

Sacramento County, California

WebGIS

(2004—Enterprise System)

System Summary

Prior to the Sacramento County WebGIS, county departments have redundantly maintained several databases in hard-copy and electronic formats. Often the same data was both stored in both electronic and hard-copy forms on various paper maps and documents for future reference at public counters or in the field. Varying data creation and maintenance procedures resulted in data inconsistencies that both impede interdepartmental coordination as well as adversely impact decision making. The end result was less than desirable work efficiency and customer service. With the development of the WebGIS, the county has begun to embark on a new way of doing business where data sharing, system integration, and regional collaboration will maximize technology investments.

Spatial geographic information system (GIS) layers, tabular data from Property Shared Database (PSD), the Assessor's Information Management System (AIMS), permit data from Building Inspection's Advantage Permit System, facility data from three different Maintenance Management Systems, orthophotos, as well as FileNET images of subdivision/parcel maps, building permits, easements, deeds, engineering improvement plans, and more, are now accessible to the user at his or her desktop. This aggregation of data from multiple databases into a single window in the WebGIS has eliminated countless phone calls, staff trips to file cabinets, storerooms, and/or public counters, as well as resource-wasting field trips. WebGIS has put GIS capabilities at every desktop computer attached to the county WAN, in addition to all wireless devices used in the field. A new level of fiscal responsibility has been achieved that has increased the GIS user base without excessively raising the costs for software, software maintenance, and staff training.

The Sacramento County WebGIS system has quickly become the most highly used and dominant work tool in the county today. The applications currently log more than 50,000 queries a month, averaging almost 2,500 in a typical workday. Queries range from

a basic address, parcel, or owner query, to more specialized uses in many different departments. County departments have benefited from WebGIS in ways not envisioned before, such as being able to identify illegal vineyards, insure rights-of-way are not excavated right after new pavement overlays, find the address of potential witnesses prior to trial, as well as early assigning of both parcel numbers and addresses to expedite the building permit process. The bottom line is that the WebGIS has now unlocked doors that many county departments have begun to open in their pursuit of greater efficiency.

This enterprise look at data has reaped some additional benefits as well. The combination of a growing user list as well as integration with other systems and databases has identified many data inconsistencies that have now been corrected. Several redundant data-maintenance tasks have been eliminated. Efficiency gains and the ability to make quicker, more informed decisions based on more accurate data have produced widespread benefits to several county departments.

Not only are the Sacramento County WebGIS applications a premier example of enterprise GIS, they are quickly expanding beyond the county to serve the needs of many other local agencies in the Sacramento region. Virtual Private Network (VPN) connections provide other local agencies with access to the WebGIS. This growing user list will ultimately result in more accurate and timely data for use at every connected desktop or field laptop. Every participating agency will benefit from data sharing, increased efficiency, improved decision making, and shared funding of application and data development in the future. The regional collaboration that has been fostered will benefit the citizens of Sacramento County for years to come.

Motivation for System Development

Because investments in GIS technology are quite expensive and uncertain economic times and budget constraints have become an annual problem, Sacramento County sought to implement GIS

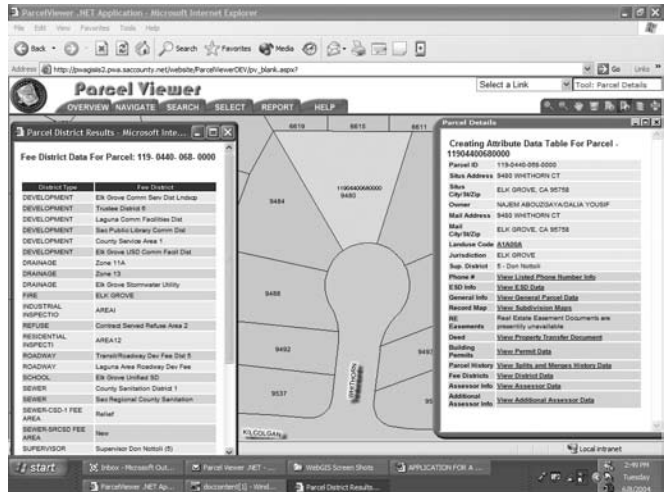
countywide in a manner that would maximize the use and access of all georeferenced data for the mutual benefit of all users. Driven by the guiding principle that the most vital corporate asset in the county is “data,” plus the knowledge that a vast majority of that data has some type of relationship with geography, Sacramento County designed, developed, and successfully implemented the WebGIS system.

In Sacramento County, many departments have struggled through tight budgets, incorporations (loss of customers and funding), and staff training and retention issues, making it extremely difficult to successfully implement GIS technology within their departments. Additionally, the GIS section observed several county departments implementing IT systems without performing a thorough needs analysis that included all affected departments. Departmental data silos were being created that adversely impacted the ability for county departments to coordinate their specific job functions. A true enterprise GIS implementation could not be attained where redundant databases and departmental data silos are the norm. A way had to be found to expand GIS functionality and database access to other departments in the county without the budget becoming the deciding factor.

At Sacramento County GIS, we believed that the majority of data used by county staff on a daily basis would be most efficiently and cost-effectively accessed with a Web browser. In the past, that data has been stored and accessed in several different ways—e.g., handwritten notes in several different assessors’ parcel book sets, paper stored in multiple file cabinets (indexed in several different ways and many times redundantly), corporate/departmental/section/personal spreadsheets or databases, as well as notes and/or data records in several custom shrink-wrapped systems. Additionally, several county departments annually purchased licenses from data providers such as MetroScan, CD Data, and Thomas Brothers. The challenge of implementing GIS throughout the county during difficult fiscal times and in an environment of distributed, disparate databases was successfully overcome by developing the WebGIS. After agreeing on the following basic tenets, Sacramento County GIS developed the WebGIS to extend basic GIS capabilities to every county employee:

- Data is a valuable county-wide asset.
- Redundant data storage and maintenance is not cost-effective.
- The true data owners should be the responsible data maintainers.
- County data should be easily accessible to all county staff who need to use it.
- Decision-making processes are more efficient when there is easy access to the most accurate, timely, and complete databases possible.
- Customer service improves when county staff members are able to utilize tools that maximize job efficiency.
- The spatial component of GIS maximizes flexibility for users to integrate, access, query, and display geographically referenced data.

Figure 1. Parcel Viewer.



Currently numbering seven individual applications, the WebGIS system allows users to access, query, display, spatially reference, and analyze multiple data types (spatial, tabular, image, and document) even though these databases are managed by multiple departments on multiple servers. WebGIS has forever changed how many county employees perform their daily business functions, greatly improved customer service, and eliminated several archaic databases and licensed vendor systems. The individual applications are described as follows:

- Parcel Viewer (see Figure 1)—enables a user to search by Assessor’s Parcel Number, address, owner name, intersection, and landmark to access property-related data associated with a parcel (i.e., zoning, land use, tax-rate area, size, value, etc.). Links to other non-GIS databases are seamless to the user. All the blue hyperlinks in the Parcel Details Table are links to additional data and images. Additionally, a comprehensive buffer/mailling label creation tool is available.
- General Map Viewer—enables a user to query and display on a very broad set of GIS data. The initial release of this viewer serves up more than 60 spatial layers of data. This application also features two of the newest Web GIS tools: Bookmarks and Redlining, using the Bookmark Drawing Tools.
- Water Quality Viewer—enables a user to access sewer infrastructure information. Same functionality as Parcel Viewer, but it also includes the spatial sewer data and searches by sewer pipe segment, manhole, and pump station. Each query provides hyperlinks to several scanned documents that are indexed to sewer facilities.
- Water Resources—Service Request Tracking System (SRTS) Viewer—enables a user to access drainage infrastructure information. Same functionality as Parcel Viewer, but it also includes the spatial drainage data and searches by drainage facility and creek segment. The SRTS module enables a

user to create new records and produce reports initiated by Water Quality and Water Resources for customer service requests. These requests are related to flood complaints and pipes-in-the-ground service requests. Additionally, specific district information is accessible per parcel as well as Sewer Response Area Investigator information.

- **Transportation Viewer**—enables a user to access transportation infrastructure information. This application enables a user to search by Streetlight Characteristics, Street Signal Characteristics, etc., to access county-maintained transportation infrastructure data. Same functionality as Parcel Viewer, but it also includes spatial transportation facility (streetlights, traffic signals, signs, striping, etc.) data.
- **Easement Viewer**—same functionality as Parcel Viewer, but it also includes spatial easement polygons and a hyperlink to the FileNET database that stores the scanned images of the originally recorded easement documents. This application is being used as a tool to validate the spatial accuracy of easements created by a conversion vendor.
- **Project Coordination**—facilitates better coordination of county departments that excavate in county rights-of-way. In addition to sewer, drainage, water, and transportation projects, this application tracks newly paved road segments that are under warranty or still in a three-year or five-year moratorium, as well as planned overlays. Online e-mail notifications are sent out to departmental staff where there are conflicts. This allows departments to better coordinate excavation projects with future overlays, both saving the county money and reducing the public nuisance caused by street-excavation projects.
- **Customer Electronic Service Request System (CESR)**—went live in the fall of 2004. All calls for any type of service including abandoned vehicles, illegal dumping, building-code infractions, as well as barking dogs within the county will be logged into CESR. The county's Board of Supervisors and all managers will enjoy simple access to a much broader view of the data than ever before.

System Benefits Achieved

A greater recognition among staff regarding the importance of data accuracy, integrity, interdependence, accessibility, and sharing has been achieved. Widespread use of the applications by multiple county departments has been instrumental in identifying many data inconsistencies and anomalies that have since been corrected. Now that users have a single place where they can go to easily view all the most commonly needed forms of property data, several hard-copy and electronic databases have been eliminated. County offices are reducing the amount of paper records that are kept for reference purposes. Data owners are more cognizant of their data-maintenance responsibilities. County departments and outside agencies are collaborating and sharing the cost burden of implementing technology. In general terms, the enterprise data infrastructure has drastically improved

and in a large part because of a proven track record of success using the WebGIS, customers are more willing to upgrade old systems to new geobased systems.

System Design Issues Encountered and Overcome

Several issues needed to be dealt with, including:

- Different versions and types of browser software.
- Problems arising from nonstandard third-party software that users have installed on their desktops.
- The technologically challenged user. Bridging the IT culture gap can be quite challenging. Newer, younger employees fresh out of school openly embrace technological change, while many longtime employees resist.
- The technologically proficient user. Designing a system that is highly customized to meet unrealistic expectations of superusers is an enormous challenge as well. The additional system modifications and enhancements that users request can adversely affect application development schedules, and, more important, almost always result in an exponential decrease in the cost benefit of that requested enhancement.
- The initial versions of the server software (ESRI's ArcIMS) had several bugs that would take the application down and adversely impacted the credibility of the WebGIS for many users. Diligent face-to-face customer service was instrumental in keeping users focused on the long-term goal and now they are reaping the benefits.

What Differentiates This System from Other Similar Systems

The WebGIS system serves as a user-friendly gateway for accessing several disparate databases all across the county. Additionally, it provides GIS capabilities to every wireless or WAN-connected computer in the county. The intuitiveness of a Web-based GIS front end gives end users easy access to data that is maintained by the true data owner. Data replication has been substantially reduced and in many cases users are now using data that in the past they never even knew existed. The county's seamless integration with FileNET has provided major dividends for staff that regularly need to access recorded subdivision and parcel maps, building permits, improvement plans, and more.

Our continued quest to make all geographically referenced county data (spatial, tabular, or image) available at every county desktop has made several county work processes more efficient. As a true "enterprise" system, WebGIS serves the county as a whole, rather than just a select few departments who have the funding to purchase custom applications. Many users also find that the WebGIS is a better way to access and view the data that they maintain, largely because of the ability to view and/or analyze the data spatially. Additionally, the WebGIS also contains several useful tools that have provided efficiency gains for county staff. A few of these include:

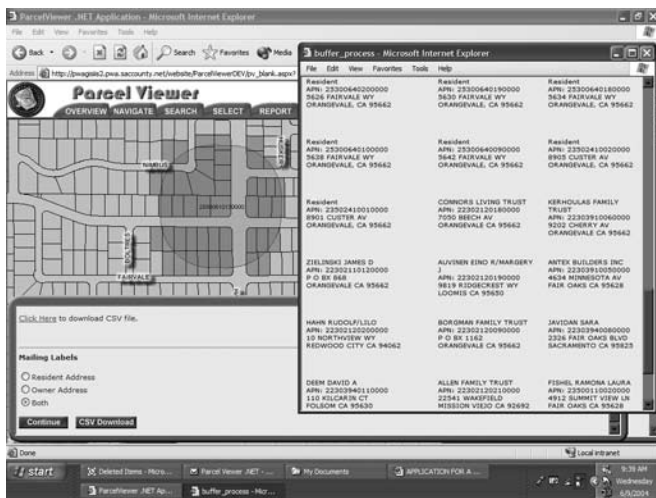


Figure 2. Mailing List Generation.

Buffer: In every WebGIS application, the user can interactively select/create a point, line, and/or polygon to be buffered, choose which spatial layer to be buffered, as well as select the buffer distance. In addition, the user can select a group of features by drawing a polygon to get the selected set he or she desires.

Mailing List Generation (see Figure 2): The primary purpose of most buffers is to generate some type of mailing list. Both "Resident Address" and "Owner Address" lists are automatically generated to an Avery label standard. An MS Excel download is available as well. The entire buffer-mailing list generation process for a standard 500-foot radius map used for notification of a zoning change takes less than a minute.

Bookmark/Redlining Tool (see Figure 3): The Bookmarking tool set enhances enterprise-wide communication and collaboration by allowing a user to save a bookmark or snapshot of the state of the WebGIS application at a point in time. For example, a bookmark that has been created stores information about layer visibility, zoom extent, feature selection, buffer results, user-created graphics, etc. Staff can communicate better by accessing shared bookmarks or e-mailing bookmark hyperlinks to other staff members. Another advantage is that a person can save his or her work and resume at a later time at the same exact spot he or she left off. The bookmark drawing tools allow a user to create text boxes, and draw objects such as text, circles, lines, and polygons onto the map. These drawing tools have improved staff's ability to communicate data errors and inaccuracies to the true data owners for correction.

Measure tool: The measure tool quickly provides an estimated distance between two points or an area of a polygon by zooming in and clicking on the mouse.

Additionally, all the basic tools, including pan, zoom, last extent, attribute selection, mouse selection, theme display on/off, and dynamic XY coordinate display, along with basic report and hard-copy printing capabilities are available.

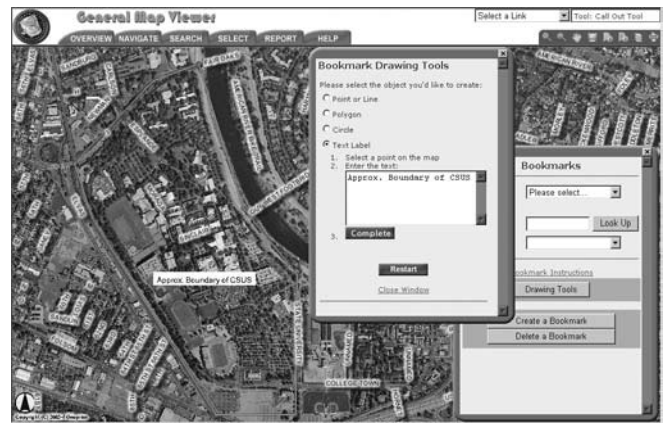


Figure 3. Bookmark Drawing Tools.

In summary, based on the impracticality of a single county-wide enterprise database, GIS has placed much of the burden of data integration on the WebGIS system. While some of the data has been centralized, much of it has been made accessible by the development of commonly understood and standardized database keys and data formats. This has allowed the successful publication of the following data sources to every personal computer connected to the county's wide area network:

- Land records including ownership
- Assessment data
- Street network with address ranges
- Early entry of new subdivisions with parcel numbers and addresses prior to recordation
- Building permits
- Zoning and land use
- Facilities (sewer, water, drainage, streetlights, signals, striping, etc.)
- Easements (spatial and imaged record documents)
- Imagery
- Scanned documents (maps, improvement plans, permits, deeds, assessor pages, etc.)
- Districts (political, school, park, fire, water, sewer, fee)
- Precincts
- Landmarks (schools, libraries, hospitals, fire stations, government buildings, etc.)
- Parcel history

County work processes are much more efficient than they were prior to the WebGIS development. Both interdepartmental and intra-agency cooperation and coordination have improved drastically. The growth in volume and accuracy of the data used on a daily basis for county decision making has enabled the county to provide a more efficient, superior level of customer service to its citizenry. The real bottom line is that the taxpayer/ratepayer in the county is not paying for multiple county departments

and/or regional agencies to build, maintain, and access many of the similar databases they have had to in the past.

System Hardware, Software, Data

Hardware:

Server Hardware:

- Compaq Proliant DL380 G3 P2800 512 KB, 2048 MB
- Two Web servers are running in parallel, configured in a load-balanced environment. The load-balanced environment includes two Cisco Content Switches that reside in two subnets, one for normal communications and one for load balancing. The two servers have two NICs teamed in failover mode connected to each Content Switch for redundancy and failover capability. The Content Switches are configured for affinity so that session states are held to the originally called server to avoid application conflicts. There is one Virtual IP Address (VIP) that users resolve to via DNS for all applications.

Software:

Server Software:

- ArcIMS 9.0
 - GeoPrise.NET 5.0
- ArcIMS is a server-based product from Environmental Systems Research Institute, Inc. (ESRI) for distributing GIS maps over the Web. ArcIMS provides Web publishing of GIS maps, data, and metadata for access over an intranet or the Internet.
- GeoPrise.NET is an ESRI business partner headquartered in Sacramento, California, that develops basic and advanced solutions for parcel, economic development, planning, and infrastructure information systems. The GeoPrise.NET software is completely customizable; new themes and data from a variety of sources, including imagery, documents, file-based and SQL-based tables, shapefiles, and ArcSDE, can be added easily to meet business requirements using a wizard-driven interface. GeoPrise.NET was the first to develop and deploy GIS Web application products that run over ArcIMS and are built from the ground up in .NET technology.

Client Software:

- Internet Explorer 5.x - current

Data:

- SQL Server
- Oracle
- FileNET
- CMMS

Data:

WebGIS Data Sources

- Property-Shared Database (PSD)—An Oracle database that stores data from many county departments. Data is continually being posted to the PSD from departmental

servers, including the Assessor, Building Permits, the Records Office, Planning and Finance. Property data includes elements such as address, zoning, ownership, land use, valuation, building characteristics, and permits.

- FileNET—Linkage to about a dozen document management databases, including scanned recorded and parcel maps, permit applications, property transfer deeds, and sewer plans.
- GIS attributes—Access to a database repository, based in SQL Server, for many facility data elements, such as sewer and drainage features, which are routinely imported from data sources of various levels of sophistication, ranging from spreadsheets to Access databases. This repository also maintains other commonly used data items that have not found homes in PSD or other departmental servers. These items include parcel “notes,” problem calls, landmarks, phone numbers, Thomas Brothers page numbers, utility billing, and many look-up tables.
- GIS spatial features—Of prime importance to GIS was the regular publication of the base map layers, including parcels and centerlines. These layers were used to register nearly all other GIS items throughout county departments, as well as provide widely used and needed data elements. These layers were complemented with several versions of county-wide orthophotography. The applications draw on a centralized storage of district boundaries, including school, fire, park, and water districts, as well as schools, hospitals, and other places with concerns for public safety. GIS also established standardized mechanisms for converting departmental files into publishable GIS themes.

Where Are We Now?/Future Directions

With the success of the Sacramento Regional GIS Cooperative (SRGC), a new level of GIS coordination and collaboration has been spawned in the Sacramento area. Not only are multiple public agencies standardized on a common landbase, but they are working together in the creation, ongoing maintenance, and access of several spatial layers. The use of the Sacramento County WebGIS applications has now expanded beyond the desktops of every county employee to more than 15 external organizations. These organizations include six incorporated cities; air quality, fire, water, park, and school districts; an electric utility and the local Council of Governments. Secure access is provided via VPN to more than 130 users in these organizations as they pilot the WebGIS capabilities within their organizations.

The flagship Parcel Viewer application has become a regional standard for accessing a multitude of property-related information. Once the individual organizations complete their pilot use of the WebGIS applications they will determine how many more connections are cost-beneficial. Two exciting projects have spawned out of the success of the previously mentioned efforts.

First, the SRGC has begun a Homeland Security Portal

Project to develop a street address maintenance Web site for efficient input of address range updates that will enable the SRGC participants to submit updates into the monthly maintenance workflow. The portal will improve work efficiency, reduce data-posting conflicts between agencies, and provide a transaction journal enabling each agency to determine the outcome of its individual data submissions. Now that all member agencies currently use the same street network file for address-matching applications, as well as public safety dispatch, the integrity and completeness of the file have drastically improved for the mutual benefit of all SRGC members.

Lastly, a pilot project has been kicked off to develop a software solution that will enable two-way access between GIS Web servers at different agencies. Ultimately, the cities can have their own version of Parcel Viewer available to their organizational desktops that will retrieve data from county servers and vice-versa. All participants will benefit by reducing redundant data storage and eliminating daily/weekly/monthly data uploads/downloads. In the future all participants will have ready-access information that is stored on the true "data owners" servers resulting in a regional integration of the most up-to-date information possible.

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