# Washoe County, Nevada
# Washoe County Map Warehouse
# (2004—Single Process)

## System Summary

Quite often a catastrophic event is the forerunner in the development of more accurate and detailed spatial data sets. This was the case in Washoe County when a 1997 flood inundated the cities of Reno and Sparks along the Truckee River. The flood of 1997 highlighted the deficiencies and shortcoming of current spatial data sets and the lack of current aerial photography. Obtaining a highly accurate parcel database was the main impetus behind the creation of a regional base map committee in 1998. Coincidentally, the development of other spatial data sets occurred at the same time, e.g., land use, elevation data, city and county boundaries. Creating all those new data sets was costly: Over the next five years, approximately $1.5 million was spent developing the capabilities of the county's geographic information system (GIS).

The cost of developing and maintaining a robust GIS database makes the task of delivering and presenting that data even more important. In reality, the value of data, GIS or other, can really be measured only in terms of data efficiency or how the data is used and delivered to solve everyday questions and problems. Certainly, we cannot justify that the data be used only in times of disaster or catastrophes or only by those proficient in complicated GIS software. Instead, methods and means must be made available to ensure that even the most inexperienced user can consume GIS data.

A plethora of Internet mapping sites exist today. Most are highly focused towards a particular user, e.g., assessor departments publishing parcel data and community development departments providing land-use data. In addition, most are map-driven, i.e., they require users to turn layers on and off and to use an identify tool to answer questions about a particular feature. Washoe County's Internet Map Warehouse is an exemplary system because it provides an alternative to the map-driven Internet sites. With the Map Warehouse, spatial data is broken down by areas of interest, e.g., administrative, land use, census, etc. Furthermore, within an area of interest, users are able to step through a series of questions that will produce a map with data of precisely what they are interested in, such as: What schools are zoned for my neighborhood? or Who is my county commissioner? or What is the land-use designation for a parcel? Additionally, users are still able to interact with the map interface using the conventional suite of map tools and buttons.

By utilizing the Map Warehouse gateway, even the most inexperienced user can consume Washoe County's GIS data. The Map Warehouse provides a single source where county employees, private businesses, and the public can query and interact with more than 60 spatial data sets with one easy-to-use interface. Additionally, users can print letter or tabloid-size maps, download premade PDF or TIFF maps such as road atlases, parcel maps, and Census 2000 maps, or visit links to other data sources. The Map Warehouse complements the county's GIS division by providing easy access to expensive GIS data in a simple-to-use Internet browser and by providing answers to what are often very simple questions.

## Motivation for System Development

The Washoe County GIS division supports effective decision making in Washoe County government by providing high-quality, current, relevant, and well-documented geographic information in digital and hard-copy formats. The division's primary activity is the development of an enterprise spatial database that is accurate and current.

In 2001, the Washoe County GIS division launched an interactive mapping Web site for the county assessor using ESRI's ArcIMS technology. The primary function of this Web site is the dissemination of parcel and associated ownership data to internal and public users. The data that was published was compiled and released twice a year at the close of each tax role. The site is extremely popular; it receives several thousand hits a week. In 2002, the site was aesthetically remodeled. Following the release

of the assessor's ArcIMS Internet site, the public works department and the sheriff's department approached the GIS division concerning developing interactive mapping Web sites for their departments. The public works GPS control point ArcIMS site came online in 2001, followed by the sheriff's ArcIMS tier 3 sex-offender site in 2002.

In 2003, the GIS division was approached once again and asked to develop an ArcIMS site for the community development department. However, several factors motivate the development of a different system. First, the overhead in man-hours to maintain not only the different data sources but also the Web interfaces for many departments was becoming unmanageable. Second, in 2002, the county's enterprise GIS database, developed with ESRI's spatial database engine (SDE) technology and MS SQL Server, came online to serve both vector and raster data to ArcView, MapObjects, and ArcIMS clients. The deployment of an enterprise spatial database allowed for the consolidation of data found throughout the different departments, as well as a generalization of different data formats. Third, the number of SDE licenses that individual ArcIMS services were consuming was unacceptable. Finally, but most important, county staff and the public had to visit multiple Internet sites to answer their questions. This inconvenience was confusing, time-consuming, and costly.

## Systems Benefits Achieved

The Map Warehouse improved the process of delivering parcel and GPS data to staff and to the public, and was also the first Washoe County system with the ability to deliver larger and more defined spatial data sets, which until now were too large and complex for anyone to easily use except for experienced GIS users running high-end personal computers. For example, more than 300 gigabytes of 6-inch rectified color aerial photography and 700 megabytes of 2-foot elevation contours were loaded into the enterprise GIS database running ESRI's SDE. The new technology found in SDE permitted this highly detailed data to be delivered to anyone's desktop via the Map Warehouse.

With the improved performance of an SDE-enabled enterprise GIS database back end, the Map Warehouse front end efficiently delivers more than 60 different spatial data sets for the staff and the public to query. Now with three clicks of a mouse and an Internet browser, building and safety-plan examiners can easily view elevation data when analyzing roof snow loads; community-development planners can examine land use for any parcel in the county; the Registrar of Voters office staff can perform spatial queries to locate voter precincts; and real estate offices can find school zones for individual properties. The list goes on and on and is only limited by the users' imagination. The Map Warehouse has helped improve effective decision making in Washoe County government and improved some of the ways in which the public interacts with county departments via the Internet.

Unexpected benefits

Some of the unexpected benefits achieved with the Map Warehouse include:

- The popularity of the system within other businesses, e.g., real estate, utility, surveying, and engineering companies.
- Use by staff GIS professionals for the simple questions, as an alternative to the more complex slower GIS software.
- The ability to edit data while the system is in use, with the resulting edits automatically displayed in the system. No copying data outside of firewalls; no starting and stopping services for changes to be reflected.
- The performance and clarity of the six-inch resolution aerial photography and other complex data sets when viewed through the Map Warehouse.

## System Design Issues Encountered and Overcome

Designing the system was very challenging and several problems had to be overcome. The enterprise GIS database had to be standardized, analyzed, and tuned. Moving ArcIMS and Internet services to a Linux 9.0 platform while maintaining the SQL enterprise GIS database on a Windows platform was untested and unsupported by the county's GIS software vendor. However, most of the design problems occurred while developing the Map Warehouse interface. Differences in Web browsers, computer monitor sizes, and resolutions created many interface design problems that were overcome by using MS Internet Explorer with 96 dpi font size as the standard.

## What Differentiates This System from Other Similar Systems

A survey of the Internet will show that a multitude of Internet mapping sites exist today. The Map Warehouse distinguishes itself from these other sites by combining a wide array of data sources into one location. No longer will users have to visit the Assessor's Office Web site for parcel information; the community-development department's Web site for land-use information; or the public-works department's Web site for GPS control-point information. Now users can visit one location and completely access all the published GIS data sets of Washoe County. From an interface approach, the Map Warehouse differs because it works in coordination with a variety of data sources via a question or query-related approach over the usual point-and-click on a map approach.

At the same time the Map Warehouse maximizes the map interface portion for those more graphically enthused users.

The Map Warehouse hardware platform and the supporting enterprise GIS database also differentiate from most other similar systems. A Linux 9.0 operating system running Apache Web server linked to the enterprise GIS database running SDE deliver a secure, reliable, scalable, and efficient system.

## System Hardware, Software, and Data

**Hardware:**

Database server

- Dell PowerEdge 6400/700
- MS Windows 2000 Advanced Server
- 700 MHz Processors
- 2 GB memory
- 750 GB storage (RAID 5)
- 1 GB network adapter

Web server

- Dell PowerEdge 1750 server
- Linux Red Hat 9.0
- 2-2.8 GHz Xeon processors
- 1 GB memory
- 70 GB disk space (RAID 5)
- 1 GB network adapter

**Software:**

- MS SQL Server 2000
- Apache 2.48 Web server
- Apache Tomcat 4.1.29 servlet
- ESRI ArcIMS 4.0.1
- ESRI SDE 8.3

The Map Warehouse Internet browser interface is a customized, lightweight HTML viewer. The Internet interface was customized using a combination of dynamic HTML and JavaScript. To minimize client difficulties with downloading and installation problems, the lightweight HTML viewer interface was chosen over other Java applications and plug-in orientated viewers. ESRI's spatial database engine (SDE) service running on MS SQL server 2000 provides the data source for the Map Warehouse.

**Data**

At the heart of the Map Warehouse is MS SQL Server 2000 and ESRI's SDE 8.3 software serving two databases that include more than 60 spatial layers. The image database contains more than 300 gigabytes of 6-inch resolution color aerial photography, 15-meter Landsat satellite imagery, and a variety of other raster data layers. The SDE database provides access to a wide assortment of vector data layers: Most important is Washoe County's parcel data, which consists of more than 140,000 parcels. The parcel feature data set is joined with the assessor's attribute data, and both are updated on a nightly basis. The Map Warehouse interface groups all the data sets into coherent groups that consists of:

- Administrative boundaries
- Census block and tract boundaries
- Facility locations
- Imagery, aerial photography, and satellite
- Land use\zoning for unincorporated Washoe County
- Assessors property data
- Survey control points
- Transportation

## Where Are We Now?/Future Directions

The overall design of the system has changed very little since its inception with the exception of colors and inclusion into the Washoe County Internet scheme. What has changed is the amount of data being made available. FEMA Flood Insurance Rate Maps (FIRM) images and Letters of Map Revision (LOMR) documents were rectified and added as data layers to the Map Warehouse. Now anyone, such as an engineer in the public-works department or a title loan officer, can query and view flood data for a parcel or geographic area.

A new map tool has been added to the Map Warehouse. This tool allows a user to draw an area (polygon) on the map; the area will be labeled on the map with dimension and area calculations. This tool allows for quick area estimations on house size or lot size, or even for estimation of paving materials need for a given street.

Plans for future modifications to the Map Warehouse include:

1. Methods to bookmark a map or save a map for later retrieval. This would save time and prove very convenient for users who often return to a specific area. Or for those who build more sophisticated maps. Bookmarking would include the ability to e-mail a bookmark that would take you directly to a preconceived map.
2. The ability to change symbolization and the drawing order of layers in the Map Warehouse would also be advantageous in producing added varieties and personalization of individual maps, as will the ability to label layers with the fields selected by the user.
3. Because Washoe County is viewed as a recreational destination, new recreational data layers such as bike paths, hiking trails, kayaking courses, and scenic overlooks will be added in the near future. This information will help local and out-of-state outdoors enthusiasts map out their recreational activities in advance.
4. Attaching permit information to the parcel data is another immediate goal that would greatly benefit the departments that use permit information in their work flow. Additionally, utility data layers, such as water and sewer lines, fire hydrants, wells and septic tanks, and other data sets when once completed, will offer added benefits for the users of the Map Warehouse.
5. Washoe County's GIS division is working toward expanding the Map Warehouse information beyond the county boundaries. To foster regional cooperation in economic development and coordinated disaster response, it plans to include orthophotography, street and facility layers such as hospitals, police, and fire stations of areas surrounding Washoe County. To further homeland security and disaster

response, Washoe County is also examining the possibility of including facility information such as floor plans and building blueprints of public and critical facilities. This confidential information would only be accessible to authorized personnel.

**Figure 1.** Parcel Building-Permit Review with Associated Two-Foot Contour Data.


**Figure 2.** Querying Polling-Place Locations.

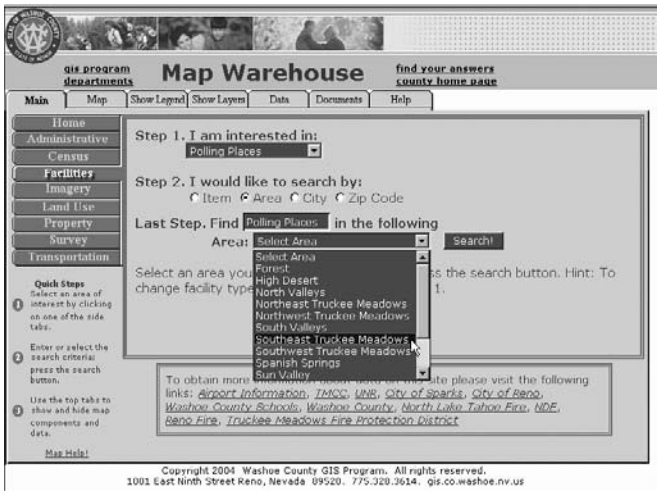


**Figure 3.** Map Warehouse Map Setup and Layout Screen.

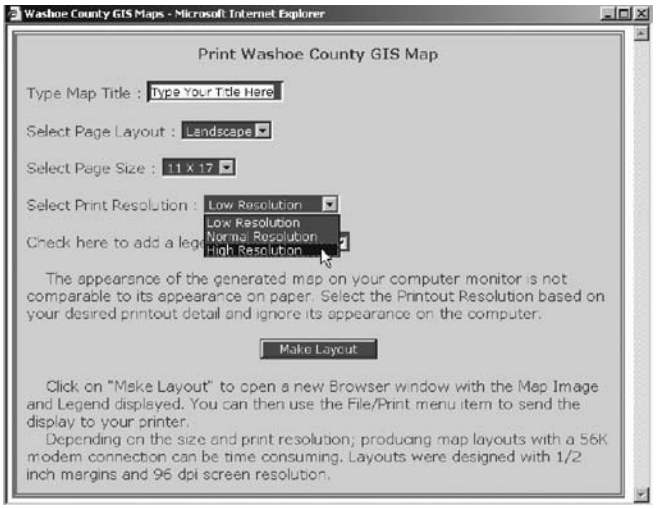


**Figure 4.** Printable Map Warehouse Layout.


## About the Author

Contact person for the system:
Thomas Lo, Ph.D.
GIS Manager, Washoe County
1001 East Ninth Street
Reno, Nevada 89520
(775) 328-3614
Fax: (775) 328-3648
E-mail: tlo@mail.co.washoe.nv.us