Having a central database stored on a networked drive would solve the problem of multiple dataset versions; however, it would still require a large investment in GIS software and training. Additionally, the added complexities of establishing an intranet would require additional resources for intranet maintenance, troubleshooting, etc. None of the communities have the capacity to manage a shared intranet.

4.2.3 Centralized Web-based Platform

A centralized web-based platform requires a server and special GIS software to "host" GIS data for access via the internet. The capital cost for this type of GIS software is high and would require a GIS consultant to develop an interface for hosting GIS data via the internet. All GIS data would be hosted on a central server. However, a networked intranet would not be necessary for data access, as all of the communities would access their data through the internet.

4.3 RECOMMENDATIONS

Based on interviews and an inventory of existing GIS resources and municipal infrastructure records, it is recommended that the partnership acquire a centralized, web-based GIS to view, utilize and share their GIS datasets. A web-based GIS would provide the functionality necessary to satisfy all of the partners needs and provide the greatest benefit to the largest number of end-users within each of the communities. Similar web-based GIS have been successfully implemented by the Authority in a single Internet-based mapping application for sixty-six communities and customers in Jefferson, Oswego, St. Lawrence, Lewis, Franklin, and Hamilton Counties. It is further recommended that the partnership standardize on ESRI software (see Section 5.2.1).

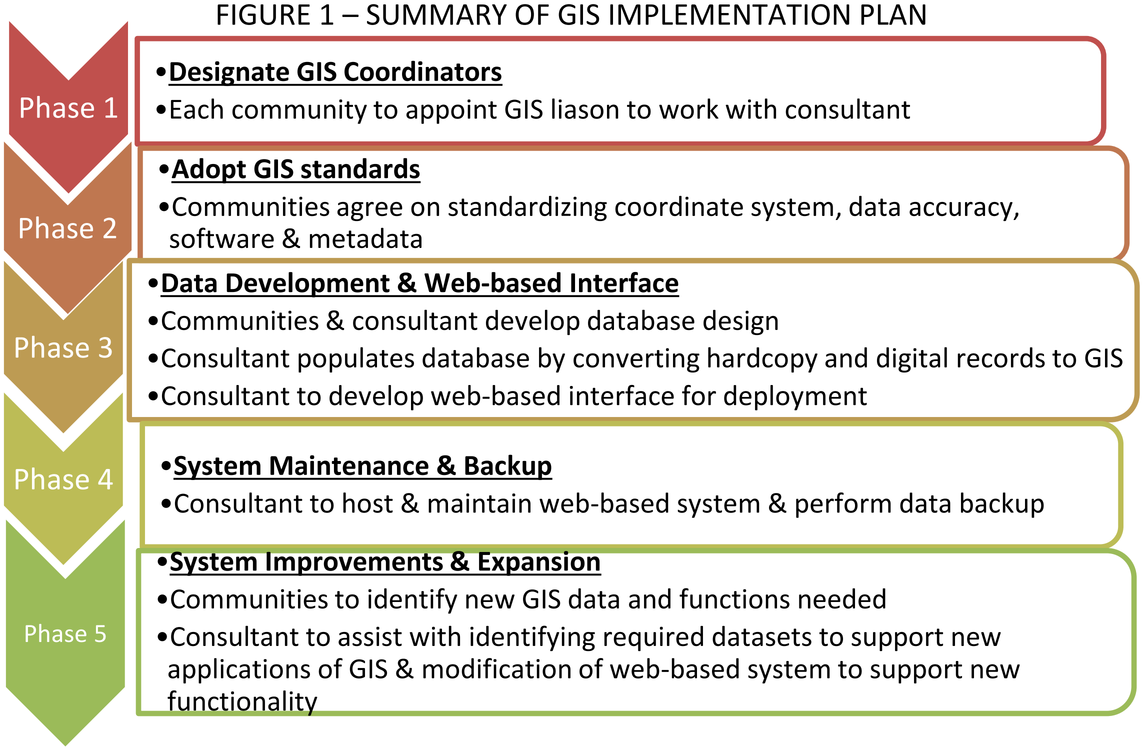
Given the partnership's limited IT and GIS resources, it is recommended that a consultant be used for converting hardcopy and digital infrastructure records to GIS and development of the web-based interface to support web-based GIS deployment. The partnership's consultant should develop all datasets identified in Appendix A. The GIS consultant should be retained by the partnership to provide hosting services and update data on the web-based system with changes provided by the communities. There are several GIS consultants that could perform conversion of hardcopy records to GIS. There are fewer consultants that additionally offer web-based hosting services, and it is rare that a County government will host GIS data for local municipalities. In the case of this partnership, the Franklin County government does not have the capacity to host GIS data for communities.

It is recommended that the partnership obtain pricing and scope of services proposals from consultants for hardcopy records conversion, web-based GIS services and data development services, and training. The best way to do this is through a formal Request for Proposals (RFP) process. Proposals and costs should be evaluated on a qualitative and quantitative basis to ensure an objective decision is made that will best meet the needs of the partnership. Lastly, given the large upfront costs, it is recommended that the partnership pursue state funding to offset the high cost of GIS development. The New York State Archives' Local Government Records Management Improvement Fund offers funding for records conversion to GIS and integration into shared services platforms.

5.0 IMPLEMENTATION PLAN

This GIS Needs Assessment provides an overview of the partnership's current structure and its functions, highlighting their needs with respect to obtaining a desired level of GIS functionality. An implementation plan works in tandem with a Needs Assessment by outlining the deployment of a GIS into logical steps that have a manageable and finite completion timetable. This implementation plan provides an *initial* roadmap for the partnership on how to develop a GIS. It is highly recommended that this plan be updated as goals are completed, new objectives defined, or when new needs are realized. A summary of the plan is provided in Figure 1 below.

FIGURE 1 – SUMMARY OF GIS IMPLEMENTATION PLAN



5.1 PHASE 1 - DESIGNATE GIS COORDINATORS

Each community should designate one primary point of contact for the GIS, known as the GIS Coordinator. Coordinators will serve as the community liaison to the GIS partnership and communicate with the GIS consultant. In communities with limited resources, often a public works employee who is knowledgeable about the municipal infrastructure serves successfully as the GIS Coordinator.

5.2 PHASE 2 - DEFINE STANDARDS

Before any data are developed, it is important that the partnership establish certain standards. For instance, what type of software will be used? What coordinate system will the GIS data be in? How will information about datasets be documented? What is an acceptable level of data accuracy? This section provides a list of recommended data standards.

5.2.1 Software Standards

As mentioned in Section 4.1.2 of the conceptual design, the partnership should standardize on ESRI software, as it is the industry standard. ArcGIS can read GIS data in a variety of different formats. Free GIS data provided by New York State Clearinghouse is available in ESRI Geodatabase format, which is proprietary. This format provides a superior level of data storage capability and access speed. The partnering communities should adopt the File Geodatabase as their standard file format.

5.2.2 Coordinate System Standards

There are several different coordinate systems used for GIS data. Universal Transverse Mercator (UTM), State Plane, and Latitude and Longitude are the most commonly employed horizontal coordinate systems. It is recommended that the partnering communities establish the New York State Plane East Coordinate System referenced to the North American Datum of 1983 (NAD 83) with unit of measure in feet as their horizontal coordinate system standard. This coordinate system is appropriate for the Franklin County area. A vertical coordinate system standard of North American Vertical Datum of 1988 (NAVD 88) should be adopted as the vertical coordinate system standard if features will contain elevation data. NAVD 88 is the most widely used vertical coordinate system by engineers who furnish as-built drawings.

5.2.3 Accuracy Standards

Accuracy standards are very important to define upfront. Conversion of hardcopy records to GIS format will not be very useful if they cannot be accurately located in the field. Accuracy should be a high priority, otherwise infrastructure could be inadvertently damaged resulting in environmental contamination or loss of service. It is recommended that the partnering communities adopt a positional standard of less than 3 feet for buried infrastructure.

5.2.4 Metadata Standards

Simply put, metadata is data about data; it gives GIS datasets a context. Metadata information includes how current the data are, how the original dataset was developed, spatial coordinate system information, access constraints, changes that have been made to the original dataset, definitions for specification entries in a feature's database, contact information for the data originator, and most importantly data accuracy. Metadata is vital when sharing data.

Metadata is an important document for managing GIS data. From a business standpoint, metadata protects the monetary and time investments afforded to collect data. There are many metadata standards available for use in the ArcGIS software suite. The most commonly used format is the Federal Geographic Data Committee (FGDC) standard and should be adopted by the partnership.

5.3 PHASE 3 – DATA DEVELOPMENT & WEB DEPLOYMENT

Data development is the next logical step in GIS implementation. Some of the necessary GIS datasets are available from the New York State Clearinghouse free of charge. However, most of the water and wastewater infrastructure datasets will need to be developed. It is recommended that data development and deployment be broken into the following steps outlined below.

5.3.1 Database Development

Database development involves furnishing a data model. A data model is a document that outlines all of the datasets for development and their database specifications. Half of the data model work has already been completed, as all of the datasets necessary for the partners are listed in Appendix A. The partnership's next step is to identify the different specifications for each dataset. For instance, a water line should have 'diameter' and 'material' specifications to identify different pipe diameters and materials.

A list of specifications for the data model could be adapted from an existing infrastructure data model. Data models should be constructed in a File Geodatabase using ArcGIS desktop software. Data modeling will require a dual effort between the partnering communities and GIS consultant to identify and define specifications.

5.3.2 Database Population

Database population entails adding data, features[3] and their specifications[4], to the model. Data development will require specialized software. The cost and level of training necessary to become proficient with data development is beyond the means of the partnering communities. Therefore, it is recommended that data development be outsourced to a consultant. Since it is important that the details contained in the original records are preserved and accurate, the consultant should work closely with water/wastewater operators, highway departments, and other knowledgeable Town employees to identify potential inaccuracies in the records. Five procedures should be followed for populating the database:

1. Digitization
2. Georectification/Tracing
3. CAD to GIS Data Conversion
4. Accuracy Quality-Control
5. Hyperlinking

[3] Features are points, lines, and polygons which have physical coordinates.
[4] Specifications are attributes noted on engineering drawings or tie sheets such as the diameter of a pipe.

Digitization – All hardcopy records identified as part of the record inventories should be scanned at a high resolution (at least 400 dpi[5]) into an imagery format compatible with GIS software (TIFF or JPEG).

Georectification – Georectification entails aligning the digitized records to a coordinate system. This is done by matching features contained in drawings to corresponding objects already in GIS format (called control points), such as parcels, building footprints, street right-of-ways, etc. This will enhance the accuracy of the record georectification process.

Once pages/sheets are georectified, GIS data can be traced off of engineering drawings and tie sheets. At this time, specifications for the infrastructure (manhole numbers, pipe diameters, etc.) can be input into the data model.

CAD to GIS Data Conversion – ESRI GIS software suites include utilities and processes for converting spatially referenced CAD data into appropriate GIS formats. In the Authority's experience, CAD to GIS conversion requires a significant level of user input, time, and effort to ensure an accurate conversion of data. The effectiveness of "out of the box" CAD to GIS tools is dependent on how the AutoCAD data is structured. Typically, the AutoCAD structure is not set up in a way that is conducive to GIS conversion without substantial user inputs. For example, AutoCAD stores textual attributes in a separate CAD file from the associated point, line, and polygon features. During the CAD to GIS conversion process, it will be necessary to associate all of the GIS feature attribute data (i.e., pipe diameters, construction material, etc.) with the actual features so that they are retrievable in the GIS.

Accuracy Quality Control – A geographically dispersed sample of infrastructure points (such as manholes, valves, etc.) should be located in the field with GPS to verify the accuracy of the georectification procedure. This will ensure that data meet the minimum accuracy requirements.

Hyperlinking – Detail drawings (including tie sheets, photographs, profiles, and other records that do not have spatial reference) should be associated to the corresponding features in the GIS through hyperlinking. When a user clicks on a feature in the web-based GIS, an option to click on a link to display the associated record should be available. Hyperlinking should be formatted as a one to many cardinality, so that more than one drawing can be associated with the same feature.

5.3.3 Web Deployment

Web deployment entails development of an interface to host the GIS data and allow end users to view and interact with the data. This requires customization of ESRI's ArcGIS Server software. Software customization requires a high-level of

[5] dpi stands for dots per inch

expertise, software familiarity, and programming. The interface must be able to support the GIS functionality identified in this Needs Assessment and the appropriate level of precision[6] to display municipal infrastructure. Web-based interface work should be outsourced to a GIS consultant. GIS web-based application functionality types are outlined in Table 6 below.

TABLE 6 – GIS WEB-BASED APPLICATION FUNCTIONALITY

Name	**Description**
Simple Display	Basic application that allows the end users to display and navigate GIS datasets
Query & Display	Application that allows end users to select or identify features based on a specific criteria (e.g. display all sewer lines that are 12 inches in diameter). Results can be displayed and/or printed.
Map Analysis	Allows end users to analyze features based on spatial relationships. For example, locating all sewer lines near a specific parcel.
Map Tools	Allows end users to use map tools to zoom and pan; measure distances and coordinates; draw lines, points, and text; access specialized tools such as Street View.
Hyperlinking	Allows end users to access and view digital copies of relevant records. For example, a user can click on a curbstop and follow a link to see an associated photograph and tie sheet of that feature.
Reports	Allows end users to generate reports which summarize GIS data from query and/or map analysis. For example, generating a table with all of the manholes that need to be rehabilitated.

Communities will have to enter into a web-based hosting agreement with a consultant to host their web-based interface, as none of the communities possess IT resources or capacity to host the interface themselves. It is recommended that the partnering communities enter into separate contracts for hosting services and have separate portals for their data. Separate hosting contracts and portals will allow the participating communities greater flexibility in the future with respect to managing data on their web-based GIS. For instance, in the future, the Village of Malone may elect to add Village-owned trees or sidewalk datasets, whereas other communities may not wish to develop and host this data.

5.4 PHASE 4 – SYSTEM MAINTENANCE & BACKUP

In order for the GIS system to be useful, GIS data converted from hardcopy records will need to be updated and maintained. Most GIS hosting agreements include provisions for consultant time to perform updates to data within the web-based GIS system with information provided by the contracting party. This is something the partnership will want to look for in a hosting agreement.

[6] The web-based interface must be able to display data at very large scales. Large scale viewing is particularly necessary for viewing laterals and water curb stops.

Data backup is necessary to ensure data is not lost in the event of a software or hardware failure and to comply with state retention and disposition guidelines. Since the data and web interface will be hosted by a consultant, the consultant should also be responsible for data backup. The partnership should clearly communicate the retention and disposition schedules of the various datasets to the GIS hosting consultant to ensure the backup routine is in-line with these schedules. The consultant should provide the partnering communities with digital backups for archiving.

5.5 PHASE 5 – SYSTEM IMPROVEMENTS & EXPANSION

System improvements and expansion are anticipated after the web-based GIS is deployed. Improvements to the web based interface are highly likely given the rapid advances in ArcGIS software functionality and releases. System expansions are anticipated as new GIS needs are identified by the communities and new datasets will have to be developed. Although it is beyond the scope of this Needs Assessment, the web-based interface could be expanded to include GIS applications and functions identified for other community departments such as Town/Village Assessors, Police, Fire, etc.

5.6 BUDGET ESTIMATES

This section provides an approximate budget for hiring a consultant to carry out Phases 2-4 of the Implementation Plan.

- Consultant costs for database development and hardcopy records conversion are assumed at $_____/hr. and include direct expenses such as travel, postage, etc. Total costs for hardcopy records conversion and database development are estimated at $_______; see Table 7 for a breakdown of estimated project costs per community and Table 8 for estimated costs by task.
- Cost to deploy web-based GIS assumes consultant will utilize standardized template. Costs will be significantly higher if the consultant has to develop a customized web-based interface.
- The communities should anticipate on-going monthly hosting costs of $________ per community for web-based hosting and updates to GIS datasets. Cost is variable based on amount of data and frequency of updates.

TABLE 7 – CONSULTANT COST ESTIMATE PER COMMUNITY

Community	Estimated Cost
Village of Malone	$
Town of Malone	$
Town of Bellmont	$
Franklin County	$
Total →	$

TABLE 8 – CONSULTANT COSTS ESTIMATE PER PROJECT TASK

Task/Item	Cost
Records Conversion & Database Development	$
Web-based Interface Development	$
Total Upfront Costs→	$
Annual On-going Cost per Community for Web-based Hosting →	$

Appendix A - Master List of Required Datasets

Dataset Name	Data Type	Comments
City/Town/Village Boundaries	Polygon	Physical extent of City, Village or Town.
District Boundaries	Polygon	Physical boundary of community's water/sewer district
Hydrants	Point	Points corresponding to water hydrants
Hydrography	Polygon	Areas covered by bodies of water (either lakes or streams)
Orthoimagery	Raster	High resolution aerial, color imagery showing ground conditions on date it was flown.
Roads	Line	Road centerlines
Sewer Lines	Line	Sewer mains & laterals, conveying wastewater from customer's edifice to WWTP. Only extent of community-owned lines.
Sewer Cleanouts	Point	Points that correspond to cleanouts which are perpendicular stubs that come off laterals above grade to allow access for cleaning instruments to remove blockages.
Sewer Flow Direction Arrows	Point	Point file that is symbolized as an arrow. Symbol is assigned a degree direction of rotation based on the direction of wastewater flow in a sewer pipe.
Sewer Grinder Pumps	Point	Point locations corresponding to areas where a grinder pump assembly is installed
Sewer Manholes	Point	Point location of manhole opening to gravity sanitary sewer line
Sewer Curbstops	Point	Points at which customer sewer service can be cutoff
Sewer Meters	Point	Points at which wastewater is metered
Sewer Pump Stations	Point	Point corresponding to sewer pump station.
Tax Parcels	Polygon	Extent of customer's property
Treatment Plant	Polygon	Water Treatment Plants and Wastewater Treatment Plants
Water Curbstops	Point	Points at which customer water service can be cutoff
Water Lines	Line	Water mains & laterals distributing water from WTP to customers. Only extent of community-owned lines
Water Meters	Point	Points at which water is metered
Water Pump Stations	Point	Point corresponding to water pump station.
Water Source	Point	Points at well sites, intake pipes, and other water sources
Water Valves	Point	Locations where water mains are isolated

Appendix B - Map of Participating Communities