



**Charleston Commissioners of Public Works
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Implementing & Maintaining the GIS at the Charleston Commissioners of Public Works

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Abstract

The Commissioners of Public Works (CPW) is utilizing GIS to develop a Facilities Management System (FMS). The software we use for our GIS: AutoCAD, ArcView, CMSEdit, and CityWorks; is designed to make additions, maintenance, and editing straightforward and efficient. AutoCAD drawings are in State Plane coordinates and are edited to fit our GIS, then imported into CMSEdit. CMSEdit sits on top of ArcView, and is a multi-user editing tool that allows more than one person to work on the GIS, minimizing the network traffic. CMSEdit allows field editing, accelerating the process of maintaining the GIS map. CityWorks is used to generate work orders for the field crew, who in turn, can then make changes to the GIS when they have made field changes to the inground inventory. The GIS will have the ability to model future trends in development in areas requiring water distribution and sewer collection service. Modeling will show any impact on our system by evaluating our capacity to handle future development and calculate our energy optimization. The GIS allows our department's electronic access to every attribute associated with both our sewer and water systems. For example, Accounting will be able to keep our inventory up-to-date, monitor what costs are associated with specific types of projects making future projects more accurate. Customer Service can provide much quicker response to customers in problematic situations, and Customer Service Representatives will immediately be able to determine what work order is necessary, cutting the time considerably. Design and Construction will have access to the most current data available, saving both time and money in the construction process. GIS will benefit our entire company allowing CPW to effect more efficient services and even new additional services to our customers.

Introduction

The Commissioners of Public Works

The Charleston Commissioners of Public Works (CPW) has been an essential part of the Charleston Community since 1917. CPW currently supplies water to portions of Charleston, Berkeley, and Dorchester counties. Wastewater treatment is provided within the City of Charleston and the St. Andrews Public Service District. Wastewater treatment is also provided to the James Island Public Service District and the towns of Folly Beach and Hollywood.. CPW also has agreements with neighboring municipalities to treat the wastewater generated by their customers at our centralized Plum Island wastewater treatment plant. (<http://www.charlestoncpw.com/>)

CPW completed a study in 1989 and established that there was a definite need for a GIS. GIS would benefit CPW by:

Objectives

1. Improving the ease of maintenance, distribution, access and accuracy of maps used throughout our organization.
2. Using the computer as a tool for the analysis and manipulation of spatial data to the benefit of CPW, it's staff, and it's customers.
3. Improving the quality and speed of service to our customers.
4. Maximizing the value of information available within CPW by increased sharing of data between personnel, simplifying employee tasks, increasing productivity, and reducing costs. (CCPW GIS Steering Committee, 1989)

CPW decided to combine the eleven types of maps used by different departments to one central GIS location. (Grids, Tax Maps, As-Builts, Plan & Profile, System Schematics, Plats, USGS Quads, Street Maps, Foreign Drawings, and Valve Cards.)

In 1997, Environmental Systems Research Institute, Inc.(ESRI) ArcInfo was evaluated on Sun SparcStation under UNIX and found that if ported to Microsoft Window NT, would fit our needs. A LAN network was installed, Hewlett Packard (HP) GIS server and two HP workstations with ArcInfo 7.1 for Windows NT were installed. In 1998, CPW purchased ESRI's ArcView 3.0.

Each Department came up with fields and layers they needed to access on the GIS. Once this was established, CPW crews surveyed the project area for a plan/profile. For the most accurate data, the feature attributes were surveyed in using both in-house survey crews and outside contractors, taking approximately three years to complete—1999 through 2000. (Denmen, 2003)

County-line base maps given to CPW by Charleston, Berkeley, and Dorchester Counties were brought in to the GIS. In 1992, Charleston County produced the most accurate

Ortho-digital quads of the county has ever flown, which is invaluable for maintaining accuracy. (Denman, 2003) In 1998, the City of Charleston's GIS department sped the progress of our map by supplying accurate pavement and parcel lines.

The water and sewer lines were connected using an outside contractor to connect our surveyed points. U.S. Filter, out of Pittsburgh, Pennsylvania, was hired to build major portions of the map using survey points, valve cards, and grids.

The Technical Services Department is in the process of filling in the gaps on the map by using As-builts, CAD drawings created by Engineering firms, and other recourses to complete the legacy data. Besides entering in new development, the Technical Services Department is also linking all electronic data associated with each attribute on the GIS. For example, one gate valve on a water line will not only display it's valve card, the manufacturer, when it was laid in the ground, etc. but is also linked to the original CAD drawing, and all other paperwork associated with it.

Software

The software CPW has selected for the GIS: AutoCAD, ArcView, CMSEdit, and Cityworks; is designed to make additions, maintenance, and editing straightforward and efficient.

AutoCAD

We require each Engineering firm provide an asbuilt and electronic CAD drawing for each job. The CAD drawings must be in state plane coordinates. All editing at CPW is completed using AutoCAD. Editing consists of transferring the Engineer's drawing into simple water or sewer lines, including all attribute features associated with the lines, such as manholes and water valves.

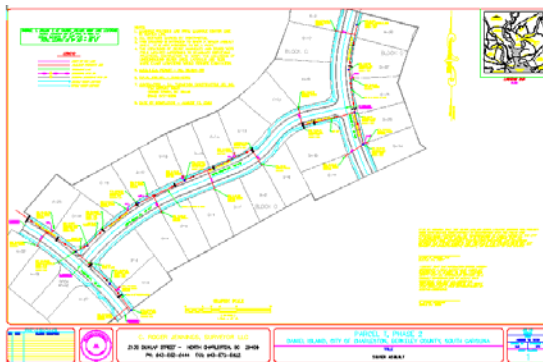


Figure 1—Electronic Auto CAD drawing of New Development

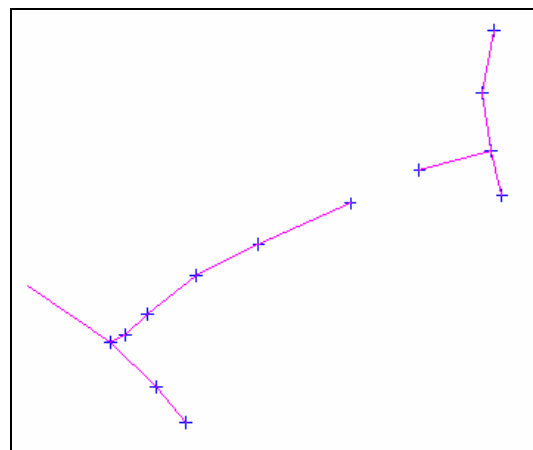


Figure 2—Edited CAD drawing

Environmental Systems Research Institute, Inc. (ESRI) ArcView

CPW selected ESRI's ArcView after testing many other GIS software packages. ESRI has established itself as a leader in the GIS software market, and its products are user-friendly.

"ArcView is the world's most popular desktop GIS and mapping software, with more than 500,000 copies in use worldwide. ArcView provides data visualization, query, analysis, and integration capabilities along with the ability to create and edit geographic data" (<http://www.esri.com/software/arcview/index.html>, 2003)

CMSEdit

CMSEdit is a multi-user editing tool that works within ArcView. An individual extracts a "geographical area for which they plan to update" (CMSEdit Training Course, 2002). The extracted area can be used to either add a new water or sewer development, or make changes and updates on the current system. The advantage of CMSEdit is that many users can be editing the GIS at the same time without slowing down the computer network system. After the user completes the update, a command "mark asbuilt" is given and the updates are sent to the master server in a single directory and posted using a batch posting process.

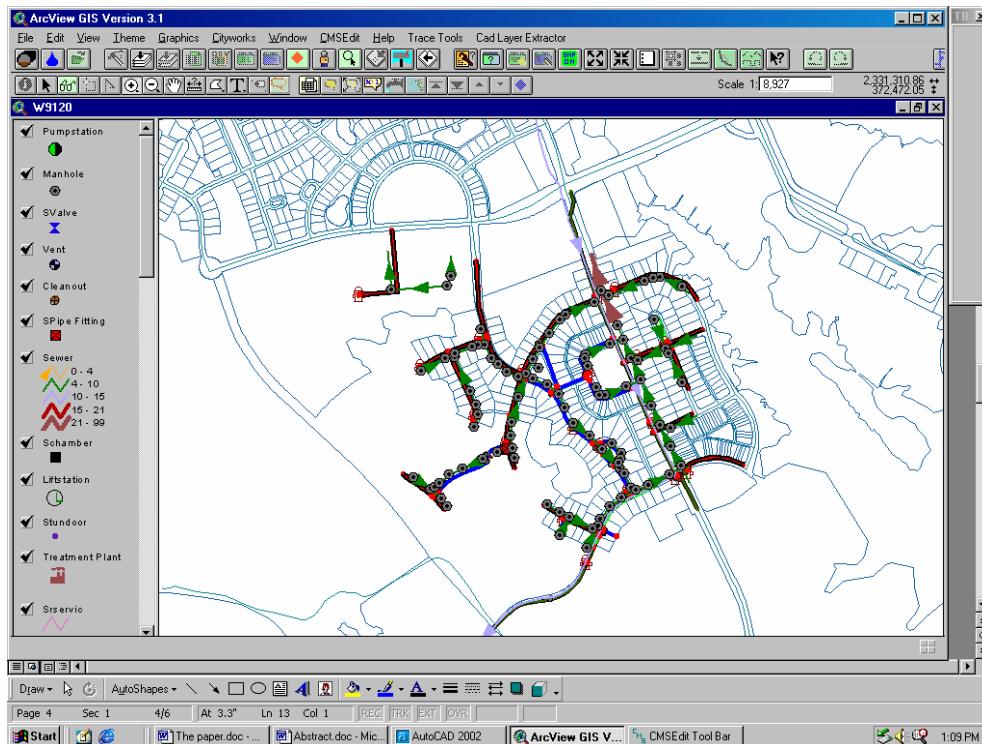


Figure 3—Area Extracted on Individual Desktop for Editing

Azteca CityWorks

"Cityworks is a GIS-centric approach to work management as an ArcGIS or ArcView 3x extension" (Cityworks Azteca Systems User Guide 2002).

In 2001, Azteca CityWorks was installed by CPW's Information Services (IS) to handle work orders for Water and Wastewater departments.

Cityworks is used to generate work orders for the field crew, who in turn can then make changes to the GIS when they have made field changes to the inground inventory. This not only speeds up the process of editing and maintaining an inventory of the systems, it also creates a database that is accurate and up-to-date, replacing the paper-grid system.

Up-dates and Maintenance

"Improving the ease of maintenance, distribution, access and accuracy of maps used throughout our organization." (Objective 1, CCPW GIS Steering Committee, 1989)

The Technical Services Department and field crews perform updates and maintenance of the GIS.

Technical Services

The Technical Services Department is responsible for building the GIS. Once U.S. Filter, the contractor who initially input data, had completed their task, Technical Services filled in missing or incorrect data. U.S. Filter did not use the original as-builts, which meant that the map was not as accurate as is required. Because accuracy is a priority, Technical Services checks all legacy data and makes necessary corrections.

New development is added to the GIS using electronic CAD drawings, editing those drawings and converting them to shapefiles to import into the map as explained earlier.

Field Crews

Field crews make changes to the GIS after making field changes to the inground inventory. CityWorks is used to generate the work orders. Crews record changes to attribute features by filling out a database field; any changes or additions are downloaded to the master server following the posting procedures.

Benefits

Standardized Information

The GIS standardizes data into one format used company-wide. Data used to build the GIS comes from several different sources, but once the data is converted and placed in the GIS, it becomes standardized.

CMSEdit uses rule-based data, allowing only drop-down menu choices that insures the accuracy of the map and eliminates the possibility of having many fields categorizing the same data. (Convertino, 2003)

Accuracy of Data

Because water and wastewater data is put on the map directly from the original source and maintenance updates are recorded from the field the same day, CPW has moved from the slow process of maintaining paper grids and old filing systems to an electronic GIS map that contains current, accurate information.

Storage and Accessibility

Moving from paper to computer storage not only saves time and space, it also better organizes data and makes it readily accessible. The old system of several departments collecting data, such as grids, water and sewer line information, valve cards, maintenance records, etc., is now collected and centralized in one location that is available to the entire company.

Departmental Access

"Maximizing the value of information available within CPW by increased sharing of data between personnel, simplifying employee tasks, increasing productivity, and reducing costs." (Objective 4, CCPW GIS Steering Committee, 1989)

CPW's GIS allows departments to have electronic access to every attribute associated with both our sewer and water systems.

The Accounting department will be able to keep our inventory up-to-date, "using GIS for inventory of what is in the ground so that we can have a better credit rating for bonds for future growth." The accounting department will also use GIS " to properly place funds into specific accounts and attributing costs to the correct jobs, monitoring what costs are associated with specific types of projects and projecting the costs for future extensions into developing areas". (Wooten, 2003)

"Improving the quality and speed of service to our customers."
(Objective 3, CCPW GIS Steering Committee, 1989)

Customer Service will have all the information required on the map to help customers and answer questions immediately. For example, each lot line has a customer number that will link to all attributes and features associated with that customers property and services. The Customer Service department will benefit by being able to "provide a much quicker response to customers in a problematic situation. The Customer Service Representatives will immediately be able to determine if the customer address is actually within our purview and, if so, generate what work order is necessary to help the customer in the most efficient and expeditious manner." (Wooten, 2003)

Design and Construction will have access to the most current data available, saving both time and money in the construction process. By not having to find all the hard copies of

drawings and documents from the vault, research time is cut down considerably. "It will allow personnel to immediately assess whether a customer or developer parcel has services available instead of checking three different resources for the same information." (Wooten, 2003)

Modeling

"Using the computer as a tool for the analysis and manipulation of spatial data to the benefit of CPW, it's staff, and it's customers."
(Objective 2, CCPW GIS Steering Committee, 1989)

The GIS will have the ability to model future trends in development in areas requiring water distribution and sewer collection service. Modeling will show any impact on our system by evaluating our capacity to handle future development and calculate our energy optimization.

The modeling software used for our water services is Stoner, Synergee, and WaterCAD. WaterCAD is especially useful in that it reads shapefiles and is therefore compatible with ArcView. Some answers found through modeling are how big the water line should be for new development, and fire flows.

HydroWorks is used for our sewer service modeling. HydroWorks is a software program used in the industry as a stormwater and sewer gravity flow and elevation model.

Summary

The Charleston Commissioners of Public Works has a large customer-base, and our goals are to continuously improve our services. CPW began utilizing GIS to develop a Facilities Management System (FMS). CPW's decision to move from paper to electronic data has been designed to produce beneficial results to the entire company. Information that was once stored in many departments, is now stored on the map and will be accessible throughout CPW.

The software chosen for the GIS was based on research done over a period of time. ESRI's ArcView was selected because it proved to be the most beneficial. CMSEdit and Azteca CityWorks were chosen to provide a more customized GIS for our needs.

Our points (manholes, valves) were surveyed for accuracy, and an outside firm was hired to "connect the points" to get the GIS up and running quickly. For legacy and new development data, all updates and maintenance of the GIS are done in the Technical Services department. Field Crews provide maintenance and other valuable information found in the field, which is then put directly into the GIS database. Because updates are made immediately, the data is much more accurate and reliable.

The GIS has standardized data for our water and wastewater systems, making the information useful to every department. The Accounting, Customer Service, and Design

and Construction departments will especially benefit by having access to the database located within our GIS.

For future development and flows that influence our system, modeling software programs can answer questions that determine our systems' capacities and how certain variables will impact our systems.

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Figures

Figure 2—Electronic AutoCAD drawing of New Development

Figure 2—Edited CAD drawing New Development

Figure 3—Area Extracted on Individual Desktop for Editing