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Arc India News

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Cover Story

GIS for Water Utilities -
Core Business Patterns

Case Study

Study of water supply &
sanitation practices in India
using Geographic Information
Systems (GIS)

Technical Article

GIS Data Quality Best
Practices for Water,
Wastewater,
and Stormwater Utilities

The cover features a collage of four images: a large green pipe with water flowing (top left), an excavator lifting a large pipe (top right), a map overlay on a landscape (middle left), and a water tap with water flowing into a bucket (bottom right).

Transforming Water Utilities



India's rapidly increasing population, urbanization and industrialization is driving a significant increase in the need for water. The average availability of water is reducing steadily with the growing population and studies estimate that by 2020 India will become a water stressed nation. Even today in India's leading cities, water problems are endemic. Even with adequate water supply, inadequate maintenance and replacements lead to technical losses in the distribution network. Errors in metering, unbilled water consumption and plain theft contribute to commercial losses leading to high levels of non-revenue water. Water plants in New Delhi, for instance, generate far more water per customer than many cities in Europe, but taps in the city operate on average just three hours a day because 30 percent to 70 percent of the water is lost to leaky pipes and theft.

Policies and Technology interventions can boost efficiency, augment supply or lessen the water-intensity of the economy to meet human and environmental water needs at affordable cost. There is an already an increased awareness among all stakeholders about the environmental effect of efficient usage of water and better treatment of wastewater. The Consolidated Foreign Direct Investment (FDI) policy announced by the Government of India allows 100% FDI both in demand as well as supply segment. This opens up investment opportunities for the foreign investors especially in the supply & distribution segment and sewage & sanitation services where there is limited private sector involvement currently.

From a technology perspective, there is tremendous opportunity to leverage Geographic Information Systems (GIS) as a solution to these challenges to help water utilities achieve better performance out of their physical assets, their employees and the natural resources they use for access to raw water. Water utilities across the world are adopting GIS to add value to their work flows. GIS which was once viewed as a niche application, is evolving into a strategic component of a utility's enterprise technology infrastructure.

Maintaining status-quo is no longer an option. Water will continue be an important investment area for public and private financial institutions in the coming years. Managing water is a complex endeavor, demanding constant vigilance to ensure water quality, as well as a long-term view for a sustainable water future. Utilities need to improve the monitoring, mapping and measurement of existing water systems, thereby informing decision making and prioritization. In addition, infrastructure upgrades must be coordinated with other infrastructure projects, including utilities upgrades, roads and highways, and wastewater and sanitation. GIS use will be differentiate or that provides a capability to provide a common operating picture for its efficient and sustainable management.

Agendra Kumar

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Designed by:

Indian National Organization gets recognized at Esri International User Conference

Esri recognized more than 170 organizations during the Special Achievement in GIS (SAG) Awards ceremony at the Esri International User Conference in San Diego, California. The SAG Awards acknowledge vision, leadership, hard work, and innovative use of Esri's geographic information system (GIS) technology.

"The SAG Awards identify the people and organizations that are using the power of geography to improve our world and drive change," said Esri president Jack Dangermond. "At Esri, we are deeply inspired by the passion and innovation of our users. They deserve recognition for solving challenges and for their invaluable contributions to the continued evolution of geographic science."

The organizations honored at the Esri UC are from around the world and span industries including agriculture, cartography, climate change, defense and intelligence, economic development, education, government, health and human services, telecommunications, and utilities.

Organisation from India recognized for Special Achievement in GIS was National Centre for Sustainable Coastal Management, India.

National Centre for Sustainable Coastal Management, (NCSCM) Ministry of Environment and Forests, has successfully completed the National Shoreline Change Assessment for the entire coast of mainland India with the extensive use of GIS technology. The NCSCM has mapped the coastline to enhance India's preparedness to face sea hazards like storm surge and tsunamis. Currently, GIS is used to delineate the coastal sediment cells (a.k.a. coastal littoral cells) to prepare a shoreline management plan for the entire country's coastline. In addition, NCSCM has also proposed to prepare an online decision support system for integrated coastal zone management plan, jointly with Esri India.

Finding Geospatial Apps and Data Just Got Easier

Esri announced the launch of ArcGIS Marketplace, a new destination that allows ArcGIS Online subscribers to search, discover, and get apps and data from qualified providers for use within their organization. ArcGIS Marketplace provides data from organizations such as DigitalGlobe, RapidEye, AccuWeather, and Esri, as well as apps created by Esri and its



ArcGIS Marketplace allows ArcGIS Online subscribers to search, discover, and get apps and data from qualified providers for use within their organization

distributors and partners, such as Latitude Geographics, Azteca Systems, and con terra that are built specifically to work with ArcGIS Online. All apps and data can easily be shared with ArcGIS Online groups and users within your organization.

"While there are app marketplaces that serve consumer audiences, only ArcGIS Marketplace is specifically designed to serve the needs of GIS users, making it truly unique," says Johan Herrlin, senior business strategist at Esri. "ArcGIS Marketplace is another facet of the ArcGIS platform. Now you can easily find apps and data services that integrate with your ArcGIS Online subscription, allowing you to get more value out of the platform."

Anyone can browse the listings in ArcGIS Marketplace, but you need to be an ArcGIS Online subscriber to get free trials or make purchases. Because all apps in ArcGIS Marketplace require an ArcGIS Online login, users can access their organization's maps via the apps. Data services acquired via ArcGIS Marketplace are also fully integrated with ArcGIS Online, so you can add them to your basemap gallery or other apps.

For apps and data service providers, ArcGIS Marketplace provides a mechanism to generate leads, provide free trials, grant access to listings, and manage subscriptions. If you have a great app or data that you would like to make available to the ArcGIS community, find out what it takes to qualify as an ArcGIS Marketplace Provider. ArcGIS Marketplace is now available globally. Keep checking in over the coming months, as the number of app and data listings will grow rapidly.

To get started empowering your enterprise with apps and data services, visit marketplace.arcgis.com.

Urban Observatory Turns Spotlight on Understanding at 2013 Esri International User Conference

Attendees of the Esri International User Conference witnessed the world's first look at the Urban Observatory—a live museum with a data pulse. A ground-breaking experience, the Urban Observatory allows people to explore simultaneous views of major cities located around the world. It provides dynamic, flowing content organized around the themes of work, people, places, movement, and systems.

The Urban Observatory is brought to you by Richard Saul Wurman, creator of Technology/Entertainment/Design (TED) and 19.20.21; Jon Kamen of the Academy Award-, Emmy Award-, and Golden Globe Award-winning film company Radical Media; and Esri president Jack Dangermond. The exhibit was unveiled on July 8, 2013, at the Esri UC, to be held at the San Diego Convention Center in San Diego, California. The Esri UC is expected to attract more than 14,000 attendees.

"A map is a pattern made understandable, and patterns must be compared to understand successes, failures, and opportunities of our global cities," says Wurman. "The Urban Observatory demonstrates this new paradigm, using cartographic language and constructive data display. People and cities can use maps as a common language."

"The Urban Observatory tells the story of the global community through analysis of our largest, most unique cities," says Dangermond. "Interactive maps and standardized information let you investigate every aspect of

life. It establishes a common language for cities to share and learn."

Attendees can visit the Urban Observatory to compare and contrast complex systems using visualized map information for a clearer understanding of life in the twenty-first century. The exhibit features large digital displays of maps, images, videos, and authoritative data for cities around the world.

More than 16 cities contributed data. The creative and technical forces at Radical Media and Esri built the first iteration of the exhibit with state-of-the-art software, hardware, fiber optics, custom kiosks, and high-quality monitors.

An ArcGIS Online web application that allows people to interact with rich datasets for each city powers the Urban Observatory experience. People can use the Urban Observatory web application to easily compare cities by using a simple web browser. As a user zooms in to one digital city map, other city maps will zoom in parallel, revealing similarities and differences in density and distribution. For instance, a person can simultaneously view traffic density for Abu Dhabi and Paris or simultaneously view vegetation in London and Tokyo.

The Urban Observatory application and exhibit will continue to evolve beyond the Esri UC. Future iterations will include more content and cities. The Urban Observatory will supply extensive benefits for government agencies and private businesses. For example, governments can view residential land use for one city and compare it to another, making discoveries along the way that have implications for their local municipalities. Businesses can explore population data, commercial buildings, and traffic patterns to make sound decisions.

For more information about the Urban Observatory, visit www.urbanobservatory.org. To learn more about the 19.20.21 initiative, visit www.192021.org.

New ArcGIS for Water Utilities App Configurations

Esri announces the availability of three new ArcGIS for Water Utilities app configurations for download. ArcGIS for Water

Utilities is a series of free and easy to deploy configurations that enable the out of the box ArcGIS platform to support common water, wastewater and stormwater workflows. These new apps bring the total number of ArcGIS for Water Utilities configurations released by Esri so far to 31, with more app configurations currently in development. The following is a brief overview of the newly released app configurations.

Watering Restrictions

Watering Restrictions is a web application configuration that enables water utilities to communicate with their customers about watering restrictions and permissible watering days. For example utilities with water usage restrictions can embed this map in their webpage or have it as a stand alone resource so that customers can access water restriction information in an interactive map to help determine with certainty when or if customers can use water to do things like water lawns, wash cars, etc.

Watering Violations

Watering Violations is a configuration of Collector for ArcGIS that enables water utilities to capture watering restriction violations in the field and also to record and view watering violations on a map in a web browser in the office. For example this app can be provided to utility field crews that are looking for customers that are violating water restrictions or investigating reports of water violations. Customer service representatives in the office can use the browser based map to record customer submitted tips about potential water violators. Water utility managers can also use the web browser based map to manage the violation inspection process and to take appropriate action with violators.

Green Infrastructure Verification

Green Infrastructure Verification is a configuration of Collector for ArcGIS to capture or verify green infrastructure locations in the field and a web browser based map of green infrastructure to enable office staff to capture, manage and view information about green infrastructure. This configuration can be used to support activities such as inspections to support requests for green infrastructure subsidies or to inventory and record green infrastructure in the field.

Source: blogs.esri.com

Letters to Editors

Dear Readers,

This section of Letters to Editors has been an important section of Arc India News and your comments/suggestions are valuable to us. We would like to have the opinion and feedback of all our readers with respect to the content being published and how it has been useful to them in day to day GIS advancement. You may also let us know what you expect to see in terms of application and technology in the magazine.

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Editorial Board

ArcGIS 10.2 Delivers Transformational Capabilities

ArcGIS Includes New Online Analysis Tools, Live Data Integration, and Enhanced Business Intelligence



Marking a major milestone in the history of the Esri platform in ArcGIS 10.2, Esri has taken advantage of the significant changes in IT that magnify the power and accessibility of GIS. The new release improves ease of use, real-time data access, and integration with existing infrastructure. It allows people to more easily deploy web GIS—the key component for implementing GIS as a platform. Web GIS helps users organize their work and simplifies geographic information discovery, access, sharing, and collaboration.

More Online Analysis Tools

ArcGIS 10.2 extends the analytic functionality of GIS to everyone via ArcGIS Online. Advanced analysis tools have been added to ArcGIS Online for investigating geographic relationships, patterns, and trends within data. New tools in ArcGIS Online include overlay layers for combining two or more layers into one single layer; enhanced hot-spot analysis; and data enrichment resources to glean information about the people, places, and businesses in a specific area or drive time.

ArcGIS Online Access

To ensure that ArcGIS for Desktop users have access to ArcGIS Online capabilities, Esri entitles every customer organization that has ArcGIS for Desktop (Basic, Standard, or Advanced) to receive an ArcGIS Online subscription. The number of named users will be equal to the total number of ArcGIS for Desktop licenses current on maintenance. This will enable users to easily get started with ArcGIS Online. It will also give access to all Esri apps—such as Esri Maps for Office, Collector for ArcGIS, and Operations Dashboard for ArcGIS—as well as numerous app templates hosted in ArcGIS Online. Esri will notify ArcGIS for Desktop customers about the details of this new entitlement in the coming weeks.

Portal for ArcGIS

At ArcGIS 10.2, Esri gives people the ability to deploy ArcGIS Online capabilities on-premises for tighter content security and control. Portal for ArcGIS provides a secure front end for

ArcGIS for Server, with dozens of easy-to-use apps and full integration with ArcGIS for Desktop. It includes geographic viewers and analysis tools designed for people without any GIS knowledge. Experienced GIS users can connect to Portal for ArcGIS from ArcGIS for Desktop, developer APIs, and other Esri applications. The Portal for ArcGIS extension software is included with ArcGIS for Server Advanced (Enterprise or Workgroup) and is licensed and priced based on the number of named users. This technology supports many capabilities:

- Enterprise geospatial content management
- Simple mapping
- Esri Maps for Office
- Integration with enterprise security
- Sharing of data, maps, and apps
- Groups
- Mashups
- Dozens of apps
- Open enterprise integration with Office, SharePoint, SAP, and others

Real-Time Data Access

Esri's new release of ArcGIS introduces a number of new technologies that enable the real-time collection and sharing of data with GIS. It includes ArcGIS GeoEvent Processor for Server, a new ArcGIS for Server extension that gives users the power to access live data streams. People can analyze and send processed results to other users or into other systems. This capability transforms GIS applications into powerful frontline decision tools, refining data quickly for consumption and enabling fast response in any situation. A number of new technologies enable the real-time collection and sharing of data with GIS, including the following:

- ArcGIS GeoEvent Processor for Server
- Operations Dashboard for ArcGIS

- Collector for ArcGIS

Web Maps Bring GIS to Everyone

Web maps have emerged as the primary instrument for generating and communicating geographic understanding across enterprises, businesses, and constituencies. They're easy to use and, with ArcGIS, increasingly powerful and dynamic. ArcGIS is designed to help people easily create, deliver, and use web maps. The following new capabilities in ArcGIS make web maps even more important:

- Hosted analysis services
- Premium content services
- Dynamic image services
- Web scenes for 3D

Expanded Business Intelligence Support

With business intelligence (BI) being relied on even more in an increasingly competitive marketplace, the new ArcGIS release expands Esri's support for major BI systems. ArcGIS 10.2

includes new MicroStrategy BI and Microsoft Dynamics Customer Relationship Management tools, allowing users of those platforms to perform location analytics on their business data and focus their marketing. Core BI tools Esri Community Analyst and Esri Business Analyst Online also get productivity-enhancing face-lifts and major customization capability. While working within the systems they use every day, these users can do the following:

- Make maps that put data in a spatial context
- Uncover and analyze spatial relationships that charts and graphs cannot reveal
- Enhance their data with Esri basemaps and demographic data

Enterprise Security Integration

ArcGIS includes new, improved integration with an organization's enterprise systems, as well as security enhancements, such as federated authentication for ArcGIS Online and public key infrastructure (PKI) authentication for Portal for ArcGIS.

ArcPad 10.2 Improves Integration with ArcGIS

Automated Data Collection and Synchronization with Online GIS among New Enhancements

Continuing its effort to connect desktop and mobile workflows in a seamless platform, Esri has released Arc Pad 10.2. ArcPad is mobile mapping and field data collection software designed for GIS professionals. The new version of ArcPad improves synchronization with the ArcGIS platform and speeds data collection in the field with new automation options.

Esri's latest release of ArcPad gives users the ability to directly open ArcGIS feature services in ArcPad and synchronize edits with hosted or on-premises GIS. The new capability significantly improves mobile workflows by enabling disconnected editing of published services. In addition, ArcPad gives users the ability to automate edits with a Quick Fields option, which can be customized to autopopulate any field during data collection.

For users who rely on desktop workflows that revolve around file sharing and distribution, ArcPad 10.2 includes new ArcGIS Online integration. With this option, users can store their ArcPad projects and QuickProject templates as an ArcPad package in their ArcGIS Online accounts for sharing with members of their group. ArcGIS Online subscribers can also browse ArcGIS Online from inside ArcPad with the ability to select and download a project or template, creating an easy, collaborative workflow.

GeoCollector for ArcPad

GeoCollector for ArcPad is the industry standard for rugged handheld data collectors. It comes with a choice of 10 centimeter (GeoCollector XH) or 50 centimeter (GeoCollector XT) hardware, after postprocessing with Trimble Positions Desktop add-in for ArcGIS for Desktop. These accuracies are also available in real time with suppliers of VRS or dual frequency base stations, which may require provider subscription fees.

Floodlight satellite shadow reduction technology, available

with two of the GeoCollector for ArcPad offerings, enhances GNSS performance to deliver more positions and better accuracies in difficult conditions.

Application Software for GPS Field Data Collection

- Each GeoCollector for ArcPad system includes an Esri ArcPad license.
- ArcPad delivers hassle-free field collection and seamless data integration with ArcGIS products by using the same data formats, symbology, and project structure in the field and in the office.
- Each GeoCollector for ArcPad system also includes a Trimble Positions ArcPad extension license. The Trimble Positions ArcPad extension collects and verifies GNSS data to enable improved GIS data accuracy.
- The extension manages GPS data to enable improved GIS data accuracy through differential correction with Trimble Positions Desktop add-in for ArcGIS for Desktop software.



ArcGIS for Water Utilities

Manage Water, Wastewater, and Stormwater Utilities

ArcGIS for Water Utilities supports daily business functions with maps and applications that can be downloaded and configured for utilities organizations.

ArcGIS for Water Utilities is designed to help:

- Run operations more efficiently
- Communicate more effectively
- Save money
- Engage with stakeholders
- Plan and carry out improvements

ArcGIS for Water Utilities is the part of the ArcGIS for Local Government solution that focuses on water, wastewater, and stormwater utilities. It is open, scalable, and interoperable and complies with industry standards. By deploying ArcGIS for Water Utilities, utilities can manage your water system without costly custom software development.

Esri solutions, technology, services, training, and expertise can help skillfully manage water utilities with industry best practices.

ArcGIS for Water Utilities Supports Daily Workflows

Asset Management

Store, manage, and map accurate spatial and descriptive information about your utility's assets. Maintain the highest possible data accuracy. Proactively monitor work orders. Access and update data in the field. Provide current information across your organization. Track, locate, and manage assets while ensuring regulatory compliance.

Tool - Infrastructure Network Editing streamlines utility data management. It includes a series of custom editing and reporting tools that improve the editing experience for ArcGIS users working with infrastructure data.

Planning and Analysis

Transform information into actionable intelligence. Identify vulnerabilities that could lead to pipe breaks. Weigh and analyze asset investment scenarios. Gain a better understanding of customer satisfaction. Take advantage of hydraulic models to support decisions related to fire flow

assessments, water quality, pump scheduling, emergency planning, and flushing. Tool - Infrastructure Capital Improvement Planning allows utilities to rate the condition of infrastructure networks and estimate the cost of capital improvement projects.

Field Mobility

Extend geospatial technology beyond the office. Use analytic tools to schedule and dispatch utility service staff for maximum efficiency. Monitor the location and progress of crews working in the field. Collaborate and communicate between the office and field with mobile and cloud-based applications.

Tool - The Infrastructure Mobile Map is a mapping and data collection application used by field crews to view detailed information, locate assets, enter field notes, and update work status.

Operational Awareness

Use maps and reports to quickly demonstrate how utility is meeting compliance requirements or responding to leaks. Identify where money is being spent. Monitor all utility operations with a user-friendly executive dashboard. Keep the public informed with web-based applications and viewers.

Tool - The Infrastructure Operations Dashboard is a configuration of ArcGIS for Server and ArcGIS Viewer for Flex that provides basemaps, operational layers, information pop-up windows, and reports. It can be used to allocate resources and update the status of work activities in real-time

Stakeholder Engagement

Develop web applications that allow citizens to view work activities in their community, submit requests for service, and see real-time alerts or news items. Provide citizens with authoritative information about local work activities. Enable customers to submit requests for service. Connect to social media feeds from YouTube, Twitter, and Flickr.

Tool - The Public Information Center provides citizens with access to authoritative information about work activities, allows them to electronically submit service requests, and enables a view of current community events and activities •

Small Water Utilities on ArcGIS Cloud Platform

With ArcGIS Cloud Platform, Esri introduces small water utilities to the cloud. Small water utilities can get started with Esri's ArcGIS® technology or get more from an existing ArcGIS investment. With cloud, ArcGIS deployment is fast and scalable. This means utilities can have more processing power when needed and no wasted capacity and can enjoy a lower cost of ownership compared to buying and maintaining their own hardware. They simply pay for what they use. In addition, they can also experience business continuity with inexpensive disaster recovery options.

ArcGIS Makes It Easy

- Access ArcGIS for Server on Amazon Web Services.
- Deploy Esri licensing, including the small-utility enterprise license agreement, within the cloud.
- Use existing authorization codes or purchase additional software licenses.
- Manage what's in the cloud with the help of ready-to-go Amazon Machine Images.

- Take advantage of Esri Managed Services, which include the hosting and management of data and applications in an environment that is scalable, secure, and cost-effective.

Small Water Utilities Geocollaborate with ArcGIS Online

ArcGIS Online is a cloud-based mapping platform, ready to use with nothing to install or set up. The software, delivered as a service, provides intuitive tools to create and publish maps and applications on demand helping utilities stay in control of their data while empowering their staff.

You Can Do It All with ArcGIS Online

- Create and view maps in a web browser.

- Host data and services.
- Provide maps to staff using smart phones and tablets.
- Share maps on blogs, web pages, web and mobile Applications.
- Send maps to Facebook® and Twitter®.
- Collect and report data.
- Create maps in Microsoft Office.
- Share maps through PowerPoint® presentations.
- Publish across the ArcGIS platform.

Maps and Apps for Water Utilities

Water utility maps and apps are used to plan, maintain, and operate water distribution, sewer, and storm water systems that provide clean drinking water and protect public health.

Data Reviewer for Water Utilities (ArcGIS for Desktop)

Perform quality control on water, sewer, and storm water data.

One of the most important components in any GIS implementation is the accuracy of the data, and a well-defined quality-control process is essential for ensuring data integrity. Data Reviewer for Water Utilities provides several preconfigured ArcGIS 10.2 Data Reviewer for Desktop batch job (.rbj) files that include quality-control checks for validating, maintaining, and ensuring the integrity of water, sewer, and storm water utility data.

Data Reviewer provides a set of tools to simplify many aspects of automated and visual data quality control. Data Reviewer provides over 40 out-of-the-box checks that can be run individually, grouped into batch jobs (.rbj files), or run as a scheduled service. The batch jobs provided with Data Reviewer for Water Utilities are configured to work with the local government Geodatabase.

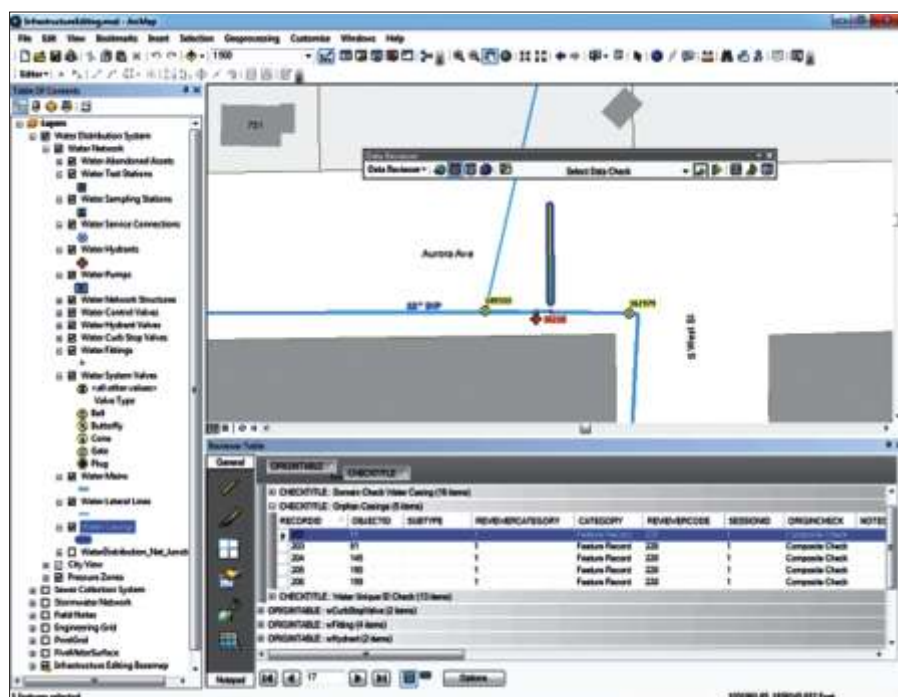
Water Utility Capital Improvement Planning (ArcGIS for Desktop)

Rate the condition of infrastructure networks and estimate the cost of capital improvements.

Water Utility Capital Improvement Planning is an ArcGIS for Desktop map that can be used by water, sewer, and storm water engineers to rate the condition of infrastructure networks and estimate the cost of capital improvement projects.



Infrastructure Capital Improvement Planning editing map



Data Reviewer for Water Utilities with the Water Utility Editing map

Water Utility Network Editing (ArcGIS for Desktop)

Manage water, sewer, and storm water utility data.

Water Utility Network Editing is a map document and add-in for managing water, sewer, and storm water utility data. It is an editing map that can be used by mapping technicians in a water utility, sewer authority, or public works department.

The Water Utility Network Editing toolbar and the Water Utility Network Reporting toolbar contain a series of custom editing and reporting tools that improve the editing experience when working with infrastructure data in many ways, including the following:

- Automatically connecting service



Water Utility Network Editing editing map

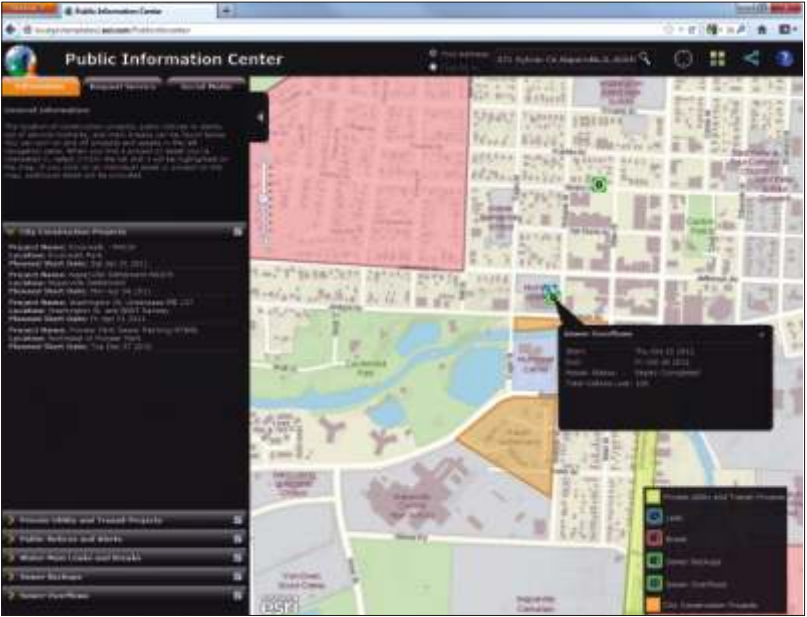
Connections to laterals and their mains

- Reporting trace results along the utility network
 - Graphing the profile of a sewer main
- Water Utility Network Editing also includes the Attribute Assistant Add-In. This add-in uses a series of predefined methods to automatically populate attributes when updating or adding features to the geodatabase. For example, one method populates the size of a valve from the water main feature it intersects. Other methods help you maintain the integrity of your infrastructure data by populating the last editor and last update date on each Feature.

Public Information Center (ArcGIS for Server)

Allow citizens to review activities published by the local government, submit requests for service in their community, and review social media feeds to see what is being said about their community.

Public Information Center is a configuration of ArcGIS for Server and a JavaScript application. This application provides citizens access to authoritative information about work activities such as capital projects, main breaks, alerts, and out-of-service hydrants. Public Information Center also allows citizens to submit requests for service. In local governments that have deployed an automated system (CRM/CMMS systems) to track service requests and work activities, the online requests can be routed to staff responsible for their resolution. If an automated system is not present in the local government, a manual service ticket can be created and routed to appropriate staff. Finally, Public Information Center allows citizens to discover what the community is saying



Public Information Center application

about local events and activities using social media feeds from YouTube, Twitter, and Flickr.

Initially, this application can be deployed for infrastructure agencies and uses operational layers typically published by water utilities or public infrastructure agencies. It can also be configured to support a comprehensive local government citizen service application organized for other agencies or issues.

Public Information Center can be used by water utilities, public works agencies, or other local government organizations to deliver a web-based public information application. This application provides 24/7 access to the organization and typically supplements customer service phone numbers staffed by local governments •

GIS for Water Utilities - Core Business Patterns

India is home to 16 percent of the world's population and has only 2.5 percent of the world's land area and 4 percent of the world's water resources at its disposal. Of the 1,869 trillion liters of water reserves, only an estimated 1,122 trillion liters can be exploited due to topographic constraints and distribution effects¹. In addition, the demand for water has been increasing at a high pace in the past few decades. The 2011 water study report by IDFC depicts that the water demand in India, combining all sectors, will grow at a CAGR of 3% till 2030.

With rapid increase in urban population and continuing expansion of city limits, the challenge of delivering water in Indian cities is growing rapidly. In addition, inadequate coverage, intermittent supplies, low pressure, and poor quality are some of the most prominent features of water supply in the cities of India. Many large Indian cities have to source water from long distances ranging from 50 to 200 km due to exhaustion or pollution of nearby sources. This increases the cost of raw water and enhances the possibility of leakage during transmission.

Even when water supply is adequate, poor maintenance and inadequate replacement leads to technical losses in the distribution network. Errors in metering, unbilled water consumption and plain theft contribute to commercial losses. All this leads to high levels of non-revenue water. With no monitoring system in place and no incentive to reduce inefficiencies, the urban water scenario in India is one of poor service delivery, poor maintenance of physical systems, poor recovery of costs, and poor generation of revenues. Water supply in India continues to be inadequate, despite longstanding efforts by the various levels of government and communities at improving coverage.

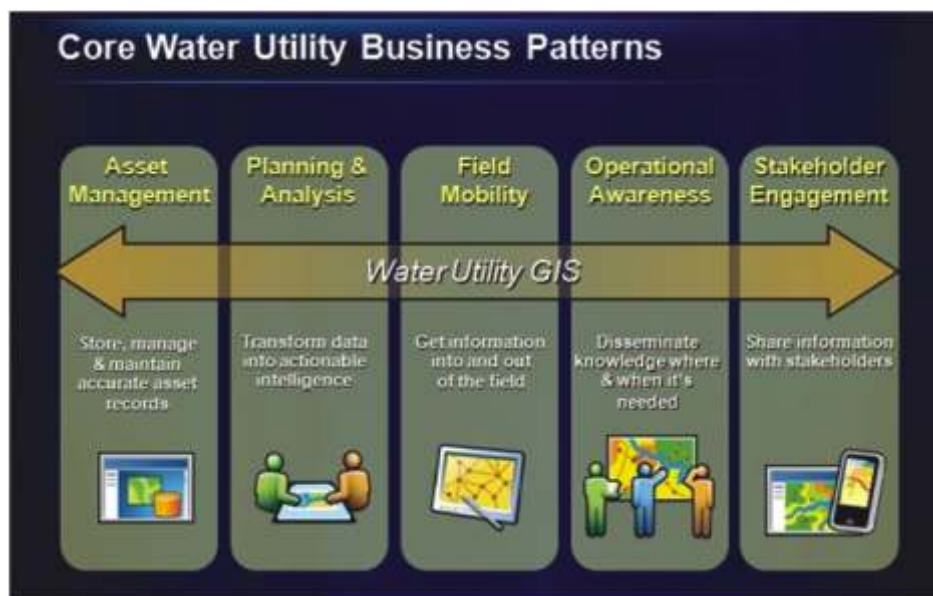
Effective management of water supply systems consists in supplying adequate quantities of clean water to the population. Water utilities need to keep track of distribution, collection, and drainage networks as well as related planning, customer care and financial records. Hence, the delivery service business of utilities requires faster decisions regarding asset utilization and resource management. The retail business of the same or new utility providers requires a more intimate understanding and relationship with their customers.

These changing business needs and advances in technology have shifted the utility industry's perspective of geographic information system (GIS) technology and spatially enabled data. Once viewed as a niche application, GIS is now a necessity, a strategic component of a utility's enterprise technology infrastructure.

GIS supports the 5 common "business patterns" of a water utility

- Asset Management
- Planning and Analysis

- Field Mobility
- Operational Awareness
- Stakeholder Engagement



The Asset Management Business Pattern

All utilities engage in some form of "asset management". Increasingly utilities are creating formalized "asset management programs". Even without a formal asset management program (and a program in this case doesn't imply a software program, it means an organizational initiative) many utilities have informal workflows and procedures that guide decision making around managing assets. So from a hunch about what assets need to be replaced or maintained to hard scientific evidence, utilities are constantly making decisions about their assets.

The cornerstone of effective asset management at utilities is good asset information. Whether a utility has a formal asset management program or an informal one, decisions require some level of information about assets – from knowledge in a worker's head to information in a computerized system.

GIS supports the Asset Management pattern of water utilities through being the authoritative system to store, manage and maintain accurate asset records that are able to be shared utility wide. Simply put, GIS manages asset information.



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Water utility field staff are among the most map centric people you will encounter. They think of their work world in terms of map book sheets. So for GIS, the Field Mobility business pattern is about providing water utility field crews with maps and map centric applications that can be rapidly updated and are easy to use. GIS also supports the Field Mobility business pattern by enabling field crews to capture GIS data in the field and efficiently pass it back into the office.

Some utilities choose to create paper or electronic field maps books out of their GIS. Other utilities are deploying mobile GIS applications for field crews that act as an interactive version of the traditional utility map book and also provide decision support and data capture tools. Whether delivering paper maps or interactive mapping applications to the field, GIS is supporting the needs of utility field workers as well as those in the office that need to share information with the field.

Operational Awareness

Talk to a manager or executive director at a utility about their information needs and most often they will say something along the lines of "I need to know what is happening around the entire utility at any given time". They need to be operationally aware.

The Operational Awareness business pattern is about having an understanding of the current state of operations at a water utility, so this is a real time or near real time understanding of how assets, utility networks and personnel are performing and how they are affecting each other. Being operationally aware empowers water utility managers to confidently make decisions based on accurate and up to date information.

GIS supports utility operational awareness by enabling utilities to have a web map based view into the current state of operations. We've heard over and over from water utility managers that a map based view into their organization is the easiest way for them to understand at a glance what is currently happening at their utility. An interactive map is also

SCADA information, recent sewer over flows, planned capital projects, etc. They would also like to be presented with KPIs and metrics derived spatially, utilize heat maps to spot trends, be able to see historic operational data on demand and be able to zoom far enough in to see all of their utility assets in detail as necessary.

Thinking about data that utility managers need to be operationally aware brings about an important point. Much of that data comes from other enterprise business systems used at utilities and can be spatially enabled by a GIS so it is placed on the map.

Stakeholder Engagement

Water utilities have many external stakeholders such as customers, elected officials, regulatory agencies, other utilities in their service area, etc. The Stakeholder Engagement business pattern encapsulates how utilities interact with external entities that are affected by the utility.

Across the industry, the trend is for water utilities to more proactively engage with stakeholders through public



outreach programs, providing more transparency while delivering information in a way that minimizes the possibility of misinterpretation. Modern water utilities recognize they need to utilize the internet and social media to communicate with their stakeholders. Presenting up to date information via interactive maps is a powerful medium to communicate with the technology savvy stakeholder.

Utilities use GIS to support Stakeholder Engagement by creating and delivering static and interactive maps. For years GIS has been used by utilities to make maps that were submitted either electronically or as a hardcopy for regulatory agencies. Utilities have also used GIS to make static maps available as an image file or PDFs on their websites. Now utilities are creating public facing web mapping applications for their stakeholders to support things like customer self-service, capital project

an easy way for utilities to take information from multiple business systems and present it through a common application.

What do water utility managers want on their interactive maps? Most want their utility networks overlaid with locations of recent callers, new service requests, open workorders, out of service customers, crew locations, limited

coordination, service interruption incident management and transparency into utility performance.

Source: 1KPMG Report on Water sector in India Esri.com

Enterprise GIS Technology for Water, Wastewater, and Storm Water Utilities

Utilities keep track of vast amounts of information about assets; distribution, collection, and drainage networks; customers; and financial records. All this information has a connection with location, whether it be the site of a water main or a customer's meter. Esri® geographic information system (GIS) technology uses these geographic connections to integrate key database systems, streamline asset data management tasks, and help utilities visualize important geospatial relationships. Using GIS helps more effectively manage water distribution, sewer collection, and storm water drainage networks as well as related planning and customer care. Utilities can think of a GIS as a "location-based operating picture" that unifies the databases essential to their activities.

Significantly more powerful and flexible than a computer-aided design (CAD) system, a GIS stores both attributes and images of pipes, valves, meters, manholes, and so forth, as objects with location coordinates. The maps created link upstream and downstream objects through strong object-to-object network connectivity and indicate normal flow direction through the pipe network. GIS is a true model of the network and can be used to

- Track and report on assets in the network inventory.
- Generate inputs into hydraulic modeling software.
- Create a common operational picture for access to network operations information.

In creating a single database of assets, utilities can eliminate redundant data collection and maintenance activities. The shared database enables engineering to produce maps, finance to calculate asset valuations, maintenance to track work activities, and operations to create network models.

GIS technology also uses geographic relationships to link and merge disparate databases. For example, utilities can place a demographic layer projecting future population values on top of an existing sewer manhole layer and use it to estimate future loadings at specific nodes on the network. They can overlay water well data on hazardous material information to determine proximity and assess contamination risks.

Enterprise GIS Integrates Utilities Operations

Build a Foundation to Support All Departments



An Esri enterprise GIS is an integrated, multi-departmental system composed of interoperable components. It provides broad access to geospatial data, a common infrastructure upon which to build and deploy GIS applications, and significant economies of scale. Esri enterprise GIS customers report benefits that allow them to

- Reduce data redundancy.
- Improve accuracy and integrity of geographic information.
- Share data efficiently and quickly.
- Integrate GIS and non-GIS applications.

Use GIS to Improve Asset Management Control

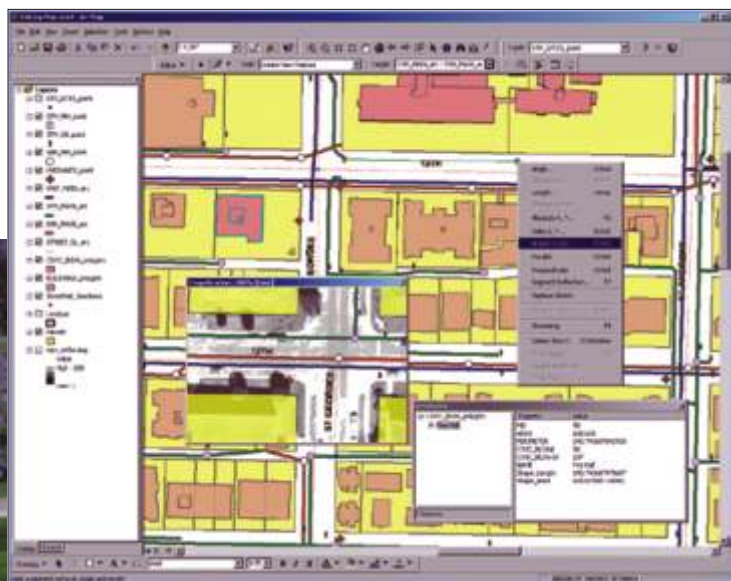
Water/Wastewater professionals monitor vast amounts of information about an ever-changing inventory of physical assets. They are responsible for handling day-to-day demands as well as ensuring the future viability of the network.

Planning

As a decision maker, they need the ability to weigh multiple scenarios that balance levels of investment against asset life span. GIS technology provides the analytical tools to perform what-if analyses and dynamic segmentation.

Performance and Tracking

Enterprise asset management (EAM) solutions help utilities improve asset performance and tracking. The asset management component of Esri GIS software provides a user-friendly access to tracking, locating, and managing assets. It also creates a consolidated view of operations and increases information availability across the organization. Good asset management means performing the proper maintenance and service at the correct location. This produces better customer service as well as savings for tight budgets. GIS-enabled Web-based tools allow field crews to annotate (redline) work order requests and put information



Enable operations crews to bring GIS into the field

directly into the database from the field. These tools improve efficiency in meeting industry financial reporting requirements that include asset valuation, proper inspections, and preventive maintenance.

Benefits

An EAM application can help achieve significant savings by standardizing

- Purchasing processes
- Maintenance procedures
- Equipment tracking
- Inventory stores

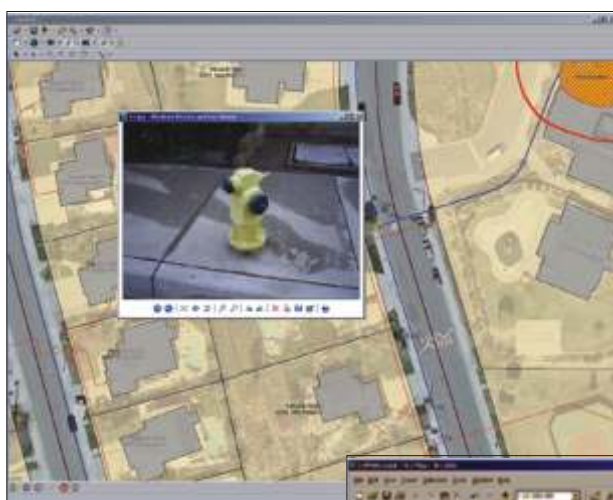
EAM also helps manage the full life cycle of critical assets including

- Procurement
- Installation
- Service
- Repair
- Disposal

Integrate GIS and Hydraulic Modeling Tools

Integrated GIS and hydraulic modeling packages provide sophisticated network modeling tools that work within a commonly shared GIS data repository, which reduces the labor costs of maintaining separate GIS and modeling databases. With a single integrated database, utilities can quickly perform modeling scenarios such as

- Demand projections
- Fire flow assessments
- Water quality simulations



An integrated map displays multiple types of data including land parcel identification, water delivery and collection systems, satellite images, and geolocated photographs of fire hydrants.

Advanced text and label placement tools are used to convey pertinent information.



- Pump scheduling
- Surge protection
- Emergency planning
- Unidirectional Flushing

Esri provides predesigned data models for groundwater, sewer, storm, and water utilities available online at www.esri.com/water-datamodels. User-contributed ArcScripts for utilities, such as manhole ID generators and custom valve isolation code, are also available for download at the link.

Access and Update Data in the Field

Utilities have always struggled with the use of maps and the needs of a mobile workforce. Mobile crews need current information at their fingertips when performing daily tasks. They are key to keeping services running at peak efficiencies. Utilities want to know where those workers are, what projects they are working on, and how projects in the pipeline rank in priority. Esri server and mobile access tools provide field crews with accurate, up-to-date maps through mobile GIS computing. These location-based applications provide them with map display and navigation, GPS support, and GIS editing. Mobile GIS application development tools allow utilities to edit versioned databases stored on a server, which makes it easy to update their database and keep its history. These tools can extend to support sophisticated field applications, like valve isolation tracing, or enhance existing non-spatial line-of-business applications with geospatial capabilities such as customer relationship management and field service automation systems. Field crews will have access to the most up-to-date information and can save time and reduce errors by inputting new information directly into digital forms.

Benefits

Mobile access to current data helps

- Improve workforce operations.
- Increase productivity.
- Improve customer service.
- Reduce costs.

A mobile computer displays watershed features. Engineers and surveyors can verify information on-site and add data with precise locations.

A hand-held device displays a street map with utility features. Field inspectors, repair crews, and meter readers use the system to navigate and can create most-efficient routing

diagrams according to the day's work orders.

Visualization Adds Operations and Maintenance Insight

In day-to-day operations, utilities can use GIS to closely model utility networks and easily integrate other related types of data such as raster images (e.g., aerial photographs) and CAD drawings. GIS spatial selection



A mobile computer displays watershed features. Engineers and surveyors can verify information on-site and add data with precise locations.



A hand-held device displays a street map with utility features. Field inspectors, repair crews, and meter readers use the system to navigate and can create most-efficient routing diagrams according to the day's work orders.

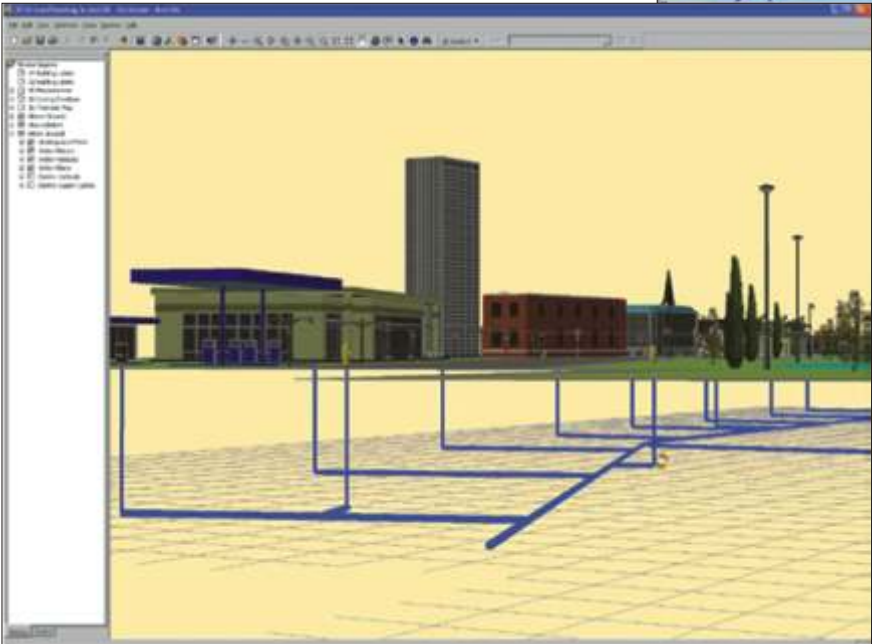
and display tools allow users to visualize both the location and all data on scheduled work, ongoing activities, recurring maintenance problems, and historical information. The topological properties of a GIS database can support network tracing. They can use it to analyze how stoppages, main breaks, drainage defects, and so forth, may impact specific properties or services. GIS supports many other operations and maintenance tasks including work order and warehouse inventory management and supervisory control and data acquisition (SCADA).

Visualize your network in three dimensions with a 3D display of buildings and the underground water network.

Analyze your network to quickly determine which valves to close when a main breaks.



Analyze your network to quickly determine which valves to close when a main breaks.



Visualize your network in three dimensions with a 3D display of buildings and the underground water network.

GIS and SCADA

A utility's SCADA system can be synchronized with GIS to show a geographic view of water management structures and distribution systems. This allows them to monitor all transactions throughout the system and perform analysis and control procedures. For example, you can use the real-time SCADA system to determine whether or not a leak is critical and requires immediate attention.

Upstream and Downstream Network Tracing

During a water main break,

utilities need to quickly determine the minimum number of valves to shut off to isolate the break. Likewise, they may need the ability to trace sewer networks, both upstream and downstream from a problem area, in case there is a break or blockage that results in an overflow. Looking at a map of water system valves, either of these tasks may seem simple. However, some valves inevitably turn out to be inoperable, which results in a scramble to find alternate valves in the maze of the water utility network. Specialized GIS tracing and isolation tools provide an efficient way to find the operable valves and isolate the main break.

Provide Up-to-Date, Accurate Information to Finance, Administration, and Customer Care Departments

Utility finance and administration personnel provide the central administrative oversight to support their organization's planning and operational activities. They can enhance budget forecasting, facility inventory analysis, customer billing, customer care, and other key administrative functions through the implementation of an integrated enterprise GIS solution. Improve accuracy and efficiency when using GIS for tasks such as



- Rate justification
- Capital improvement project planning
- Customer care
- Complaint tracking
- Real property management
- Redistricting

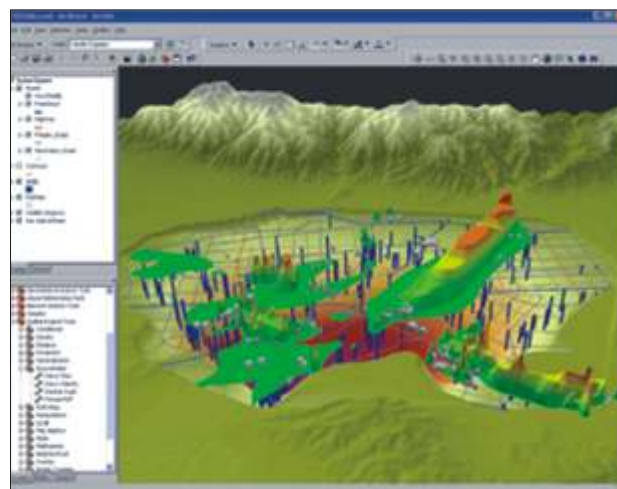
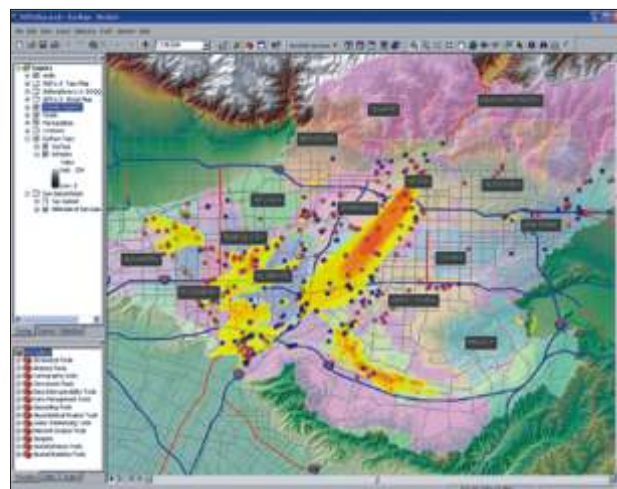


Sharpen Planning and Engineering Analyses

Esri's GIS software allows to represent a project in three-dimensional form and visualize the impact of facilities on the landscape during the design process. Data can be combined with other computer-aided engineering functions to assist in the planning and scenario testing of multiple designs. Water agencies use Esri GIS software to map the full extent of their water distribution systems and link them to a database, defining each element including reservoirs, pipe segments, services, and system appurtenances. As a result, job planning, equipment inventory, and flow analysis become automated procedures integrated into one intelligent database.

Planning and engineering tasks that can be accomplished easily using Esri GIS software include

- Watershed and groundwater management modeling
- Water distribution system master planning
- Population and demand projections



Model your groundwater system with integrated data that includes topography, roads, municipality boundaries, and water well and volatile organic compound information.

- Water quality monitoring
- Hazardous materials tracking and underground tank management
- Well log and data management
- Site analysis
- Geobibliography (past studies)
- Development review and approval
- Right-of-way engineering
- Automated mapping
- Capital improvement project tracking
- Underground service alert

Visualize the entire watershed picture with 3D modeling.

Source: www.esri.com

Study of water supply & sanitation practices in India using Geographic Information Systems (GIS): Some design & other considerations in a village setting

Introduction

Safe water is one of the most important felt needs in public health in developing countries in the twenty first century. The year 2005 marked the beginning of the “International Decade for Action: Water for Life” and renewed efforts to achieve the Millennium Development Goal (MDG) to reduce by half the proportion of the world’s population without sustainable access to safe drinking water and sanitation by 2015. It is estimated by World Health Organization (WHO) and United Nations International Children’s Emergency Fund (UNICEF) that 1.1 billion people lack access to improved water supplies and 2.6 billion people lack adequate sanitation.

Availability of clean water and adequate sanitation facilities are of prime importance for limiting diarrheal diseases. This study examined the water and sanitation facilities of a village in southern India using geographic information system (GIS) tools taking into consideration the socio-cultural factors impacting water safety (derived from survey on water handling and usage, sanitation and defaecation practices in a village in southern India using questionnaires and focus group discussions). The objective of the study is to describe the water supply and sewage distribution systems in relation to human and animal dwellings, their wastes, drinking water quality and sanitary practices in the same village in southern India. Geographic information system (GIS) tools are used to demonstrate spatial relationships for a clearer understanding of problems and possible solutions.

Methodology:

The study was carried out in Nelvoy (12.82210710N, 79.13330370E), a village in Kaniyambadi block of Vellore district in Tamil Nadu State, India. Places of residence, water storage and distribution, sewage and places where people in the village defecated were mapped and drinking water sources were tested for microbial contamination in Nelvoy village. The village, with a total population of 1166 residents, is geographically divided into two parts, the ‘Main village’ where 41 per cent of the residents lived, and an area demarcated for the lower caste called the ‘Harijan colony’ for 59 per cent of the residents.

Spatial mapping and analysis: Streets, houses, water supply network, garbage, sewage channels, functional toilets in the village and community defaecation areas in the surrounding fields were mapped using a hand-held global positioning system (GPS) receiver. The ‘waypoints’ and ‘trackpoints’ provided by the GPS were downloaded. They were then converted to ‘shapefiles’ using ArcGIS software. The attributes were then layered to ascertain spatial relationships. Significant spatial clustering of dry or subterranean taps located in the village was identified systematically in circular fashion over a geographic area. The radius of the window may vary from zero to a user-defined upper limit. For this analysis, the upper limit of the circular window was specified as the geographic size that included 50 per cent of the study region, allowing both small and large clusters to be detected. Likelihood ratios were calculated and P value derived by conducting Monte-Carlo replications of the dataset using the Bernoulli model. The ‘wet’ taps were considered as controls, and ‘dry’ and ‘subterranean’ taps respectively as cases.

Testing water quality: To ascertain the microbiological quality of drinking water, a total of 20 water samples, 10 from

the households, 8 from individual taps and 2 from the tanks, were chosen randomly using a stratified random sampling technique (stratified by streets), and tested for presumptive and confirmed coliform counts using the most probable number technique and for residual chlorine levels. The ‘pump-driver’ of the village was asked about chlorination practices.

Statistical analysis: Data were analyzed using SPSS software. To test for differences in the contamination levels between the water samples obtained from the tanks, taps and the households, Kruskal-Wallis test was performed. Fisher’s exact test was performed to test for difference in dry and subterranean taps between the ‘Main village’ and the ‘Harijan colony’.

Results: Water in the village was found to be microbiologically unfit for consumption. Analysis using direct observations supplemented by GIS maps revealed poor planning, poor engineering design and lack of policing of the water distribution system causing possible contamination of drinking water from sewage at multiple sites.

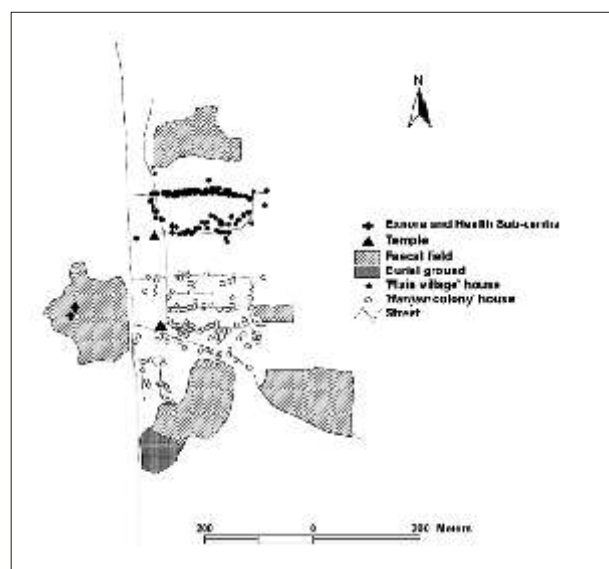


Fig. 1. Distribution of streets, houses, and “faecal fields” in Nelvoy village. The local health sub-centre and “Exnora” (a self-help organization to promote for environmental management, especially municipal solid-water management) could be visualized inside the largest “fecal field”

Nelvoy had 57 functional toilets. There was a public pay and use toilet/bath for women and children that was seldom used. Defecating in the open fields was a common practice, both in the ‘Main village’ and in the ‘Harijan colony’. The three most frequented defaecation areas (polygons) surrounding the village were located within 100 m of the village (Fig. 1). There were different sites for defaecation for men and women. The largest defaecation area was on the opposite side of the village, across the highway and had an area of approximately 14466.69 sq m, with a perimeter of about 519.16 m. All defecation areas together comprised 61923.12 sq m while the settlement area was 73757.31 sq m. The ratio of the settlement to defecation area was 1:0.84. The ‘defecation or fecal fields’ were also located in close proximity to the drinking water sources and areas under cultivation.

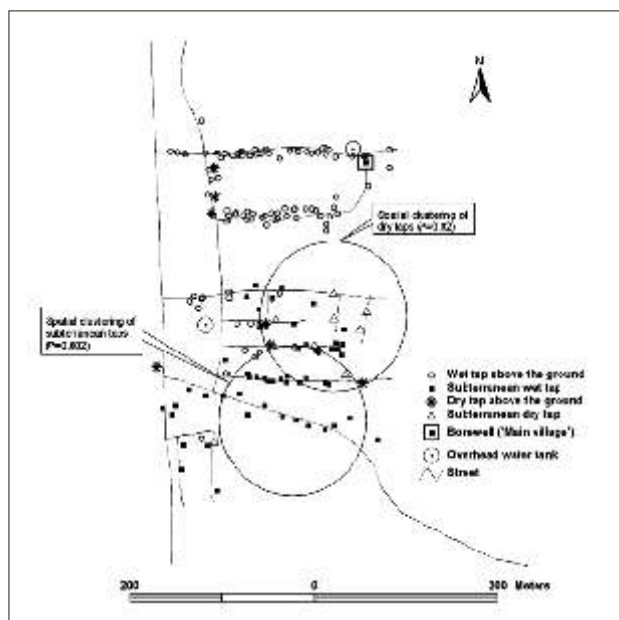


Fig. 2. Distribution of taps and tanks and borewell in Nelvoy village. Circles represent the spatial clustering of dry and subterranean taps. The borewell supplying the 'Harijancolony' was located about 1.5 km to the west of the village.

Discussion & Conclusion

Provision of safe drinking water has been of primary concern in rural India. Studies done in and around Vellore town, both in epidemic and endemic settings have found drinking water to be microbiologically contaminated and unfit for human consumption. In this study also, coliforms present in water samples collected at various locations and was suggestive of contamination both at the source (overhead tanks) and also in the distribution taps and water stored in homes. In Tamil Nadu, there are guidelines for provision of potable drinking water in villages and to ensure segregation of sewage and drinking water. This includes setting up a village level water and sanitation committee to formulate a master plan for sewage and drainage. These guidelines state that water pipes should not go through sewage or should not be submerged in sewage at any point. However in this village, as with other villages, sewage channels were found to run parallel to water pipes and cross them at various junctions. Since these are

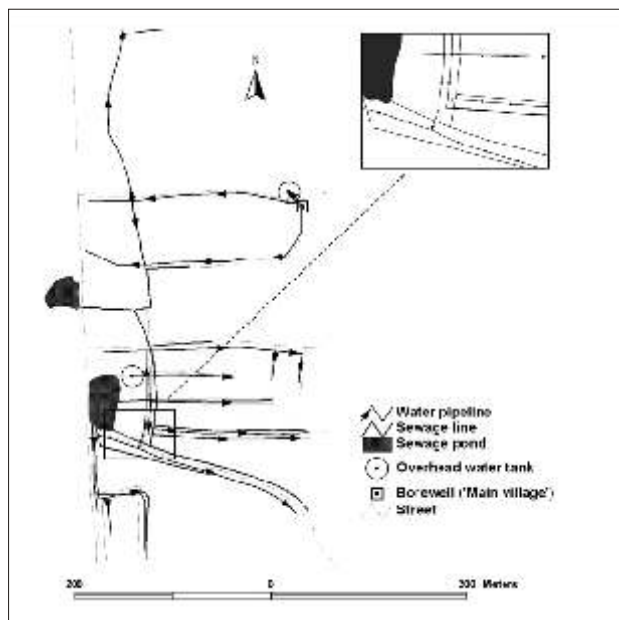


Fig. 3. Water pipelines and sewage channels in Nelvoy village. Inset shows the spatial proximity of water pipelines and sewage channels in 'Harijan colony'.

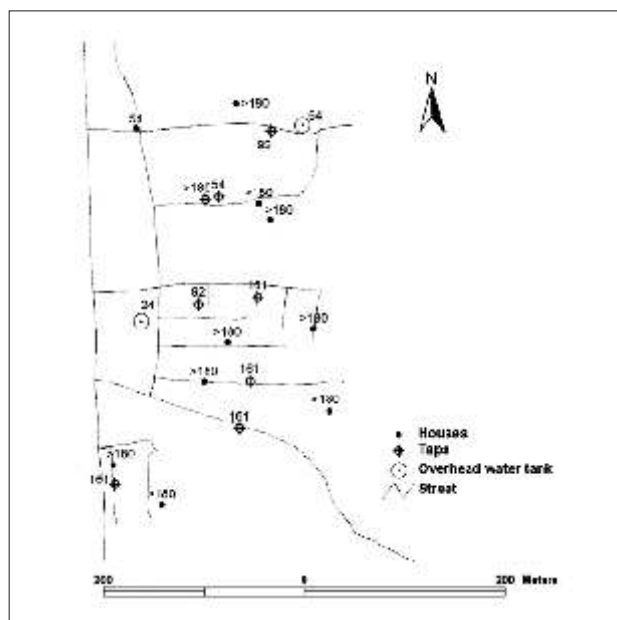


Fig. 4. Distribution of tanks, taps and houses from which water samples were obtained for presumptive coliform counts.

open sewage channels, there is the possibility of sewage mixing with the piped water, especially as the water supply is intermittent, causing negative pressure in pipes. In order to ensure proper segregation of sewage and faeces from drinking water, alternate designs are needed. Elevating the water pipe at places where water lines cross sewage and covering the sewage channels at junctions are possible methods to minimize contact of sewage with drinking water. The guidelines also specify the maximum permissible taps per tank (depending on its capacity) and prohibit people from lowering taps into pits (referred to as subterranean taps). At the distal end of 'Harijan colony' a cluster of subterranean taps was seen inside dug pits, which was an indirect evidence of lower water pressure. This also resulted in sewage channels being at a higher level than the taps. After rain, entry of sewage through these taps was a distinct possibility. Open air defecation and the practice of tethering animals close to human dwellings contributed to the conversion of large areas of land in and around the village into 'defecation or fecal fields'. In our study, animal and human fecal contamination of topsoil was evident on inspection of these areas. A mapping of these areas showed reservation of a substantial land area for this purpose, while sanitary toilets would require less land and serve to segregate feces from water sources. These 'fecal fields' potentially put the village at risk of flooding with fecal material from surrounding areas during rains. In an adjoining village, a suspected outbreak of cholera was reported after heavy rain because of poorly maintained water supply pipes that ran through a fecal field. Existing Tamil Nadu Water Supply and Drainage (TWAD) Board guidelines specify that the public should not defecate around the tanks and the taps, but is non-specific when it comes to defecation in other places, not accounting for the fact that common defecation areas are usually in the public land where the water supply pipes are laid. The use of GIS tools to store information about a community with regard to their environment is a novel way to use this technology in public health. GIS maps have an advantage over traditional hand drawn maps since it is possible to integrate environmental attributes such as slopes and soil into a single visual representation by the layering technique. In this study, most of the observations made were supplemented with GIS maps which were helpful in identifying potential risks. In conclusion, poor planning and maintenance of the water supply system has led to inappropriate usage and over-exploitation of available resources, thereby causing contamination in the study village.

The existing guidelines need to be modified. Proper measures should be formulated for periodic monitoring and stricter implementation of these guidelines, and policy makers should be sensitized.

Acknowledgment

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Enhancing Water Department Efficiency

Using GIS and GPS to produce quality maps of rural water system features

Summary

Current and accurate information about underground waterlines is critical for water departments. Incomplete maps slow service call response. A grant helped rural communities in western Alabama update these maps.

What really happens when a waterline in a rural system breaks? Customers are without water, and industries may have to stop production. To repair the break, water department employees spring into action, quickly responding to water outage complaints no matter what hour of the day or night.

Department superintendents are responsible for routing crews to multiple problems simultaneously. If crew members do not know the exact location of underground lines, locating lines and determining connections will take longer. This means customers may be without water longer, more water will pour onto the ground and be wasted, and additional expense will be incurred by the water department, which ultimately results in higher rates for customers.

Generally, rural water departments contract with engineering companies to install large lines (i.e., pipes with diameters of six inches or more). These lines are mapped, and updated copies of these maps are distributed to water departments periodically. However, in an attempt to save money, water departments often install smaller lines. Consequently, maps are incomplete because these smaller lines are not included in map updates.

That is where the West Alabama Regional Commission (WARC) comes into the picture. [One of 12 regional councils in the state, WARC serves local governments and citizens by coordinating regionwide projects and services and carrying out state and federal programs on a regional basis.] WARC



The Englewood-Hulls Water System in rural West Alabama participated in a mapping project funded by the Appalachian Regional Commission that used ArcGIS and GPS to locate all features in the system and create accurate maps for system employees.

was recently awarded a grant by the Appalachian Regional Commission (ARC) to compile detailed maps of all features in select rural water systems in western Alabama using GPS and GIS. Fourteen water systems in Bibb, Pickens, and Hale counties were involved in the project. According to ARC, these three counties are the most economically distressed in the western Alabama region.

Initial Preparations

After funding for the project was assured, WARC staff immediately began researching GPS software and receivers and the software and programs needed to convert the data into shapefiles for use in ArcGIS. Three Trimble GeoXT handheld GPS units, able to access as many as 12 separate satellite signals (under ideal conditions) and collect data with sub-meter accuracy, were ordered. TerraSync software, loaded onto the Trimble units, was used to collect data in all systems. GPS Pathfinder Office software was purchased to download data from the GPS

units to the computer and perform necessary differential corrections to the data in addition to those automatically performed in the field.

WARC computers had already established a system of filing directories so only additional folders were needed to accommodate the growing project. Using ArcCatalog, folders for the GPS project were added into the main directory for each county. In each folder, individual directories for the separate water systems were created with storage folders for base data, work data, and final data. Base data includes the data correction files downloaded from various stations that were used to correct field data to produce more accurate feature locations. The work folders were used initially to export corrected data out of Pathfinder Office and into ArcCatalog. The folders for final data were used to store

edited data and final maps that were ready for distribution to various water departments. This system successfully organized the large amounts of data that were collected during the 18-month long project.

Scheduling Data Collection

Another major portion of this project involved scheduling and managing data collection sessions with water system personnel. With 14 systems included in the project, WARC staff members were hesitant to schedule data collection in too many systems at once. Because water department employees' schedules tended to be fluid (no pun intended), it was often difficult to coordinate fieldwork days. WARC dedicated one employee to this project at all times and, when needed, additional assistance was divided among three other full-time employees and part-time college interns who were available. Limiting the number of systems analyzed to two made organizing incoming data and managing schedule conflicts between data collectors and water personnel easier.

Collecting Data

Data dictionaries were created and loaded into the Trimble GPS units. These dictionaries contained listings of the features that field-workers would encounter while collecting data on the water systems. It was important to the integrity of the final map products that meters, control valves, system valves, water mains, fire hydrants, pumping stations, tanks, wells, generators, springs, and treatment plants be located. Menus for individual listings allowed WARC employees to collect additional information such as the size of a feature, the county and system in which the feature was found, the type of feature (e.g., gate versus butterfly valve or fire versus flush hydrants), and other information that became more important than the WARC staff originally anticipated when completing the project's final maps.

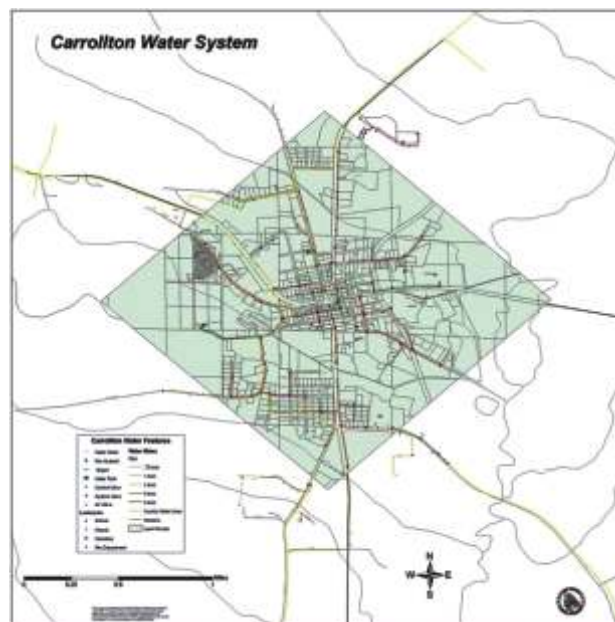
While in use, GPS units had to remain stationary over each individual feature for a minimum of 20 seconds to record its position accurately and completely. The data, saved by the GPS units as waypoints, was transferred to the computer using Pathfinder software.

Collecting lines required an antenna mounted on the roof of a vehicle and connected to the GPS unit. Water department employees instructed WARC staff where the lines were located; staff members then drove along the lines as closely as possible. For particularly difficult areas, lines had to be added or connected back in the office.

Weather conditions, cloud cover, satellite position, landscape features, and human-made features affected the accuracy and ease of data collection. Surprisingly, depending on the position of the satellites, it was often more difficult to obtain a steady signal on a clear, cloudless day than on an overcast or rainy one. Features located near power lines, under trees, or next to buildings were almost always more difficult to collect. Ultimately, more than 1,000 individual features were collected in Bibb and Hale counties and more than 7,000 features collected in Pickens County (despite the fact Pickens County system officials opted not to have meters mapped due to time constraints).

Editing the Data

Once the data was successfully collected and returned to WARC offices, it was downloaded, corrected, and exported as shapefiles and accessed using ArcGIS. For some water departments, AutoCAD files of the lines were obtained from the engineering firms originally hired by the water departments. Generally, this data did not overlay well with the collected data and had to be edited extensively. As a result of the conversion processes between the software programs, lines were often misplaced by several miles. Much of this data was outdated and inaccurate. In addition, features such as valves and hydrants originally created in AutoCAD did not



WARC employees developed maps of all features in the participating systems including the Town of Carrollton, Alabama

convert as single graphics but as collections of individual lines shaped as the intended object. These features converted into large symbols that were less accurately located than features acquired using GPS.

Originally, U.S. Census TIGER files were used for the roads in all three counties. These files were also not very accurate when placed on top of orthographic photos of the areas. Roads were located several miles from the correct position and often were not correctly shaped. TIGER files for each county were edited so when waterline files were added to the project, they could be more accurately placed relative to the roads. The road lines did not always intersect cleanly and required additional data editing.

It was extremely important to have accurate road networks because the waterlines can cross roads multiple times. Editing road networks became essential for producing accurate maps that showed waterlines on the proper side of the road. Because lines needed to connect through the control valves, they were sometimes shifted slightly.

Conclusion

The maps produced by the project will save time, energy, and money by assisting responders from water departments to locate lines and features more quickly and efficiently. Darren Rice, superintendent for the Englewood-Hulls water system in Hale County, said, "We are very excited to get these maps. It's going to help our employees readily locate features, and to be able to see everything in this system right there on the map will be great. We could have used this a lot in the past. I know it is going to be very helpful to us."

With a detailed representation of every feature in the system, water department employees will be able to locate and repair damages more quickly. They can also assist employees from other utilities, such as natural gas companies or sewer departments, locate water lines and prevent accidental breakages.

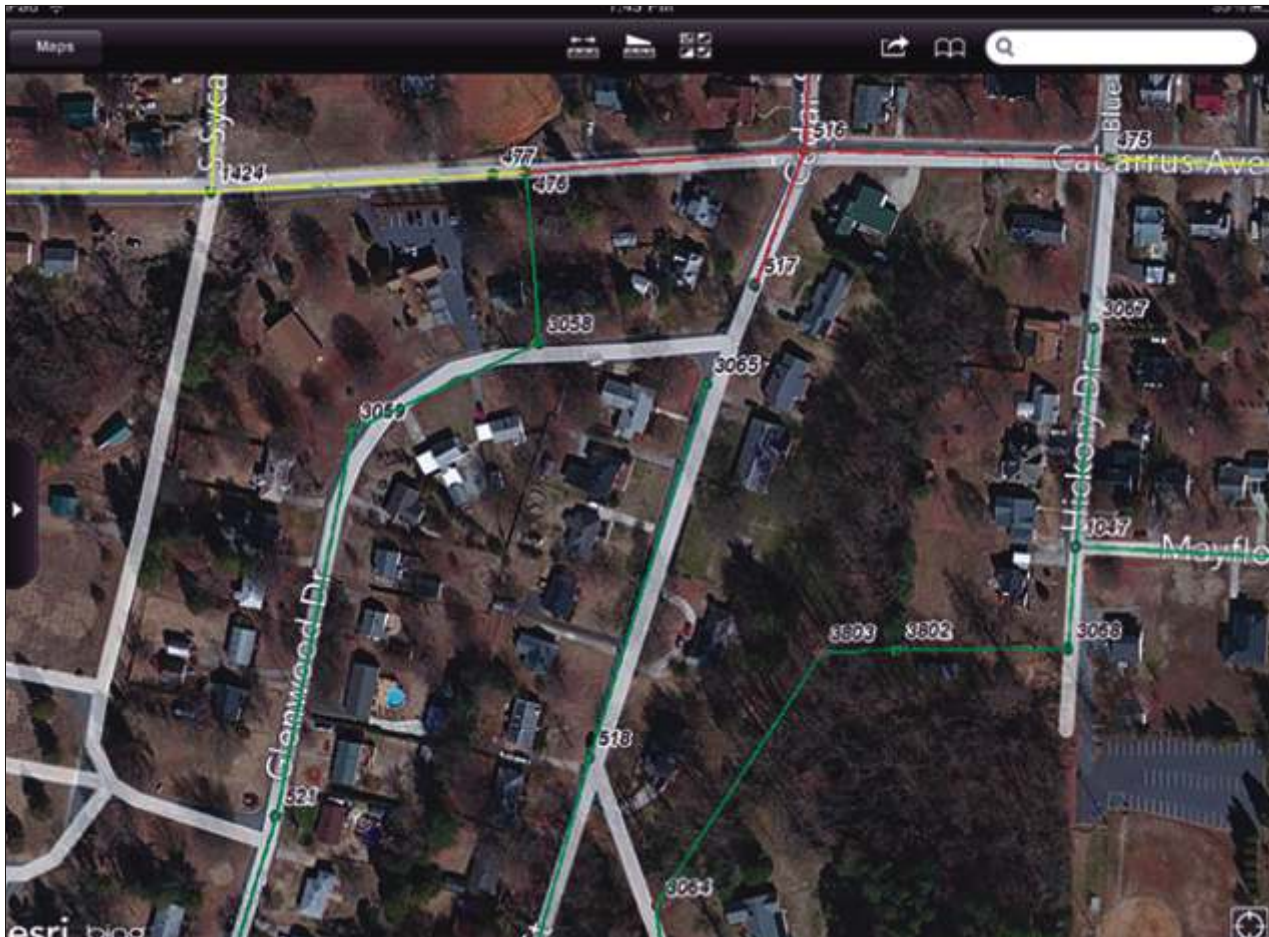
WARC presented paper copies of the maps to the individual water departments and provided each with the shapefiles associated with their specific water system. The data was also given to a variety of agencies including the Appalachian Regional Commission, Alabama Department of Environmental Management, and Alabama Rural Water Association.

Town Sharpens Proactive Sewer System Management

In 2010, the Town of Mooresville, North Carolina, began experiencing a rise in the number of sanitary overflows and sewer stoppages. The reason for the problem was evident: the Town of Mooresville has more than 6,000 manholes and 250 miles of sanitary sewer gravity-main lines, and only 30 percent of that infrastructure has been constructed in the last 20 years. In addition to aging infrastructure, the Town of Mooresville population has tripled in the last 20 years, thus putting more strain on the significantly aged sanitary sewer system.

dedicated a crew to do all the line cleaning, and with this continuity, we were able to grasp the needs of our wastewater collection system."

To assist WSMD in identifying distressed spots on the system, the Engineering Department needed to pinpoint these locations on a map and assign dates for when the sewer features (manholes, sewer main) were cleaned. WSMD maintained monthly data, from August 2009 to January 2011, in Microsoft Excel spreadsheets of where and when the



GIS Data Quality Best Practices for Water, Wastewater, and Stormwater Utilities

The Challenge Water, wastewater, and stormwater utilities recognize a geographic information system (GIS) as an authoritative repository of asset information that should be shared throughout the entire utility and integrated with other enterprise utility business systems. To maximize the benefit of utility-wide GIS, the data being shared must reliably meet the needs of the utility. Asset data in the GIS must be accurate positionally (in the right place), descriptively (describes the asset appropriately), and temporally (up-to-date). As a result, water, wastewater, and stormwater utilities are now heavily focusing on quality assurance (QA) and quality control (QC) to ensure that their GIS data truly meets their needs.

Why Data Quality Is Important for Water Utilities

Data Access

The evolution in GIS technology has made it easier to ubiquitously deploy geospatial data throughout all departments within a utility. Utility-wide GIS access means that more people have access to the most current data/information. Poor quality data impacts decision making and is often expensive to fix.

Data Integration

Utility-wide GIS also means the ability to integrate with other enterprise business systems to spatially enable them. It is typical for work order management, customer information, and laboratory information management systems (LIMS), as well as financial, billing, hydraulic modeling, and other water utility systems, to be integrated with GIS. This type of integration has raised the bar for water utilities to ensure data accuracy and currency.

Data Usage

The way water utilities are using GIS is also driving an increased focus on data quality. Several years ago, GIS was primarily used to produce paper maps. As long as the features looked accurate at the scale of the printed map, everyone was satisfied with the quality of the data. Now, most water utility staff are exposed to GIS via web-based and mobile applications. This allows interaction with GIS data at many different map scales and the ability to drill down for detailed information.

Data Content

Lastly, data quality is paramount when using GIS to perform spatial analysis and for reporting purposes. For example, water utilities use GIS to produce statements such as impervious surface calculation for stormwater billing and asset reports to regulatory bodies and for real-time or periodic generation of key performance indicators (KPIs) for utility management. The increased usage of GIS for reporting—especially when related to regulatory approvals, customer billing, and KPIs—drives the need for quality data.

QA/QC Overview

While it may be easy to engage staff members in cleaning up bad data, it is not so easy to find out where edits/corrections need to happen or to define workflows that allow them to swiftly make required corrections to the data. This is true for ongoing data updates made through redline submissions. To

effectively and efficiently identify problems in data and make the most of data correction efforts, QA/QC procedures and tools must be introduced into workflows to prevent errors from occurring in the first place.

ArcGIS® offers a wide range of tools, extensions, and database modeling capabilities that can be used to improve data quality. This paper will explore some of the options that can be considered best practices for water utilities.

Quality Assurance Techniques

QA is the process of establishing a set of guidelines or best practices to ensure the production of quality GIS data. Performing QA has many benefits, including less data reworking, because quality requirements have previously been identified and are being measured and monitored continuously.

QA is often thought of as performing tests on data to ensure its accuracy. In actuality, this is QC. While QC is a key part of QA, quality assurance takes a step back and looks at the overall structure and workflows to implement measures that prevent the introduction of errors. The following are some useful features of ArcGIS that can provide key advantages when implementing QA:

Use a Geodatabase

Shapefiles and coverages are used mostly for data export and interchange and do not provide the appropriate GIS data repository for the needs of a water, wastewater, or stormwater utility. The geodatabase, on the other hand, is a data storage structure for ArcGIS that enables water utilities to encapsulate both data and business rules in one location. Some of these rules prevent you from making editing mistakes, such as not allowing invalid attribute values to be entered, while other rules ensure that network connectivity and relationships between connected features are maintained. The geodatabase is the receptacle that provides the ability to implement these rules; for the geodatabase to be effective, you need to properly design and maintain your data model.

Have a Properly Configured Data Model

A data model or schema is how you represent real-world features in your geodatabase. The data model is used to configure your data's structure to suit your needs. A properly configured data model, especially one that utilizes domain values wherever appropriate, minimizes the possibility of misrepresenting features in your GIS. That is, a well-designed data model that is implemented in a geodatabase prevents the user from creating invalid data. While it is impossible to design a data model that prevents all editing errors, it is possible to minimize errors by using data modeling within your organization. The Esri water, wastewater, or stormwater data models offer a good way to start, as much of the initial data modeling work has already been completed, thereby saving time and money and allowing you to utilize industry best practices.

Use Geometric Networks

Another key feature of the geodatabase is the geometric network, which is a set of connected edges (lines) and junctions (points), along with connectivity rules that is used to

represent and model the behavior of a common network infrastructure in the real world. The geometric network provides extra behavior that allows you to define how edges and junctions connect and how water, wastewater, and stormwater flow through the network. In a water network, the flow of water is from a reservoir to a customer via various appurtenances such as valves, fittings, and pump stations. Connectivity rules help define how the features in the network connect to each other. For example, a fire hydrant can only be connected to a service lateral of type hydrant; a fitting of type tee should be connected to exactly three pipes.

While a well-defined data model allows you to store information about real-world features and assets, the geometric network allows you to encapsulate how your distribution or collection systems actually operate. More information on geometric networks is available at blogs.esri.com/Dev/blogs/waterutilities/archive/2009/11/17/Geometric-networks-for-water-utilities.aspx.

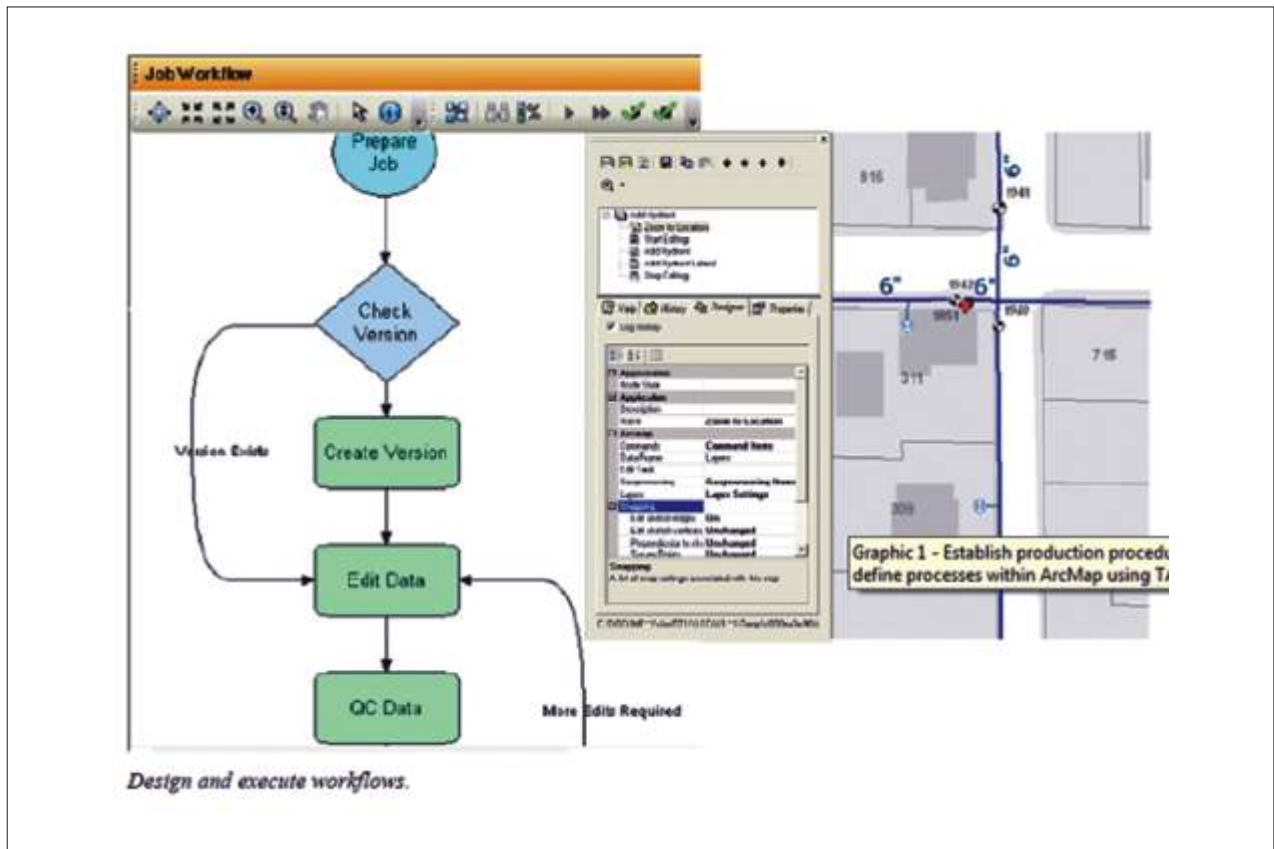
Formalize Your Workflows

actively being worked on, who has been assigned to complete the task, what work is behind schedule, and so on. Task Assistant Manager, a component within Workflow Manager, provides microlevel workflows that allow you to streamline tasks within ArcMap™. This is a great way to guide users through defined processes within ArcMap, execute ArcMap commands or geoprocessing tools, and set layer properties such as visibility and snapping. Using these workflows can prevent errors and help execute common processes consistently throughout the utility.

Take Advantage of Versioning

With multiple editors, using a versioned geodatabase will enable you to implement an editing workflow that can allow you to identify and resolve potential data issues, such as conflicting edits, and perform quality control on recently edited data before all the GIS users and integrated systems see the edits. Versioning is highly beneficial to safeguard your data.

A typical use case for versioning is when designing proposed



The next step toward producing quality data is to standardize and formalize your organizational workflows. This is especially important when multiple editors are accessing your data. Formalization of workflows could be as simple as having clearly written and documented standard operating procedures. However, in reality, most water utilities are looking to design and distribute workflows. This can be achieved by developing custom tools suited to your organizational needs (this option would require that you update and maintain the source code for every release). Alternatively, you can utilize the out-of-the-box tools within the ArcGIS Workflow Manager extension to design, execute, track, and distribute your workflows.

With Workflow Manager, utility managers and supervisors can query data and generate reports to summarize what is

projects or plans for expansion. You may want to use the GIS to model the potential results of placement of pipes, for example, for a proposed construction project. However, you will want to isolate these proposals from the production database until the project is finally built and accepted. By isolating these changes to a different version, you can prevent others from performing analysis on the wrong data. Managing versions in a large utility to ensure that data is published at the correct times can be challenging. ArcGIS Workflow Manager allows you to automate version management to avoid having to manage them manually. Instead of using ArcCatalog™ to administer job versions, you can simply allow the Workflow Manager workflow to create, reconcile and post, and delete the versions. With Workflow Manager, you can take advantage of versioning without the typical overhead associated with version management.

Use Geoprocessing Models and Scripts

Within a utility, if there are common data editing or manipulation functions that occur on a regular basis, it may be worth the effort of automating these tasks with geoprocessing. You can easily turn data manipulation and editing tasks into repeatable tasks and combine functions by using geoprocessing models or scripts, which can be scheduled to execute in a batch mode. You can preset values to reduce the likelihood of incorrectly entering information. Geoprocessing models and scripts ensure that functions are executed successfully and in the same order.

Configure the Infrastructure Network Editing Template

The Infrastructure Network Editing template is an ArcGIS 10 editing map and toolbar for managing water, wastewater, and stormwater utility data. The Infrastructure Editing toolbar contains a series of custom editing and reporting tools that enrich the editing experience for utilities working with infrastructure data. For example, there are tools for the following tasks:

- Automatically connect service connections to laterals and their mains.
- Report tracing results along the utility network.
- Graph the profile of a main.

The template also includes an editor extension called Attribute Assistant. This extension uses a series of predefined methods to automatically populate attributes when you update and/or add new features to the geodatabase.

Utilize On-the-Fly Validation



Increase the efficiency of GIS data creation using on - the - fly feature validation

A geodatabase is used to model predefined attribute rules. For example, setting up domains can limit the values only in an individual field. However, in reality, attribution rules are often more complex, and in many cases, the value in one field may depend on the value in another. Esri® Production Mapping allows you to create extended validation rules so that when you are creating new features or updating existing features, it is possible to validate attributes according to these rules. If an



This sample Select by Attributes query has been configured to find water main features that are enabled and have a null value for the installation date.

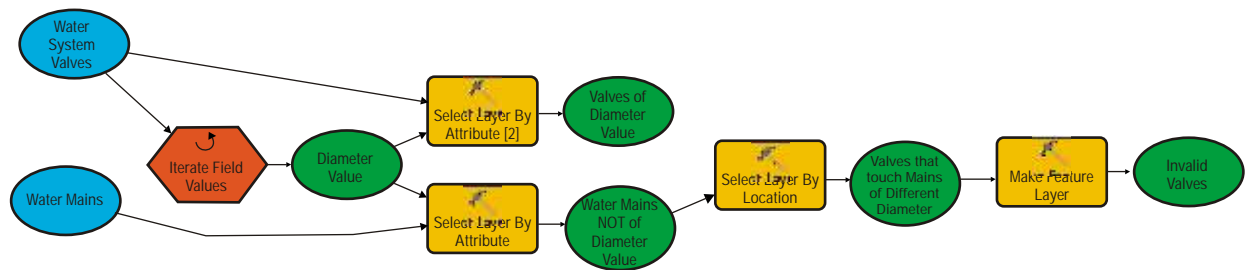
incorrect attribute value is entered, an error message is returned. You must fix the error before the change is committed to the feature. You can also choose to return a warning depending on the severity of the error. In such cases, the change will be committed, but it is recommended that you correct the issue. This type of attribute validation on the fly allows you to ensure that there are no invalid combinations of values assigned to a template or a selected feature before committing the values to the database.

Quality Control

Tools Quality control is focused on identifying and resolving existing errors. The key to quality control is to regularly check your data for errors. Data checks can range from running queries (spatial, attribute, or both) to generating and reviewing random samples to perform visual exploration of data. Data checks can (and should) be formalized workflows that are automated and reusable where possible.

Finding Issues with Queries

The ArcMap Select By Attribute and Select By Location query dialog boxes allow you to define parameters and select features that meet those parameters. You can build queries to find attribution errors, for example, pipes installed after January 2000 with a material type of wood or clay. Spatial



This sample geoprocessing model finds valves whose diameters do not match the diameters of the connecting mains.

queries can be used to find features that may not be in the correct geographic location. When performing spatial queries, you can compare features that are within your water network as well as other features. For example, you can compare your service.

Geoprocessing Models or Scripts

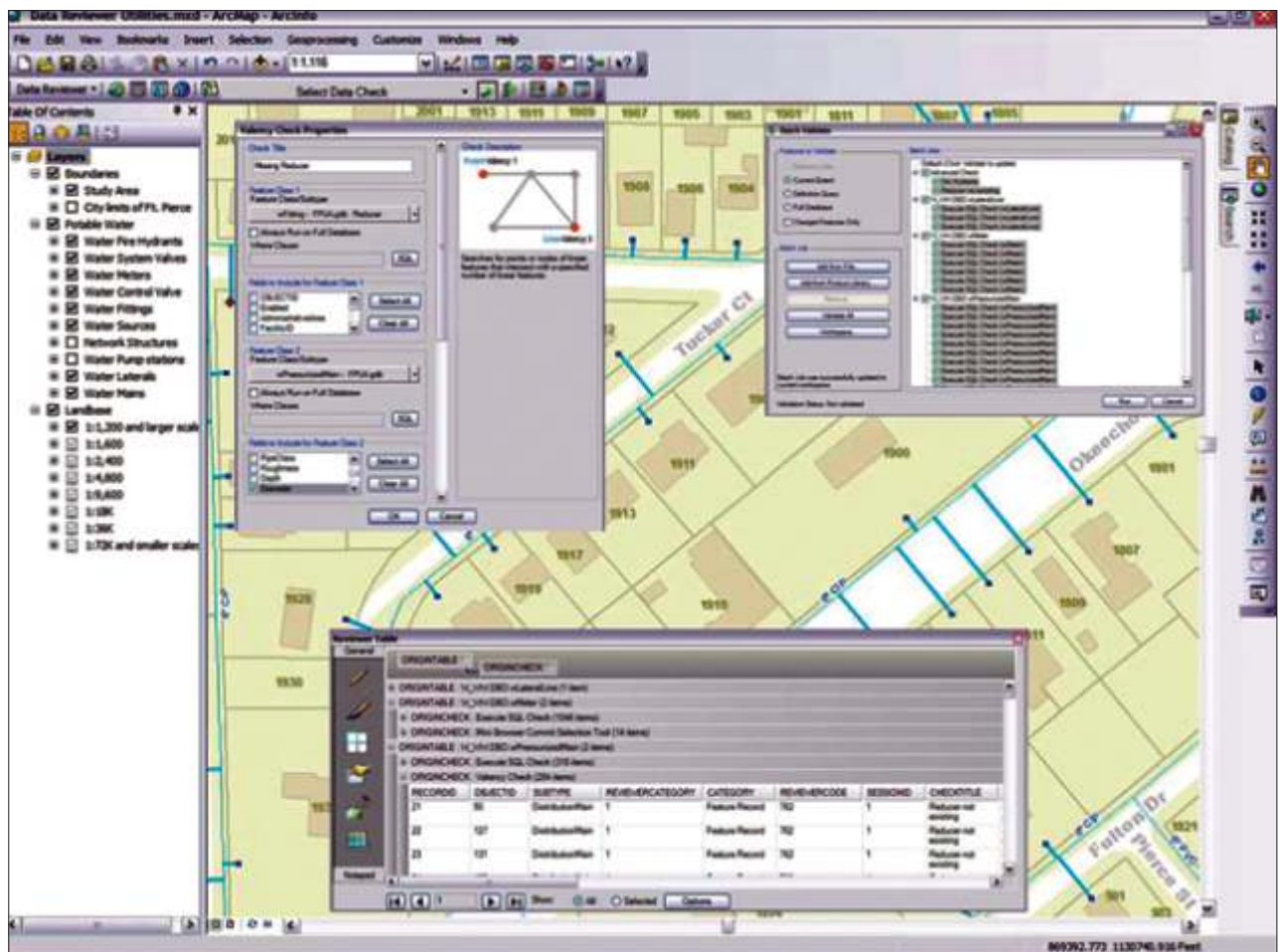
With queries using the Select By Attribute or Select By Location tools, the parameters must be filled out every time you want to run the query. This may introduce the possibility

of user errors while entering the parameter values. With geoprocessing models or scripts, you can store as many preconfigured values as are needed, which provides consistency in running the queries. Geoprocessing also offers the ability to perform (and automate) complex queries and additional behaviors such as combining multiple queries and iterating.

Automated Quality

Control While it is possible to automate some of the quality

Check Name	Check Description	Use Case Example
Domain	Validates features where coded value and range domains have been assigned to ensure that all values meet geodatabase attribute domain Constraints	These checks are useful when migrating GPS-collected data and data from another format, like CAD, shapefile, or coverage, into the geodatabase.
Subtype	Searches for features with improper or null (optional) subtype code	
Connectivity Rules	Finds features that are part of a geometric network and violate connectivity rules	Connectivity rules are an important aspect of a network. Identifying features that violate Geometric network rules and resolving them will enhance data integrity. This helps functions like valve isolation, which uses the geometric network.
Relationship	Searches for records that are orphans or have improper cardinality in a relationship class	Knowing the exact number of pumps in the pump station or treatment plant is important. This check can find orphan pumps that do not have a relationship to a pump station or treatment plant.
Duplicate Geometry	Finds features of the same geometry type that are collocated and optionally share attributes (Features can be from either two different feature classes or the same feature class.)	This check can find locations where two or more junctions in a geometric network are on top of each other. Only one of those junctions can actually be connected to the network. These duplicate features can be identified and addressed to ensure proper connectivity of network features.
Geometry on Geometry	Finds features that have a specific spatial relationship, from either two different feature classes or the same feature class, and optionally compares specific attributes	This check can find valves that are connected to mains and compare the diameter. If the diameters do not match, it is reported as an error.
Valency	Validates relationships between point and line features or line features within the same feature class by ensuring that specific patterns of features are met with valency, such as how a point must have a specified number of lines connected to it	This check can validate spatial relationships; for example, tees should be connected to three pipes or a reducer must connect two pipes of different diameters.



Automate and simplify the data review processes with tools to assess, document, correct, and verify the overall quality of water/wastewater data.

control tasks with geoprocessing models or scripts, you may have to develop and maintain a number of models/scripts to cover all your data validation rules. The ArcGIS Data Reviewer extension to ArcGIS Desktop provides easily configurable, out-of-the-box data checks to automate your quality control process. Over 40 automated data checks can be run ad hoc or as a group in a batch job. Batch jobs are distributable, thereby allowing you to standardize the validation process throughout the utility. This also allows repeatability; that is, you can reuse the batch jobs to validate features as you make updates to them. Features that violate the parameters that you've specified are collected and managed in a central table. You can also schedule the checks to run at set intervals—eliminating the need to manually run the batch job—to further free up resources and reduce the time needed to obtain and maintain high-quality data. Examples of some of the automated checks available are described in the following table.

You can further simplify your quality control process by integrating the ArcGIS Data Reviewer and ArcGIS Workflow Manager extensions and using the provided custom steps in your workflow. This allows you to run batch jobs as part of your overall workflow and automatically assign an editor to make corrections to the errors found.

Ensuring Issues Are Corrected

While it is important to know where errors have occurred in your data, it is equally important to ensure that the errors are corrected in a timely manner. ArcGIS Data Reviewer tracks errors as they are resolved and verified, storing the errors in a central location, called the Reviewer table, which allows you

to monitor and organize the error information. The table can be used to generate reports that represent an accurate picture of the overall quality of your data. By examining the information stored in the Reviewer table, you continually improve the quality of your data. For example, the table allows you to sort and group error information to see what feature classes are most prone to errors and what types of errors are most prevalent. This can help you make decisions about QA/QC methods that can be introduced to maximize efficiency and ensure high-quality data.

Summary

This paper describes many options that are available to water, wastewater, and stormwater utilities to ensure the quality of their data. The geodatabase offers key features, such as domains and geometric networks that allow you to model real-world features within the database as well as minimize the possibility of introducing errors. Tools like Select By Attributes and Select By Location and geoprocessing models allow you to search for problems in your data. Additional extensions like ArcGIS Data Reviewer, ArcGIS Workflow Manager, and Esri Production Mapping are designed to find errors and ensure consistency of workflows that improve the overall quality of your data.

This paper also outlines various options for QA/QC. To summarize, start by taking a careful look at how the most critical errors in your data are introduced, and then begin implementing ideas that are provided in this paper to address those situations.

Source :www.esri.com

Department of Geography University of Madras, Chennai

The Public Petition dated 11-11-1839 initiated the establishment of Madras University. It was in January 1840 with Mr. George Norton as its President, that the University Board was constituted. In 1854 after a lapse of 14 years, the Government of India formulated a systematic educational policy for India and as a sequel to this; on 5th September 1857 by an act of legislative council of India the University was established. The University was organised in the model of London University.

Madras University is the Mother of almost all the old University of South India, reaccredited with 'A' level by National Assessment and Accreditation Council (NAAC). The University of Madras was also one among the first five Universities in the country to receive the recognition from the UGC as a "University with Potential for Excellence".

The Department of Geography at the Madras University is one of the oldest Departments in this country and celebrated its Golden Jubilee in the year 1983. The Department has built high traditions of teaching and research in the past 81 years. It regularly publishes the Indian Geographical Journal through Indian Geographical Society. This Journal is one of the oldest and first geographical journal in India.

The Department of Geography initiated international collaboration for enhancement of new techniques in spatial science and Geoinformatics and has collaboration with University of Waterloo, Canada for linkage programme, sponsored by CIDA. The department has MoU with Staffordshire University (UK), The University of Northampton (UK) and Salzburg University (Austria) and offers joint programmes. The department also takes care of the social responsibility through the OIKOS International, and hosts the Chennai Chapter of the OIKOS programme.

The M.Sc Applied Geography Programme is a highly specialised one with a in-depth training on applied aspects of the discipline especially on sustainability issues, Geo-spatial

technology. An innovative M.Sc course in Spatial Information Technology was introduced in 2000, which was the first of its kind where an inter-disciplinary training in geography, spatial statistics, modeling and programming was introduced. A P G Diploma in GIS Management, an evening programme started in 1999 is yet another need based course offered as University-Industry and Community Interaction Centre (UICIC) programme.

The Department is currently offering the following PG programmes

I. Regular Programmes

- M.Tech in Geoinformatics
- M.Sc. Applied Geography
- M.Sc. Spatial Information Technology

II. Under Private Study

- M.Sc Geoinformatics

III. International on-line courses

- M.Sc Geoinformatics, Sustainability and Natural Resource Management with Staffordshire University, UK
- M.Sc Geoinformatics and Urban Sustainability with Staffordshire University, UK
- M.Sc International Environmental Management with The University of Northampton, UK
- M.Sc Geographical Information Science and Systems with Salzburg University, Austria
- Professional Diploma in Geographical Information Science and Systems with Salzburg University, Austria.

The Department has also been alive towards strengthening the teaching of geography in the affiliated colleges and to that end, has been organising Refresher Courses, Workshops

and Curriculum Development Programs, In recent years, faculty members are involved in advising and undertaking socially relevant and industry oriented projects. Some prestigious consultancy projects were successfully completed. Collaborations with overseas scholars, universities and research institutes are progressively added. Some of the milestones in the growth of the Department in the past were as follows.

1. MoU signed between the University of Madras and University of Waterloo, Canada for linkage program sponsored by CIDA, Canada for establishing a GIS Laboratory- 1991.
2. Introduction of UGC-SAP (DRS-I)- 1994-1999 and UGC-SAP(DRS-II)- 1999-2004
3. Support under DST-FIST for developing infrastructure in Geo-Information Technology- 2001-2006
4. MoU with Staffordshire University, UK for offering an M.A programme in Sustainable Development supported by Commonwealth Scholarship Scheme- 2004.
5. MoU with Staffordshire University, UK and the University of Northampton, UK for offering On-line M.Sc programs supported by UKIERI Scheme- 2008
6. MoU with Salzburg University, Austria for offering on-line M.Sc programs – 2011
7. Support under UGC-Innovative program for M. Tech

Geoinformatics - 2011 In addition to these, the Indian Geographical Society, the oldest association of learned geographers in India has been housed by this Department.

The Department has been involved in research/consultancy projects funded by Social Sciences and Humanities Research Council of Canada, German Research Foundation (DFG) in collaboration with Bonn University, Hansbury Foundation, Hamilton in collaboration with RMIT, Australia, Indian Council for Social Science Research, World Bank project for Chennai Metropolitan Area, University Grants Commission, Ministry of Human Resources Development, Government of India, Ministry of Earth Sciences, Government of India, Department of Information Technology, Government of India etc.

The alumni of this Department have been actively involved in various professional avenues related to application of geographical knowledge such as policy making, research, city planning, advocacy research, micro level planning, teaching etc. •

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(Contd. from page No. 15...)

The first step was to create the cleaning data. ArcGIS was used to calculate the number of sewer mains that were cleaned that month and their lengths. The frequency of how often a line had been cleaned was calculated and coded using a red/yellow/green scheme. Hot spots, or areas that had been cleaned seven or more times, were displayed as red so it would be evident where there were issues.

Locating the Cleaning Hot Spots

The ability to map where the sewer cleaning was occurring and how often it occurred yielded some interesting results. There were over a dozen separate areas where the sewer mains had been cleaned 7 to 12 times in an 18-month span. This information became a catalyst for improved interdepartmental communication between WSMD and the Town of Mooresville Fat Oils Grease (FOG) Department.

Says Jamie Levis, FOG compliance officer, "Our sewer cleaning map has helped us identify those areas that require more frequent inspections and increased pumping/cleaning frequencies for food service establishments. The use of GIS has helped the FOG staff identify and remedy problem grease interceptors [problem spots] on multiple occasions. With the use of this tool, what used to take weeks now takes minutes to look up and identify."

Fixing the Hot Spots

Mapping the hot spots gave WSMD and the FOG Department specific areas to target and improve. Several methods were used to investigate these areas, such as reviewing closed-circuit television of the sewer mains and inspecting all the oil/water separators in the vicinity of the sewer cleaning hot spot. Several problems were fixed by using simple root control treatments and locating grease violations by local restaurants.

Prior to this project being implemented, in 2010, WSMD did

not know where the hot spots were and did not have a way to track areas that were being repeatedly cleaned. In 2010, the town cleaned 51 miles of sewer mains. Of those cleaned sewer mains, 58 percent had already been cleaned earlier that year. In 2011, after the project, the town cleaned 144 miles of sewer mains, and only 32 percent were repeats. By having the ability to identify hot spots and correct issues, the town was able to clean almost three times as many areas and cut the repeat trips by 26 percent.

"Since our productivity has increased, we have noticed a decrease in main line stoppages and after-hours callbacks, resulting in cost reductions, including less overtime pay for employees," says Johnson.

Ryan Rase, deputy town manager, also praises the results of the project: "The WSMD has not been immune to the downturn in the economy, and we are constantly being asked to do more with less. Through the use of technology and teamwork, we were able to provide a tangible example of how WSMD has been able to become more efficient."

Going Mobile

Today, the town continues to map the sewer cleaning. Using Esri's ArcGIS, workers can now use iPads to log cleaning data directly into the system from the field (instead of keeping track of Excel spreadsheets). The sewer cleaning crew can instantly view where the cleaning truck has been in the past two years and be strategic in cleaning by maximizing the route of the cleaning crew and migrating to areas that need attention. Additionally, it can easily identify hot spots that show up red on the map and communicate where customer intervention may be needed. This project created a proactive approach to maintaining the town sewer system and enhanced interdepartmental communication. •

Did you know you can Access ArcMap Menu Commands through Shortcuts too

The following table lists the keyboard shortcuts for some common commands:

Shortcut	Command	Menu
CTRL+N	New	File
CTRL+O	Open	File
CTRL+S	Save	File
ALT+F4	Exit	File
CTRL+Z	Undo	Edit
CTRL+Y	Redo	Edit
CTRL+X	Cut	Edit
CTRL+C	Copy	Edit
CTRL+V	Paste	Edit
DELETE	Delete	Edit
F1	ArcGIS for Desktop Help	Help

- To access the main menu, press ALT and use the arrow keys to move through the menus; press ENTER to make a Selection.
- Press ESC to close a menu or dialog box.

Window handling

- CTRL+F opens the Search window.
- ESC moves the focus from the Catalog window or the Table Of Contents window to the map display.
- F3 puts the focus to the Table Of Contents window.
- Hold down CTRL while dragging a toolbar or dockable window to prevent it from docking.
- To dock or undock any dockable window, double-click its title bar, or if it is stacked with another docked window, double-click its tab.

Refreshing or suspending map drawing

- Press F5 to refresh and redraw the display.
- Press F9 whenever you want to suspend or pause drawing so you can make changes to your map without having the map redraw after each change. Press F9 again to resume Drawing.

Dragging and dropping to move or copy

- You can drag and drop or copy and paste multiple layers in the table of contents and between ArcMap sessions. You can also drag and drop or copy and paste data frames between ArcMap sessions.
- Use drag and drop to move layers in and out of a group layer within a data frame.
- Layers that are dragged and dropped between data frames and ArcMap sessions are copied; hold down CTRL while dragging and dropping to move layers between data frames and ArcMap sessions.

- Data frames that are dragged and dropped are moved; hold down CTRL while dragging and dropping to copy them.
- Layers that are dragged and dropped inside a data frame are moved; hold down CTRL while dragging and dropping to copy them.
- Similarly, in ArcCatalog, you can hold down CTRL while dragging and dropping to copy items.

Navigating the table of contents with the keyboard

- F3 or clicking inside the table of contents puts the keyboard focus on the table of contents so you can navigate and interact with it.
- ESC or clicking the map puts the keyboard focus on the Map.
- HOME selects the first item in the table of contents.
- END selects the last item in the table of contents.
- PAGE UP or PAGE DOWN arrows move through the items in the table of contents.
- Left/Right arrows or the + and - keys expand or collapse selected items. They also toggle among the tabs at the bottom of the table of contents when they have keyboard focus.
- SPACE turns drawing of the selected layers on or off.
- CTRL+SPACE turns all the layers in the data frame on or off when a single layer is selected in the table of contents. If the selected layer is part of a group layer or a composite layer, such as an ArcIMS image service layer, all the members of that layer will be turned on or off. If multiple layers are selected, CTRL+SPACE works like SPACE by itself and toggles only the selected layers on or off.
- F2 renames the selected item.
- F12 or ENTER opens the selected item's properties dialog box. If the currently selected item is a heading, symbol, or label, the Layer Properties dialog box will open with the Symbology tab shown on top.
- SHIFT+F10 (or the APPLICATION key, if your keyboard has one) opens the shortcut menu for the selected item.
- Use SHIFT+F1 or F1 to obtain context help when an item has keyboard focus or when the properties dialog box tab or a table of contents tab is selected.
- F11 activates a selected data frame, or hold down ALT and click a data frame to activate it.
- When there are multiple data frames in the map, use CTRL+TAB to cycle through each data frame and activate it. Using mouse shortcuts in the table of contents.
- CTRL+click an expansion control (+/-) to expand or collapse all the items at that level. If any items are currently selected, only the selected items are expanded or collapsed.
- CTRL+click selects or deselects multiple layers or data frames.
- SHIFT+click selects all layers or data frames between two layers or data frames within the same table of contents level.
- ALT+click a data frame to activate it.

- CTRL+click a layer's check box turns all the layers on or off at that level. If any items are currently selected, only the selected items are turned on or off.
- ALT+click a layer's check box turns that layer on and turns off all others at that level.
- ALT+click a layer's name to zoom to the extent of that layer. This saves having to right-click a layer and click Zoom To Layer.
- When dragging layers, hover the pointer over an Expansion control to expand or collapse any item.
- Right-clicking features, layers, and data frames always opens a shortcut menu.

Navigating maps and layout pages

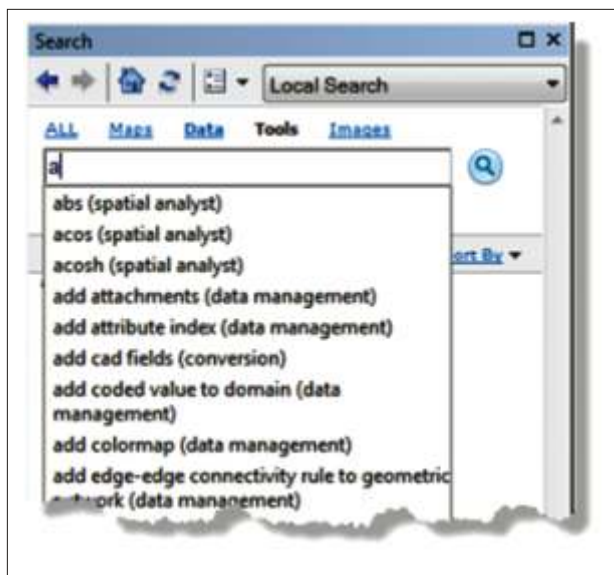
Hold down the following keys to temporarily turn the tool you are currently using into a navigation tool:

- Z—Zoom In
- X—Zoom Out
- C—Pan
- B—Continuous Zoom/Pan (Drag with mouse button zooms in/out; drag with right mouse button pans.)
- Q—Roam (Hold down mouse wheel until cursor changes, then drag or hold Q.)

These shortcuts work in data view and layout view. In layout view, they apply to the page by default. Hold down SHIFT as well as the key to apply it to the data frame you click instead of the page.

Opening and closing table windows

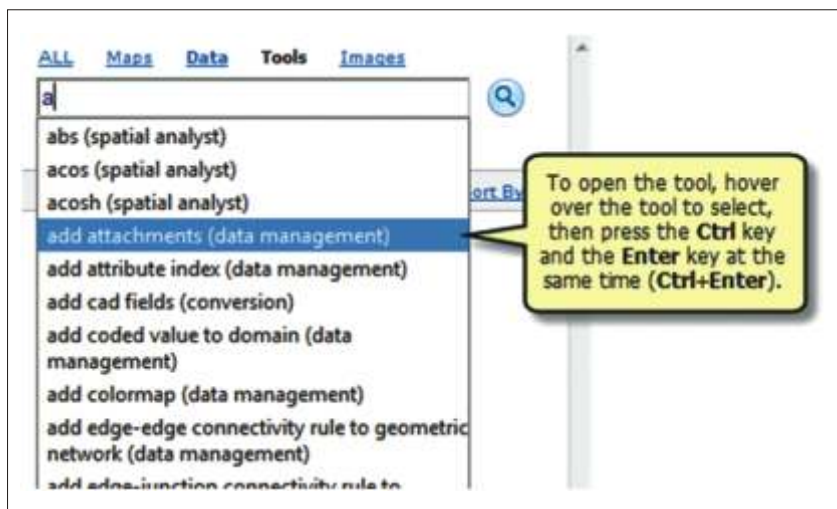
- CTRL+double-click a layer or table in the table of contents to open its table.
- CTRL+T or CTRL+ENTER to open the table of the selected layer or table in the table of contents.
- CTRL+SHIFT+T to minimize or maximize all open table windows.



- CTRL+SHIFT+F4 to close all open table windows.

Tool Index

- Prior to version 10.0, the ArcToolbox window had an Index tab which listed each tool in alphabetical order. If you knew the name of the tool, you could quickly find it in The Index tab. This functionality has been replaced by the Search window—all you need to do is to start typing the name of the tool and the drop-down list will automatically show the tool or tools that match the characters you enter.
- To open the tool's dialog, hover over the tool in the drop-down list and press the Ctrl key and the Enter key at the same time.



Tips on improving map display performance

- ArcMap includes a series of tools that enable you to optimize and tune your ArcMap documents for fast display performance. As an ArcMap user, it's always important to explore ways to increase the display performance of your interactive map documents—especially for maps that you plan to share with other users. Using the Analyze Map tool to analyze and improve display performance
- The Analyze Map tool helps you to improve the drawing performance of your ArcMap documents by generating a list of potential display performance issues.
- Each problem description guides you to suggest updates that you can make to your map layer to address the issue and improve map-drawing performance. Using base map layers to precompute your map display
- You can include basemap layers in your maps to improve display performance. Basemap layers are only computed once—the initial time you visit an extent at a map scale. These tiled views are used in subsequent map displays as you pan, zoom, and navigate your map. Because these views are precomputed, map display is optimized.
- You can overlay or mash up your other operational layers (the layers that draw on demand) on top of the base map.
- Basemap layers are flexible and easy to manage. They manage themselves automatically so little work is required to define them in your map documents. Essentially, you can add and remove the layers in your basemap layer as needed. Leveraging caching in ArcGIS
- ArcGIS for Desktop uses a series of caching strategies to reduce the number of round trips to retrieve data, to Precompute some GIS results, and to reuse map displays during a session. There are a number of strategies that can be used.

Zoom To the GPS Location

The below code snippet shows how to get the current GPS position of a mobile device and show it on the map. Action script code to retrieve the current GPS point and show on the map in Flex Mobile

The Geolocation class is used to get the location of the device. The Geolocation class dispatches events in response to the device's location sensor. If a device supports geolocation, you can use this class to obtain the current geographical location of the device. The geographical location is displayed on the device in the form of latitudinal and longitudinal coordinates (in WGS-84 standard format). When the location of the device changes, you can receive updates about the changes. If the device supports this feature, you will be able to obtain information about the altitude, accuracy, heading, speed, and timestamp of the latest change in the location.

```
public function ZoomToGPS():void
{
    var geolocation:Geolocation = new Geolocation();
    var geometryService:GeometryService = new
    GeometryService("http://sampleserver1.arcgisonline.com/ArcGIS/rest/services/Geometry/GeometryServer");
    //Check if the GPS is active on the mobile device
    if(!geolocation.muted)
    {
        //set the update interval so that the current position of the
        mobile device is updated at a fixed interval of time.
        Geolocation.setRequestedUpdateInterval(10000);
        geolocation.addEventListener(GeolocationEvent.UPDATED, onGPSLocationChanged =
        function(event:GeolocationEvent):void
        {
            var long:String = Number(event.longitude.toString());
            var lat:String = Number(event.latitude.toString());
            // the GPS point must be projected to the target
            projection system using the GeometryService.project()
            method in order to show on the map.
            var gpsPoint:MapPoint = new MapPoint(long, lat);
            gpsPoint.spatialReference =
            new SpatialReference(map.spatialReference);
            var projParams:ProjectParameters = new ProjectParameters();
            projParams.geometries = [gpsPoint as Geometry];
            projParams.outSpatialReference =
            map.spatialReference;
            geometryService.project(projParams,
            new AsyncResponder(onResult, null));
            // Handle result of the projection to the target
            coordinate system.
            function onResult(result:Array, token:Object =
            null):void
            {
                //Assign the projected geometry to the point in the graphic
                layer
```

```
gpsGraphic.geometry = Geometry(result[0]);
```

```
//zoom to current position
```

```
map.zoomTo(MapPoint(result[0]));
```

```
}
```

```
});
```

```
}
```

```
}
```

MXML code:

// In MXML Section, we need to declare a graphic layer on top of the tiled map service to hold the GPS point and show it on map.

```
<esri:Map>
```

```
<esri:ArcGISTiledMapServiceLayer
url="http://server.arcgisonline.com/ArcGIS/rest/services/Wor
ld_Topo_Map/MapServer"/>
```

```
<esri:GraphicsLayer id="gpsGraphicsLayer">
```

```
<esri:Graphic id="gpsGraphic">
```

```
<esri:symbol>
```

```
<esri:SimpleMarkerSymbol
```

```
color="0x0066FF" size="15" style="circle"/>
```

```
</Esri:symbol>
```

```
</esri:Graphic>
```

```
</esri:GraphicsLayer>
```

```
</esri:Map>
```

Editor Component

This sample demonstrates how to use the editor component in flex Mobile.

The Editor component provides out-of-the-box editing capabilities using an editable layer in a Feature Service. It combines functionality from the out-of-the-box TemplatePicker, DrawTool, EditTool and GeometryService classes with additional editing functionality. When writing editing applications, we can try to take advantage of the skinnable and customizable out-of-the-box Editor component.

Editing behaviors:

- To create a new feature, click a feature template in the TemplatePicker and start creating the new feature.
- Click on a feature to select it and edit it.
- To rotate and scale a feature, click on an already selected feature to activate scaling and rotate mode.
- Move a selected feature by dragging it to its new location.

MXML CODE:

The Editor Component requires a Map with FeatureLayer to work on and a geometry service for aiding the Editor component in projection and simplification of features.

```
<fx:Declarations>
```



```
<esri:GeometryService id="myGeometryService"
url="http://sampleserver6.arcgisonline.com/arcgis/rest/services/Utilities/Geometry/GeometryServer"/>
</fx:Declarations>
<esri:Map id="myMap" wrapAround180="true">
<esri:extent>
<esri:Extent id="socal"
xmin="-13471000" ymin="3834000" xmax="-12878000"
ymax="4124000">
<esri:SpatialReferencewkid="102100"/>
</esri:Extent>
</esri:extent>
<esri:ArcGISTiledMapServiceLayer
url="http://server.arcgisonline.com/ArcGIS/rest/services/World_Street_Map/MapServer"/>
<esri:FeatureLayer id="incidentsAreas"
mode="snapshot"
OutFields=" [data_security,description]"
```

```
url="http://sampleserver3.arcgisonline.com/ArcGIS/rest/services/HomelandSecurity/operations/FeatureServer/2"/>
```

```
</esri:Map>
```

```
<esri:Editor id="myEditor"
```

```
width="100%" height="180"
```

```
geometryService="{myGeometryService}"
```

```
Map="{myMap}"/>
```

```
ACTIONSSCRIPT CODE:
```

```
import mx.events.FlexEvent;
```

```
protected function application1_initializeHandler
```

```
(event:FlexEvent):void
```

```
{
```

```
//Assign an array of feature layers to bind with the Editor
```

```
myEditor.featureLayers = [incidentsAreas];
```

```
}
```

Get more Information From Imagery and Data

EXELIS

ENVI – The premier software Solution
used to extract information from
geospatial imagery

ENVI for ArcGIS Server – Author,
publish and distribute image analysis
tools to the ArcGIS enterprise

E3De - addresses user needs across
industries to quickly and accurately
get 3-D products from data.

IDL – The Scientific programming
language used to create meaningful
visualizations from complex data

Visual Information Solutions



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Tel: +91 (124) 4002702 Email: ENVI@esriindia.com

Esri Helps the National Audubon Society Build National Bird Map for Habitat Conservation

Bird Inventory, Scientific Data, and GIS Platform Destined to Drive Habitat Protection Policies

Redlands, California—Esri and the National Audubon Society are working on an initiative to provide geospatial data and map production abilities to Audubon's 467 chapters, 47 education centers, and all 22 US state offices. Audubon will meld Esri's cutting-edge GIS mapping technology with the latest scientific species data to study and reduce bird habitat losses.

Each Audubon state office, nature center and chapter will receive Esri's ArcGIS software and access to a vast library of the latest authoritative data and scientific research via Esri's GIS cloud platform, ArcGIS Online. Audubon will use the platform to study birds and other species by combining years of field data collected by Audubon scientists as well as government, academic, and wildlife protection nonprofits sources.

"Esri transformed the face – or rather, the map – of the conservation movement two years ago with its incredibly generous donation of licenses, training and software to Audubon," said Audubon president and CEO David Yarnold. "We couldn't do what we do without Esri's tools and support. From winning protection of 11 million acres in Alaska's national petroleum reserve area, to bringing partners together to protect Pennsylvania's Kittatinny Ridge, we rely on Esri's tools. ArcGIS helps us answer tough questions, democratize data, and create a culture of collaboration. And

now, as we roll out this technology even more widely across the Audubon network, we know that conservation results are going to increase significantly, thanks to Esri's partnership and generosity."

All Audubon offices will be sorting through massive amounts of cloud-based data about bird and other species' ranges, food sources, and shifts in bird demographics. GIS will enable them to combine this data with habitat, water, geology and land ownership data to study patterns and relationships. They can then assess changes and study environmental impacts on bird populations at local, national, and international levels.

"The end value of technology comes from people adopting it," said Jack Dangermond, president of Esri. "Our work with the National Audubon Society allows chapters to be the principal consultants for the public, provide advice and show important bird information on web maps. They can work with other conservation organizations to forward science."

The largest, longest-running animal census on the planet is the Audubon Christmas Bird Count. Every winter, about 70,000 people join this famous citizen science project to compile and submit count data about local bird populations. This bird count has now been added to the National Audubon Society's geodatabase. The 2013 count will be mapped with GIS and made available on an interactive website.

Esri Goes Hollywood

Esri City Engine 2013 and New SDK with Maya Plug-In to be Previewed at Siggraph 2013

Create realistic—and futuristic—cityscapes with CityEngine 2013.

Redlands, California—When Esri merged geospatial technology with digital urban design in CityEngine in 2011, it created a revolutionary new methodology for 3D cityscape creation. At Siggraph 2013, taking place in Anaheim, California, July 23-25, Esri will demonstrate the powerful capabilities of City Engine and other GIS solutions for digital artists in film, television, and game design.

Creating realistic 3D city designs is a notoriously expensive process, typically involving teams of designers and multiple specialized software programs. At Siggraph, Esri will show how CityEngine helps simplify and improve the quality of urban designs by connecting spatial datasets with building design rules, resulting in more impressive and accurate 3D models.

"Designing realistic cities is one of the more challenging and expensive tasks in the entertainment industry," says Dominik Tarolli, Esri's business development director for 3D markets. "Using CityEngine to build 3D metropolis models gives designers an edge by integrating geography into the artistic process."

CityEngine's highly automated drag-and-drop process for creating cities has been used in movies such as *Cars 2*, *Total Recall*, and *Man of Steel*, as well as in TV commercials and video games.

Highlights of Esri's exhibit at Siggraph 2013 include

- CitEngine 2013 demonstration
- Preview of SDK plug-in that enables the 3D-building generator capabilities inside Maya
- Oculus Rift 3D city demo

For more information and free product trials, visit www.esri.com/entertainment.



DID YOU KNOW?

Esri Standards and Interoperability Increasing Access to Geospatial Data and Services

As geographic information is increasingly distributed on the Web and routinely integrated into thousands of applications and services, geographic information systems (GIS) have become more open. The ArcGIS platform conforms to open standards and enterprise IT frameworks that allow users to incorporate GIS into any application on a variety of computing and mobile device.

Esri, along with strategic business partners, is committed to building interoperable and open commercial off-the-shelf software products. Open access to geographic data and software functionality using widely adopted, practical standards is our primary focus.

Comprehensive Approach to Interoperability

ArcGIS supports an organization's workflows and business requirements by providing a software platform that supports spatial data management, editing, analysis, and display. ArcGIS supports multiple approaches to interoperability:

- Web—SOAP, XML, REST, JavaScript™, KML, Virtual Earth™
- OGC—GML, WFS, WMS, WCS
- Enterprise Integration—SOAP, XML, EJB, SQL
- Application Content—CAD, Image, PDF

Open Platform and Technology Support

The ArcGIS platform conforms to open standards and enterprise IT frameworks that allow organizations to incorporate GIS into any application on a variety of computing and mobile devices.

ArcGIS supports multiple approaches to standards and interoperability:

Geospatial Standards

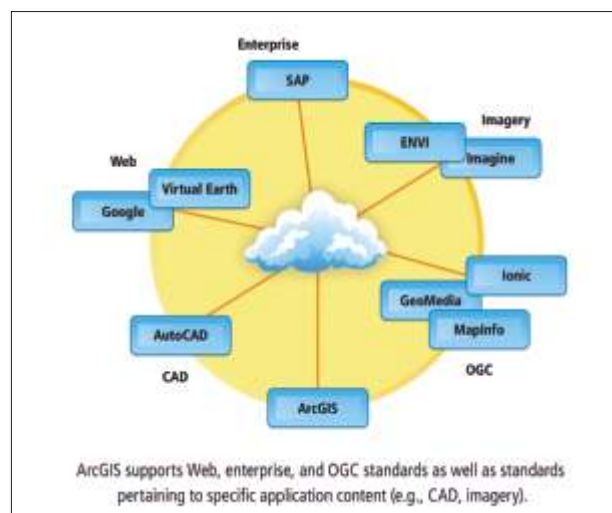
Esri is a principal member of the Open Geospatial Consortium (OGC), and actively participates in the development of many specifications. Members of Esri's standards and interoperability team serve as representatives on some of the ISO/TC 211 committees.

IT Standards

Esri supports and complies with virtually all commonly accepted IT standards. For our users, this means compatibility and interoperability support with major enterprise systems such as enterprise resource planning (ERP), customer relationship management (CRM), enterprise application integration (EAI), work management systems, and others.

Some of the supported standards include

- Operating systems including Windows, UNIX, and Linux
- DBMSs such as IBM DB2 Universal Database and Informix Dynamic Server, Oracle, and Microsoft SQL Server (including support for all spatial types) and PostgreSQL



- Spatial data formats including translators; direct read and data access via SQL, OLE COM, XML, KML, and GML; published APIs; CAD data; and other GIS formats
- Network protocols such as TCP/IP, HTTP, and HTTPS
- Developer environments including Visual Basic, C#, C++, Visual Studio .NET, and Java
- Mobile devices and operating systems such as Windows Mobile 2003, 5.0, and 6.0 for various Pocket PCs, smartphones, and PDAs; Windows CE for Tablet PCs and laptops; and Windows 2000 or XP for laptops
- Enterprise applications such as SAS, IBM DB2, Oracle, SAP, IBI, and FileNet
- Web Services such as XML, SOAP, UDDI, and WSDL; OGC specifications such as WFS, WMS, and GML; and application servers such as Oracle and WebSphere

Support for Leading Web Standards—WMS, WFS, WCS, KML

The ArcGIS product family supports several leading OGC Web standards: Web Map Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS), metadata and catalog services, and Keyhole Markup Language (KML).

OGC WMS and ISO 19128 WMS

WMS is an open GIS standard specification for interactive mapping based on requesting map images from a server over the Internet. Using WMS with the ArcGIS product family:

- Users can access WMS services containing large numbers of layers over the Internet and add them to their maps as layers.
- WMS services are expandable to enable drilling into Layers and layer collections for use directly in maps or globes.
- WMS legends can be added to a map as a graphic.

Additionally, the ArcGIS WMS implements the Styled Layer Descriptor (SLD) specification.

OGC WFS

WFS is a service that allows users to publish vector feature collections that may be queried and updated by clients. Esri supports the simple features profile of GML and both the read-only and transactional (WFS-T) version of the WFS specification. WFS - T allows any GIS client to carry out

transactions against a published Geodatabase.

OGC WCS

WCS is a data service that allows users to publish coverages on the Web. Using the WCS specification with the ArcGIS product family

- Clients can get subsets of the data.
- Clients can request server-side re-sampling of the data.
- Geoprocessing models can be published that consume WCS Services.

KML

KML is an XML- based file format used to represent geographic features in Web-based applications such as ArcGIS Explorer.

- Maps and layers can be converted to KML and read by any client capable of reading KML.
- Map and image services expose a KML network link through a Representational State Transfer (REST) interface.
- Clients can query map layers or perform a geoprocessing or geocoding operation and obtain the results as KML.
- Clients can consume published ArcGIS Server KML Services for dynamic maps that show the latest information.



Metadata and Catalog Services

ArcGIS supports the collection, management and use of metadata throughout the life cycle of geospatial data and services. Metadata provided in a catalog service allows producers to advertise their data and services and users to discover them. Support for the OGC web catalog Service (CS-W) specification is also provided.

Defense Standards

Esri anticipates the needs of the defense and intelligence community for implementing key standards and interoperability protocols by complying with standards for platforms, programming, security, and application development.

Supported military symbol sets include

- MIL-STD-2525B—The common war fighting symbology for the Department of Defense (DoD)
- APP-6A—The North Atlantic Treaty Organization (NATO) standard for representing entities in the battle space
- Geospatial Symbols for Digital Displays (GeoSym)—A standard that the National Geospatial-Intelligence Agency (NGA) developed to display Vector Product Format (VPF) data

Data Interoperability

Integrating multiple data sources is often crucial to building a system or completing a model. ArcGIS supports this need for interoperability with the following:

Extensibility Products

Extensibility products eliminate the barriers to data sharing and enable GIS professionals to use any standard data, regardless of the format.

Products offered include

- ArcGIS Data Interoperability provides state-of-the-art direct data extraction, transformation, and loading (ETL) capabilities. This extension enables ArcGIS for Desktop users to easily use and distribute data in many formats.
- ArcGIS for AutoCAD is a free application that allows CAD users to visualize and query GIS data without conversion in AutoCAD. CAD users can work directly with ArcGIS map services to add full GIS context to their AutoCAD sessions.
- ArcGIS for Server Geoportal provides all the tools and templates to create a GIS portal. Based on Esri's ArcIMS and ArcSDE server technology, this standards-based solution, offered through Esri's Professional Services, is a cost-effective way to get a functional site up and running quickly.

Metadata Capabilities

ArcGIS for Desktop products (Basic, Standard, and Advanced) allow users to create, manage, and edit metadata stored in an XML representation of Federal Geographic Data Committee (FGDC) Content for Digital Geospatial Metadata or the ISO 19115 Metadata Standard.

ArcIMS Metadata Services enable users to create a central, online metadata repository that facilitates publishing and

browsing metadata over the Internet. The metadata documents stored as ArcIMS Metadata Services can then be accessed using any client that communicates using ArcXML, such as

- ArcCatalog: ArcCatalog is the geographic and tabular data management, creation, and organization application for ArcGIS for Desktop.
- ArcIMS Metadata Explorer: A set of Java Server Pages (JSP) can be used to build a customized, browser-based means of searching for metadata.
- Z39.50 Clients: Z39.50 is a national standard that defines a protocol for computer-to-computer information retrieval.
- ISO 239.50 Clients: ISO 239.50 is an international standard that defines a protocol for computer-to-computer information retrieval.

Database Models

The ArcGIS geodatabase architecture allows the creation of common or essential data models for specific industries and applications. ArcGIS data models provide ready-to-use, nonproprietary frameworks built on the accepted standards for modeling and capturing the behavior of real-world objects in a geodatabase.

Open Data Formats

The shapefile spatial data format is open and published by Esri. A shapefile stores nontopological geometry and attribute information for the spatial features in a dataset. Shapefiles can support point, line, and area features. This file format is growing in adoption and capability to accommodate more complex spatial data; Esri will announce and publish changes as they are developed. Esri encourages developers and users to create interchange capabilities to both read and create shapefiles.

Web GIS FAQs

Q: What is Web GIS and why does it matter to me?

A: Web GIS is a new pattern for delivering GIS capabilities and is at the center of Esri's strategic direction for implementing GIS as a platform. Maps on the web provide a new paradigm for how people everywhere access and use geographic information. They use GIS maps on their desktops, the web, on tablets, and smart phones for a sophisticated range of activities to apply advanced geographic information. It builds on and fully integrates your existing ArcGIS investments. This pattern helps existing users do their work, and also extends the reach of GIS to everyone.

- Web GIS naturally brings GIS into the hands of people. People expect to be able to use maps from modern consumer devices such as smartphones and tablets, simple web browsers, or directly embedded in the tools they commonly use such as Microsoft Office. Web GIS enables you to easily build maps that work seamlessly across different devices and form factors: maps that work everywhere.

- Web GIS reduces the need to create custom applications. The wide variety of ready to use applications and application templates included with Web GIS let you tailor simple and to the point user experiences to let people get the job done quickly and intuitively.

Web GIS provides a platform for integrating GIS with other business systems. In fact Web GIS is based on simple protocols like REST and other proven web standards so you can effectively embed GIS into existing enterprise systems. IBM Cognos, MicroStrategy, or SAP, to name a few, are examples of systems that 'plug and play' with the Web GIS delivered through ArcGIS.

- Web GIS enables cross organizational collaboration, facilitating communication and optimizing the use of information throughout organizations. Web GIS opens the door for creating a participatory environment where GIS tools are made more accessible and flexible.

- Web GIS enables access to vast collections of ready to use maps (base maps, demographic, and terrain maps, etc.) and GIS services, including geocoding, routing, geoenrichment, etc.

- Web GIS allows organizations to properly manage all their geographic knowledge. At the heart of Web GIS is a map-centric content management system, which helps organize, secure, and facilitate access to geographic information products. This central component, which we will refer to here as the 'ArcGIS portal,' represents a common gateway for everything geo in your organization. It indexes all your maps for easy discovery, allows for defining rules as to who can access which data, map, GIS application etc. The portal is a central component of embracing Web GIS.

Q: Are Web GIS and ArcGIS Online the same thing?

A: Web GIS is a new modality for delivering GIS capabilities. As a concept, Web GIS is agnostic to how it gets implemented. You can run it on your local network on premises using ArcGIS Server and Portal. Or, you can run it

using ArcGIS Online, the cloud implementation hosted by Esri. Or use both. ArcGIS is built specifically so that you can embrace Web GIS following an implementation pattern that really fits you. You can run it completely in the cloud (such as ArcGIS Online ready to use applications, contents and services available), in your own infrastructure (such as Portal for ArcGIS), or in a hybrid pattern (such as combine ArcGIS for Server and its extension Portal for ArcGIS with ArcGIS Online).

Q: As an ArcGIS for Desktop user, does Web GIS really matter to me?

A: Absolutely. ArcGIS for Desktop is a foundational part of Esri's Web GIS solution. It is the premier application for authoring high-quality maps and content. ArcGIS for Desktop provides excellent tools to digest all sorts of data, analyze it, and convert it into useful information products.

- Web GIS organizes this work in a common repository (the portal) where users can keep things private for internal use, or share them with other desktop users. Desktop users can use the Web GIS portal to build a common library of useful maps and resources for use within Desktop; as well as a common library that can be accessed from anywhere.

- Web GIS provides users with ready-to-use base maps and services that can speed up desktop projects. Esri is making huge investments in data, maps and functional services that plug right away into your ArcGIS for Desktop.

- Web GIS is also the best way to share work done on the desktop with non GIS experts. People are eager to use maps, but are not necessarily ArcGIS experts. In fact, people expect to be able to find and use maps right from their own consumer devices, like a

smartphone or tablet. Web GIS enables all of this, and it is relevant to you, because making your work accessible and useful to others makes you relevant.

- Web GIS allows users to easily make desktop maps work on the web, mobile devices, and literally any system. Take the opportunity to learn more about Web Maps and how they relate to ArcGIS for Desktop, and all the devices and applications that people could use to find and use the beautiful work you do in ArcGIS for Desktop.

Q: What is Esri doing to help desktop users benefit from Web GIS?

A: First of all, a big part of Web GIS is being able to access lots of ready-to-use content from the cloud. Esri is investing to make sure you get the best content for Desktop through ArcGIS Online. You can also access an incredible variety of maps from authoritative content providers from many other GIS users like you. Starting with ArcGIS 10.2, desktop users will begin to see a growing number of GIS services available from ArcGIS Online. This includes many analytical services such as routing with live traffic data, service area, and terrain analysis, enhanced worldwide geocoding, and even services for geo-enriching your data.

For the past few years, the major driver for our development work at Esri has been focused on enabling Desktop users to fit easily into Web GIS as contributors. Its simplicity causes us to often underestimate how powerful this is.

1. Role: Project Manager

Skill Set

- Strong exposure and work experience with ESRI products
- Solution Architecting of ArcFM, ArcGIS Server, and Desktop based solutions
- Hands on experience with ArcFM, ArcGIS Server any one of Web APIs, REST and SOAP API
- Security Implementation for GIS Services and Web Services
- Strong working experience with Microsoft Technologies
- Development of Web Services, WCF Services and Work flow services
- Exposure on latest features of .Net such as Entity Framework, LINQ etc
- Handling of Large Database
- Integration with Content Management Systems
- Knowledge of DB e.g. Oracle / SQL 2008, 10, 12 and MySQL etc
- Managing customer on daily basis
- Project / Program / Delivery management
- Good exposure to quality process in SDLC with QMS process adherence and its implementation in projects
- Financial management of gross profit of projects
- Familiarity with US business will be added advantage
- People management is critical for the account

Desired Skill

- Knowledge and experience with CMMi environment preferred
- Knowledge of GIS technologies

Experience
10+ years

Qualification
BE / B. Tech /
MCA / M.Sc /
M.Tech

Requirement
1

Location
Bangalore

2. Role: Regional Sales Manager

Skill Set

- Must have exposure to "Government" Sale
- Should be from IT – SW, GIS Industry
- Driving sales targets and should understand the entire sales cycle

Desired Skill

- Excellent inter-personal skills.
- Go getter attitude
- Excellent communication skills
- Rich experience in client relationship management

Experience
10+ years

Qualification
Graduate

Requirement
1

Location
Mumbai

3. Role: Business Manager (Sales)

Skill Set

- Must have exposure to "Government" Sale
- Should be from IT – H/W or S/W, GIS Industry
- Driving sales targets and should understand the entire sales cycle

Desired Skill

- Excellent inter-personal skills.
- Go getter attitude
- Excellent communication skills
- Rich experience in client relationship management

Experience
5 - 7 years

Qualification
Graduate

Requirement
1 each

Location
Lucknow
and Mumbai

4. Role: Business Executive/Sr. Business Executive

Skill Set

- Must have exposure to "Government" Sale
- Should be from IT – H/W or S/W, GIS Industry
- Driving sales targets and should understand the entire sales cycle

Desired Skill

- Excellent inter-personal skills.
- Go getter attitude
- Excellent communication skills
- Rich experience in client relationship management

Experience
5 - 7 years

Qualification
Graduate

Requirement
1 each

Location
Mumbai and
Chandigarh

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Head, Human Resource,
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