water writes

ESRI • Spring 2007

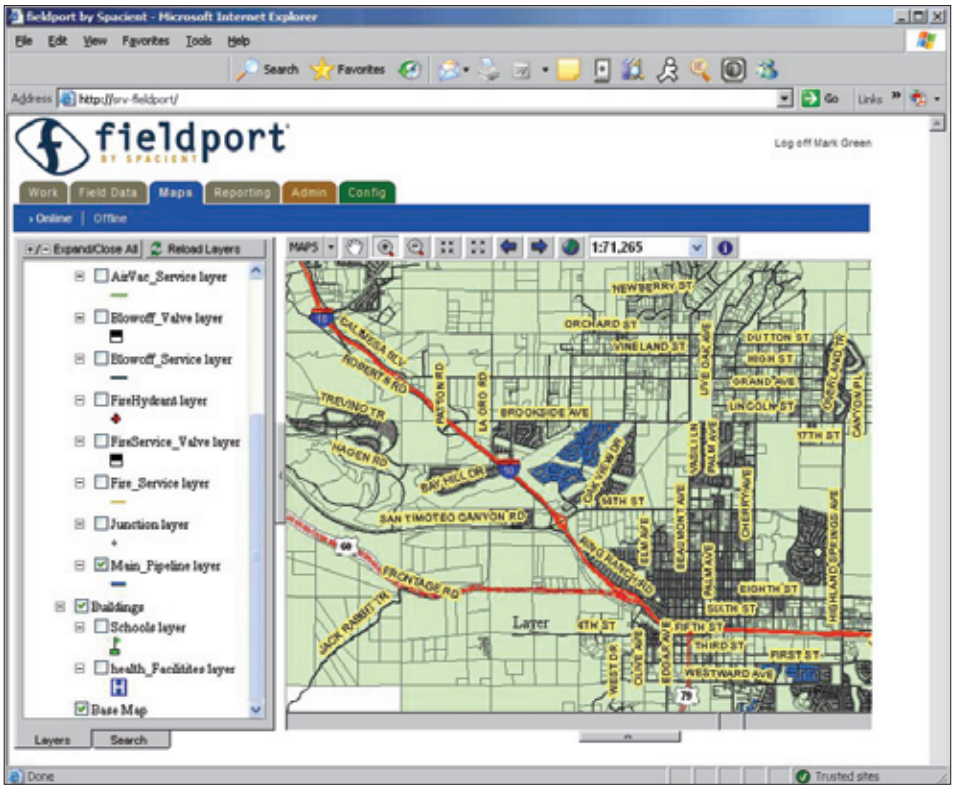
GIS for Water/Wastewater

In This Issue

Leveraging Mobile GPS and GIS Technology for Infrastructure Data Collection

Chuck Butcher, General Manager, Beaumont-Cherry Valley Water District, and Chris Stern, President/CEO, Spacient Technologies, Inc.

The Beaumont-Cherry Valley Water District (BCVWD) was established in 1919 and provides water utility services throughout Beaumont and most of Cherry Valley, California. Like many rapidly expanding communities in Southern California, the water utility has been challenged to maintain accurate water facility infrastructure maps and records that keep pace with growth. Spacient Technologies, Inc., a leader in enterprise field service management and mobile mapping solutions for government and utilities and authorized Trimble and ESRI business partner, has delivered a mobile global positioning system (GPS) solution for BCVWD's geographic information system (GIS) project.



Mobile Global Positioning System Solution for BCVWD's GIS Project

The Spacient Mobile GPS and GIS solution provides BCVWD field staff with the tools required to meet this challenge. Using Spacient's Fieldport software and ESRI technology combined with Trimble GeoXT handheld GPS equipment, BCVWD field crews are able to efficiently collect, store, and map water system infrastructure and facility locations throughout the service area. Using the Spacient mobile GPS and GIS system, field crews collect submeter location and detailed facility information for critical water infrastructure throughout the service area and electronically transmit this data to a central database that publishes the information using the Fieldport Web GIS viewer powered by ESRI ArcGIS 9.1 mapping technology. The ArcGIS geodatabase is used to store and manage the geographic information and spatial data collected in the field. This gives BCVWD the advantage to tailor the geodatabase to fit ESRI's water utilities data model, which represents a collection of objects defined for water distribution networks.

Spacient provided all system planning, design, installation, and training services for BCVWD staff and field personnel.

"The project is a great opportunity to showcase how Spacient's mobile GPS and GIS can

continued on page 7

ArcGIS Integration Improves the Workflow in the South Bay Water Recycling Program

Tim Hayes, Senior Geographic Systems Specialist, City of San José Environmental Services Department, and Kent Brown, Geographic Systems Specialist, City of San José Environmental Services Department

The South Bay Water Recycling (SBWR) Program, managed by the City of San José Environmental Services Department's Water Utility Division, consists of more than 110 miles of pipe serving the cities of Milpitas, Santa Clara, and San José, California. During the summer months, an average of 12 million gallons of recycled water are produced and distributed to more than 550 customers per day. SBWR provides recycled water that is used for landscape irrigation and industrial cooling processes within the Silicon Valley.

The Situation at SBWR before GIS

Prior to using GIS at SBWR, there were no tools on hand to keep system maps current, track changes to infrastructure, or identify customers impacted in the event of a service interruption. Furthermore, some infrastructure that was shown on the engineering drawings was different than what was actually seen in the field. This untenable situation resulted in maintenance crews spending an inordinate amount of time trying to locate infrastructure in the field. This combination of factors led to decreased staff morale, high levels of frustration, and higher system operating costs.

GIS Implementation

To address the shortcomings mentioned above, SBWR began a phased GIS implementation process. For this process, SBWR integrated the following ESRI and ESRI business partner products into its operations:

- ArcGIS Desktop 9 (ArcInfo)
- GPS by Trimble Inc.
- ArcIMS 9
- GeoSmart.net by MoosePoint Technology

This process involved creation of a personal geodatabase to store data, collection of field data using GPS and a digital camera, and development of a Web-based GIS application.

Furthermore, the free ArcGIS DS Mapbook extension, available for download at the ESRI Web site, was used to generate system map books. These map books were given to field maintenance crews for use in repairing any problems found with the system.

For the field data collection, two Trimble GeoXH handheld GPS field computers (sub-foot accuracy) and two digital cameras were used to identify and photograph the location of each asset. The following table illustrates the assets that were mapped.

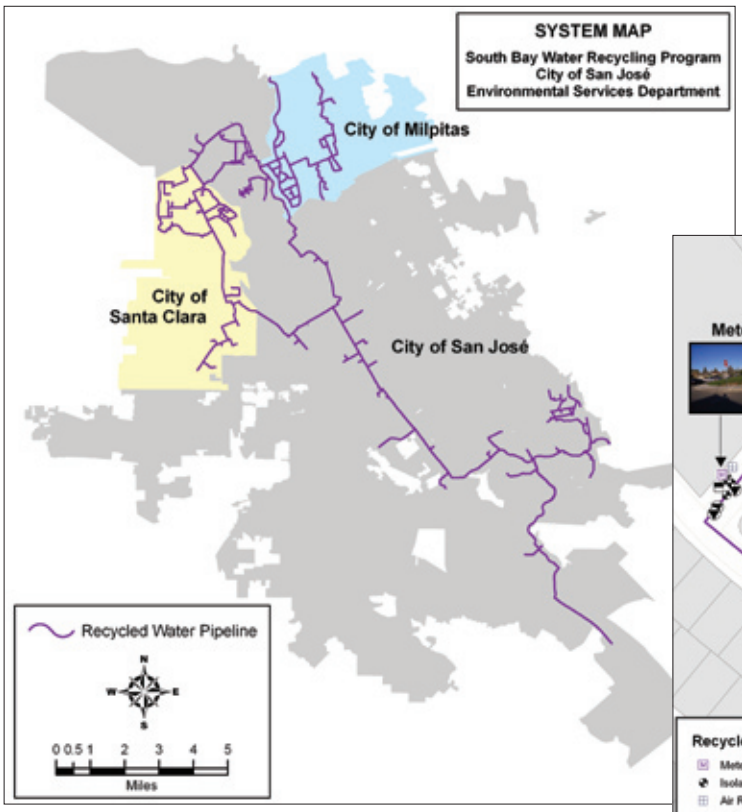


Figure 1: System Map—South Bay Water Recycling Program

Meter	Isolation Valves	Blowoff Valves
Air Relief Valves	Anodes	Cathodic Protection Test Stations
Stub Outs	Monitoring Wells	Cathodic Protection Cabinets
Pump Stations	Reservoirs	Pressure Monitoring Stations

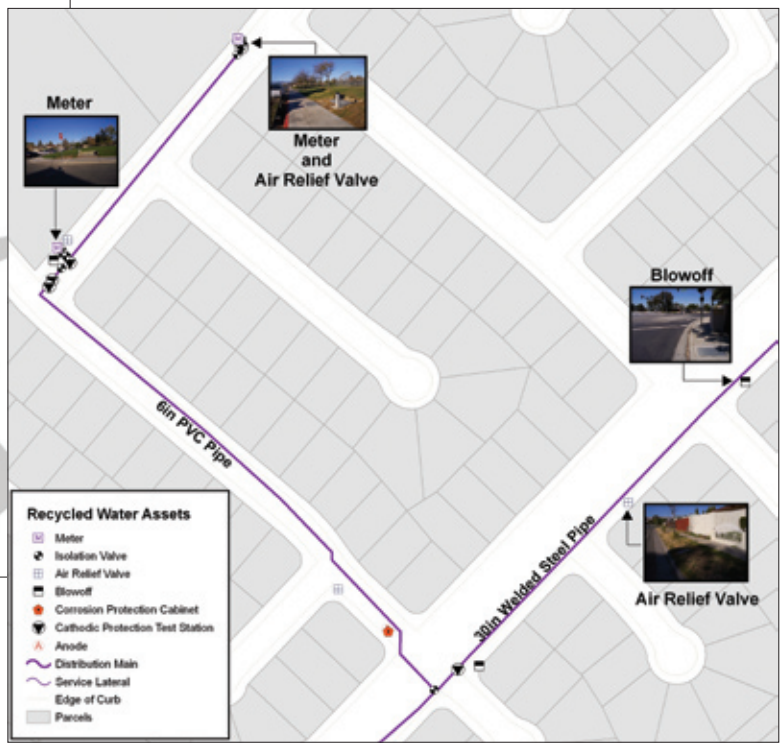


Figure 2: GPS-Derived Data and Hyperlinked Digital Photos as Displayed in ArcGIS

In addition, for those assets that were in the middle of a street or otherwise difficult to access, a Lasercraft XLRic laser range finder was used to obtain the correct x- and y-coordinates. The laser range finder was able to connect to the GeoXT units using wireless Bluetooth technology.

Two GIS interns were tasked with walking the entire 110-mile span of the pipeline network and locating and photographing all aboveground SBWR assets. Furthermore, they opened all vault and meter box covers for asset verification purposes and to check for any maintenance problems.

Once back in the office, the GPS data was downloaded, postprocessed, and exported as shapefiles using Trimble GPS Pathfinder Office software. These shapefiles were then imported into the personal geodatabase. The next step involved making this information available to all SBWR staff via their Web browsers and providing them with key GIS tools that could be integrated into the established workflow. ArcIMS was chosen for this task. However, given the fact that the staff of the GIS section consisted of two GIS specialists who were responsible for overseeing the GIS operations of the entire department (consisting of more than 400 employees and five divisions—Waste Management, Watershed Protection, Water Pollution Control Plant, Water Utilities, and Technical Services), there was little time available for developing custom ArcIMS applications. As a result, SBWR purchased GeoSmart .net by MoosePoint Technology. Using the premade GIS tools contained in GeoSmart.net, powerful ArcIMS user interfaces were quickly created within a drag-and-drop Windows-based environment.

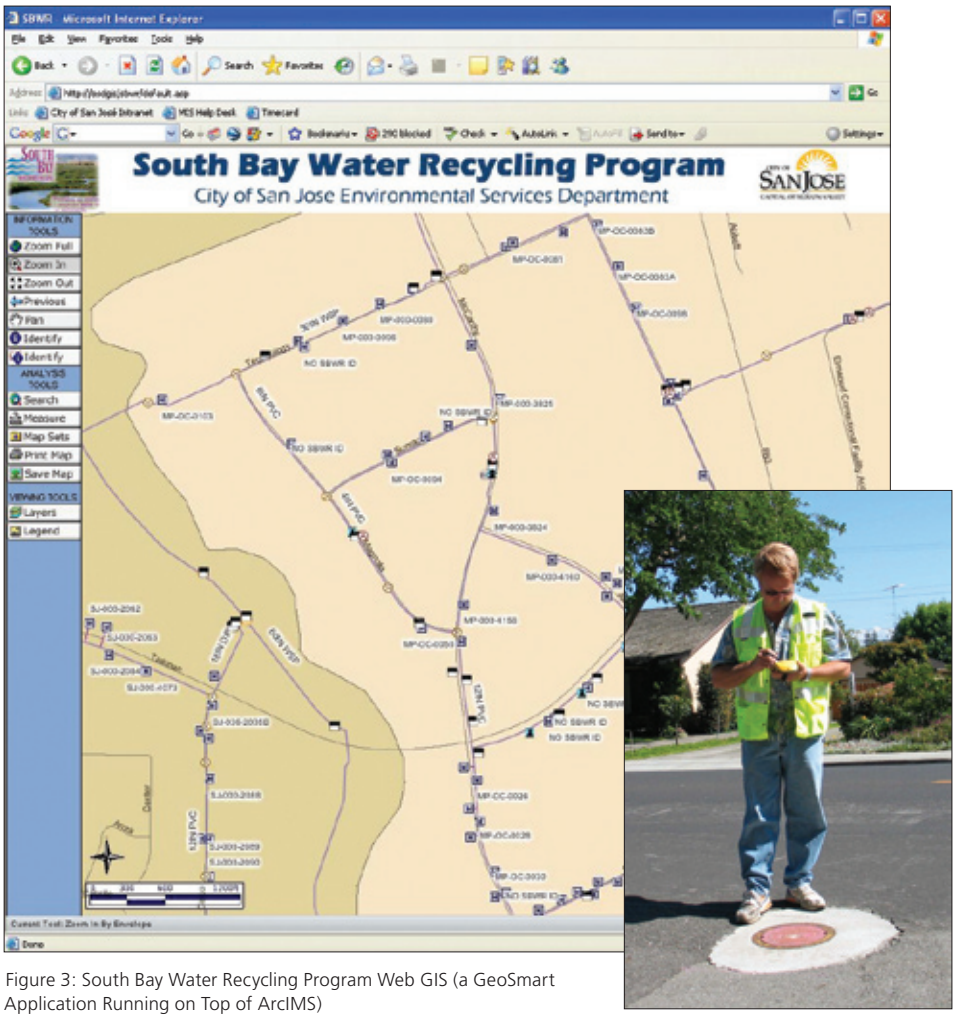


Figure 3: South Bay Water Recycling Program Web GIS (a GeoSmart Application Running on Top of ArcIMS)

Conclusion

The combined use of ArcGIS Desktop, ArcIMS, GeoSmart.net, and Trimble GPS for the management of recycled water system assets and new construction has already provided significant cost benefit returns. The inherent properties of these software packages as data management tools have assisted in tracking system assets, repairs, and modifications so that they are reviewed and approved before operation.

These software tools, used in conjunction with GPS, are already providing opportunities for maximizing the distribution of recycled water and minimizing construction costs. For example, GeoSmart.net has provided SBWR with the ability to efficiently track previously constructed service laterals and assets as well as plan new pipelines. Opportunities to use these tools at SBWR also include their incorporation into regulatory compliance and site oversight, horticultural site review and trending, the geographic evaluation of the maximized efficient use of recycled water with respect to its distribution system, and planning future expansions of the recycled water system.

The use of these technologies in the SBWR workflow has led to increased productivity, faster identification and location of field assets, decreased staff frustration in trying to locate critical asset information, and improvement of the system maintenance workflow for the South Bay Water Recycling Program.

Spatially Enabling Office/Field Workflows at Eastern Municipal Water District

Joe Lewis, EMWD Engineering Services; John Foster, EMWD Facility Locations; Keith Bratisax, EMWD Information Systems; and Angus Wood, DCSE

The Eastern Municipal Water District (EMWD) provides water resources management and water/sewer/recycled services for a population of approximately 500,000 over an area of approximately 600 square miles in the rapidly developing Inland Empire area of Southern California.

Over the years, EMWD has had experience with a number of GIS platforms and has recognized the integral value of spatial data in support of EMWD business processes. In 2004, EMWD initiated a plan to consolidate spatial data within an ESRI ArcSDE/geodatabase (GDB) environment. Water resources, business development, and facilities data is now managed within the ArcSDE/GDB data store. Data is accessible via ArcGIS Desktop and ArcIMS applications. Periodic exports to non-ESRI formats are performed utilizing Safe Software's FME. FME is also utilized to generate custom personal geodatabases (PGDBs) that are loaded to Tablet PCs and laptops and provide spatial data support for office/field workflows.

Spatially Enabled Workflows

Rather than building GIS applications, EMWD has followed the approach of spatially enabling business processes and workflows. Although it may seem that there is no more than a semantic difference, the objective is quite distinct. Workflows are fundamentally transactional and have little or no analytical component. A workflow describes the life cycle of a "task" such as an inspection, work order, customer service request, or one-call "locate." Workflow tasks have common characteristics such as origination, assignment, execution, and archival. They invariably require supporting tabular data, and efficiency of execution is often greatly enhanced with supporting spatial data.

Case Study: EMWD's Underground Service Alert Workflow Implementation

EMWD facility locators have the responsibility to mark underground services in a prompt and accurate manner to prevent costs, liabilities, and customer inconvenience of interrupted service due to line hits from digging. Development contractors depend on the locators' efficient efforts. Rapid land development within the district has prompted the implementation of a GIS-based Underground Service Alert (USA) ticket management system to systematize and improve the efficiency of EMWD's overall USA ticket workflow.

The USA workflow is very demanding. Utilities are required by law to mark facilities within 48 hours of notification of intention to dig. It is essential that an accurate location of the proposed dig site be provided to the locator and that the locator clearly and completely marks facilities in proximity to the dig site. Significant damage can occur if, for example, a large water main or influent force sewer main is hit. It is also critical that thorough records be maintained regarding the date, time, location, and marking activity for each USA locate. Archival of USA tickets within a robust database environment provides defensibility in case of damage claims.

EMWD has implemented the USA workflow within the DCSE Field Mapplet workflow management framework. The system consists of a server-side "agent," running primarily autonomously and managing the USA ticket workflow and database. The operator "console" allows office personnel to perform workload balancing as necessary, handles exceptions, and performs reporting functions. Facility locators utilize the Mobile Client application. When connected to the EMWD network, locators send completed tickets and receive new tickets. A sync process will update the desired map document (MXD), PGDB, or configuration files on the Mobile Client. When disconnected, the locator is entirely self sufficient, having all necessary tabular and spatial data "on-board."

USA tickets are sent via e-mail to EMWD from the Southern California Dig Alert center in Pomona. Various types of tickets may be sent including New, Retransmit (corrects an error), No Show (one or more utilities have not been marked), Update (most frequently extends the validity of a ticket), and Cancel. Tickets may also be prioritized as *rush* indicat-

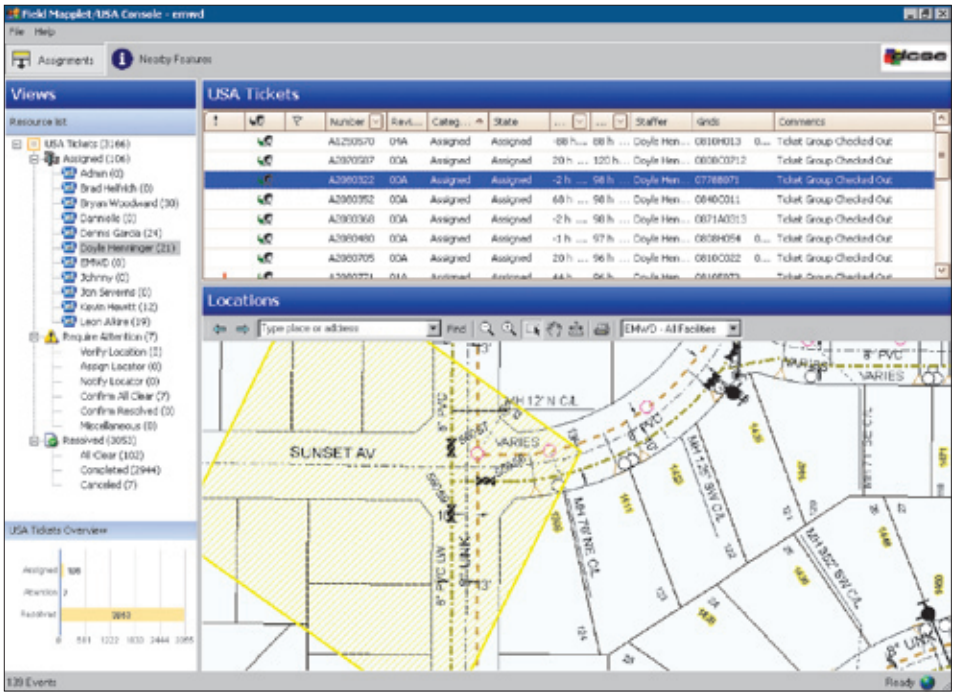


Figure 1: EMWD USA Workflow Console

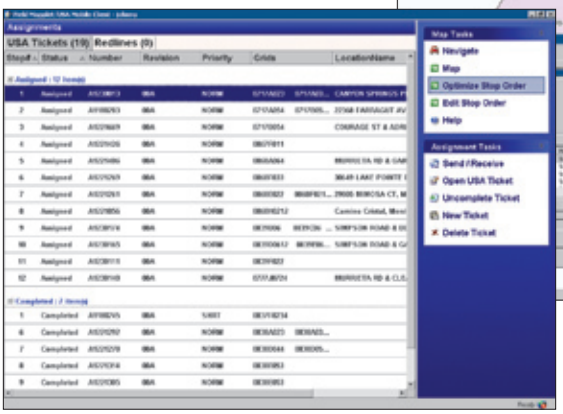


Figure 2: EMWD USA Locates on the Mobile Client

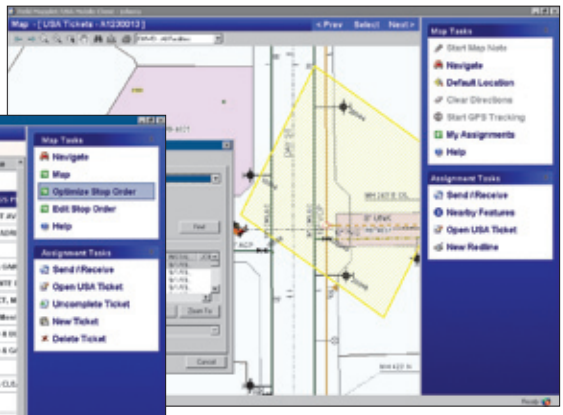


Figure 3: Facilities map for USA ticket displays Find dialog box.

ing immediate attention is required. Workflow logic is designed to handle each type of USA ticket correctly.

EMWD has defined four geographic Areas of Responsibility (AORs). A facility locator is responsible for tickets within an AOR. Tickets are geolocated and assigned to the correct AOR using address, Thomas Bros. grid, or a polygon digitized by the Dig Alert center. Tickets are assigned to a locator's queue on the console based on the AOR. A proximity search is also performed by the agent to determine proximity of the ticket to EMWD GIS facilities. If no facilities intersect a buffer around the dig site, the ticket is placed into a Potential All Clear queue for clearing or assigning by the console operator. Workload balancing is performed by dragging tickets between queues on the console.

Locators upload completed USA tickets and download newly assigned tickets to laptops or Tablet PCs running the Mobile Client workflow component. Tickets are presented as a tabular listing and may be grouped by one or more fields and sorted by any field. Prior to leaving the office, the locator will browse each ticket to confirm that the location impacts EMWD facilities. A highlighted ticket can be mapped showing EMWD facilities centered on the ticket location. With between 20 and 40 locates to perform each day, the locators will utilize the optimize stop order function to provide an initial routing for facility locates. This initial routing may also be edited to accommodate unscheduled stops or "meet and mark" arrangements.

Standardized MXD/Optimized PGDB

Standardizing spatial support for business processes and workflows is beneficial both from the perspective of leveraging invested effort and referencing spatial data for communication. EMWD has invested significant effort in establishing a comprehensive enterprise facilities database and establishing a "master" facilities MXD. The master facilities MXD has become the common spatial component for spatially enabled business processes within EMWD.

Due to hardware limitations for field-based computing, the PGDBs that are cut weekly for the Field Mapplet Mobile Clients have been optimized while still supporting the master MXD. A Microsoft Access database manages ArcSDE layers and specifies attributes that will be exported to PGDB to control data volumes. FME files are generated dynamically from the Access database, facilitating refinement of the exported PGDBs.

Redlining

Redlining is considered an auxiliary workflow. By making the redlining workflow conveniently accessible to field personnel, in conjunction with a primary workflow such as USA ticket location, the field personnel are able to electronically capture errors and issues with facilities data while in the field. When the field operator performs a data upload, captured redlines are passed to a target queue and may then be manually or automatically forwarded to data maintenance personnel for handling. Redlines

continued on page 7

Team Water/Wastewater would like to thank our 2006 User Conference Sponsors:

Advanced Infrastructure Management
ARCADIS G&M, Inc.
Avineon, Inc.
Azteca Systems, Inc.
Bergmann Associates
Black & Veatch Corporation
Camp, Dresser & McKee Inc.
CartêGraph Systems
CEDRA Corporation
CH2M HILL
Datastream Systems
DCSE, Inc.
DHI Water & Environment
E.H. Wachs Company
EMA, Inc.
GBA Master Series, Inc.
Geographic Information Services
GeoNorth
HDR
ICOMMM
Impress Software
iWater, Inc.
Malcolm Pirnie
Marshall GIS & Remote Sensing Solutions
Merrick & Company
Metric Engineering, Inc.
Michael Baker Jr., Inc.
MoosePoint Technology, Inc.
MRO Software
MWH Soft
Nobel Systems
PBS&J
Penwell Corporation
Pipelogix
RBF Consulting
RouteSmart Technologies, Inc.
SAP America, Inc.
Spacient Technologies
Timmons Group
UAI
Wallingford Software, Inc.
Watershed Concepts
Westin Engineering, Inc.
Weston Solutions, Inc.
Woolpert
XP Software, Inc.

Water/Wastewater User Group Committees

National
James Bates, Louisville Water Company, KY
Marc Brown, Orange County Sanitation District, CA
Kathryn Browning, Municipality of Anchorage, AK
Beth Degironimo, Chairman, Mohawk Valley Water Authority, NY
Jon Henderson, City of Bozeman, MT
Kent Lage, Johnson County, KS
Joe McEachern, Boston Water and Sewer Board, MA
Jim Moening, City of Columbus, OH
Phil Oswalt, Montgomery Water Works and Sanitary Sewer Board, AL
Barbara Quinn, Cincinnati Area GIS, OH
Deborah Viera, Dade Water and Sewer Department, Miami, FL

Partner Council
Bryan Dickerson, Woolpert LLP
Dave Disera, EMA
Gary Graybill, Advantica
Brian Haslam, Azteca
Alan Hooper, CDM
Steve Line, ICOMMM
Bo Nielsen, DHI
Michael Samuel, Nobel Systems
Cliff Tompkins, Westin

International
Jim Carlson-Jones, Chairman, South Australia Water Company
Adam Chadwick, City of Kamloops, BC, Canada
Krystyna Jastal, Boytom Communal Enterprise Co. Ltd, Poland
Patrick Vercruyssen, PIDPA, Antwerp, Belgium
Curran Weilbacher, Pohnpei Utilities Corp., Federated States of Micronesia

Arizona
Vincent Boccieri, Salt River Project
Robert Czaja, Tucson Water
Terry Dorschied, Chairman, Water Services Department, City of Phoenix
David Hatchner, City of Flagstaff
Mark Ledbetter, City of Scottsdale
Dianne Lynas, Arizona Department of Water Resources
Dave Varela, City of Chandler

California
Mike Brown, Las Virgenes Municipal Water District
Mike Hoolihan, Chairman, Irvine Ranch Water District
Albert Lin, Long Beach Water Department
Nathan Look, Los Angeles Department of Water and Power
James Ollerton, Elsinore Valley Municipal Water District
Nadeem Shaukat, City and County of San Francisco
Fred Wong, Union Sanitary District

California Partner Council
Raymond Brown, LSA Associates Inc.
Ali Diba, DCSE
Yazdan Emrani, Advanced Infrastructure Management, Inc.
Erick Heath, MWH Soft
Don Rhodes, iWater, Inc.
Chris Stern, Spacient Technologies, Inc.

ESRI Partner Corner

MWH Soft

MWH Soft has been the hydraulic modeling software vendor of choice by the majority of water, sewer, and storm water agencies and their consulting firms for many years. As the only ESRI business partner to offer hydraulic modeling solutions that are 100 percent integrated inside the ArcGIS 9.x platform, MWH Soft is the obvious choice for users who want to take the all-important step to complete one-to-one data correlation between GIS and model data.

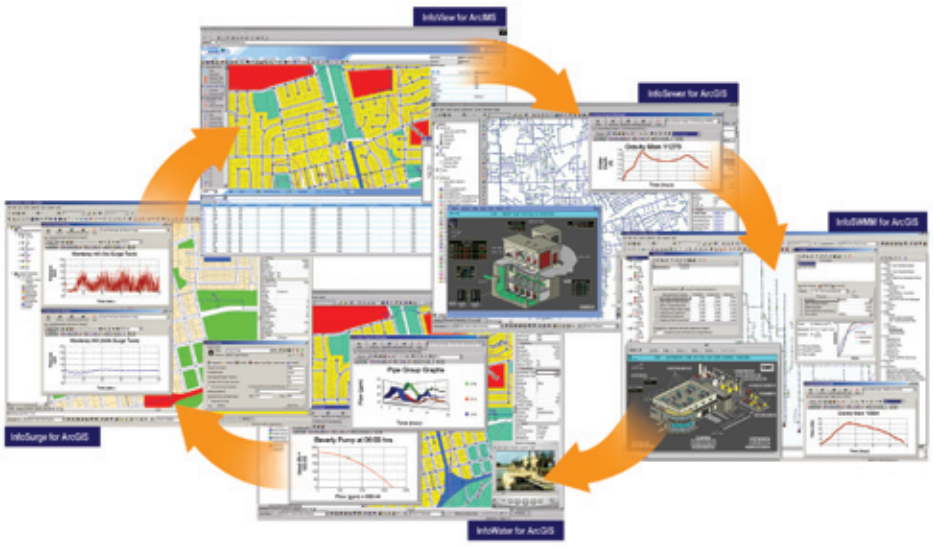
MWH Soft's Info series of products have all passed the extremely rigorous testing procedures to become certified by the ArcGIS software-focused National Association of GIS-Centric Software (www.nagcs.com).

The amount and variety of unique modeling tools that are 100 percent integrated include

- InfoWater—Perform water distribution system hydraulic, water quality, and energy analyses.
- InfoWater UDF—Easily and quickly determine optimum unidirectional flushing (UDF) sequences and print flushing field books.
- InfoWater SLM—Automatically determine optimum locations for water quality sensors based on any number of input data including water age; demands; pressures; distance to hospitals, schools, and critical water users; and others.
- InfoWater LDM—Determine field procedures and plans for locating system leaks based on the time-tested step method.
- InfoSurge—Determine system pressure surges (transients) and evaluate the effectiveness of any number of surge protection devices.
- InfoSewer—Perform sanitary sewer collection system analyses.
- InfoSWMM—Perform hydraulic modeling for sanitary, combined, and storm water collection systems. Includes modeling of hydrogen sulfide, CSOs, overland flows, and much more.
- InfoSWMM Pond—Design any combination of storm water storage ponds including interpond routing.

MWH Soft®

Erick Heath
300 N. Lake Avenue, Suite 1200
Pasadena, California 91101
626-568-6855
erick.heath@mwhsoft.com
www.mwhsoft.com



Continued from page 5

Spatially Enabling Office/Field Workflows at Eastern Municipal Water District

have an associated geographic location to assist data maintenance personnel in locating the GIS facility requiring attention.

Realizing Benefits

EMWD has established the core components for managing and spatially enabling office/field workflows. The USA workflow is an initial implementation. Workflow specification is complete for non-automated meter reading (AMR) (recycled and potable). Further workflows are queued for implementation.

There are distinct advantages of the workflowcentric approach over the GIS applicationcentric approach. The workflow approach promotes reuse of the common spatially enabled workflow framework including software components, requirements analysis techniques, implementation methods, the standard MXD, and common datasets. Focus on the workflow provides a very bounded scope, resulting in a software solution that is tailored to a specific business task. User acceptance is higher, the learning curve is lower, and ambiguity of realized benefit is reduced. Implementing office/field workflows within the common spatially enabled workflow framework will improve communication between EMWD personnel and ease transition from one workflow to another.

Field Mapplet/USA provides EMWD locators with a single application framework to manage USA tickets from origination to archive, providing extensive spatial support at each step in the workflow. Improvements in the efficiency of the USA workflow will support the increased demands that rapid development is placing on the locators within the district.

Continued from page 1

Leveraging Mobile GPS and GIS Technology for Infrastructure Data Collection

streamline utility field data collection and infrastructure mapping," said Miguel Hernandez, Spacient's senior project manager for BCVWD. "We're excited to assist Beaumont-Cherry Valley Water District with its GIS mapping and facility management needs."

Being a part of the Water/Wastewater Team has been vital to our progress in GIS development and deployment. We were in on the ground floor with ESRI developing the Water Data Model. One of the greatest benefits we have had over the years comes from the lessons shared by others on the team as they refined their programs. The professional and social exchange of contacts with other agencies and supporting consultants enables us to stay current with the industry and further refine our own GIS program. This intangible benefit cannot be obtained through any other means. We take every advantage we can from the Water/Wastewater Team.

Gene Talmadge
Planning Manager and GIS Program Manager
Las Virgenes Municipal Water District

water writes is a publication of
the Water/Wastewater Group of ESRI.

To contact the ESRI Desktop Order Center,
call
1-800-447-9778
within the United States
or
909-793-2853, ext. 1-1235,
outside the United States.

Visit the ESRI Web site at **www.esri.com**.
See *water writes* online at **www.esri.com/waterwrites**.

Advertisers can contact **ads@esri.com**.
To subscribe to ESRI publications, visit **www.esri.com/subscribe**.
To unsubscribe from ESRI publications, visit **www.esri.com/unsubscribe**.

Requests for back issues, missed issues, and other circulation services may be sent via **requests@esri.com**; 909-793-2853, extension 1-2778; or faxed to 909-307-3051.

To update your mailing address, visit **www.esri.com/coa** or use any e-mail, phone, or fax option.

If you are from outside the United States, please contact your international distributor to subscribe, unsubscribe, or change your address. For a directory of distributors, visit **www.esri.com/distributors**.

Send inquiries to
Lori Armstrong, Water Resources
Industry Solutions Manager
larmstrong@esri.com

106447
DUAL 4.5M 3/07tk