

water writes

Esri • Spring 2011

GIS for Water/Wastewater

Fine Wine to Enterprise GIS Cucamonga Valley Water District

The Cucamonga Valley is an area that lies between the cities of Los Angeles and San Bernardino in San Bernardino County, California. Originally known for its vast vineyards and wineries, the valley hosted 60 wineries and over 35,000 acres of vine from the mid-1800s to the 1940s. In recent years, most of the vineyards have given way to unprecedented growth in residential, commercial, and industrial development, with two wineries and under 1,000 acres of vineyard remaining.

Cucamonga Valley Water District (CVWD) was formed in 1955 as a special district under the provisions of Division 12 of the California State Water Code and is an independent unit of local government. It was formed from 23 small agricultural water systems and pipelines and serves the City of Rancho Cucamonga and portions of the cities of Fontana, Ontario, and Upland. CVWD serves over 180,000 customers within a 47-square-mile service area that includes 50,000 water connections and 35,000

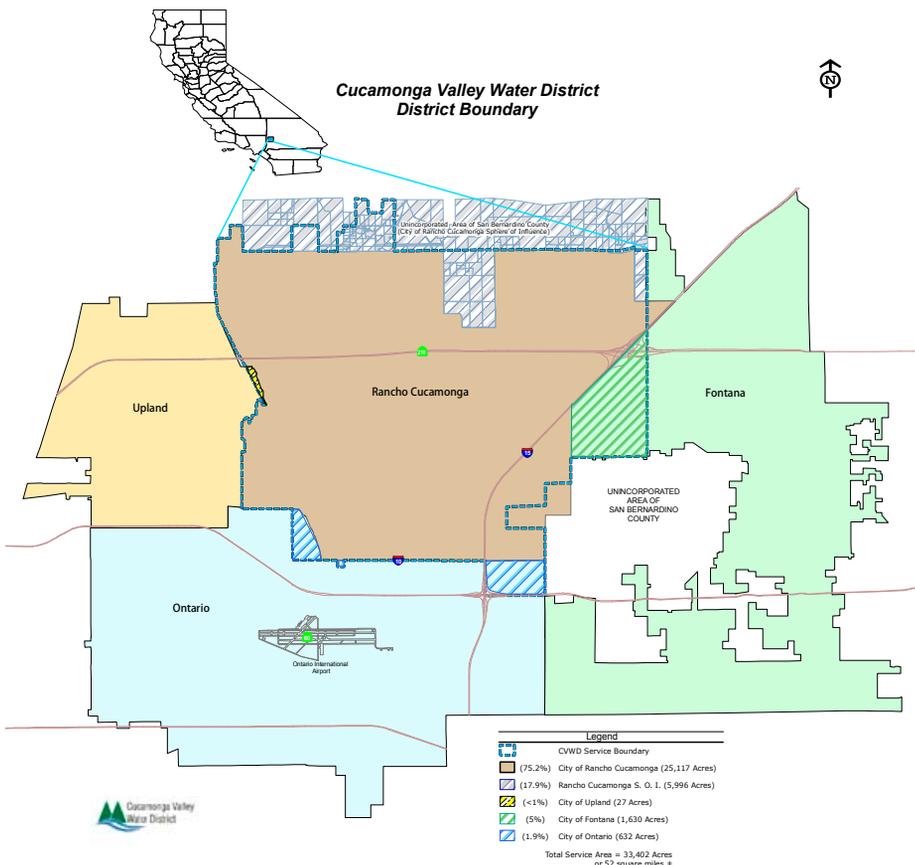
In This Issue

Esri on the Road	p2
Esri Online	p2
Esri News	p2
GIS Puts Culver City Sewer Maps in Their Place	p6
Subsurface Utilities Mapping Program Decreases Cost and Reduces Risk	p8
iWater—Take Your GIS to the Next Level	p11

sewer connections and an average daily demand of approximately 50 million gallons. Its water source is from purchased water (Metropolitan Water District), ground water wells, and surface runoff from the local foothill canyons.

From its inception in 1955 until 1997, the district, like most utilities, used paper-based atlases and valve file cards to keep information. Field representatives and inspectors kept their own information on any field installations and changes, penciled in on their individual atlases. Some of the changes would find their way to the Engineering Department for inclusion on the atlas, but many did not. Managers and supervisors didn't have a good handle on information that could be used in water modeling, on aging pipelines, or for future planning. In 1997, it was determined that CVWD needed to bring the district into the Information Age, and thus its geographic information system (GIS) was born.

The first order of business was to develop a strategy to implement the GIS. Esri was contracted to develop the database model with Nobel Systems, Inc., doing the data capture of over 6,000 as-built construction drawings. The land base and centerline data already existed in both the City of Rancho Cucamonga



continued on page 4



Where **technology**
sparks your **imagination**

Esri International User Conference

July 11–15, 2011 | San Diego, California

Register by May 20, 2011

esri.com/uc

Fine Wine to Enterprise GIS

and San Bernardino County's GIS systems and was used as the basis of CVWD's GIS. This initial process took approximately 18 months to complete. Over the last 12 years, with technology constantly improving, the GIS has gone through several iterations of land base adjustments and an increase to 9,000 captured as-builts of water, recycled water, and wastewater, with the majority of data capture now being done in-house.

Originally, the district's GIS was used to construct paper and digital atlases that could be readily updated from field changes and to provide exhibits for board members and meetings with additional improvements of data

capture using GPS. The disparate databases within the district were also consolidated into ones that were compatible with GIS.

Although championed by a forward-thinking board of directors, the full potential and power of this system was not realized until 2007, when it was determined that the district needed to move in the direction of a computerized management maintenance system, or CMMS; GIS would be at the core of this development.

GIS Challenges

With the advent of these changes, it was necessary to upgrade the GIS system from the personal geodatabase to an enterprise sys-

tem utilizing Microsoft's SQL Server 2005 and ArcGIS Server Standard Enterprise with ArcSDE. It was determined that Azteca's Cityworks would be the CMMS application and work in concert with the iWater product infraMap for field data collection for water/wastewater. Weston Solutions was contracted to help facilitate the rollout of these applications. Office desktops and front-counter applications used the GeoViewer 6.2 data viewer from Nobel Systems, Inc. Figure 1 shows the design of the enterprise GIS system as it is today.

The initial rollout for the CMMS was to the Customer Service and Water/Sewer divi-

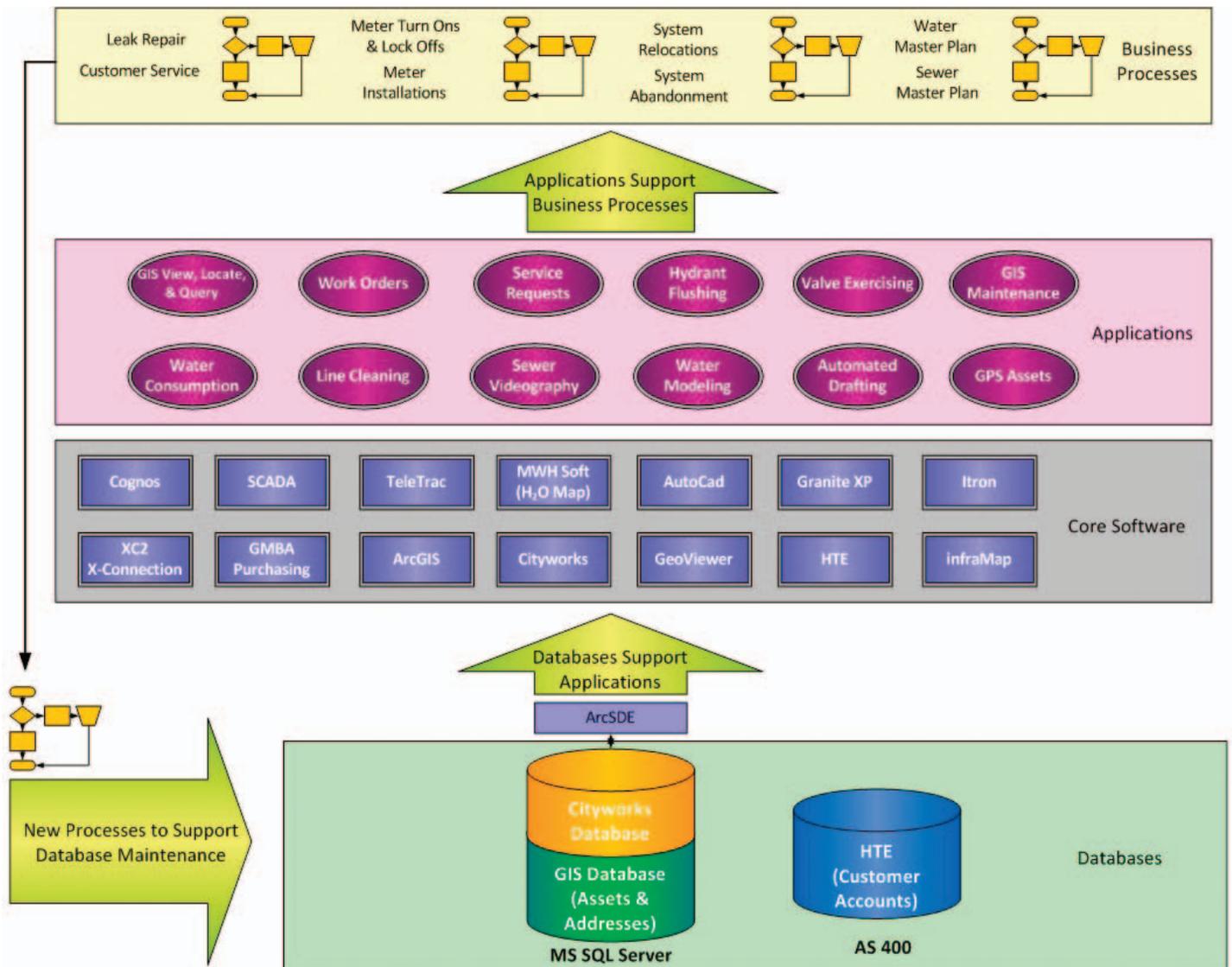


Figure 1. Business Approach to the Enterprise GIS Design (Drawing Format Taken from Providence Water Supply Board Article, Summer 2008 *Water Writes*)

sions, where it was tested both in-house and in the field before being released to the rest of the Operations department (Production and Treatment divisions). Field crews use ruggedized Tablet PCs with the infraMap application for work order processing and field data collection such as valve exercising, hydrant flushing, sewer line jetting, and providing redlined drawings of field changes to the GIS group via e-mail when the laptops are synchronized each evening to the master database.

An example of the work order workflow would be a service order being created in Cityworks by a customer service representative from a customer call-in and forwarded to the appropriate field service representative (FSR) for investigation. Depending on the severity of the problem, either the FSR or water crew would be dispatched to remedy the problem. If a leak is detected, the field crew converts the service order into a work order on the Tablet PC, which runs both Cityworks and infraMap applications. When the work is completed, the crew closes out the work order in the field. If the leak is on the customer side of the meter, the customer is contacted to initiate the repair. This proactive approach saves the district water loss and the customer an excessive water bill.

Through the use of GeoViewer and 42" LCD monitors, the Engineering Counter can provide the customer with quick and easy access to location and attribute information as well as have the ability to hot-link scanned construction drawings and district easements or other pertinent documents.

Future Plans

The district is currently expanding or building new geodatabases for production and water treatment facilities specifically to use with CMMS. A different approach to the database design is being taken because of the almost 3D effect of the multiple structure levels in the treatment plants. The GIS will be loaded with more in the way of related object tables to define the assets. There is also a plan to hot-link service manuals and images of the assets and

a possible fly-through or 360° photo of various facilities to aid in operational efficiency.

The district will also be integrating SCADA from Iconics Genesis 32 into the GIS and the H2OMAP Water software for system modeling.

Another system the GIS will be connected to is Sungard's HTE Financial software that contains the district's customer and billing information. Because of HTE's proprietary software, this will require an interface to be built and may only render a one-way data flow from HTE to the GIS without the ability to put updates back into HTE.

In the field, the district is waiting for improvement in speed for wireless connectivity

for Tablet PCs. Replicated geodatabases are currently stored locally on the hard drives that utilize a two-way synchronization each evening to the master geodatabase.

The district will also explore the creation of more web-based applications and map services on both its intranet and the Internet.

In this time of severe drought, in California and elsewhere, GIS can provide the answer to long-term planning in use, storage, and the movement of water within the district. The effort to provide customers with the most efficient service and highest water quality is paramount, and GIS holds the key.

For more information, visit esri.com/water.

Special Thanks to Our 2010 Esri Water/Wastewater Sponsors

Cast Iron Level



Concrete Level



PVC Level

Aquaveo	ARCADIS/Malcolm Pirnie	Azteca Systems	Baker
Black & Veatch	CH2M HILL	Dig-Smart	ESRI Canada Limited
GBA Master Series	Global Water	IDModeling, Inc.	iWater
Marshall GIS	Merrick	MWH Soft	Nobel Systems
PBS&J	Pennwell	RedZone	RouteSmart
TC Technology	Wachs Water Services	Woolpert	

GIS Puts Culver City Sewer Maps in Their Place

By Jessica Wyland, Esri Writer

Harry H. Culver started making plans in 1913 for the city that carries his name. Culver City, California, was officially established in 1917, halfway between the cities of Los Angeles and Venice. Buoyed by a strong economic base of movie studios, small businesses, and industrial endeavors, the city grew to include more people, more land, schools, and city government. By the year 2000, the city had quadrupled in size and is now a community of nearly 40,000 residents.

The effects of time and growth compromised Culver City's public works data, especially the city sewer system. When Marcos Mendez accepted an internship in 2007 at the Culver City Information Technology Department, he began a committed collaboration with the Public Works Department to update citywide sewer

maps. Mendez started by redeveloping sewer data using GIS technology from Esri.

Compiling Sewer Plans

Mendez started the process by looking at all the city's sewer as-built plans and profiles. This was a real challenge, since the city does not have a staff member dedicated to full-time maintenance of sewer plans. Mendez cobbled together sewer plans from various files including street plans, tract plans, and parks and recreation records. One thing Mendez had working for him was the city's mature GIS program, replete with many datasets developed over a span of more than 10 years. This information ensured greater accuracy and provided aerial photography for cross-referencing.

A goal of the project was to hyperlink sewer

plans to the GIS sewer line so that the data would be accessible via a web application. When a user visits the city website, the web application displays the sewer map. With a click on a sewer line, the user can retrieve a scanned PDF of the as-built.

Since Culver City was founded in 1917, some of the original sewer plans were missing. Other plans, dating back to 1922, were very difficult to scan internally, so the city completed that portion of the project through contracted experts. However, there were still blanks to be filled.

"We used numbers in each field within the GIS data to designate the status of sewer plans," Mendez explained. "For example, I would place a 0 in the attribute information if the sewer line was okay. A 1 means it is missing a sewer plan. A 2 means the plans could

Culver CITY
SEWER GIS MAP BOOK

A1	A2	A3	A4	A5	A6	A7
B1	B2	B3	B4	B5	B6	B7
C1	C2	C3	C4	C5	C6	C7
D1	D2	D3	D4	D5	D6	D7
E1	E2	E3	E4	E5	E6	E7
F1	F2	F3	F4	F5	F6	F7
G1	G2	G3	G4	G5	G6	G7
H1	H2	H3	H4	H5	H6	H7

Disclaimer

The City of Culver City makes no representation or warranties of any kind with respect to the accuracy of the information or claims furnished herein, as the data is a compilation of records and information obtained from various sources. The data displayed on this map is for representational purposes only. It is neither a legally recorded map nor a survey and is not intended to be used as such. No part of this map may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording systems except as expressly permitted in writing by the City of Culver City.

© City of Culver City. All Rights Reserved.

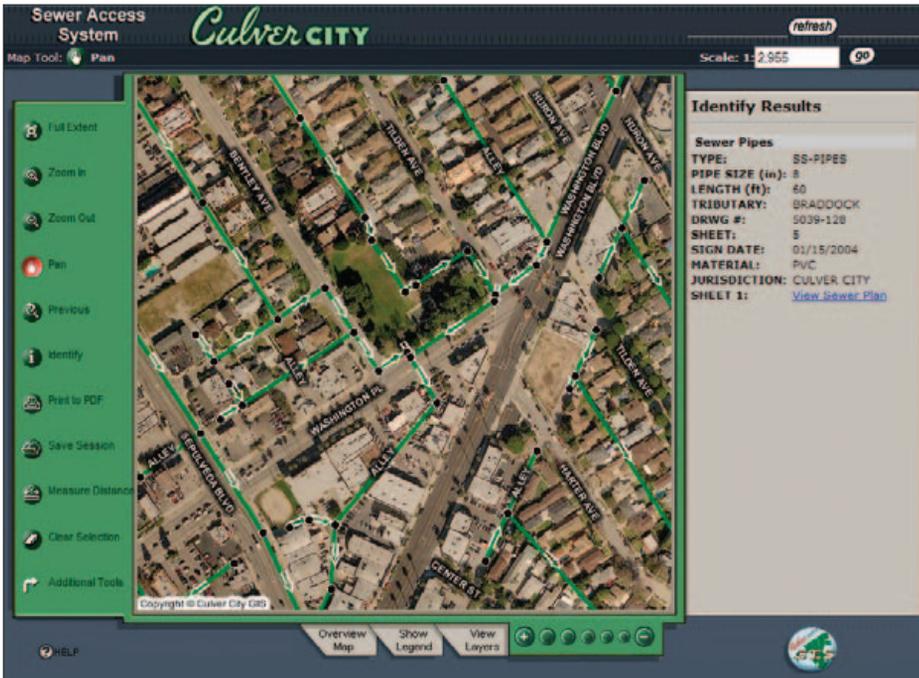
REVISION	DATE
----------	------

CITY OF CULVER CITY
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION - CULVER CITY, CALIF.

SEWER GIS MAPBOOK
TITLE SHEET

APPROVED BY CHARLES S. LIBERTSON
CITY ENGINEER

Through ArcGIS, Culver City was able to develop the Sewer GIS Mapbook.



The Online Sewer Access System map makes it easy for users to retrieve scanned sewer as-built plans.

not be scanned and needed to be contracted out. A 3 indicated there was a question for the sewer maintenance manager.”

Mendez coordinated as-built plans with sewer lines where possible. If he could not find a match, he used aerial images or GPS data to georeference the location. Culver City engineers checked every single line and point to ensure accuracy before approving the data.

A Job Well Done

Because of diligent GIS work, Culver City now has an up-to-date citywide sewer GIS map book and a web application to share the data with the public.

“Our sewer GIS database has increased productivity and propagated better information flow a thousand-fold,” said Johnnie Griffing, GIS project manager. “Thematic maps are now generated that depict entire portions of the system as connected to each pump station. This was a big revelation for engineers and field crews who had not previously had a means for visualizing the extent of the sewer system’s relationship to pump stations. The map book offers a fine level of detail previously only available by retrieving and viewing hundreds of paper drawings—reflecting the most current and staff-verified picture of sewer distribution as it is in the field. Management

can now review these details of the system to make better decisions.”

The Online Sewer Access System map shows sewer pipes, flow direction, manholes, aerial imagery, parcels, pump stations, pumps, and wet wells. GIS layers are served on top of city infrastructure layers such as streets and city boundaries. Users can navigate based on address or intersection, click on a line or point, see the attribute information, and view associated scanned drawings that have been hyperlinked.

The city’s sewer data now includes material, footage, year installed, tributary, and ownership data. All pipes have documented material, size, and diameter information, as well as digitized outfalls from the city of Los Angeles. There is also manhole data, such as cleanouts and lamp holes, not included in previous versions of sewer maps. Mendez is currently adding manhole identification to the data, which will further assist field crews. To improve functionality of the web application, the city plans to launch ArcGIS Server by the end of this year.

“GIS made everything come together,” Mendez said. “Culver City staff can go into the web application and access everything they need from one system. GIS is saving us a lot of time because we don’t have to dig through cabinets for information or rely on memory.”



The Sewer GIS Mapbook shows detailed information of the city’s wastewater infrastructure.

Subsurface Utilities Mapping Program Decreases Cost and Reduces Risk

San Jose/Santa Clara Water Pollution Control Plant

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

The San Jose/Santa Clara Water Pollution Control Plant (WPCP) is located at the southern tip of the San Francisco Bay Estuary in San Jose, California. This wastewater treatment plant treats the wastewater from two million residents of the Santa Clara Valley who live in the cities of San Jose, Milpitas, Santa Clara, Cupertino, Los Gatos, Campbell, Monte Sereno, and Saratoga. Built in 1954, the WPCP

has a capacity to treat up to 200 mgd of raw sewage to an advanced tertiary level of treatment. It resides on 2,700 acres consisting of plant operations, solar drying beds, treatment lagoons, and buffer lands. It is managed by the City of San Jose Environmental Services Department.

Over the 55 years of WPCP operations, record keeping pertaining to most assets was

inconsistent. Information on buried pipeline and valve locations resided on very old hard-copy record drawings or in the minds of staff who are soon to retire or was nonexistent, having been lost long ago. Hundreds of thousands of dollars were spent in issuing change orders to construction contractors due to previously unknown buried pipes being encountered; accidental damage to buried pipelines during

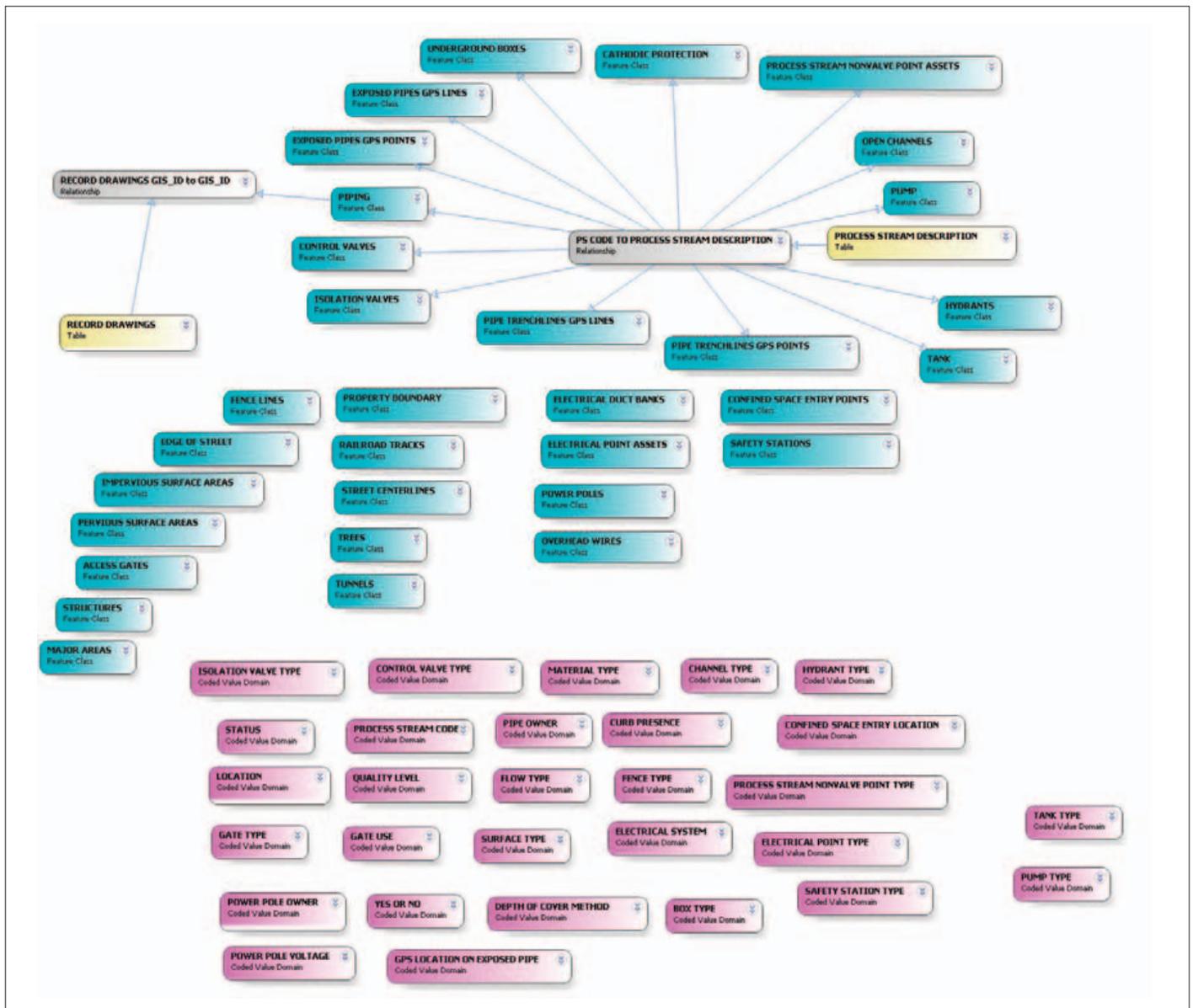


Figure 1. Plant GIS Data Model as Seen in ArcGIS Diagrammer

Water/Wastewater User Group Committees

National

Beth Degironimo, Chairman, Mohawk Valley Water Authority, NY
James Bates, Louisville Water Company, KY
Doug Rulison, Orange County Sanitation District, CA
Kathryn Browning, Municipality of Anchorage, AK
Jon Henderson, City of Bozeman, MT
Phil Oswald, Montgomery Water Works and Sanitary Sewer Board, AL
Kent Lage, Johnson County, KS
Deborah Viera, Miami-Dade Water and Sewer Department, Miami, FL

Partner Council

Brian Haslam, Azteca
Alan Hooper, CDM
Bryan Dickerson, Woolpert LLP
Bo Nielsen, DHI
Andy Moore, CH2M HILL
Michael Samuel, Nobel Systems
Ali Diba, Spatial Wave
Chris Stern, Trimble
Dave DiSera, EMA

International

Jim Carlson-Jones, Chairman, South Australia Water Company
Adam Chadwick, City of Kamloops, British Columbia, Canada
Krystyna Jastal, Boytom Communal Enterprise Co. Ltd, Poland
Patrick Verduyssen, PIDPA, Antwerpen, Belgium

Arizona

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

California

Mike Hoolihan, Chairman, Irvine Ranch Water District
Albert Lin, Long Beach Water Department
James Ollerton, Elsinore Valley Municipal Water District
Nadeem Shaikat, City & County of San Francisco

California Partner Council

Erick Heath, Innovyze
Don Rhodes, iWater
Paul Hauffen, IDModeling, Inc.



Figure 2. Plant Basemap as Seen in ArcGIS

digging activities was an all-too-common occurrence, and misinformation was common as to which valve to close during a buried pipe leak scenario. A solution was to implement a comprehensive subsurface utilities mapping project. ArcGIS 9.3 would be the centerpiece software of this effort.

Project implementation involved a phased approach.

Phase I: Data Modeling, Basemap Creation, and Data Entry

The buried pipelines were categorized into 76 product streams. Examples include sulfur dioxide, process water, and thickened sludge. A data model and file geodatabase were then developed using ArcGIS Diagrammer (figure 1). It was critical that pipe location information be mapped to a quantifiable level of accuracy for the purposes of new construction digging activities.

Consequently, among the data fields included in the Piping feature class was Quality

Level. Quality Level denotes the degree of horizontal accuracy determined for each buried pipe segment in accordance with the ASCE/CI 38-02 Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data.

Using high-resolution aerial photos, structures were planimetrically drawn in ArcMap. The structures included buildings, tanks, lagoons, drying beds, street centerlines, and edges of curbs (figure 2).

The buried pipelines shown on record drawings were entered into the geodatabase. If drawings were already in a CAD format, they were georeferenced using the Georeferencing toolbar in ArcGIS; if not, they were scanned and also georeferenced. The pipelines on each drawing were then digitized or imported into the file geodatabase, with the original documents linked via a hyperlink column in the geodatabase.

continued on page 10

Subsurface Utilities Mapping Program Decreases Cost and Reduces Risk



Figure 3. The Various Tools and Technologies Used to Collect Data on Subsurface Utilities



Figure 4. Using the Trimble GeoXH with ArcPad to Collect Information on Buried Piping Exposed during Construction

Phase 2: Field Mapping and Confirmation

It was critical to ensure that the locations identified on the record drawings match what was found in the field. A variety of tools were used to achieve this: Trimble GeoXH GPS Field Computers with ArcPad 8, Trimble Zephyr External Antennae, laser range finders, digital cameras, ground-penetrating radar, conductive/inductive pipe locators, and a magnetic locator (figure 3). At-grade assets (e.g., valves and manholes) were matched to their associated buried pipes during this phase.

Furthermore, a “call when you dig, but only if you find a pipe” program was implemented. Whenever digging occurred and a pipe was found, the GIS staff was called to the scene. Using the GeoXH with ArcPad 8, external antenna, laser range finder, and digital camera and a tape measure, the location, photo, and depth of the pipe was recorded (figure 4). This information was then correlated with existing buried pipe locations in the geodatabase to achieve greater locational accuracy.

Phase 3: Publish and Serve the Information

A map service was created in ArcGIS Server consisting of almost 80 different layers (figure 5). Using ArcGIS Server, WPCP staff can now readily access critical buried pipe and valve information in a time-efficient and cost-effective manner.

Successful Outcomes

Work on this project continues. After just two years, 120 miles of buried pipelines have been mapped, and the team created a comprehensive WPCP basemap containing 42 miles of roads and 733 structures.

Furthermore, using the data from this project, an on-site subsurface utility locating and designating program was implemented that has resulted in substantial reductions in ac-

cidental damage to buried pipes during digging. A lesser number of change orders are now issued for pipeline construction projects, resulting in a savings from tens to hundreds of thousands of dollars depending on the project size. Valves are now not only easier to locate but also more easily associated with their respective buried pipelines. This has led to a significant reduction of risk during buried pipeline leak scenarios.



Figure 5. Plant GIS (PGIS) Used by Staff to View, Query, and Analyze Subsurface Utility Information in ArcGIS Server

iWater—Take Your GIS to the Next Level

iWater provides services, accurate data, reports, maps, attributes, and problem identification to cities, municipalities, and private utility companies. This valuable information assists in making better informed decisions in emergency situations, facilitates long-term planning, and reduces operational costs. It has a 100 percent rate of completing projects on time and within budget. This is due to field expertise, Esri technologies, advanced GPS capabilities, and efficient operational procedures. Since its inception in 2000, it has



- Equipped field crews with capabilities to operate, test, and log data for system assets and record them with GPS
- Maintained Department of Health Water Distribution Grade 2 certification or higher for all crew leads
- Updated over 300,000 facilities in Southern California
- Installed in-vehicle computer systems utilizing GPS technology and wireless communication
- Developed infraMap mobile GIS software



As a result of the fieldwork that crews perform daily, iWater developed the infraMap software product. This ArcGIS Engine software-based application was originally designed for its own field crews. After over seven years in the field, infraMap is now a commercial off-the-shelf solution used in over 40 cities and municipalities across the United States. The software is truly designed for field crews, by field crews.

iWater has provided information in over 150 cities covering almost 5,000 square miles of infrastructure. This has included

- Creating and updating maps of water, sewer, storm water, and fire systems
- Operating and repairing valves and hydrants
- Replacing and testing service meters
- Fire flow testing and unidirectional flushing
- Converting paper and outdated system maps to Esri technology
- Deploying infraMap mobile GIS software for field inspections and work management

This information has been used to meet GASB 34 requirements, homeland security guidelines, Department of Health standards, fire department reporting requirements, and National Pollution Discharge Elimination System permit compliance and has improved internal efficiencies and overall cost containment.

Technology developments are constantly made to improve the time and cost of making decisions for all levels within iWater and with its customers. The company is dedicated to providing its clients with quality products by maintaining high-quality standards, efficient operations, and state-of-the-art technologies.



Water/Wastewater User Group Committees (continued)

Northeast

- Gilbert Osei-Kwadwo, Fairfax County Wastewater Management, VA
- Sigi Sharp, Washington Suburban Sanitary District, Washington, DC
- Dave Ward, Loudoun County, VA

Northeast Partner Council

- Ryan McKeon, Wachs Water Services, MD
- Ron Wallace, IBM, NY

Mid-America

- Becky Mckinley, Chairman, Hammond Sanitary District, IN
- Will Allender, Colorado Springs Utilities, CO
- Bruce Butler, Butler County, OH
- Jeffrey Duke, Northeast Ohio Regional Sewer District, OH
- Dave Krenek, City of Fountain, CO

Mid-America Partner Council

- Jerry Mohnhaupt, Arcadis, CO
- Nicole Schmidt, Lucity, MO
- Adrienne Black, Black & Veatch, MO
- Scott Rebman, RJN Group, IL
- Tom Delaura, Westin, MI

Pacific Northwest

- Geoff Chew, Chairman, City of Portland, Water Department, OR
- Dale Bertelson, Clean Water Services, OR
- Pete Brandstetter, City of Albany, OR
- Ian Von Essen, Spokane County, WA

Pacific Northwest Partner Council

- Elizabeth Marshall, Marshall, WA

Southeast

- James Carter, Chairman, Metro Water Services, TN
- Ron Hawkins, Orlando Utilities Commission, FL
- Joel Watson, Spartanburg Water System, SC
- Veronica Owens, JEA, FL
- Alan Lee, Opelika Utilities, AL
- Matt Sanders, Mobile Area Water & Sewer, AL

Southeast Partner Council

- Sonny Beech, Geographic Information Services, AL
- Michael Gilbrook, HDR, FL
- Mark Nelson, Jones Edmunds & Associates, Inc., FL
- Karyn Tareen, GeoCove, FL

AWWA Liaison

- Paul Olsen, American Water Works Association, CO

WEF Liaison

- Jack Benson, Water Environment Federation, VA



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 website at esri.com.

View *Water Writes* online at esri.com/water.

Advertise with Us

E-mail ads@esri.com.

Submit Content

To submit articles for publication in *Water Writes*, contact Lori Armstrong at larmstrong@esri.com or Jessica Wyland, editor, at jwyland@esri.com.

Manage Your Subscription

To update your mailing address or subscribe or unsubscribe to Esri publications, visit esri.com/managemysubscription.

International customers should contact an Esri distributor to manage their subscriptions. For a directory of distributors, visit esri.com/distributors.

Circulation Services

For back issues, missed issues, and other circulation services, e-mail requests@esri.com; call 909-793-2853, extension 2778; or fax 909-798-0560.

Team Water/Wastewater

Lori Armstrong, Industry Solutions Manager

E-mail: larmstrong@esri.com

Christa Campbell, Water/Wastewater Coordinator

E-mail: ccampbell@esri.com

Copyright © 2011 Esri. All rights reserved. Esri, the Esri globe logo, ArcGIS, ArcSDE, ArcMap, ArcPad, [@esri.com](http://esri.com), *Water Writes*, arcgis.com, and esri.com are trademarks, registered trademarks, or service marks of Esri in the United States, the European Community, or certain other jurisdictions. Other companies and products mentioned herein may be trademarks or registered trademarks of their respective trademark owners.

120554
QUAD8.6M6/11tk

My Esri News keeps you connected with GIS users and events in your area. Sign up today at esri.com/myesri/news.

380 New York Street
Redlands, California 92373-8100 USA



Presorted
Standard
U.S. Postage
Paid
Esri