The GIS Nucleus

A Synergistic Mechanism for Wastewater Operations Management

Abstract

Deep within the daily operations of the McCandless Township Sanitary Authority (MTSA) lies a developed GIS system, positioned to organize and direct all other management operations. Through a server-based GIS hub, regulatory satisfaction, infrastructure management, accounting, and customer demographics interface in an additive fashion to deliver a model utility package. Total operations managed through a centralized ArcGIS driven solution allow for governmental utilities to stage for a changing future of compliance and necessary operative efficiency.

Background

The McCandless Township Sanitary Authority (MTSA) has recently decided to move to a GIS based network to help facilitate CMOM compliance and management decisions. The approach implemented allows for detailed infrastructure management, regulatory compliance, and efficient customer service while ensuring future viability. This venture began by reviewing the Authority's current infrastructure data management systems. Through several meetings and planning sessions with Buchart-Horn, Inc. (BH), the Authority's consulting engineer, MTSA board members, and MTSA staff, decided to start planning their organization's GIS network system requirements. Specifically they tasked BH to develop a systems analysis and action plan for meeting those needs. The following paper addresses, and where applicable, magnifies the key points considered during the analysis, migration, and development process. In doing so, the paper lays the basic framework for implementing an initial GIS network solution as well as providing some insight into future data conversion and systems development.

The project discussed here showcases one local wastewater authority's approach to managing current and emerging operating requirements and regulatory initiatives. To address these requirements MTSA and BH developed a near term plan for upgrading the Authority's data management capabilities. Working together, BH and MTSA developed a suitable work plan to help MTSA migrate from a localized GIS system to an authority wide server based GIS network. The transition shifted the role of their current GIS away from a map making utility and towards a data management system. This is a multi-step process involving the following procedure:

1) **Analysis –** The examination of current GIS data, how it's being used, where it's being stored, and who's using it. Current and future regulatory requirements were also addressed.
2) **Migration –** Continued maintenance of the current GIS data to meet current regulatory requirements while configuring a scalable GIS network to meet the Authority's future needs.
3) **Development –** Decide how to incorporate additional departmental information into the planned GIS network for interactive distribution to internal decision makers.

MTSA had already made significant hardware investments with the purchase of a new server and the upgrading of several employee workstations in preparation for a centralized data management system. Under the previous system, the Authority was using ArcView 3.x and 8.x to run their GIS. These software programs were installed on several separate workstations. To keep each computer current, the GIS data was periodically updated on each workstation with a CD form the Authority's GIS department.

The Authority also employs several Hewlett Packard Handheld PCs with ArcPad 6.x for field data collection and infrastructure inspection. The data collected from field inspections, particularly dye testing and manhole inspections, is very important for fulfilling some of the Authority's regulatory requirements and needed to be available to several departments within the organization on a daily basis. The decision to purchase a new server was driven by the need to eliminate the inconsistencies with current data distribution and integrate other areas of the Authority with the GIS. The new system focuses data management responsibilities while maintaining security and quality control.

Key to integrating the Authority's various requirements was building the system around a common identifier. Most residents within the Authority's service area are associated with a unique lot and block number. This number is a unifying character used throughout most of Allegheny County (County) and is important for sharing data and information with other municipalities. This is also consistent with prior and current drafts of the GIS data dictionary maintained by the County which, when complete, will be used to help unify county wide GIS data under current regulatory requirements. Currently the Authority has approximately 15,000 residential customers, most of which are uniquely identified by lot and block number. The Authority has begun to incorporate these numbers into the GIS system and will continue doing so to maintain their GIS network migration and implementation.

Analysis

The Authority started to address their data management issues by reviewing the primary data needs for both operational and regulatory requirements. To meet this need the Authority needed to address their concern for distributing data, both current and archived, throughout the Authority for reporting purposes. Bi-weekly meetings with BH and MTSA staff helped guide the analysis and track the development process for the Authority and its board members.

Figure 1: GIS Network Migration Progress Chart

At first analysis focused on converting some of the Authority's hard-data into spatial data that could be displayed and queried within their GIS system. The data within their GIS is largely shared via maps and tabular printouts. The major drawback of their current system was it was a stand alone system, accessible only by those who knew how to use the software, have licensed access, and saw a foreseeable need for use. If the Authority wished to meet their current operational data needs under upcoming deadlines, they needed to evaluate what those requirements were and what is the most effective solution.

Current Operating Requirements

Among the current responsibilities of the Authority, are several programs requiring large amounts of data collection and analyses. Dye testing is probably the most data intensive inspection the Authority undertakes. Each dye test produces vital information for inflow and infiltration (I&I) reduction for each account. The dye tests show whether or not a house may be illegally connected via downspout or area drain to the Authority's sewer system. Every inspection collects data on the downspout, area drain, fresh air vent, and the manholes upstream and downstream of the dye test location. Once the data is gathered and the test complete, letters of notification and/or lien letters are generated. The collected data is manually entered back into the GIS after each test.

The manhole inspection program also aids in I&I reduction. Every manhole inspection collects data particular to each manhole; size, condition, riser, invert, line size, etc. Again the information is collected on paper forms, scanned, archived, and entered back into the

GIS by hand. There is a new handheld dye test program as well as a manhole inspection program used by the Authority to help eliminate the redundancies and paper forms accompanying both inspections. These two new programs are discussed in greater detail in the Development section below.

Treatment plants and flow monitoring are two areas that currently do not use the GIS but generate loads of valuable data. The Authority operates 4 treatment plants, which collect and analyze several chemical aspects of each plant's influent and effluent. Currently none of this information is stored within the GIS. Concurrently, flow monitoring also gathers large amounts of very important stream and infrastructure flow data. The data collected from flow monitoring is important in analyzing I&I reduction as well as monitoring line capacity and performance. Again, there is no flow monitoring data currently stored within or linked to the GIS system.

Future Operating Requirements

Through both federal and state regulations, the Authority is required to collect large amounts of infrastructure data for reporting purposes. One foreseeable responsibility of the Authority will be undertaking the dye testing duties from the Town of McCandless. This may or may not include the addition of any new accounts. Most of the current residents of the Town of McCandless fall within the service area of the Authority. This does, however, create additional data collection and the new information will need added to the GIS. The Authority may also want to incorporate the Treatment Plant and Flow Monitoring Program data into the GIS. The information gathered from these two departments would be significant additions to the GIS system. These considerations are data driven and need a solution capable of handling additional spatial and non-spatial digital data.

Current Regulatory Requirements

MTSA is responsible for reporting systems information, semi-annually and annually, to fulfill requirements under their Corrective Action Plan and Chapter 94, respectively. These responsibilities include reporting on treatment facility loadings, sewer extensions, operating and maintenance programs, pump station conditions and capacities, dye testing, manhole rehabilitation, special investigations, line replacements, and several other areas related to the overall condition of the sewer system. The requirements are reported to the Allegheny County Sanitary Authority (ALCOSAN) as well as the Pennsylvania Department of Environmental Protection (PADEP). There is a substantial amount of systems data that accompanies these reports. Most of which is contained within the GIS. Data collected for sewer extensions, dye testing, manhole rehabilitation, CCTV work, line cleaning, and line replacements are stored within the GIS system. Summaries highlighting the work preformed within each of these areas are a main component of these reports and help satisfy the Authority's regulatory responsibilities.

Future Regulatory Requirements

In the very near future the Authority will be signing the Allegheny Health Department's Administrative Consent Order (ACO) agreement. The agreement addresses the need to assess, re-mediate, and prevent collection system problems within the Allegheny County

Sanitary Authority's (ALCOSAN) service area. Under the agreement the Authority will need to fully inventory their collection system. To do this they will need to compile GIS data, compliant with the Allegheny County GIS Data Dictionary, describing their portion of their system that contributes to the ALCOSAN collection system. Once the dictionary is defined, the attribute data and forms can be adjusted and the inspections can begin. Most importantly the data collected will already be formatted to fit within the Authority's proposed GIS network.

Departments

In addition to operational and regulatory requirements, each department was examined for areas where GIS could be used to help make data collected within each department more accessible. Finding ways to incorporate the GIS system helps to eliminate unnecessary paper transfer, creating a broad based system accessible by each department. Below is a summary listing of who is using the GIS, how they are using it, and what their proposed future uses may be. This list helps guide future discussions within the organization about GIS and how it may be incorporated into other areas of the Authority. This is by no means a complete list, but more a suggested foundation for further examination.

Management

Management uses the GIS to facilitate and evaluate work being completed throughout the various departments. They also use the GIS to oversee some of the projects within the organization that use the GIS, such as Dye Testing, CCTV work, and Manhole Inspections. Previously they used ArcView 3.x with GIS data loaded from a CD to access the system. Updated information was periodically given to the department upon request. Each system was stand alone and only as current as the last updated CD installation.

Within the framework of the GIS network, Management has access to the most current IMS maps directly from their desktops. GIS related work performed daily, when loaded into the ArcIMS by the GIS personnel, is continually reviewed. This eliminated the need for any periodic CD updates. The Management team also has access to the supplemental GIS databases such as the Dye Test database. Map printing and data querying capabilities continue to be available through the IMS.

New Housing and Commercial Development

Development uses the GIS to support the growth of new permitted additions to the MTSA service area. Typically maps showing where new development is going to be and what surrounding infrastructure is there, is the key function of GIS within the department. In addition to locating infrastructure information for new development, they also keep required permits for developers as well as tracking those permits' status. The records are archived and their status is routinely updated within an Excel spreadsheet back dated approximately to the year 1996. Any earlier permits are stored within indexed books that catalog the location of the permits within the paper archive. These maps and supplemental tables were created using ArcView 3.x with GIS data loaded off of a CD. Again the CD was periodically updated per request through the GIS/GPS department.

As with the rest of the departments, Development now has access to the most current GIS data available within the IMS. The new GIS network allows the department to print and query GIS data directly through the ArcIMS viewer. From here they keep up to date printouts and attribute information on hand and available for those who may need it.

Program & Project Coordination

GIS is the central framework for the majority of the Program and Project Coordination department's functions. They are responsible for dispersing maps, querying data in support of other departments, editing data, developing GIS related projects, GIS support for Dye Testing and Manhole Inspections, and many other GIS related needs within the organization. The department uses ArcGIS 8.x in conjunction with Access to handle the bulk of the Authority's GIS needs. They also use ArcPad 6.x to facilitate the Handheld PC GIS field applications. In addition, their workstation also has the GIS CCTV Truck Link program installed to import the incoming CCTV project files into the GIS. All of these operations rely heavily on the current GIS system.

This department is where the main ArcIMS application viewer is maintained. ArcIMS resides on the server, but the page's authoring occurs in this department and is responsible for keeping the ArcIMS site up to date and adding any needed additional information upon request. Here is also where incoming Handheld PC GIS data is uploaded onto the server. Any time a field GIS project is completed, it is loaded onto the ArcIMS site. The department is the final validation step to ensure the quality of data being served through the ArcIMS site, throughout the organization, is optimal.

Line Maintenance

The Line Maintenance department primarily uses the GIS to print maps for any line repairs or replacements. They may sometimes use the GIS to query the spatial data for line segment and other corresponding infrastructure information. Previously they were printing maps using ArcView 3.x loaded with data from a CD, which was periodically updated.

Within the new GIS network, Line Maintenance is be able to access the most current GIS information within IMS through the viewer. They retain GIS functionality including printing and querying capabilities. Furthermore, they have access to the supplemental Access databases necessary for line maintenance activities.

I&I Reduction

Here GIS is primarily used for printing maps for field work, flow monitoring, dye testing, and manhole inspections. The data is also occasionally queried to look for relevant information on line segments or other infrastructure data. The department previously shared a workstation loaded with ArcView 3.x with Line Maintenance to print maps for daily crew activities.

Within the new network, the department is able to access the entire GIS system with up to date information directly from their desktop. The department retains the same GIS

functionality as before with the additional access to any permissible supplemental GIS Access databases.

GIS/GPS

This is the Authority's central GIS department. Here data is created, edited, monitored, and stored. The department has two workstations that are licensed with ArcGIS 8.x software. There are several HP Handheld PCs loaded with ArcPad 6.x and customized Dye Test and Manhole Inspection projects. One of the main functions of the GIS/GPS department is to collect, edit, and distribute GIS data. Here is where the majority of maps and map books are created and printed. Supplemental GIS data accompanying Authority projects and reports is typically processed here also.

This department continues to function as before. The GIS/GPS department along with the Program/Project Coordination department maintains the entire GIS network. Data is stored on the central server and edited through ArcView 3.x and ArcGIS 8.x. The uniform ArcIMS Viewer is available for other end-users within the Authority who wish to access the GIS information.

Maintenance

The Maintenance department is in charge of overseeing the Authority's maintenance needs. They manage the Authority's vehicle and facilities maintenance. The department utilizes a rolling fleet maintenance program with parts' catalogs and repair diagrams to meet most of their repair needs. Previously they did not use the GIS system and still to some extent remain detached from the system to this day.

There may, however, be a need in the future to integrate a part's inventory or vehicle tracking system into the GIS. These additions would be adequately served within the GIS network. With the installation of GPS technology on each of the fleet vehicles, the Authority could monitor where there vehicles are, where they're going, and where they've been. This could help cut wasted time, gas, and materials, potentially saving the Authority significant costs.

Financial

This department is unique in that it represents a separate division of the Authority in their main office. The Financial department, a stand alone system, handles the financial records and billing for the Authority. The department had limited GIS needs and did not previously use the GIS system in any real capacity. They did on occasion request data for certain sections of infrastructure to assess whether or not a house had been dye tested, but aside from that they were for the most part removed from the GIS.

This arrangement has changed with the new ArcIMS GIS network. Within the GIS network, the department now has access to the IMS network information. They are able to query dye tested houses themselves, print correspondence, and monitor the status of those houses. Additional documentation may also be scanned or entered into the GIS for querying purposes.

Treatment Plants

Like the Financial department, the Treatment Plants are supervised offsite from the rest of the facility's departments. Much of the data collected for each plant is stored at each individual plant. Historical data is also compiled and archived per plant. None of this data is or was currently available within the GIS system.

Within the new GIS network, both new and old treatment plant data now have the opportunity to be stored and queried. Information concerning pump stations, effluent testing, and other plant data could be accessed directly from within ArcIMS. Historical documentation could also be scanned or entered into the GIS. This may eliminate the need to search archives of scanned paper forms.

Data Management Configuration Options

Following the extensive analysis of the Authority's GIS system needs, BH presented MTSA with three suggested options available to the Authority to complete the migration process:

1) The Authority could continue with their current localized GIS system
2) Migrate to ArcIMS using the new server as the central storage device
3) Employ ArcIMS within a Database Management System such as ArcSDE

BH and MTSA outlined the three options for the Authority to meet their suggested data requirements for fulfilling current and future operating and regulatory responsibilities. The first option was to remain within the current localized GIS system, making hardware and software upgrades where necessary. The second was to move into a multi-user GIS network employing ArcIMS as the principle software to run the system. The last option is to run ArcIMS with ArcSDE to store and query large amounts of data within a DBMS (Database Management System) environment. These options are discussed in detail below with an associated summary highlighting the Authority's pros and cons.

Option 1

With this option, MTSA would need to invest in several software and hardware upgrades. The current GIS system has two single-use licenses for ArcGIS 8.x. Both license agreements allow the installation and operation of the software onto one machine per license. They can make one copy for archival purposes and for use on one portable computer. These licenses are, however, being used on several machines within the Authority. To give their employees the appropriate access necessary to the GIS, the Authority would need to spend additional capital in licensing fees for ArcGIS 8.x. In addition the Authority may have to upgrade several additional computers to enable them adequate access to the GIS system.

- **Pro:** Staying within the current system, moving the GIS data to the server, and purchasing the necessary software and hardware upgrades will distribute the data throughout the Authority.
- **Con:** Option 1 will only supply an immediate solution. Installing a multi-user license for either software package will expand the number of users but may prove limiting and costly to upgrade. The Authority may also have to invest in

additional access for other facilities, such as treatment plants and additional field offices. Supplemental training may also be necessary for those employees who wish to use the software. Overall, this option may prove to have several further hidden costs for implementation, training, and support.

Option 2

A second means of meeting the current data management concerns of the Authority was to migrate to ArcIMS. The initial phase of the migration requires installing ESRI ArcIMS (Internet Map Server) software onto a central server. ArcIMS is a network GIS software package, which creates a browser based system to distribute GIS data throughout the Authority. The viewer (webpage) is completely customizable through ArcIMS and can, among many other things, run queries and print maps based on each individual user's request. Once the initial viewer is created, end-users within the organization can access the GIS data with Microsoft Internet Explorer from their desktops. Installing ArcIMS eliminates any need for additional licenses for ArcView or ArcGIS. The ArcIMS software needs only one license and resides on one machine. By installing ArcIMS, the Authority is creating the foundation upon which to build and grow their information structure. The initial setup will begin to bring together the departments within the organization and will give them broad based access to the Authority's system information.

- **Pro:** Migrating to ArcIMS creates a broad based multi-user network in which the Authority can begin to bring together information and data from different departments. Typical installation of ArcIMS can significantly handle up to 100,000 map requests per day. There is no need for any additional licensing for ArcView. The Authority will retain their current licenses for both ArcView software packages for data management and development purposes. ArcIMS is only purchased once and there are no additional licenses necessary. The software will function with the server investment already made.
- **Con:** ArcIMS may require additional training for the site's primary author. There may also be additional consulting costs warranted for implementation and support. ArcIMS installed onto one machine with one server is limited by the amount of data it can store but should sufficiently handle a customer base of 15,000.

Option 3

The third option would be to Install ArcIMS concurrently with ArcSDE. ArcSDE is a centralized spatial database utility that provides access to data stored in a DBMS. Within this environment users can retrieve and query large amounts of vector (shapefiles) and raster (image) data. The utility will also permit multi-user editing, since ArcSDE provides a way to manage several versions of different files simultaneously. The utility is helpful when a limit on the current network architecture is realized and a new means for distributing large amounts of data to many users may be necessary. The migration into an SDE environment should be commensurate with an increase in the amount of data, users, and/or the need to serve the GIS system externally, over the internet.

- **Pro:** This option will produce the same benefits as option 2 but will progress the network database capabilities with ArcSDE. MTSA would be able to store and

manage their spatial and tabular data within a DBMS environment. They would also gain the capability of adequately serving their GIS data over the internet

- **Con:** To install and run ArcSDE, MTSA would need to purchase ArcIMS and ArcSDE, but they would also have to upgrade ArcView to ArcEditor. An ArcEditor license is required when using ArcSDE. MTSA would also need to upgrade to MS SQL Server to run ArcSDE. There might also be a significant amount of additional training needed in order to manage the system. The Authority might also consider purchasing an additional server, under recommendation, to run both ArcIMS and ArcSDE.

Configuration Recommendation – Option 2

It was BH's recommendation the Authority choose Option 2. Migration to a scalable, multi-user, GIS network, served through ArcIMS, will lay the groundwork for meeting the Authority's future GIS needs while continuing to meet current operational and regulatory requirements. By starting with ArcIMS the Authority is able to serve its employees the data they need nearly out of the box. This gives a timely cost effective solution that fits within a long term plan for expansion.

After the Authority becomes comfortable with ArcIMS, analyzed their potential data needs, and prioritized planned data conversion and application development, they may be ready to begin discussing future implementation of ArcSDE. ArcSDE could prove to be an applicable objective for the GIS system, but moving directly to Option 3 was not the most cost effective resolution at the initial point. Given the amount of data required, in accordance with the Authority's current regulatory objectives, ArcIMS sufficiently handles their operating needs. ArcSDE is designed to handle large amounts of both vector and raster data, which the Authority currently has little of. These types of systems are mature, well developed systems that have exceeded their current capacities in order to meet their present demands.

Migration

One main objective for the migration to a GIS network is to provide the Authority with a centralized utility capable of communicating information throughout their organization to its end users. Much of the data available separately within each department is now distributed throughout the organization digitally. Doing so, helps the Authority better fulfill its operational requirements. By employing the GIS system as the central tool, the Authority can begin to eliminate needless paper transfer, gaining significant value from the capabilities of a multi-user GIS network.

The main priority while completing the migration is for the Authority to continue to meet its immediate regulatory needs. In order for the Authority to submit for credit for past work under the Administrative Consent Order (ACO), a consent order agreement signed by local municipalities to asses, re-mediate, and prevent collection system problems, they needed to continue collection and editing of dye testing and manhole inspection data for their infrastructure system. This means the current GIS system needed to stay fully functional while the beginning phase of migration took place. While initializing the

implementation, the handheld dye test and manhole inspection programs were used to complete the data collection. By having a concurrent system, the Authority was able to readily analyze and fulfill their regulatory requirements while building a scalable GIS network.

Once an option was chosen and implemented for the GIS network migration, the Authority began to examine how each department interacts within the GIS network and what applications were currently being used to supplement the GIS. Each department has its own responsibilities with unique data needs. By having a clear understanding of what each department's data requirements are, the Authority is better suited to prioritize future data conversion and application development.

Following analysis of the Authority's data needs during migration, MTSA and BH also began prioritizing allocated application conversion. BH and MTSA examined the need to adapt certain GIS driven applications that assist in integrating some of the immediate and future data needs of the Authority. These processes are analyzed below to provide some insight and guidelines on what the Authority considered while migrating their data management system.

Applications

The Authority uses several different GIS functions and applications to support its daily operations. Previously, each application was separate and there was no system in place to facilitate sharing of information between applications. Each application uses both digital and archived data that may or may not be available within the GIS. With the migration to a GIS network, the Authority began to link their current and archived data between these applications. This improved GIS management efficiency and available reporting capabilities. Following is a breakdown of each application, how it used to use the GIS, and how it functions currently within a centralized GIS network.

Creating and Editing Data

The Authority has fairly mature infrastructure data collected over the past several years. This cuts down on the amount of new resources spent creating and collecting basic system data, the most expensive part of any GIS system. Except in the event where there are improvements, additions, subtractions, or any other major changes within the basic system, the creation of new data is fairly minimal. The editing of existing data is, however, a fairly routine function of the Authority. Updates to the current infrastructure, rising of buried manholes, and repairs to line segments are common additions to the GIS system. Adding attribute information to this additional data is probably the most significant aspect of the editing process. Information is continually collected and edited, primarily on one stand alone machine. The updated information was copied periodically onto a CD and distributed throughout the organization to those users who need it. Given the current Authority structure, there is no immediate need for a multi-user editing environment. Should the need arise in the future; the new network will accommodate the addition of a concurrent ArcEditor license to facilitate multi-user editing.

Now, storing the GIS data in one central location allows permissible users within the Authority to view the latest GIS information within ArcIMS. When new data is entered into the GIS system, those who need to evaluate the information have the opportunity to do so. Having a network setup eliminates the need to periodically update everyone's workstation with new GIS data from a CD.

General Field Support

Foremost, the GIS system supports those field activities that require a map or attribute information about infrastructure data. Field crews often need paper maps to locate and inspect manholes, TV line segments, or respond to one call requests. They also may need tabular information supplementing these maps. The maps and tables are an invaluable resource and a primary function of daily operation for the Authority. Each map or table was printed per request by either the GIS/GPS or Program/Project Coordination departments and is specific to each employee's task. These maps were, however, only as current as the latest CD update.

Within the new GIS network, every departmental leader is able to access the entire GIS system from their own desktop, eliminating the need to fragment the transfer of information between departments. The crew leaders can display what they want, when they want, and print both map and attribute data directly from their own workstation. Within this framework, they are able to more effectively utilize the GIS system by having the most current GIS information readily available for their crews from their desktops.

Dye Testing

Being actively involved in dye testing requires the support of the GIS system. The original process of using paper map books and paper field sheets for data collection is being replaced. The Authority moved to a digital Handheld PC GIS system capable of collecting the dye test data. The GIS is capable of providing system data, per service area, to the dye test field crews through customized Handheld PC ArcPad projects. Within these projects, the crews can store the information gathered from dye testing directly into the GIS Handheld. The data collected through this process is stored onto the GIS server and updated within the shapefiles of the ArcMap Dye Test project. The data accompanying these shapefiles is also stored within the Dye Test Access database where reports are printed, data queried, and no lien and correspondence letters are generated. The new GIS system places new field information collected from dye testing directly onto the server, Figure 2.

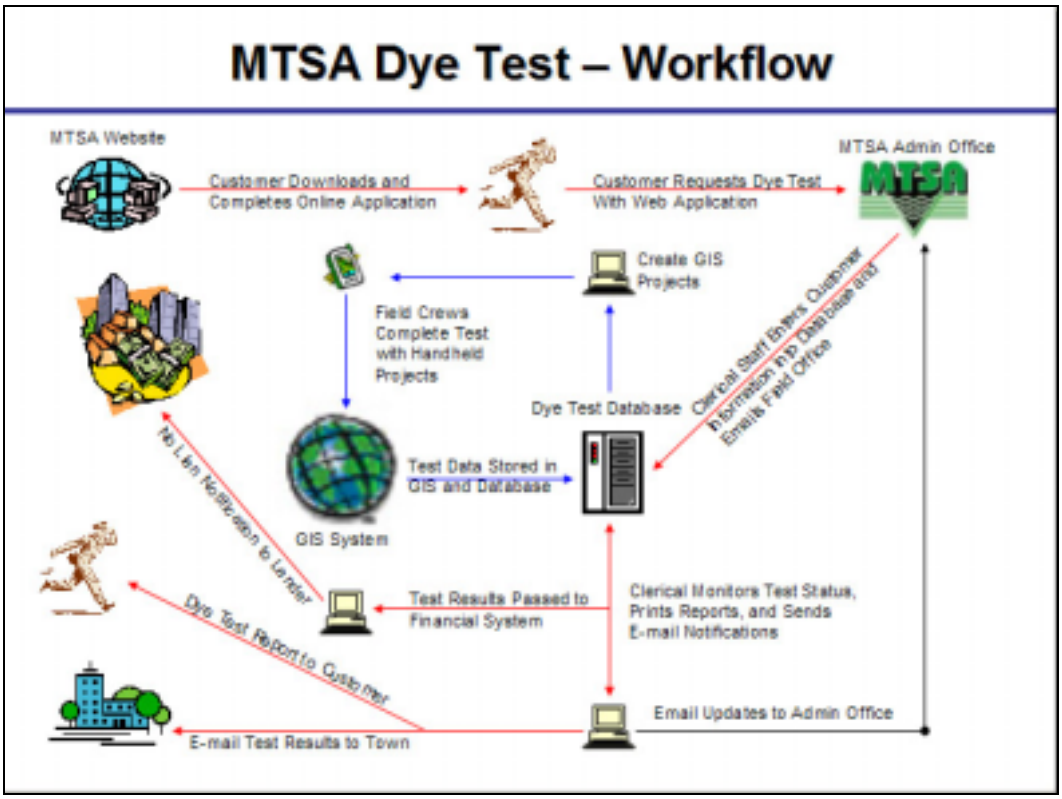

Figure 2: Dye Test Flow Chart

This method allows permitted end users to view the information from their own workstation. Through the IMS, users are able to look up houses dye tested, when they were done, and whether or not they passed or failed. This is done through ArcIMS with data stored on the GIS network and the Dye Test Access database. The ArcIMS viewer can display the data layers available to show the dye test information. ArcIMS in conjunction with the Dye Test database is proving to be a very powerful tool to manage dye testing with the MTSA service area.

Manhole Inspection

The Manhole Inspection program functions similarly to the Dye Test program. Initially all inspections were done on paper and the documents were filed and scanned accordingly. The Authority now has a GIS Handheld PC application for manhole inspections. The program allows the field crews to store manhole inspection information directly into the GIS through a series of customized drop down menus built into ArcPad. When the information is brought back into the office, the data is verified and stored within the ArcMap Manhole Inspection project. The corresponding shapefiles are updated and saved onto the GIS server. A Manhole Inspection Access database prototype is also available to store additional data and enable printing of manhole inspection reports. Permissible users within the Authority access and review the manhole inspection data through the ArcIMS viewer. The viewer contains those layers necessary to display the collected manhole assessment information. The Access database also resides on the server allowing users to print the inspection reports.

CCTV Truck GIS Link

One of the main maintenance and inspection tools of the Authority is CCTV inspection. The data collected through CCTV inspection is very valuable information and is important for the Authority's fulfillment of its regulatory requirements. Previously the information collected from the CCTV truck was downloaded and stored on one stand alone location. The data stored was copied onto several CD's and is loaded into the CCTV Truck Link program, a customized ArcMap project and corresponding Access database utility that stores and prints the text and video data from the inspections. In order for others to view the information, reports had to be generated and/or the shapefiles again were loaded onto each individual's workstation via CD.

The CCTV Truck Link program functions similarly as it did before except on the new GIS network, the data is stored in a central location on the new server. This provides access to the data for those who need it and eliminates the need to transfer information separately between workstations. The ArcMap CCTV project still resides on one workstation but the data created is stored on the GIS server. The spatial data is accessible to permissible users through the ArcIMS viewer. With ArcIMS, users are able to print maps of lines inspected and review the data.

Development

With the ArcIMS system up and running, the Authority will begin to move into the third phase of their GIS network implementation, development. This phase of migration focuses on the merging of assessed data needs with possible future application developments. This is where the Authority can begin to prioritize new applications and evaluate the means necessary to implement them. The Authority will begin to develop each application on a priority basis. The order in which these are developed will bear weight on their relative importance. This will help to eliminate redundancy and maximize the benefits of GIS development.

Supplemental to application development is data conversion. This is the process of translating previously archived data, such as dye test report scans, flow monitoring reports, and manhole inspection reports, to make them applicable within the GIS network. Although associated costs for data conversion and application development are not well defined at the moment, we have attempted to summarize some of the main areas of the Authority's GIS development considerations.

Link Past Dye Test Reports

In conjunction with the manhole inspection program, the Authority will examine the means necessary for submitting past dye test inspection reports. There is a large amount of inspection data scanned and stored within their current document management software. A suggested method may be to link these documents to the proposed GIS network, giving the Authority broad based access to these reports. This should give the Authority the capability of hanging the archived reports within the proposed GIS network to provide a means for reporting certification under their current ACO agreement.

Flow Monitoring Field Reports

Another suggested area for data development is the conversion of the Flow Monitoring Program's field reports. The reports are currently archived and indexed in paper form. These documents could be easily linked into the new GIS network to flow monitoring locations throughout the Authority's service area. The Authority may need to create a shapefile containing the GPS locations and characteristics of all flow monitors. Each monitor will need to be uniquely identified with a specific name or number. Potentially then, the prior documentation can be scanned and associated with each monitoring location within the GIS. This would allow Authority wide access to permissible users to view the associated field reports with each flow monitor. Querying capabilities can be accomplished within ArcIMS and necessary documents could be printed.

ArcSDE

As more and more data and tools are accumulated, the network may need to expand. The natural expansion accompanying data application development will grow in due course within the proposed GIS network. There may come a point, however, when the proposed network architecture may reach its limit. There also may develop a desire for a multi-user editing environment and a need to establish a more sophisticated means of data querying between vector and raster data. ArcSDE could be the solution to satisfy the potential need for expansion. By implementing Option 2, MTSA has already taken the first step to migrating to a fully integrated data management system capable of molding to fit the immediate and foreseeable needs of the Authority.

Conclusion

The Authority, in following with current and emerging operating requirements and regulatory initiatives, will continue to develop their GIS system. The sustained development follows a three step analysis, migration, and development process. Following this process has shifted the role of the Authority's current GIS from a map making utility towards a data management system. The main objective for which is to provide the Authority with a centralized utility capable of communicating information throughout their organization to its end-users. They have accomplished this by implementing the suggested Option 2 with ArcIMS as the central distribution utility. By having a centralized data repository in place, the Authority is be able to fulfill their current regulatory requirements while building for the future. Concurrently the Authority has been assessing future foreseeable regulatory and operational data needs with Buchart-Horn, Inc. Along with this the Authority is beginning to further prioritize data conversion and supplemental application development. The Authority has taken these steps to remain well suited to continue their GIS development by discussing future systems architecture requirements with possible ArcSDE implementation.

Authors

Shawn M. Summers
The McCandless Township Sanitary Authority
Pittsburgh, PA
Phone: 412-364-2119
Email: shawnsummers@mtsaonline.org
http://www.mtsaonline.org/

Kevin R. Perkey
Buchart-Horn, Inc.
Pittsburgh, PA
Phone: 412-261-5059 x16
Email: kperkey@bh-ba.com
http://www.bh-ba.com/