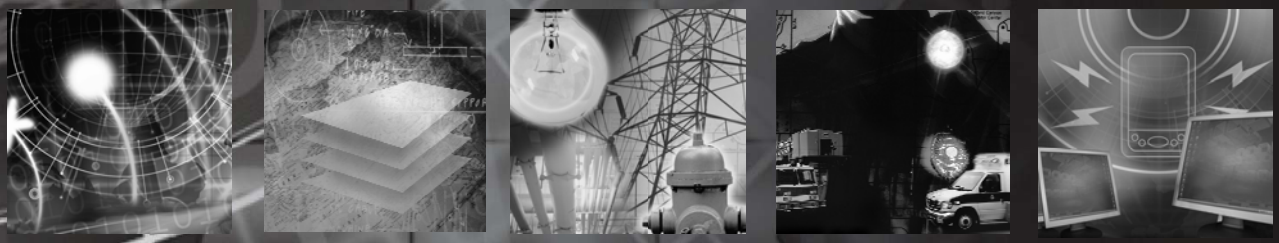
GIS STRATEGIC PLAN

GIS Needs Assessment and Implementation Plan 2007 Update



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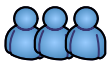
Guide to the Icons in the Document
Interspersed throughout this document are icons used to designate specific information and draw attention to key topics or points.

	Included in the needs assessments to designate a section about Personnel and Duties.
	Included in the needs assessments to designate a section about Hardware and Software.
	Included in the needs assessments to designate a section about GIS Needs and Duties.
	Designates a recommendation or key concept specific to a GIS need
	Included in the needs assessments to designate a Case Study
	Designates GIS Data Layers or data that can be converted to GIS Data
	Designates a section about GIS Applications to meet specific GIS goals
	Designates a specific GIS Application to meet specific GIS goals
	Identifies or designates Multi-tier GIS Users

Chapter One: Project History and Purpose

The City of West Sacramento has identified and utilized technology as a means for improving its business processes, infrastructure, services, information and decision-making. In 2004, the City recognized the value and importance of an enterprise Geographic Information System (GIS), thereby taking the necessary action to ensure that its implementation of GIS was efficient, effective, and viable. The City understood that to effectively implement GIS a roadmap was needed to identify the benefits, priorities and optimal implementation of the technology. The City contracted with Geographic Technologies Group (GTG) to perform a GIS Needs Assessment and Implementation Plan. This document has served as a road map for the successful implementation of the technology City-wide. Additionally, the City realized that for GIS to be effectively implemented a lead GIS staff person was needed. The City hired a GIS Specialist to direct the City's efforts.

As the acquisition, management, and dissemination of information continue to become increasingly valuable functions within local governments, so too has GIS proven to be increasingly valuable. The City of West Sacramento is no exception to this observation, as it too has benefited from its implementation of GIS. GIS and GIS-based technologies have contributed to improve the City of West Sacramento's business processes, infrastructure, services, information, and decision-making.

Of critical importance to the continued success of GIS at the City is maintaining a vision of the needs and direction of the program for the near future. This document will serve as that strategic direction. In July of 2007, GTG interviewed each department to discuss GIS successes and future needs. From this data gathering an update to the GIS plan has been formulated that identifies the project priorities for the next three years.

The City of West Sacramento's Geographic Information System (COWSGIS) is housed in the Information Technology (IT) Division of the City Manager's Office (CMO). The GIS team is comprised of a GIS Specialist and GIS Interns. GIS staff is assisted as needed by a compliment of information system professionals within IT.

The City of West Sacramento's GIS team has several fundamental goals. These goals are to:

- Maintain and provide high-quality spatial data to City Departments and the public
- Offer mapping services to citizens through the City's on-line mapping application
- Provide data to vendors for City-wide projects
- Offer new opportunities for in-house analysis
- Provide each City Department with the ability to obtain information more rapidly
- Create a system that will reduce maintenance costs, eliminate redundancy, and increase productivity
- Establish system standards that will insure system compatibility with outside agencies

- Foster interdepartmental coordination and cooperation, thereby avoiding interdepartmental conflict and assuring the most effective use of GIS resources
- Provide the public easy access to City services through mapping applications
- Create a user friendly system accessible to the public via the Internet

After formal adoption of the GIS Needs Assessment and Implementation Plan, initial development began in 2005. This initial development centered around the creation of GIS layers, incorporation of legacy data from existing information technology systems, and the acquisition of aerial imagery of the City. These tasks provided the City with the essential building blocks needed to implement enterprise-wide GIS.

The initial year's implementation focused on integrating existing data, data creation and procuring software. Another key ingredient was staff training. Training enabled the Information Technology Division and the GIS Specialist with the tools to lead the initial development of West Sacramento's GIS. Another goal was for the City to experience some early GIS successes. The need for GIS data access via a web browser interface was identified as a key target to show the utility of the technology. City staff created an intranet site that showcased the data that was being created/acquired and the ease-of-use of the technology. The intranet site was a significant success and allowed the City to move to true enterprise GIS in the first year of the project.

Year Two focused on continued database development and integration with existing applications. Training for IT and departmental staff was still a centerpiece during the second year. Public access to GIS data was given a priority as a public access kiosk and access to GIS via the Internet was implemented.

Year Three of the West Sacramento Strategic Plan is revolving around continued data sharing throughout the organization and maintenance of the City's geospatial data asset, GIS applications, and mapping products. The commitment by City staff to the three-year phased implementation plan has provided the City of West Sacramento a GIS that has become an indispensable tool for internal staff and the citizens of the City. In a short three year span, the City has gone from very little GIS to an enterprise GIS that rivals any municipal GIS on the West Coast.

COWSGIS has made great strides in data development since its inception. The creation of a GIS Implementation Plan has been critical to the successes to date. Many geospatial data layers have been acquired or created. In addition to the development of geospatial data layers, the City of West Sacramento is in the beginning stages of developing detailed metadata for most data layers, greatly enhancing its usefulness.

The City of West Sacramento's GIS team has identified advantages of the implementation of the enterprise-wide GIS. These advantages are comprised of:

- Quick access to data
- Centralization of information
- Querying capabilities from databases and legacy systems
- Inventory of infrastructure
- Mapping of emergency response resources

- Sharing of information between departments
- Elimination of redundant efforts between departments and agencies

Seven Keys to GIS Success in West Sacramento

At the outset of the GIS project it was identified that seven key ingredients needed to be put into place to realize full GIS success at the City of West Sacramento. The initial GIS plan identified ways to satisfy each of these key ingredients. These keys are based on an in-depth study of what components must be in place to have a successful GIS in municipal government. Over 500 local government GIS implementations have been analyzed and the seven keys below are found in all of the top implementations. West Sacramento has been meticulous in insuring that each of these keys was addressed and thus has become successful at the enterprise level. The following section details how each of these keys were accomplished and future opportunities for further success.

Key #1 – GIS Master Plan

There are no documented successful enterprise-wide municipal GIS implementations that have not developed a GIS Master Plan. As is typical with most municipalities, pockets of GIS usage can be found within a few departments before any formal GIS strategy is adopted. This is true for West Sacramento. A few departments were utilizing GIS for project specific tasks but these departments could not effectively share data amongst themselves resulting in inefficiencies, redundancies, and an inability to attain data needed to perform a task. The City of West Sacramento realized that to effectively utilize GIS a GIS plan was a must. Therefore, a GIS plan was authorized and contracted. The plan took an in-depth look at the needs and business processes of each department. This allowed for the prioritization of implementation tasks and the identification of how much funding was required. The three year plan was adopted and served as the foundation for the West Sacramento GIS initiative.

The failing of some municipalities is that they do not update the GIS plan. Over time priorities change, technology changes, and the organizational needs evolve. Therefore, it is critical to update the GIS plan. The City of West Sacramento understands the need to maintain a continual vision for the direction of this important project. If no plan is in place then the GIS initiative will stall. Geographic Technologies Group was contracted to assist the City with the creation of the GIS plan update. This document details the GIS successes to-date while taking a look at the additional needs of each department and the organization as a whole. This update to the plan should serve as the guide for City staff for the continued implementation of the technology. A three year vision for the City is the culmination of this effort and can be found at the end of this document.

Key #2 – Coordination

The master plan serves as the rudder of the ship. However, the ship also needs a knowledgeable captain on board. All of the most successful GIS programs have a full-time project leader. Having this person is the *most* important of the seven keys to GIS success because leadership can make or break the project. The City of West Sacramento understood this need and hired a GIS Specialist, Anthony Arieas, to spearhead the GIS implementation.

GIS Specialist
Anthony Arieas

The GIS Specialist position was placed within the Information Technology (IT) Division of the City Manager's Office. The IT Division has no inherent GIS needs of its own and is a service department for all other departments. This allows the Specialist to serve the entire organization equally while not feeling the pressure to serve the GIS needs of his own division to the detriment of other departments. The GIS Specialist is required to run diverse IT and GIS systems, networks, and GIS software and the people skills to coordinate, sell, champion, teach and referee the implementation of this revolutionizing technology.

Key #3 – Quick Successes

Many GIS implementations have not been successful because early successes were not identified and realized. Ironically, the initial phases of a GIS implementation are the most expensive and least glamorous. The most expensive component of a GIS is the creation of data. Some GIS project leaders have insisted that a host of GIS databases be excessively accurate before products are generated. Others have demanded that the GIS databases be excessively accurate before deployment-sometimes to within a millimeter when a few feet would suffice. Both of these scenarios kill the momentum of a GIS project. Months can turn into years as these databases are created. And with no visible products, leaders in an organization begin to question investment in the GIS.

The ultimate success of a GIS is often decided in the first year of the project. There is a honeymoon period of a few months, but after that, decision makers, under pressure to run government more like a business, need to see real work-related results. And once on their way, even successful GIS implementations can lose their momentum if staff rest on past successes. Products must be continually generated. Benefits must be quantifiable year after year. West Sacramento staff understood the need to identify short term success and make sure that these successes were made available to staff enterprise-wide.

The early successes that West Sacramento has completed, illustrate to City staff, elected officials and the public that GIS technology is worthwhile and realizing a return-on-investment. There are a number of projects that were a success in the first few years of the GIS implementation. These projects include the following:

- Rollout of GIS Desktop Applications
  - ArcGIS
  - ArcEditor
  - ArcIMS
  - Safe Feature Manipulation Engine FME
- West Sacramento Online GIS Web Portal
- Use of GIS for various needs involving: Land Use, Planning, Zoning, Addressing and Public Safety
- Public access kiosk application
- Access to Assessor PDF maps
- Access to subdivision index images
- Redevelopment utilization of GIS
- Enterprise GIS Training and Education
- Critical layer and dataset creation and access
- Annual imagery updates for West Sacramento

These successes are discussed in more detail in the next section of this document.

An organization that has a mature, successful GIS like West Sacramento, has to guard against staff complacency and myopia. Traditional GIS staffing structures do not allow much room for growth and advancement. Routines are established and the desire to find innovative uses of the technology can wane. GIS staff may find themselves doing the same kind of tasks over and over.
It is important to allow GIS staff to work on a variety of projects. This keeps the job interesting, broadens staff perspective and experience, and fosters innovative uses of the technology. Staff becomes more creative and more effective. New uses of the technology should be showcased and shared with the rest of the organization. If the GIS is to continue to be useful to the organization, all staff must continually be reminded about the powerful tool they have available to them. If months go by and no new GIS products and uses are shared, staff begins to lose interest in the system.

The next three years of the West Sacramento implementation have much promise for continued success. The immediate low hanging fruit is the further integration with the existing IT systems such as Accela and the Public Safety applications.

Key #4 – Education

A GIS project is not successful unless it meets a specific need or solves a specific problem and unless the GIS is considered a tool by all departments in the organization. For a department to look at the GIS as a problem-solving tool, an education process has to occur. Lack of knowledge about the capabilities of GIS is one of the major reasons that the technology is underutilized in some organizations. It is critical to the project's success that the GIS Specialist and other GIS staff explain the capabilities of GIS frequently in a variety of venues.

Although formal GIS hardware and software training is important, it is often less than effective for educating an organization about the usefulness of GIS technology. Users need information about how the technology is being used specifically in their field. Software training focuses on software functionality, usually in generic terms. Trainees who attend software classes can get a good understanding of how to make the software operate but still may not understand how they can apply it to their own tasks.

There are various methods of educating your organization about GIS. The City of West Sacramento should take advantage of two components of training identified in Chapter 8 of the Needs Assessment and Implementation Plan. The first component of GIS education outlines training for three types of users of GIS applications: Tier 1, Tier 2 and Tier 3. This type of formal training should be ongoing throughout the life of this project. This is not a one-time process and current training needs are outlined in this document update. The second GIS training component is user group involvement and GIS user conferences. A GIS user group should be formed and begin meeting quarterly. It is recommended that the following key components of GIS education are pursued over the next few years:

- A quarterly West Sacramento GIS users group meeting
- Involvement in the "City Lights" quarterly newsletter
- Formal software training as needed.
- Relevant GIS articles circulated to each department

Users Group - A GIS users group should be convened at West Sacramento. The group should meet at least once a quarter. A users group is an excellent way for users to share their expertise and experiences. All users of the GIS should attend these meetings. Each meeting should address the following topics:

- Current project – Each department/division should share the details of any GIS projects that are being worked on. Maps and data should be brought to show others.
- Upcoming projects – Upcoming projects should be discussed. Ideas on how best to accomplish the projects should be shared.
- Industry trends – New software releases, new hardware, and networking issues should all be discussed. This forum allows all users to stay abreast of the latest technology.
- New databases or changes to existing databases
- Upcoming GIS conferences and/or training
- A brief technical session – A user might conduct a brief how-to seminar on some aspect of the GIS.
- Organizational and staffing issues
- Joint project initiatives
- New funding sources
- Other issues

A users group will provide an excellent opportunity for communication among all GIS users at the City. It is a good venue for users to share their successes and failures. Duplication of effort will be minimized, and sharing of ideas and data will be optimized.

The main objective for the key to GIS education is to involve GIS users throughout the City of West Sacramento. Participation by Tier 1, Tier 2 and Tier 3 users will help everyone understand how GIS can assist City staff in doing their jobs more effectively.

Key #5 – Ease of Use

Many organizations implementing GIS have failed because they have given tools that are too complex to staff. The staff failed to realize the full potential with GIS because of their frustration with these tools. GIS tools must be easy-to-use and Tier 3 users need to be provided with the appropriate tool-set.

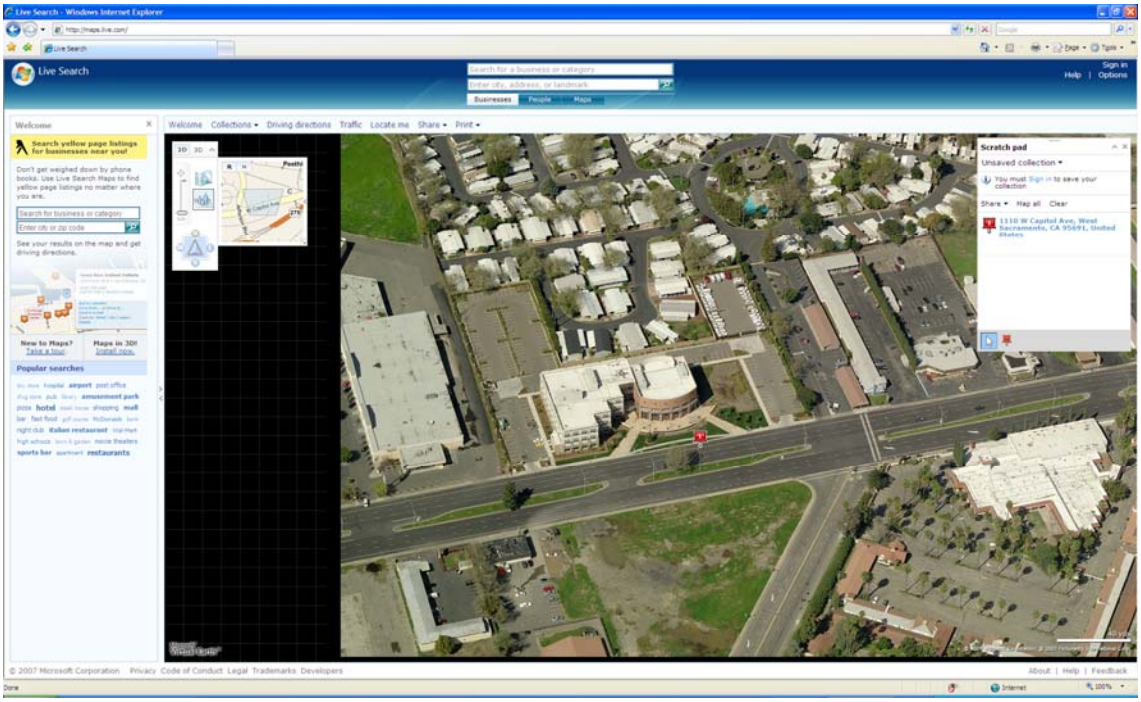
The City of West Sacramento has successfully rolled out an intranet/extranet browser application that is easy to use and allows access to all users of GIS. Additionally, a public access kiosk is available to access the wealth of GIS data at the City.

Public Access Kiosk – Second Floor Civic Center

Key #6 – Enterprise-Wide Implementation

Some organizations implementing GIS have failed because they have not provided tools to an adequate amount of staff to realize the benefit from the organizations investment in GIS. Each department that will be using the GIS frequently (more than once a month) will need trained staff. The GIS Specialist may conduct training for departmental staff in-house or arrange for formal training sessions conducted by a vendor. What is important is that each department develops its own expertise and has the appropriate tools to conduct their own GIS related tasks. The GIS should be presented as another tool for existing staff to use

in their daily tasks. Like a word processor or a spreadsheet, it should be seen as an indispensable tool.



Enterprise Access to GIS Data via a Web Browser

The GIS Specialist has focused on getting the proper level of GIS tools to each staff person. Some departments embraced the technology immediately and have trained staff to use it. Other departments will only use the technology infrequently and need a readily available enterprise-wide tool for their sporadic usage. The City of West Sacramento has an intranet browser for internal use and an Internet application available for public consumption. These tools have insured that a large group of users have access to the GIS investment. Additional application portals should be created as end user applications to meet a specific need.

Key #7 – Quantify Benefits vs. Cost

Quantifying the benefits of GIS is an on-going task for the GIS Specialist. This task involves keeping a current list of ways GIS technology has saved the City of West Sacramento time, money, and any other benefit that can be measured. There will be some obvious examples of how GIS technology has achieved a return-on-investment and other times when it is necessary to dig a little deeper to illustrate these instances.

- During the June 2007 interviews, City staff identified many times that having access to GIS data via a web browser saved hours of time by not having to gather information from various sources. Planning and Public Works can get as many as 15 calls during a 4 ½ hour shift regarding zoning for specific parcels. Each request could have taken hours but now that the Planning Division has access to GIS data via the web they can resolve these requests in minutes. This has made their job easier and customer satisfaction has increased.

- Potential savings exist with the developing layers of infrastructure data and City maintained assets.
- Capital Improvement Program (CIP) cost savings are likely because planning of future projects will identify where developers can tie in sewer and utilities and allow CIP to use City resources in more vital areas.
- Asset management pertaining to backflow devices and water meters. Public Works could identify where these assets are in the field allowing other divisions/departments to check these devices when they are on the same site location.
- The potential for life savings is enhanced as Public Safety has access to tools that allow them to analyze crime and fire incidents, respond to calls for service more quickly, and view critical data before arriving at a site.

It is important for GIS staff to continue to keep an eye on the return-on-investment (ROI) in regards to GIS. The graphic on the next page shows categories for ROI that should be analyzed by GIS staff. Each GIS application and use should fall under one or many of these ROI categories. If not, staff needs to consider if the investment is worth the expense.

GIS Return on Investment

Improve Efficiency

GIS helps organizations reduce and eliminate redundant steps in workflow processes. By implementing GIS programs you can reduce workloads for your staff and you can develop new procedures, resulting in increased productivity and ultimately efficiency.

Increase Productivity

GIS puts accurate, current information at your staff's fingertips when they need it, eliminating the need to waste time searching for lost data or trying to correct inaccurate data. Accurate digital and electronic GIS mapping can be easily accessed by and shared among all departments. And because information can be accessed so quickly and accurately, productivity will improve in all departments.

Save Time

Having the information when you need and want it saves time, staff resources, and ultimately money. Information can be made available to the public through a Web site or touch screen kiosks in convenient locations, reducing the demands on your staff.

Save Money

GIS helps control spending through cost savings and cost avoidance. Immediate savings can be seen through better decisions and increased productivity. Cost avoidance becomes apparent over time, as GIS helps organizations reduce and eliminate costs.

Make Better Quality and More Effective Decisions

A GIS is a critical tool to query, analyze and map data in decision support. GIS can, for example, be used to choose a location for a development that has minimal environmental impact, is located in a low risk area, and is close to a population center.

Improve Data Accuracy

GIS creates maps from data. Paper maps can be digitized and translated into GIS. Maps can be created on any location, at any scale, and showing selected information to highlight specific characteristics. Precise GIS data enables users to generate accurate reports and produce quality maps instantly.

Automate Workflow Procedures

GIS helps automate tasks that expedite workflow and enhance your ability to react efficiently during a crisis. GIS can automate routine analysis, map production, data creation and maintenance, reporting, and statistical analysis.

Save Lives

In an emergency, GIS can lead rescuers quickly and accurately to the scene. In an emergency, every second counts. The time saved in locating a citizen can be the difference between life and death.

Improve Information Processing

Enterprise-wide GIS streamlines the flow of information throughout the organization, leading to better accuracy, better access, and increased efficiency in every aspect of the organization.

Comply with State and Federal Mandates

Digital inventories of water, sewer, and storm water infrastructure are becoming increasingly important in local governments. A complete GIS program includes asset management, inventory control, and depreciation based on accurate and timely data including age, size, and construction materials; this allows managers to predict and schedule repairs and replacement.

Protect Your Community

GIS helps public safety officials develop emergency plans and respond to disasters more effectively than ever before. GIS offers the tools to monitor conditions, recognize threats, predict consequences, and respond effectively and efficiently to man-made or natural disasters. GIS can also help officials deliver information to citizens during an emergency, through emergency notification systems and the Internet.

Improve Communication, Coordination, and Collaboration

Good communication is the key to running an effective organization. GIS helps staff members and elected officials convey complex information in easy-to-understand formats.

Provide Data to Regulators, Developers, and Other Interested Parties

GIS makes it easy to deliver information for complex political and regulatory requirements. GIS allows regulators and developers to consider all pertinent data, which results in informed decisions and better results.

Respond More Quickly to Citizen Requests

With GIS data at hand, staff members can easily respond to citizen requests for information with maps. Maps are inherently easy to understand; they convey complex statistics and graphs clearly and easily.

Improve Citizen Access to Government

Internet access to GIS information is the ultimate convenience for citizens: 24/7/365, from their home or office. Staff is then free to help citizens with more complicated requests, resulting in increased customer satisfaction.

Effective Management of Assets and Resources

Effective management starts with analyzing, tracking, managing, allocating, and conserving assets. GIS technologies make production and delivery quick and efficient with maximum benefits.

Chapter Two: City of West Sacramento GIS (COWGIS) Implementation Success and Progress

The City of West Sacramento has made much progress towards an enterprise-wide GIS since the creation of the original "GIS Needs Assessment and Implementation Plan". The City has advanced from a few isolated pockets of GIS usage to a coordinated effort to enable all staff and the citizens with GIS data and GIS applications. This chapter details the progress made since 2004 in regards to all facets of the implementation.

Applications

Core GIS Applications

The original GIS implementation plan identified the need to adopt a core GIS technological solution. Various GIS software companies exist but by far Environmental Systems Research Institute (ESRI) is the leading GIS Company in the world and is the GIS software of choice for most municipalities. This was the recommendation software suite and has become the standard for West Sacramento. Additionally, West Sacramento utilizes Autodesk to update much of their digital mapping data. This data is then converted into an ESRI file format utilize SAFE software from FME.

ArcGIS 9.x

The GIS Specialist and key City staff are utilizing Environmental Systems Research Institute (ESRI) ArcGIS 9.x to maintain and develop the COWSGIS assets. The ArcGIS 9.x Suite affords the City the most robust GIS toolset available. The software tools allow for data management, sophisticated analysis, and data editing.

The City is considering utilizing Microsoft SQL Server in combination with ESRI's ArcGIS Server for data management. This combination will allow the City to efficiently store all geospatial data in a centralized data store. All City GIS data should be a part of this centralized data store to insure data consistency, backup, and compliance with City standards.

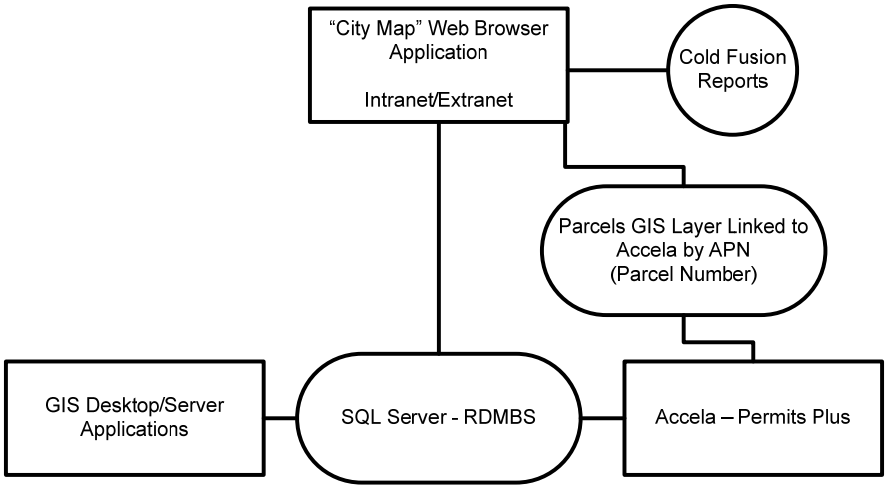
Additionally, ArcView is utilized by various departments for data manipulation, map production, and analysis. ArcIMS is utilized to allow users to access GIS via the intranet. More information about the end user browsers will be discussed further in this chapter.

Continued use of ESRI software is recommended. The latest version of the ESRI software ArcServer has been released and will allow West Sacramento to more effectively serve out data and applications to the user base.

Data Warehouse

The IT Division with the assistance of the GIS Specialist are combining GIS data and non-GIS data in a unique way. SQL Server is utilized to house all the City's permitting data (Permits Plus) and GIS data (ESRI). The GIS Specialist is

developing and maintaining the geospatial component with geographic information system (GIS) desktop and server applications in this SQL data warehouse. This same data warehouse is utilized to push the data to the intranet/extranet web browser application. The IT Division Staff utilize Cold Fusion from Adobe to pull department and division specific data into a report and make it easily accessible via the intranet application. Therefore, data from the GIS and Permits Plus is being accessed and mined via the central data storehouse.



West Sacramento Central Data Storehouse

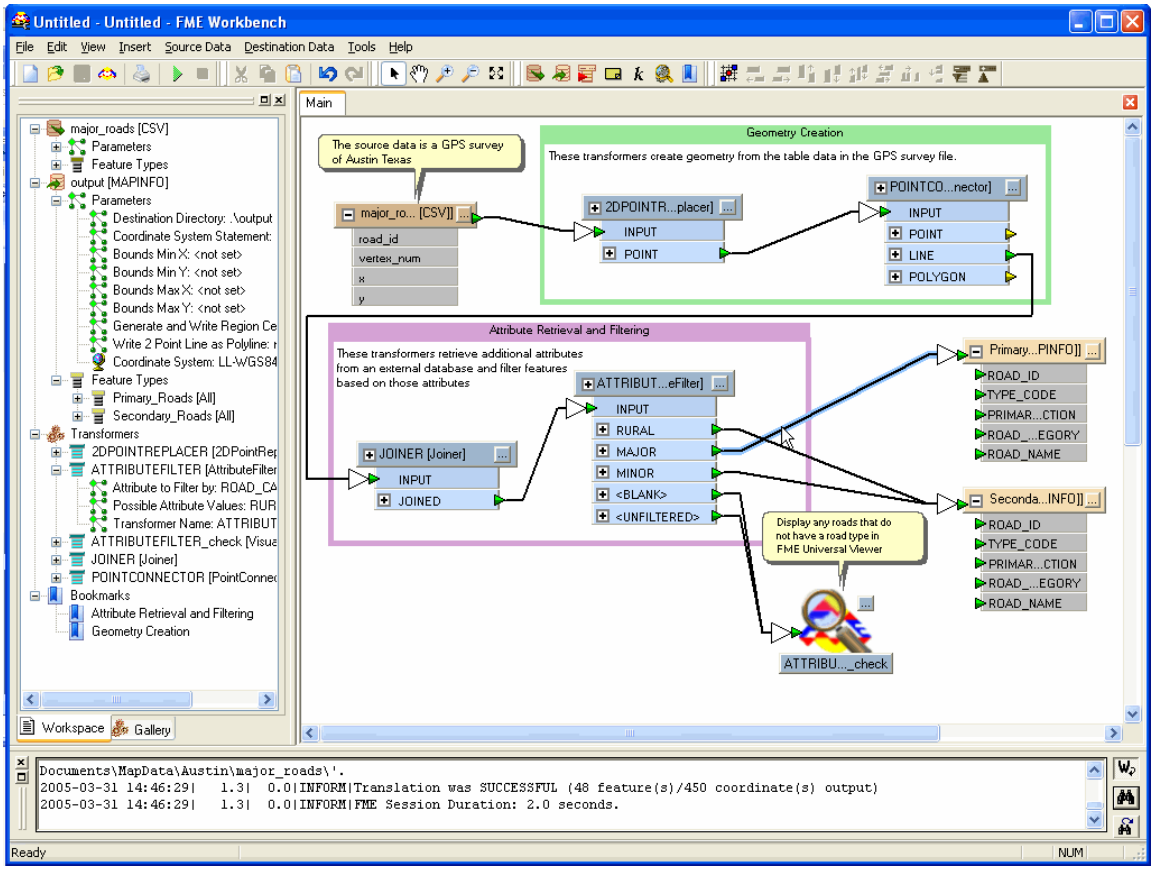
ESRI License Summary

The following table lists the current licenses of ESRI software, the type of maintenance, maintenance expiration data, and who is assigned the license:

Product	Maintenance Type	Expiration Date	User Name
ArcIMS (one server 2 cpu's)		2/1/2008	Information Technology
ArcIMS Developers Support		2/1/2008	Information Technology
Spatial Analyst		2/1/2008	Stacie Myers
3D Analyst		2/1/2008	Katie Yancey
Network Analyst		2/1/2008	Katie Yancey
Spatial Analyst		2/1/2008	Katie Yancey
ArcEditor	Primary	2/1/2008	Anthony Arieas
ArcView	Primary	2/1/2008	Stacie Myers
ArcView	Secondary	2/1/2008	Brian Coward
ArcView	Secondary	2/1/2008	David Tilley
ArcView	Secondary	2/1/2008	Extra
ArcView	Secondary	2/1/2008	Extra
ArcView	Secondary	2/1/2008	Cats Server
ArcView	Secondary	2/1/2008	Katie Yancey
ArcView	Secondary	2/1/2008	Robert Miller
ArcView	Secondary	2/1/2008	Ed Turley
ArcView	Secondary	2/1/2008	GIS Intern
ArcView	Secondary	2/1/2008	Dean Hebenstreit
ArcView	Secondary	2/1/2007	Bruce Williams
Community Sourcebook America w/ArcReader		8/4/2006	Redevelopment
ArcGIS Server Enterprise	Primary	2/1/2008	Information Technology

Safe Feature Manipulation Engine (FME)

FME (Feature Manipulation Engine) is an integrated collection of Spatial ETL (Extract, Transform, and Load) tools for data transformation and data translation. This is important for West Sacramento because it allows the Drafting Services Section to use their desktop application AutoCAD 2007 in tandem with ESRI's ArcGIS suite. Drafting Services works on data such as address point, storm water and sewer layers. FME will convert the AutoCAD 2007 files and provide them in a compatible format for ArcGIS. This allows the City to continue to leverage its expertise and investment in AutoCAD while seamlessly including the data into the central GIS storehouse.



Safe Feature Manipulation Engine (FME) User Interface

Tier 3 – End User Applications

The GIS implementation plan identified the need to have easy-to-use GIS applications for end users. Some organizations have made the mistake of putting too intricate of a tool in the end users hands. The result of this is that the user does not utilize the tool. West Sacramento made the decision to utilize ESRI's ArcIMS to serve easy-to-use software applications to their users via the intranet and to the public via the Internet.

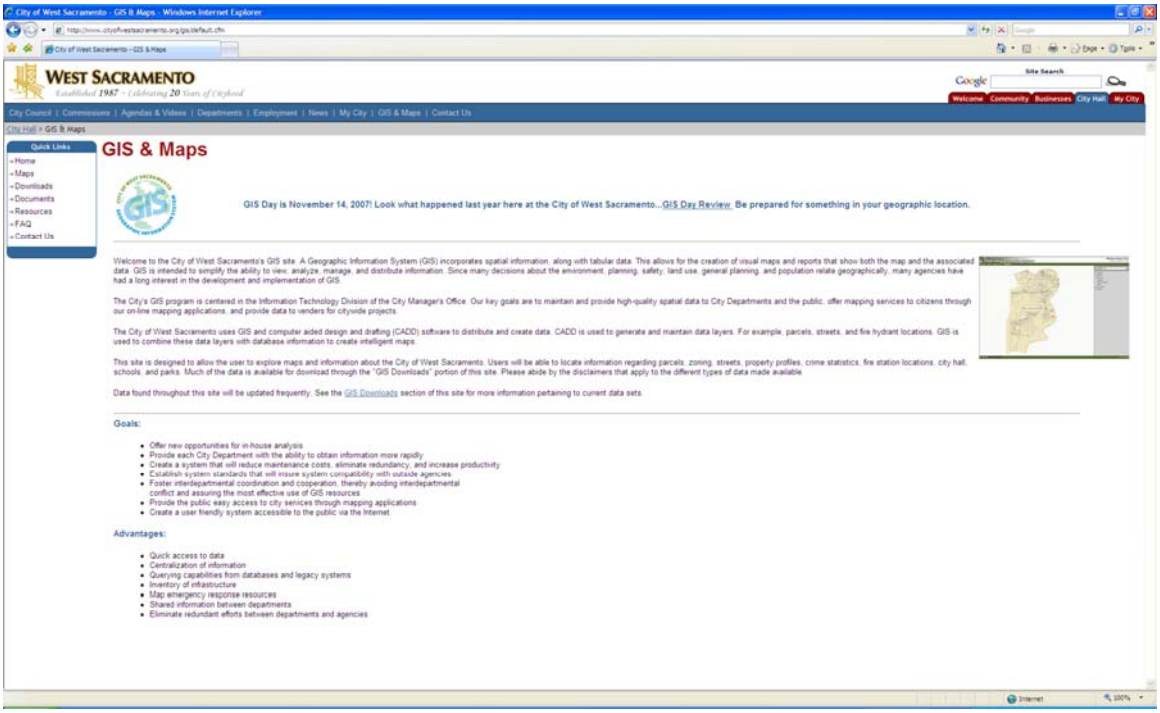
West Sacramento City Map Application – Public Access

ArcIMS is being utilized by the IT Division to publish geospatial data over the World Wide Web. The web application is named City Map and is available through the City's website. The site has been a big success on many levels. First, the public has access to the GIS investment made by the City and can answer many of their geographic related questions without having to ask City staff. Secondly, City staff has realized significant productivity gains. Staff now has central access to data that they had to gather from various sources in the past. During the interview process in June of 2007, many staff stressed that the web based sites have been a tremendous help to them and have saved them countless hours.

The following sections detail information that is being shared on the City's GIS web portal.

West Sacramento GIS and Maps Web Site

The West Sacramento GIS and Maps website is clear and concise in providing users information about the goals and advantages of providing geospatial data to the City and region of West Sacramento. The site allows users to contact the GIS Specialist and provides guidance to users who are not familiar with GIS. This site is designed to allow the user to explore maps and information about the City of West Sacramento. Users are able to access information regarding parcels, zoning, streets, properties, fire station locations, City Hall, schools, and parks. Much of the data is available for download through the "GIS Downloads" link of the website. The website can be accessed at: http://www.CityofWestSacramento.org/GIS



West Sacramento GIS & Maps Homepage

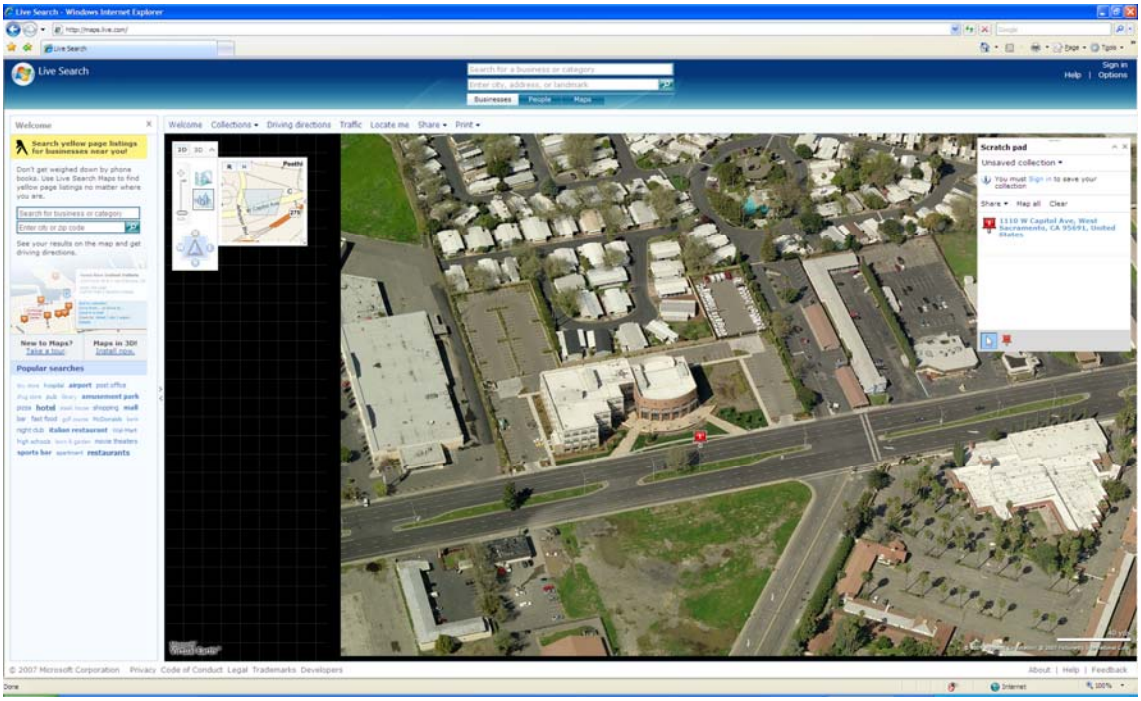
A long term goal for year one was to provide GIS data access via a web browser interface. This was a significant success making GIS available to the internal staff of the City of West Sacramento. In 2006, the West Sacramento GIS and Maps website went online. As new data becomes available, the website can easily incorporate new and updated data sets.

West Sacramento Oblique Imagery

The West Sacramento Maps Page contains a link to Oblique Imagery. This offers public access to a new feature from Microsoft called Live Search. Live Search is a free global mapping and search service that allows users to see West Sacramento from a bird's eye view. Some aerial photography was created in a joint effort with the Sacramento Area Council of Governments (SACOG). More information on aerial photography efforts can be found at the end of the layer listing later in this chapter.

The West Sacramento Maps page helps the user in understanding the definition of "oblique" and provides the link to viewing oblique imagery offered from Microsoft "Live Search" Website. The following is a description of the oblique imagery as described on the West Sacramento website:

> *"What does oblique mean? Oblique is the technical term used to describe an aerial photograph that is taken at an angle. This means that a feature, such as a house, building, street light, fire hydrant etc. can be seen in its entirety. For instance with Pictometry, you can see the front door of a house, the back door, the sides of the house, etc."*



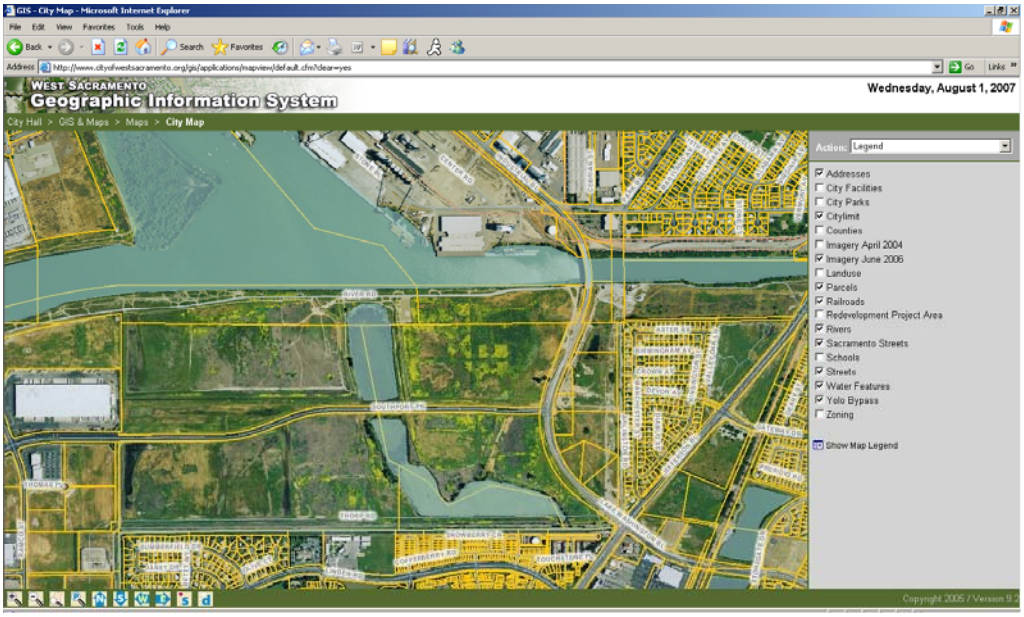
West Sacramento City Hall featured on the Windows "Live Search" Website

West Sacramento City Map Application – Public Access

ArcIMS is being utilized by the IT Division to publish geospatial data over the World Wide Web. The web application is named City Map and is available through

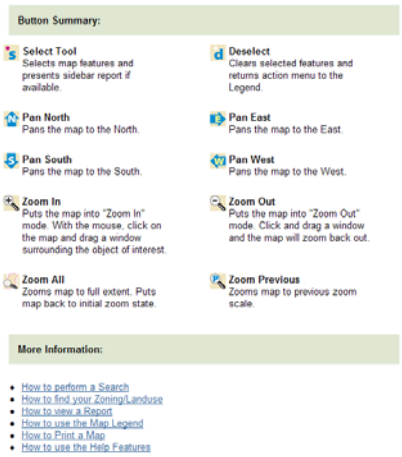
the City's website. The site has been a big success on many levels. First, the public has access to the GIS investment made by the City and can answer many of their geographic related questions without having to ask City staff. Secondly, City staff has realized significant productivity gains. Staff now has central access to data that they had to gather from various sources in the past. During the interview process in June of 2007, many staff stressed that the web based sites have been a tremendous help to them and have saved them countless hours.

The City Map site allows the GIS Specialist to serve geospatial data such as streets, schools, City parks and City facilities to the City's web server. West Sacramento citizens have praised the City for the availability of data and ease of use of the application.



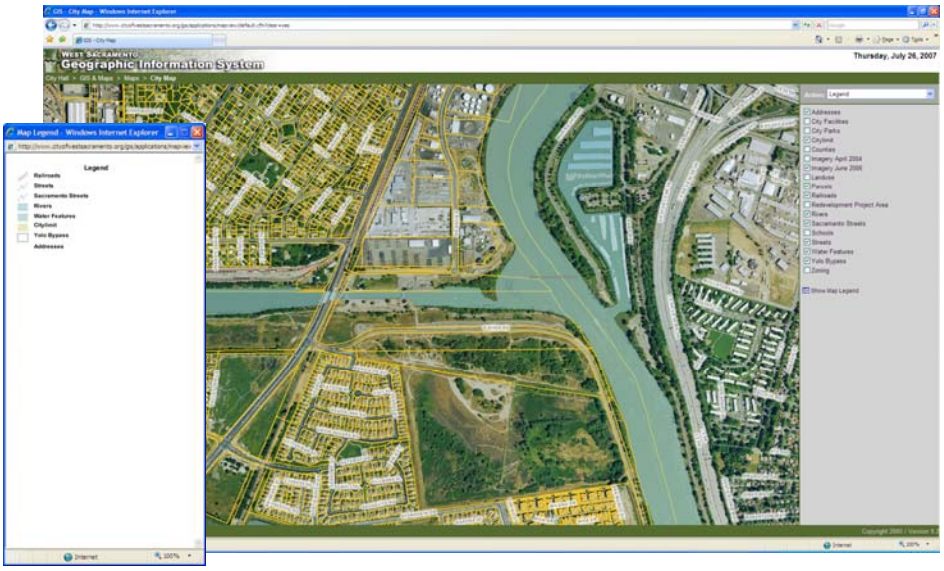
City Map Provides Users an Easy-to-Use GIS Portal

The site has an on-line users guide to step the users through the application. The Map User's Guide supplies information on searching, viewing reports, printing maps, and other helpful features.



West Sacramento City Map User's Guide

The City Map Application has a readily accessible map legend identifying available data layers.



Map Legend for the City Map Application

COWSGIS Downloads Page

West Sacramento has provided a portal for users to download and view selected data sets. The GIS Specialist updates these files to ensure that the data is current. If data issues are found the site has contact information for users to provide feedback.

Download Data Disclaimer | Download Data File | Send E-mail

Layer Name	Category	Type	Size	Updated	Notes	Owner/Agency	Contact
ArcGIS Projection File	ALL	ArcGIS File	461 bytes	03/01/2005	Use this file in order to assign COWS Projection to a shapefile.	I.T. Division	GIS Specialist
Address Points	Basemap	DWG & SHP	1.74 MB	01/03/2007	City address point layer.	I.T. Division	GIS Specialist
Street Centerline	Basemap	DWG/SHP/GeoDB	461 KB	07/11/2007	City street centerline file.	I.T. Division	Engineering Tech
West Sacramento Parcel Base	Basemap	DWG & SHP	5.14 MB	07/11/2007	City parcel base.	Engineering	Engineering Tech
Planning	Basemap	DWG & SHP	23.38 MB	09/05/2006	City zoning/landuse data.	Engineering	Engineering Tech
City Limit	Basemap	DWG & SHP	270 KB	01/03/2007	Citylimit polygon file.	I.T. Division	Engineering Tech
West Sacramento Schools	Basemap	DWG & SHP	113 KB	06/01/2006		I.T. Division	GIS Specialist
City Facilities	Basemap	SHP	24 KB	07/10/2007		I.T. Division	GIS Specialist
Water Features	Basemap	SHP	1.18 MB	04/27/2007		I.T. Division	GIS Specialist
City Monuments	Basemap	DWG & SHP	161 KB	03/01/1995	Metadata included within .zip file	Engineering	Engineering Tech
Fire Districts	Fire	SHP	1.08 MB	04/27/2007		I.T. Division	GIS Specialist
City Parks	Parks	DWG & SHP	440 KB	06/01/2006	Park polygon locations.	I.T. Division	GIS Specialist
Building Footprints	Planimetrics	SHP	427 KB	07/12/2007		Engineering	Engineering Tech
Police Beats	Police	DWG & SHP	12 KB	07/01/2005	Police Beat polygons.	I.T. Division	GIS Specialist
14 layers currently available.							

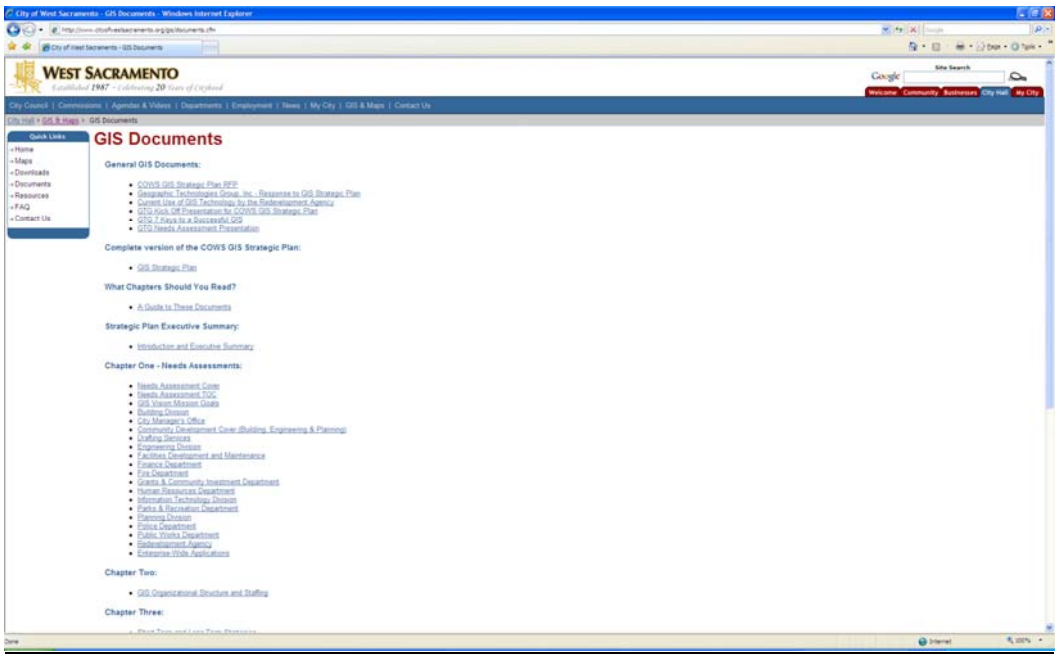
COWSGIS Downloads Page

The GIS data access area contains fourteen data layers available for the public as shown below. An internal version exists with an expanded data layer list available for City staff.

ArcGIS Projection File	This file contains the City of West Sacramento projection information in a format for ArcGIS users.
Address Points	The City Address Point Layer is maintained and owned by the IT Division. This layer is available in AutoCAD and ESRI format.
Street Centerline	The City Street Centerline Layer is owned by the IT Division and maintained by Drafting Services. This layer is available in AutoCAD and ESRI formats.
West Sacramento Parcel Base	Parcel information is maintained by the Drafting Services Section and is available in AutoCAD and ESRI format.
Planning	Planning layers provide information on Zoning and Land Use. This layer is maintained by Drafting Services and available in AutoCAD and ESRI formats.
City Limits	The City Limits layer is provided in AutoCAD and ESRI format. This layer is maintained by Drafting Services.
West Sacramento Schools	The West Sacramento Schools are available in AutoCAD and ESRI format. The Schools layer is maintained and owned by the GIS Specialist.
City Facilities	City facilities are provided in the ESRI shapefile format. This layer is maintained and owned by the GIS Specialist.
Water Features	West Sacramento water features are in the ESRI shapefile format. This layer is maintained by the GIS Specialist.
City Monuments	City monument points provide accurate survey information for future development. This data is available to users in AutoCAD and ESRI format and maintained by the Engineering Division.
Fire Districts	Fire District information is provided in ESRI format. The ownership and maintenance is provided by the GIS Specialist.
City Parks	City Parks are provided in AutoCAD and Shapefile format. This layer is maintained and owned by the GIS Specialist.
Building Footprints	Building Footprints are maintained by the Engineering Division. This information is gathered from the latest imagery. The data is in ESRI format.
Police Beats	Police beat data is maintained and owned by the GIS Specialist. This data is available in AutoCAD and ESRI format.

COWSGIS Documents

The West Sacramento GIS Documents page contains documents outlining the substance of COWSGIS. The GIS Documents page provides access to the GIS strategic plan and other pertinent information.



COWSGIS Documents Page

The complete version of the strategic plan is available as well as a breakdown of the plan by section and chapter.

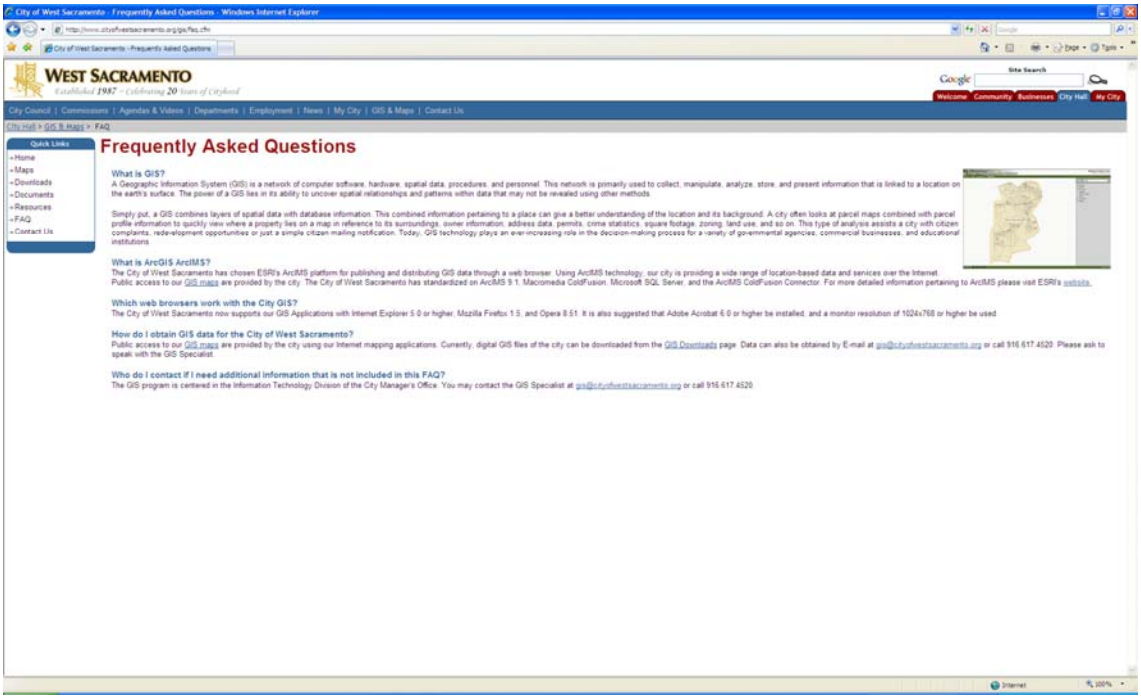
Resources

This section of the site supplies links to resources that are helpful to City employees and GIS users of the website. The links identified on the site include:

- Area Cooperatives – Sacramento Area Council of Governments (SACOG) and Yolo County
- GIS Education – ESRI Training and ESRI Glossary of Terms
- User Groups - Urban and Regional Information Systems Association (URISA) and the National Emergency Number Association (NENA)
- Geography Links - Association of American Geographers (AAG), The Census Bureau and The United States Geological Survey (USGS)
- Vendor Links - Geographic Technologies Group, Inc. (GTG) Environmental Systems Research Institute (ESRI) and Autodesk

Frequently Asked Questions

This section of the website is helpful for users entering the site for the first time or for someone needing help with additional information. The site answers frequently asked questions and provides links to find more detailed information.



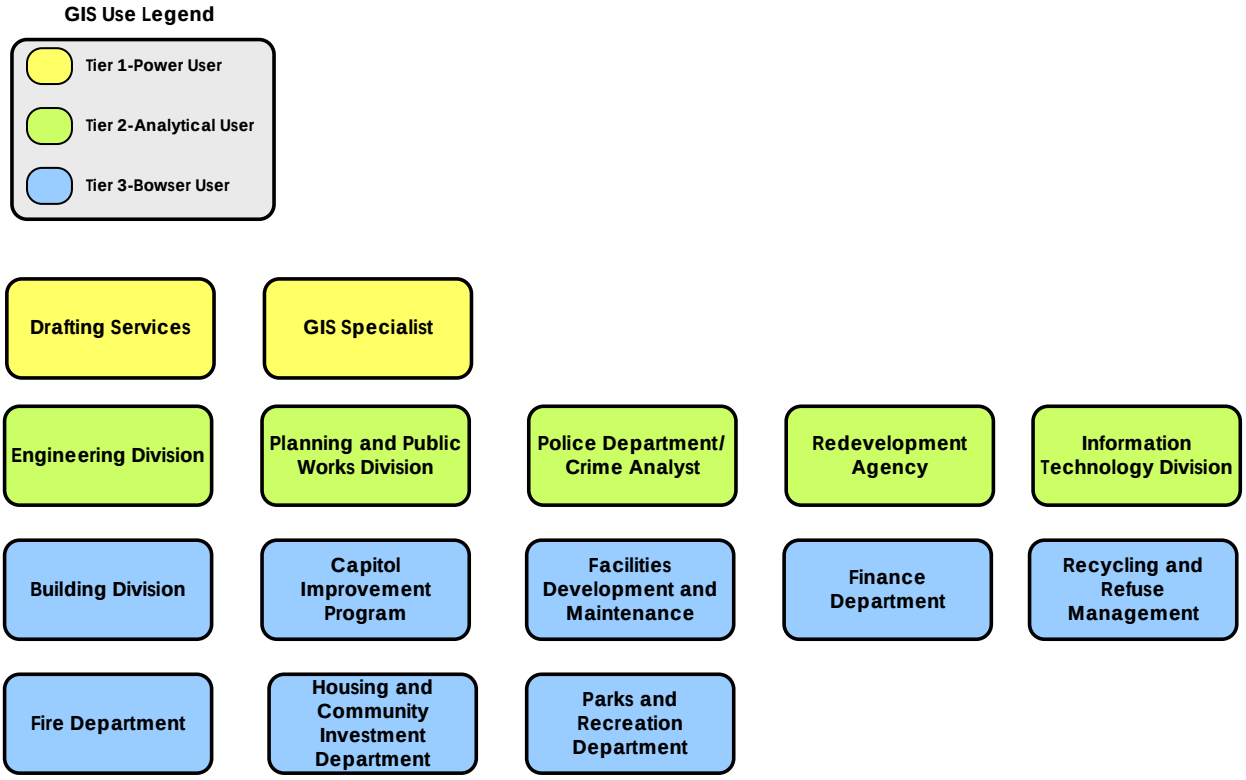
Frequently Asked Questions

Employee Usage

Although the site is available to the entire Internet community, a significant percentage of the COWSGIS website usage comes from the employees of the City of West Sacramento. Employees are finding the applications to be very useful in their daily job responsibilities. For example, the West Sacramento Planning Division has used the Internet Mapping Service to respond to public inquiry calls and site verification of projects. The users can quickly find addresses and verify zoning information regarding specific parcels. This allows City staff to take minutes gathering information via the web versus gathering this information in the zoning map books and other resources.

Tiers of GIS Usage

The GIS Strategic Plan outlined three types of users (Tiers 1-3) for geospatial information. The Tier 1 user is a power user of GIS tools and should have access to a fully functioning application with maintenance and data development capabilities. Tier 2 users will use GIS applications primarily for analysis of existing geospatial data. Tier 3 users have access to the City's data via the intranet/extranet web browser application. The following graphic illustrates which departments are at which Tier of GIS usage:



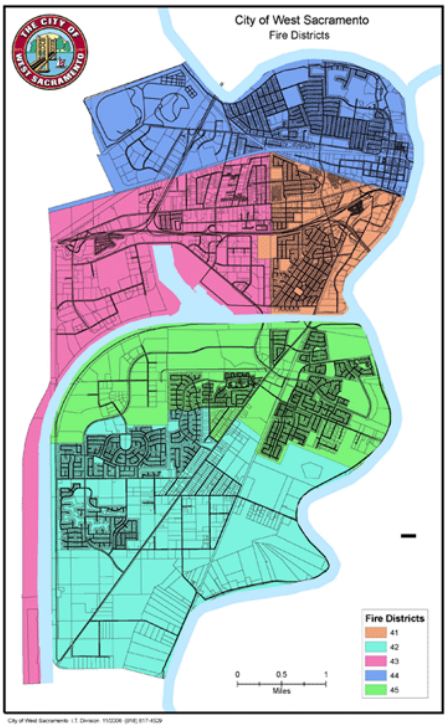
City of West Sacramento Multi-tier GIS Software Users

Exemplary Projects

The West Sacramento GIS effort has yielded many success stories. Some of these manifest themselves as specific tasks to fulfill a need for a department or group. Samplings of these successes are discussed in this section.

Fire Department – Station Coverage Map:

One of the driving forces for any municipal GIS is Public Safety. One of the initial efforts is to document, delineate, and optimize response areas. The map at the right depicts the City's fire districts and fire station coverage areas. The GIS Specialist maintains this layer data. A logical use of GIS is to study response time and optimal location of any future facilities to serve the citizenry. A focus during the upcoming year will be to map out fire incidents, hazardous materials, and building pre-plans. Each of these will allow fire officials to better prepare and respond to emergency situations.



Redevelopment Agency Utilization of GIS

The mission of the Redevelopment Agency is to stimulate positive change, build a vibrant retail sector, a prestigious office address, diverse, high-quality residential neighborhoods, and to provide quality employment opportunities for all residents. The Redevelopment Agency facilitates redevelopment within a project area by encouraging investment by private developers and property owners, aggregating development sites and planning and entitling properties for development. Other activities include assisting in the financing and installation of public facilities and attracting and retaining businesses and targeted industry facilities.

The Redevelopment Agency uses GIS to track data such as vacant land, leaky and underground storage tanks, brownfields and crime. Other data that impacts decision making are locations of day cares, businesses with liquor licenses and areas where improvement have been made.

Mapping all of these factors is important for Redevelopment. The Agency utilizes mapping products to encourage revitalization and to document issues critical to the well being of West Sacramento.

Washington Unified School District

The West Sacramento GIS has been beneficial to the local school system. The map at the right depicts the school locations by type. Assistant Superintendent Susan Brothers complemented the City of West Sacramento for making data available that they were able to use to update their attendance areas. The GIS Specialist has strived to provide pertinent data for public consumption and for use by other government agencies. The school district is able to utilize the public web site to locate addresses and do geographic queries pertinent to district staff. The school district has taken advantage of the City Map Application street search utility and can insure that they are assigning students to the proper school.

Training and Education

Another key component for GIS success is education of City employees and the public on the uses of GIS tools and data. Annually, there is a national GIS Day to promote awareness of the technology. West Sacramento has utilized GIS Day as a forum to educate staff and the public about GIS and its uses by the City. The following information details the 2006 and 2007 GIS Day events and is taken from the West Sacramento web-site.

Wednesday , November 15, 2006

2006 GIS DAY

The Planets Are Aligned on GIS Day West Sacramento, California

The Northern California Chapter of the Urban and Regional Information Systems Association (NorCal URISA) along with the City of West Sacramento partnered to celebrate GIS Day in November at the West Sacramento Civic Center. The event, which included a wide variety of participants encompassing professionals from federal, state, and local governments as well as environmental consulting firms, GIS equipment vendors, and local GIS educators, treated its guests to a special hosted lunch and a GIS Day cake for dessert.

Visiting the transportable Topcon Satellite Theatre was the highlight for many attendees, as GIS moviegoers interested in positioning technologies were able to view a movie on the inside of a 360-degree planetarium dome. The movie, titled Celestial Connections—Guiding GIS Solutions, was a fictional characterization based on a real-life story of a GIS professional attempting to collect GPS position data, attributes, and digital photographs who experiences frustration dealing with multiple pieces of hardware, as well as buildings and tree canopy that block the GPS signals.

The movie showed viewers how spatial technologies could be used to overcome these obstacles to achieve project success.

"Going to the Topcon Satellite Theatre as part of our GIS Day really made the event special," says Anthony Arieas, City of West Sacramento GIS Specialist and GIS Day event organizer. "GIS is not just about making maps; it is also about data and data collection. The theater gave our attendees the chance to have fun learning about GPS in GIS—how it works, how satellites work—and they were able to walk away with a better grasp of what GIS really is."

2007 GIS Day

This year GIS Day is Wednesday, November, 14th 2007. Allowing the West Sacramento Region to view what has been accomplished by the IT Division in year two of the Strategic Plan. Taking advantage of GIS day creates goodwill with City staff and citizens of the area. Maintaining this event allows GIS users of all levels to visit with the IT Division and keeps the City abreast with current technologies in hardware and software.

GIS Training and Education

The City of West Sacramento has taken advantage of training offered by ESRI in years one and two of the strategic implementation plan. It is important to provide continuing GIS education in year three for Tier 1, Tier 2 and Tier 3 users. The City of West Sacramento continues to be proactive in sending the GIS Specialist to GIS conferences. This is a benefit because it allows the City to receive information on the most up-to-date GIS technology.

Below is a summary of training taken during the first two-years of this project:

Tier 1 User - GIS Specialist:
Introduction to ArcGIS I – Year One
Introduction to ArcGIS II – Year One
Introduction to ArcIMS – Year One
ArcIMS Administration – Year One
AutoCAD Map – Year One
Safe FME – Year Two
ESRI International Users Conference
Urban and Regional Information Systems Association (URISA)

Tier 3 Users
Utilization of the Tier 3 Internet/intranet data browser
Utilization of the Tier 3 Public Access Kiosk application

Layer and Dataset Creation

The following table displays what data has been created or acquired during the first two years of the project. Data layers highlighted in blue have been created/acquired and those not highlighted are identified as future data layers:

Dataset/Layer	Complete	Maintained By
Address Points	Yes	GIS
Aerial Photography	Yes	GIS
Backflow Devices	In progress	Drafting Services
Bad Bridges		
Bicycle/Pedestrian Facilities		
Building Permits		
Buildings with Site Plans		
Business Data	Yes	Finance
Business Loans		
Census Data	Yes	GIS
Certificates of Compliance		
City-Owned Property	Yes	GIS
Commercial Addresses		
Community Facilities District	Yes	Drafting Services
Crime Data		
Critical Facilities	Yes	GIS
Day Care Facilities		
Drafting Water Sources		
Easements		
Encroachment Permits		
Enterprise Zone Boundary		
Entrapment Areas		

Dataset/Layer	Complete	Maintained By
Facilities	Yes	GIS
Fire Hydrant Permits		
Fire Hydrants	Yes	Drafting Services
Fire Incidents		
Fire Inspections		
Fire Investigations		
Flood Zones		
GCI Special Plan and Special Study Areas		
General Plan	Yes	Drafting Services
GPS Monument Map	Yes	Drafting Services
Hazardous Materials		
Housing Condition Data		
HUB Zone Boundary		
Impervious Surfaces		
Industrial Pretreatment		
Irrigation Lines		
Irrigation Sprinkler Heads		
Jurisdictions (Adjacent)	Yes	GIS
Labor Force		
Landscaping Planters (CFD maintained)		
Land Use	Yes	Drafting Services
Levees		
Licensed and Unlicensed Businesses		
Liens		
Lighting and Landscape Base Map	Yes	GIS
Liquor Licenses		
Major Intersections		
Measure "K" Street Rehabilitation		
Mello-Roos Districts		
Neighborhood Watch Areas		
Oak Trees (Heritage)		
Parcels	Yes	Drafting Services
Park Benches		
Park Facilities	Yes	GIS
Park Lights		
Park Signs		

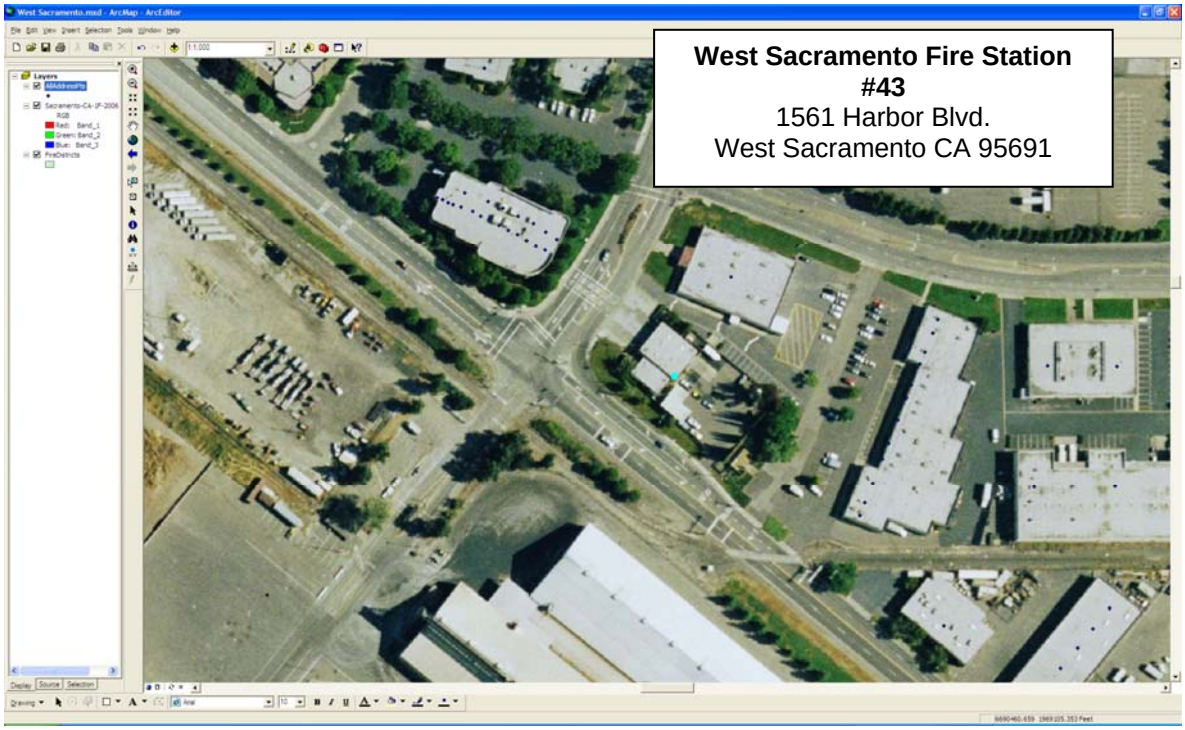
Dataset/Layer	Complete	Maintained By
Park Tables		
Park Trash Receptacles		
Park Tree Canopies		
Parks	Yes	GIS
Parolees		
Planning Department Special Projects		
Police Beats	Yes	GIS
Police Department Special Projects		
Police Station Location	Yes	GIS
Port	Yes	GIS
Real Estate Sales		
Reclamation District Base Map		
Record of Survey Base Map		
Redevelopment Project Areas	Yes	GIS
Redevelopment Projects		
Rehabilitation Projects		
Riverfront Infrastructure		
Schools	Yes	Drafting Services
Sewer Base Map	Yes	Drafting Services
Sewer Fees Base Map		
Sexual Offender Locations		
Sidewalk Trip Hazards		
Signs		
Site Location Base Map		
Social Service Facilities		
Speed Zones		
Sphere of Influence	Yes	Drafting Services
Storm Base Map	Yes	Drafting Services
Storm Drain Fee Map		
Street Lights		
Street Sweeping Routes	Yes	Drafting Services/GIS
Street Trees		
Streets	Yes	Drafting Services
Striping & Pavement Markings		
Tax Assessment Districts		
Telecommunication Facilities		
Topography/Contours		

Dataset/Layer	Complete	Maintained By
Traffic Accidents		
Traffic Base Map		
Traffic Calming Devices		
Traffic Counts		
Traffic Signals		
Transit Routes		
Trees (Parks)		
Truck Routes		
Under-Utilized Buildings		
Vacant Properties		
Water Base Map	Yes	Drafting Services
Water Meters	Yes	Drafting Services
Water Quality Complaints		
Waterways		
Work Orders		
Zoning	Yes	Drafting Services

2007 Imagery Update of West Sacramento

The Sacramento Area Council of Governments (SACOG) is an association of local governments in the six-county area of El Dorado, Placer, Sacramento, Sutter, Yolo and Yuba. SACOG coordinates geospatial information in the Mapping Center with several GIS staff members. This endeavor allows local governments to pool their resources for aerial imagery into one collection effort. West Sacramento has participated in this regional effort.

The regional effort has provided West Sacramento with superior quality imagery meeting National Map Accuracy Standards (NMAS). The full color aerial photography has a high resolution and accuracy. Each pixel represents approximately six inches of ground distance and the accuracy is +/- six inches. This resolution is superior quality and provides COWSGIS with photography to capture and maintain current and future datasets at an approximate scale of 1:200.



2007 West Sacramento Aerial Photography

Multiple versions of digital aerial photography have been acquired by the City. The City contracted with Air Photo USA in 2004 to create a comprehensive digital orthophotography layer of the City. The City participated with a consortium of other cities and SACOG to contract for new photography in 2006. One foot and ½ foot pixel resolution aerial photography was obtained in the 2006 flyover. A new flyover is being considered for 2008. This imagery can assist in interpreting land use information, future development, flood plain analysis and a host of other tasks.

Summary

The City of West Sacramento is in its third year of GIS implementation. Many significant milestones have been accomplished and many more opportunities await. The City has been proactive in disseminating GIS data and educating the internal and external users as to the benefits of the technology. The next two chapters detail the remaining needs of the organization and prioritize their implementation.

The chart on the following pages highlights departmental goals that were identified in the original implementation plan and their current status.

City of West Sacramento, California
Departmental Goals

City Department	Goal	Goal Accomplished?	Progress Towards Goal
City Manager's Office	1. Support enterprise-wide implementation of GIS		
	2. Participate in GIS Steering Committee		
Information Technology Division	1. Implementation of three levels of enterprise-wide GIS support (training and technical)		GIS Newsletters, email notifications, and training opportunities.
	2. Provide ad hoc GIS user support		
	3. Provide GIS software support		
	4. Provide training for City employees on new GIS applications		
	5. Continued evaluation of network infrastructure and configuration		
	6. Coordinate GIS collaboration with regional organizations, including Yolo County and SACOG		
Building Division	1. Implement a GIS application that provides access to multi-departmental GIS data layers		
	2. Work with GIS Specialist to spatially enable Permits Plus data		

City of West Sacramento, California
Departmental Goals

City Department	Goal	Goal Accomplished?	Progress Towards Goal
	3. Work with GIS Specialist and IT to integrate mapping interface with existing online permit search application		
	4. Utilize GIS to map and analyze building and sewer inspection locations, occupancy, permit fees, inspection and code violations and more	Partial	The Drafting Services Section is currently mapping our Sewer and Building Infrastructure. Reports, searches, and inspections are in our scope.
Engineering Division	1. Utilize GIS to map and analyze transportation, utility, and facilities infrastructure	Partial	The City of West Sacramento has been working on data creation and GIS standards for the last three years. IT anticipates more analysis with this data over the next three years. Facilities and the City infrastructure have been mapped.
	2. Implement a GIS-based transportation infrastructure management solution	Partial	Working towards a routable street centerline file with SACOG and our Yolo County GIS Consortium.
	3. Implement hand-held computers to provide field staff with access to geo-spatial data	Partial	The City of West Sacramento's IT Division is now prepared to support mobile devices in the field with a high speed cellular connection.
	4. Conduct GIS-based transportation modeling and analysis, including traffic accident and traffic flow analysis	Partial	Working towards a routable street centerline file with SACOG and our Yolo County GIS Consortium.

City of West Sacramento, California
Departmental Goals

City Department	Goal	Goal Accomplished?	Progress Towards Goal
	5. Implement an application that provides staff with access to automated neighborhood and vicinity mapping		
	6. Work in conjunction with the GIS Specialist and IT to provide a public Internet GIS data browser that includes access to transportation, utility, and facilities infrastructure data		
Drafting Services	1. Coordinate GIS data production and maintenance efforts with GIS Specialist		
	2. Work with GIS Specialist to standardize, centralize, and consolidate geo-spatial data to an enterprise data store		
	3. Continue to produce and map the City's base map data		
	4. Continue to produce and map the City's infrastructure data		
	5. Convert selected datasets from CADD format to a geo-spatial format		
	6. Implement and enforce digital submission standards for external maps		

City of West Sacramento, California
Departmental Goals

City Department	Goal	Goal Accomplished?	Progress Towards Goal
Facilities Development and Maintenance Division	1. Utilize GIS for mapping and spatial analysis of facilities and maintenance data		
	2. Implement hand-held computers to provide field staff with access to geo-spatial data	Partial	The City of West Sacramento's IT Division is now prepared to support mobile devices in the field with a high speed cellular connection.
	3. Work in conjunction with the GIS Specialist and IT to provide a public internet GIS data browser that includes access to City facilities and proposed development locations	Partial	City facilities completed. Proposed development is a layer that we have not gotten too.
Planning Division	1. Implement various GIS applications to support mapping and spatial analysis of land use and zoning data		
	2. Implement an application that provides staff with access to automated neighborhood and vicinity mapping	Attempted	Found issues defining neighborhoods between departments.
	3. Implement GIS-based planning support systems to conduct scenario modeling and analysis		
	4. Work in conjunction with the GIS Specialist and IT to provide a public Internet GIS data browser that includes access to City facilities		

City of West Sacramento, California
Departmental Goals

City Department	Goal	Goal Accomplished?	Progress Towards Goal
	5. Implement a public access kiosk to provide front counter support		
Finance Department	1. Convert and consolidate all relevant databases maintained by Finance Department to GIS data layers using applicable address information	Partial	Many addresses have been normalized to our Address Point Layer. The Assessor Tax Roll information, Permits Plus data, CFD and Lighting & Landscaping information has been incorporated.
	2. Work with the GIS Specialist to migrate and integrate all GIS data into a centrally managed, distributed data store		
Fire Department	1. Continue to expand and enhance GIS capabilities to reduce response times and coordinate resources		
	2. Establish streamlined access to accurate parcel, centerline, and address data in and beyond city limits		Addresses are mapped inside our city only.
	3. Identify and produce new GIS data layers for fire and emergency management, including Entrapment Areas, Automatic Aid Areas, and more	Partial	Some layers are still in the works.
	4. Implement mobile GIS technologies for use by field staff for resources and response management	Partial	

City of West Sacramento, California
Departmental Goals

City Department	Goal	Goal Accomplished?	Progress Towards Goal
	5. Implement a web-based mapping application that allows citizens to view risk information and fire department infrastructure (e.g. fire stations, hydrants, etc.)		Fire Stations and Hydrants are posted and complete.
Grants & Community Investment Department	1. Utilize GIS for mapping and spatial analysis, including viewing and analyzing City demographic information, proposed real estate project location analysis, identifying vacant and under-utilized land, Community Development Block Grant Benefit Analysis (CBA) for projects, programs, and CDBGs and more		Not yet although census data has been added to our GIS site internally.
	2. Work with GIS Specialist to produce cartographic products for grant proposals		
	3. Work in conjunction with the GIS Specialist and IT to provide a public internet GIS data browser that includes access to housing and land information		
Human Resources	1. Support Enterprise-wide GIS implementation		
Parks and Recreation Department	1. Utilize GIS to improve facility and program management		
	2. Mapping and spatial analysis of parks and recreation data		

City of West Sacramento, California
Departmental Goals

City Department	Goal	Goal Accomplished?	Progress Towards Goal
	3. Field access to geo-spatial data	Partial	The City of West Sacramento's IT Division is now prepared to support mobile devices in the field with a high speed cellular connection.
	4. Work with the GIS Specialist to implement a GIS interface to irrigation control system		
	5. Implement a GIS-based work order management system (long-term)		
	6. Work in conjunction with the GIS Specialist and IT to provide a public Internet GIS data browser that integrates existing on-line activity registration application with mapping capabilities		The City is looking at going away from our current system. Once a decision is made we will incorporate GIS punctuality.
Police Department	1. Utilize GIS to facilitate crime, incident, and traffic accident analysis, hot spot mapping, court case and logistical support and more	Partial	Crime Mapping coming on line late September.
	2. Provide field spatial data access for officers through mobile GIS technologies	Partial	The City of West Sacramento's IT Division is now prepared to support mobile devices in the field with a high speed cellular connection. A GIS is ready for consumption by our PD mobile devices.
	3. Implement GIS-enabled applications for use with department RMS		

City of West Sacramento, California
Departmental Goals

City Department	Goal	Goal Accomplished?	Progress Towards Goal
	4. Implement a web-based mapping application that provides citizens with access to criminal activity and reports	Partial	
Public Works Department	1. Utilize GIS to improve management and regulation of City infrastructure		
	2. Provide spatial data access for field crews through mobile GIS technologies	Partial	The City of West Sacramento's I.T. Division is now prepared to support mobile devices in the field with a high speed cellular connection.
	3. Convert and consolidate department databases from disparate formats and databases to GIS data layers		
	4. Work with Drafting Services to convert legacy knowledge ("brain trust") to digital GIS data layers	Partial	All Sewer, Water, Storm infrastructure is currently being GPS and mapped.
Redevelopment Agency	1. Utilize mapping and spatial analysis for support of economic development and Redevelopment projects, including proposed project location analysis, identifying vacant and underutilized land, CDBG administration and analysis, Environmental Assessment for CDBGs, focus area identification and evaluation, citizen education and advocacy	Partial	Working with Redevelopment in order to obtain many of these layers, evaluate their status, and incorporate them in to our city wide GIS and GIS maintenance workflow.

City of West Sacramento, California Departmental Goals			
City Department	**Goal**	**Goal Accomplished?**	**Progress Towards Goal**
	2. Work in conjunction with the GIS Specialist and IT to provide a public Internet GIS data browser that provides access to site- specific information, creating increased awareness of the benefits of business investment in West Sacramento	Partial	

Chapter Three – Departmental GIS Needs

Departmental Needs and Priorities

As detailed in the previous sections of this document, West Sacramento has experienced a variety of GIS successes. A number of data layers have been developed or acquired to serve the needs of all departments. An Internet/intranet GIS portal has been developed to allow staff and citizens to utilize the GIS investment and create GIS products and conduct analysis as needed. A variety of department specific projects have been completed that showcase the utility of GIS.

The next few years of this project should focus on additional GIS layer development, targeted departmental applications, and integration with existing IT investments (Accela, FirePoint, VisionAir). The following sections detail the needs and priorities for each of the departments/divisions as identified in the on-site interviews.

Finance Department

GIS Goals and Background

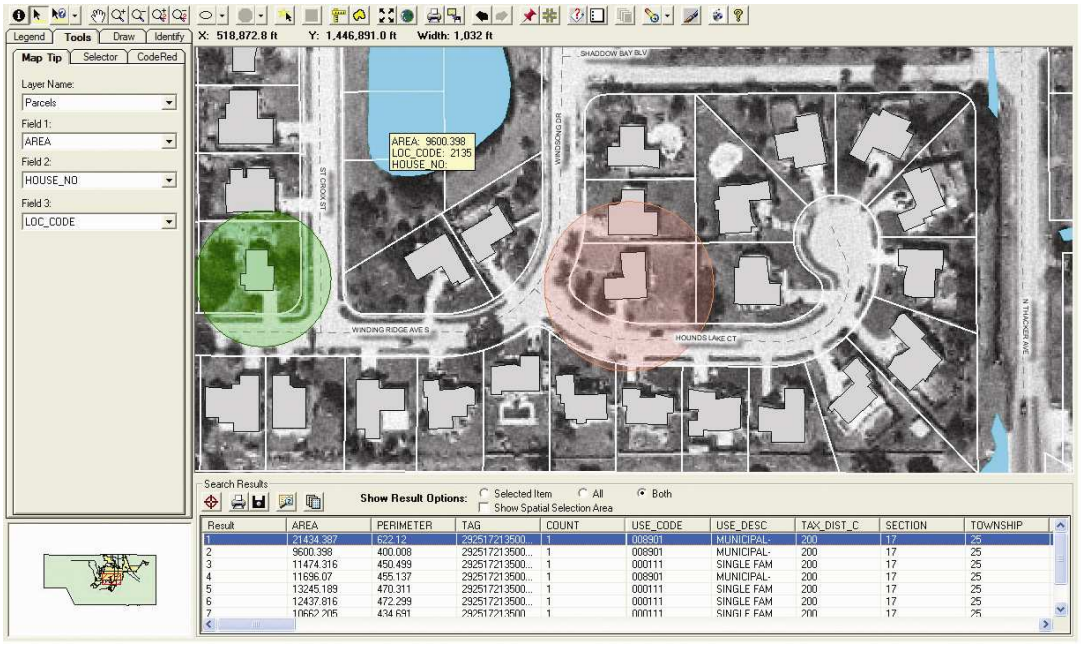
The Finance Department will never be a heavy GIS user or data generator. However, Finance has some unique and important needs that can be fulfilled through the use of GIS. Progress has been made in achieving the Finance Department's goals identified in the original GIS Implementation Plan (Refer to Chapter Two of this plan for a listing of previous goals and their status). Finance creates, renews, and maintains business licenses which have been GIS enabled and can be viewed via the intranet GIS application. Additionally, street sweeping, refuse, collection and recycling have been incorporated into the GIS.

GIS Goals

The following are the goals for the Finance Department in regards to further GIS implementation over the next few years:

Goal #1 – Access to an Intranet Data Browser for Quick Access to Data

The City GIS has created an intranet data browser for viewing and querying the available GIS data. This initial GIS portal is a generic portal to allow all departments access to GIS data. The Finance Department has the ability to conduct identified tasks such as; 1) clicking on the map and determining which garbage pickup route and schedule is applicable for the area and 2) viewing business licenses by location. The City will be moving to the latest GIS technology which will drive the next generation of intranet sites. The Finance Department will have the opportunity to work with the GIS Specialist to identify further reporting and GIS functionality as this new technology is implemented. Each department should have an intranet web portal designed for their specific needs.



Targeted Intranet Portals for Each Department

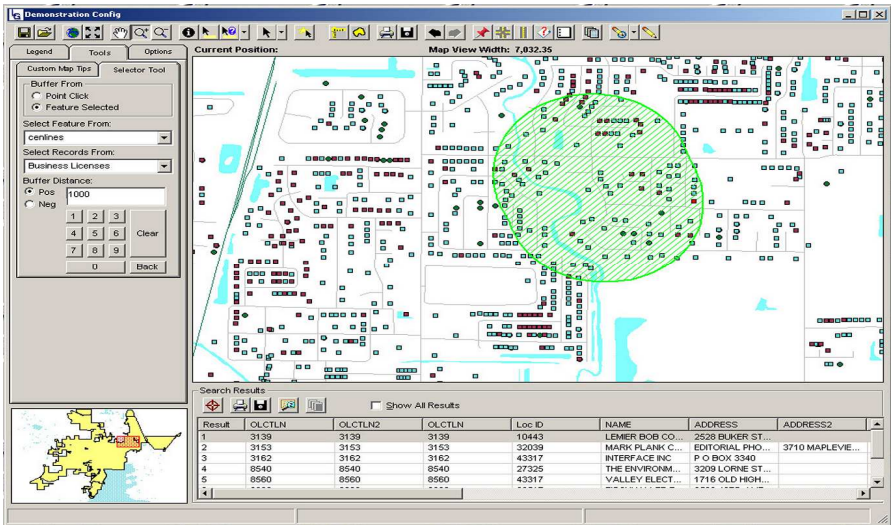
Goal #2 – Mapping Critical Data and Identify Lost Revenue

This goal was detailed in the original Needs Assessment and was again identified as a high priority for the Department. Department staff indicated that querying and mapping unlicensed business is a key need. In addition to creating a property layer, the Department should work with the GIS Specialist to create dynamic data layer that provides up-to-date business license information, based primarily on utility billing information stored in Springbrook. GIS has proven to be a valuable tool for unlicensed business analysis and increased revenue generation (see Case Study section below). This type of analysis should be conducted in conjunction with the GIS Specialist.

The City maintains a lien database that identifies the parcels that have delinquent utility liens, mortgage liens and code enforcement liens. Finance personnel identified a need for utilizing GIS to map this lien information. It is recommended that as with unlicensed business tracking, the Department should work with the GIS Specialist to spatially enable the lien database. Mapping and analysis of this information can be conducted utilizing an intranet GIS data browser (see GIS Applications below); in addition, the GIS Specialist can provide additional mapping and analysis support.

Goal #3 – Incorporate Meter Database into the GIS

The water meter reading has moved from a manual process to remote reads. Each of the meters is being geographically located by a contracted firm, Golden State. Golden State is assigning an X,Y coordinate to each of the meters. This data is then provided to the City as a spreadsheet which is being input into Springbrook. This data should be GIS enabled. Golden State should be contacted to acquire the raw data which should then be converted to GIS. Once done the billing data from Springbrook can then be quickly tied to the GIS by meter number.



GIS Can be Utilized to View Water Meters and Billing Information

Fire Department

GIS Goals and Background

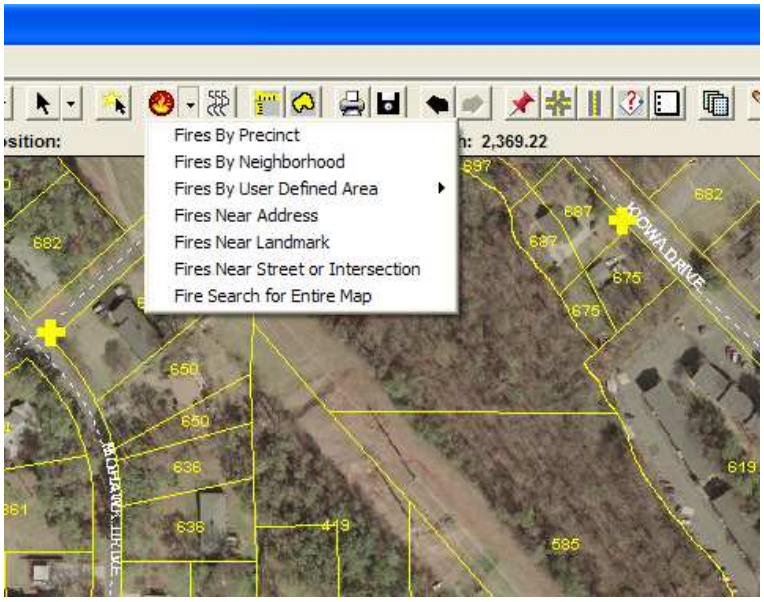
The Fire Department has begun to achieve some of the goals identified in the original GIS Implementation Plan. Fire vehicles are being outfitted with mobile technology that will enable the access of key GIS data in the field. The most pressing needs of the Fire Department are the GIS enablement of existing data and the creation of new data sets.

GIS Goals

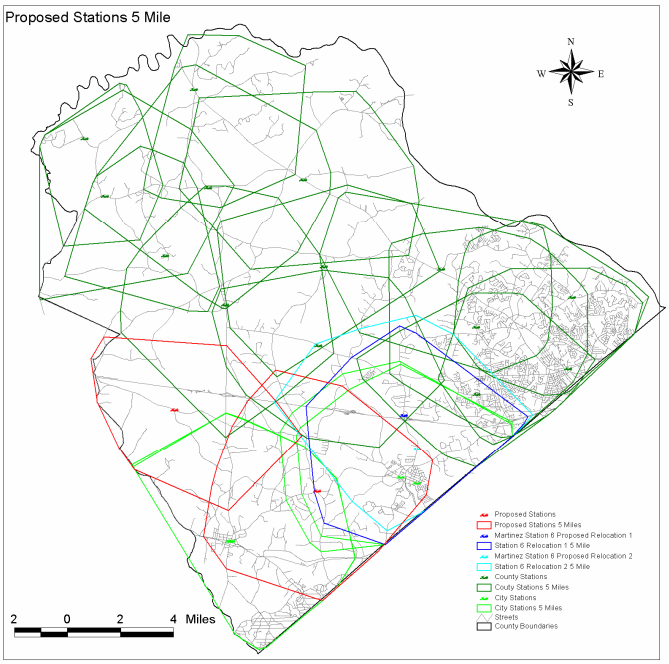
The following are the goals for the Fire Department in regards to further GIS implementation over the next few years:

Goal #1 – Spatial Analysis of Fire Incidents and Inspections

E-911 calls are handled by Yolo County, who then dispatches the call to the appropriate agency. Call information is then downloaded into FirePoint software. FirePoint then houses this incident information for reporting and analysis. It is being recommended that the City implement an ArcServer based intranet browser. This browser will allow each department to view pertinent data in a geographic context. FirePoint data will be address matched to the recommended address point layer. Each record will then be given a fixed x, y coordinate and will be available on the map for analysis, query, and reporting. Other data tied to these records such as pre-plans and hazardous materials information will be accessible via the intranet. This application will allow staff to access incident information; as well as; do routing and quickly determine areas affected by a spill or fire.



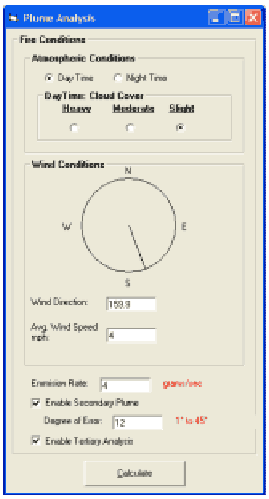
Quick Viewing of Incident Data Residing in FirePoint



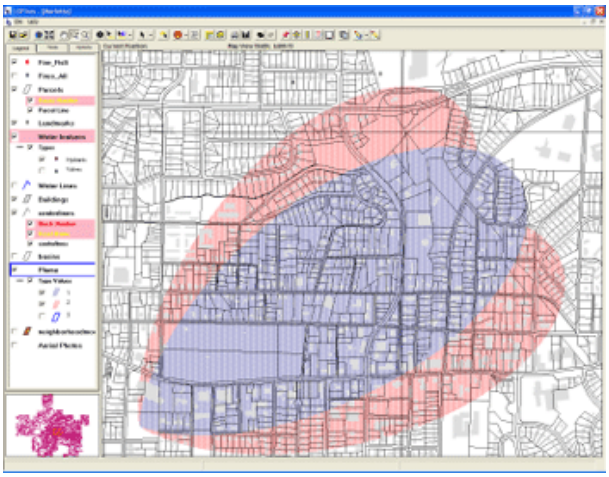
Fire Department staff should utilize the intranet GIS data browser to conduct basic spatial analysis and to produce maps and to assist in day-to-day activities. This intranet browser will serve the entire City but will have a specific link for the Fire Department. For more advanced analysis and other tasks such as data creation, determining drive times, or finding the optimal location of a new fire station, the Fire Department will need to work with the GIS Specialist.

Fire Station
Location Analysis Using GIS

GIS can also be used to conduct hazardous material release/contamination modeling. GIS offers a means for deriving time-critical information, such as plume analyses for gas releases, water and sewer contamination modeling (contaminants in water/sewer systems), and risk/catastrophe modeling.



Example of Plume Analysis Modeling Interface



A Plume Analysis Map Can Provide Valuable Information for Determining Contamination Paths, Rates of Dispersion, and Identification of Affected Populations

Goal #2 – Use GIS to Improve ISO Rating

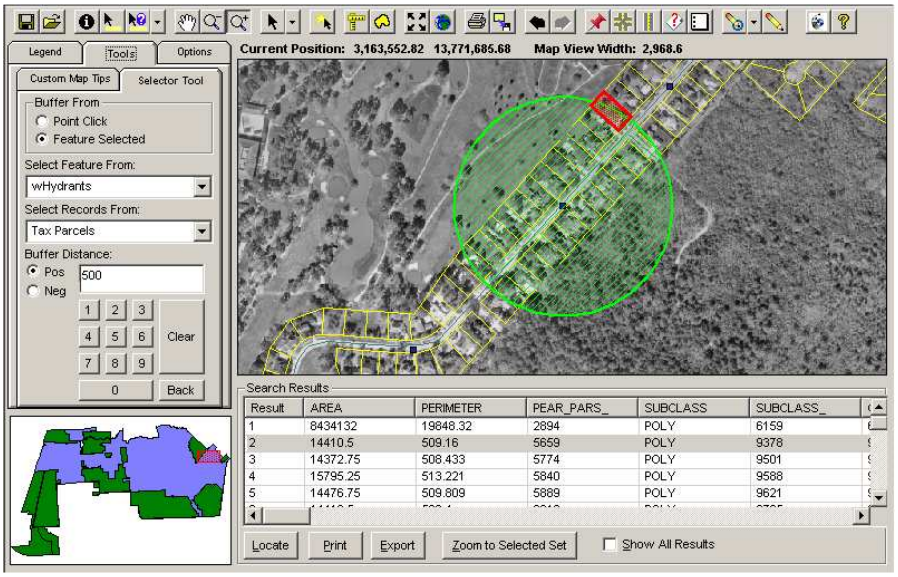
The following recommendation has not changed since the original GIS Implementation Plan. The City of West Sacramento's Fire Department can use GIS to improve its ISO rating. Less expensive fire insurance premiums are the result of a lower ISO rating. The ISO rating process requires fire departments to have the following resource documents and mapping capabilities:

a. *Community Street Map* – To Scale
   Plotted information Base
   - Named streets
   - Community boundary lines
   - Areas NOT built upon
   - Fire Station locations

b. *Community Water Map* – To Scale
   Plotted Information Base
   - Named streets
   - Water mains by size
   - Fire hydrants – numbered
   - Water tanks / Storage – capacity
   - Water pumping stations
   - Pressure zone(s)
   - Static water suction points
   - Dry hydrants

c. *Map – Drawings of Water Supply Works*
   Plotted Information Base
   - Intake supply line – size
   - Filtration-Purification Arrangement – capacity gpm
   - Pump Arrangement – capacity vs. head
   - Clear well(s): arrangement/capacity
   - Primary feeders: size arrangement

d. *Fire District Map – To Scale*
   Plotted Information Base
   - Fire Protection Response Boundary – served by community
   - Five mile response boundary
   - Boundary of areas served by hydrants
   - Static water suction points
   - Dry hydrants
   - Bridge capacities
   - Schools
   - Shopping Centers
   - Commercial Centers



Using GIS to Improve ISO Ratings. A Query Based on 500 Foot Buffer around a Fire Hydrant Shows Which Properties Can Be Reached

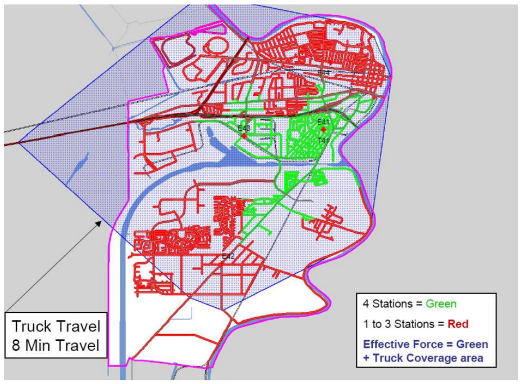
e. Regional Fire Protection Map – To Scale

Plotted Information Base

- Location of automatic aid companies
- Location of outside aid companies

The Fire Department and GIS Specialist should build on the "Deployment Analysis to Determine Fire Station Coverage" study conducted by CityGate Associates in October 2003. This study utilized GIS to analyze and derive a variety of information about the Fire Department's fire response and station locations. Maps produced for the study included Existing Stations RHAVE (Risk, Hazard, and Value Evaluation) Scoring, Distribution 4/8 Min Travel Time (see Figure FD-1.3), Existing Stations and Alternate Proposed Locations, and various response/travel time analyses. Several GIS data layers were produced for the analysis, including "best-fit" stations, structures, incidents, routes, and drive times. This study is a showcase of the power of GIS and how it can benefit the Department.

It is recommended that the Fire Department continue to utilize GIS to analyze its station locations as well as its response to incidents. The 2003 study provides a great foundation for the GIS Specialist, who can use the analyses and summary report as a baseline for future fire station and response time analyses. In addition, the data produced for the project should be leveraged, updated as needed, and integrated as part of the City's enterprise GIS data.



Existing Concentration—8 Minute Travel Time Map Produced for "Deployment Analysis to Determine Fire Station Determine Fire Station Coverage" study

Goal #3 – Use GIS for Emergency Operations – Disaster Response and Recovery

During an emergency Fire Department staff becomes a key part the Emergency Operations Center (EOC) team. During an emergency staff are required to manage disaster response and recovery; as well as; be in the field after a disaster, such as a flood. They are required to manage damage assessment and report this information back to the City for reporting to the state and federal government and for recovery operations. It is recommended that West Sacramento implement a disaster recovery tool that will enable staff with pen top computers to quickly assess and report the extent of a disaster. This application will allow users to enter the damage done on a site by site basis. Also, the computers should be GPS enabled so that the location of each field representative and the path they have already traveled can be easily ascertained. This application should be tested annually to insure that each of the components is in an operational state. Fire Department staff should work closely with the GIS Specialist to model the extent of flooding in the event of a breeched levee. Elevation data can be used in conjunction with ESRI Spatial Analyst software to understand what areas would be flooded depending on where a break occurs and the flow of water through the break. Various GIS tools exist for disaster management. MaxResponder is utilized by some organizations.

MaxResponder

MaxResponder brings geospatial tools to the aid of Fire, EMS, Police, HAZMAT Spill Response, Emergency Management and other agencies responding to everything from small house fires to large-scale terrorist incidents. MaxResponder includes an administration module which allows organizations to create and manage their own first responder databases including strategic pre-plans and floor plans geo-linked to their own custom GIS layers. In order to allow remote data entry of pre-plan data into the database, MaxResponder includes a data collection module. Finally, to distribute this geospatial database in the field, the MaxResponder mobile module gives responders a user-friendly in-vehicle geospatial solution.

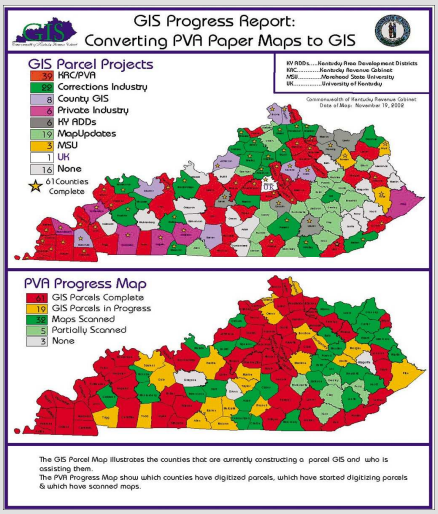
Case Study – The following case study illustrates how GIS can be utilized for post disaster recover. This case study reinforces that investment in GIS tools can return in time and money savings for local government and the public.

Case Study: Providence, Kentucky, Digs Out From Tornado Damage with the Help of GIS

On Sunday, April 28, 2002, at 3:00 a.m., an F3 (on a scale of F0-F5 with F5 being the most violent) tornado hit the small town of Providence, Kentucky, damaging 378 structures in a town of approximately 2,500 parcels. More than 150 houses were destroyed in this natural disaster.
On Monday morning, the Webster County Property Valuation Administrator's (PVA) Office contacted the Kentucky Revenue Cabinet (KRC) to inform it of the disaster and request assistance.

Background
The PVA uses GIS to maintain maps of parcel lines to identify property ownership with tables of information and characteristics of each parcel and road centerlines to assist 911 in addressing, and it uses customized printouts to show price per square foot of residential housing or price per acre for farmland to assist in assessment of properties geographically.

In 2000, Webster County received a technology grant under Commissioner of Revenue Vince Lang and purchased computer equipment and ArcView software under a state bid procurement to begin digitizing parcels.



Old maps were scanned in by the Technical Support staff and registered to MrSID aerial photos using the ArcView Image Analysis extension. This was a relatively simple task that required a project be set up in ArcView with the base layer being the desired output data; then the scanned images were moved and resized by clicking on two points that should be identical. The software yielded a distortion factor to allow the user to see what level of distortion may be occurring between registered control points.

Technical Support then trained the Webster County staff on digitizing parcels from the overlay and other information tables on parcels. Digitizing parcels is done by registering old map information, then digitizing the lines as they appear on the registered image. When that image is removed, the lines should fit on the newer image. This required learning how to set up projects, add image layers, add feature layers, set properties for points and lines such as color and size, and use draw functions.

Webster County PVA was also assisted by Bill Smith and Philip Meyer of the Green River Area Development District who GPS located road centerlines and provided shapefiles of county, city, and other data that they had digitized or acquired from other sources.

Taking the Bull by the Horns
With this wealth of information available, Commissioner Lang sent KRC GIS Coordinator Mike Tackett to ground zero to begin the assessment of damage. Tackett obtained the most current shapefiles from PVA to begin this project. Entering an area that had been secured by National Guardsmen, Tackett received assistance from the nearby Crittenden County Road Department. In a little more than one day, they were

able to GPS locate each damaged structure; enter information into a table, and hyperlink a photograph. This enabled PVA to locate each damaged structure for reassessment and estimate the damage that had occurred. "GIS is essential for disaster projects such as the Webster County tornado project," says Tackett. "Instead of the damage assessment work taking months, with GPS and GIS the damage can be assessed in days or weeks. The GPS data was collected and photographs were taken in less than two days with all the processing and hot linking of photographs done at night in Webster County. And with just a little extra work, PVA assessment data was attached to show an estimated amount of property damage."

More than 150 houses were destroyed in this natural disaster

The Technical Support staff took this information and printed maps for Webster County PVA, Municipal Office, and county officials. The Municipal Office used these maps to track turn-offs and turn-ons of electric, gas, and water and debris.

"ArcView helped us assemble the data and print maps for the Providence Fire Department," says Tackett. "These maps were used to mark any property missed in the initial survey and keep track of gas valve or electricity turnoff for the Fire Department."

The maps and data were provided to the U.S. Federal Emergency Management Agency (FEMA), which then declared the area a federal disaster eligible for federal assistance for cleanup and rebuilding. Since then, many individuals are either in new homes or at some stage of repair or rebuilding of their damaged homes.

Although GIS has been used by other agencies in Kentucky over the past 15 to 20 years, GIS is relatively new to the Commonwealth of Kentucky Revenue Cabinet, which has made great strides in digitizing parcels in many Kentucky counties with the assistance of State Valuation's Technical Support Branch--Ron Johnson, cartography branch manager; Patti Royster, program coordinator; Mike Tackett, GIS coordinator; and Patti Hall, David Thornton, and B. David Wilson, geoprocessing specialists.

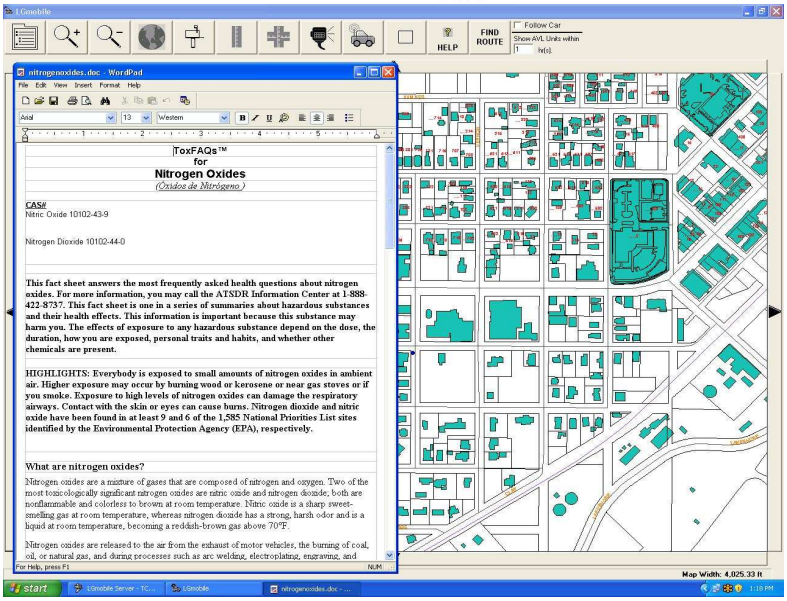
To see the path of the tornado with damaged structure points, visit www.webstercountypva.com and click on Property Maps. A map of this county has been set up by Kent Anness of the Kentucky Infrastructure Authority, which has provided support and assisted with the Webster County GIS. For more information on Kentucky GIS, visit. www.kygeonet.state.ky.us.

**Case Study Courtesy of ESRI ArcNews Magazine*

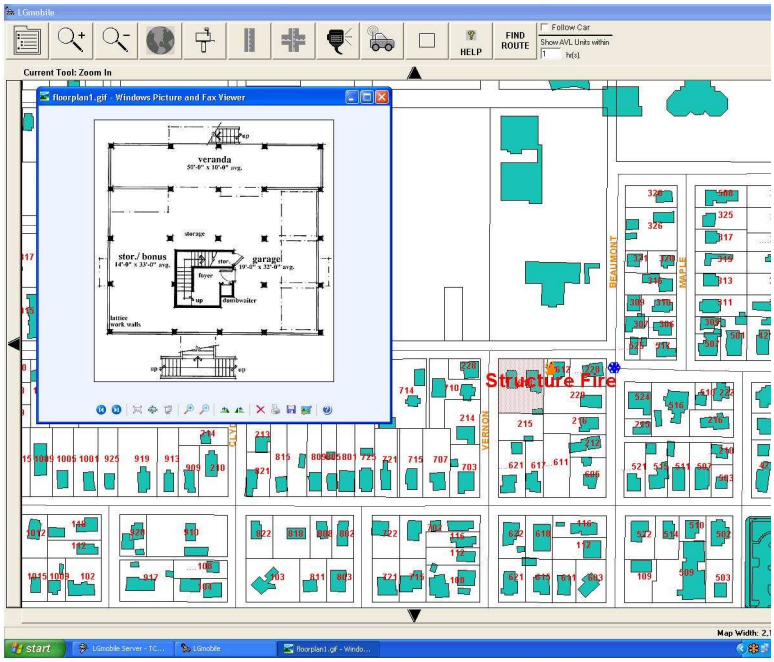
Goal #4 – Provide Enterprise Access to Digital Pre-Plans and Hazardous Material Data

The Fire Department is creating and maintaining many pre-plans in Visio. Linking plans to GIS can add additional information and analysis capabilities. Pre-plans of critical facilities should be linked to the GIS intranet application and a mobile data

browser application. These pre-plans should be linked to the GIS by its corresponding address record and then the images retrieved via the GIS interface. An icon will show up in the application if a pre-plan is available for a structure. Additionally, hazardous material information is maintained in a MS SQL database which should be linked to the GIS. These records could then be quickly access via the intranet GIS browser.



GIS Accessing Pre-Plans and Hazardous Materials Information



GIS Accessing Pre-Plans and Hazardous Materials Information

Goal #5 – Provide field mapping

Fire incident mapping available at the Fire Stations will be a great asset. However, to truly leverage the utility of GIS for the Department the information must be made available to the staff in the field. Currently, there is an initiative to provide mobile computing for all Fire vehicles. The Fire mobiles are scheduled to be installed in October 2007. If intranet access is consistent throughout the City the staff will be able to access the intranet application previously described in Goal #1. If not, a copy of the data should be automatically downloaded to each laptop and a mobile data browser should be utilized to view the GIS data.

Information Technology Division

GIS Goals and Background

The GIS Specialist within the Information Technology (IT) Division will continue to spearhead the GIS implementation for the City. Additionally, other IT staff will continue to support the GIS Specialist especially in regards to integration with existing IT systems. Four main items should be the focus of IT over the next few years to include: 1) data layer creation; 2) organizational education 3) targeted application development/implementation; and 4) integration with existing IT investments.

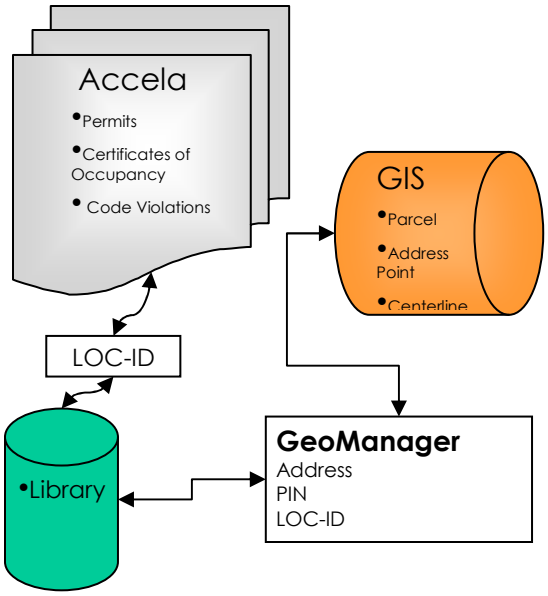
GIS Goals

The following are the goals for the IT Division in regards to further GIS implementation over the next few years:

Goal #1 - Integrate with existing systems such as Accela, FirePoint, and VisionAir

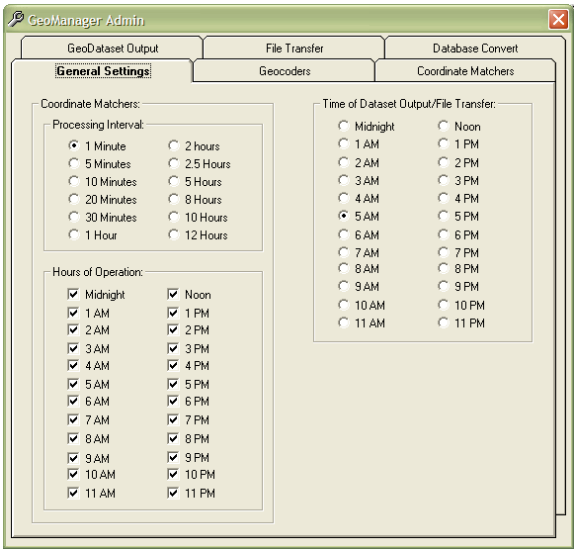
Information Technology supports many existing investments in software applications for departmental use. All of these applications contain data that is tied to geography. Records store information about an address, parcel number, and/or customer number. Each department can benefit from GIS enablement of these data sets.

The number one priority for IT and the GIS Specialist should be GIS enabling these products. This is accomplished by geocoding records within these applications to parcels or preferably address points. Various applications exist that perform this task. One such application, GeoManager, has been used successfully by many other organizations. The GeoManager application is an automated geo-coding service that creates GIS data layers from non-spatial relational databases. West Sacramento currently utilizes FME which has some data extraction capabilities. FME might suffice for these tasks. The results of a successful geo-coding effort will be stored in an industry standard relational database management system (SQL Server). Once data has been geo-coded, users can quickly do geographic searches and reporting on the data in these databases. The automated process is based completely on standard SQL statements and is customized to utilize a variety of stored location-based data (Parcel APN's or Address). A second function of the automated service is to generate GIS layers in an industry standard portable format (shapefiles or SDE layers) that could be utilized by a variety of applications. These GIS layers will be created to user specifications. X, Y coordinates will be utilized to display features in a GIS layer. The graphic below shows the process of using GeoManager to extract data from the Accela application.



Practical Example – Accela

All Accela records related to a specific location can be mapped by linking each record to a spatial feature such as an address point. The GeoManager can generate and export the resulting GIS layers on a regularly scheduled basis. These resultant GIS layers are then made available via the intranet site and for use within other GIS applications. As soon as records are entered into Accela they show up as a point on the GIS layer with the appropriate data fields available for query.



GeoManager Service Settings

Optimally, as each record is assigned an X, Y coordinate, the coordinate pair is stored in a field within the primary application (Accela, VisionAir). That way each record has a validated X, Y coordinate and can be mapped at any time. Additionally, those that do not have a valid X, Y coordinate can be researched and assigned the appropriate geographic reference.

Goal #2 - Continue data layer creation and data quality assurance testing

Many of the needs identified for the user departments require the creation of additional GIS data layers. The GIS Specialist with assistance from City departments and divisions should systematically continue to create the needed data layers. Also, of major importance is that each department needs to identify a person/s responsible for data update and maintenance. This topic is discussed in more detail in Chapter Four of this document.

The GIS Specialist is responsible for establishing and maintaining the corporate GIS database. As new data layers are created, the GIS Specialist will need to ensure that each layer is at an acceptable accuracy level and that a data update methodology has been established. The GIS Specialist will work closely with each department to ensure that they have the appropriate training and skills to maintain their own GIS layers where appropriate. These datasets will be stored on the existing corporate GIS server. The City should prioritize layers and insure that they are made available expeditiously. This will mean that a combination of in-house data creation and outsourcing should occur. Additionally, the creation of many data sets can be automated by utilizing an automated service as is described in Goal #1.

The full listing of existing and needed data layers have been documented at the end of Chapter Two.

Goal #3 – Prioritize user involvement and goal setting

The GIS Specialist's primary duty is to provide consistent guidance and coordination in support of GIS and its related components. In general terms, the IT Division is responsible for providing technical support and guidance with the GIS Specialist. Enterprise GIS coordination encompasses a variety of tasks, processes, and procedures, all of which have a cross-functional context within the scope of GIS implementation planning—the GIS Specialist will have frequent contact with staff from other departments as well as external entities.

The following are GIS coordination needs that are being provided both internally and externally:

<u>City of West Sacramento</u>

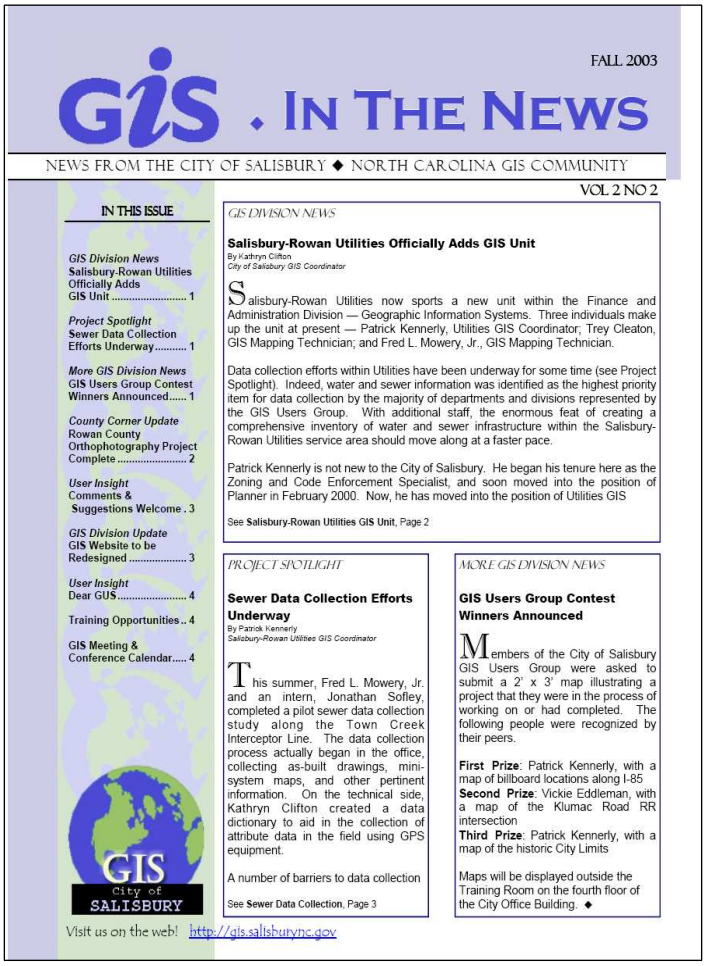
- Installation, maintenance, and upgrade of hardware and its operating systems
- Provision of training for users in the organization
- Establishment of database standards
- Plans and procedures for effective integration or transfer of GIS data from various sources into usable databases
- Establishment of mapping standards
- Maintenance of data security and integrity
- Primary contact for user problems and vendor support
- High-level cartography
- Project management
- Inter-departmental collaboration on GIS projects and initiatives

<u>External</u>

- Collaboration with other local agencies

- Frequent attendance and participation in local and regional GIS groups (SACOG, URISA, GIS Technical Committee)
- Distribution and acquisition of geospatial data
- Participation with state and federal agencies on GIS initiatives

The GIS Specialist must continue to champion GIS and encourage its usage throughout the City. GIS user's group meetings have been held in the past at the City (URISA, GIS Technical Committee). It is highly recommended that the City User's Group, comprised of GIS using employees from each division, meet on a quarterly basis. A GIS User's Group meeting provides the GIS Specialist with an excellent opportunity for communication with all GIS users within the City of West Sacramento. The meetings should highlight GIS successes at the City, provide education on new tools, and serve as a general mechanism for users to understand how the technology can benefit them. Additionally, it is recommended that during these meetings GIS users review goals for their specific departments or divisions. Involving users in setting and reviewing their own goals, timelines and achievements will be a big plus in allowing the GIS Specialist and IT Division to achieve the overall goals of the City.



FALL 2003

GIS . IN THE NEWS

NEWS FROM THE CITY OF SALISBURY ◆ NORTH CAROLINA GIS COMMUNITY

VOL 2 NO 2

IN THIS ISSUE

GIS DIVISION NEWS

Salisbury-Rowan Utilities Officially Adds GIS Unit

By Kathryn Clifton
City of Salisbury GIS Coordinator

Salisbury-Rowan Utilities now sports a new unit within the Finance and Administration Division — Geographic Information Systems. Three individuals make up the unit at present — Patrick Kennerly, Utilities GIS Coordinator; Trey Cleaton, GIS Mapping Technician; and Fred L. Mowery, Jr., GIS Mapping Technician.

Data collection efforts within Utilities have been underway for some time (see Project Spotlight). Indeed, water and sewer information was identified as the highest priority item for data collection by the majority of departments and divisions represented by the GIS Users Group. With additional staff, the enormous feat of creating a comprehensive inventory of water and sewer infrastructure within the Salisbury-Rowan Utilities service area should move along at a faster pace.

Patrick Kennerly is not new to the City of Salisbury. He began his tenure here as the Zoning and Code Enforcement Specialist, and soon moved into the position of Planner in February 2000. Now, he has moved into the position of Utilities GIS

See **Salisbury-Rowan Utilities GIS Unit**, Page 2

PROJECT SPOTLIGHT

Sewer Data Collection Efforts Underway

By Patrick Kennerly
Salisbury-Rowan Utilities GIS Coordinator

This summer, Fred L. Mowery, Jr. and an intern, Jonathan Sofley, completed a pilot sewer data collection study along the Town Creek Interceptor Line. The data collection process actually began in the office, collecting as-built drawings, mini-system maps, and other pertinent information. On the technical side, Kathryn Clifton created a data dictionary to aid in the collection of attribute data in the field using GPS equipment.

A number of barriers to data collection

See **Sewer Data Collection**, Page 3

MORE GIS DIVISION NEWS

GIS Users Group Contest Winners Announced

Members of the City of Salisbury GIS Users Group were asked to submit a 2' x 3' map illustrating a project that they were in the process of working on or had completed. The following people were recognized by their peers.

First Prize: Patrick Kennerly, with a map of billboard locations along I-85
Second Prize: Vickie Eddleman, with a map of the Klumac Road RR intersection
Third Prize: Patrick Kennerly, with a map of the historic City Limits

Maps will be displayed outside the Training Room on the fourth floor of the City Office Building. ◆

GIS City of SALISBURY

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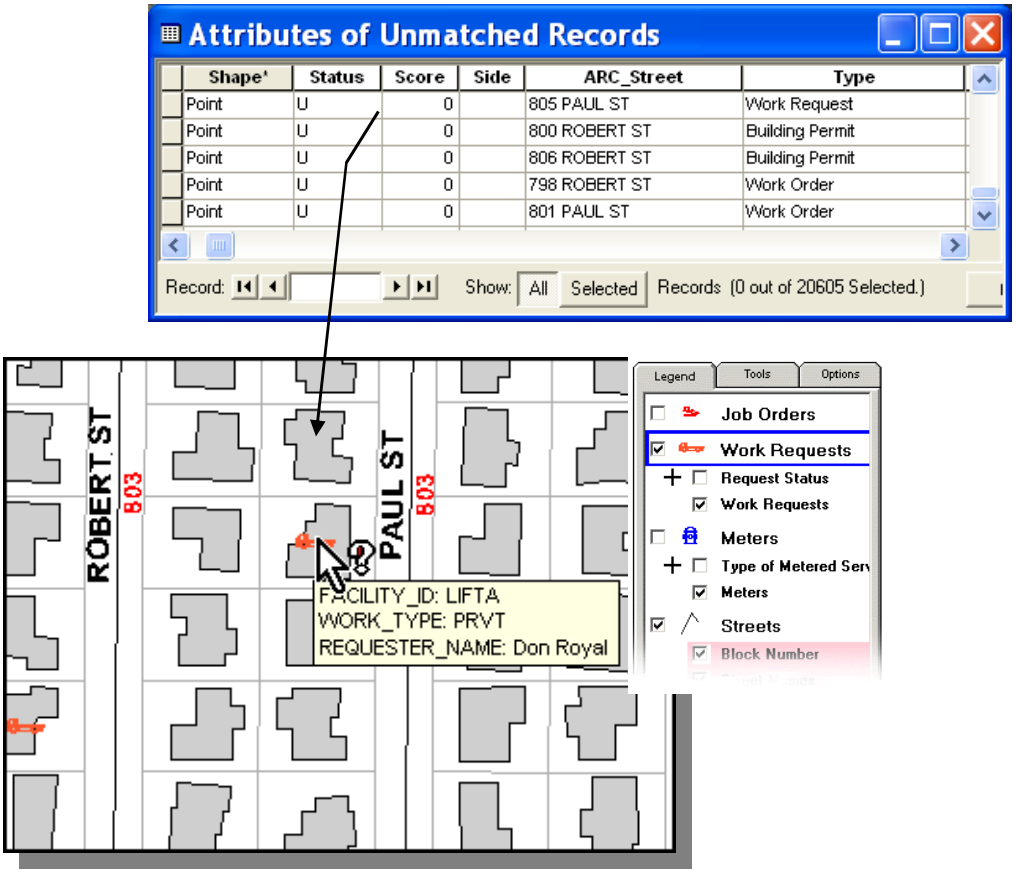
Another mechanism to promote GIS is the creation of a GIS newsletter. This is an excellent mechanism to share user and enterprise-wide successes with all City staff. Articles have been written for the "City Lights" publication and should continue. Development of a GIS Newsletter should be supervised by the GIS Specialist, but there also must be contributions from each department that utilizes GIS on a regular basis. A GIS Newsletter will help foster communication between departments and help build support for increased GIS use.

Goal #4 – Refine the GIS Based Addressing Repository

Are accurate address points and street centerlines really that important?

Why do we need address points that are so accurate? Why are we so concerned with cleaning up the address database? West Sacramento is faced with the challenge of accurately mapping the location of work orders, work requests, building permits, and outage calls throughout the City. If an accurate address point layer does not exist, unfavorable results will occur when trying to map building permits and work requests using an address. Lack of an accurate address point layer will often result in unmatched records. The organization will then need to invest additional time and resources attempting to determine the location of the information manually.

Why aren't my records matching correctly?



Example of unmatched records due to inaccurate GIS address data

If we have good street centerline data, why do we need an address point layer?

Having an accurate street centerline layer is vital, but relying solely on street centerline data to map addresses has some limitations. The geocoding (address matching) process uses a mathematical algorithm to place addresses at an offset along the street centerlines based on the attributed address range. This results in address points that may or may not be placed next to the correct structure.

If, however, an accurate address point layer is used to match addresses, a much more accurate placement will be realized.

Addresses Matched to Street Centerlines (less accurate)

Addresses Matched to Address Point Layer (very accurate)

For years, cities and counties all over the country have been using table database structures to update and maintain addresses. Organizations often had many disparate address datasets feeding multiple computer applications. Often entry of this data was not regulated. Therefore, addresses were being entered free form without any standards. Instead of clean valid addresses – an addressing nightmare was created. One municipal government had entered the address for the local mall in their enterprise IT application 98 different ways. This old world method is often cumbersome, allows for error in data entry, and data standards are difficult to enforce. The new method for maintaining good address records is for an address points GIS layer to serve as the City-wide authoritative address repository.

Currently an address point layer is being maintained. The current process involves storing the address data in Permits Plus, notifying the GIS Specialist as a new address is entered, and then updating the GIS layer and Permits Plus with X,Y coordinates. This is arguably the most important base layer for a municipal GIS. As discussed in Goal #1 the creation of many GIS layers can be automated. This requires an accurate and complete address point layer. This layer should become the official and authoritative address repository for the City. As such, other applications should use this repository to populate their address fields. Each of these other applications (VisionAir, Accela, FirePoints, etc.) would then have a pick list of valid addresses. Users would only then be able to assign valid addresses to a record. Optimally, integration between the GIS and these IT applications would be programmatically accomplished.

The City must continue to prioritize address management as they have been doing of late. Many address management steps have taken place. CD has done much work in accomplishing address management tasks. The following steps need to be in-place (many of these have already been accomplished by CD) for continued success at the enterprise-level:

- Verify and complete address points layer – a full audit and field inspection should take place to insure 100% accuracy. This step has been completed and updates are taking place on an as-needed basis.
- Move the address layer to the central GIS repository – data should no longer be maintained in AutoCAD but should be moved to the central GIS repository and maintained as a geodatabase. An automation routine will need to be utilized to take the AutoCAD annotation file and move it to GIS. The routing should utilize the AutoCAD rotation feature to insure that the GIS layer annotation is suitable. Some clean-up of annotation will need to take place. Ties to Permits Plus software are currently being maintained and will need to be preserved.
- Identify gatekeepers that have the authority to update the layer – only a select few employees should have the ability to add, change, or delete records from the address point data layer. An initial recommendation is to have a representative from Drafting Services, Community Development, and the GIS Specialist given the training and capability to edit the address point data layer. The GIS Specialist should review each entry to insure that GIS and enterprise address database rules and compliance are met. Work has already been done to identify gatekeepers. The City's intention is to fully implement the gatekeeper concept upon full completion of address clean-up.
- Provide an address update GIS application – this application should allow for the update of the critical GIS layers. This application is described later in this section.

- Integrate the process with core applications such as Accela – optimally the address point GIS application will have integration points with enterprise applications such as Accela. This step has been accomplished but will need to be revisited if another permitting software option is pursued.

The following sections take a look at how to finalize the address points GIS layer. One of the big impetuses for this layer is integration with existing systems. The centerpiece for this integration should be the permitting system – Accela or a new permitting system if Accela is replaced. The other IT systems such as VisionAir, FirePoint, etc. should use the address data to populate their address tables and validate address data entry. Therefore, the following sections are written with the assumption that this process will not only validate the current address points but clean up Accela address records and integrate with the enterprise permitting system. Much of this has been accomplished but the following serves as a good checklist of tasks. Depending on what is decided in regards to the enterprise permitting software, participation by the enterprise permitting vendor and some programmatic integration may be required.

Address Validation and Accela Integration

It is highly recommended that West Sacramento audit and validate the existing digital address point layer. The City has gone through many of the appropriate steps to create the current address point layer. However, the following information is included as documentation on the optimal process for 100% validation of the layer. Address information stored within Accela should be used as a source for address point creation and validation.

Once address points are validated and finalized, a GIS based application should be used by identified gatekeepers to update all new addresses and create or modify all address points. This step has been completed by City staff. Optimally, the GIS based addressing application will integrate with the existing enterprise-wide applications, especially Accela. Integration with Accela has been accomplished but will need to be revisited if a new software product is implemented. Through the use of an integrated GIS addressing/Accela application, users can simultaneously maintain accurate address points and address records within Accela. Staff is currently working on this type of integration with Accela. Additionally, the address points should serve to feed the master address tables in other IT applications.

The following is the recommended methodology for the finalization of a digital address point layer using existing data including Accela data, a cleaned Accela Address Database, and implementation of a GIS based address management tool. The following methodology will not only insure 100% completion of address points but will insure that data within the Accela application integrates with the address points.

Digital Address Point Creation and Accela Cleanup

Step 1: Database Inspection
Step 2: Address Point Generation
Step 3: Manual Adjustment of Digital Address Points
Step 4: Field Verification of Digital Address Points
Step 5: Digital Photographs Linked to Problem Addresses
Step 6: Bulk Update of Accela Records and GIS Overlay

Addressing and Street Centerline Maintenance

Step 1: Maintenance Application
Step 2: Maintenance Procedures Report (This has been done by CD staff)

Digital Address Point Creation and Accela Cleanup

Step 1: Database Inspection

Inspection of the Accela database is the critical to the success of the address creation. A custom extract application must be used to perform the extraction of the Accela data to a more manageable format. It is important to acquire all the necessary GIS layers in order to accomplish the project tasks. These data layers might include address points, street centerlines, parcels, and aerial photography.

Inspection of the Accela land/address database is used to identify errors with the data that may prevent addresses from being matched correctly. Some of the problems that may be encountered include the following:

- Data has been entered into the database incorrectly
- Apartment numbers in the street post qualifier or street pre qualifier fields
- Street post qualifier information in the apartment number field (SCHOO in post qualifier and L in apartment – appears to be apartment L)
- Address Ranges (3500-3590 State Rd 84)
- Addresses with multiple units (3490 101St Street Bldg 5 Unit 1-6)

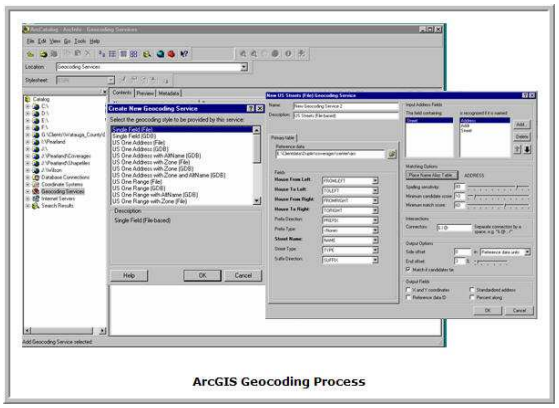
Performing a database inspection facilitates the accurate assessment of the current database state and identifies ways to most efficiently map the addresses. This step has been completed by CD and is updated if problems are identified.

Street Number	Prefix	Street Name	Street Type	Post Qualifier	Apartment
8420		STATE RD 7		U-611	
8420		STATE RD 7		U-609	
8420		STATE RD 7		U-601	U-612
3504		OLD COUNTRY	MNR	U-325	328
3505		OLD COUNTRY	MNR	U-317	324
2985		PALM TRACE LANDINGS	DR	U310	
3506		OLD COUNTRY	MNR	U-308	316
3507		OLD COUNTRY	MNR	U-301	308
3508		OLD COUNTRY	MNR	U-213	220
204		EVERGREEN	PL	U204	
3508		OLD COUNTRY	MNR	U-125	132
3509		OLD COUNTRY	MNR	U-113	124
8480		STATE RD 7		U-101	103
3510		OLD COUNTRY	MNR	U-101	112
2945	SW	45	ST	TRAI	PUBLI
654		STIRLING	RD	SCHOO	L

Example of a Sample Address Database Structure

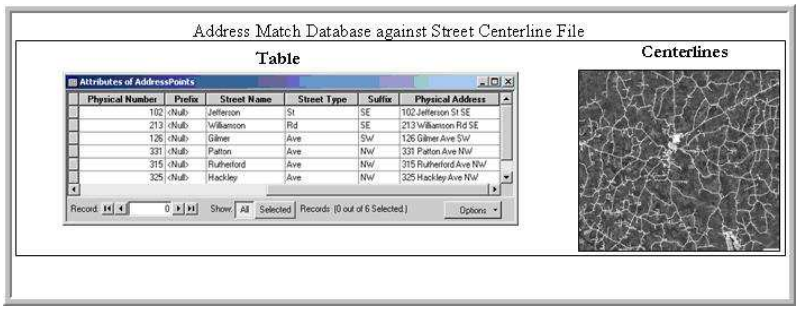
Step 2: Address Point Generation

Once the addresses that need to be generated on the map are determined, the cumulative physical address field in the database will be address matched (also known as geocoded) against the attributed GIS existing address point and street centerline file. The database will be processed through the ESRI ArcGIS Geocoding Service in ArcCatalog.



ArcGIS Geocoding Process

An alias table may also be created to store detailed address information about common (vanity) location names, such as "City Hall". The result of the initial geocoding process will not be a complete point file, but it will eliminate some of the work necessary for the finalization of the point layer. Addresses that do not have a matching address point location will be addressed matched to another GIS data layer such as a building or the street centerline file. Due to the mechanisms used to determine the addresses of rural structures, the geocoding process against the street centerlines should use a single range option. This option will geocode the points to the center of the street and will have a lower level of initial accuracy than a geocode based on other systems such as a dual range system.



In the GIS, the new address point Geodatabase feature class created by the geocoding process will include two additional fields: 1) "Status" and 2) "Score". "Status" indicates whether individual records were matched or unmatched, with values of "M" or "U", respectively. "Score" indicates the percentage of confidence in the match. One hundred (100) % indicates an exact match, 70% a less than perfect match, etc. The Geocoding Service in ArcGIS allows users to control what score will constitute a match. In addition, all unmatched addresses can be interactively matched.

Geocoded address points can be offset at a designated distance; otherwise, each will be placed on top of the street centerline. "Status" and "Score" fields will remain visible to City staff responsible for maintaining the master address point layer, but should not be visible to end users.

Many of the Accela records will match the existing address points. Others will not match due to erroneous data within Accela and others will not match because of erroneous or missing address point data. CD is very close to completing this and closing all remaining gaps.

Step 3: Manual Adjustment of Digital Address Points

A manual review and inspection of this digital point address data must be performed followed by the adjustment of the dataset (or data records) to their actual location on the earth's surface. Using the aerial photography each digital point should be placed in the middle of each structure.

The following procedures are applied during this step:

1. Coding of matched digital address points
2. Correction of obvious address problems (address located on wrong structure)
3. Detailed documentation of changes made

1's are green; 2's are red

1. Coding of matched digital address points – Address verification field indicating the status of each address point should be added to the digital address point layer. The following methodology should be followed:

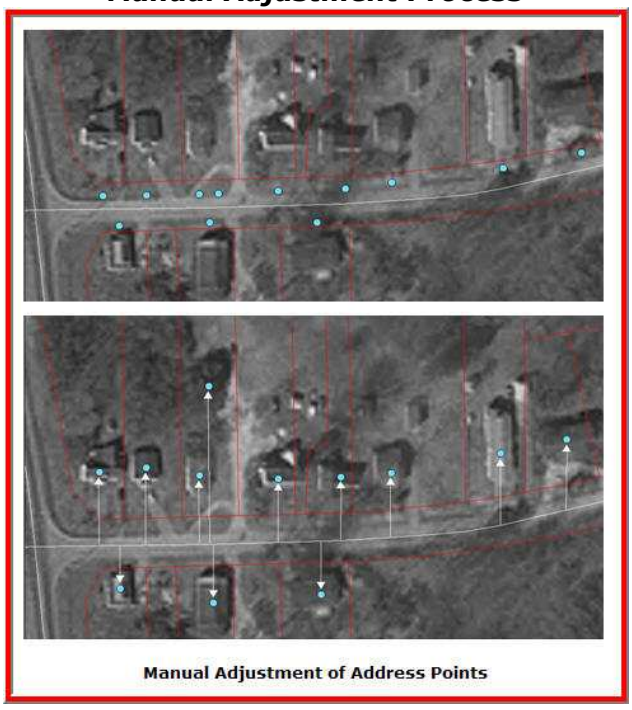
Field of the Digital Address Point Layer:

Code	Status	Description
1	OK	The point or street has been verified and moved to the appropriate location
2	Field Verify	The point or street cannot be placed on a structure with 100% certainty and needs to be field verified

2. Obvious problems in regards to data entry errors should be corrected and the placement of all address information in the appropriate fields within the address point layer should be completed. This is currently being done by CD staff. CD staff is also trying to identify errors that will take longer to fix (i.e. one that will require public notification).

3. Detailed documentation of any and all changes made to the data should be maintained so that a full record of any changes that have been made. This is currently being done by CD staff.

Manual Adjustment Process



Manual Adjustment of Address Points

Step 4: Field Verification of Digital Address Points
Many of the addresses will need to be field verified after they have been address matched and manually inspected. The corresponding structures or the address for these points may not be decipherable from a heads up digitizing method using the aerial photography. Apartment complexes and commercial buildings will need to be visited in order to determine the appropriate location for these address points.

In the process of verifying each site address, field crews should employ a defined process to identify and record attributes for those records that may need additional review. Additionally, GIS software employs several alternative electronic data comparison routines to verify the accuracy of each address record to existing data sets, such as the street centerline file and parcels. This process provides the means to ensure each address is correctly field verified.

The following methodology should be used during the field verification process:

Verification Field of the Digital Address Point Layer:
A verification field should be added to the address point layer with the following attributes:

Code	Status	Description
6	Field Verified	The point has been field verified and moved to the appropriate location
3	Problem	The address has not been placed with 100% certainty due to various problems encountered during the field verification.

Verification of Secondary Address Units

Secondary address units are utilized when a building has more than one place where an individual could live or work. Approximately twenty-five percent of residential housing units are in structures with more than one unit. This housing is typically referred to as "multi-family." Multi-family housing, commercial structures and mobile homes represent the majority of secondary address units. The location and addressing for secondary address units is a critical component of the effective delivery of government services, from emergency services and routing to the collection and allocation of personal property taxes.

Often for multi-family structures, field crews can obtain a site map from the apartment complex administration office. This map is a reliable source to verify the address and location of each living unit in the complex.

The focus in the field verification process should be to ensure that the digital address points for each structure is placed in a highly accurate and cost-effective manner.

Step 5: Digital Photographs Linked to Problem Addresses

Some of the problems that may be encountered during field verification include the following:

- Does Not Exist – somewhat positive that this address no longer exists.
- Could Not Find – the point did not correspond to a nearby structure. This may include meter boxes or utility locations.
- No Posted Number – a building was present but there was no posted number.
- Grouped Mailboxes –there were mailboxes grouped and the address could not be matched to a specific structure.
- Wrong Address – the address street number or apartment number appears to be wrong because it does not fit with other addresses in the vicinity. Or the street name is wrong.
- New Development – the address could not be accurately placed because it is located in a new development that does not appear on the ortho-

photography, or the structure or building was under construction at the time of field verification and no address information was posted, or the parcel has an address but no structure has been constructed.

- Empty Lot – appears to be an empty lot or vacant parcel.

During the field verification process, a defined process should be deployed to identify all problem addresses. A digital photo should be captured for each structure that could not be visually verified, where no address number is posted on the house, or grouped mailboxes exist. The digital photo will be linked via GIS and can be opened within any GIS software application when clicking on the address point.

Problem Address Digital Photo Capture

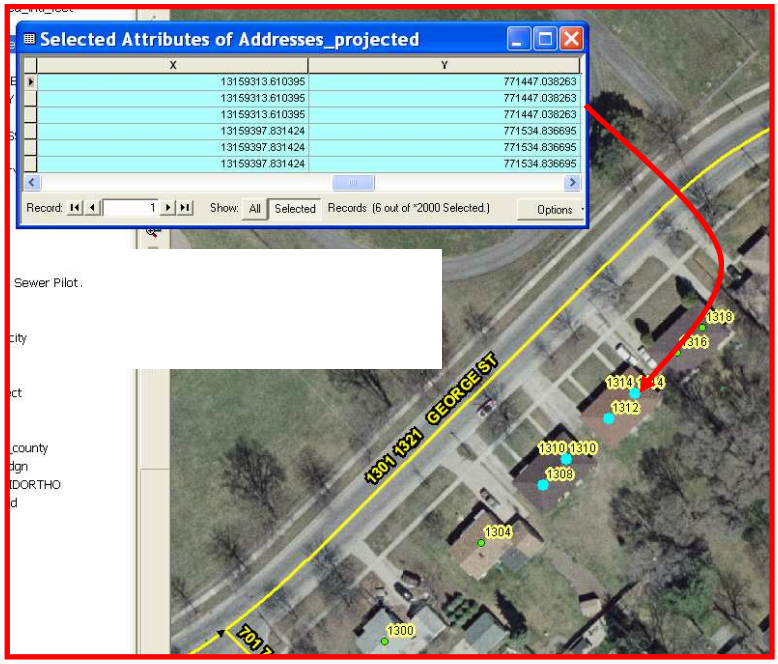
Step 6: Bulk Update of Accela Records and GIS Overlay

Step 6 will require detailed knowledge of Accela (or a new enterprise permitting system) data structures and data interaction. This step will bulk update of the Accela address/land records utilizing the new GIS databases. The unique record ID for each Accela record should be maintained through the address point finalization process. Each one of the valid Accela records should have a corresponding valid address point. The addresses associated with the address point should be the official address. This official address can then be utilized to insure that the Accela record contains a clean address. This can be completed by using a SQL script to update each record based on its X, Y location. Currently the City updates Accela and then updates the GIS.

The following describes all the typical fields that should be updated when this update script is applied:

- Street Number
- Street Prefix
- Street Name
- Street Type
- Street Suffix
- Unit

In addition, the Accela record should allow for the addition and population of an X,Y (latitude, longitude) field. This field would get updated for all Accela records that have a corresponding GIS address point.



X and Y Coordinate Values (Northing and Easting) of individual address points

Not all of the Accela records will be able to be associated with a valid address point. Some of these records may contain addresses that no longer exist or are invalid for other reasons. These records should be researched to determine if an accurate address can be determined and corrected. At this point, the City would have a 100% complete address point layer and each Accela record would have an accurate X,Y coordinate. West Sacramento assigns an address to all parcels even if they do not have a structure.

Addition of New Address Records into Accela

Throughout the address adjustment and verification phases many new addresses not existing in the Accela database will be found throughout the City. This has already been identified by City staff.

Using various methods new digital points for these addresses should be created. Some of the methods that will be used to accomplish this include the following:

- Use of existing GIS address point layer (if available)
- Use of existing GIS parcel layer (if available)
- New addresses found during the field verification process

These new points should be included in the final Accela integration process. New address/land records should be created for these addresses making them address records that will be available to the appropriate Accela modules.

Mass GIS Overlay Possibilities

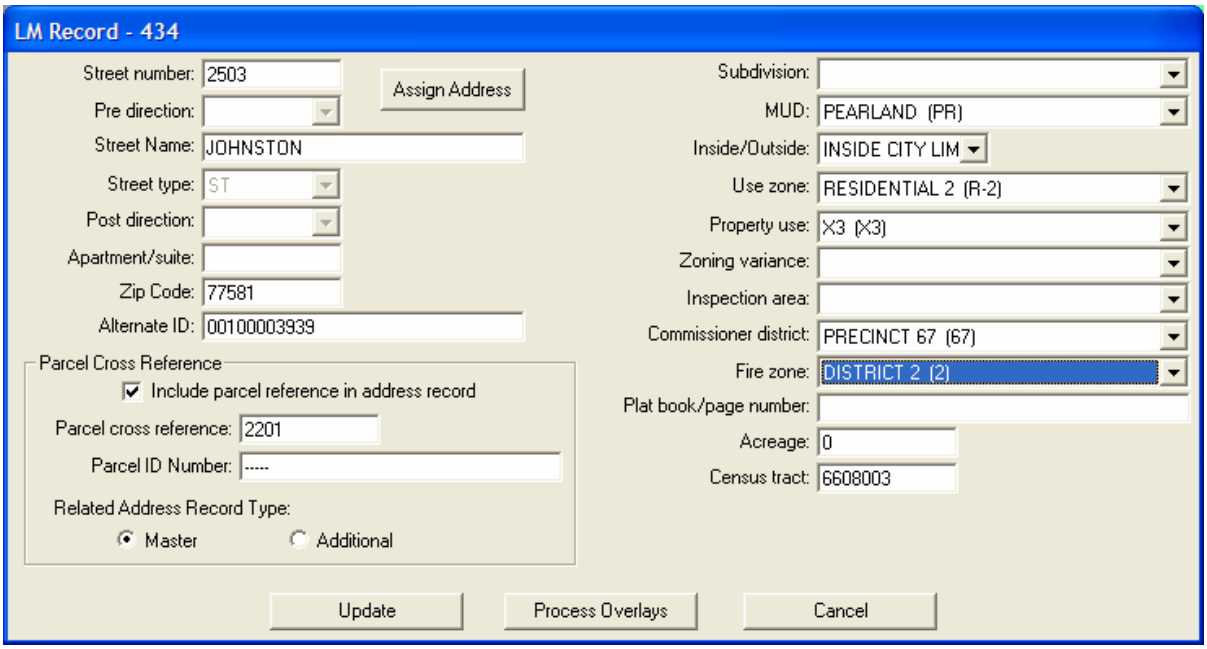
Once all address records have been updated and loaded into Accela, attribute values for many of the fields in the Accela database can be updated based on the new and improved address point spatial location information. For example, the zip code layer, if up-to-date in the GIS, will be used as an overlay, allowing all Accela address records to be updated with the correct zip code based on spatial location.

Map overlay capabilities provide the user with a window into GIS and parcel management data records. This will allow for the bulk update and overlay of GIS layers to maintain spatial attributes in Accela.

Examples of GIS layers that could be overlain with address points to extract information that could populate Accela fields:

- Parcel
- Zip Codes
- Council District
- Zoning
- Land use
- Inspection District
- In/Out of City or County
- Subdivision
- Fire Zone
- Jurisdiction

This list of GIS layers to be included in the overlay will be dependent on whether or not these layers currently exist. If not, these layers should be developed.



GIS overlays provide users a thorough view into their address data records

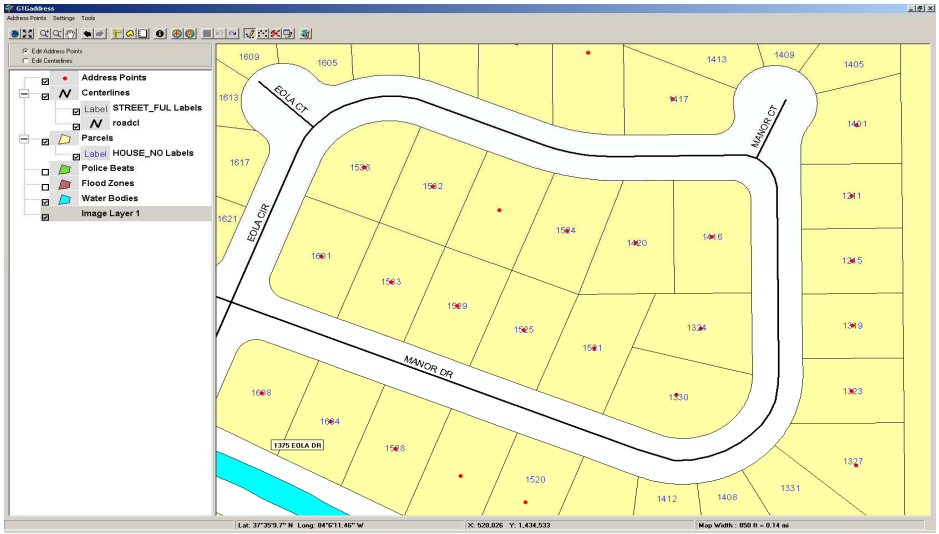
Addressing and Street Centerline Maintenance

Various applications exist that allow an organization to update address points and street centerlines. Some organizations utilize out-of-the box ArcGIS to edit these layers. However, it is recommended that a custom ArcServer application be created that allows for the maintenance of these GIS layers; as well as, integrate with Accela. The application should be used for both address point and centerline maintenance. Only identified gatekeepers should be allowed to utilize this application. This application should allow a user to input new addresses, delete addresses, and/or change addresses via the GIS. Currently, address changes are done in Permits Plus and then a GIS address point is created.

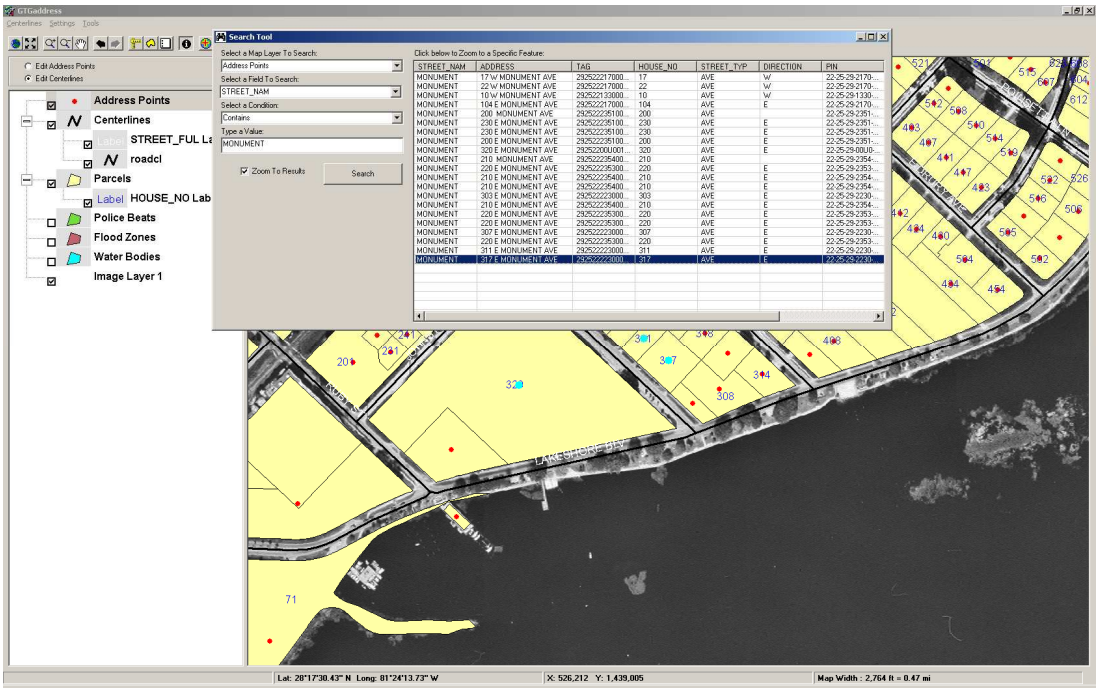
If a new enterprise permitting application is selected, West Sacramento should work closely with the vendor to develop bi-directional components that allow for automatic integration with their records. The application should maintain a one-to-one relationship between address points and the Accela records. The application should show the user any records that do not have a validated X,Y coordinate. The user should be able to click on the record and then the appropriate address point to associate the record with the accurate point. This would allow the user to permanently assign this correct address and X,Y to the record. Each record will then be able to be quickly accessed via GIS applications.

The application should allow West Sacramento to interactively and accurately map the location of address records stored in the permitting application. These addresses represent the GIS foundation for mapping the location of:

- CD Permits – Building, Engineering, Public Works
- Occupational Licenses
- Code Enforcement
- Utility Billing
- Work Orders
- Accounts Receivable
- Planning & Zoning



Using an Addressing Tool to Edit Address Data



Example of Addressing Application's GIS Search Tool

The application should also allow users to carry out custom queries to search for specific information stored in various GIS layers such as streets and parcels. Users will be able to search for specific street names or addresses within the address point layer or street centerline layer. Also, users can find specific locations on the map by entering a latitude and longitude.

Goal #5 - Implement ArcGIS Server

West Sacramento has committed to utilizing ESRI based GIS software. Recently, ESRI has released its latest GIS core products. These products are a radical departure from the previous versions. ArcGIS Server is the core technology and acts as the central command center for the ESRI suite of products. ArcIMS is no longer being sold and eventually will not be supported. West Sacramento needs to migrate to the new suite of tools as soon as is feasible. The following section describes the new Server concepts and components.

Server GIS

Server GIS allows GIS software to be centralized on application servers—delivering GIS capabilities to large numbers of users over networks. ESRI offers a range of server GIS software products—ArcGIS Server, ArcGIS Explorer, ArcIMS, and ArcGIS Image Server. These products allow GIS and data services to be hosted in a server-based environment. Centralized data management and application support, combined with adherence to information technology standards, make server GIS software products the key to broad use of geospatial technology with enterprise information systems.

Basically, Server GIS enables you to push your maps, models, and tools out to others in your organization in a way that fits well into their workflows. Staff in other departments and out in the field can query accurate, up-to-date data without a lot of training. This increases their productivity as well as yours. Server GIS complements ArcGIS Desktop by allowing GIS analysts to cost-effectively author maps, globes, and geoprocessing tasks on their desktop and publish them via a server using integrated tools. GIS functions can then be delivered as services throughout the enterprise. Server GIS allows GIS capabilities to be delivered to large numbers of users. Enterprise GIS users connect to central GIS servers using traditional desktop GIS as well as Web browsers, mobile computing devices, and digital appliances. ESRI's server-based GIS products and standards are compliant and interoperate well with other enterprise software, such as customer resource management (CRM) and enterprise resource planning (ERP) systems. [This compliance supports interoperability in both the GIS domain (Open Geospatial Consortium) as well as the broader IT domain (W3C).] By maintaining compliance, other enterprise systems can interface with ESRI's server-based GIS products.

ArcGIS Server

ArcGIS Server is ESRI's primary server GIS product. It is a complete and integrated server-based GIS. It comes with out-of-the-box, end user applications and services for spatial data management, visualization, and spatial analysis. ArcGIS Server can be distributed by single use license, server license, server deployment license, developer license, and developer and testing server license. Listed below are two tables which outline of each of the available ArcGIS Server editions and levels.

ArcGIS Server Editions	
Basic	This edition of ArcGIS Server is essentially ArcSDE bundled together with database replication functionality.
Standard	This edition of ArcGIS Server includes all of the functionalities associated with the Basic edition, standard map publishing (similar to ArcIMS), Globe Server for 3D map rendering (such as ArcGIS Explorer), and standard geoprocessing.
Advanced	This edition of ArcGIS Server includes GIS feature editing through a web browser, support for connected or disconnected mobile clients through the mobile Application Development Framework (ADF), and advanced geoprocessing.

ArcGIS Server Levels	
Workgroup	This level of ArcGIS Server includes a version of ArcSDE that works only with SQL Server Express 2005 and is limited to ten users, 4 GB of data storage, and one socket.
Enterprise	This level of ArcGIS Server allows for unlimited users and SDE database size, but requires the use of a Database Management Service (DBMS), such as SQL Server or Oracle.

West Sacramento should eventually move to ArcGIS Server Advanced Enterprise (The City is currently at ArcGIS Enterprise Standard).

ArcGIS Explorer

ArcGIS Explorer is a lightweight client that is included with ArcGIS Server. It offers an easy way to deliver access to GIS content and capabilities. ArcGIS Explorer supports 2D and 3D mapping services as well as geoprocessing services for spatial analysis. ArcGIS Explorer is distributed by single use license only.

ArcGIS Image Server

ArcGIS Image Server is a management, processing, and distribution platform for geospatial imagery that integrates with ArcGIS Server. It provides fast and open access to geospatial imagery, allowing organizations to leverage their investments in raster data. ArcGIS Image Server can be distributed by single use license, server license, server deployment license, developer license, and developer and testing server license.

ArcIMS

ArcIMS is widely used for GIS Web publishing to deliver maps, data, and metadata to many users on the Web. For example, ArcIMS provides browser-based access to many GIS catalog portals that enable users to publish and share geographic knowledge with other users. ArcIMS can be distributed by single use license, server license, server deployment license, developer license, and developer and testing server license. The product will not continue to be sold individually in the near future. Instead, this product will be merged into ArcGIS Server.

As part of paid maintenance, West Sacramento has received the standard enterprise version of ArcGIS. West Sacramento has committed to implementing ArcGIS Server. Initially, the City should implement this in a test environment and then move it to a live environment once staff are comfortable with the technology.

Goal #6 - Expand the Use of Intranet and Internet GIS Applications

The ability to view data in a quick and easy format is important for local governments and is needed throughout an enterprise. Web-based data browsers allow quick viewing and printing of map data. IT has created an ArcIMS based GIS web portal for Internet and intranet usage. This application has been a great success and has allowed the public and staff to utilize the City's GIS investment. However, as mentioned in the previous goal, ArcIMS is becoming obsolete as ArcGIS Server has been released. City staff should recreate this data browser in ArcGIS and make it available to the users. However, the City should expand this GIS via the browser concept to multiple public and internal portals. The current site meets the generic needs of the users; viewing data, creating maps, doing general analysis, etc. However, the next step is to create targeted portals for GIS users. Each department should have their own ArcGIS Server application that serves up GIS data and targeted uses for their department. For instance, the Police Department application should be targeted for crime mapping and analysis while the Community Development should focus on permitting, building, sewer and water infrastructure, and inspections. Each portal should be refined to meet the needs of the department. Only data pertinent to the department would be available. Custom reports and queries would be created to meet the needs of the particular department. The public web site should keep the "generic" browser capability that it currently has.

Intranet GIS Data Browser

The City currently has an existing platform that can serve as the backbone for Internet and intranet GIS Data Browsers. Existing software from ESRI will need to be upgraded to the latest technology, ArcServer. ArcServer software from ESRI will serve as the underlying GIS component.

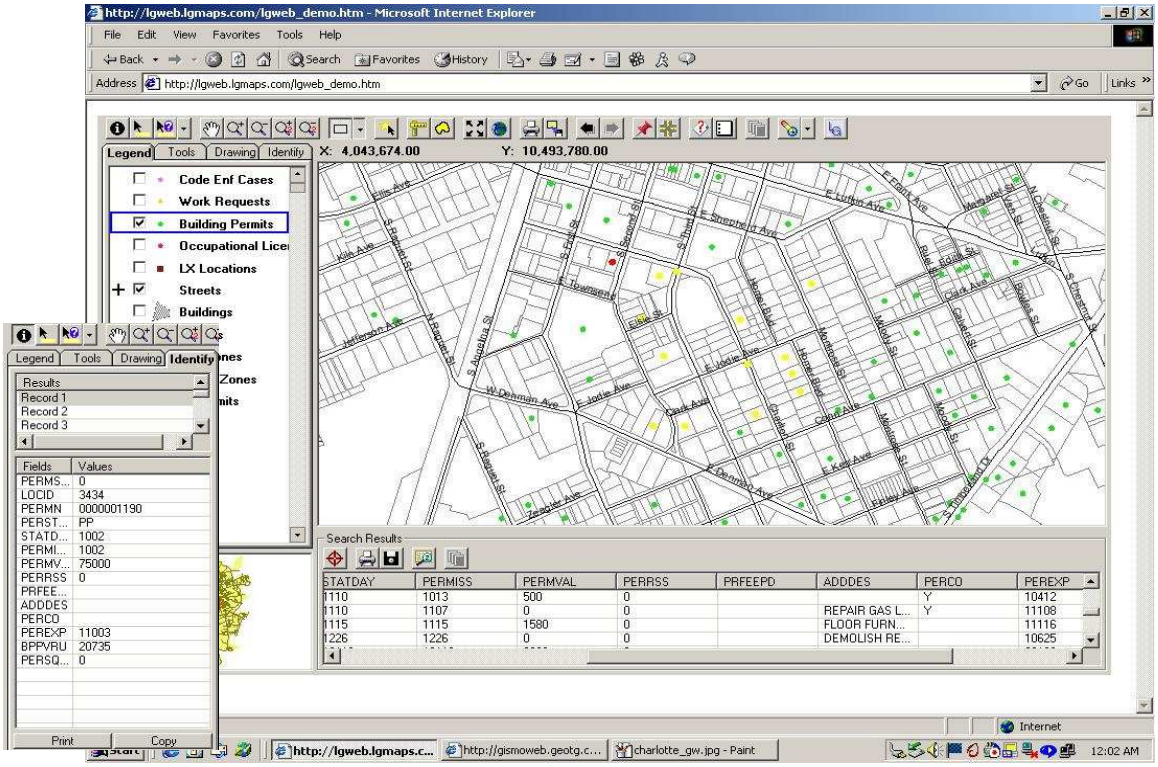
Upon consolidation, centralization and standardization of GIS data, the intranet GIS data browser should be modified to provide department-specific data and functionality. Additional functionality should include the ability to view all base map data, department-specific queries, and standardized mapping templates. Additional departmental/divisional requirements are provided in specific department/division sections in this chapter.

The ArcServer platform utilized for the intranet GIS data browser can also be leveraged to implement other intranet GIS applications in the future as well as an Internet GIS data browser.

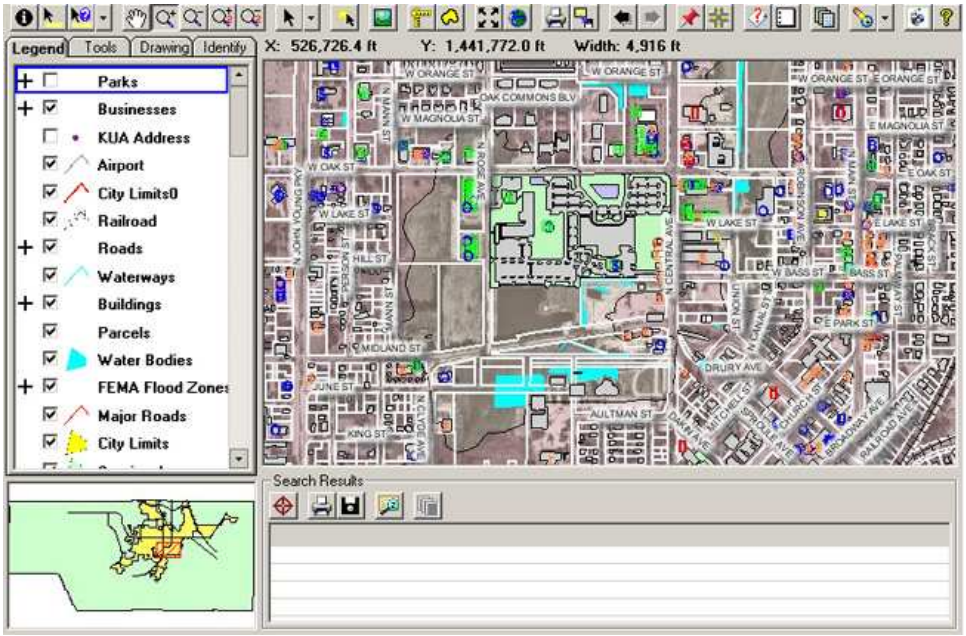
Benefits and Concepts of Intranet Application

The intranet solution brings the targeted tool set for local governments while leveraging all of the data residing in existing data sets. Users can:

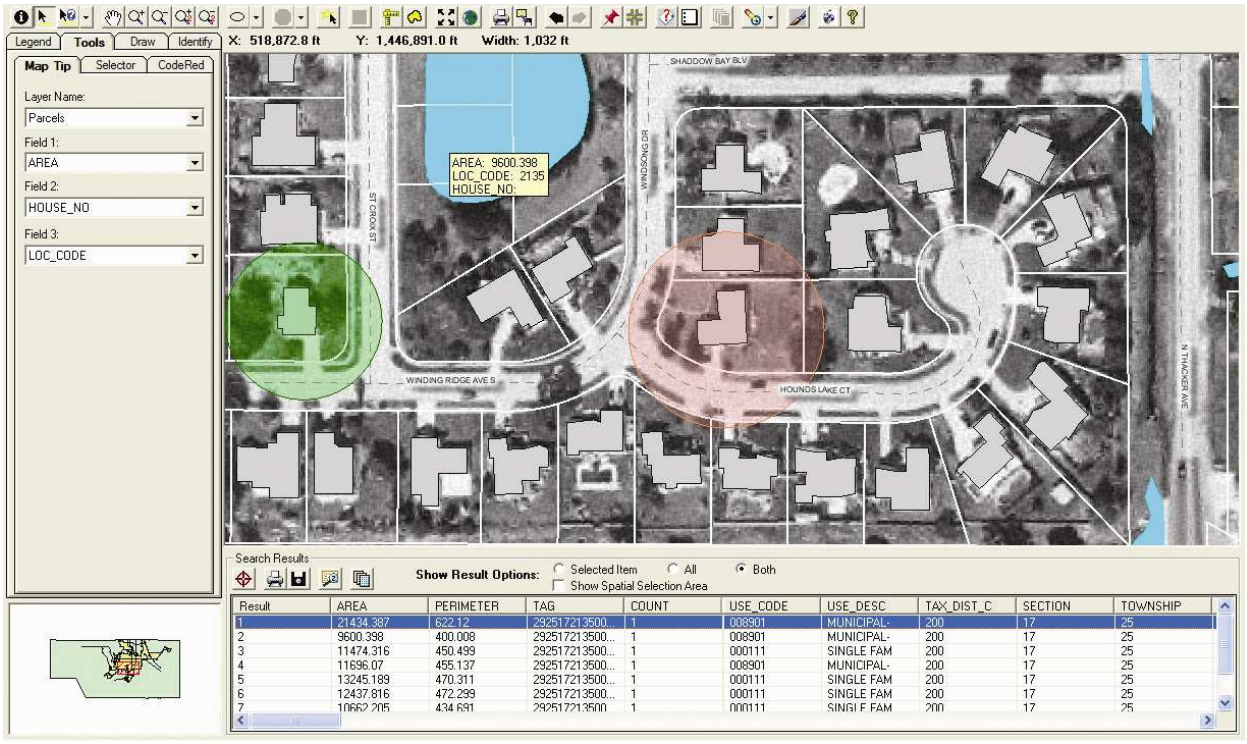
- Geographically query land base data. For instance, show me all work orders in my service area or show me all certificates of occupancy in the downtown area. Users can now geographically query their existing data.
- Utilize maptips – users can now hover over a GIS record and have tabular data displayed. As the cursor is moved over the map, any combination of data is automatically shown to the user.
- Find addresses easily – The tool should provide a smart intersection finder and advanced address finding capabilities.
- Produce advanced reports – An infinite amount of pre-defined reports can be made available to the end users. Gone are the days of having to try to create a cumbersome report via a report writer. A well written intranet tool will make this a task which is accomplished in seconds. This includes mailing labels, letters to customers, or any report needed.
- Quickly measure distance and area – In local government the size of a lot, the distance from a house to a utility, or the dimensions of a building footprint, etc. are often needed. This has traditionally been a cumbersome task. The intranet tool should allow the user to do this in a few seconds and see results in acres, square feet, and square miles automatically.
- Notify citizens – with a reverse dialing extension (TeleWorks, CodeRed) users can quickly select a geographic area and have their citizens phoned automatically. This is used for emergency and non-emergency events.
- Print quality maps – Maps of any size and scale can be printed by the user.



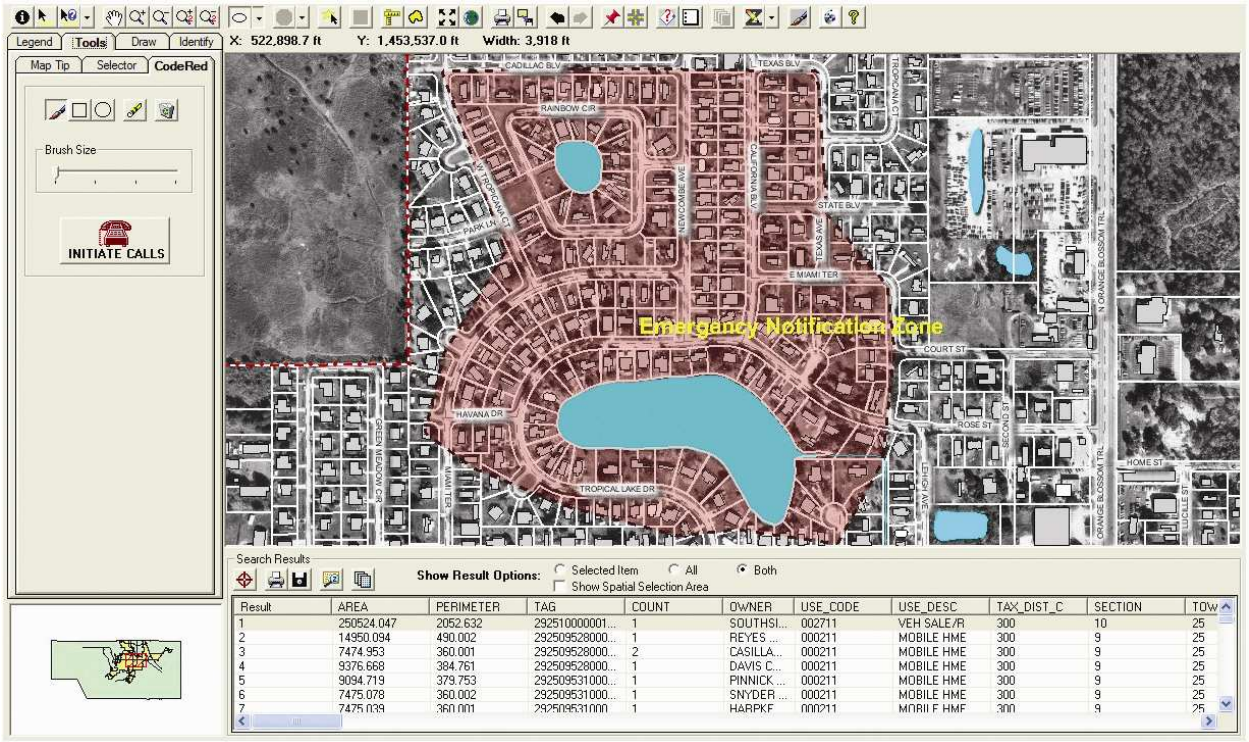
Example intranet application with an easy-to-use browser interface



Simple yet Powerful Integration of Existing IT Data



Easy selection tools for the user should be included



Integration of notification software should be considered

Multiple Interfaces or Services by Department or Function

The browsers should have a selection box for every major department or function in the organization. Once the department is selected then the interface, layers available, search mechanisms, and available reporting change to focus on the needs of that department. These associated layers and stored queries should be definable by staff and not require the use of programmatic changes to edit or update.

Data Search Methods and Stored Queries

Various methods of finding information should be available. Each departmental interface will have a definable list of data search methods. These methods will be editable and storable by an administrative user and the shared out to the end user community. The following graphic depicts some more popular ways of searching for data in local government.

Departmental or Function List of map Interface

Standard Neighborhood Search or Stored Configurable Search list

Data Display and Hyper-linking

The browser solutions should support hyper linking to web supportable file formats. Following are excellent examples of hyper-linking opportunities from the application datasets:

- Images within Accela
- Sexual Offenders link to the State
- Imagery of Community Facilities
- Pictures of individual structures
- Maps to community facilities

Sample of Sexual Offender Link

Internet GIS Data Browser

The current Internet data browser has been very successful. An enterprise Internet GIS Browser application, based on ArcServer, will need to be implemented to provide a comparable solution. The Internet browser application should include an intuitive interface, and should incorporate the use of a graphic outline. The interface should be developed to match the current City of West Sacramento web site in color scheme, layout, logo etc. Other targeted Internet applications such as one based on economic development should be made available over time.

Goal #7 – Improve the Public Access Kiosk

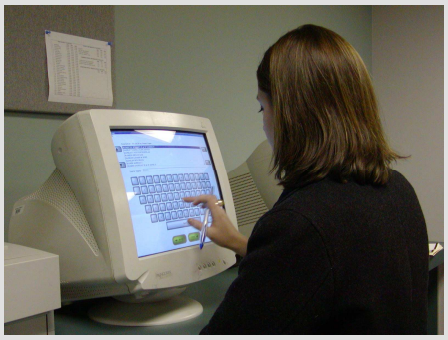
West Sacramento has had great success in data sharing and public access to GIS data. However, with any successful GIS new and innovative ways for sharing data and enabling the public must always be pursued. The City acquired a kiosk from a company that is no longer in business and cannot support the hardware. Therefore, replacement hardware will need to be considered in the future. West Sacramento provides a GIS portal on its web-site. Access to a variety of data is provided via the web-site. As outlined in the previous goal, staff should continually evaluate ways to streamline and improve the site. Not everyone is going to access data they need via the Internet. Many citizens will continue to come to the City offices to gather needed information. In that regard, there are many innovative ways for citizens to access needed data at the counter. West Sacramento should prioritize the refinement of a public access front counter solution. This manifests itself in various ways at various organizations. Some utilize a variation of their existing web portal. However, this is often lacking because many people coming to the counter do not have the savvy to utilize a web solution. Additionally, others have physical limitations, such as poor eyesight, that limit the use of a typical web portal. Therefore, many organizations utilize a large button touch screen kiosk that is streamlined to answer the top ten questions that are encountered at a front counter. The application should focus on user friendliness and ease-of-use. Touch screen kiosk GIS applications can be acquired commercially or created in-house. If done in-house it should be created utilizing ArcObjects. The current application has been received well but is underutilized. A campaign to educate the public about its existence and encourage its use should be undertaken.

Kiosk Application with Large Buttons

Case Study – The following case study illustrates how local governments can gain efficiency by providing public access tools in a self serve environment. The tools were developed to build upon the County's investment in GIS data and its desire to increase productivity. This case study reinforces what investment in public access tools can return in time saving for local government.

Case Study: Sharing Data Made Easy

Like all local governments nation-wide, Wayne County North Carolina's staff spend a large amount of time accessing data for the public and for internal use. David Ward, Tax Administrator for Wayne County, knew that the appropriate GIS tools would allow staff to operate more efficiently. Mr. Ward points out that; "Our mapping staff were spending 10-20 hours a week helping the public acquire the map information they needed. We were finding it difficult to spend all of this time with the public and keep our tax maps up-to-date. Also, our internal staff continually had to walk back and forth to map cabinets to find information they needed." Wayne County decided to employ a touch screen GIS solution to assist in streamlining their operations.



The Public Now Prints There Own Maps Saving Many Staff Hours

Wayne County knew it wanted to serve the public need for data much more quickly. David Ward had seen a demonstration of touch screen GIS and saw the utility of the tool as a public access front-counter solution.

David Ward states; "Our touch screen solution has been a resounding success at Wayne County. The public love the tool and our staff are now freed up to do their daily tasks. We are purchasing our third touch screen. Our biggest problem now is that we often see the public lining up to utilize the application. The demand has been great. We have had to roll out more copies of the application just to meet the demand."

Goal #8 - Provide City staff with GIS training, education and support

Training is a vital part for any IT implementation. Users need a variety of training opportunities and venues. Previous goals detailed the need for establishing user group meetings and the distribution of a GIS newsletter. Training and education should be an on-going year-round commitment.

The GIS Specialist has obtained key training in the needed GIS skills to move West Sacramento to an enterprise GIS. It is essential to follow up with the training as outlined in this document. Training and users are categorized in three areas:

- Tier 1 - A Tier 1 user is a power GIS user who should have access to all ArcGIS tools. In the Information Technology Division this is the GIS Specialist.
- Tier 2 - A Tier 2 users focus is data analysis in addition to general browsing capabilities.
- Tier 3 - A Tier 3 user requires only general browsing GIS data functions.

Below is a summary of training taken during the first two-years of this project:

Tier 1 - GIS Specialist:

- Introduction to ArcGIS I
- Introduction to ArcGIS II
- Introduction to ArcIMS
- ArcIMS Administration
- AutoCAD Map
- Safe FME
- ESRI International Users Conference
- Urban and Regional Information Systems Association (URISA) – member and Vice President of Northern Chapter

Tier 3 Users

- Utilization of the Tier 3 Internet/intranet data browser
- Utilization of the Tier 3 Public Access Kiosk application

Tier 1 Training

The GIS Specialist is responsible for the creation/maintenance of GIS databases in the ArcGIS environment. The next steps in training for the GIS Specialist should focus on maintaining geodatabases, maintaining and utilizing ArcSDE technology and the ArcServer products. More details on specific training classes is provided in Chapter Four of this document.

Tier 2 Training

The GIS Specialist should provide training and technical support for all enterprise-wide GIS applications. All GIS software training should be coordinated through the GIS Specialist and IT Manager to ensure efficiency at a minimum cost. It is recommended that the GIS Specialist work with the Information Technology Division to ensure that relevant technical staff receives adequate training.

Tier 2 users should be provided training from the GIS Specialist or a certified ArcGIS trainer covering the Tier 2 application ArcView 9.x. The most cost efficient method is for the City to conduct Tier 2 training in-house to new employees or as new upgrades to software become available.

Tier 3 Training

Tier 3 users should continue to receive customized training sessions on each individual application and reporting tool that is developed. Training can be performed by the GIS Specialist or IT staff on-site. This format will be the most cost effective for the City.

The following two tables identify the full training needs of the City:

GIS Training Matrix

Class	Site	Trainer	Days	Participants	Cost
Introduction to ArcGIS Server	Off	ESRI Authorized Trainer	2	GIS Specialist	$ 950
ArcGIS Server Enterprise Configuration and Tuning for SQL Server	Off	ESRI Authorized Trainer	2	GIS Specialist, Network Specialist, Tier one GIS Users	$ 950
Introduction to ArcGIS I	Off	ESRI Authorized Trainer	2	Various Departmental Staff	$4,000
Building Geodatabases I	Off	ESRI Authorized Trainer	3	GIS Specialist, Network Specialist	$ 1,425
Data Management in the Multi-user Geodatabase	Off	ESRI Authorized Trainer	3	GIS Specialist, Network Specialist (if needed)	$ 1,425
Tier 3 Applications	On	Internal	1	Various	N/A

Recommended Number of Personnel (by Department) for ArcGIS I, ArcGIS Server Configuration, and Tier 3 Applications Training

Department/Division	ArcGIS I	ArcGIS Server Configuration	Tier 3 Applications
IT Department	2	2	10
Drafting Services Section	3	0	3
Engineering Division	2	0	20
Facilities Maintenance	1	0	8
Finance Department	0	0	3
Fire Department	1	0	15
Parks & Recreation	1	0	6
Planning Division	2	0	6
Police Department	1	0	15
Public Works	1	0	10
Redevelopment Agency	1	0	7
Total	**15**	**2**	**99+**

Goal #9 – Implement Latest GIS Tools and Functions

Distributed GIS Editing

ArcGIS Server opens up some exciting new opportunities for creating applications to enable field personnel to view and edit GIS data. At the Advanced Enterprise level of ArcGIS Server, the Mobile ADF (Application Development Framework) becomes available. The Mobile ADF allows for the development of custom applications in the .NET environment that can be targeted for use on smart phones and PDAs running the Windows Mobile operating system or for laptops or tablet PCs running Windows XP. It has been established that West Sacramento has a future need for mobile GIS tools. The ArcGIS Server- Mobile ADF will play a significant role in the enablement of field personnel with portable GIS.

Mobile ADF

Applications developed on the Mobile ADF operate from a map cache that is retrieved from ArcGIS Server map services and stored locally on the device. This allows the applications to operate in a disconnected state from the server. The applications can be designed to synchronize its map cache with the server at set intervals, when certain network conditions are present or simply on demand by direct command of the user. These synchronizations would both retrieve changes to the map data that have occurred elsewhere, but will also upload any changes that the application has been designed to allow the user to make to the GIS data. The Mobile ADF minimizes the amount of data transferred during synchronization from SDE data sources to only the individual feature edits that have occurred since the last synchronization. This data is then modified within the existing map cache stored locally on the device. Therefore, bandwidth utilization is reduced and data synchronization over virtually any wireless connection becomes feasible. Wireless connection within West Sacramento is available.

Editing from the Mobile ADF is restricted to versioned SDE GeoDatabases and user edits are stored in a version until an administrator reviews the changes and performs a post and rectify process within ArcMap.

Recommendations

In general, it is recommended that each department consider carefully where mobile access to GIS data could benefit the workflow of any City staff member that works in the field for even a portion of the day.

Also, West Sacramento should consider what types of devices will be utilized by staff for each set of tasks. The choice of device will significantly impact the capabilities of the application and also the ultimate cost of deploying the application. Obviously, applications written for smart phones will have the smallest display area and the most limited user control, which means that these applications would need to remain simple. Designing for PDA deployment offers greater display area and user interaction and would offer the best target device for intermediate complexity, highly mobile applications. For high functionality mobile applications, the Mobile ADF can be used to develop applications targeted at laptops or tablet PCs. These applications offer the greatest display area and user input and should be highly considered for any task that will require the staff to be entering large amounts of data.

Listed below are common types of mobile access options and a brief description:

Type	Description
Cellular Telephone 	Cellular telephones are wireless telephones that use analog or digital transmission. Functionality and interface vary depending on each telephone. Some cellular phones combine telephone and handheld computer functionality. In recent years, GPS capabilities have been integrated with cellular phones.
Handheld PC 	Handheld PCs are computers that have a subset of functionality compared to that of notebook (laptop) computers. Handheld PCs typically have a monochrome or multi-color display, extendable keyboards, and various types of input devices. Some handheld PCs have been combined with cellular phones to function as a combined computer and phone.
Tablet PC 	Tablet PCs are a hybrid designed to function as a combination PDA and notebook PC. Tablet PCs provide a keyboard-less means of viewing and entering information in a computer; Tablet PCs provide greater functionality than a PDA (as well as additional processing power) and greater ease-of-use than notebook PCs.
Notebook/ Ruggedized Notebook 	Notebook computers are portable personal computers (PCs) that include a keyboard and large display. Notebook computers are more robust than other mobile computers; however, notebook computers tend to be heavier and less transportable. Notebook computers typically have a comprehensive operating system installed, as well as sophisticated applications. Ruggedized notebook computers are specially designed computers that have a reinforced casing, are water-resistant, and have shock absorption mechanisms to minimize the damage that can occur if a computer is dropped or hit.

Department of Parks & Recreation

GIS Goals and Background

Parks & Recreation has many possible uses of GIS. Many of these needs can be met by collecting needed data in the field and acquiring and enabling databases. The Department primarily focuses on the people utilizing services and the physical infrastructure and amenities that allow for the delivery of these services.

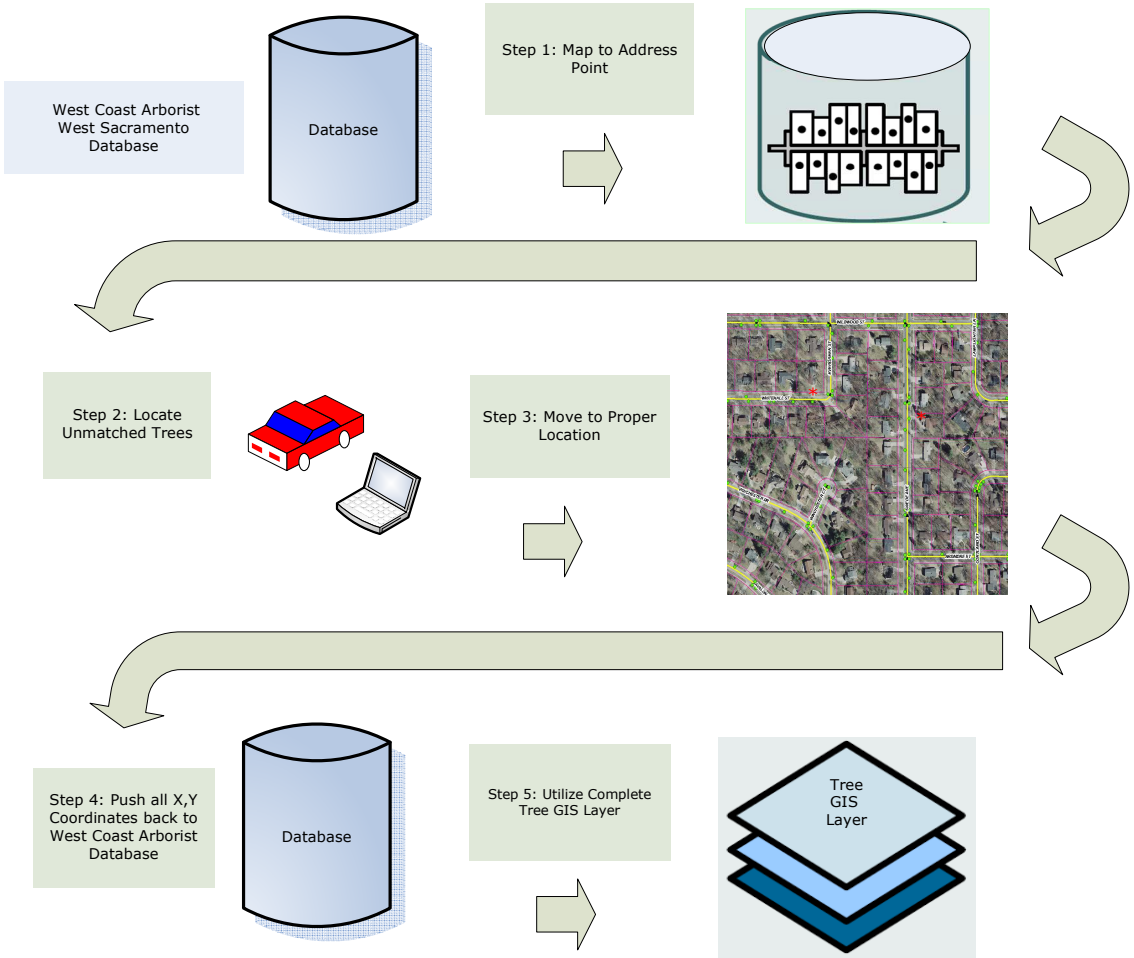
GIS Goals

The following are the goals for the Department of Parks & Recreation in regards to further GIS implementation over the next few years:

Goal #1 – Map Trees and Tree Permits

One duty of the Department is the promotion and management of trees within the City. The Department issues tree permits and will supply trees in some cases to citizens. A visual survey was conducted of all trees by West Coast Arborist. A text based list was provided to the City and West Coast Arborists maintains a database that the City can access remotely. The City contracts out right-of-way tree trimming. The City also pays particular attention to trees meeting certain size and age criterion or "Heritage Trees." Staff are part of the site planning approval process. As such, they review the tree plan for compliance to City standards.

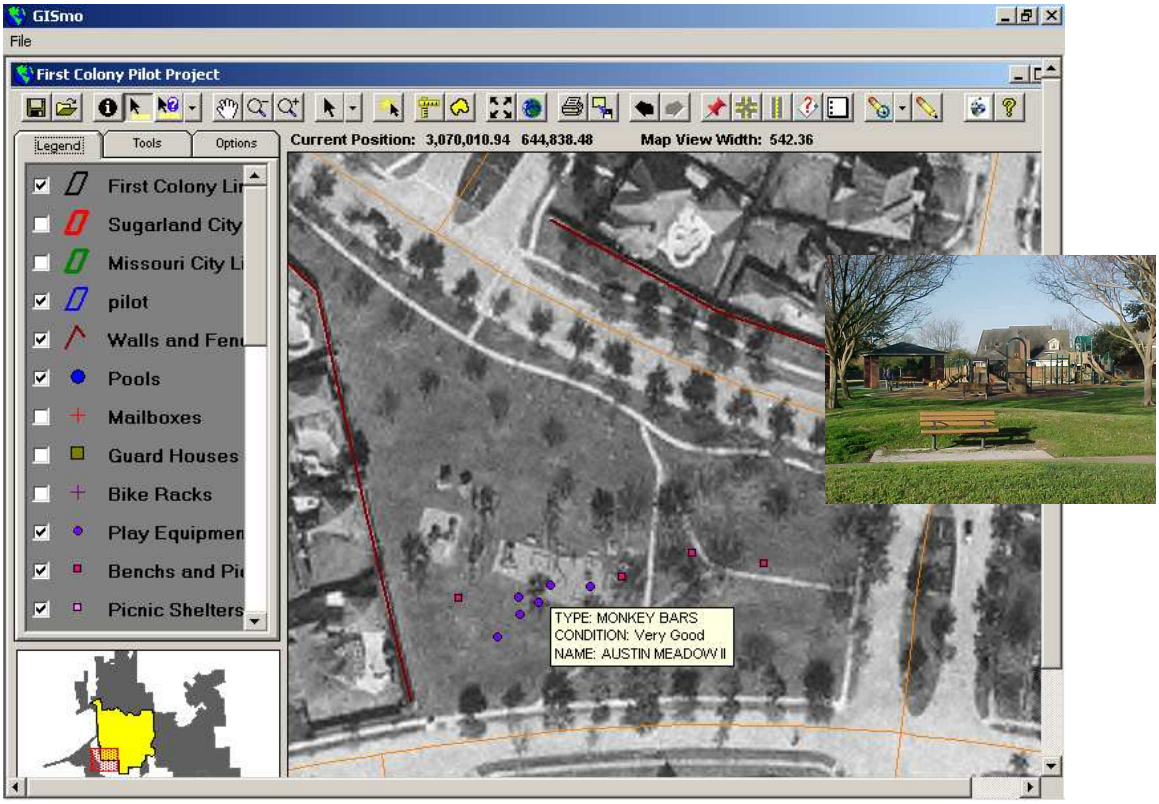
If a tree is removed, City staff email West Coast Arborist and the tree is removed from the database. Species and circumference of the trees are tracked. Approximately 16,000 trees are in the databases. A majority of these are assigned an address. These trees can be matched to their proper location by this address. It is recommended that the City acquire a copy of the West Coast Arborist database and map these records to the address point GIS layer (the address point GIS layer is discussed in detail in the IT Section of this Chapter). Tree records that do not match can be analyzed and matched manually to their proper location. Once complete the X,Y coordinates for each of the trees should be given back to West Coast Arborists for permanent storage in the database. As new trees are added to the database their GIS locations should be captured as well. This can be done by placing them on the screen utilizing GIS software or through GPS data collection. Additionally, nine-hundred tree permits exist. These could be scanned and linked to the tree record for viewing via GIS. The graphic on the following page depicts the workflow of getting the tree inventory from its current database only format to a GIS layer.



Tree Layer Creation - Data Flow

Goal #2 – Map Park Infrastructure

Parks & Recreation (P&R) will benefit from GIS as long as the assets, facilities, and buildings can be represented and displayed within the GIS. Initially the parks (boundaries) should be created as a GIS layer. Next, the Department's assets should be located on a GIS layer (e.g. irrigation systems, trees). For a GIS to be an effective management and mapping tool the assets that P&R maintains and manages must be represented in data layers.



Infrastructure Mapping with Photographs

P&R will need to collect the location using a global positioning system (GPS) of key parks assets. A Trimble GeoXH GPS unit is highly recommended for use by the City. It is recommended that a third-party vendor be contracted to conduct the data collection. The following is a list of assets that should have their location collected; the parentheses identify the data type each asset would be represented by:

- Trees (points)
- Irrigation lines (segments) and heads (points)
- Paths and trails (segments)
- Playing fields and amenities (polygons, points, lines)
- Park lights (points)
- Picnic areas (points, polygons)
- Shelters (polygons)
- Play structures (points, polygons, lines)

Once the locations of these assets are know P&R will be able to track activities at an individual asset level such as:

- Status path light/field light repairs
- Status of fertilization application
- Status of playground equipment repairs/construction
- Status of park structure repairs/construction
- Status of trail and path repairs/maintenance
- Status of field repairs
- Status of tree maintenance/blow-down

Additionally, all new parks facilities (e.g. lights, trails, playground equipment) that are installed or constructed, as well as changes to existing infrastructure (e.g. repainting goal posts), must be reflected in the digital database through field data collection processes that utilize GIS to capture location and attribute information. In the future as assets are added these can be annotated and measured from existing assets for data creation and data layer updates.

Goal #3 – Acquire a Parks & Recreation Application that is GIS Enabled

The primary need for P&R is data creation and development. No park asset records have been developed into GIS data layers. The P&R GIS data development and maintenance process will need to be based on some degree on the acquisition of a P&R software package such as RecTrac. This type of application represents the core data repositories for the Department. Data layer development will need to be developed from data entered into this P&R management package. A package like MainTrac will supply the asset data, such as tree inventory, chemical/fertilization locations, and related activities (e.g. dates, amounts). RecTrac manages users, the reservation system, including the online application, for parks facilities. It is also used for mailings and program planning. Currently, P&R is looking at various management packages such as Class, RecTrac and RecWare. The remainder of this section is predicated on one of these being in place. For the sake of illustration the remainder of this Goal will use RecTrac as an example.

Following the recommendation given for field data collection to define the locations of field assets, it is recommended that P&R identify the data from new management software packages as they are acquired. The data in these applications could be used as attribution for GIS datasets. For instance, RecTrac data that should be utilized are the customer addresses, program registration, and program location records. These records would enable the data to be placed on a map from which analysis and review could be completed.

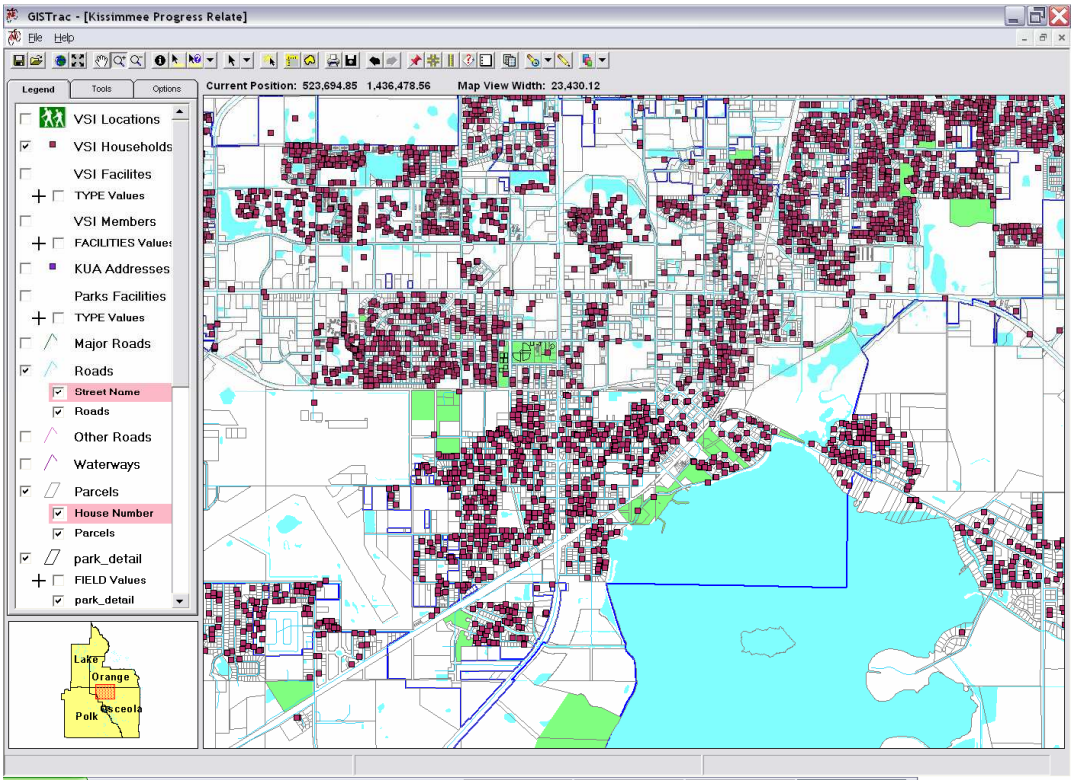
The IT Department and GIS Specialist will need to use a geoprocessor that will be able to link the P&R management data to a feature (point, line, or polygon) on a GIS data layer. Through SQL (Structured Query Language) statement the geoprocessor will access and develop a GIS data layer for each feature type (e.g. trees).

Most of the GIS users in the P&R Department will be Tier 3 users. Tier 3 users typically use GIS data browsers that enable the user to access pre-defined data layers for information lookup and mapping. The section below describes some analysis that could be performed with P&R management data integration:

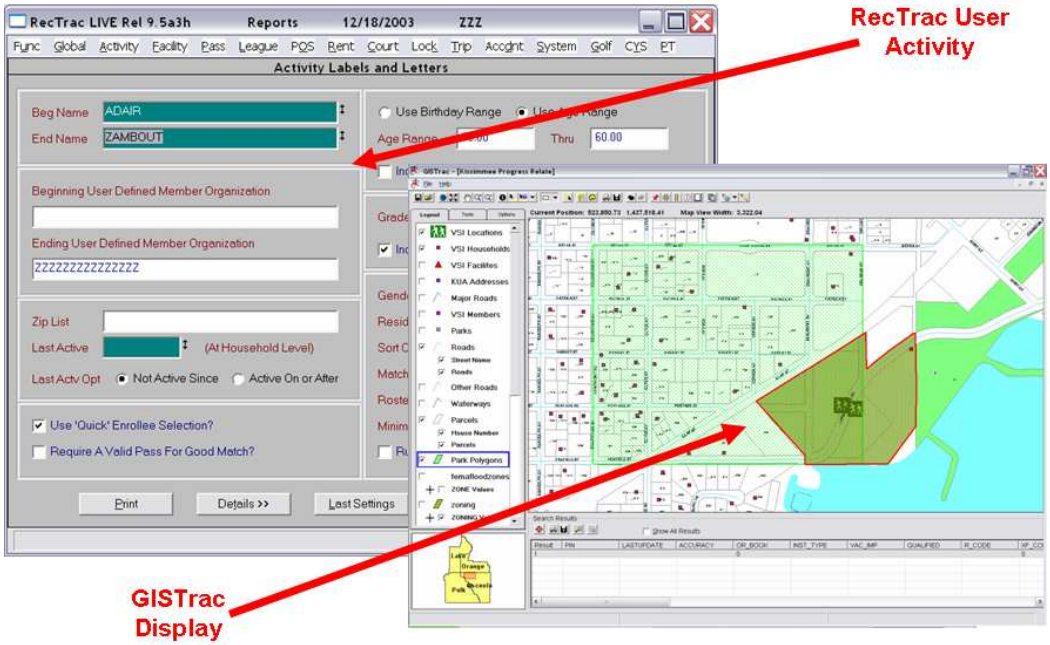
Intranet GIS Data Browser and Analysis
An intranet data browser is an application that can be used to conduct simple spatial analysis for decision support.

Using a GIS data browser P&R Department personnel can:

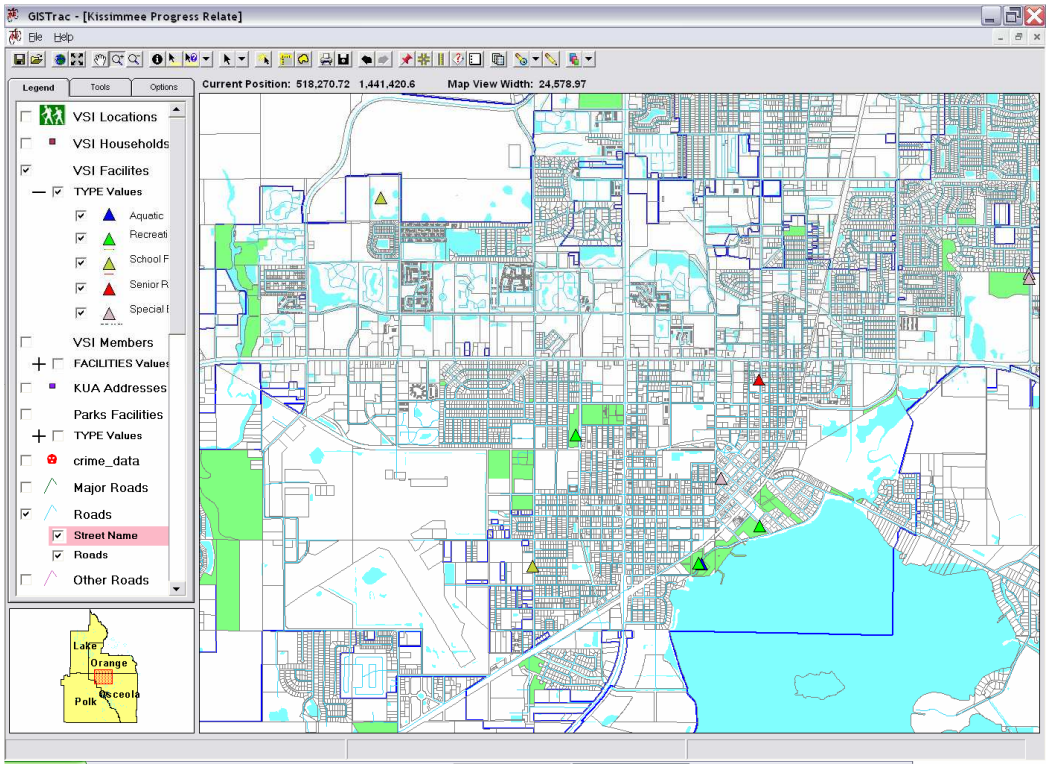
- Identify park facility users and non-users
- Develop marketing mailing lists
- Relocate activities based on user proximity
- Analyze crime adjacent or within parks
- Identify available facilities for customers



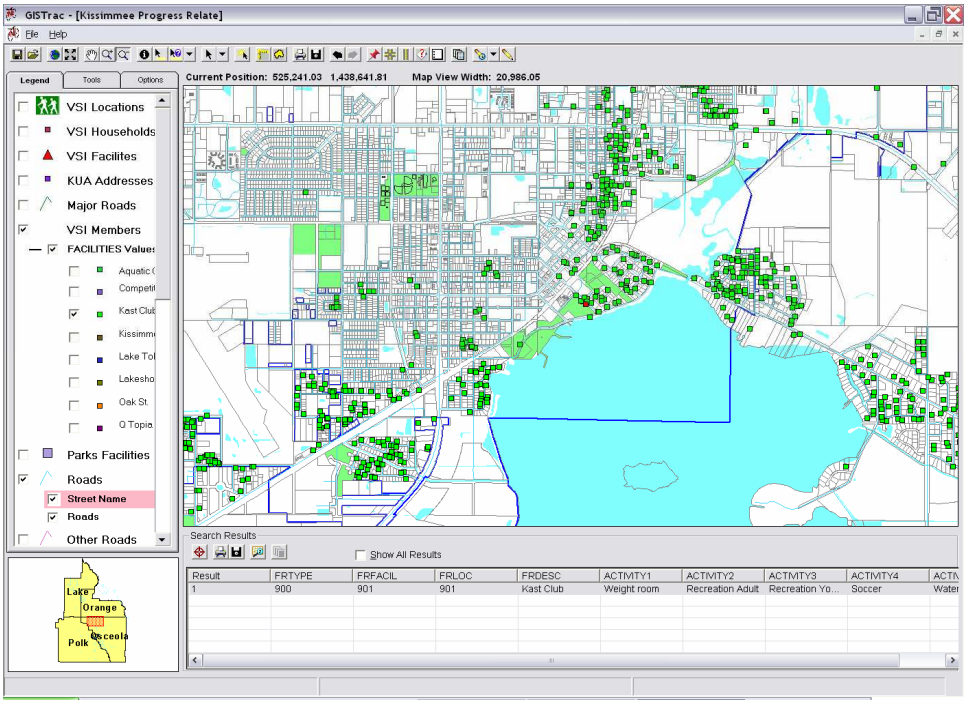
Identify all parks users



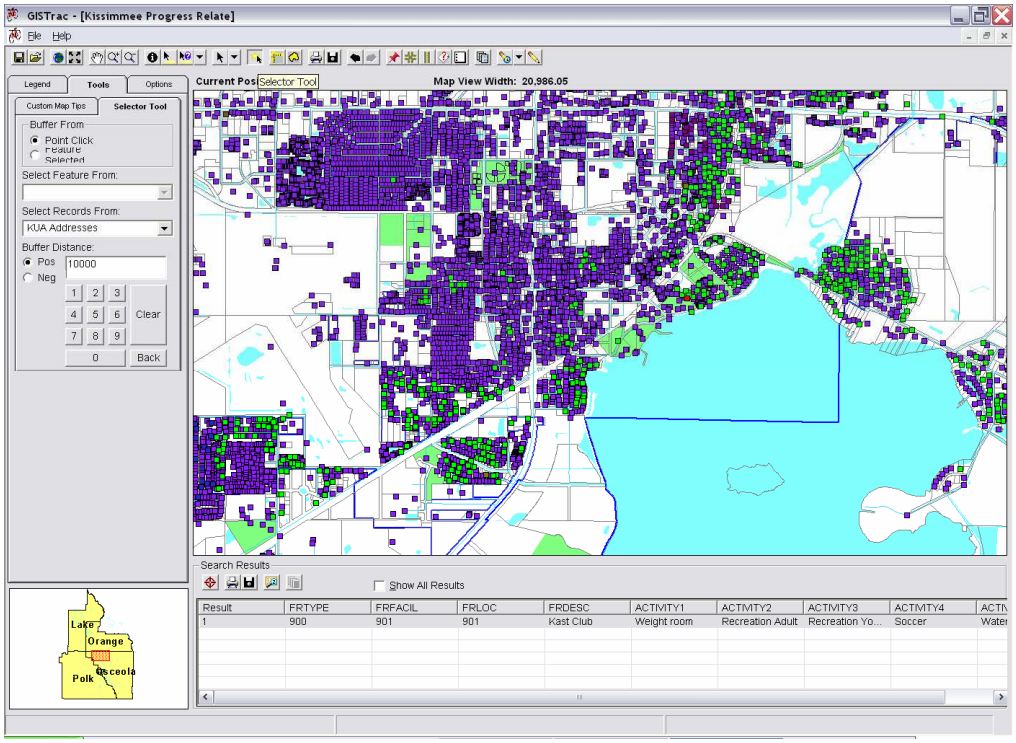
Analyze park usage



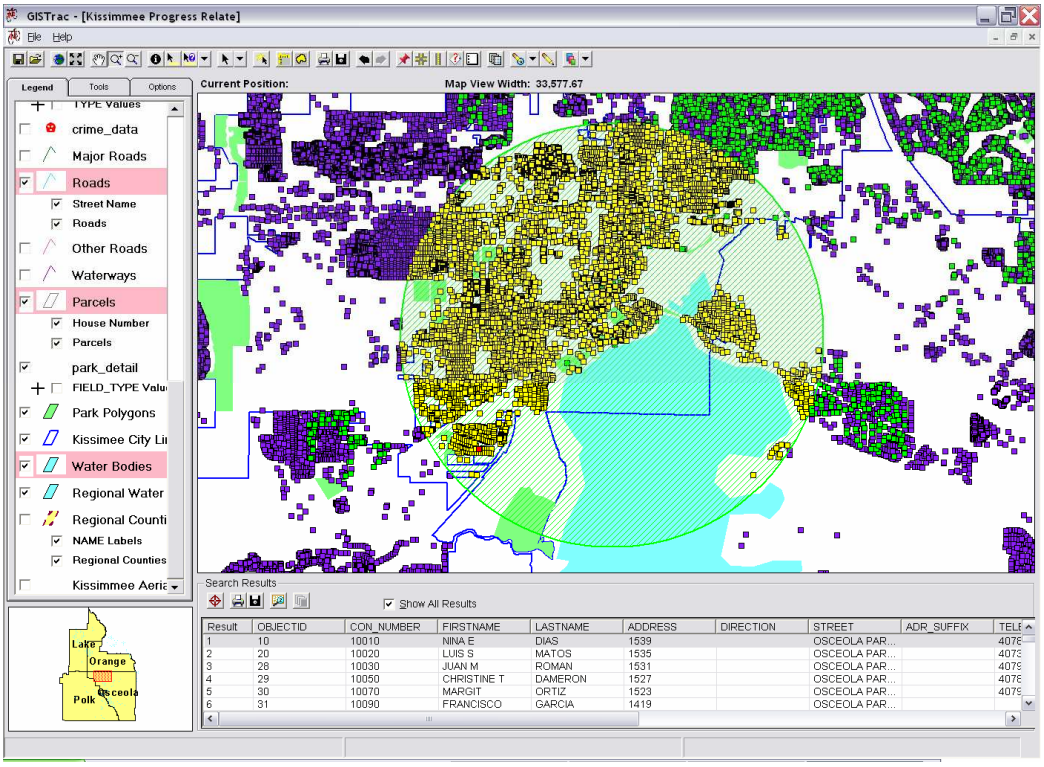
Identify park facilities by type



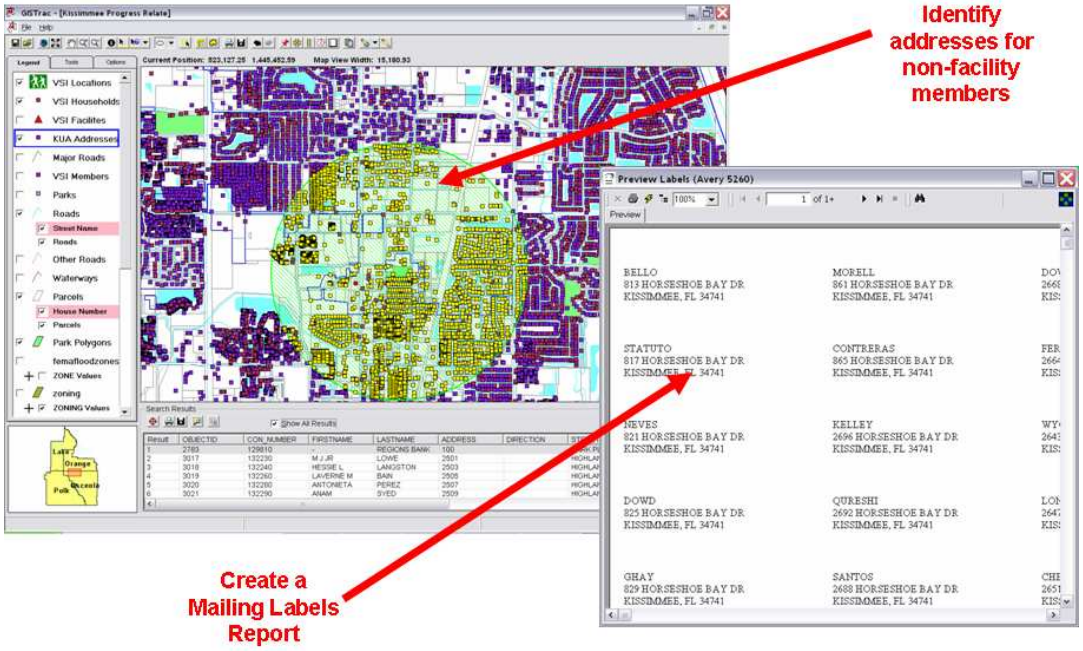
Identify park users by facility



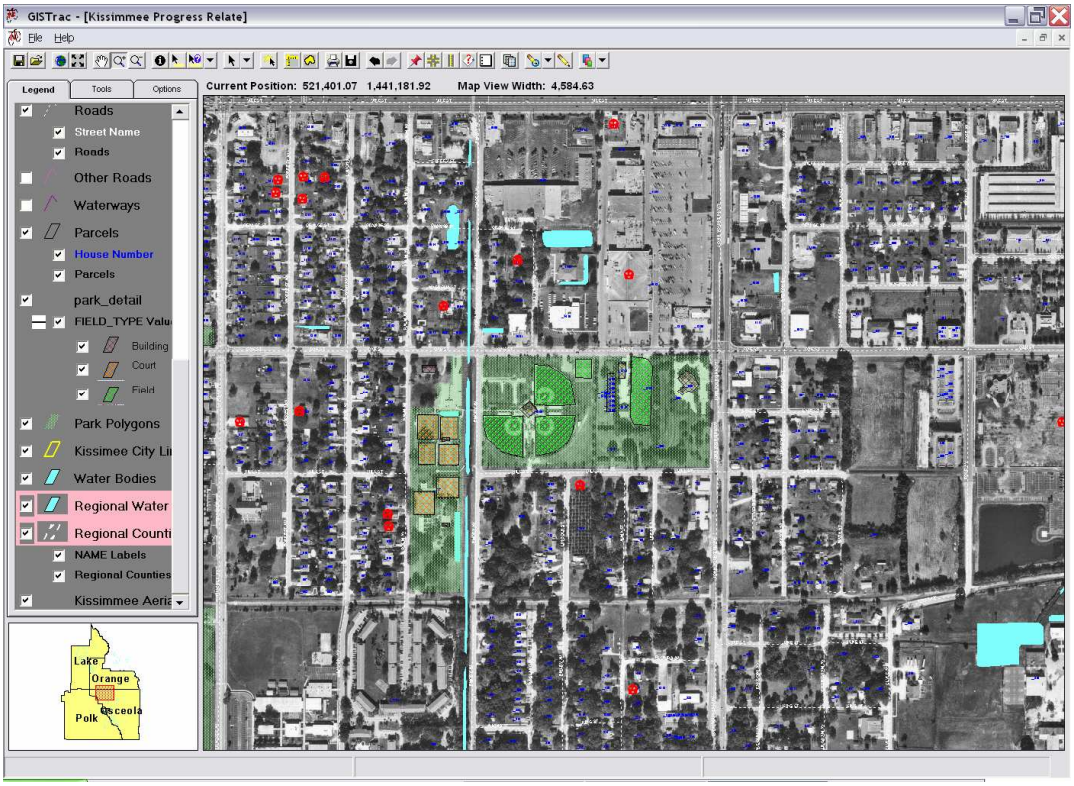
Identify facility non-users



Select non-users within a pre-defined distance of a facility



Develop marketing mailing list from proximity search (e.g. print labels)



Analyze crime adjacent to park locations

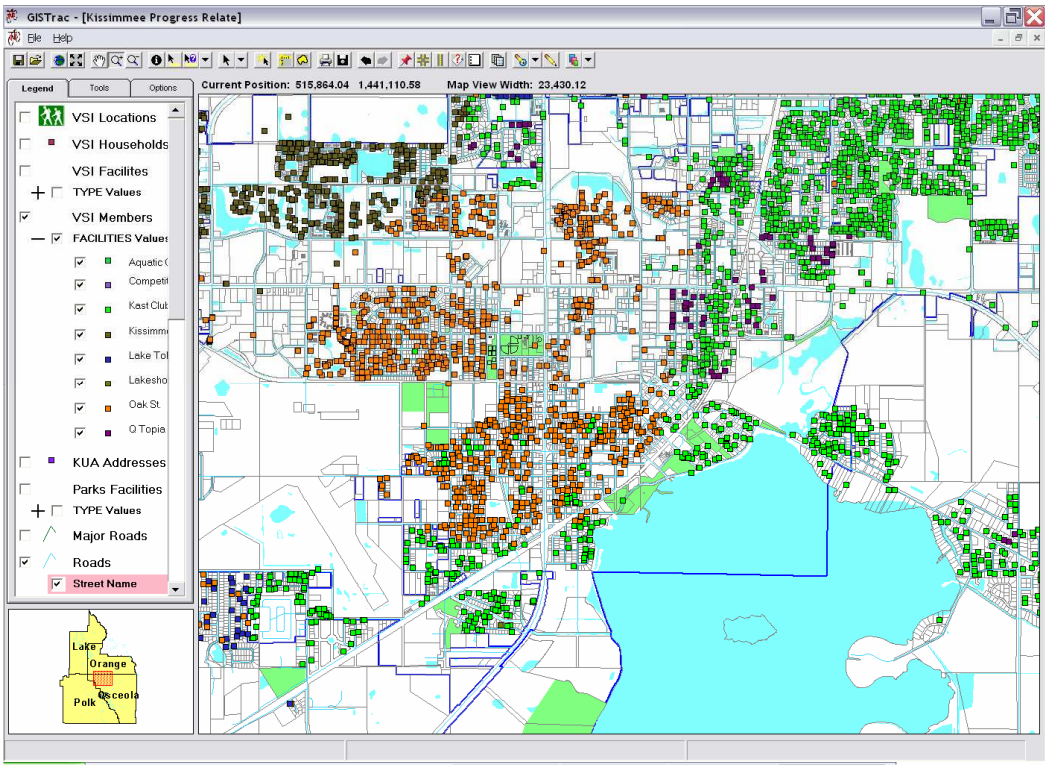
In the future, GPS units can be used in conjunction with mobile computing, allowing mobile devices (e.g. handheld computers) to capture and link existing data to data collected in the field that requires a spatial component (e.g. trees, irrigation lines, or playing fields can be mapped as a point, line or polygon respectively).

Park and facility location plays a key role in planning and scheduling recreational programs. Thematic maps can provide Recreation program planners with visual representation of park usage and related program interest. The majority of maps that can be utilized by the Department are simple mapping requests and queries that do not involve spatial analysis or modeling. These are the types of maps that should be fulfilled through a simple interface with prioritized data layers for easy use and query. More advanced spatial analysis should be completed through the GIS Specialist.

Initially the P&R Department should be provided with access to a pre-defined set of GIS data layers, including data layers developed from new P&R management data. Through the data browser the layers could be overlaid, queried, and scaled using an intranet GIS data browser.

The following maps should be developed based on RecTrac type data imported into the GIS:

- Park facility usage
- Program registration
- Trail Maps (bike routes)
- Facility locator maps



Park users by facility

Goal #4 – Use GIS for Spatial Analysis such as Optimal Park Site Location

Spatial analysis is the process of extracting or creating new information about a set of geographic features. Spatial analysis is useful for evaluating suitability and capability, for estimating and predicting, and for interpreting and understanding the relationship between phenomena that are spatially distributed. Spatial analysis is often referred to as modeling; however there are temporal components to modeling that are not necessarily present in spatial analysis. In GIS, there are four traditional types of spatial analysis: spatial overlay and contiguity analysis, surface analysis, linear analysis, and raster analysis.

P&R does not have personnel dedicated to GIS or data analysis. However, the Department does have access to GIS-based mapping and personnel that have some GIS training (GIS Specialist). Additionally, a GIS liaison will need to be established in the Department. Upon further implementation of the enterprise GIS, the P&R will be able to conduct the following types of mapping and analysis:

- Park use analysis (e.g. demographics)
- Programs analysis (e.g. proximity)
- Spatial target marketing

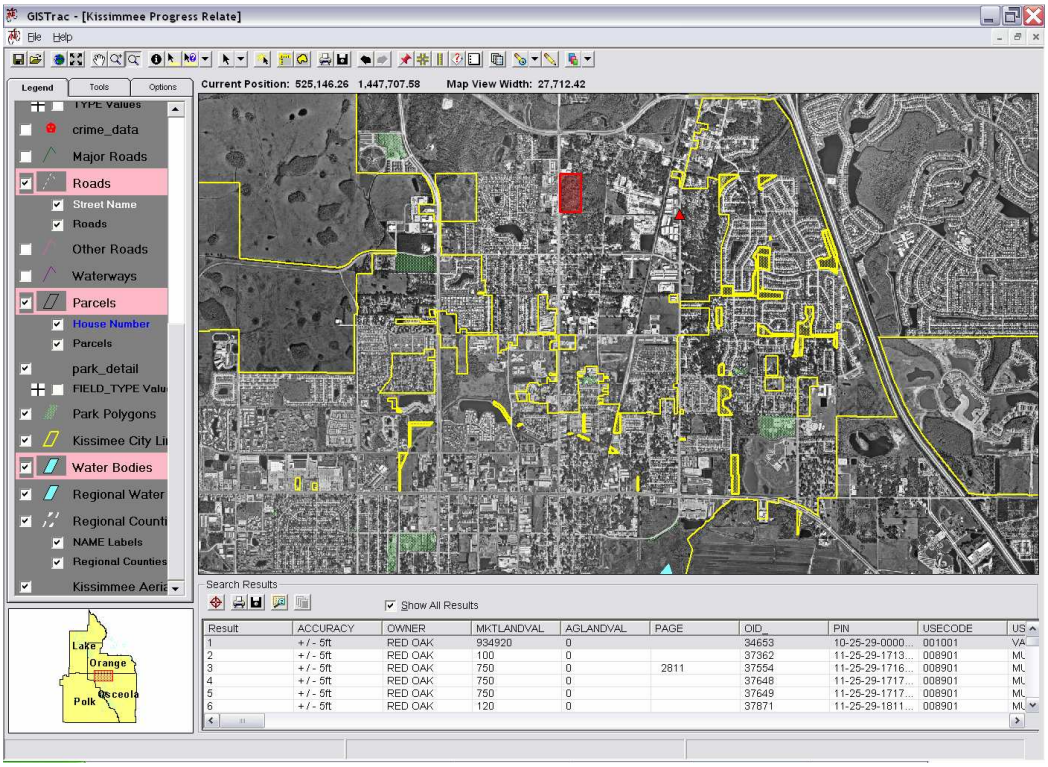
Much of the information used for spatial analysis will come from a management application such as RecTrac. Reservation and survey information captured in RecTrac can be linked to specific P&R Department locations and facilities to develop use maps based on the proximity of users to the location of programs and events. By spatially enabling a MainTrac type database, the Department will establish a solid foundation for mapping and analysis efforts of maintenance and operations. The following identifies the applications and analysis that can be conducted with an integrated GIS:

Intranet/Desktop GIS Data Browser

An intranet data browser is an application that can be installed on any computer on the City's network or intranet. The application has access to pre-defined GIS data layers depending on the user's business process and workflow.

Using a GIS data browser P&R personnel can:

- Look up work order locations for grounds and facilities
- Check status of fields and park structures
- Identify structures that require safety inspections
- Identify fields that require repair or chemical application
- Temporally analyze (time and date) a selection of repairs or inspections (e.g. by type or location)
- Identify potential sites for new parks



Analyze available land for park development

Case Study: GIS A Tool to Locate New Park and Recreation Services

Where is the best location to set up a new recreation facility such as a water park for a city? Who are the people living nearby and who may come out to use it? Is it maximally accessible to all residents? How many minutes, on average, does it take residents living within a mile radius to walk to the facility? How long do residents living five miles away need to drive there? What volume of transportation will be added to the area? In what zoning district will it be situated, and so on? Recreation and park administrators have so many questions and uncertainties to be answered in the process of making such a decision.

Over the years, recreation and park administrators and managers have come a long way in searching for effective tools for planning and managing park and recreation facilities and resources. Geographic information systems (GIS) have recently emerged as a helpful and accountable vehicle to fulfill the mission of providing sufficient and equitable park and recreation services (Tarrant & Cordell, 1999; Nedovic- Budic, et al 1999).

GIS can be used to measure geographic, environmental and socioeconomic attributes in relation to an existing or planned park or recreational facility, to describe the spatial distribution of socio-demographic attributes in a given residential area, to discover potential market segments, to examine spatial relationships between existing recreational or natural resources and distances traveled from origins of potential visitors, to use network analysis to minimize traveling time and find an optimal route, to derive new variables (e.g., population density) from existing datasets, or to track concealed damage of a forest fire in a national park. GIS, as defined by Burrough (1986), is an information system used to capture, store, manipulate, integrate and display geographic information. More specifically, GIS is a computer-supported information system that enables storage, transmission, retrieval,

processing and description of geographical- referenced information. For instance, a creek can be described as a line, a fishing pier as a point, and a park as an area. All of those can be represented either in the form of the "raster" data structure that describes space in small units (a series of geometric shapes, often called "grid cells"), or the "vector" data structure that treats space as a continuous surface.

GIS is technically both a database system and a set of operations for describing geographical properties. GIS has two major operational capacities: spatial information, stressing a large database inventory; and spatial analysis, stressing functionality and a wide range of data modeling (Goodchild, 1992).

Historically, GIS originated from cartographic techniques of drawing maps with a pencil and board. Limited by the capabilities of manual activities, cartography mainly focused on mapproducing techniques rather than analyzing and integrating technologies (Foote & Lynch, 1995). It was the adoption of computer technology that allowed GIS to evolve as a geo-referenced dynamic information system.

Today, GIS has emerged as a multidisciplinary instrument that links such disciplines as geography, computer science, remote sensing, civil engineering, statistics, marketing, and other social and behavioral sciences including park and recreation management.

The Early Use of GIS

Literature on the applications of GIS first appeared in the journals of park, recreation and leisure research back in the late 1960s. Lentnek, Van Doren and Trail (1969) conducted a survey of recreational boaters' spatial behaviors on inland lakes in the state of Ohio. GIS was used to display and analyze how those water resources were spatially distributed, and how far the visitors traveled to access them, in order to test the "distance decay function."

Namely, as distance increased, the cost of traveling to the place increased and the rate of recreation participation by people traveling from the distance origin will decrease. GIS helped the researchers to learn that travel distance was related to trip purpose in recreational boating. For instance, sailors and water skiers traveled short distances, while non-specialized boaters traveled longer distances.

Hodges and Van Doren (1972) evaluated disparities in urban recreational opportunities with an early version of a GIS tool (SYMAP). The study tried to demonstrate how to use the mapping technique to assist in planning new recreational centers in the Dallas, Texas, metropolitan area. A set of maps displayed population density, service radii of selected recreation centers, and a potential mobility index based on ownership of automobiles in each census tract.

Maps helped to establish specific criteria for planning a new recreational facility. Accordingly, two new sites were identified as high priority locations based on the criteria: (1) large populations living about three miles away from an existing center, (2) a relatively mobile population, and (3) a trend of population expansion and movement.

In the following 30 years, adoption of GIS technologies in park and recreation services slowly emerged into two channels: outdoor recreation management and urban park and recreation administration. Applications of GIS in outdoor recreation have focused on resource location, spatial patterns of distribution, distance measurement and other statistical analyses. The use of GIS in urban park and recreation administration focuses on facility allocation, service planning and issues of accessibility and disparity.

GIS and Outdoor Recreation

GIS was frequently used to describe the characteristics of recreational sites aimed at satisfying certain needs of visitors (Confer & Graefe, 1994; Hecock, 1970; Kim, Mutter, & Westphal, 1997; Lee, 2004). Hecock (1970) created GIS maps to describe the spatial correlation between recreational sites and visitors' occupations, which revealed that site preferences of visitors in different occupations were associated with the character of the nearby lodge

facilities. People with high socio-economic status characteristics appeared to be drawn to the sites with lodge facilities having above average aesthetic qualities.

GIS was also used to depict the proportion of visitors hosted by each site at a given time. Confer and Graefe (1994) studied boaters' attitudes and activity patterns regarding recreation sites. GIS technology was used to display sites that were "most enjoyed" and "least enjoyed" by visitors. In this study, GIS helped the management team improve services by locating clusters of problematic areas. Lee and Graefe (2004) incorporated GIS to identify sites preferred by different age groups of visitors. Through a terrain analysis, it was found that younger visitors preferred sites with higher elevation and steeper slopes.

Integrating GIS with statistics enables users to quantify the quality of surfaces (McCoy & Johnston, 2001). For instance, in spatial statistics, the "kriging" method is often used to perform surface analyses. Kriging is an interpolation method dealing with continuous data. Explicitly, through the kriging method, users can collect data from sampled points and assign values to the area between the points. For example, if a park ranger wants to determine annual precipitation in a forest, with a series of sample points, kriging will enable him/her to measure precipitation in inches.

Another form of spatial analysis is a spatial regression model, which tests the correlation of measured variables (e.g. household income or residents' ethnicity background) and locations of visiting sites. In practice, Tarrant and Cordell (1999) and Porter and Tarrant (2001) incorporated census block group data within a GIS database to determine the relationship between outdoor recreational sites and social economic status of local residents.

GIS has also helped to identify disparity issues of environmental justice. Lee, Graefe and Burns (2003) integrated county level census data with GIS to analyze demographic segments of local residents along the Columbia River Gorge National Scenic Area in Oregon. They found a relationship between the fees paid and the level of education and family composition. Persons with a higher educational background, with children aged 16 and younger spent more. They also found that age differences and marital status may determine which particular sites residents may visit.

Measuring distance with GIS is pervasive in leisure research. Distance is an important factor influencing visitors' recreational behaviors. Gitelson and Crompton (1984) found that repeat visitors are usually those living closer to the facility. Debbage (1991) used distance to predict visitors' participation behaviors: the farther they traveled, the longer they intend to stay, and the more they wanted to see and do. Fesenmaier, Goodchild and Lieber (1980) tested the distance decay model with GIS.

A series of 3-D maps described outdoor recreation participants' travel distance, both visually and spatially, in miles and in travel time. Zawachi and Marsinko (1999) used GIS to calculate the travel cost of trips to South Carolina recreation areas. The authors used GIS to measure costs along routes and eliminated the need to rely on respondent memory to get an estimated mileage, mini mizing the possibility of human error.

GIS in Urban Parks and Recreation

Applications of GIS in urban parks and recreation are still in their infancy. Devine and Kuo (1991) noted that "extremely little has been done in urban recreation analysis in applications of GIS except straightforward applications for displaying location of facilities and plotting general respondents to a survey" (p.83). GIS technology adoption has remained relatively low (Nicholls & Shafer, 2001). However, previous studies have laid groundwork for exploration of GIS for urban park and recreation services.

Wicks, Backman, Allen and Blaricom (1993) were the first to thoroughly discuss trends of GIS applications in the field of park and recreation management. They summarized prevalent uses of GIS as follows:

Recreation facilities
- Area mapping and reporting about park and recreation sites
- Tracking and analyzing facility development trends
- Managing maintenance at recreation facilities such as fields, courts and pools
- Selecting a location for new facilities
- Land Development, updating lot boundaries and displaying land record data
- Land use, displaying and analyzing land use data

Users
- Documenting demographic patterns and trends
- Population segmentation analyses, market area identification
- Tracking attitudes and interest survey data and displaying it spatially

The authors also illustrated how to assess planning and policy issues in urban settings with a GIS tool. A series of maps were produced showing the needs for recreation development from the perspective of physical size and the distribution of existing parks versus other social economic factors. GIS showed that areas with high levels of poverty had the most need for leisure services.

Nicholls and Shafer (2001) adopted GIS technology in urban park and recreation services to assess accessibility and equity in a local park system. The authors used radii buffer techniques, which involve drawing a line around a feature at a given distance, to find out the number of facilities and proportion of population in the selected area. The authors also performed a network analysis to calculate actual travel distance along streets to a local park.

Network analysis is one of the cornerstones of GIS functionality (Worboys, 1995) and is a necessary technique in measuring travel distance. The technique takes geographical constraints into account, and instead of measuring straight-line distance, it bases its data on geographic factors and gives the actual route distances. Network analysis allows seeking an optimal route and minimizing travel time between two locations (Bailey & Gatrell, 1995).

GIS application in parks and recreation is not a new phenomenon, but, coupled with the powers of advanced computer technologies, the use of GIS is stepping into a new era. GIS has great potential to play an important role in managing, planning, marketing and evaluating park and recreation services.

However, "useful" technology does not necessarily mean "useable" technology. The improvement of end-user- friendly interface platform designs and the perception and willfulness of park and recreation administrative agencies in adopting GIS are crucial for the extensive use of GIS. Regardless, Goodchild (1992) predicted, eventually, GIS would change in the meaning of the "S" word, from "system" evolving into "science." Namely, a geographic information science everyone can use.

**Case Study Courtesy of National Recreation and Park Association*
By Bob Lee and Alan Graefe

Police Department – Including Code Enforcement

GIS Goals and Background

The Police Department has made progress in GIS utilization since the original GIS Implementation Plan was created. Yolo County receives emergency calls and dispatches the West Sacramento Police Department to the appropriate location. Each of these calls prompts the creation of a record in the CAD system (PRC). Each reportable incident is then entered into the City's records management system (RMS). VisionAir is utilized as the crime incident tracking and reporting system – RMS. Historically, crime incident data entry was not current (up to six months behind). The officers would fill out a written report and this data was given to data entry clerks. This created inefficiencies and delays in timely data being available for crime analysis and reporting. Recently the Police Department has changed its mode of operations and now has the officers creating a digital report which is then validated by other staff in records. This new work flow yields more accurate and up-to-date data which can be used for pin mapping, reporting, and crime analysis.

The Police Department employs a Crime Analyst who utilizes a GIS package, CrimeView, ArcView, and a report generator, Crystal Reports, to create maps and do targeted analysis. The Analyst does the statistical reports and maps required by the Police Department. Additionally, the Analyst provides citizens statistics on neighborhood crime rates upon request. There are many tasks that can be accomplished to expand GIS usage internally for the officers and externally for the public.

The Police Department also oversees code enforcement for the City. Code Enforcement staff utilize Permits Plus from Accela to track citizens concerns and complaints. Citizens can utilize the City's web site to log complaints. Four Code Enforcement Officers operate within four districts to respond to complaints and enforce compliance. Many internal staff need to know the status of cases and currently have to call the Code Enforcement Manager to ascertain the status of the case. The process is reactive and can be improved by streamlining and improving the current data flow and by utilizing GIS tools to disseminate information and optimize resources.

The following section will examine the GIS goals for policing and code enforcement separately by priority.

GIS Goals

The following are the goals for the Police Department in regards to further GIS implementation over the next few years:

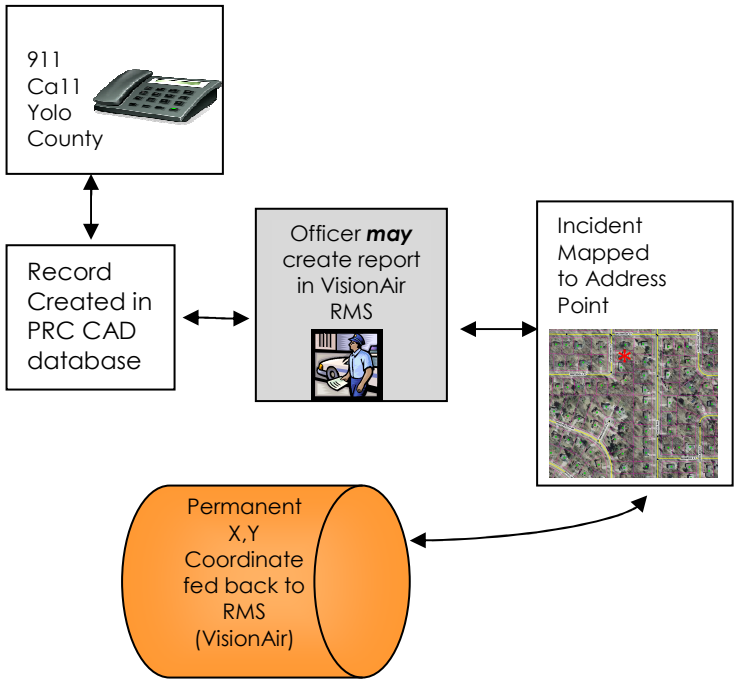
Goal #1 (Police) – Improve address work-flow and digital crime map layer

The Department's Crime Analyst utilizes various software tools to do crime analysis and reporting. Data is downloaded from the RMS system (VisionAir) and compared to GIS data by address. Currently ninety percent of the RMS data is matching accurately to the GIS data. This yields a point (or pin) on a map representing the incident. The RMS data is compared to address point data and to street centerline data to yield a digital "pin map". However, ten percent of the RMS data does not match. This is due in part to the lack of data standards established within the RMS

package. Officers are allowed to enter data free form into the RMS. Therefore, bogus addresses can be entered. Optimally, the City will maintain a 100% accurate and up-to-date address point layer (discussed in detail in the IT Division Needs Assessment elsewhere in this chapter). This layer would contain a complete address database that should be utilized within the RMS to populate pick lists of address for the officers. These pick lists would prevent the officers from entering an erroneous address and would ensure a 100% match to the GIS address points. Additionally, all crime incidents would then match the address points to yield a complete crime incident layer with each incident being shown at its exact address.

Currently Some Incidents are Being Mapped to Street Centerlines (less accurate)

Optimally All Incidents would be Mapped to Address Points (very accurate)

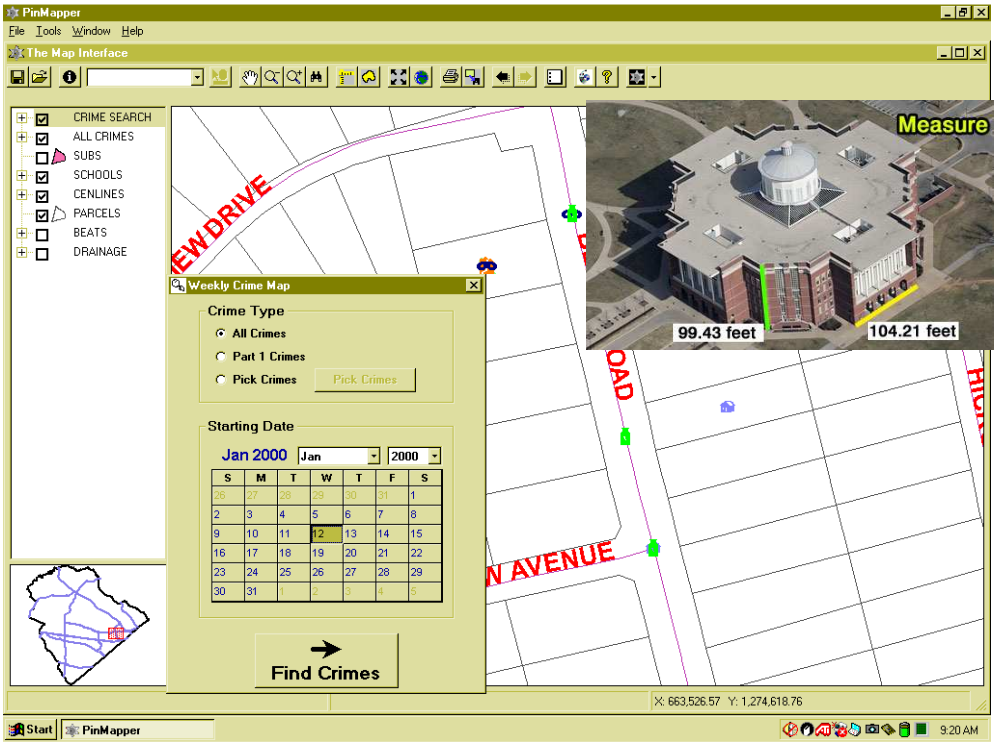


RMS and GIS Work Flow

Optimally, each one of these matched incidents would allow for the assignment of valid X,Y coordinates for each record. These X,Y coordinates should then be assigned to their corresponding record within the RMS. This would be accomplished by comparing the unique RMS case number for the mapped record back to its corresponding RMS record. Once matched the X,Y coordinate would be permanently assigned within the RMS. This would allow for much quicker mapping since the records will not need to be "re-matched" every time they need to be mapped. Additionally, any records that do not have an X,Y coordinate would not have matched a GIS address point. This would expose the record as having a bad address or the GIS as having a missing address either of which could easily be corrected.

Goal #2 (Police) – Provide GIS incident mapping capabilities to the entire department

The Crime Analyst utilizes CrimeView software for crime analysis. This tool allows for advanced statistical analysis and in-depth crime studies. This is a valuable tool and was recommended in the original GIS Plan. However, due to its complexity and cost this tool is not recommended for use beyond the Crime Analyst. Each officer should have the ability to create a digital incident map for any area and any time frame of interest. For example, an officer can view the data by time of day, incident type, specific UCR code, officer responding, case status, alcohol involvement, etc. Any data that is entered into the RMS crime-reporting package can be accessed and queried from this GIS interface. Various GIS based crime mapping applications are on the market. The key thing to look for is that the application is written in an open programming language and that it utilizes ESRI GIS technology at its core. An Arc Server intranet interface to the RMS data is recommended. This data would be automatically mapped via a nightly download and upload program from the RMS. Each staff person would then have quick and easy access to crime data in a map format. This Intranet application should incorporate the Pictometry (3-D photography) data available at the City. Additionally, the application should map the database of sex offenders with access to their mug shots.



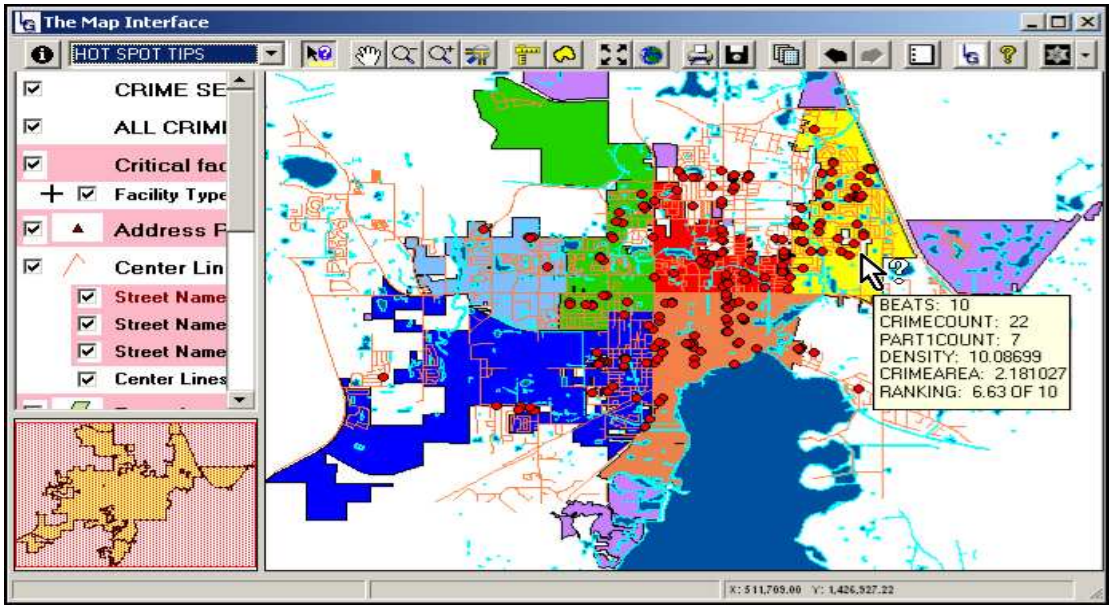
Crime Incident Analysis with Pictometry Interface

Additionally, the application should map the database of sex offenders with access to their mug shots.

Mapping Sex Offenders by Last Known Residence

Goal #3 (Police) – Use GIS to balance beats

GIS should be utilized to analyze Police response areas or beats. Calls for service can be mapped and then GIS can be utilized to optimize beat configuration. Once mapped, incidents can be equally distributed between beats. Police staff can quickly change a zone boundary and recalculate total calls for the new zones. The Crime Analyst can accomplish this process in-house. Additionally, the Crime Analyst will be able to create zones of concern such as drug free zones around schools and search buffers around sex offender's residences.



Using GIS to Optimize Beats

Goal #4 (Police) – Provide field mapping

Crime mapping available at the Police Department headquarters building will be a great asset. However, to truly leverage the utility of GIS for the Department the information must be made available to the officers in the field. Currently, mobile computing has been enabled for all Police vehicles. The Police mobiles have been installed and tested for intranet access. If intranet access is consistent throughout the City the officers will be able to access the intranet application previously described in Goal #2. If not, a copy of the data should be automatically downloaded to each laptop and a mobile data browser should be utilized to view the GIS data.

Goal #5 (Police) – Create a public access crime mapping web portal

The public is beginning to demand more in regards to data dissemination from local law enforcement. Many agencies have begun to provide crime data via the Internet. Typically, this information is manifest as a generalized pin map or a thematic map showing crime volume by type. West Sacramento has stated a desire to provide this type of service. The application should be an ArcServer web portal with easy to understand tools for doing rudimentary crime mapping for the public.

Case Study – The following case study illustrates how City of Albuquerque distributes crime related data and how the GIS department works in conjunction with the Police department to share data. Through the use of GIS data, the Albuquerque Police Department can perform analysis and reporting on their data.

Case Study: Department-wide Access to Crime Analysis

The Albuquerque Police Department's Crime Analysis Unit provides mapping and crime analysis capabilities to 885 sworn officers and 300 civilian staff. Using ArcIMS and a custom Active Server Pages (ASP) reporting application that has been seamlessly integrated with ArcIMS, this information--available 24 hours a day, seven days a week--is delivered by a Windows NT 4.0 server over the City's local area network (LAN).

This system was developed for the department by ESRI and implemented in November 2000. The customized ArcIMS interface displays 15 data layers. Offense information is used for pattern/trend detection and analysis, for directed patrol, and as an information source for neighborhood watch organizations. The data in the reporting portion is automatically updated every day at 0100 hours. The crime shape files are manually updated once a week using a procedure created by police staff.

The Shape of Crime

The crime shape file data includes aggravated assault, burglary, robbery, sexual offenses, motor vehicle theft, vandalism, narcotics, and auto burglary. When an incident is selected, ArcIMS displays data specific to that case. Crime shapefiles contain 28 days worth of data--an amount chosen because it provides enough data to show crime patterns but, by limiting the amount of data, allows the user to see and select individual offenses. Limiting the amount of data also keeps the size of the shape file manageable so it loads quickly. This data is pulled from the department's records management system.

Information on crime occurrences is complemented by suspect shape files that contain information on known sex offenders and burglars. The attribute data supplies a physical description of the suspect, vehicle information, and the name and phone number of the probation and parole officer assigned to each suspect. Contact information for the probation and parole officer is significant because it provides access to information about the suspect's schedule. An officer or investigator can enter the premises to talk to the suspect when accompanied by the probation and parole officer. Suspect data, maintained in the New Mexico Corrections Department database, is exported to a spreadsheet and e-mailed to the department.

The City of Albuquerque's GIS group supplied static, non-crime shape files such as the City council districts, street network, parks, and neighborhood associations. Police-related datasets, such as gang territories, beats, and area commands, were created by the department. Added to aid in the analysis of gang-related offenses, the gang shape file contains membership numbers, graffiti, rivals, and allies. The data behind the gang territories shape files was developed by detectives; the City GIS group constructed the shape file; and police personnel enter data into it. Other jurisdictional shape files (i.e., area command and beat) allow for reporting of crime information by area.

Using ArcIMS and a custom Active Server Pages (ASP) reporting application, the Albuquerque Police Department's Crime Analysis Unit provides mapping and crime analysis capabilities to 885 sworn officers and 300 civilian staff.

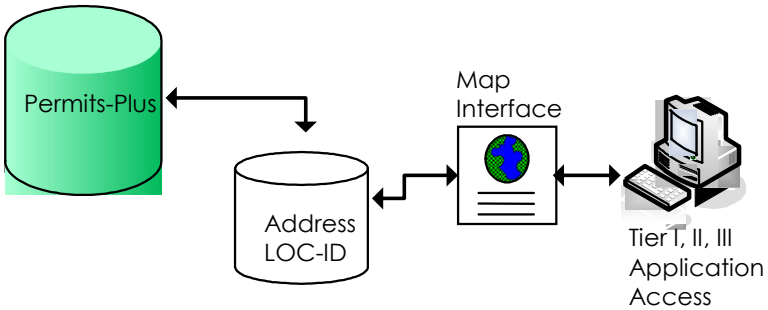
Analyzing and Reporting

The reporting application developed for use with ArcIMS provides summarized offense data as well as the ability to examine trends in offense data by hour of day or day of week for different datasets. Analysis can be run on all offenses or can be limited to Part I offenses, Part II offenses, or individual types of offenses.

The system replaces a simpler ArcView pin and density mapping application. Because it is Web based, the ArcIMS application is more accessible to law enforcement personnel. The response to the new application has been good--officers, sergeants, and police command staff all use the system. Department staff have received training on the system, a user manual is available, and user support is ongoing.

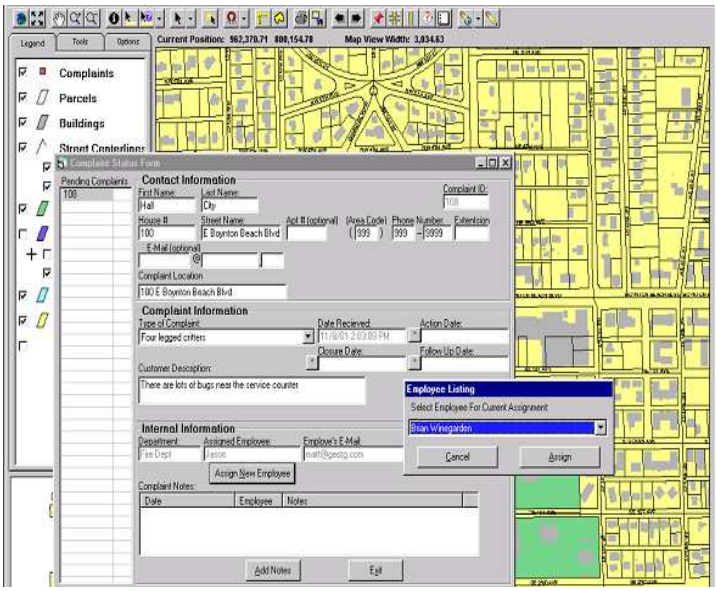
Case Study courtesy of ArcUser Online: http://www.esri.com/news/arcuser/0402/crimemap.html

Goal #1 (Code Enforcement) – Integrate with Permits Plus for tracking complaints



Code Enforcement utilizes Permits Plus for entering and tracking citizen complaints and code enforcement cases. Other departments need to know the status of cases frequently and there is no effective way to disseminate this information in place. West Sacramento would benefit from a web-based GIS interface to the Permits Plus records for tracking citizen inquiries, complaints, concerns, and

other code enforcement data. The graphic above shows how data entered into Permits Plus would be compared to addresses in the GIS and made available to users via an Intranet map interface. An ArcGIS Server Intranet application should make this data available to all City Departments. Such an application would enhance communication with the public, and allow the City to quickly and effectively respond to requests. From the citizen's perspective, one call to any City staff member should result in an inquiry or complaint being logged into the system, routed to the correct department or point of contact, action taken by City employees, and follow up to the initial inquiry in an effective and timely manner. Inquiries or complaints should also be logged and tracked via the Internet or in person.



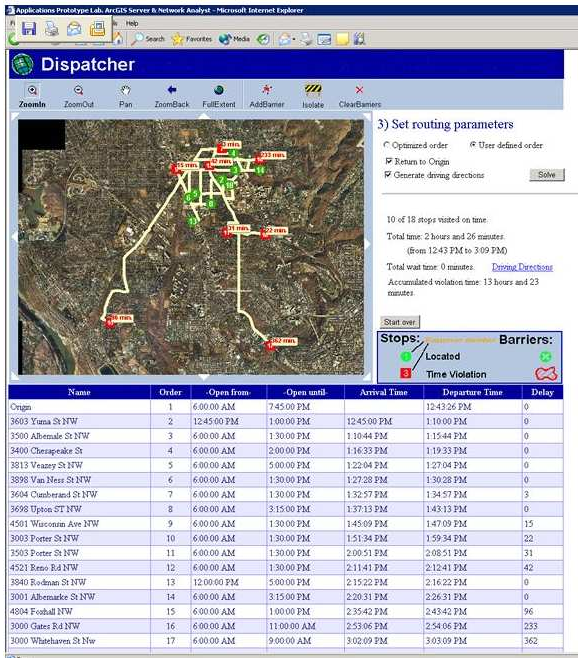
GIS Interface to Code Enforcement Data – Sample User Interface

By implementing such an application, the public no longer has to be transferred from one department to another on the phone or in person. Routing of inquiries and complaints would be done internally through email notification, and is therefore transparent to the citizen. Code Compliance staff can then proactively track, manage, analyze, map and report inquiries and complaints, actions taken, final results, and citizen satisfaction.

Goal #2 (Code Enforcement) – Utilize GIS to balance districts based on workload

Code compliance staff have to work with hard copy maps to view the current district boundaries. They have to reference the map frequently to determine the location of a call and determine which district the call falls within. These districts should be made in a GIS layer and staff should then utilize the intranet application described in Goal #1 above to determine exact location. Additionally, staff needs to map out all of the cases annually to determine if the existing districts are balanced. The GIS can be used to move boundaries and instantly recalculate the total number of cases based on these new boundaries. With GIS, staff can quickly balance the districts and change them as needed.

Goal #3 (Code Enforcement) – Use GIS for optimal routing and scheduling



Name	Order	-Open from-	-Open until-	Arrival Time	Departure Time	Delay
Origin	1	6:00:00 AM	7:45:00 PM		12:43:26 PM	0
3603 Yuma St NW	2	12:45:00 PM	1:00:00 PM	12:45:00 PM	1:10:00 PM	0
3500 Albemale St NW	3	6:00:00 AM	1:30:00 PM	1:10:44 PM	1:15:44 PM	0
3400 Chesapeake St	4	6:00:00 AM	2:00:00 PM	1:16:33 PM	1:19:33 PM	0
3813 Veazey St NW	5	6:00:00 AM	5:00:00 PM	1:22:04 PM	1:27:04 PM	0
3898 Van Ness St NW	6	6:00:00 AM	1:30:00 PM	1:27:28 PM	1:30:28 PM	0
3604 Cumberland St NW	7	6:00:00 AM	1:30:00 PM	1:32:57 PM	1:34:57 PM	3
3698 Upton ST NW	8	6:00:00 AM	3:15:00 PM	1:37:13 PM	1:43:13 PM	0
4501 Wisconsin Ave NW	9	6:00:00 AM	1:30:00 PM	1:45:09 PM	1:47:09 PM	15
3003 Porter St NW	10	6:00:00 AM	1:30:00 PM	1:51:34 PM	1:59:34 PM	22
3503 Porter St NW	11	6:00:00 AM	1:30:00 PM	2:00:51 PM	2:08:51 PM	31
4521 Reno Rd NW	12	6:00:00 AM	1:30:00 PM	2:11:41 PM	2:12:41 PM	42
3940 Rodman St NW	13	12:00:00 PM	5:00:00 PM	2:15:22 PM	2:16:22 PM	0
3001 Albemarke St NW	14	6:00:00 AM	3:15:00 PM	2:20:31 PM	2:26:31 PM	0
4804 Foxhall NW	15	6:00:00 AM	1:00:00 PM	2:35:42 PM	2:43:42 PM	96
3000 Gates Rd NW	16	6:00:00 AM	11:00:00 AM	2:53:06 PM	2:54:06 PM	233
3000 Whitehaven St Nw	17	6:00:00 AM	9:00:00 AM	3:02:09 PM	3:03:09 PM	362

The intranet data browser should support service area analysis, routing, generating travel directions, and finding closest facility.

Code Enforcement staff spend much time in the field working on cases. Currently, each day office staff refers to a dated wall map for making decisions on the optimal routes and case balancing for the day. It is recommended that the intranet browser solution have multi-point routing capabilities. This would allow office staff to assign cases to a staff person and then generate an optimal path and a route manifest for that person to follow for that day. As additional calls come in, they can be added to the run list and the route manifest can be updated and provided to staff via laptops connected in the field or via the phone.

Public Works and Community Development

GIS Goals and Background

In 2006, the Public Works Department and Community Development Department merged, forming the Public Works and Community Development Department.

Public Works focuses on administering the operation, maintenance, and management of the City's capital infrastructure. This includes City utility systems such as water, sewer, and storm water, in addition to the road network, treatment facilities, and equipment maintenance. Public Works currently uses GIS for base mapping and fundamental spatial analysis.

Community Development consists of the Planning, Building, and Engineering Divisions. The Planning Division is responsible for regulating the location and quality of new development in the City. The Building Division provides building inspection and plan checking services for all construction projects within the City for compliance with uniform construction codes. The Engineering Division is responsible for performing all professional and sub-professional engineering functions for the City. The primary GIS goals for all of these divisions are covered in this needs assessment.

Community Development staff have done a tremendous amount of work on various GIS data sets, street name and address cleanup, parcel cleanup, data integration, and data security. Their work on these data sets is critical and has set the stage for further success throughout the organization.

GIS Goals

The following are the goals for Public Works (PW) and Community Development (CD) in regards to further GIS implementation over the next few years:

Goal #1 – Refine the GIS Based Addressing Repository

This goal has been detailed in the IT section of this chapter but major components have been reiterated here due to their importance to both IT and CD. It is of critical importance that the City maintains a 100% accurate address repository. CD staff expressed the need for improving consistency between the City's address GIS data and addresses entered into other systems such as Accela. In essence, standardization of addresses within GIS data needs to conform to the city address policy and system. Currently there are inconsistencies and discrepancies between official addresses, based on the formal address system and addresses in several datasets. These inconsistencies and discrepancies typically include:

- Multiple or inconsistent street names
- Buildings with no address/suite numbers assigned to them
- Differences between City and the local telephone company

CD has already completed street naming corrections and changes. Additionally, they are nearing completion of a revised street name and addressing policy.

It is recommended that CD work with the GIS Specialist to identify address inconsistencies in and between datasets/databases. CD and the GIS Specialist will need to develop an optimal strategy for rectification of addresses in each

dataset/database. In addition, the GIS Specialist will need to work with CD to implement appropriate processes and procedures that will ensure that addresses are added and/or updated in a consistent, standardized manner. Such efforts typically require several iterations of design and implementation in order to develop adequate processes and procedures. Validation rules and routines can greatly improve address entry into systems, by preventing users from entering incomplete or invalid addresses. The address point layer will need to be validated and then be utilized as the primary source of address data for the city. Depending on the final decision in regards to a new or upgraded permitting system, it might make more sense to enter data into the permitting system and then generate and address point. However, optimally address points would be created on the GIS which then automatically populate a new record within the permitting system. A majority of the tasks outlined in this paragraph have been completed by CD.

Currently an address point layer is being maintained. The current process involves storing the address data in Permits Plus, notifying the GIS Specialist as a new address is entered, and then updating the GIS layer and Permits Plus with X,Y coordinates. This is arguably the most important base layer for a municipal GIS. As such, other applications should use this repository to populate their address fields. Each of these other applications (VisionAir, Accela, FirePoint, etc.) would then have a pick list of valid addresses. Users would only then be able to assign valid addresses to a record (Some of this is currently being accomplished at the City). Optimally, integration between the GIS and these IT applications would be programmatically accomplished.

The City must continue to prioritize address management as they have been doing of late. Many address management steps have taken place. CD has done much work in accomplishing address management tasks. The following steps need to be in-place (many of these have already been accomplished by CD) for continued success at the enterprise-level:

- Verify and complete address points layer – a full audit and field inspection should take place to insure 100% accuracy. This step has been completed and updates are taking place on an as-needed basis.
- Move the address layer to the central GIS repository – data should no longer be maintained in AutoCAD but should be moved to the central GIS repository and maintained as a geodatabase. An automation routine will need to be utilized to take the AutoCAD annotation file and move it to GIS. The routing should utilize the AutoCAD rotation feature to insure that the GIS layer annotation is suitable. Some clean-up of annotation will need to take place. Ties to Permits Plus software are currently being maintained and will need to be preserved.
- Identify gatekeepers that have the authority to update the layer – only a select few employees should have the ability to add, change, or delete records from the address point data layer. An initial recommendation is to have a representative from Drafting Services, Community Development, and the GIS Specialist given the training and capability to edit the address point data layer. The GIS Specialist should review each entry to insure that GIS and enterprise address database rules and compliance are met. Work has already been done to identify gatekeepers. The City's intention is to fully implement the gatekeeper concept upon full completion of address clean-up.

- Provide an address update GIS application – this application should allow for the update of the critical GIS layers. This application is described later in this section.
- Integrate the process with core applications such as Accela – optimally the address point GIS application will have integration points with enterprise applications such as Accela. This step has been accomplished but will need to be revisited if another permitting software option is pursued.

The following sections take a look at how to finalize the address points GIS layer. One of the big impetuses for this layer is integration with existing systems. The centerpiece for this integration should be the permitting system – Accela or a new permitting system if Accela is replaced. The other IT systems such as VisionAir, FirePoint, etc. should use the address data to populate their address tables and validate address data entry. Therefore, the following sections are written with the assumption that this process will not only validate the current address points but clean up Accela address records and integrate with the enterprise permitting system. Much of this has been accomplished but the following serves as a good checklist of tasks. Depending on what is decided in regards to the enterprise permitting software, participation by the enterprise permitting vendor and some programmatic integration may be required.

Address validation and Accela Integration

It is highly recommended that West Sacramento audit and validate the existing digital address point layer. The City has gone through many of the appropriate steps to create the current address point layer. However, the following information is included as documentation on the optimal process for 100% validation of the layer. Address information stored within Accela should be used as a source for address point creation and validation.

Once address points are validated and finalized, a GIS based application should be used by identified gatekeepers to update all new addresses and create or modify all address points. This step has been completed by City staff. Optimally, the GIS based addressing application will integrate with the existing enterprise-wide applications, especially Accela. Integration with Accela has been accomplished but will need to be revisited if a new software product is implemented. Through the use of an integrated GIS addressing/Accela application, users can simultaneously maintain accurate address points and address records within Accela. Staff is currently working on this type of integration with Accela. Additionally, the address points should serve to feed the master address tables in other IT applications.

The following is the recommended methodology for the finalization of a digital address point layer using existing data including Accela data, a cleaned Accela Address Database, and implementation of a GIS based address management tool. The following methodology will not only insure 100% completion of address points but will insure that data within the Accela application integrates with the address points.

Digital Address Point Creation and Accela Cleanup

Step 1: Database Inspection
Step 2: Address Point Generation
Step 3: Manual Adjustment of Digital Address Points
Step 4: Field Verification of Digital Address Points
Step 5: Digital Photographs Linked to Problem Addresses
Step 6: Bulk Update of Accela Records and GIS Overlay

Addressing and Street Centerline Maintenance

Step 1: Maintenance Application
Step 2: Maintenance Procedures Report (This has been done by CD staff)

Digital Address Point Creation and Accela Cleanup

Step 1: Database Inspection

Inspection of the Accela database is the critical to the success of the address creation. A custom extract application must be used to perform the extraction of the Accela data to a more manageable format. It is important to acquire all the necessary GIS layers in order to accomplish the project tasks. These data layers might include address points, street centerlines, parcels, and aerial photography.

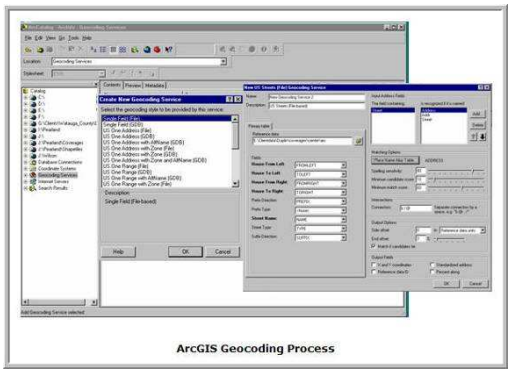
Inspection of the Accela land/address database is used to identify errors with the data that may prevent addresses from being matched correctly. Some of the problems that may be encountered include the following:

- Data that has been entered into the database incorrectly
- Apartment numbers in the street post qualifier or street pre qualifier fields
- Street post qualifier information in the apartment number field (SCHOO in post qualifier and L in apartment – appears to be apartment L)
- Address Ranges (3500-3590 State Rd 84)
- Addresses with multiple units (3490 101St Street Bldg 5 Unit 1-6)

Performing a database inspection facilitates the accurate assessment of the current database state and identifies ways to most efficiently map the addresses. This step has been completed by CD and is updated if problems are identified.

Street Number	Prefix	Street Name	Street Type	Post Qualifier	Apartment
8420		STATE RD 7		U-611	
8420		STATE RD 7		U-609	
8420		STATE RD 7		U-601	U-612
3504		OLD COUNTRY	MNR	U-325	328
3505		OLD COUNTRY	MNR	U-317	324
2985		PALM TRACE LANDINGS	DR	U310	
3506		OLD COUNTRY	MNR	U-308	316
3507		OLD COUNTRY	MNR	U-301	308
3508		OLD COUNTRY	MNR	U-213	220
204		EVERGREEN	PL	U204	
3508		OLD COUNTRY	MNR	U-125	132
3509		OLD COUNTRY	MNR	U-113	124
8480		STATE RD 7		U-101	103
3510		OLD COUNTRY	MNR	U-101	112
2945	SW	45	ST	TRAI	PUBLI
654		STIRLING	RD	SCHOO	L

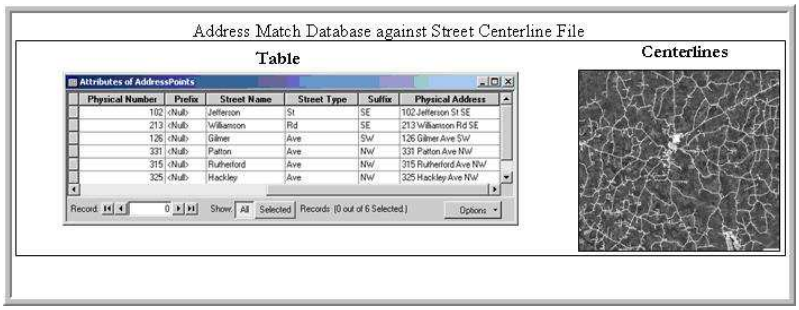
Example of a Sample Address Database Structure



Step 2: Address Point Generation

Once the addresses that need to be generated on the map are determined, the cumulative physical address field in the database will be address matched (also known as geocoded) against the attributed GIS existing address point and street centerline file. The database will be processed through the ESRI ArcGIS Geocoding Service in ArcCatalog.

An alias table may also be created to store detailed address information about common (vanity) location names, such as "City Hall". The result of the initial geocoding process will not be a complete point file, but it will eliminate some of the work necessary for the finalization of the point layer. Addresses that do not have a matching address point location will be addressed matched to another GIS data layer such as a building or the street centerline file. Due to the mechanisms used to determine the addresses of rural structures, the geocoding process against the street centerlines should use a single range option. This option will geocode the points to the center of the street and will have a lower level of initial accuracy than a geocode based on other systems such as a dual range system.



In the GIS, the new address point Geodatabase feature class created by the geocoding process will include two additional fields: 1) "Status" and 2) "Score". "Status" indicates whether individual records were matched or unmatched, with values of "M" or "U", respectively. "Score" indicates the percentage of confidence in the match. One hundred (100) % indicates an exact match, 70% a less than perfect match, etc. The Geocoding Service in ArcGIS allows users to control what score will constitute a match. In addition, all unmatched addresses can be interactively matched.

Geocoded address points can be offset at a designated distance; otherwise, each will be placed on top of the street centerline. "Status" and "Score" fields will remain visible to City staff responsible for maintaining the master address point layer, but should not be visible to end users.

Many of the Accela records will match the existing address points. Others will not match due to erroneous data within Accela and others will not match because of erroneous or missing address point data. CD is very close to completing this and closing all remaining gaps.

Step 3: Manual Adjustment of Digital Address Points

A manual review and inspection of this digital point address data must be performed followed by the adjustment of the dataset (or data records) to their actual location on the earth's surface. Using the aerial photography each digital point should be placed in the middle of each structure.

The following procedures are applied during this step:

1. Coding of matched digital address points
2. Correction of obvious address problems (address located on wrong structure)
3. Detailed documentation of changes made

1's are green; 2's are red

1. Coding of matched digital address points – Address verification field indicating the status of each address point should be added to the digital address point layer. The following methodology should be followed:

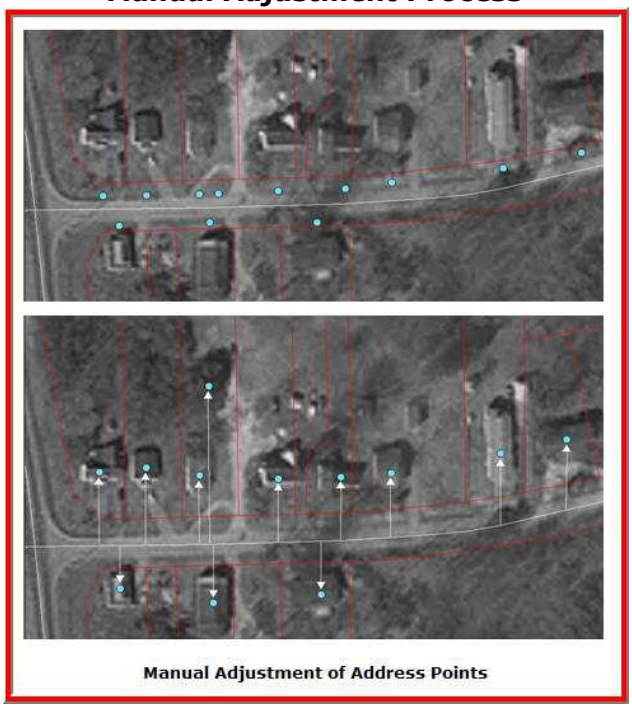
Field of the Digital Address Point Layer:

Code	Status	Description
1	OK	The point or street has been verified and moved to the appropriate location
2	Field Verify	The point or street cannot be placed on a structure with 100% certainty and needs to be field verified

2. Obvious problems in regards to data entry errors should be corrected and the placement of all address information in the appropriate fields within the address point layer should be completed. This is currently being done by CD staff. CD staff is also trying to identify errors that will take longer to fix (i.e. one that will require public notification).

3. Detailed documentation of any and all changes made to the data should be maintained so that a full record of any changes that have been made. This is currently being done by CD staff.

Manual Adjustment Process



Manual Adjustment of Address Points

Step 4: Field Verification of Digital Address Points
Many of the addresses will need to be field verified after they have been address matched and manually inspected. The corresponding structures or the address for these points may not be decipherable from a heads up digitizing method using the aerial photography. Apartment complexes and commercial buildings will need to be visited in order to determine the appropriate location for these address points.

In the process of verifying each site address, field crews should employ a defined process to identify and record attributes for those records that may need additional review. Additionally, GIS software employs several alternative electronic data comparison routines to verify the accuracy of each address record to existing data sets, such as the street centerline file and parcels. This process provides the means to ensure each address is correctly field verified.

The following methodology should be used during the field verification process:

Verification Field of the Digital Address Point Layer:
A verification field should be added to the address point layer with the following attributes:

Code	Status	Description
6	Field Verified	The point has been field verified and moved to the appropriate location
3	Problem	The address has not been placed with 100% certainty due to various problems encountered during the field verification.

Verification of Secondary Address Units

Secondary address units are utilized when a building has more than one place where an individual could live or work. Approximately twenty-five percent of residential housing units are in structures with more than one unit. This housing is typically referred to as "multi-family." Multi-family housing, commercial structures and mobile homes represent the majority of secondary address units. The location and addressing for secondary address units is a critical component of the effective delivery of government services, from emergency services and routing to the collection and allocation of personal property taxes.

Example of Shopping Centers with Multiple Addresses

Often for multi-family structures, field crews can obtain a site map from the apartment complex administration office. This map is a reliable source to verify the address and location of each living unit in the complex.

The focus in the field verification process should be to ensure that the digital address points for each structure is placed in a highly accurate and cost-effective manner.

Step 5: Digital Photographs Linked to Problem Addresses

Some of the problems that may be encountered during field verification include the following:

- Does Not Exist – somewhat positive that this address no longer exists.
- Could Not Find – the point did not correspond to a nearby structure. This may include meter boxes or utility locations.
- No Posted Number – a building was present but there was no posted number.
- Grouped Mailboxes –there were mailboxes grouped and the address could not be matched to a specific structure.
- Wrong Address – the address street number or apartment number appears to be wrong because it does not fit with other addresses in the vicinity. Or the street name is wrong.
- New Development – the address could not be accurately placed because it is located in a new development that does not appear on the ortho-photography, or the structure or building was under construction at the time of field verification and no address information was posted, or the parcel has an address but no structure has been constructed.
- Empty Lot – appears to be an empty lot or vacant parcel.

During the field verification process, a defined process should be deployed to identify all problem addresses. A digital photo should be captured for each structure that could not be visually verified, where no address number is posted on the house, or grouped mailboxes exist. The digital photo will be linked via GIS and can be opened within any GIS software application when clicking on the address point.

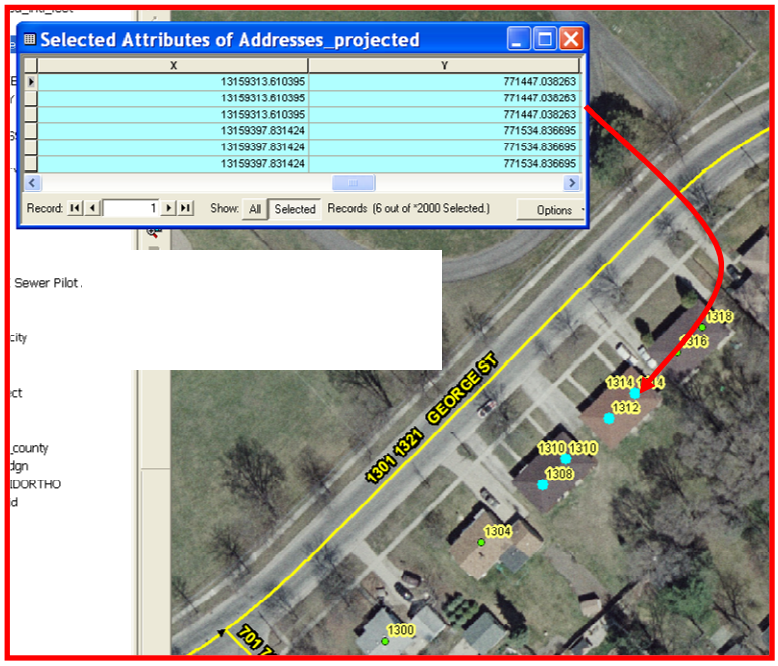
Problem Address Digital Photo Capture

Step 6: Bulk Update of Accela Records and GIS Overlay
Step 6 will require detailed knowledge of Accela (or a new enterprise permitting system) data structures and data interaction. This step will bulk update of the Accela address/land records utilizing the new GIS databases. The unique record ID for each Accela record should be maintained through the address point finalization process. Each one of the valid Accela records should have a corresponding valid address point. The addresses associated with the address point should be the official address. This official address can then be utilized to insure that the Accela record contains a clean address. This can be completed by using a SQL script to update each record based on its X, Y location. Currently the City updates Accela and then updates the GIS.

The following describes all the typical fields that should be updated when this update script is applied:

- Street Number
- Street Prefix
- Street Name
- Street Type
- Street Suffix
- Unit

In addition, the Accela record should allow for the addition and population of an X,Y (latitude, longitude) field. This field would get updated for all Accela records that have a corresponding GIS address point.



X and Y Coordinate Values (Northing and Easting) of individual address points

Not all of the Accela records will be able to be associated with a valid address point. Some of these records may contain addresses that no longer exist or are invalid for other reasons. These records should be researched to determine if an accurate address can be determined and corrected. At this point, the City would have a 100% complete address point layer and each Accela record would have an accurate X,Y coordinate. West Sacramento assigns an address to all parcels even if they do not have a structure.

Addition of New Address Records into Accela

Throughout the address adjustment and verification phases many new addresses not existing in the Accela database will be found throughout the City. This has already been identified by City staff.

Using various methods new digital points for these addresses should be created. Some of the methods that will be used to accomplish this include the following:

- Use of existing GIS address point layer (if available)
- Use of existing GIS parcel layer (if available)
- New addresses found during the field verification process

These new points should be included in the final Accela integration process. New address/land records should be created for these addresses making them address records that will be available to the appropriate Accela modules.

Mass GIS Overlay Possibilities

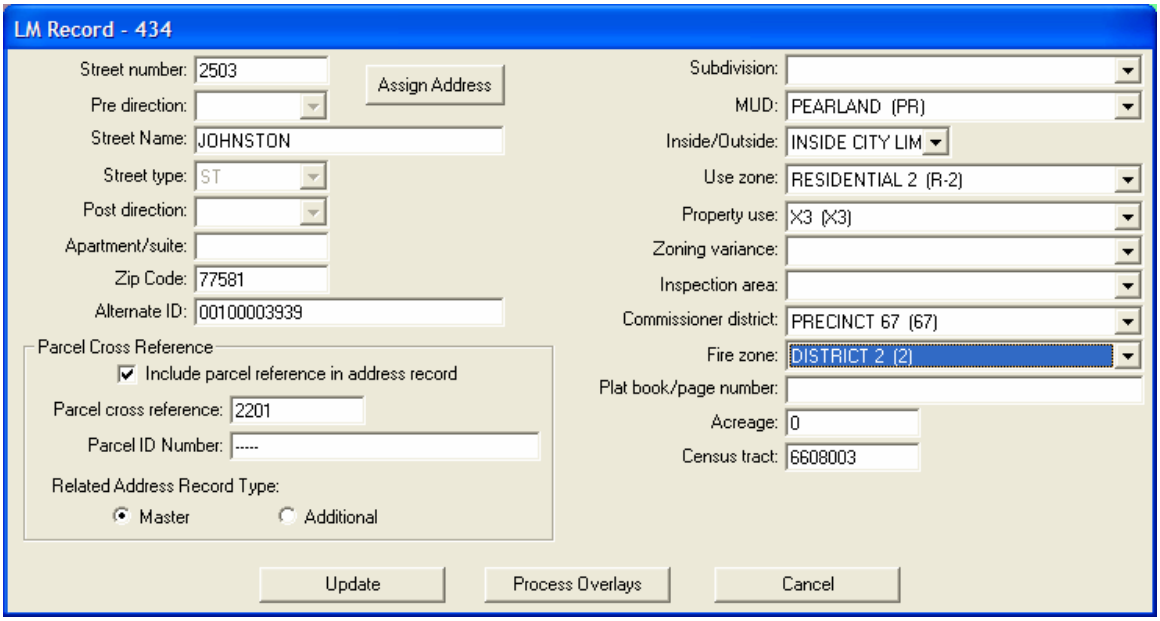
Once all address records have been updated and loaded into Accela, attribute values for many of the fields in the Accela database can be updated based on the new and improved address point spatial location information. For example, the zip code layer, if up-to-date in the GIS, will be used as an overlay, allowing all Accela address records to be updated with the correct zip code based on spatial location.

Map overlay capabilities provide the user with a window into GIS and parcel management data records. This will allow for the bulk update and overlay of GIS layers to maintain spatial attributes in Accela.

Examples of GIS layers that could be overlain with address points to extract information that could populate Accela fields:

- Parcel
- Zip Codes
- Council District
- Zoning
- Land use
- Inspection District
- In/Out of City or County
- Subdivision
- Fire Zone
- Jurisdiction

This list of GIS layers to be included in the overlay will be dependent on whether or not these layers currently exist. If not, these layers should be developed.



GIS overlays provide users a thorough view into their address data records

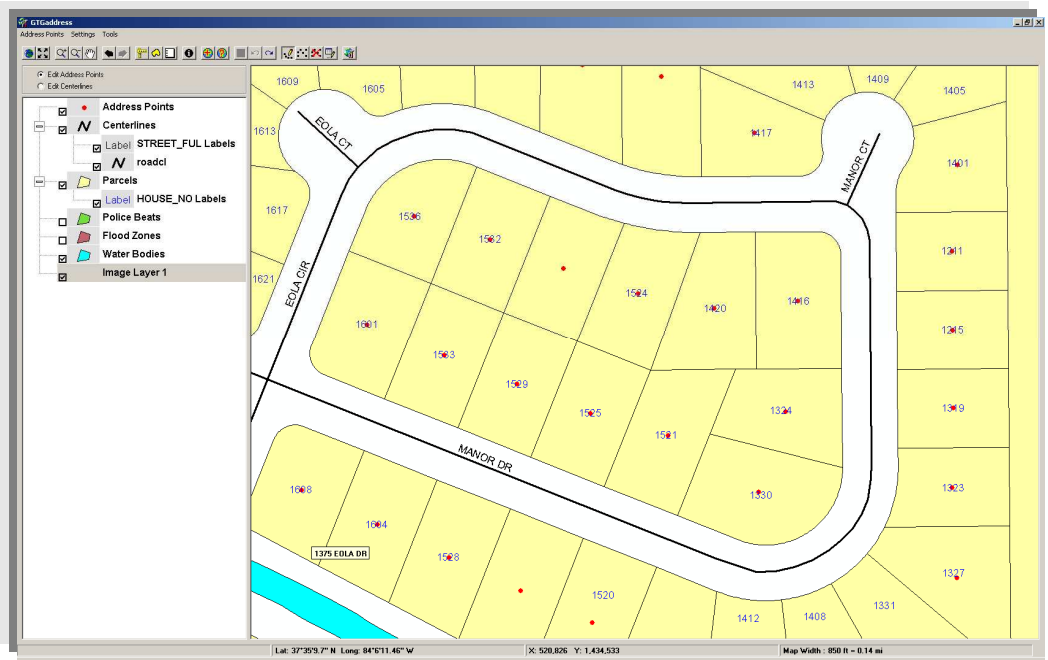
Addressing and Street Centerline Maintenance

Various applications exist that allow an organization to update address points and street centerlines. Some organizations utilize out-of-the box ArcGIS to edit these layers. However, it is recommended that a custom ArcServer application be created that allows for the maintenance of these GIS layers; as well as, integrate with Accela. The application should be used for both address point and centerline maintenance. Only identified gatekeepers should be allowed to utilize this application. This application should allow a user to input new addresses, delete addresses, and/or change addresses via the GIS. Currently, address changes are done in Permits Plus and then a GIS address point is created.

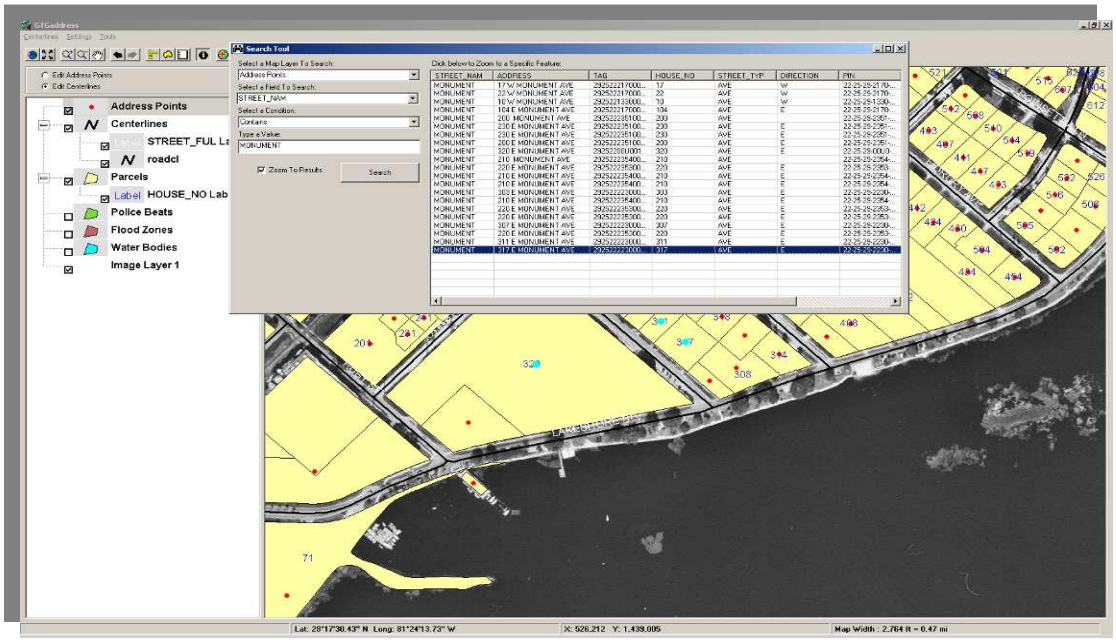
If a new enterprise permitting application is selected, West Sacramento should work closely with the vendor to develop bi-directional components that allow for automatic integration with their records. The application should maintain a one-to-one relationship between address points and the Accela records. The application should show the user any records that do not have a validated X,Y coordinate. The user should be able to click on the record and then the appropriate address point to associate the record with the accurate point. This would allow the user to permanently assign this correct address and X,Y to the record. Each record will then be able to be quickly accessed via GIS applications.

The application should allow West Sacramento to interactively and accurately map the location of address records stored in the permitting application. These addresses represent the GIS foundation for mapping the location of:

- CD Permits – Building, Engineering, Public Works
- Occupational Licenses
- Code Enforcement
- Utility Billing
- Work Orders
- Accounts Receivable
- Planning & Zoning



Using an Addressing Tool to Edit Address Data

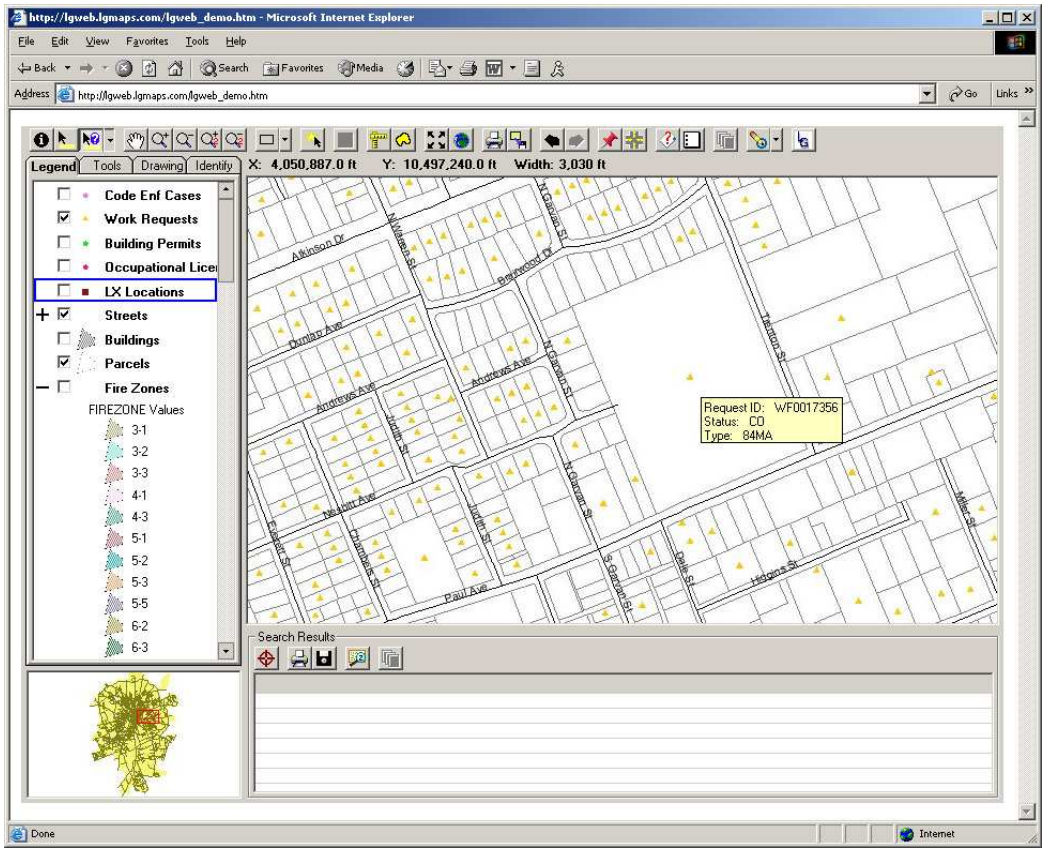


Example of Addressing Application's GIS Search Tool

The application should also allow users to carry out custom queries to search for specific information stored in various GIS layers such as streets and parcels. Users will be able to search for specific street names or addresses within the address point layer or street centerline layer. Also, users can find specific locations on the map by entering a latitude and longitude.

Goal #2 – Improve Public Access to Community Development Permitting Data

Community Development staff expressed the importance of public interaction and improving customer service. The ability of sharing code enforcement information, permit information, and various other activities was deemed very important. Staff expressed the desire to be able to manage and visualize the development review process via the GIS. Staff would be able to view the status of an application quickly. For example, permits that are active would show up in one color and ones that are not approved would show up in another color. Users would be able to quickly view the status at any point during the project. A check list of all variables required during the review would be tracked in a database. The user would be able to visualize the status on the GIS and access the entire development review process via the GIS. This information would be available for staff internally and for the public via the Internet.



Development review data- stored and quickly viewed via the GIS

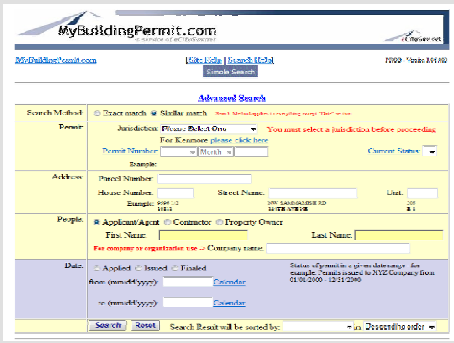
A middleware application should be deployed that can point to the City's Accela Permits Plus tabular data and "geocode" it to the City's address point layer, thus generating ESRI GIS data layers describing the Community Development permitting information. Prior to that, it is imperative that the address point layer be fully audited and overhauled using extensive field verification methods (see Step #1 above). Community Development personnel should work closely with the GIS Specialist within IT to integrate the Department's Permits Plus GIS data into the Internet-based data browser application.

Public access to geospatial Community Development data will increase productivity by reducing the need for staff to personally respond to questions from citizens. The Internet GIS data browser should allow citizens to view and query Department-related permitting information without disturbing or disrupting staff productivity. The application should provide an intuitive, user-friendly mapping interface that provides users the ability to view, query, and print relevant permitting information. Staff members field numerous questions on a daily basis such as:

- What is the status of my building permit?
- At what stage is the Engineering review?
- Where are all of the code enforcement cases around me?

Many of these questions can be answered via a public access Internet GIS data browser that includes the new permitting GIS data layers. The savings in staff time will equate to hundreds of hours a year.

CASE STUDY: Expanding the Use of Internet GIS Applications – Bellevue, Washington

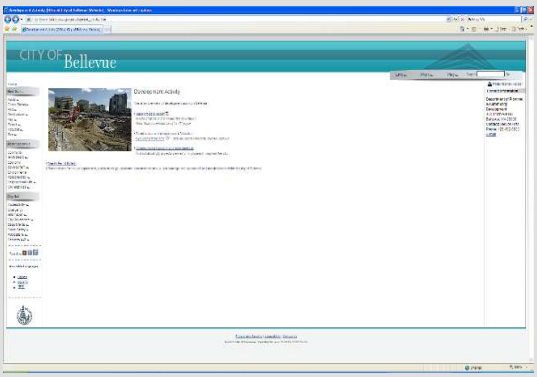


Community Development staff throughout the county need to publish the current status of their permitting activities. Much time is spent hunting down an interested party's permit, and its corresponding status. The City of Bellevue, Washington has a web-based system that details the status of a permit throughout the approval process, as outlined below:

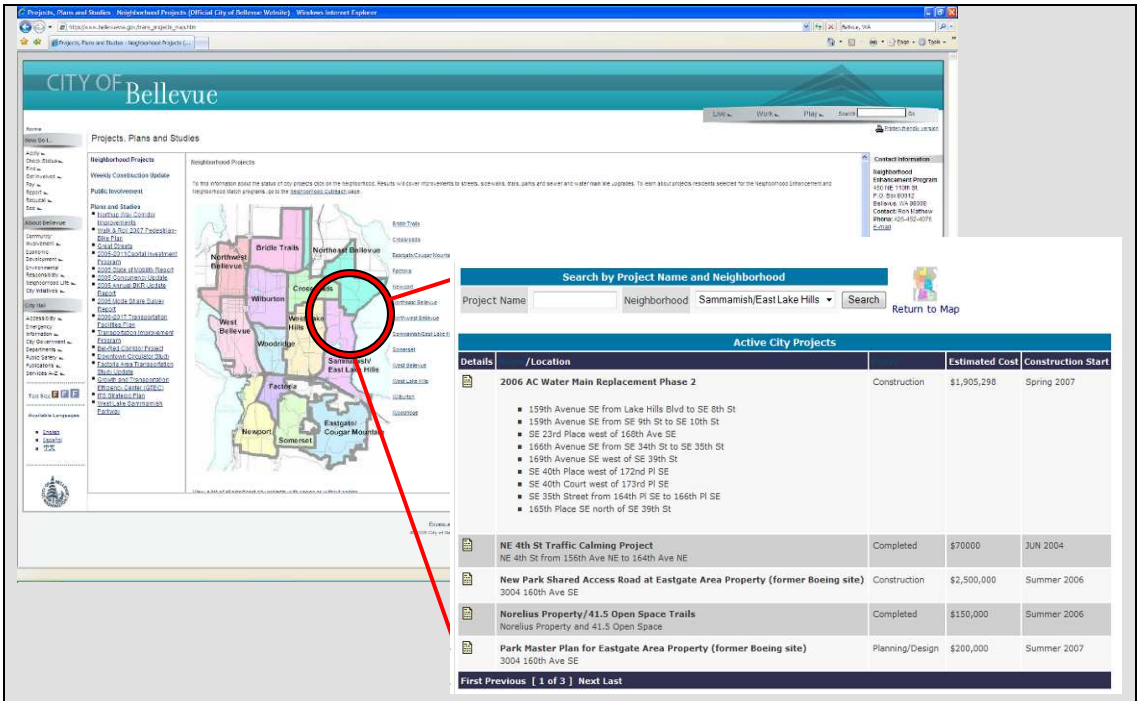
Construction Permitting – Users can quickly view the status of their construction permit.

An easy-to-use permitting portal makes it possible to apply, pay for, and receive electrical, low voltage, mechanical, plumbing, and re-roof permits from each of the participating jurisdictions. This is designed as a one-stop portal. The site also provides permit research and status information, construction tip sheets, inspection checklists, links to resources and contacts, and lists of upcoming events and seminars.

Development Activity – Mapping and reporting of development activity is available to the user.

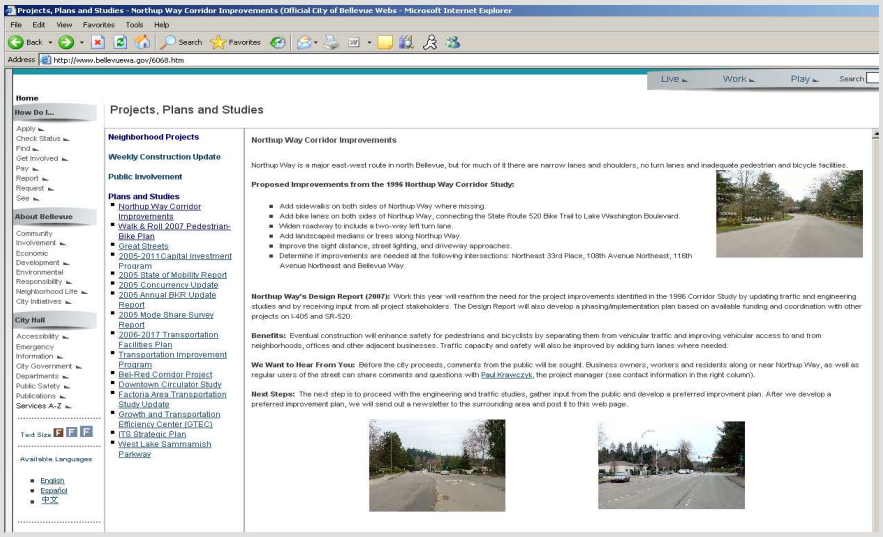


Neighborhood Projects – status of special projects are available to the citizenry. To find information about the status of city users click on their neighborhood. Results cover improvements to streets, sidewalks, trails, parks and sewer and water main line upgrades. To learn about projects residents can select Neighborhood Enhancement and Neighborhood Match programs from the Neighborhood Outreach page.



Easy Access to Neighborhood Project Status via the Web Portal

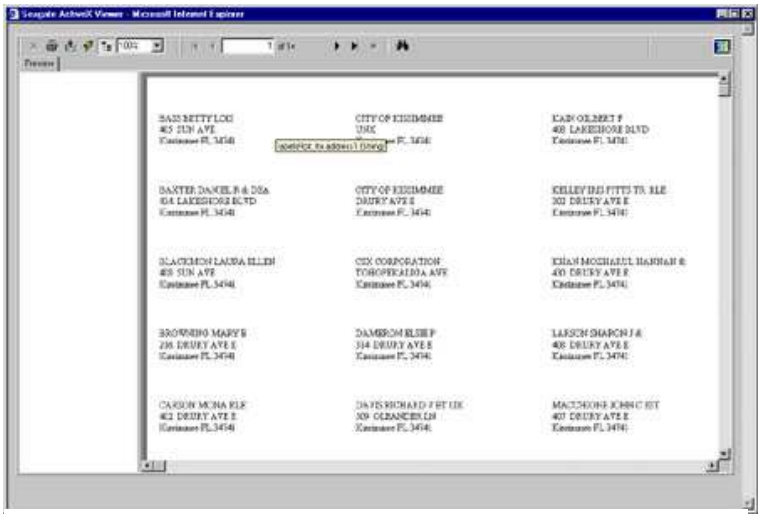
Transportation Plans and Project Studies – All major plans and studies are available via the web portal.



Sample Online Transportation Plan

Goal #3 – Interactive Reporting

Public Works and Community Development (PW&CD) needs information and needs it quickly. One of the challenges of the existing permitting system, Accela, is the creation of ad-hoc custom reports. Currently PW&CD staff has to work with IT staff to define needed reports. However, PW&CD staff has the need to create reports



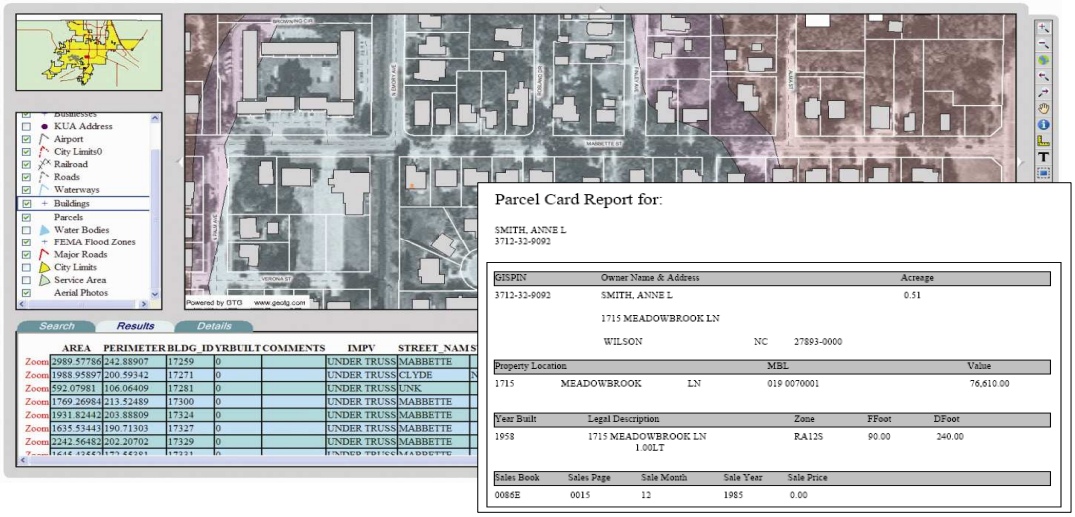
based on geography that is impossible with any non-GIS based report writer. Previous goals detailed the creation of GIS data layers from the Accela permitting system. Once done it is easy for a user to query the data and create a custom report.

Mailing Labels would be Available as a Report

CD desires to have the following reporting functions which should be made available via an intranet GIS browser with reporting capabilities:

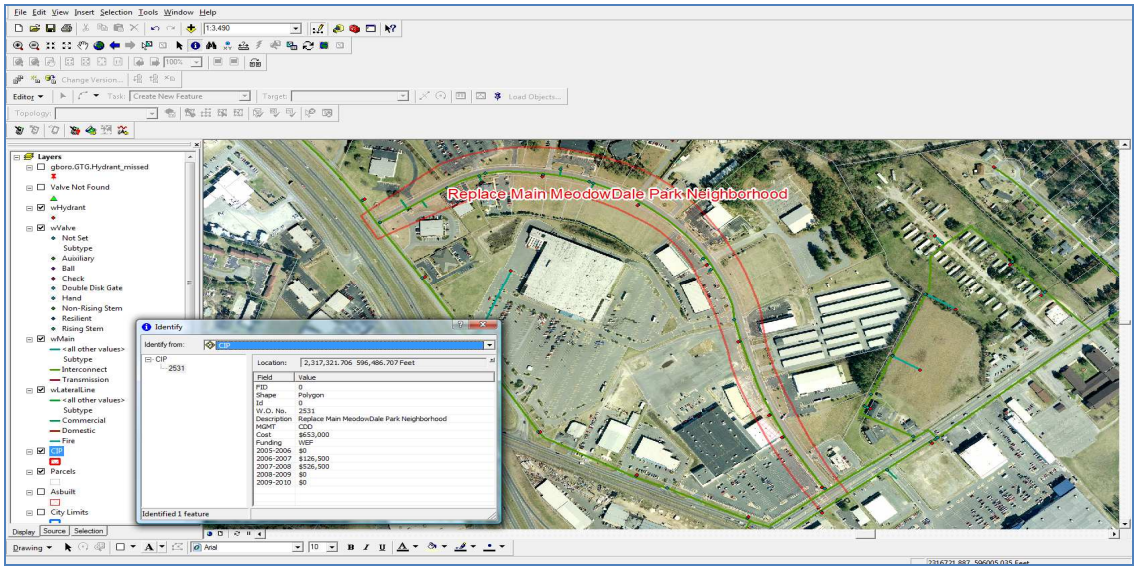
- Weekly results of locations of permitting activity
- Monthly results of locations of permitting activity
- Overall number of inspections and permits issued and completed
- Ad-hoc reporting
- Geography based reporting

The new geography based reports should make it easier to see patterns and trends making the information dynamic in addition to only producing a static report. As discussed in detail in the IT needs assessment, the intranet GIS data browser should be modified to provide department-specific data and functionality. Additional functionality should include the ability to view all base map data, department-specific queries, and standardized mapping templates. CD staff voiced a need to be able to establish both automatic routine reports, as well as ad-hoc requests, so the CD intranet GIS data browser should incorporate a robust querying and reporting tool set.



Goal #4 – Create Capital Improvement Program and Special Projects GIS Layer

The creation of GIS data layers for the Capital Improvement Program (CIP), special projects, and new developments/subdivisions (particularly for notification of maintenance transition to City from developers) are critical to PW&CD. Drafting Services will develop and maintain these layers. ArcEditor should be utilized to create polygons of project areas and maintain a database on all key project data. Additionally, the City could utilize interns to enter historic data for these layers.



CIP Project Tracking via GIS

The following information identifies information that should be captured for these key GIS layers:

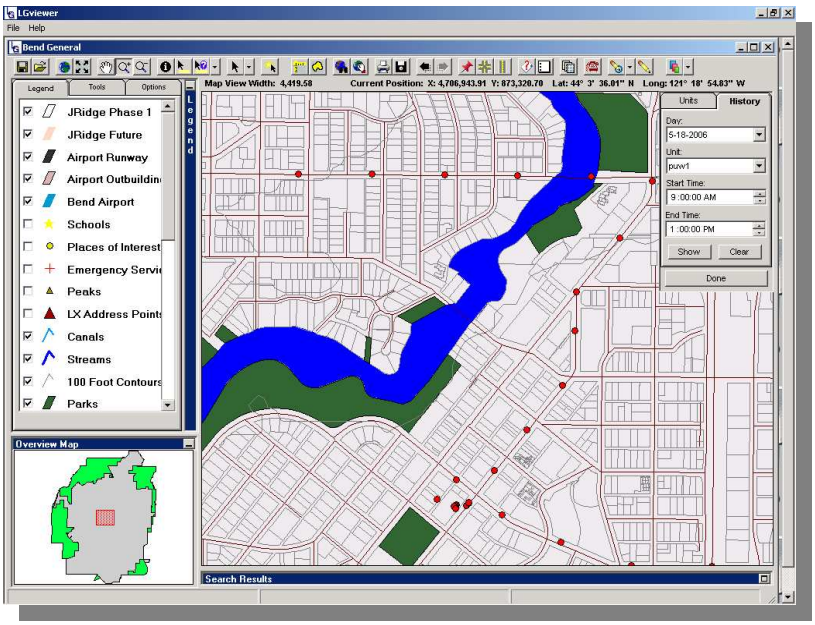
- **Capital Improvement Program (CIP)**
  This layer should contain a feature dataset with separate yet related point, line, and polygon feature classes illustrating each of the CIP projects with desired attributes. Points should be developed to show specific locations such as road intersections, Lines for entire street segments and sidewalks, and polygons (areas) for showing larger geographic boundaries.

- **Special Projects**
  A sub-unit of CIP (created by Community Development), this layer should showcase any unique Public Works projects that do not necessarily fit within the CIP.

- **Current Projects**
  One Polygon (area) feature class layer for real estate developments that includes a subtype field designating whether the development is proposed (yet to go to any governing body), under review, approved, under construction, or transferred (maintenance responsibility to the City).

- **Fire Hydrant Water Meters -** Water meters currently rented to developers. These need to be mapped for the purpose of asset tracking and revenue recuperation. Permits for these need to be tracked in the permitting system.

Goal #5 – Mobile, Wireless, and AVL Capabilities



AVL Capabilities through an Intranet GIS Portal

PW&CD will benefit from having access to the GIS data repository in the field. Efforts have already been undertaken to give the Police and Fire Department support in the field by providing laptops with access to maps and GIS data. Mobile computers are recommended to provide key PW&CD field personnel with access to dynamic mapping and basic spatial analysis capabilities. At present, field personnel in PW&CD use no form of digital mapping in the field. As the wireless computing initiative in Police and Fire is successfully complete, PW&CD will need to decide which personnel will benefit from mobile mapping tools. Optimally the wireless solution will allow staff to access the PW&CD intranet site and not require a separate tool on the laptop.

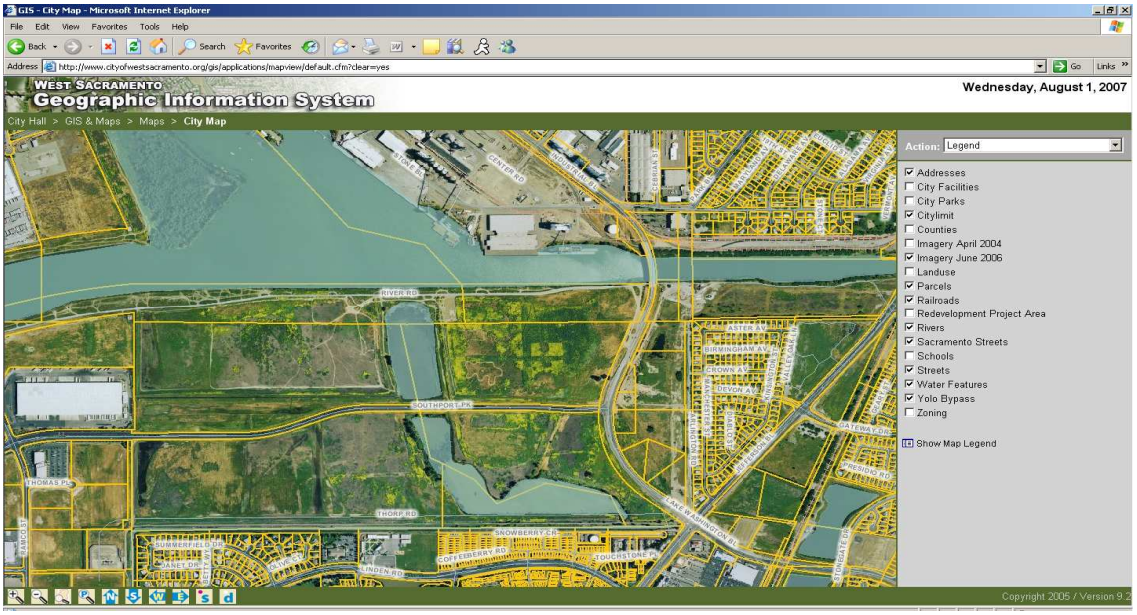
Staff also expressed the desire for Automated Vehicle Location (AVL) software. The software allows GPS enabled vehicles to be tracked via a GIS interface. It takes GPS data from vehicles and places a moving map symbol on the GIS map interface that corresponds to the vehicles location in the real world. Historical AVL information can be stored if desired. AVL technology could be imbedded within the outlined intranet portal discussed in detail in the IT section of this Needs Assessment.

Goal #6 – Hire an Additional Staff Person for Permitting and GIS

Staff was interviewed in regards to GIS and in regards to permitting and related tasks. Because of the volume of work in maintaining GIS data and working with all aspects of the permitting process it is recommended that the CD hire a technical resource that can accomplish both tasks.

Goal #7 – Save Time and Money with GIS

To show the effectiveness of the City of West Sacramento's investment in GIS, quantifiable examples of Return on Investment (ROI) resulting from GIS must be showcased. Recent interviews identified a good example of ROI for PW&CD. Before the City's GIS data browser was deployed, Planning personnel spent a large percentage of their four and one-half hour shift researching zoning information requests. Once the web-based GIS data browser was implemented, Planning staff's time was reduced to minutes per case which was a significant reduction. The quantifiable time reduction by utilizing the data browser was approximately 70% per case. Other automation routines discussed throughout this assessment will yield a tangible ROI.



Staff Have Been able to Quantify a Return on Investment in GIS

Goal #8 – Complete "Recommended" Critical GIS Layers

One of the key components to success is having access to needed GIS layers. Drafting Services has begun work on creation of critical infrastructure layers (sewer, water, and storm). These layers are not only important to PW&CD staff but to staff in almost every City department. An updated list of all GIS layers can be found in Chapter Two of this document.

Mapping and spatial analysis are key tasks that will enable PW&CD to improve management, operations, administration, and maintenance of the City's infrastructure. The most expensive yet important aspect of the GIS initiative is the creation of complete and accurate data sets.

The following is a list of the more pressing layers needed for Department staff to perform their daily tasks:

- **Permitting Activities**
  As discussed previously in Goal #2, point GIS data layers should be generated of data housed in Permits Plus. One point file per activity (permits, certificates of occupancy, and code enforcement cases) should be automatically produced via geocoding. The resultant data would then be available via the intranet and Internet GIS portals. More information on the "geocoding" process can be found within Goals #1 and #2 detailed earlier in this Needs Assessment.

- **Vested Financial Boundaries**
  Within Permits Plus, a "grandfathering" option exists that locks a development project (as well as City Bonds) into the financial structure that was available at the time of their submittal. Staff expressed a need to be able to visually see these frozen "grandfathered", or vested, financial boundaries on a map. A polygon GIS data layer should be developed illustrating all of these vested financial boundaries.

- **Public Infrastructure**
  PW&CD staff will need access to all infrastructure data as it becomes available.

- **Subdivisions**
  A polygon GIS data layer should be digitized detailing all the subdivisions. This can be done in house outsourced to a data creation firm. Once completed it should be maintained by PW&CD staff.

- **Capital Improvement Program (CIP), Special Projects, Other Projects**
  One feature dataset with separate yet related point, line, and polygon feature classes illustrating each of the CIP projects with desired attributes. A sub-unit of CIP, this layer should showcase any unique Public Works and Redevelopment projects that do not necessarily fit in with the CIP. PW&CD should complete this data layer. Community Development staff during interviews stated a lack of cross-departmental communication in regards to landscaping projects. At times new landscaping has to be removed due to other projects. Having access to various Parks and Recreation projects via GIS would reduce these mistakes thus saving money and public consternation. This same issue applies to many other projects such as Redevelopment, CIP, Development, and Public Works. Multiple examples exist of overlapping projects have not been coordinated effectively, resulting in the City paying for improvements or changes that would not have been necessary if projects were properly coordinated. The main difference with coordinating with Parks (trees) is that above ground improvements (esp. trees) are very visible to the public whereas most underground improvements are not.

- **Current Development Projects**
  A Polygon (area) feature class layer for real estate developments should be created that includes a subtype field designating as to whether the development is proposed (yet to go to any governing body), under City review, approved, under construction, or transferred (maintenance responsibility to the City). CD should complete this data layer.

- **Fire Hydrant Water Meters**
  Describes water meters currently checked out to developers and CIP projects for the purpose of asset tracking and revenue recuperation.

- **Fire HAZMAT**
  The Fire Department currently maintains an Excel spreadsheet detailing all the hazardous materials on commercial properties. A GIS point layer should be created by "geocoding" the spreadsheet to the City's address point layer. The creation of this layer has been recommended and will be made available to PW&CD.

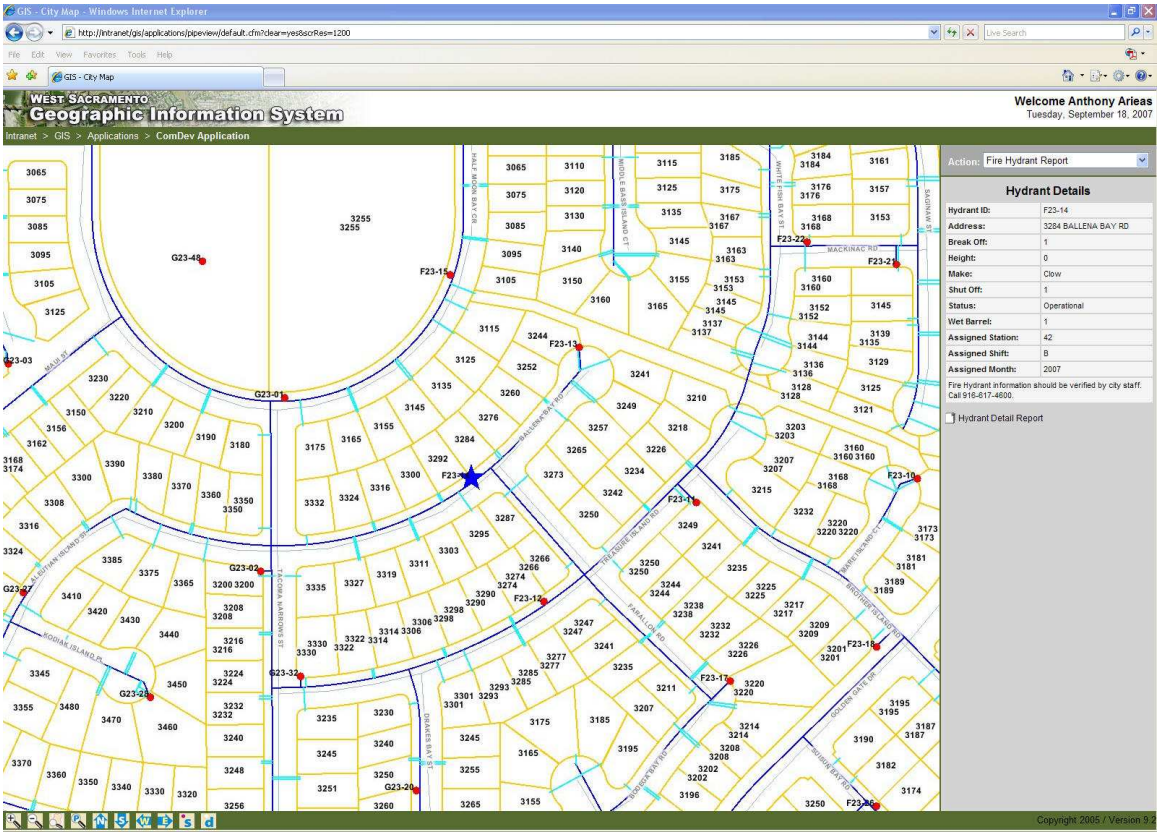
- **Tree Inventory**
  It has been recommended that the Parks and Recreation tree database be GIS enabled. The process is outlined in the Parks and Recreation section. The results should be made available to PW&CD.

- **Sidewalks** – Some sidewalk inventory data exists. Sidewalk encroachment permits are stored in a database (will be transferred to Accela within a year). A full inventory of sidewalks should be completed and the encroachment database should be GIS enabled. Once completed, information about repairs, replacements, and reported injuries due to tripping should be maintained on the GIS.

- **Signs** – Currently none of these have been collected. Sign data (type, location, etc.) should be collected utilizing GPS. Drafting Services will be responsible for conducting GPS data collection activities, and the development and maintenance of the sign layer. Public Works Street Maintenance personnel will coordinate with Drafting Services in locating signs for data collection purposes, and provide notification when new signs have been installed. This can be managed through a work order management system.

- **Transportation** – A street centerline layer exists for the City. The Department conducts pavement management surveys. This information should be tied to the GIS and a GIS based pavement management system should be utilized. More information on a GIS based pavement management system is discussed later in this chapter. Pavement markings can be captured via heads-up digitizing from the aerial photography.

- **Storm, Water, and Sanitary Sewer** – (less than 33% complete) – The City is responsible for maintaining this infrastructure and should have a complete inventory of features in the GIS. ESRI based geodatabase models should be created to house this data.



Infrastructure Data Maintained with GIS

A full inventory of available and anticipated layers can be found in Chapter 2 – "City of West Sacramento GIS (COWSGIS) Implementation Success and Progress".

Each of the above layers needs to be completed and then maintained by PW&CD – Drafting Services. A GIS based work order management system must be implemented to maintain and analyze all of this data. Current efforts are underway to do much of this data collection in-house. In February 2006, Drafting Services began mapping the City's utility infrastructure (i.e. water, sewer, and storm-water features). Drafting Services has developed a two phased approach to GPS data collection and digital mapping of the water, sewer and storm utility infrastructure. Phase I is for the Southport area and Phase II is for areas North of the Deep Water Channel. The estimated time of completion for Phase I is February 2009. Completion of Phase II is projected to be September 2012. Approximately 48% of Phase I has been completed.

These layers represent a significant investment for the City. Public Works and Community Development has identified the need to acquire this data and ensure that these layers are comprehensive and up-to-date. Before any data conversion or collection continues, agreed-upon utility data models must be created (see original implementation plan for more information on data models).

In September 2004, one Leica GS 50+, Survey Grade (1 centimeter accurate), GPS rover was purchased for in-house GPS data collection. An annual subscription fee is paid for access to a local GPS base station, allowing for real-time RTK GPS data

collection. It is recommended that GPS data collection be conducted by Drafting Service personnel in order to conduct comprehensive, City-wide GPS utility data collection. Primary advantages of in-house data collection are; cost savings gained by not paying an outside contractor; saving time in establishing horizontal control for Capital Improvement Projects (CIP); limiting survey personnel's exposure to traffic hazards; reducing survey personnel to one; ready access to infrastructure records for researching locations of covered infrastructure; knowledge of errors in existing records, and a vested interest in locating utility infrastructure.

An important consideration when collecting infrastructure for GIS data layers is determining the accuracy level at which to collect the data. Survey grade GPS data will also be utilized in the development of Capital Improvement Projects. It is recommended that Drafting Services use survey grade GPS data collection, for water sewer and storm drain infrastructure. Therefore, the Department should continue to allocate the appropriate staff and financial resources for the collection and maintenance of this data.

It should be noted that lesser accuracy levels may be adequate for some of the Department's GIS needs, depending on the type of mapping and analysis that will be performed by staff.

Below are some considerations that should be noted when determining the need for survey-grade geo-spatial data. As mandated by Public Works, GPS data collection shall have an accuracy of greater than one foot, after post processing. Furthermore, terrestrial survey methods may need to be incorporated in areas of dense tree canopy.

- Consumer GPS units cost $200-300 per unit, whereas survey grade GPS units cost as much as $15,000 - $20,000 per unit
- It is important to determine real-time corrections versus office post-processing options; it is optimal to have both real-time differential corrections and office processing for raw satellite data
- Costs incurred beyond the initial purchase should be considered as well. Equipment costs may be much less than the actual cost of data collection
- Training and data processing time can be extensive for survey-grade data collection
- Landscape conditions may affect data collection; it may not be possible to collect GPS data in some locations
- GPS data collection budgets should reflect how frequently new data sets will be collected

According to price and functionality offered, features can be located within 5 meters ($200-300 GPS receiver), within 1 meter ($6,500+ combined GPS receiver, mobile computer, and mapping software, such as the Leica GS-20), to within less than 10 centimeters ($15,000+ survey-grade GPS receiver).		
< 5 meters	***< 1 meter***	***< 10 cm***
		

Goal #9 – Implement Pavement Management

PW&CD maintains ratings for the streets of the City of West Sacramento. The GIS street centerline file should house the attributes that are necessary for maintaining a pavement management system. A pavement management application should be acquired to augment the GIS capabilities within ArcGIS. Alternatively, a geodatabase model can be established to house the pavement management data along with other street centerline features. If a pavement management system is pursued it must be ArcGIS compliant and should be rich in analytical features such as cost projections and paving prioritization. Various pavement management solutions exist. Pavement management is either a stand-alone application or a module of a work order management suite of software. Various off-the-shelf software applications exist for work order management systems (WOMS). These are detailed in Goal #10 below.

Goal #10 – Implement a Work Order Management System (WOMS)

A properly implemented work order management system (WOMS) will allow City staff to quickly input specific information about a task and then print out a paper work order with an accompanying map. This map should show the infrastructure for the area of concern. Field crews would then mark any changes or additions to the system on the work order. Once the job was complete, Public Works field personnel would return the work order with changes back to support staff for input into the WOMS and for update of appropriate GIS data layers. An added benefit of such a system is continual fine-tuning and improvement of PW&CD GIS data.

If any errors exist on the GIS maps, then field crew will mark and correct the error. In turn, this information will be corrected in the GIS data repository. Therefore, instead of GIS data degrading because of information not flowing back from the field, GIS data will continually improve because of corrections made in the field. Subsequently, the GIS data will reflect a very accurate depiction of what is in the field. Implementing a WOMS will ensure that this data is accurate and will facilitate rapid determination of assets in the field. Integrating a GIS-based WOMS will increase efficiency and provide a mechanism to move the data from the office to the field and vice-versa.

WOMS Software Providers

The City of West Sacramento should choose from one of the following software packages to meet the enterprise needs of PW&CD.

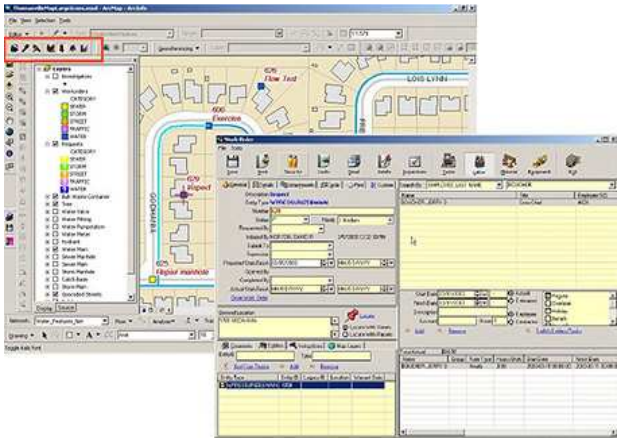
The following solutions are specifically tailored to support a GIS-centric WOMS:

1. Azteca Systems Inc.
2. GBA Master Series
3. Hansen
4. CartêGraph
5. Accela

An alternative to acquiring one of these off-the-shelf applications is to develop or acquire an ArcGIS Server application that allows for basic work order generation and tracking. This application would store each work request in the corporate database and would have a tracking mechanism that would require that each work order is closed out through update of the GIS.

Azteca Systems Inc. - Cityworks

Cityworks is a GIS-centric WOMS created specifically for Public Works and Utilities. Utilizing the data contained in the GeoDatabase, Cityworks works to manage the dispersed infrastructure with tools for creating and tracking maintenance activities associated to assets and/or addresses. These include handling requests for service, conflict resolution, work orders, tests and inspections, ad-hoc search and reporting and much more.

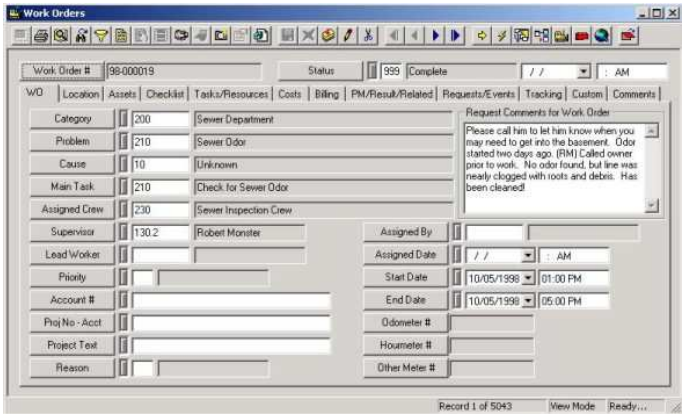


Cityworks Work Order Module

With integration of ESRI's technology, Cityworks is compatible with ArcGIS. Cityworks FM, whose underlying infrastructure data models are based on industry standards. Off-the-shelf GeoDatabase models are available for Water, Wastewater, Storm water, Streets, Traffic, Signs, Trees, Parks and Recreation facilities and many others.

GBA Master Series

The GBA Master Series Infrastructure and Asset Management Software is based on integration of the following three solutions; maintenance management, asset management and GIS integration. Similar to other GIS centric asset management solutions the GIS interface is a critical component for the dissemination of data from the various systems. GBA Master Series software combines maintenance management, asset inventory and inspection, and GIS compatibility to provide the user a comprehensive infrastructure management program. GBA Master Series software can easily integrate with ArcGIS. By combining Department asset data with the intuitive nature of a GIS map, employees can quickly locate assets, accurately analyze information and ultimately make better decisions.



GBA Master Series Work Order Interface

GBA Master Series offers the following functionality:

- Work Orders
- Customer Service Requests
- Preventive Maintenance
- Task Planning and Budget Tracking
- Parts Warehousing and Inventory Management
- Mobile/field applications
- Communications
- Traffic Accident Management
- Traffic Volume Management

Hansen

Hansen Information Technologies is a supplier of application software that helps manage the operations of government organizations. Hansen's products aggregate citizen and business requests for services and business transactions, across the enterprise, offering multiple channels (i.e. web portal, kiosk, front counter, telephone, and email) of secured access to back-office functions. Hansen offers several enterprise product suites including; Citizen Relationship Management, Financial Accounting, Revenue Management, Operations Management, Business Intelligence.

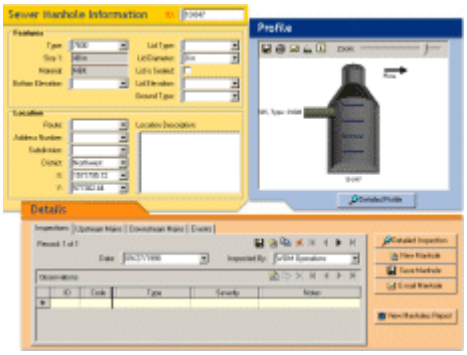
Hansen has several options for adding spatial decision support tools to a GIS solution, from integrated mapping within Hansen's 7 Series solutions to interfaces that create, link and synchronize your Hansen data with leading GIS applications.

The Hansen solution is best when paired with other Hansen systems within the organization. This should be considered when evaluating the usefulness of Hansen as a utilities management solution. Hansen is an ESRI business partner and has several interfaces available for integrating GIS.

CartêGraph | Better Government ***CartêGraph***

CartêGraph is an ESRI business partner that specializes in offering several solutions to help manage the ongoing activities of local government organizations. A few pertinent modules are as follows:

SEWERview



SEWERview is designed to manage both storm sewer and sanitary sewer assets. SEWERview is a management tool to inventory, inspect, test, manage and map all information related to sewer networks. Tabs on the side of the SEWERview screen allow easily access detailed information about the main components in your sewer network:

- pipes
- junctions (manholes)
- intakes
- channels
- pump stations

Each of these components may record a wide range of identification, feature, location, inspection and history information. SEWERview also allows users to associate photos, documents, plans and other pertinent information to sewer network components.

SEWERview has the flexibility to record as much or as little detail as desired.

Functionality:

- identify network connectivity
- keep on-line inspection records
- record miscellaneous tests
- associate video distress logs
- queries and reports
- user-defined data entry fields
- user-defined Overall Condition Index
- interface with standard hydraulic modeling programs

MARKINGview

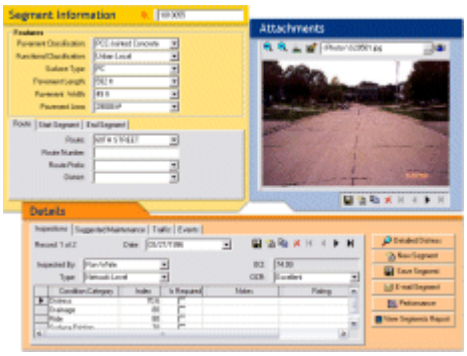
MARKINGview is a tool for developing and maintaining a database of intersections, streets and highway pavement markings. View important details including the cost of materials for reapplication, amount of paint needed for reapplication and predicted condition of the marking at any time. In-depth records that include location, features and maintenance history are available with a click of a button and can be used for reporting, budgeting, improving safety and more.

Functionality:

- identify location by vicinity, coordinate, network or intersection
- calculate estimated costs of marking applications automatically
- record data describing how the material was applied
- run queries and reports
- access on-line libraries

PAVEMENTview

PAVEMENTview allows users to maintain accurate and up-to-the-minute pavement inventory, inspection and maintenance information for high-volume paved roads to low-volume unpaved roads. PAVEMENTview is based on concepts introduced by the Federal Highway Administration and the U.S. Army Corps of Engineers and is suited for both field and office use. PAVEMENTview facilitates optimized data collection, improved records accuracy, departmental efficiency, simplified analysis and decision making, streamlined work plan development, and decreased maintenance costs.



Functionality:

- detailed inventory of paved and unpaved road segments
- inspection records
- location identification
- identify road segment classifications
- queries and reports
- on-line SI&A forms
- reference FHWA (SHRP) and USACE distress libraries and deduct curves
- record ADT history
- establish user-defined Overall Condition Index

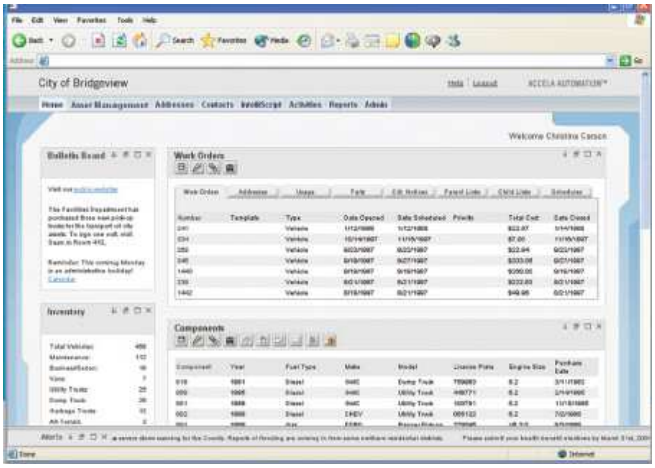
All of CartêGraph's software operates independently or in conjunction with ESRI's GIS software. Tabular data stored in CartêGraph's software can be dynamically linked to ArcGIS if spatial information is available for each asset that is being tracked.

For over 25 years, Accela has been the leading provider of government enterprise software solutions that provide agencies with the ability to automate workflow, track information, and manage data from a centralized database. Accela's products allow agencies to reduce workload, increase efficiencies, and provide citizens and businesses with easier, more convenient access to government services.

Accela Asset Management

Accela Asset Management™ tracks and manages assets and resources, providing an automated solution for costing, inventory, maintenance, investigations, and inspections. Accela Asset Management is flexible enough to manage an agency's entire assets—fleet, street, water, wastewater, parks and recreation, plant and facilities, sewer, railway, roadway, and more.

The Accela Asset Management solution can help manage and track the following activities:



- Public Works
- Wastewater Collection
- Water Distribution
- Street Transportation
- Parks and Recreation
- Fleet Management
- Treatment Plants
- Storm Water Management
- Facilities Management

Accela Asset Management provides historical data on your assets to allow an agency to perform maintenance analysis and planning. You can track past work orders by history, costing, parts, location, or any other criteria. This information can be used to schedule preventative maintenance.

Accela Service Request

Accela Service Request™ automates and manages interdepartmental or citizen requests for service, complaints, or inquiries. Accela Service Request allows you to organize and manage requests and strengthen citizen relations.

Departments that currently use Accela Service Request include:

- Call Centers
- Mayor's Office
- Customer Service
- Police
- Code Enforcement
- Real Estate
- Facilities

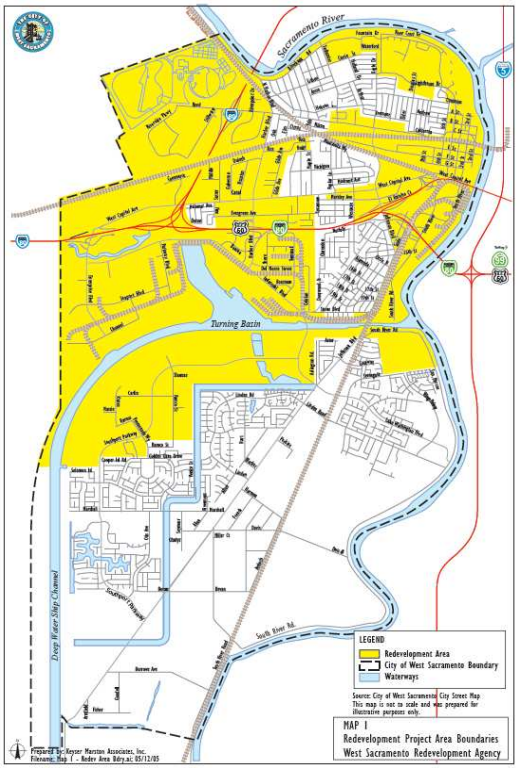
Improve Customer Service
By automating all service requests and providing a centralized database for this information, Accela Service Request ensures that an agency is able to access real-time information about the status of any request at any time.

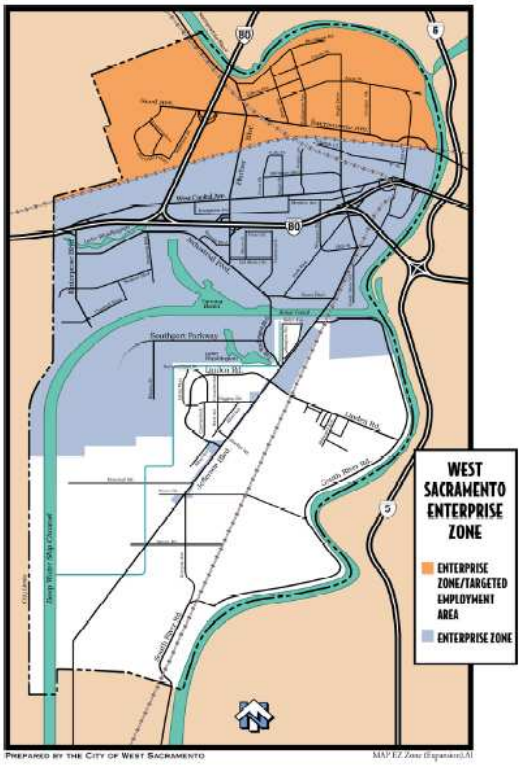
Assign Projects Automatically
Accela Service Request allows an organization to automatically assign service requests based on a variety of criteria that help determine who is most qualified to handle the request. Additionally, alerts can be set to automatically request a follow-up action or additional information. By automating internal procedures, service can be provided consistently and thoroughly to all citizens.

Redevelopment Agency

GIS Goals and Background

The Redevelopment Agency is responsible for implementing the city's redevelopment plan. This plan is the framework for the planning and revitalization of the redevelopment area. The plan provides the Agency with powers to take certain actions such as to buy and sell land within the area covered by the plan (the project area); and to use tax increment financing for public improvements, blight removal and business and job recruitment.





Examples of GIS/mapping use within the Redevelopment Agency

The West Sacramento Redevelopment Project Area contains 5,416 acres and comprises much of the nonresidential portion of the northern part of the city. The urban area contains a mix of developed and vacant land, and some limited residential areas. The Agency has been utilizing GIS for many projects and GIS is critical to the Agency's operations. Currently, the redevelopment agency houses one full-time high-level GIS analyst and a dozen consumers of the two online GIS applications run by the city.

The Redevelopment Agency utilizes Permits Plus to track permitting activity, vacant land inactivity, and available land ripe for development. In addition, the redevelopment agency also monitors the amount of impact fees assessed and collected in the project area, for the purpose of tracking the capital improvement projects completed in the project area and the resulting progress in blight removal and neighborhood revitalization.

GIS Goals
The following are the goals for the Redevelopment Agency in regards to further GIS implementation over the next few years:

Goal #1 – GIS Mapping of Vacant Property Available in the Defined Redevelopment Agency Area

A major goal for the Redevelopment Agency revolves around their ability to track and maintain a vacant properties polygon GIS data layer. This effort should assure that not-for-profit organizations like churches or philanthropic entities are marked as not being available for redevelopment projects.

Building permits issued within vacant land marked for redevelopment are currently being tracked by Permits Plus detailing all the stages of project status. As Permits Plus is updated with current information on a project, so should a new vacant properties polygon GIS data layer.

As features are added or updated to the polygon GIS data layer, it is imperative that a dynamic link be established between the GIS and Permits Plus vacant property building permit data by the Assessor's Parcel Number (APN). The polygon GIS data layer should be considered a "container" template that includes the APN so that all the Permits Plus database information can be joined to it by APN. As a result, Redevelopment staff can add the vacant property Permits Plus data to a map, allowing the Redevelopment Agency to track the development of properties and analyze geospatial and development trends.

Goal #2 – Provide a Proactive Approach to Recruiting Business and Developers

The Redevelopment Agency stated they wanted to be more proactive in their approach to recruiting businesses that will develop projects within the City of West Sacramento. To do this effectively it is essential that the City understands and knows specifically what types of demographics specific businesses look for when analyzing areas of investment.

The Redevelopment Agency has made strides in obtaining pertinent economic data. The Community Asset Tracking System (CATS) contains all businesses within the City of West Sacramento along with demographic information such as age, education, and household income. The CATS tool is available online for public use. This tool can be used to analyze areas of underdeveloped opportunities that exist within West Sacramento.

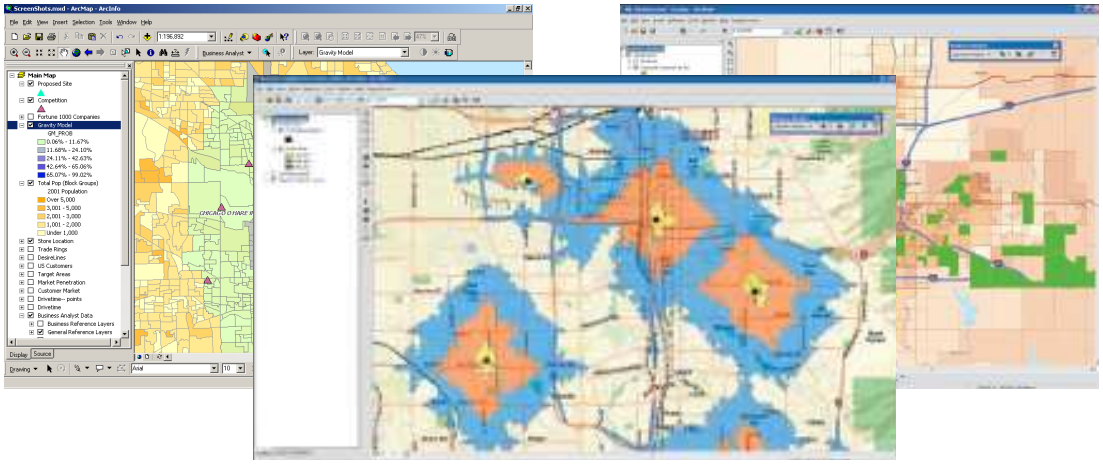
Utilizing existing GIS software and data, the City can be more proactive in its approach to recruiting business. City personnel can analyze existing demographics and business information to find areas within the City of West Sacramento which meet the goals of prospective industries and trades. These areas should be presented to potential business recruits.

This goal should be developed into an ongoing automated routine. Scheduling time once a quarter to analyze these developments should be customary. Focusing on

this goal will keep the City of West Sacramento prepared to present pertinent demographic data to prospective developers and businesses

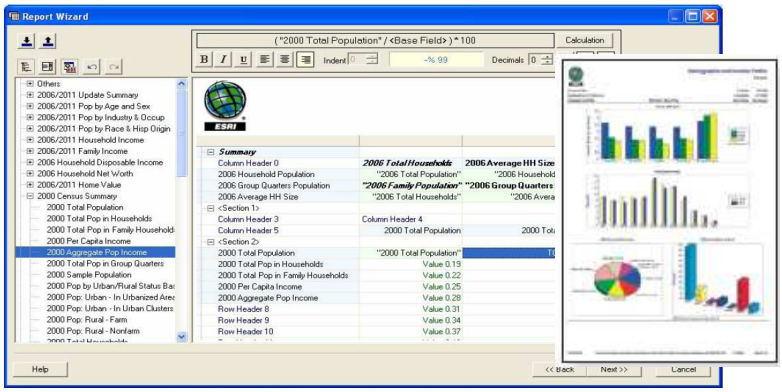
The Redevelopment Agency has made progress with the tools currently available. Utilizing the Business Analyst extension for ESRI's ArcGIS 9.2 will aid the Redevelopment Agency in understanding the composition of West Sacramento's citizen base, and in turn better understand what types of employers the City should recruit. Existing GIS data sets such as those from InfoUSA can assist in these analyses.

Business Analyst from ESRI allows the City of West Sacramento to use GIS with consumer, demographic and business data. With Business Analyst, the Redevelopment Agency will have access to advanced spatial analysis, improved maps, and detailed reports. These results should then be provided over the City's GIS web portal to provide developers and other interested parties with more insight into the citizen base and business opportunities of West Sacramento.



Screenshots of ArcGIS Business Analyst 9.2

Business Analyst can help the Redevelopment Agency answer questions on the optimal site locations for new businesses and how to effectively promote specific customer segments to business.



Custom Reports for Prospective Businesses

Goal #3 – Complete "Recommended" critical GIS layers

The Redevelopment Agency would benefit from creating additional GIS data layers to assist in achieving the goals and planned activities in the Redevelopment plan. During the interview process, several items were identified that would make GIS a more useful and embedded technology throughout the Agency.

Specifically mentioned during the interview process by the Redevelopment Agency were the following GIS data layers:

- **Public Infrastructure Improvements -** Having the capability to visualize, review, and analyze every public infrastructure improvement throughout the City was a key GIS need identified during the Redevelopment staff interviews. Staff has an explicit need to see all existing and planned capital improvements through GIS. One of the responsibilities of the Redevelopment Agency and the Economic Development Division housed within the Agency is recruiting businesses and marketing property in the project area. Developers typically want information about the public infrastructure available for a particular site. Infrastructure improvements available through a GIS environment would allow staff to quickly provide the necessary information to interested developers. Beyond assisting potential developers, these layers will provide staff with a better understanding of how targeted areas are being served (or underserved) by the City. Staff also expressed a need to quantifiably show the impact Redevelopment Agency investment, and City investment, has had on specific redevelopment areas. Infrastructure data is needed to accomplish this task.

- **Underutilized Parcels -** The data for underutilized parcels is a high priority for the Redevelopment Agency. There is a direct benefit to the Redevelopment Agency for acquiring this data layer. Difficulty lies in the sheer size of the amount of data to be captured, in addition to the maintenance of the data once it is generated. It is recommended that the creation and maintenance of this layer should be outsourced.

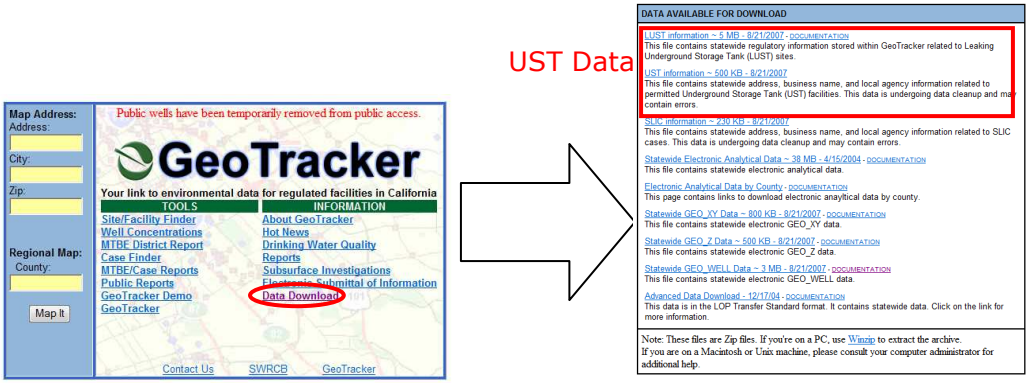
- **City Licenses & Permitting Activity -** The Redevelopment Agency expressed a need for using a point file that details all the City's licensing and permitting activities. Specific staff interests include liquor licenses and daycare permits. A GIS point layer should be generated using the existing address information attached to those activities with the City's address GIS layer. The Redevelopment Agency uses this data to analyze blighting influences and opportunities for the provision of childcare.

- **Annual Blight Progress Report Indicators -** Redevelopment law requires that the Redevelopment Agency file an annual blight progress report. Indicators included in this progress report are code enforcement action, police contact counts, and incidents of fire department and medical service response that occur within the project area. Creating a spatial key and implementing consistent data entry would allow staff too quickly and quantitatively sort and spatially analyze these blight indicators for the annual blight progress report

- **Underground Storage Data**
  Phase I and Phase II environmental analysis of underground storage facilities and other forms of environmental contamination is of particular interest to the Redevelopment Agency because any type of environmental contamination or regulatory action adds costs and complexity to prospective development.

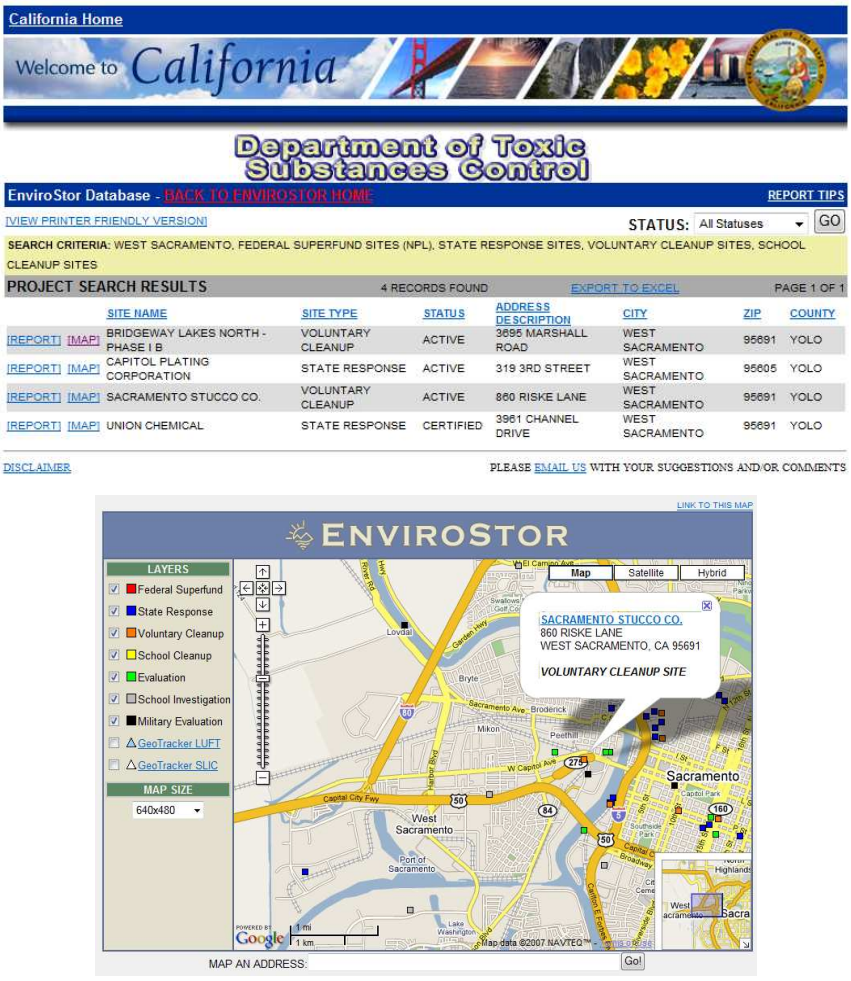
  The Barry Keene Underground Storage Tank Cleanup Fund Act of 1989 was created by the California Legislature, and is administered by the California State Water Resources Control Board, to provide a means for petroleum UST owners and operators to meet the federal and state requirements. The Fund also assists a large number of small businesses and individuals by providing reimbursement for unexpected and catastrophic expenses associated with the cleanup of leaking petroleum USTs.

  On January 1, 2005, the State Water Board adopted regulations that require electronic submittal of information (ESI) for soil and groundwater of underground storage tank (UST) cases and non-UST cleanup programs, including Spills-Leaks-Investigations-Cleanups (SLIC) sites, Department of Defense sites (DOD), and Land Disposal programs. The GIS Specialist within IT should download the appropriate GIS data inside the State's "Geotracker" utility (http://geotracker.waterboards.ca.gov/data/), as shown below:



Screenshots of the State's GeoTracker system

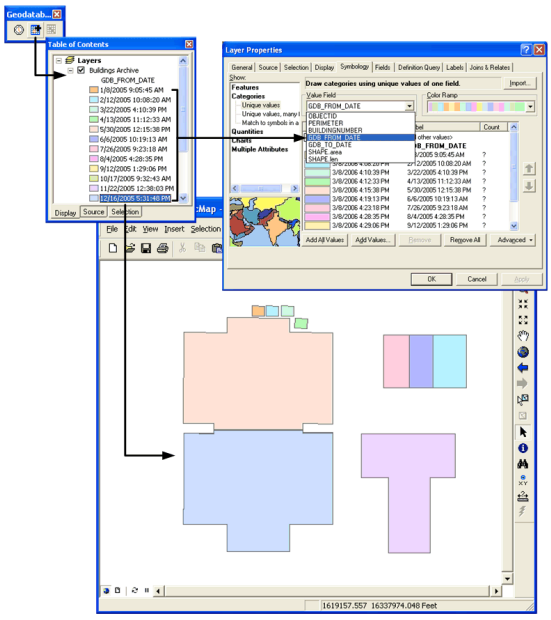
- **Brownfield Sites**
  Brownfields are property and parcels where land (re)development may be hindered by the presence or potential for hazardous substance on-site. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land and both improves and protects the environment. The State of California's Department of Toxic Substances Control (DTSC) offers the new EnviroStor database, which is an online search and Geographic Information System tool meant for identifying sites with known or potential contamination, and sites where DTSC's environmental oversight or review has been requested or required. Searches can be conducted by site name, address, city, and county, or EnviroStor ID number. The EnviroStor database can also be downloaded.



Screenshots of the State's EnviroStor system

- **Telecommunications Infrastructure**
  There is a need for the Redevelopment Agency to have access to a telecommunications GIS layer. Areas that are underserved by broadband data and communications infrastructure have impediments to development making the recruitment of targeted industries more difficult. Some of this information will need to be acquired from telecommunications companies. Other data can be harvested from city encroachment permit applications for telecommunications installations.

Goal #4 – Track Parcel History for all Areas of West Sacramento – "Parcel Genealogy"



Archiving in ArcGIS 9.2

The Redevelopment Agency has a need for tracking the history of all parcels. A chronicle of a parcels history can be maintained using ArcGIS 9.2. This new feature now available in ESRI's ArcGIS version 9.2 is known as archiving. The archiving tool has the ability to show snapshots in time of all parcel data in the data repository.

Archiving allows the City to preserve data through time, without storing complete copies of the entire parcel dataset for each desired moment in time. Archived data can be viewed, queried and analyzed by ESRI's ArcGIS 9.2. Enabling this feature will allow the Redevelopment Agency to achieve its goal of tracking the history of any parcel maintained in the GIS.

Conditions need to be met to allow this feature of ArcGIS 9.2 to work. First, the data must reside in an ArcSDE 9.2 geodatabase. Second, another feature called versioning must be enabled. The GIS data must be fully versioned to utilize archiving. Once these two prerequisites are met, the Redevelopment Agency can take full advantage of ArcGIS 9.2's archiving capabilities.

Currently the City maintains the parcels in AutoCAD and converts the layer to GIS. If utilizing ArcGIS to maintain parcels is not feasible then a snapshot version should be maintained on an annual basis. Over time archived versions that depict these annual snapshots will be available for comparative purposes.

Goal #5 – Equitable Distribution of Revenue Tracking

An essential goal of the Redevelopment Agency is to assist and facilitate capital improvement investment in the project area. The Redevelopment Agency would like to track the degree to which the city fees collected in certain areas fund improvements in those same areas.

When an applicant submits a request for developing a parcel of land, it is vital to be able to trace all fees collected within specific areas. New land development can be associated to one or multiple census tract boundaries. The Redevelopment Agency analyzes the fee revenue generated from real estate developments, and the amount of fee revenue returned to specific areas in the form of capital improvements.

Presently the business workflow process for tracking the equitable distribution of fee revenues is cumbersome. During interviews, Redevelopment Agency staff stated a

desire to better automate and simplify this review process. It is recommended that an ArcGIS Server based application be written to improve this process. The GIS Specialist will need to work with Agency staff to identify GIS tools that can streamline the process.

Goal #6 – Migrate Redevelopment Agency GIS Data to the COWSGIS Data Repository

The Redevelopment Agency houses a significant asset of the City of West Sacramento. The Community Asset Tracking System (CATS) manages and tracks the City's economic development areas of interest. Much GIS data is generated and maintained within the Agency. Some of this data would be beneficial to other departments. Additionally, for backup and security reasons this data should be housed on the central GIS server.

Currently the data warehouse for CATS is available only to the Redevelopment Agency. The IT Division with assistance from the GIS Specialist should work with the Redevelopment Agency on meshing the Community Asset Tracking System (CATS) data with the central data repository.

Chapter 4 – Initiatives and Implementation Plan Update

The following sections recap and further define some of the key components that are integral to the continued GIS success for the City of West Sacramento.

System Governance

As discussed in detail in the original GIS Strategic Plan, it was recommended that West Sacramento utilize a **hybrid organizational structure** for its GIS effort. The hybrid organization structure has a core group of GIS experts at its core with each department having an internal GIS liaison to handle GIS tasks. The core group of GIS experts at the City is comprised of the GIS Specialist in IT who is supported by other IT experts who assist with technical tasks and a few expert GIS users in other departments; such as, Public Works, Redevelopment, and Community Development. This combination of staff has realized very good successes in the first few years of this project. However, the ability of the current staff to manage the additional data layers recommended in the original GIS Strategic Plan and this Plan Update cannot reasonably be expected. The GIS Specialist should be focused on overall project management and technical GIS issues for the City and not be doing day-to-day data update and creation. Community Development, Police, Public Works, and Redevelopment have staff that are assigned to updating GIS data. Other departments such as; Fire, Finance, and Parks and Recreation do not have the volume of GIS usage to merit staff responsible for updating GIS data. The need for another technical staff person to handle permitting task, GIS related tasks, and other technical tasks in Community Development was identified. Additionally, based on the sheer volume of data the City should be maintaining, it is recommended that a GIS Technician is hired in IT under the supervision of the GIS Specialist.

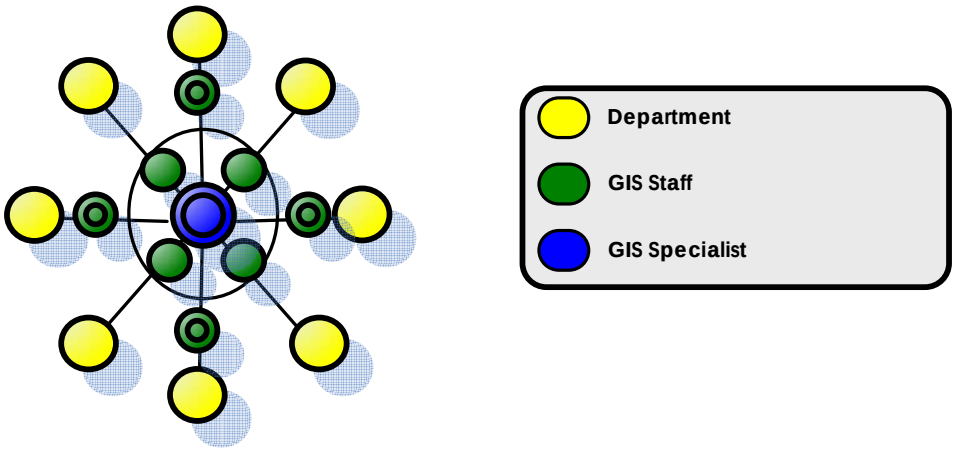


Figure 4-1 - Hybrid GIS Organizational Structure

One component of GIS governance that warrants reiteration is the need for City Departments to maintain their own GIS data. The original GIS Strategic Plan stressed that GIS-participating departments have to ultimately be responsible for the creation and maintenance of departmental GIS data layers. Additionally, staff must receive the training to accomplish these tasks. To date, few City personnel outside of the GIS Specialist have received any formal GIS training. This must become a high priority. Information on training needs has been detailed later in this chapter.

To reiterate, The GIS Specialist should continue to implement three levels of departmental support, depending upon the current level of GIS use and internal capabilities per department. Levels of support include:

> *Level 1* – GIS Specialist provides minimal support for department/division/office GIS activities, system and application support. The GIS Specialist is used primarily for strategic and procedural support. The Drafting Services Section is essentially at Level 1. Other departments/division, including the Engineering and Planning Divisions should aspire to be at Level 1 in the near future.
>
> *Level 2* – GIS Specialist provides partial support for department/division/office GIS activities. A Level 2 department/division/office will do most of its own data maintenance, but the GIS Specialist will provide advanced support; the GIS Specialist will also be responsible for advanced spatial analysis as well as application development.
>
> *Level 3* – GIS Specialist provides all support for department/division/office GIS activities. The GIS Specialist is responsible for data maintenance, complex data analysis, and cartographic products.

While a stepped multi-level approach to GIS support is advised, each department/division must still strive to achieve Level 1 support status as GIS develops and is incorporated into its respective business processes. As such, the GIS Specialist, in conjunction with the Information Technology Division, must continue to provide training and technical support for all enterprise-wide GIS applications. All GIS software training should be coordinated through the GIS Specialist to ensure maximum efficiency and effectiveness at a minimum cost.

Not every department/division/office at the City of West Sacramento that wants to utilize GIS is able to hire GIS-only staff to effectively handle the tasks of data analysis and data maintenance. The GIS Specialist will assist these departments/divisions/offices with their GIS needs. However, as usage of GIS in the aforementioned entities grows, the GIS Specialist must encourage and facilitate the acquisition of appropriate resources (e.g. PC hardware, ESRI ArcEditor/ArcInfo software licenses, formal training) to handle data maintenance responsibilities for these departments/divisions/offices.

The City still has the need to create and manage many GIS data layers. The current staffing level is not sufficient to accomplish data layer creation and maintenance. The City should hire a GIS Technician/Analyst within Information Technology for these tasks. Additionally, this person will assist user departments with project related GIS tasks. A GIS Intern should be utilized to assist with data creation and collection tasks especially as the new GIS data layers are being created.

To recap, how GIS fits within the organization is essential to the success of its enterprise-wide effort. The City of West Sacramento should continue to utilize a hybrid organizational structure. Having a GIS Specialist is an important factor with regard to GIS success. The GIS Specialist should continue to be utilized to direct the overall GIS efforts of the organization. He should not be seen as the person who will conduct all daily GIS tasks for various departments. The GIS Specialist should provide technical expertise, training, and direction for all City of West Sacramento staff. However, each department/division/office should eventually develop its own expertise and begin to utilize GIS in its daily routine as the City's GIS implementation progresses.

Software

The City of West Sacramento currently maintains the following software that can be used as part of the City's GIS:

Table 4-1 - Existing GIS Software

Product	Maintenance Type	Expiration Date	User Name
ArcIMS (one server 2 cpu's)		2/1/2008	Information Technology
ArcIMS Developers Support		2/1/2008	Information Technology
Spatial Analyst		2/1/2008	Stacie Myers
3D Analyst		2/1/2008	Katie Yancey
Network Analyst		2/1/2008	Katie Yancey
Spatial Analyst		2/1/2008	Katie Yancey
ArcEditor	Primary	2/1/2008	Anthony Arieas
ArcView	Primary	2/1/2008	Stacie Myers
ArcView	Secondary	2/1/2008	Brian Coward
ArcView	Secondary	2/1/2008	David Tilley
ArcView	Secondary	2/1/2008	Extra
ArcView	Secondary	2/1/2008	Extra
ArcView	Secondary	2/1/2008	Cats Server
ArcView	Secondary	2/1/2008	Katie Yancey
ArcView	Secondary	2/1/2008	Robert Miller
ArcView	Secondary	2/1/2008	Ed Turley
ArcView	Secondary	2/1/2008	GIS Intern
ArcView	Secondary	2/1/2008	Dean Hebenstreit
ArcView	Secondary	2/1/2007	Bruce Williams
Community Sourcebook America w/ArcReader		8/4/2006	Redevelopment
ArcGIS Server Enterprise	Primary	2/1/2008	Information Technology

ArcGIS Server (AGS) is the latest version of ESRI's enterprise software and replaces pre-existing technology. Therefore, stand-alone ArcSDE and ArcIMS will no longer need to be maintained as AGS encompasses the functionality of both these products. It is recommended that a standard be established for the maintenance and management of software licenses; this standard will ensure that all GIS users have the same version of a specific type of software. All licenses should be under one account number and maintained by IT and the GIS Specialist.

The following table identifies GIS software recommended for the City of West Sacramento by department (based on license requirements):

Table 4-2 - Recommended GIS Software by Department

Department / Division	Software	Recommended Number of Licenses or Users
All Departments	ArcGIS Server	Enterprise Level recommended; Workgroup Level limited to 10 editors
All Departments	Intranet GIS Data Viewer	Site License – Different Views for Each Department

Department/Division	Software	Recommended Number of Licenses or Users
Public	Internet GIS Data Viewer	Site License – Multiple Public Applications
All Departments	GeoManager - for automated mapping of legacy data from existing IT investments (Accela, CATS, FirePoint, Springbrook, etc.)	1
Drafting Services Section and GIS Specialist	Address Management	1
Parks and Recreation	Parks and Recreation Management Application with GIS Component	10
Engineering Division	Work Order Management System	Site License
Public Works	Pavement Management	1
Police, Fire, Public Works, and Community Development	Mobile GIS Access (Either via wireless connection to intranet applications or a mobile data browser)	100+
Redevelopment Agency	Business Analyst	1

Eventually, the City will need to upgrade from the currently licensed ArcGIS Server Standard Edition to the more robust Advanced Edition. ArcGIS Server Advanced includes web-based editing and advanced mobile tools. By publishing a web-based editing service, the reliance on multiple versions of ArcEditor licenses can be avoided.

The ArcGIS Server Enterprise-Level Advanced Edition upgrade currently costs $20,000 per socket. Therefore, upgrading should be done only when the advanced mobile tools and the web-based editing is needed.

Hardware

Desktop Computers

Like many organizations, the City of West Sacramento is continually upgrading personal computers. New software solutions often require new computer hardware. Individual departments are budgeting replacements for their older PCs. Therefore, recommendations are given in this report that specify minimum and desired configuration of personal computers to run GIS applications. The City of West Sacramento needs to refer to these specifications to see if it will need to upgrade PCs to run specific GIS applications. Specifications will be looked at in two tiers.

- **Level One**: PCs to run robust desktop GIS software such as ArcGIS (ArcInfo, ArcEditor or ArcView)

- **Level Two**: PCs to run ArcServer client applications, such as the Intranet and/or Internet Data Browsers

There is a difference between a typical personal computer and a GIS workstation. A typical personal computer for word processing is not likely appropriately configured for GIS use. A GIS workstation demands, at a minimum, a high-end processor, large amounts of memory (RAM), and large disk space.

In the short-term, it is important that all City of West Sacramento personnel that will utilize level one computers are capable of effectively supporting recommended GIS applications. In the long-term, as more City of West Sacramento personnel begin to use level 1 and level 2 GIS applications, they should have access to computers that can effectively support these applications.

Level 1 PC to Run ArcInfo, ArcEditor and ArcView

Minimum Configuration

Approximate cost = $1,500 each

- Windows XP Professional Edition
- 1.2 GHz Pentium PC or Greater
- 1 GB of RAM or Greater
- 17" or Greater High Resolution Monitor
- 30 Gigabyte hard drive or greater
- 10/100 MBPS Ethernet Card
- 32 MB Video RAM or greater

Recommended Configuration

Approximate cost = $2,250 each

- Windows XP Professional Edition
- Intel Core 2 Duo 2.6 GHz Processor or Greater
- 2 GB of RAM or Greater
- 19" or Greater High Resolution Monitor
- 80 Gigabyte Hard Drive or Greater
- 100 MBPS Ethernet Card
- 64 MB Video RAM or Greater

Level 2 PC to Run ArcServer-based End User Applications

Minimum Configuration

Approximate cost = $800 each

- Windows XP
- 512MB of Ram or Greater
- 17" Monitor
- 1.2 GHz Processor or Greater
- 100 MB of Unused Disk Space or Greater
- 10/100 MBPS Ethernet Card
- 16 MB Video Ram or Greater

Recommended Configuration

Approximate cost = $1,500

- Windows XP
- 1GB of Ram or Greater
- 19" Monitor or Greater
- 2.0 GHz Processor or Greater
- 100 MB of Unused Disk Space or Greater

- 100 MBPS Ethernet Card
- 32 MB Video RAM or Greater

Table 4-3 - Summary of GIS PC Specifications

Level	OS	RAM	Monitor	Processor	Disk Space	Video RAM
❶	XP Pro	1 GB	>17"	>1.2 GHz	>30 GB	>32 MB
	XP Pro	2 GB	>19"	>2.8 GHz	>80 GB	>64 MB
❷	XP	512 MB	>17"	>1.2 MHz	>100 MB	>16 MB
	XP	1 GB	>19"	>2.0 GHz	>100 MB	>32 MB

Legend
Minimum
Recommended

Notebook Computers

The recommended solution for field access to spatial data for the Fire, Police, Community Development and Public Works Departments is the use of notebook computers. Fire and Police already have or are acquiring the needed hardware for a mobile initiative. Notebook computers have much more memory capacity and processing speed than hand-held computers, and also have much larger screens.

Ruggedized notebook computers are recommended for field personnel for access to GIS data in the field. Mounts for notebook computers should be installed in any vehicle that will contain a notebook computer. Mounting computers in vehicles makes them much easier to access and reduces wear on the machine. The mount should not be permanent, however, as notebook computers will need to be taken out of the field periodically to update data. Ruggedized notebook computers are more expensive than regular notebook computers, but the cost of ruggedized notebook computers is offset by their longevity.

The following is the recommended configuration for notebook computers:

Notebook Computer – Approximate Cost = $3,500

- Ruggedized
- Weigh Less than 5 Pounds
- 1.6 GHz Processor or Greater
- 12 Inch or Greater Anti-glare Display
- CD-ROM Drive
- 1 GB RAM or Greater
- 80 GB Hard Drive Space or Greater
- 10/100 MBPS Ethernet Card and Wireless Network Adapter

Hand-held Computers

In the long term, it may prove beneficial to provide field staff with additional GIS capabilities via the use of hand-held computers. The hand-held computers should be able to support various relevant applications such as ESRI's ArcPad or applications developed with ArcGIS Server Advanced Mobile ADF tools. The following is the recommended configuration for hand-held computers:

Hand-Held Computers – Approximate cost = $500

- RAM: 128 MB
- Operating System:
- Pocket PC, Pocket PC 2002, and Pocket PC 2003 (also known as Windows Mobile 2003 for Pocket PC)
- CPU Chips for Windows Pocket PC
  - Hitachi SH3 and SH4
  - XScale
  - StrongARM
  - MIPS
  - X86
- GPS Support
  - National Maritime Electronics Association
  - Trimble
  - Delorme Earthmate
  - Rockwell

The aforementioned configuration for hand-held computers should be adequate in the short-term. However, hand-held computers are becoming increasingly faster and capable of supporting larger memory. All relevant departments should invest in new, faster hand-held computers as needs and demand dictate. A general recommendation is provided for the acquisition of hand-held computers by the Information Technology Division for use in the development and testing of applications and configurations that will be used by personnel that utilize GIS in hand-held computers.

Servers

The newest generation of server technology released from ESRI, called ArcGIS Server, represents a major shift in the way that GIS data can be distributed to the end users and what impact that delivery will have on the organization's infrastructure. ArcGIS Server replaces ArcIMS and integrates the previously separate product of ArcSDE into a centralized server application suite.

One of the most important considerations to make when migrating to ArcGIS Server is the choice of hardware that will be used to host ArcGIS Server and the DBMS that will serve as the repository for the geodatabase. Inadequate sizing of the servers implemented for these tasks, will cause performance issues that will degrade end user confidence in any applications consuming the GIS data that is being provided.

The City of West Sacramento, having had two maintained licenses of ArcIMS and two maintained licenses of ArcSDE at the release time of ArcGIS Server 9.2, should qualify for the free upgrade to ArcGIS Server Standard Enterprise. The free upgrade provided that one license ArcIMS and one license of ArcSDE would convert into two socket licenses of ArcGIS Server Standard Enterprise. By extension, since the City of West Sacramento had two licenses of both ArcIMS and ArcSDE, the city should qualify for four socket licenses of ArcGIS Server Standard Enterprise.

Whenever the city desires to upgrade to ArcGIS Server Advanced Enterprise, the city would need to pay the difference in socket price between ArcGIS Server Standard Enterprise and ArcGIS Server Advanced Enterprise for each ArcGIS Server license that the city has in use. The price difference between standard and Advanced is currently $10,000 per socket. So, the cost to upgrade from standard to enterprise would currently cost the city an additional $40,000 in licensing fees to ESRI.

There are many options in the way that ArcGIS Server can be deployed, and each option has its own merits and draw backs in complexity, performance, and cost. In the case of the City of West Sacramento, GTG recommends the two stage implementation outlined below.

Stage 1: 2 Servers

1) Utilize existing "GISSQL" server
- No ESRI software installed on this server.
- This server is dedicated to SQL Server.

2) Acquisition of Dual Processor Xeon 5160 Server
- All ArcGIS Server components installed on this server.
  - Web ADF
  - SOM
  - SOC
  - ArcSDE
- Two ArcGIS Server socket licenses used.

This scenario utilizes one of the existing City GIS servers. "GISSQL", the current SQL Server 2005/ArcSDE server, would function as the central GIS data repository. One new server would be procured to host all of the ArcGIS Server application server processes, including the Web ADF, SOM, SOC, and ArcSDE. This new server would utilize two socket licenses of ArcGIS Server. Since the existing server "GISSQL" will not have any ESRI software present, it will not impact the available socket count.

Table 4.4 illustrates a possible capacity planning scenario based on the hardware recommended in this stage. The server reaches 100% capacity with 114 concurrent users in two groups. The first group of users is comprised of 10 ArcGIS desktop users that are using Direct Connect to access vector and raster data directly from SDE and assuming that the average map request will transfer approximately 1 MB data from SQL Server. The second group is comprised of 104 users that are utilizing ArcGIS Server Map Services. These users can be end users that are using a web browser based application, custom desktop applications, or ArcGIS Desktop applications.

The following are definitions of terms found in the hardware specifications on the next pages:

SOC – Server Object Container - The SOC is the component of ArcGIS Server that handles the direct interaction with the GIS data.

SOM – Server Object Manager - This component manages requests from users by assigning the requests to an available SOC process or by spawning a new SOC process if needed.

Web ADF – Web Application Development Framework. This component provides the web services that are used to access ArcGIS Server functionality from web pages, custom application, and ArcGIS desktop products.

Cores – Cores refer to the number of embedded processors contained internally on a single CPU. Essentially, a dual core processor is a single processor that internally contains two prior generation processors working in tandem.

Socket – This is a term that is generally referring to a single physical processor regardless of the number of cores present within that processor. This is further complicated when considering the licensing for ArcGIS Server. ESRI allows for up to two cores per socket and if that limit on a single socket is exceeded, licensing costs increase beyond one socket. So, for example, a single quad core processor would actually count as two sockets for ESRI ArcGIS Server pricing.

Web Application Server – When ArcGIS Server is installed on multiple servers, this machine is used to host the Web ADF and SOM components of ArcGIS Server.

Container Machines – When ArcGIS Server is installed on multiple servers, this machine is dedicated entirely to the SOC component. When installed in a single server environment, this machine contains the Web ADF, SOM, and SOC components.

Database Server – This server is used to host SQL Server and the underlying databases of the SDE Geodatabases. Under our recommendation of using Direct Connect from all client applications and ArcGIS Server map services, there should be no ESRI software loaded on this server. If the ArcSDE component of ArcGIS Server is placed on this server to host traditional ArcSDE service connections from clients, all processors on this server will need to be licensed under ArcGIS Server socket licensing.

Stage 2: 3 Servers

1) Utilize existing "GISSQL" server
- No change from stage 1.

2) Utilize Dual Processor Xeon 5160 Server acquired in stage 1
- Remove Web ADF and SOM
- This server will be dedicated to the SOC processes.
- Still utilizing two ArcGIS Server socket licenses.

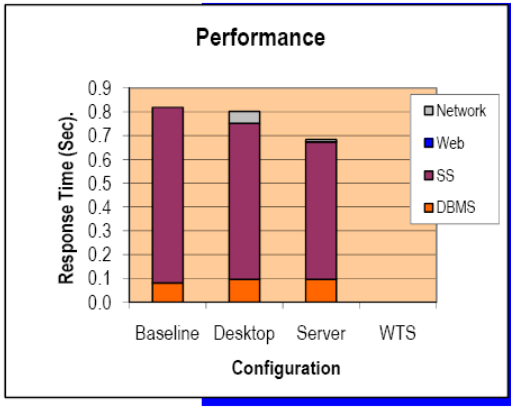
3) Acquisition of Single Processor Xeon 5160 Server
- Will host ArcGIS Server Web ADF and SOM processes.
- One ArcGIS Server socket license used.

This stage builds on the configuration established in stage 1 by adding one additional server to offload some of the processing loads from the single ArcGIS Server machine. By offloading the Web ADF and SOM processes, the new configuration is able to increase capacity from 114 concurrent users to 153 concurrent users under the same capacity planning scenario outlined earlier. Table 4.5 describes this scenario.

Requirements Analysis						
Types of Workflows		User Requirements				0.2
		Peak Workflow			Network	Actual
	Data Source	Users	DPM/Client	DPM	Mbps	Mbps
						100.000
P_ArcGIS AI Desktop	SDE Server/DBMS	10	10	100	8.333	6,000
2_ArcGIS Desktop WTS/Citrix	SDE Server/DBMS		10			
3_AGS9.2 Map Server	SDE DC/DBMS	104	4	416	6.933	24,960
4_IMS ArcMap Service	SDE DC/DBMS		6			
5_IMS Image Server	SDE DC/DBMS		6			
6_AGS9.1 Map Server	SDE DC/DBMS		6			
1_Batch Map Production Process	SDE DC/DBMS		143			
2_Batch Reconcile and Post Process	SDE DC/DBMS		11			
Total Workload		114		516	15.267	

Map Image
Map Image
1.000 MB
1.000 MB
0.100 MB
0.100 MB
0.100 MB
0.100 MB
0.100 MB
0.100 MB
0.100 MB

Web Application Server		Platform		/ Node	SRint2000	
		Intel Xeon 2 core (1 socket) 3000(4) MHz			60.0	
				2	30.0/Core	
		Service Times Seconds	Capacity Display/Min	Multiple Nodes	Platforms Capacity	Fix Nodes
Web Performance =	**0.67 sec**	**0.68 sec**	**Sockets = 2**			**Minimal**
Container Machines		**Platform**	**8 GB RAM**	**/ Node**	**SRint2000**	ADF+SOC
ADF+SOC	0.786	Intel Xeon 4 core (2 socket) 3000(4) MHz			120.0	SOC
Average User ..... 4 DPM		Cores = 4	Sockets = 2	1	30.0/Core	104
Total Required ..... 416 DPM		Service Times Seconds	Capacity Display/Min	Multiple Nodes	Platforms Capacity	Fix Nodes
CPU Utilization ..... 100% CPU						
Peak Users 104.0	104.0 / Node	0.577	416	1	416	1
			24,970 TPH		24,970 TPH	
Database Server		**Platform**	**8 GB RAM**	**/ Node**	**SRint2000**	
	0.082	Intel Xeon 2 core (2 socket) 3200 MHz			37.1	
Average User ..... 5 DPM		Cores = 2	Sockets = 2	1	18.6/Core	617
Total Required ..... 516 DPM		Service Times Seconds	Capacity Display/Min	Multiple Nodes	Platforms Capacity	Fix Nodes
CPU Utilization ..... 42% CPU						
Peak Users 272.6	272.6 / Node	0.097	1,234	1	1,234	1



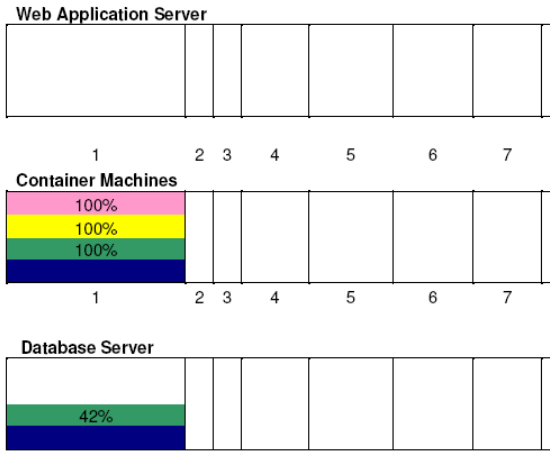
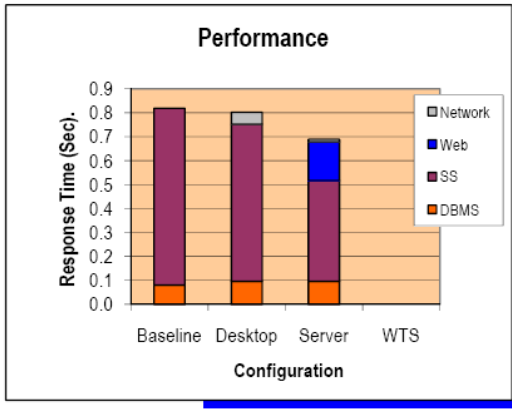


Table 4-4: GIS Server Configuration Step One – Utilize existing "GISSQL" Server + 1 New Server (Phase One Recommendation)

Requirements Analysis							
Types of Workflows		**User Requirements**				0.2	
		Peak Workflow			Network	Actual	
	Data Source	Users	DPM/Client	DPM	Mbps	Mbps	
						100.000	Map Image
P_ArcGIS AI Desktop	SDE Server/DBMS	10	10	100	8.333	6,000	1.000 MB
2_ArcGIS Desktop WTS/Citrix	SDE Server/DBMS		10				1.000 MB
3_AGS9.2 Map Server	SDE DC/DBMS	143	4	572	9.533	34,320	0.100 MB
4_IMS ArcMap Service	SDE DC/DBMS		6				0.100 MB
5_IMS Image Server	SDE DC/DBMS		6				0.100 MB
6_AGS9.1 Map Server	SDE DC/DBMS		6				0.100 MB
1_Batch Map Production Process	SDE DC/DBMS		143				0.100 MB
2_Batch Reconcile and Post Process	SDE DC/DBMS		11				0.100 MB
Total Workload		153		672	17.867		
Web Application Server		Platform	4 GB RAM	/ Node	SRint2000	44,478	
ADF	0.221	Intel Xeon 2 core (1 socket) 3000(4) MHz			60.0		
Average User ..... 4 DPM		Cores = 2	Sockets = 1	2	30.0/Core	371	
Total Required ..... 672 DPM		Service Times	Capacity	Multiple Platforms		Fix	
CPU Utilization ..... 91% CPU		Seconds	Display/Min	Nodes	Capacity	Nodes	
Peak Users 168.8		0.162	741	1	741		
Web Performance =	**0.68 sec**	**0.69 sec**	**Sockets = 3**			Minimal	
Container Machines		Platform	8 GB RAM	/ Node	SRint2000	ADF+SOC	
SOC	0.573	Intel Xeon 4 core (2 socket) 3000(4) MHz			120.0	SOC	
Average User ..... 4 DPM		Cores = 4	Sockets = 2	1	30.0/Core	143	
Total Required ..... 572 DPM		Service Times	Capacity	Multiple Platforms		Fix	
CPU Utilization ..... 100% CPU		Seconds	Display/Min	Nodes	Capacity	Nodes	
Peak Users 142.8	142.8 / Node	0.420	571	1	571	1	
			34,269 TPH		34,269 TPH		
Database Server		Platform	8 GB RAM	/ Node	SRint2000		
	0.082	Intel Xeon 2 core (2 socket) 3200 MHz			37.1		
Average User ..... 4 DPM		Cores = 2	Sockets = 2	1	18.6/Core	617	
Total Required ..... 672 DPM		Service Times	Capacity	Multiple Platforms		Fix	
CPU Utilization ..... 54% CPU		Seconds	Display/Min	Nodes	Capacity	Nodes	
Peak Users 280.9	280.9 / Node	0.097	1,234	1	1,234	1	



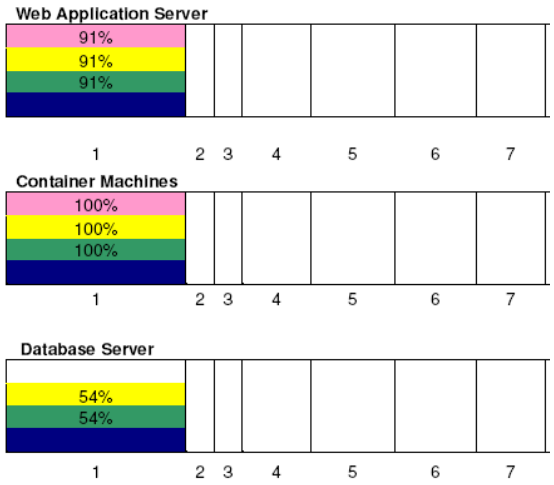


Table 4-5: GIS Server Configuration Step Two – Utilize existing "GISSQL" Server + 2 New Servers (Phase Two Recommendation)

Data Capture Devices

GPS Receivers

The City's Drafting Services Section utilizes a Leica GS50+ GPS receiver with Leica's GIS DataPro software. The potential utilization of GPS for data capture covers a wide range, from mapping grade GPS receivers, such as those used by the Drafting Services Section, to less accurate, lower-grade GPS receivers. It is recommended that one additional mapping-grade GPS receiver be procured as a shared resource for the GIS Specialist and departments that require field collection of high-accuracy data. In addition, it is recommended that a basic hand-held GPS received be procured for use by the GIS Specialist (and GIS Intern). The GIS Specialist will regulate the use of GPS resources and provide ad hoc assistance as needed by each department.

In addition, the City of West Sacramento will eventually need to acquire GPS receivers for use in vehicles and field equipment. The utilization of these units will vary according to department. It is recommended that departments utilize these GPS receivers to their full capability by implementing several tracking applications, such as Automatic Vehicle Location (AVL) tracking.

Field-mounted GPS receivers will need to be configured and linked, as needed, to City of West Sacramento computing resources, including computer systems (hand-held computers, notebook/tablet computers, workstations, and servers), networks, and enterprise-wide databases. The GPS receivers will be used to accurately identify the location of City facilities and infrastructure for data layer development and attribution.

It is recommended that the City acquire the Trimble GeoXH as its mapping grade GPS receiver. The Trimble is ideal for use by utility companies and local government organizations managing assets or mapping critical infrastructure that requires spatial accuracy and data capture. Some recommended key features of the Trimble GeoXH and accessories include:

Trimble GeoXH - *Approximate Cost = $4,295*

- H-Star technology (enables sub-foot accuracy)
- Microsoft Windows Mobile
- 512 MB memory with removable SD memory
- Bluetooth and wireless LAN connectivity
- TrimPix technology for wireless camera

Zepher Antenna- *Approximate Cost = $2,195*

- Dual frequency antenna for 8 inch accuracy with the GeoXH handheld or GPS Pathfinder ProXH receiver
- Advanced design with sophisticated multipath mitigation and low elevation tracking
- Integrated screw thread allows for easy mounting onto a range pole or backpack

Size:	6.35 in diameter x 2.3 in high (16.1 cm x 5.8 cm)
Weight:	1 lb (0.45 kg)
Operating temperature:	–40 ºF to +158 ºF (–40 ºC to +70 ºC)

Storage temperature:	–58 ºF to +176 ºF (–50 ºC to +80 ºC)
Humidity:	100% humidity proof, fully sealed
Power consumption:	0.6 Watts
Gain:	50 dBm
Noise:	1.5dB max
Frequency:	1575.42 ± 10 MHz
Connector:	TNC
Mounting:	5/8-11 Thread
Cable:	1.5 m TNC to SMB antenna cable

Rover extension Pole for Zepher Antenna- ***Approximate Cost = $250***

Mounting Bracket for GeoXH- ***Approximate Cost = $135***

ArcPad 7 – Approximate Cost as part of Package $95
Enables

- GPS data collection
- GIS data collection
- Integrate external hardware
- ArcPAD tools for ArcGIS desktop
- Symbology and Style Sheets
- Language Support
- Customization

GPS Analyst – Approximate Cost $1995

- View, edit, and analyze GPS data in ArcGIS
- Improve productivity by eliminating extra file conversions and processing outside the GIS
- Differentially correct for improved GPS position accuracy including Trimble H-Star processing for sub-foot accuracy
- Check data out to shapefiles for update in the field with ArcPad and the GPScorrect extension, then check new and updated features and GPS positions back into the geodatabase
- Import features and GPS positions from Trimble SSF files, including data collected with Trimble TerraSync software
- Validate GPS positions to ensure features meet your accuracy requirements
- Store detailed quality information for GPS data in the geodatabase
- Use ArcGIS in the field to collect features and GPS data directly to the geodatabase
- Use ESRI ArcObjects to customize workflows or data processing to suit your requirements
- License Manager allows easy management of multiple licenses, including the choice of single-use or floating licenses.

Output Devices

Printers

It is important that the City's GIS users have the means to print maps and documentation generated from these applications. Every GIS user should have access to a high-resolution color printer, to print 8"x11" or 8"x14" maps. In the short-term, each GIS user should have access to at least one networked color printer, even if it is not in their immediate work space. As output demand increases, additional color printers should be purchased for appropriate departments and users.

Plotters

It is important that Tier 1 users (ArcInfo, ArcEditor and ArcView) have access to wide-format plotters. Many maps must be output onto large sheets to be properly visualized. The following are recommend specifications for wide format plotters:

Plotters – Approximate Cost = $9,000

- 36" or Greater Paper Sheet Size
- 64 MB of Built-in RAM
- 7.5 GB Hard-drive
- 1200 dpi Addressable Resolution
- Adobe PostScript 3 Capability

The City currently maintains three plotters and one large format printer: three HP DesignJet 1055 CM plotters and one Xerox Phaser 790 color printer located in the Engineering Division. The Information Technology Division, Engineering Division, and Police Department each have one of the HP plotters. These three plotters are adequate to address most, if not all, of the City's wide-format GIS printing needs.

Networks

The City of West Sacramento must continue to maintain and manage optimal networking of computers. A major challenge for many enterprise-wide GIS efforts is inadequate network speed (capacity). GIS data are usually quite large compared to other software, and often such large data sets can slow a network considerably, thereby rendering GIS applications non-functional.

The City is connected to an SBC Central Office (CO) via multiple PRI T1 lines. Currently there are T1 connections between all City buildings, with the exception of the Police Department, which has a dedicated fiber connection. Existing 1 GBPS fiber connections between some buildings will prove beneficial to the implementation effort, and it is recommended that in the future all network connections between buildings be upgraded to this standard. The existing network infrastructure is adequate for current GIS needs, but more network bandwidth will be required as data access and distribution needs increase in the near future.

GIS Services

The City of West Sacramento may consider external support to enable the successful updated implementation of the City's GIS. Expert support will ensure that the City will realize the maximum return on investment during the implementation and deployment process. Additionally, expertise of external support will enable the gradual transfer of missing knowledge to City personnel. This will ensure that staff has the knowledge for continued utilization of the GIS as a critical decision support system.

The possible tasks and deliverables provided by third-party spatial service providers follow. Some of these tasks can be performed by the GIS Specialist depending on time constraints.

- Setup of Intranet and Internet ArcGIS Server Portals
- Optimal Setup of ArcGIS Server
- Data and Database Development (Creation of all required layers)
- All Departments Data Collection (Multiple scenarios outlined in chapter three)
- Setup of Extraction Routines and Clean Up of Existing IT Databases (Accela, FirePoint, VisionAir, Springbrook, etc.)
- Development of Specialized Economic Development Web Site
- Hyperlinked Scanned Images Integration
- Other Technical Support Issues

Training

Personnel at the City of West Sacramento will require training for the ArcGIS suite of products. This training will lay the foundation for knowledge transfer and understanding of the technical GIS platform that will be deployed at the City.

Introduction to ArcGIS Server (AGS)

Overview

ArcGIS Server provides a complete server-based GIS system that supports the use of centrally managed spatial data for mapping and analysis. This course introduces ArcGIS Server and teaches how to install, configure, and use the product as administrators and consumers of GIS services. Students learn how to publish maps, globes, and geoprocessing models that are optimized for performance. Students also create out-of-the-box Web applications using Manager and learn how to use GIS services in both Web applications and ArcGIS Explorer.

Audience

This course is designed for those new to ArcGIS Server who want to learn about its architecture, capabilities, and client applications.

Goals

Those completing this course will be able to:

- Understand the client and server components of the ArcGIS Server architecture.
- Configure the ArcGIS Server system.
- Administer the GIS server and GIS services.

- Optimize the performance of GIS services.
- Build Web applications that consume GIS services.
- Utilize ArcGIS Explorer to work with GIS services.

Topics covered

- ArcGIS Server overview: Basics of ArcGIS Server architecture; Authoring content for GIS services; Publishing GIS services; Administering ArcGIS Server using ArcCatalog and ArcGIS Server Manager.
- Map services: Map service capabilities; Optimizing map service performance; Building a map service cache; Creating a Web mapping application for consuming map services.
- Globe and 3D services: Authoring content for a globe service using ArcGlobe; Publishing a KML service; Building a globe service cache; Consuming globe services using ArcGIS Explorer.
- Geoprocessing services: Authoring content for a geoprocessing service using ModelBuilder; Considerations when authoring a model for a geoprocessing service; Ensuring data access for ArcGIS Server; Consuming a geoprocessing task using a Web mapping application, ArcGIS Explorer, and ArcMap.
- Editing in a Web mapping application: Authoring content for an editable map service; Publishing a map service for editing; Configuring the Editing task for a Web mapping application; Basics of using the Editing task.
- Customization overview: Making simple customizations to an existing Web mapping application; Customizing the help pages for a Web mapping application; Making your server an ArcGIS Explorer home server; Creating a custom skin for clients of your home server; Developer tools for creating custom ArcGIS Server Web and mobile applications.
- Administration and optimization: Installing ArcGIS Server; Securing access to the server; Considerations for data access; Options for scaling your ArcGIS Server system; Using log files to troubleshoot ArcGIS Server problems.

Prerequisites and Recommendations

Students should have completed Introduction to ArcGIS I or Learning ArcGIS Desktop *or have equivalent knowledge*.

ArcGIS Server Enterprise Configuration and Tuning for SQL Server

Overview

ArcGIS Server includes ArcSDE technology, a server-side software product that acts as the GIS gateway to spatial data stored in relational database management systems (RDBMS). It is an integrated part of ArcGIS and a core element of any enterprise GIS solution. This course prepares Microsoft® SQL Server® database administrators to implement an enterprise geodatabase by teaching how to set up an individual ArcSDE server. Students get familiar with the ArcSDE architecture and learn how to configure SQL Server to support ArcSDE, install and configure ArcSDE, and identify and troubleshoot connection types and issues. The course emphasizes the importance of managing storage settings for loading vector and raster data and teaches techniques for maintaining geodatabase performance in an editing environment. Additionally, the course explains how ArcSDE interacts with SQL Server databases and

presents solid strategies for maintaining and managing an enterprise geodatabase.

Audience
This course is designed for experienced SQL Server database administrators who need to understand how to install and configure an enterprise geodatabase. Students may choose to also enroll in Data Management in the Multiuser Geodatabase, which complements this course.

Goals
- Configure SQL Server to support ArcSDE.
- Install and configure ArcSDE.
- Customize storage for spatial data.
- Configure, create, and monitor connections.
- Implement data management strategies for vector and raster data.
- Optimize ArcSDE.
- Maintain performance of an enterprise geodatabase.

Topics covered
- ArcSDE installation: Evaluating the configuration of SQL Server; Preparing SQL Server to use ArcSDE technology; Installing ArcSDE; Starting and stopping the ArcSDE server; Exploring ArcSDE system tables.
- Data loading: Creating storage space; Creating users and assigning privileges; Creating vector feature classes; Creating raster datasets; Examining feature class components; Customizing storage with the DBTUNE table.
- Monitoring data access: Creating application server and direct connections; Monitoring connections with ArcSDE and SQL Server tools.
- Editing in a nonversioned environment and managing a multiversioned geodatabase: Registering feature classes as versioned; Compressing the geodatabase; Monitoring changes to the adds, deletes, and system tables.

Prerequisites and recommendations
Students should have experience with SQL Server database administration or application development. Although these courses are not required, students will benefit from completion of Introduction to ArcGIS I, Introduction to ArcGIS II, or Building Geodatabases.

Introduction to ArcGIS I

Overview
ArcGIS Desktop is ESRI's full-featured GIS software for visualizing, creating, managing, and analyzing geographic data. This course provides the foundation for becoming a successful ArcGIS Desktop user. Students learn fundamental GIS concepts and become familiar with the range of functionality available in the software. In course exercises, they work with ArcGIS Desktop and see how it provides a complete GIS software solution.

Audience
This course is designed for those who are new to ArcGIS and to GIS in general.

Goals

- Describe the structure of ArcGIS Desktop software.
- Display geographic data.
- Query a GIS database.
- Edit geographic data.
- Associate tables using joins and relates.
- Create maps, reports, and graphs.

Topics covered

- ArcGIS overview: Capabilities and applications; Interacting with the interface; Basic display.
- Spatial data concepts: Representing spatial data and descriptive information.
- ArcGIS data model: Geodatabases; Shapefiles; Coverages; Feature types; Attributes.
- GIS software: Components; Functions; Applications.
- Spatial coordinate systems and map projections: Georeferencing data; What map projections are; How ArcMap works with map projections.
- Querying data: Selecting and identifying features; Creating reports and graphs.
- Map displays: Creating; Symbolizing; Scaling; Adding map elements.

Prerequisites and recommendations

Students should know how to use Windows®-based software.

Building Geodatabases I

Overview

This course provides an overview of the structure and capabilities of the geodatabase. Students learn how to create a geodatabase, migrate existing GIS data to a geodatabase, and edit and maintain data stored in a geodatabase. The course covers some advanced geodatabase topics including how to build a geodatabase topology; maintain data integrity using subtypes, attribute domains, and relationship classes; and create a geodatabase schema. In course exercises, students work with the file geodatabase and learn how to migrate personal geodatabase data to a file geodatabase and create various geodatabase components. This course is taught using an ArcInfo license of ArcGIS since many of the advanced features of the geodatabase require an ArcEditor or ArcInfo license.

Audience

This course is designed for experienced ArcGIS users who want to store data in a geodatabase and take advantage of advanced geodatabase functionality. Data managers will find this course of particular benefit.

Goals

- Understand the geodatabase structure.
- Explain advantages of a file geodatabase.
- Understand advantages of geodatabase validation rules.
- Load vector and raster data into a geodatabase.
- Create and apply attribute domains, subtypes, and relationship classes.
- Edit data using attribute domains, subtypes, and relationship classes.

- Create and edit geodatabase annotation.
- Create geodatabase topology and apply topology rules.
- Edit topological data.
- Perform geometric network editing and tracing.

Topics covered

- Introduction to the geodatabase: Advantages of the geodatabase; Focusing on the file geodatabase; Overview of elements within the geodatabase; Geodatabase tables in a database management system (DBMS).
- Attribute validation rules: Subtypes and domains; Creating subtypes; Editing subtypes in ArcMap; Creating domains; Editing with domains in ArcMap; Coded value vs. range domains; Subtypes and relationship rules.
- Relationship classes: Creating relationship classes; Setting relationship class properties; Using relationships in ArcMap; Relationship rules; Validation; Simple vs. composite relationships.
- Annotation: Creating, editing, and managing annotation features in the geodatabase.
- Geodatabase topology: Topology management in the geodatabase; Building a topology; Setting the properties of a topology; Setting appropriate topological rules; Fixing topological errors; Editing topological data.Geometric networks: Creating and editing geometric networks; Performing analysis; Setting and using connectivity rules.
- Building geodatabase schema: Different ways to define geodatabase schema; Creating tables, feature classes, and feature datasets.
- XML data interchange: Understanding XML schemas of the geodatabase; Exporting the contents of a geodatabase to XML; Importing an XML file into a geodatabase to define its schema.
- Vector data in the geodatabase: Loading data from shapefiles, CAD files, coverages, and Excel spreadsheets; Using ArcGIS vector data loading tools.
- Raster data in the geodatabase: Storing raster datasets, raster catalogs, and raster attributes in the geodatabase.

Prerequisites and recommendations

Students should have completed Introduction to ArcGIS I or Learning ArcGIS Desktop and Introduction to ArcGIS II or have equivalent knowledge.

Data Management in the Multiuser Geodatabase

Overview

ArcSDE technology is an integrated part of ArcGIS Server and is used to access multiuser geographic databases stored in relational database management systems (RDBMS). This course prepares GIS and database administrators to implement an ArcSDE geodatabase by teaching how to load and manage ArcSDE data. The course presents concepts applicable to both workgroup and enterprise ArcSDE geodatabases but focuses primarily on the enterprise ArcSDE geodatabase. Students learn the basic architecture of a multiuser geodatabase and are introduced to ArcSDE connection types. The course focuses on loading and managing vector and raster data and emphasizes best practices for interacting with a multiuser geodatabase. Students explore multiuser

geodatabase design strategies and editing options for data stored in a multiuser geodatabase, including versioning.

Audience
This course is designed for GIS and database administrators who want to implement a workgroup or enterprise ArcSDE geodatabase.

Goals
- Describe the multiuser geodatabase architecture.
- Create connections to an enterprise ArcSDE geodatabase.
- Understand and manage user permissions.
- Design, load, and manage vector and raster data.
- Describe client optimization practices.
- Understand editing options in a multiuser geodatabase.
- Understand the basic architecture and workflow of multiuser editing.

Topics covered
- Defining geodatabase architecture: Multi-tier architecture; Geodatabase options; Elements of a workgroup and enterprise installation.
- Geodatabase administration: User roles and privileges; Management tools.
- Connecting to the geodatabase: Direct and application server connections; OLE DB connections.
- Data loading and management: Configuring dbtune parameters for spatial data storage; Tools for data creation; Vector storage; Raster storage and organization; Managing spatial and attribute indexes; Associating spatial and non spatial data; Geodatabase design considerations.
- Multiuser editing: Overview of available options; Versioning concepts including reconcile, post, and conflict detection.
- Maintaining performance: Compressing the geodatabase; Recommendations for maintaining performance; Tips and tricks for data managers.

Prerequisites and recommendations
Students should have completed Introduction to ArcGIS I or Learning ArcGIS 9 or have equivalent knowledge. Students should also be familiar with basic RDBMS concepts.

The following two tables identify the full training needs of the City:

Table 4-6 - GIS Training Matrix

Class	Site	Trainer	Days	Participants	Cost
Introduction to ArcGIS Server	Off	ESRI Authorized Trainer	2	GIS Specialist	$ 950
ArcGIS Server Enterprise Configuration and Tuning for SQL Server	Off	ESRI Authorized Trainer	2	GIS Specialist, Network Specialist, Tier one GIS Users	$ 950
Introduction to ArcGIS I	On	ESRI Authorized Trainer	2	Various Departmental Staff	$ 950

Class	Site	Trainer	Days	Participants	Cost
Building Geodatabases I	Off	ESRI Authorized Trainer	3	GIS Specialist, Network Specialist	$ 1,425
Data Management in the Multiuser Geodatabase	Off	ESRI Authorized Trainer	3	GIS Specialist, Network Specialist (if needed)	$ 1,425
Tier 3 Applications	On	Internal	1	Various	N/A

Table 4-7 - Recommended Number of Personnel (by Department) for Intro to ArcGIS Server, ArcGIS Server Configuration, and Tier 3 Applications Training

Department / Division	Intro to ArcGIS Server	ArcGIS Server Configuration	Tier 3 Applications
IT Department	2	2	10
Drafting Services Section	3	0	3
Engineering Division	2	0	20
Facilities Maintenance	1	0	8
Finance Department	0	0	3
Fire Department	1	0	15
Parks & Recreation	1	0	6
Planning Division	2	0	6
Police Department	1	0	15
Public Works	1	0	10
Redevelopment Agency	1	0	3
Total	**15**	**2**	**99+**

Implementation Plan Matrix Key

The matrices below provide a list and prioritization of the implementation items and tasks identified in this *Phased Strategic Plan Update*. The following is a key to the prioritization, item type, and item process. The item type is a categorization of the implementation item as it relates to the system infrastructure, architecture, and user training. The item process is a categorization of the implementation item as it relates to the phase of work of the implementation lifecycle. The priorities have been broken down as priority one, priority two, or priority three. Priority one items should be done as soon as possible and as funding is available. Priority two and three items, although important, are not as pressing as those identified as priority one. These are not set in stone and if an item becomes a higher priority it can be acted upon earlier.

Implementation Item Type:		Implementation Item Process:	
Application/Software		Design/Plan	
Network/Communications		Procurement/Provision	
Hardware/Equipment		Development/Test	
Database/Data		Integration	
Training/Information		Deployment/Rollout	

Priority One

These priority one items should be acted upon as soon as possible. The City should give consideration to utilizing a combination of internal resources and external resources to accomplish these tasks. The cost associated with each item assumes outsourcing in most cases. However, it is understood that some of the items will be done in-house. Additionally, maintenance costs are not listed but can be assumed to be around 21% for most products.

Priority one items are as follows:

Priority One			
COWSGIS Development Action	**Item Type**	**Item Process**	**Costs**
Software			
Implement ArcGIS Server	Software	Deployment	$5,000
Acquire GeoManager for Integrating Existing IT Investments (Accela, FirePoint, VisionAir)	Software	Provision	$6,000
Acquire or Create ArcServer Intranet Data Browser	Software	Provision	$20,000
Acquire or Create ArcServer Internet Data Browser	Software	Provision	$15,000
Address Management Application for Address Gatekeepers with Accela Integration	Software	Provision	$3,000
Implement Field Mapping for Police and Fire	Software	Provision	$0 if can access Intranet $20,000 otherwise
Hardware			
Acquire GIS Server for ArcServer	Hardware	Provision	$5,000
Acquire Trimble GPS Unit	Hardware	Provision	$7,000

Data Development			
Address Point Verification and Completion	 Database	 Development	$30,000
Rectify Accela and Address Points	 Database	 Development	$15,000
Meter Database Creation - Finance	 Database	 Development	$10,000
Crime Layer Nightly Download and Creation	 Database	 Development	$3,000
Fire Layer Nightly Download and Creation	 Database	 Development	$3,000
Accela Layers Nightly Download and Creation (Permits, Certificates of Occupancy, etc.)	 Database	 Development	$5,000
Infrastructure – Public Works High Priority Items (Water, Sewer, Storm Water)	 Database	 Development	$500,000
Subdivisions	 Database	 Development	$5,000
Other Selected Layers Listed in Chapter 2	 Database	 Development	$100,000
CIP Layer – Public Works	 Database	 Development	$5,000
Special Projects Layer - Public Works	 Database	 Development	$5,000
Current Projects Layer – Public Works	 Database	 Development	$5,000
Services			
Setup of ArcServer Intranet Portals for Fire, Police, Community Development, Public Works, and Redevelopment	 Software	 Deployment	$7,500

Setup of ArcServer Internet Portal - Generic	 Software	 Deployment	$2,000
Setup Community Development Reporting on Intranet Application	 Software	 Development	$5,000
Setup Database Integration with Accela, FirePoint, Springbrook, and VisionAir	 Database	Integration	$5,000
Develop a Bi-Directional Interface to Accela That Integrates Addresses	 Database	Integration	$15,000
Education and Training			
Introduction to ArcGIS Server – Cost does not include travel and per diem	 Training	Provision	$1,000
Building Geodatabases I – Cost does not include travel and per diem	 Training	Provision	$3,000
Data Management in the Multiuser Geodatabase	 Training	Provision	$3,000
Introduction to ArcGIS I – on-site – should be provided annually	 Training	Provision	$7,500
ArcGIS Server Enterprise Configuration and Tuning for SQL Server	 Training	Provision	$2,000
Address Manager Training – On-site	 Training	Provision	$1,000
Geo-Manager Application Training – On-site	 Training	Provision	$1,000
Intranet and Internet Data Browser – On-site	 Training	Provision	$2,000
Organizational Direction			
Reinstitute GIS User Group Meetings	 Information	Plan	$0

Create a 1/4ly Newsletter	Information	Plan	$0
Identify Address Gate Keepers	Information	Plan	$0
Hire Technician Staff in Information Technology and Community Development			Costs Deter-mined by HR

Priority Two

These priority two items should be acted upon after priority one issues have been accomplished. The City should give consideration to utilizing a combination of internal resources and external resources to accomplish these tasks. The cost associated with each item assumes outsourcing in most cases. However, it is understood that some of the items will be done in-house. Additionally, maintenance costs are not listed but can be assumed to be around 21% for most products.

Priority two items are as follows:

Priority Two			
COWSGIS Development Action	**Item Type**	**Item Process**	**Costs**
Software			
Acquire a GIS Enabled Parks and Recreation Management Package	Software	Provision	$15,000 - $50,000 depeding on modules
Acquire a GIS Based Work Order Management System	Software	Provision	$150,000
Acquire a GIS Based Pavement Management System	Software	Provision	$25,000
Implement Field Mapping for Public Works and Community Development	Software	Provision	$0 if can access Intranet $20,000 otherwise
Hardware			
Replace Kiosk as Needed	Hardware	Provision	$10,000

Acquire Second Server for ArcServer Expansion for Additional Users	 Hardware	Provision	$5,000
Data Development			
Lien Layer – Finance Data Extraction and Setup	 Database	 Development	$1,000
GIS Enable Fire Preplans	 Database	 Development	$10,000
Hazardous Materials Layer	 Database	 Development	$15,000
Tree Layer Integration and Completion	 Database	 Development	$7,500
Tree Permits Scanned and Linked	 Database	 Development	$5,000
GIS Enable Complaints Database from Permits Plus	 Database	 Development	$1,000
Vacant Property Layer – Redevelopment	 Database	 Development	$5,000
Other Selected Layers Listed in Chapter 2	 Database	 Development	$50,000
Services and Projects			
Setup of ArcServer Intranet Portal for Finance	 Software	 Deployment	$1,500
Setup and Customization of ArcServer Internet Portals – Crime, CD, Economic Development	 Software	 Deployment	$20,000
Utilize GIS for ISO Rating – Fire Department – in house as needed	 Database	 Development	$0
Flooding Project – in-house or outsourced	 Database	 Development	$10,000

Setup Parcel Genealogy	Database	Development	$3,000
Organizational Direction			
Migrate Redevelopment Data to Central Data Storehouse – in-house	Database	Development	$0

Priority Three

These priority three items should be acted upon after priority one and two issues have been accomplished. The City should give consideration to utilizing a combination of internal resources and external resources to accomplish these tasks. The cost associated with each item assumes outsourcing in most cases. However, it is understood that some of the items will be done in-house. Additionally, maintenance costs are not listed but can be assumed to be around 21% for most products.

Priority three items are as follows:

Priority Three			
COWSGIS Development Action	**Item Type**	**Item Process**	**Costs**
Software			
Move to ArcServer Advanced Enterprise	Software	Provision	$40,000
Implemented an ArcServer Distributed Editing Application	Software	Provision	$5,000
Implement Mobile ADF Solutions	Software	Provision	$50,000
Routing and Scheduling Module for Intranet Application – Code Enforcement	Software	Provision	$8,000
Business Analyst for Redevelopment with State Level Data	Software	Provision	$8,500
Data Development			
Vested Financial Boundary Layer	Database	Development	$2,000

Underground Storage, Brownfields, Underutilized Buildings, and Phone Data Layer Acquisition for Redevelopment	 Database	 Development	$25,000
Other Selected Layers Listed in Chapter 2	 Database	 Development	$50,000
Services and Projects			
Flood Zone Review Submit to FEMA	 Software	 Deployment	$15,000
Optimal Park Site Analysis – Parks and Recreation – in house as needed	 Database	 Development	$0
Optimal Police Beat Creation – Police – in house as needed	 Database	 Development	$0
Code Enforcement District Balancing – in house	 Database	 Development	$0

GIS STRATEGIC PLAN

CITY OF WEST SACRAMENTO

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