

BIOGRAPHICAL INFORMATION

Bruce B. Taylor
Engineering Services Supervisor
Clayton County Water Authority

Specific Responsibilities

I joined Clayton County Water Authority in 2000 as the GIS Program Coordinator. As such I was responsible for building the GIS program from ground up. This program serves 350 employees involved in water production and distribution and wastewater collection and treatment as well as constructed wetlands and a 24,000 sprinkler land treatment facility. In addition to utility information, our program maintains a street database, building footprints, and parcels (in progress).

Since 2002, I have served as Engineering services supervisor, which has expanded my role to include integration of other technology into Clayton County Water Authority's business practices.

Past Experience

My past experience includes Engineering consulting (GIS and environmental remediation), and manufacturing (environmental sampling containers).

Educational Information

M.S. Geology, Georgia State University
B.A. English/Environmental Studies, Dartmouth College

Professional Memberships

Georgia URISA, Immediate Past President
URISA International
GITA
Project Management Institute

THE PERFECT CIRCLE: STREAMLINING DATA MANAGEMENT

Bruce B. Taylor
Clayton County Water Authority
1600 Battle Creek Road
Morrow, Georgia 30260

ABSTRACT

Accurate and timely data is key to any successful geospatial program. It is also very costly and difficult to achieve—often burning through a great percentage of a GIS budget. Finding efficient ways to capture, convert, and perform quality control on data can provide enormous cost savings to any enterprise. Clayton County Water Authority has implemented a multi-tier data capture and conversion process comprised of GPS data capture, conversion of as-built contractor submittals, and red lining by field crews. This streamlined approach is based on tight standards for electronic CAD submittals; well defined data dictionaries for CAD, GIS, and GPS data collectors; an aggressive education program; and the use of conversion software for unattended conversions. The result is enhanced quality and timeliness of data with low overhead costs. With the rollout of wireless updates of field computers, turnaround times are in many cases less than 24 hours.

INTRODUCTION

Clayton County Water Authority (CCWA) is the primary GIS data provider for Clayton County, a rapidly growing county of 250,000 residents in the metropolitan Atlanta region. As such the GIS section is responsible for simultaneously building and maintaining GIS datasets for water and wastewater networks as well as a 24,000-sprinkler head land application facility, a constructed a wetlands system, streets, edge-of-pavement, and subdivision parcel data. In spite of a relatively small GIS staff and a tremendous amount of data, CCWA is able to keep each of these datasets current on a daily basis.

Relying on automated processes, system additions and field red-lines are incorporated daily into the GIS central geodatabase, then converted to shapefile format, and uploaded to each field worker's laptop the following day through a wireless connection to a laptop in the worker's truck. Most of these processes are performed without human intervention other than QC review. Contractors are required to submit CAD data electronically, which is converted to GIS data in a hand-free process. In return, custom datasets are provided to contractors, free-of-charge, with an average turnaround time of less than one hour.

These fast and cost-effective processes are possible through the use of off-the-shelf third-party software conversion software (Safe Software's FME), custom scripting for standard

GIS software (ESRI's SDE scripting), detailed and strict CAD submittal standards, and an aggressive education program. Not only has data quality and timeliness dramatically improved, but this system is roughly 400% more efficient than the former system. As a result, end users – whether office or field workers – have access to any data submitted on the previous day with complete transparency.

DATA COLLECTION

Data collection at Clayton County Water Authority takes many forms from survey data of facilities to electronic conversion of Computer Aided Design (CAD) drawings, to field redlining using laptop computers and GIS software. In addition, Personal Digital Assistants (PDAs) are used to collect attribute data, which can be joined to GIS data.

Survey Data

Survey data is collected using both conventional survey instruments (Topcon) and GPS units but with the same data collector. Using feature code libraries that closely correspond to GIS data dictionaries and CAD layering, data is constrained to pre-defined features and attribute ranges. This data is then daily uploaded to the central server, and processed using a standard surveying software package. Depending on the application, the processed data is then exported to CAD or GIS file formats. Survey data collection is completely paperless, and contractors are required to follow the same data formats.

Electronic As-Builts

New subdivisions represent the majority of the new data that is brought into the GIS. In the past, CCWA received hard copy as-built plans from engineering firms. These plans were originally hand drawn on mylar map book sheets. More recently they were digitized twice in CAD: once to reproduce the as-built, and a second time to produce map book pages. Yet another version was created for GIS. Thus a given subdivision was produced a total of four times, a great waste of resources with ample opportunity for degraded data quality.

Under the streamlined system, engineering firms digitize the as-builts according to tight CAD Standards and submit them electronically to CCWA. The contents, topology and naming of very layer is detailed in the standards, which are available on the CCWA web site along with sample as-built drawings. As the as-builts are received, they are logged in and checked using a plan review database. Items that do not conform to the standards are quickly flagged and a follow-up letter is automatically generated. Most plans are accepted with only one or two reviews. Once accepted, the CAD files are converted directly to GIS format using Safe Software's Feature Manipulation Engine (FME). FME allow a completely unattended conversion: CAD files that meet the CAD standards are converted without further editing.

Field Redlining

As part of a program to accurately map water system valves, CCWA survey crews used standard GIS software (ArcView 8.3) to produce “red-line” drawings of valves. Formerly these crews produced hand-drawn sketches, which were later redrawn (by hand or in CAD), and then converted to GIS. Rather than survey the valves, each valve was digitized in ArcView in the field placed using aerial photos (GPS was not used due to tree cover, which would have prohibited survey-grade accuracy. Additionally for the near future survey-grade GPS will be too expensive to provide for each maintenance crew). Since maintenance crews use tape measures to reacquire valves, distances were measured from valves to nearby visible points such as light poles, hydrants, and manholes. These measurements as well as the measurement points and the valves were digitized directly into a personal geodatabase in ArcView. The personal geodatabase was then uploaded to the server at the end of the day.

The “red-line” drawings were uploaded to a enterprise Geodatabase, and the original water lines and existing valve information was edited to conform to the data collected in the field. This two-stage process was used to enable the field crews to quickly capture data, and allow an experienced GIS editor to make the time-consuming judgments regarding connectivity, which often required further research.

PDA's

PDA's provide an extremely cost-effective component in GIS data collection. Although PDA's can be combined with portable GPS units to collect geographic as well as attribute data, CCWA opted to use PDA's directly, without GPS for a sewer manhole inspection project. The GPS was not used mainly to reduce the cost of the project. The PDA's used for this project were less than \$300 (they can be purchased for as little as \$100 or less now) and thus were virtually disposable.

Since the manholes had previously been surveyed and incorporated into the GIS, field crews used printed maps showing the manholes and associated IDs. The crews input the IDs into the PDA's along with the rest of the inspection data using tightly constrained input fields and a “wizard” type of interface. At the end of the day, the data was “synched” with the master database, which was in turn linked directly to GIS.

DATA DISTRIBUTION

Enterprise Geodatabase

CCWA maintains a central GIS database stored in SQL Server using ESRI's Spatial Data Engine (SDE) technology. This database provides an efficient environment for multi-user editing, storage and retrieval. For office personnel, it also provides a safe environment for viewing a rich set of geographic features and attributes. Updates to the geodatabase are available immediately. Overnight a batch routine runs automatically to export SDE data to both shapefile and personal geodatabase format for upload to mobile computers.

Distributed Data

Field personnel form the other half of GIS users. All field crews are equipped with a laptop computer with a GIS viewer, and a wireless 802.11g LAN device. At the start of the working day, the crew starts their truck, and boots up the computer. Immediately an update script runs, which pulls the latest data and project files from the network. Once the update is complete (usually less than five minutes for the entire GIS dataset), the crew can begin work.

Field crews use ESRI's ArcReader, a free GIS browser, which reads personal geodatabases directly and features excellent symbology and an easy-to-use interface. ArcReader projects are created directly in ArcGIS using the ArcPublisher extension, a relatively inexpensive addition to the core ArcGIS software. With limited GIS staff, this system creates functional GIS field tools with no additional training using existing software. Most crews—even those with no prior computer experience—are able to browse and query data with a few hours of training.

Perfect Circle: Data Updates

In the past, field crews had very little motivation to provide updates to mapping staff. Not only did updates take months or often years to become part of the hard-copy map books, when they did, they were often so poorly drawn that they were useless. By conducting multiple training courses, creating standard procedures, standardized forms, and providing constant feedback, CCWA has dramatically increased the rate of participation. A significant motivating factor is the rapid rate of updates by GIS staff. Once received by GIS staff, the data is updated within a week – the ultimate goal being same-day updates.

CONCLUSIONS – SIMPLY THE RIGHT TECHNOLOGY

Clayton County Water Authority has dramatically improved its geographic data management practices through the use of a variety of high-, medium-, and low-tech solutions. From something as basic as standardizing data collection forms and processes, to something as advanced as 802.11g wireless technology and unattended data conversion, each solution was selected based on cost-effectiveness and within the context of CCWA's existing technologic and human environments. In addition, each of these solutions was based on the overarching principle of simplicity. Although some of these solutions were not entirely simple to implement, and many required significant planning and up-front development, all represent an effort to create systems which maximize the flow of information to the end-user, with a minimum amount of overhead. The result is a set of systems that maximize efficiency and minimize the opportunities for errors.