Esri News
for Water & Wastewater

Stormwater Issue
Summer 2012

Residents "Go Green" with Green Up DC

Map Interface Supports Stormwater Projects

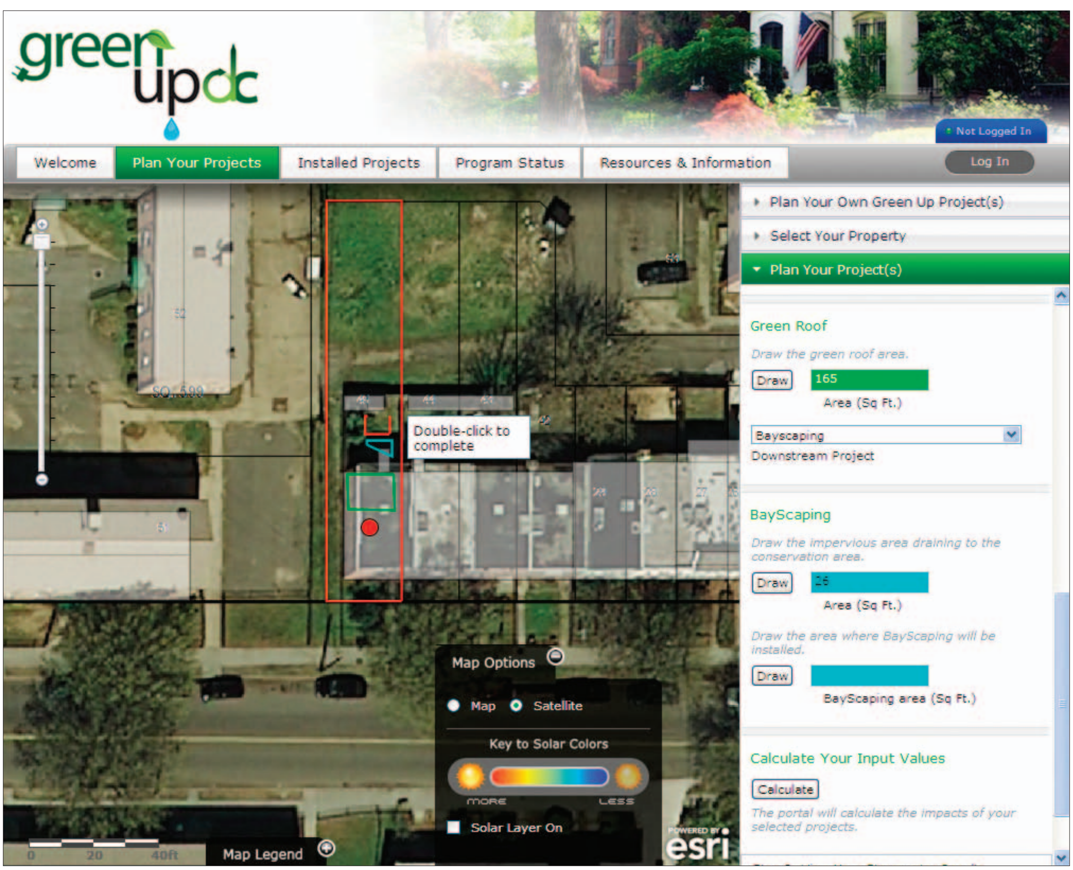
By Jessica Wyland, Esri Writer

Stormwater runoff from Washington, DC, carries contaminants such as tar, mercury, and herbicides downstream to nearby Chesapeake Bay, the nation's largest estuary. Now, area residents can take an active role in protecting the bay's health by using a new interactive web mapping application, Green Up DC, provided by the District Department of the Environment (DDOE).

Green Up DC offers Washington, DC, residents tools to help reduce the amount of contaminants that enter Chesapeake Bay. Residents and business owners may plan new stormwater management projects such as green roofs, pervious pavement, and rain barrels. They also can access information about financial subsidies and rebates, register completed projects, and view maps of other property owners' projects.

"Many stormwater problems are the result of excessive runoff from hard, impervious surfaces such as roofs, sidewalks, and driveways," said Jenny Guillaume, an environmental protection specialist with DDOE's watershed protection division. "Anyone can visit the Green Up DC site to look at their own property and find out how to reduce stormwater [runoff]."

Green Up DC features an intuitive, →



← Interactive drawing tools allow users to design projects.

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→ mapcentric interface that was created with Esri ArcGIS API for JavaScript and runs on the web via Esri ArcGIS. Users can choose from 14 project types. The site also offers energy conservation projects including solar electricity and hot water, air sealing and insulation, hot water conservation, and duct sealing repair. A homeowner can simply type in an address, zoom to the property, and draw the location of energy conservation or stormwater projects, using an aerial photo background as a guide.

The Green Up DC application calculates project costs and benefits and provides a list of experienced local vendors that can install the project or quote a price. Registered users of Green Up DC can save planned projects or register projects that they have already completed.

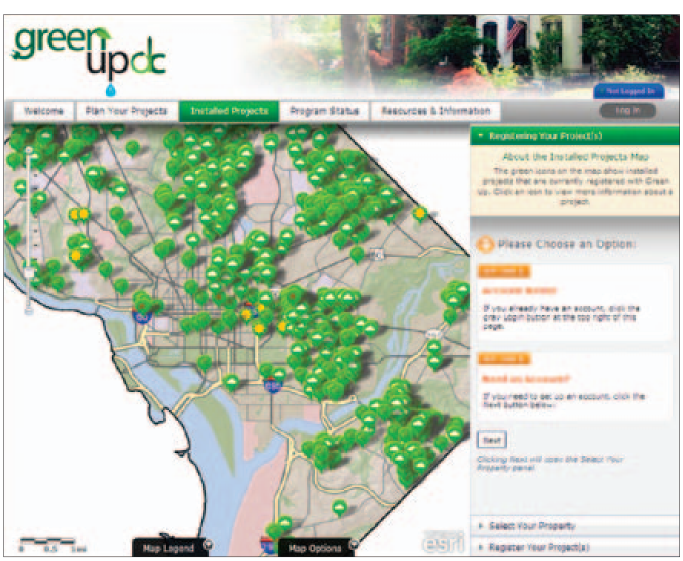
"As with many other urbanized areas, the district has significant stormwater management challenges, including flooding and water quality issues from sediments and other contaminants," said Bruce Taylor, a project manager with Esri partner Critigen. "The Green Up application makes it easier for homeowners to take an active role in reducing stormwater runoff."

Critigen, a technology consulting and IT outsourcing company, uses location data, business intelligence tools, and cloud computing in its work with public and private clients. Taylor and his team worked with DDOE to design Green Up DC, which is based partly on ecoportals built for other clients. With its partner CH2M HILL, Critigen adapted a stormwater runoff model developed by the Center for Watershed Protection so it could be easily used by people who have no technical background. Critigen used land base data, aerial photographs, and impervious surface information from the district's ArcGIS for Server map services to display property characteristics and provide input data for the calculators.

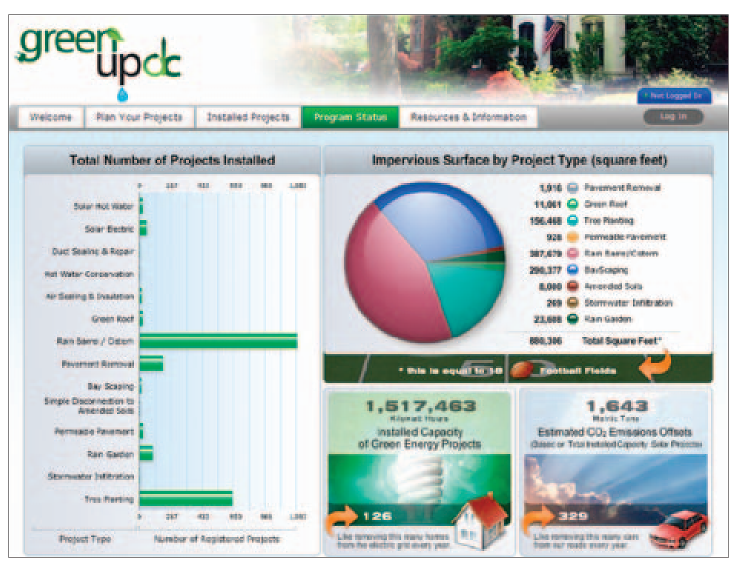
Green Up DC maps both planned and registered projects and provides a program status dashboard and reports that can be used to monitor the progress of the program. Home and business owners can access the status dashboard to see the anticipated impact of a particular project. DDOE officials will be able to verify how many projects are completed and add the data to reports for the city as well as the Environmental Protection Agency. The reports include summaries listed by specific watershed, sewer shed, or political jurisdiction.

"We hope to see more people implementing projects and sharing projects," Guillaume said. "Green Up DC's link to Facebook helps us tap into social media to spread the word. We would love this tool to help homeowners plan and complete their projects."

> "Many stormwater problems are the result of excessive runoff from hard, impervious surfaces such as roofs, sidewalks, and driveways."
>
> Jenny Guillaume, Environmental Protection Specialist with DDOE's Watershed Protection Division



↑ Existing projects are mapped so users can identify other projects installed in the neighborhood.



↑ Status dashboards display high-level program metrics or key performance indicators (KPIs).

City of Columbus Manages Stormwater Utility Impervious Billing

By Todd Pulsifer, City of Columbus, Ohio, Department of Public Utilities

The City of Columbus Department of Public Utilities (DPU) provides drinking water and sanitary and storm sewer services to approximately one million citizens in central Ohio. The service area covers approximately 700 square miles that encompass parts of five counties. In addition to water, sewer, and stormwater services, the city operates a small electric utility that provides power to customers and more than 53,000 streetlights within the city.

While City of Columbus has operated a stormwater utility based on impervious areas and equivalent residential units (ERU) since the mid-1990s, the city determined that with new advances in technology—specifically, better lidar capabilities—and the city's initiative to better leverage its existing Esri software, the time had come to perform an overhaul of the entire stormwater utility impervious mapping and billing process. In doing so, the city has improved the efficiency of its processes and the accuracy of its data.

Moving On from CAD

City of Columbus DPU established a stormwater utility to cover the costs associated with maintaining the city's stormwater infrastructure. At the time, the city digitized all the nonresidential impervious areas into a CAD system from orthophotographs. The CAD system was only available to the mapping technicians, which made it difficult to share information among the various sections within the department.

Unfortunately, the CAD system was never integrated with the billing system. Because of that, additional staff effort was required to keep the CAD and billing systems in sync manually. This brought forth the usual chance of data input error traditionally associated with such processes. Furthermore, the city maintained other stormwater-related data, such as credit information, in non-GIS flat files. The potential for errors existed in this previous situation, and although the staff worked hard to maintain it, it became more and more evident that the city needed to improve those processes.

"With the newly acquired data and tools, Columbus DPU has identified other opportunities to be more responsive to customers."

Todd Pulsifer, City of Columbus, Ohio, Department of Public Utilities

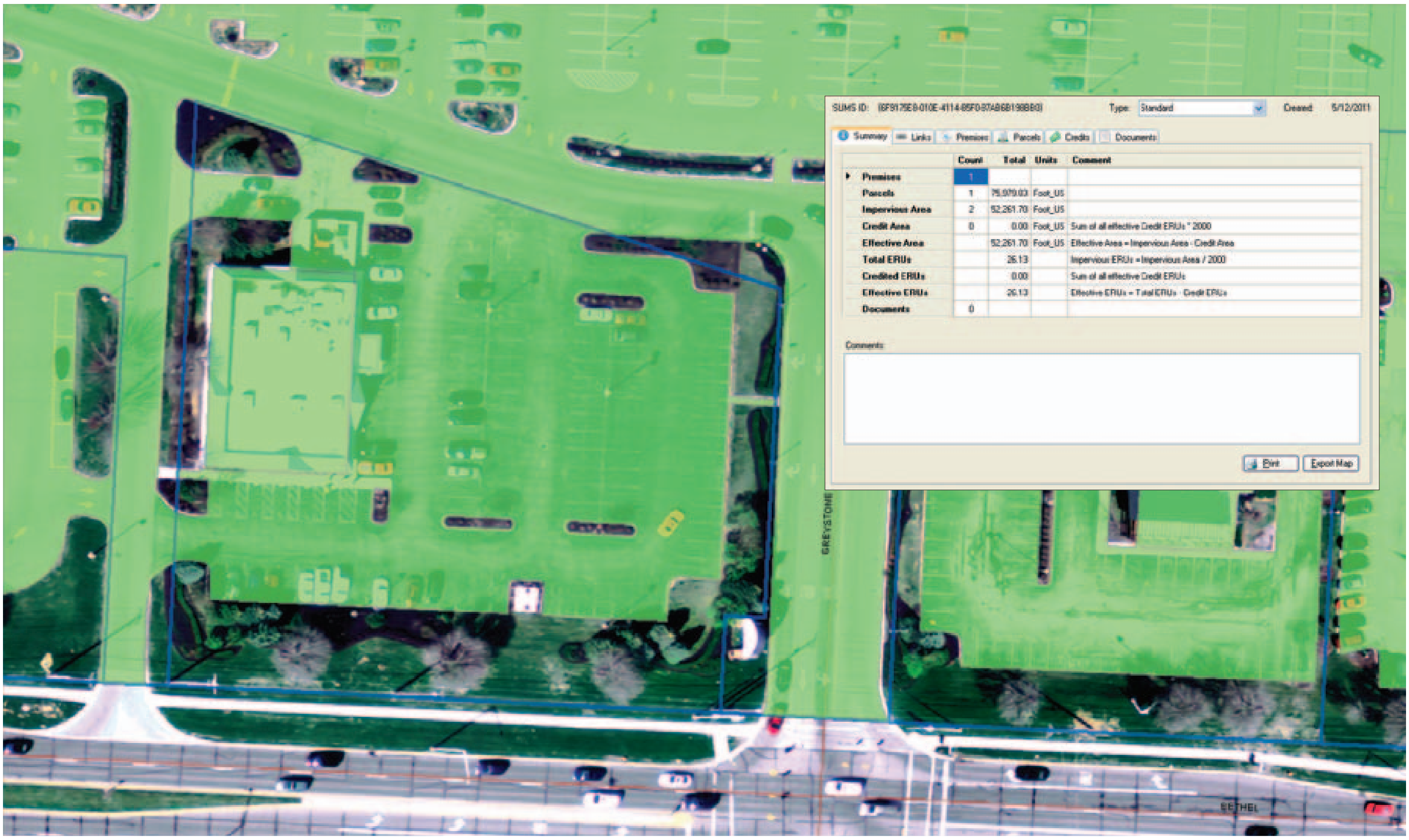
Improving Efficiency, Customer Response

City of Columbus DPU partnered with a local two-firm consulting team, EMH&T, Inc., and Woolpert, Inc., to provide services for this initiative. Woolpert obtained a service-area-wide orthophotograph and performed lidar data collection, from which it extracted the impervious areas for the nonresidential properties—the only accounts that were being charged based on actual measured impervious area. While the city had already worked to maintain an impervious layer in the CAD system, this new collection effort allowed the city to verify its existing data while identifying areas that may have been missed for a variety of reasons over the years. While the city does not yet have the final return-on-investment numbers for the project, it is expected that the data collection effort will have paid for itself within the first year.

The new data would only address one aspect of the overall efficiency improvements needed. Concurrent with the mapping and impervious data-extraction effort, EMH&T began the design and development of a stormwater utility management system (SUMS) application that is an Esri ArcGIS extension. The application creates a straightforward GUI interface for the GIS technicians to both update and manage the impervious areas within ArcGIS.

Additionally, SUMS integrates through the back end with the city's customer information system (CIS). This improves efficiency for the GIS technicians charged with maintaining the impervious data by allowing them to update the CIS directly from the ArcGIS interface. It also eliminates the need for a GIS technician to jump between multiple applications, and it eliminates the risk of making errors while keying in the updated ERU information into the billing system, as that information is passed seamlessly from SUMS to the CIS. SUMS is also able to handle the various stormwater credits that the city provides to qualified businesses that successfully apply.

With the newly acquired data and tools, Columbus DPU has identified other opportunities to be more responsive to customers. With that in mind, Columbus DPU is currently working with Woolpert to develop an internal JavaScript solution based on ArcGIS for Server that will allow the customer service representatives (CSRs) to pull up a customer's impervious area map and summary directly from within the CIS application. Historically, stormwater questions were often referred to the GIS Mapping and Damage Prevention Section to be answered because CSRs did not have easy access to the impervious mapping. This application will allow CSRs to see a customer's impervious area on a map; provide a summary of the billed ERUs, including any credits



↑ ArcMap Showing Impervious Areas with the SUMS Application

the customer may have; and print and e-mail that information to the customer. This will provide CSRs with access to previously unavailable information, which will allow them to answer customer questions in a timely manner.

In the Future: Self-Service Customer Access

City of Columbus DPU will continue to look for ways to improve efficiency and responsiveness to its customers. While the CSR application is only internal now, the city intends to provide customers with the ability to view impervious areas and ERU summary information from home or work. Using this self-service ArcGIS for Server application, customers will be able to find the answer to many of their questions without having to call a CSR.

The investment made for this initiative has already yielded benefits by improving the efficiency of the GIS technicians' workflow, reducing the potential for errors by integrating the Esri technology-based SUMS application into the CIS, and improving access to impervious-area account information in a timely manner.

Contact Todd Pulsifer at tfpulsifer@columbus.gov.

Fort Worth Battles Flood Troubles with Sturdy Data

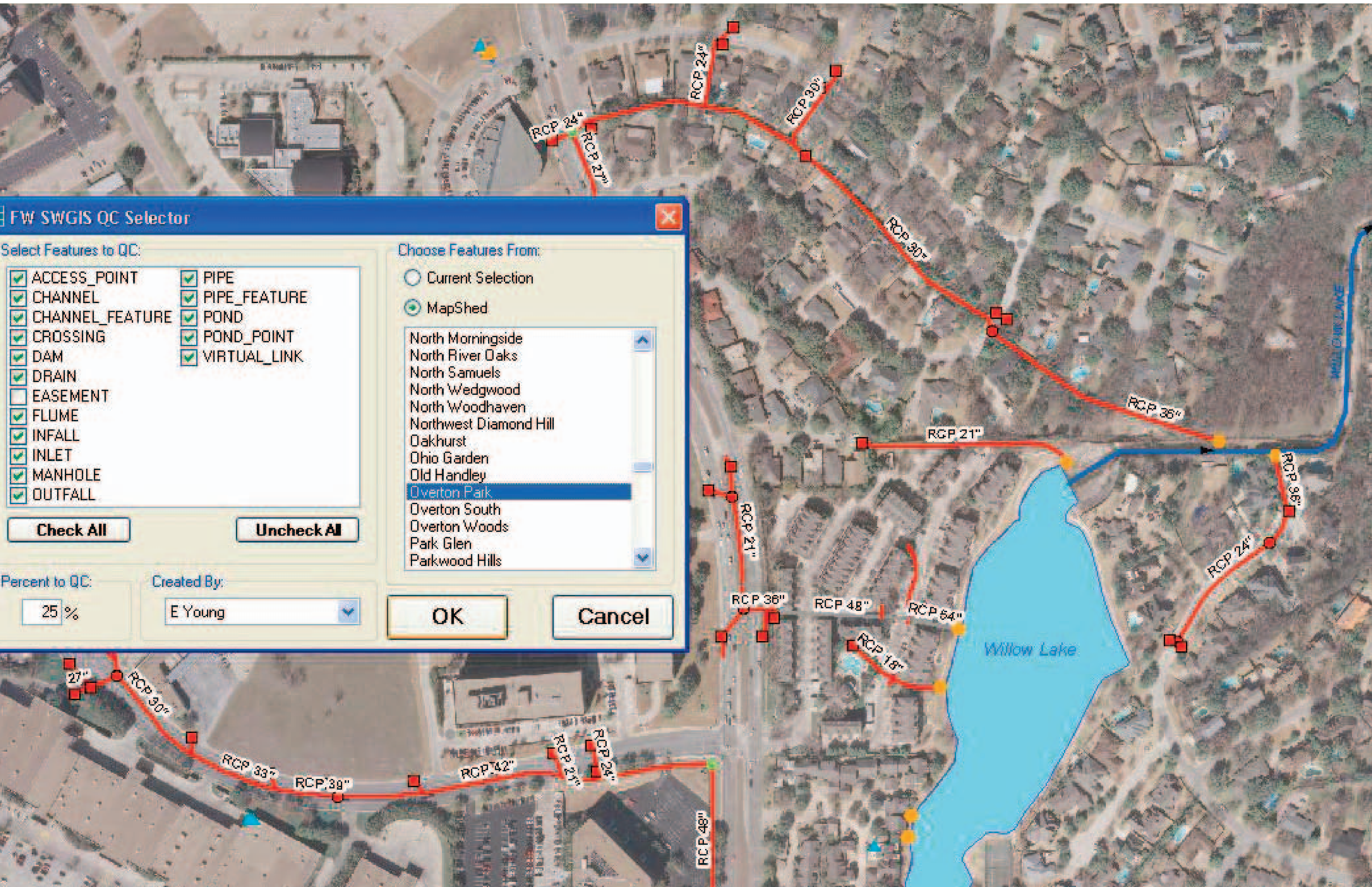
By Elizabeth Young, City of Fort Worth, Texas, Transportation and Public Works Stormwater Management Division

> "The GIS includes detailed attribute information for modeling, photos for all surface features, and links to plans and plats for each asset."
>
> Elizabeth Young, City of Fort Worth, Texas, Transportation and Public Works Stormwater Management Division

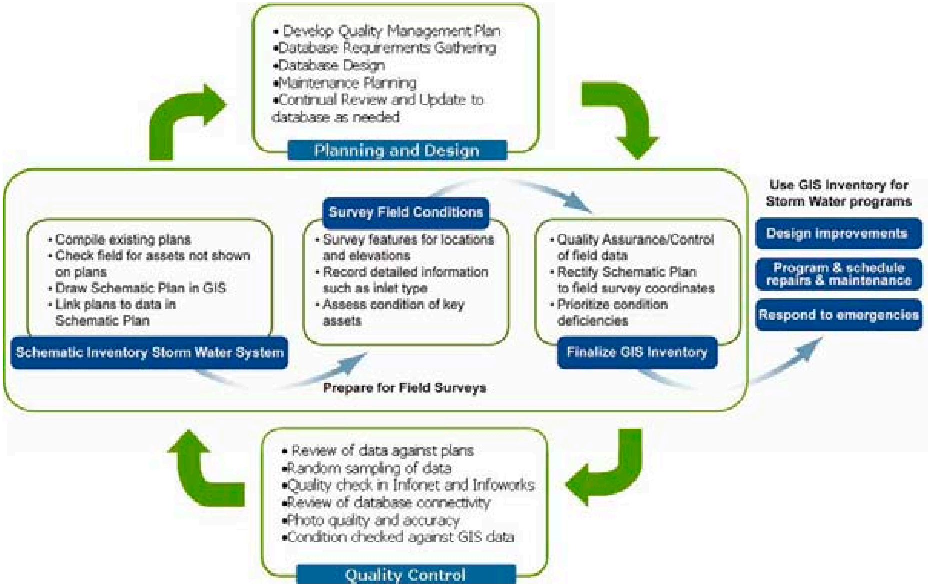
Fort Worth, Texas, developed a stormwater utility in 2006 to begin addressing flood issues at more than 700 known locations. With the city's tragic flood history, including 17 deaths from 1986 to 2007, operators at Fort Worth's Stormwater Management Division knew they had to get a better understanding of its assets and where they were located. In 1992, the city worked to create CAD maps of its assets. However, these maps were never maintained.

Since then, Fort Worth has experienced rapid growth, with an increase in population of nearly 40 percent from 2000 to 2010. When operators at Stormwater Management Division decided to map all assets, they believed the city had roughly 20,000 storm drains. The team was surprised to find out that the rapid growth had increased the number of inlets to more than 35,000 and more than 5.6 million linear feet of pipe—this is equivalent to the distance from Orlando, Florida, to New York City, New York.

In October 2008, Stormwater Management Division kicked off a four-year project to create a comprehensive GIS, representing the open and enclosed stormwater system, to better manage stormwater runoff. While many cities that currently face this challenge are working toward



↓ A custom GIS tool was developed to assist in the quality control process. The tool generates a random sample selection to be reviewed by the team as well as checks for over 600 possible attribute errors.



↑ The diagram above illustrates the iterative process used for data creation. Data development is the core piece of the process, but equally important are planning and quality control.

→ Survey data, as well as detailed attribute information, is collected in the field for all inlets, infalls, outfalls, and manholes.

a similar goal, Fort Worth has chosen to create a database that exceeds the detail and accuracy of most asset databases. In addition to the typical asset information, the GIS includes detailed attribute information for modeling, photos for all surface features, and links to plans and plats for each asset as well as condition video when available for it. The end product will be a robust, model-ready dataset that can help drive decisions, improve maintenance response, and help protect people and property from dangerous stormwater runoff.

The project was broken into manageable pieces, and a work breakdown structure was created with an iterative process of planning and design, data development, and quality assurance/control. At the core of the process is data development. The city chose to pull all data from plans, creating a schematic at the beginning of the project. By doing so, the mapping team made data available to staff as quickly as possible. While the data had flaws in parts of town, it was better than anything historically available. Another added benefit was the plan index (with hyperlinks) that gives engineers and crews quick and easy access to the original designs. While the final product was years away, Stormwater Management Division was already realizing the benefits.

The next step in data development was to survey the data, collecting x,y,z coordinates, detailed measurements, attributes, and the current flow and field condition of each asset. Detailed documentation was developed to ensure that survey data was collected consistently.

The final data development piece is to link the plan data back to the survey data through a rectification process. This is completed by GIS technicians, who snap schematic data to the survey points. While cumbersome, this phase ensures that a high-quality data product is available and that the data shown in the plans accurately reflects what is on the ground.

The quality assurance and control component is a critical part of the processes; therefore, additional care and thought went into this part of the project. While no dataset is ever perfect, it must provide reliable and accurate information. Similar to quality control steps taken in other organizations, a random sample is being conducted to check the data. However, because the team intends to use the data for complex modeling, three additional layers of review have been incorporated: a modeling software program, to ensure that easily detected modeling errors are being avoided; ArcGIS, to check for topology errors; and a custom ArcGIS tool, to check for more than 600 possible errors in attribute data.

Currently, the asset mapping project is wrapping up year 3 of the four-year project. The schematic data is currently available to engineers and field supervisors through ArcGIS and custom map books. Stormwater Management Division is looking forward to creating a mobile work force and increasing access to the data for those who can use it most.

Contact Elizabeth Young at 817-392-6785 or Elizabeth.Young@fortworthtexas.gov.

Jefferson County Connects Stormwater Infrastructure

By Jonathan Stanton, Jefferson County, Alabama, Department of Health, Watershed Protection Division

Jefferson County Department of Health (JCDH), Watershed Protection Division, in conjunction with Stormwater Management Authority, Inc., currently manages stormwater for 21 municipalities throughout Jefferson County, Alabama. The department has searched for innovative solutions for flooding, pollution control, older municipal infrastructure identification, and other stormwater-related issues by integrating the use of GPS with GIS technology. JCDH is in the process of using GPS units to map the conditions, type, flow, and chemical pollutant presence and to create a reference picture for both stormwater inlet structures and outfalls.

The metropolitan Birmingham area has a common problem in that stormwater infrastructure presents itself in many different forms throughout the various political boundaries. During the past 50 years, many of the creeks and older neighborhoods have had stormwater systems put in place that are now deteriorating, or creeks may be entirely under municipal streets or other structures. The fact that most of these structures are impossible to move and sometimes even hard to find makes the mapping of a system difficult without using GIS to locate patterns and direction of storm sewer flow. Identifying these was performed by JCDH and Stormwater Management Authority by developing a data dictionary to store most types of stormwater infrastructure and the intended direction of flow.

The data dictionary, built in Trimble Pathfinder Office, allows a flow, structure type, and picture to be exported into ArcGIS. This dictionary was uploaded using Trimble GPS units. Crews and various municipal employees were sent with these units to conduct stormwater visual inspections and database inventory reports. After the crews finished mapping the area, the data was downloaded into Trimble Pathfinder Office, differentially corrected, and exported as a shapefile. The data was then integrated into ArcGIS to be used in concurrence with other layers (aerial, contour, street centerline, etc.). The use of other ArcGIS maps along with this data gave a general direction on estimated flow patterns. If flow patterns could not be determined, then municipal maps, if available, were used to fill in the infrastructure holes. A pipe layer was used to plot any infrastructure as open channel, pipe, or concrete flume. Final verification was conducted using GIS to inspect for illogical connections.

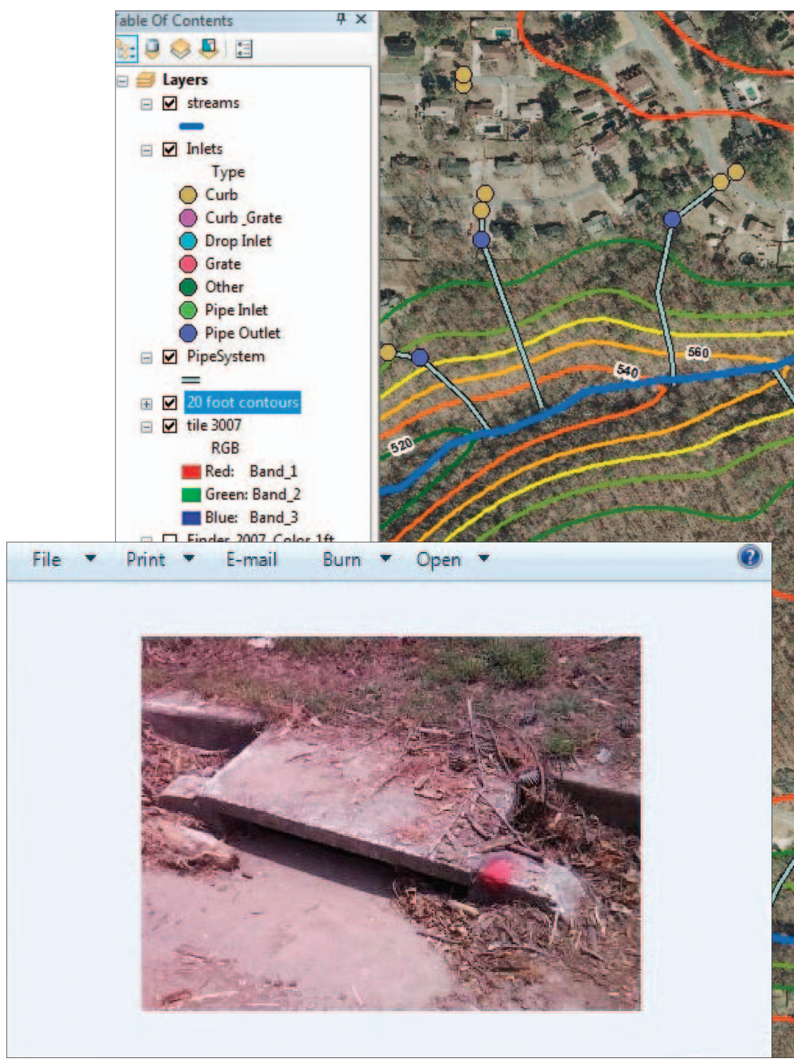
The same general procedure was used for the actual outfall into the local water body. A data dictionary was developed for the outfall process. The major difference is that during outfall inventory, pollutant testing must be conducted on all flowing outfalls. Each outfall is examined for the eight pollutants mandated by the Clean Water Act.

A data dictionary was loaded onto a Trimble Nomad GPS. The unit was selected due to its water resistance in a creek environment. Once a crew returned from the field, data was downloaded into Trimble

"The combination of the two geodatabases using GIS technology helps identify possible pollution sources and areas where infrastructure is most vulnerable."

Jonathan Stanton, Jefferson County, Alabama, Department of Health, Watershed Protection Division

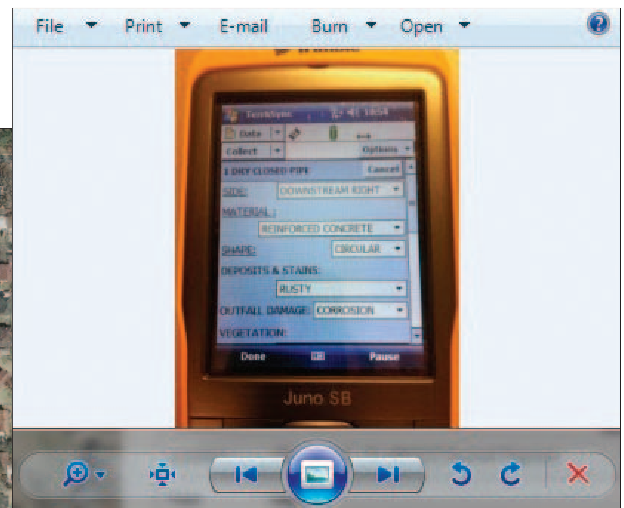
↓ Storm Drain Inventory, Pleasant Grove, Alabama

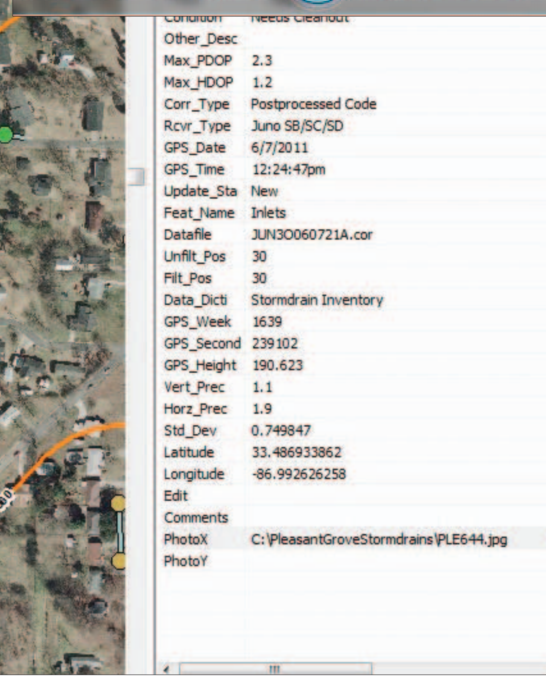


Pathfinder Office, differentially corrected, and exported as a shapefile. The outfall data was added as a layer into ArcGIS for connection with the existing storm drain system map. The pollutant levels data was also transferred from GIS into a local JCDH water quality analysis software that relies on SQL Server.

The combination of the two geodatabases using GIS technology helps identify possible pollution sources and areas where infrastructure is most vulnerable. The system was never more important than after the tornadoes that ravaged through Alabama in April 2011. Several members of Stormwater Management Authority had municipal infrastructure that was impacted by the storm as well as existing critical infrastructure that needed protection. GIS technology, along with the databases developed prior to, during, and after the storm, helped the JCDH Emergency Preparedness and Watershed Protection Division develop a plan to maximize GIS-related resources to solve these problems as well as address other public health concerns.

Contact Jonathan Stanton at Jonathan.Stanton@jcdh.org or 205-933-9110.





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One City, One Model, One Software

The concept behind MIKE URBAN is to generate as much value and efficiency as possible by using one software package for all urban water modeling activities. In addition to the productivity enhancements gained from using MIKE URBAN, it helps reduce overall expenses and administrative burdens, since there is only one product to purchase, one software tool to learn, and one company to deal with.

Regardless of which type of model is being used, all the system and model data is stored and managed in a standard ArcGIS geodatabase. This allows organizations to fully leverage their investment in ArcGIS by viewing and editing MIKE URBAN model data using standard ArcGIS tools. In addition, the flexible data exchange tools provided by MIKE URBAN ensure an effortless and reliable exchange of data with virtually any common structured data format.

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MIKE URBAN is being used in thousands of towns, cities, districts, and municipalities around the world for a wide range of applications:

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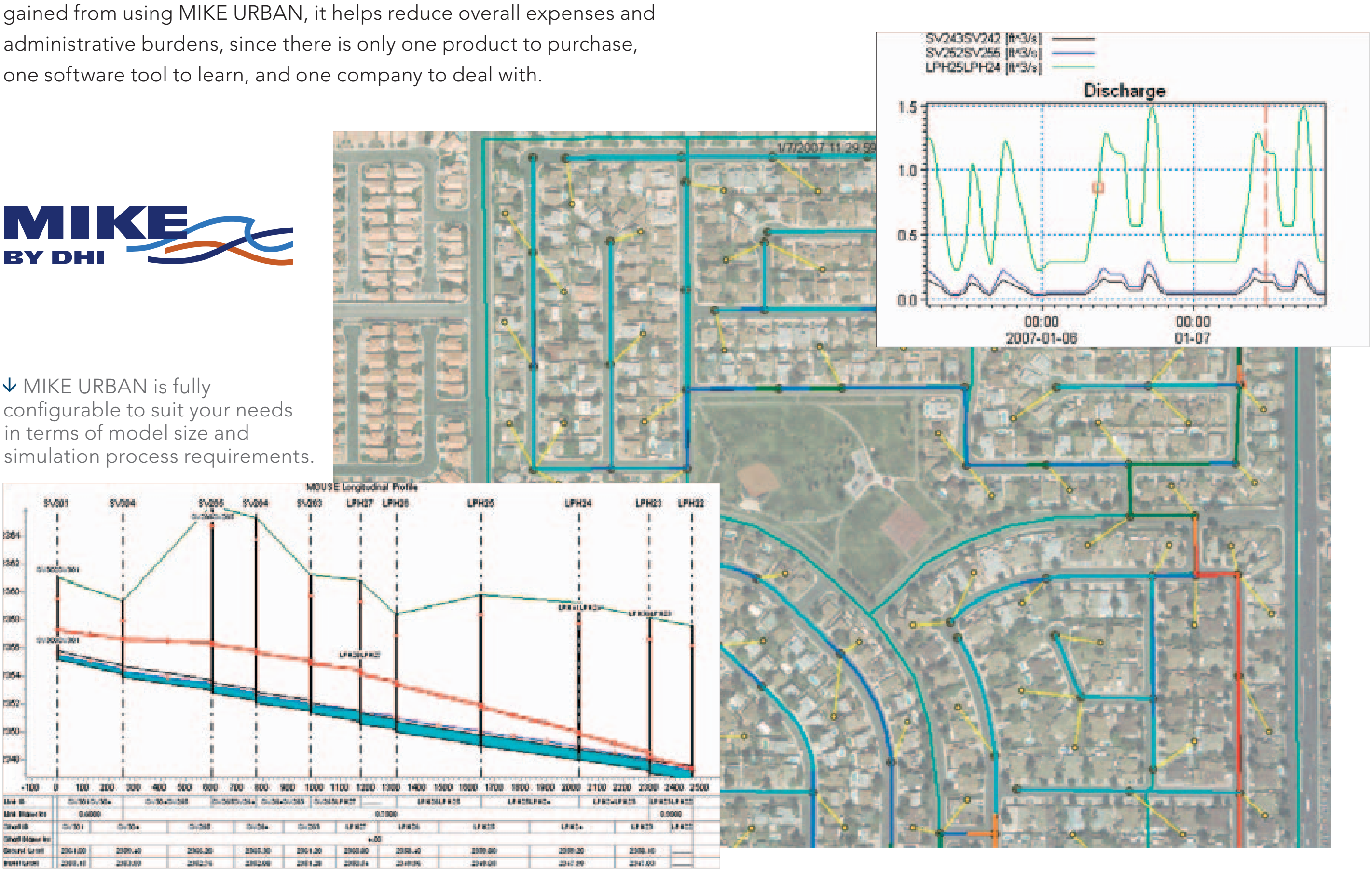
- Designing long-term control plans for reducing inflow and infiltration and minimizing combine sewer overflows
- Evaluating development plans to ensure compliance with stormwater management requirements



↓ MIKE URBAN is fully configurable to suit your needs in terms of model size and simulation process requirements.

- Designing and optimizing low-impact development projects for reducing peak flows due to stormwater runoff

MIKE URBAN truly is the only GIS-based modeling system that provides everything you need for planning, optimization, operation, and design of water, wastewater, and stormwater infrastructure.

Customizable Configurations

MIKE URBAN is fully configurable to suit your needs in terms of model size and simulation process requirements. It has a base module, Model Manager, containing the core GIS and data management functionality required for all modeling activities, and then there is a selection of add-on modules for enhancing the simulation capabilities of the package. Each of these modules is briefly described below, while a more detailed description of each is provided in the following sections.

Model Manager is a full-featured, GIS-based data management and urban water modeling system including the following:

- Network data management for the stormwater collection, wastewater collection, and water distribution systems
- Standard GIS functionality, effective time-series data management features, comprehensive data processing and manipulation tools, and powerful data visualization capabilities for all data entities
- SWMM5, the US EPA's fully dynamic stormwater and wastewater network modeling package
- EPANET, the US EPA's standard model for simulating hydraulics and water quality in distribution networks

For more advanced water distribution (WD) modeling activities, you may also add WD Tools, which include automatic calibration of water distribution network models, advanced fire-flow analysis, and advanced rule-based control simulation options.

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- CS Pipeflow models a wider range of hydraulic structures than any other package. It includes rising pressure mains, user-defined hydraulic structures, complex operational rules, long-term simulations, and automated pipe design.
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- CS Control features advanced real-time control (RTC) simulation capabilities for urban drainage and sewer systems.
- CS 2D Overland Flow enables dynamic integration between the MOUSE hydraulic engine and DHI's MIKE 21 model for 2D overland flow.
- CS—Pollution Transport simulates the transport, dispersion, and concentration of dissolved substances and suspended fine sediments in pipe flow.
- CS—Biological Processes works in conjunction with the Pollution Transport module, thereby providing many options for describing the reaction processes of multicompound systems.

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American Water Works Association
Annual Conference & Exposition
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Dallas, Texas, USA
www.awwa.org

Singapore International Water Week
July 1–5, 2012
Marina Bay Sands, Singapore
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National Rural Water Association
WaterPro Conference
September 24–26, 2012
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