

THE NEW MEXICO RESOURCE GEOGRAPHIC INFORMATION SYSTEM: A WEB APPLICATION FOR DISCOVERING, VISUALIZING, AND ACQUIRING GEOSPATIAL DATA IN SUPPORT OF WATER STEWARDSHIP DECISION MAKING

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The Resource Geographic Information System (RGIS, <http://rgis.unm.edu>) Program mission is to develop and expand geographic information and use of GIS technology, creating a comprehensive GIS resource for state and local governments, educational institutions, nonprofit organizations, and private businesses; to promote geospatial information and GIS technology as primary analytical tools for decision makers and researchers; and to provide a central clearinghouse to avoid duplication and improve information transfer efficiency. GIS technologies and data provide critical assistance to water stewardship decision makers through the availability of timely data, implementation of analytic tools, and visualization of data and analysis results. The current version of RGIS meets some of these goals and the series of RGIS upgrades planned throughout 2004 will implement a framework supporting the implementation of these capabilities within a user-friendly, web-based data discovery/visualization/acquisition environment.

Water stewardship decision-making requires a wide variety of well-documented, up-to-date geospatial data. The clearinghouse of NM geospatial data hosted through the RGIS program provides easy access to applicable data. Available data include: local-, regional-, and state-level boundary coverage, 1m resolution digital orthophotos, land-use/land-cover, climate, elevation, geology, hydrology, and historic Rio Grande channel and acequia datasets. All of these data are available for download via a web interface, in some cases, in a variety of formats. Federal Geographic Data Committee (FGDC) metadata are available for some of the data and preview images are also available for some datasets.

Planned upgrades to the RGIS application include the addition of satellite imagery, near-real-time precipitation data, interface enhancements, data documentation improvements, greater flexibility for downloads, and online tools for previewing data and generating printable maps. Prototypes of some of these functions are under development; the entire upgrade process is planned for completion by the end of 2004 or early 2005.

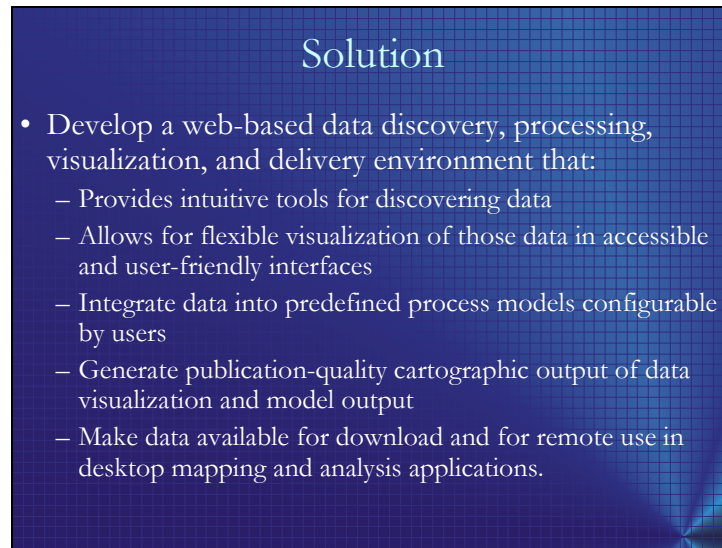
The individual elements of the RGIS upgrade contribute the evolution of RGIS into an application framework capable of supporting a wide array of water stewardship decision-support requirements including: data delivery and visualization, custom interfaces to hydrologic models, registration of geospatial data and data services provided by other NM data providers, integration of those services into decision-support tools.

The purpose of this presentation is to provide an introduction RGIS, both in its current version, and with the upgrades planned for completion by early in 2005. These materials were developed and presented by Karl Benedict, Research Scientist and IT Manager EDAC. Development and hosting of RGIS is one of many applications that EDAC continues to work on as a center for the development of geospatial applications including desktop GIS, internet mapping, image processing, and data clearinghouse services.

Technical Problem

- Water allocation decision-making requires current geospatial data
- GIS and hydrologic modeling tools are complex computer applications requiring extensive training and experience to develop
- Decision-makers are not, and should not need to be experts in Geographic Information Systems (GIS)
- The wide availability of validated analysis services in addition to data would enhance decision-making

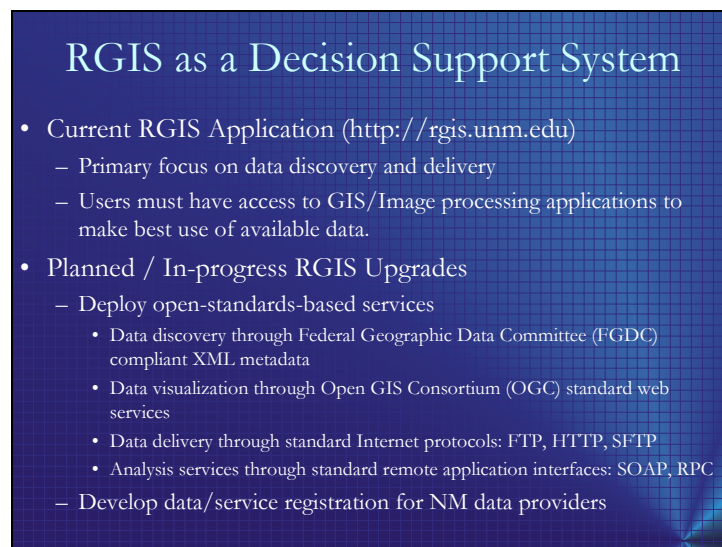
The technical problem that this presentation addresses consists of several components. Water allocation decision-making requires geospatial data that are both current and accurate. Some geospatial data products are frequently updated based upon newly acquired data (e.g., from satellite imagery, newly surveyed transportation networks, etc.) and the ease with which those data are made available has a direct impact upon their utility in decision-making. When attempting to make effective decisions, decision-makers need the best available data presented in an understandable manner. This presentation often requires GIS and hydrologic modeling skills that are not, and need not be, part of the skill set of decision-makers. The development of user-friendly, validated model execution environments that are based upon the best available data and algorithms would greatly enhance decision-making.



Solution

- Develop a web-based data discovery, processing, visualization, and delivery environment that:
 - Provides intuitive tools for discovering data
 - Allows for flexible visualization of those data in accessible and user-friendly interfaces
 - Integrate data into predefined process models configurable by users
 - Generate publication-quality cartographic output of data visualization and model output
 - Make data available for download and for remote use in desktop mapping and analysis applications.

One potential solution to the technical problem previously outlined is to develop a web-based interface to hydrologic data and models that facilitates the execution of models and the presentation of model results in a clear and dynamic environment. The planned upgrades the RGIS have the capability to provide such an interface.

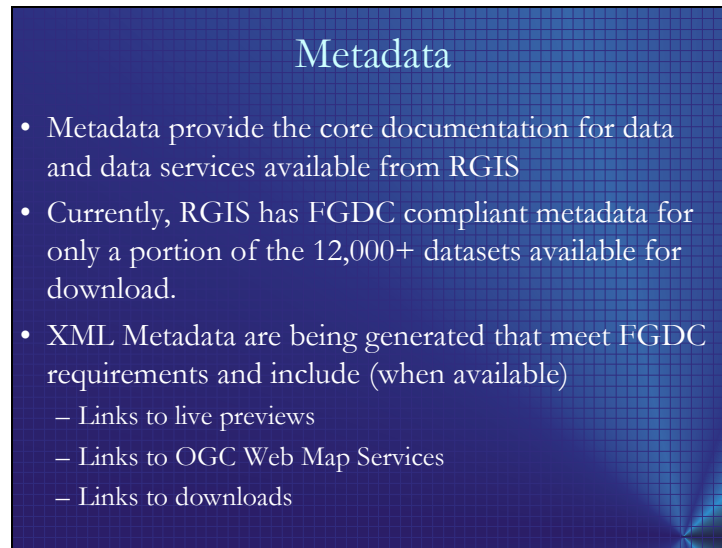


RGIS as a Decision Support System

- Current RGIS Application (<http://rgis.unm.edu>)
 - Primary focus on data discovery and delivery
 - Users must have access to GIS/Image processing applications to make best use of available data.
- Planned / In-progress RGIS Upgrades
 - Deploy open-standards-based services
 - Data discovery through Federal Geographic Data Committee (FGDC) compliant XML metadata
 - Data visualization through Open GIS Consortium (OGC) standard web services
 - Data delivery through standard Internet protocols: FTP, HTTP, SFTP
 - Analysis services through standard remote application interfaces: SOAP, RPC
 - Develop data/service registration for NM data providers

The current version of RGIS is focused on the discovery and delivery, via download, of data to geospatial data users for use within their own applications (e.g., desktop GIS, image processing, modeling tools). The next version of RGIS is currently under development (as resources permit) and is planned to provide a combination of data visualization and delivery services in addition to streaming data services that provide direct client application support through the use of open-standards-based internet technologies. The standards being employed in the next version of RGIS include those developed by the Federal Geographic Data

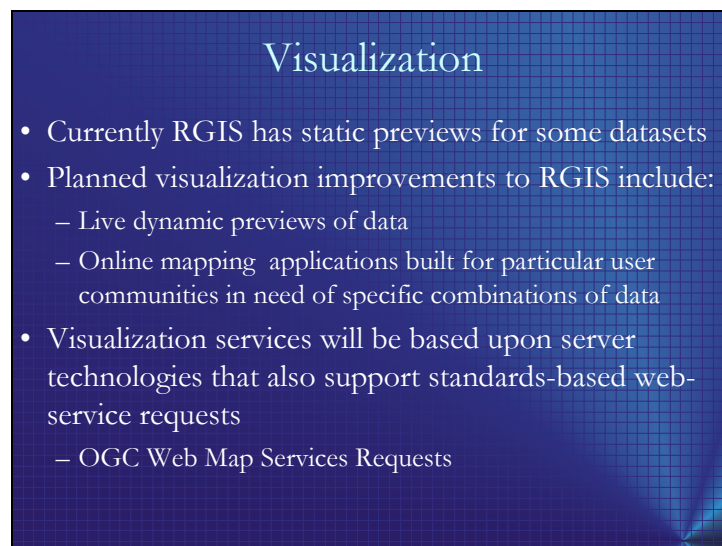
Committee (FGDC), the Open GIS Consortium (OGC), and the World Wide Web Consortium (W3C). The resulting services will also include a data and service registration application for New Mexico geospatial data providers.



Metadata

- Metadata provide the core documentation for data and data services available from RGIS
- Currently, RGIS has FGDC compliant metadata for only a portion of the 12,000+ datasets available for download.
- XML Metadata are being generated that meet FGDC requirements and include (when available)
 - Links to live previews
 - Links to OGC Web Map Services
 - Links to downloads

A key standard being implemented within the next version is the FGDC XML metadata standard. The creation of FGDC compliant metadata for all data in RGIS will provide systematic access to a variety of services based upon data within the RGIS repository. These services include live (interactive) previews of the data, links to OGC compliant web services (WMS, WFS, WCS), and links to downloadable data files and/or services that will generate downloadable files. This upgrade represents a substantial improvement over the currently available metadata for some data in RGIS.



Visualization

- Currently RGIS has static previews for some datasets
- Planned visualization improvements to RGIS include:
 - Live dynamic previews of data
 - Online mapping applications built for particular user communities in need of specific combinations of data
- Visualization services will be based upon server technologies that also support standards-based web-service requests
 - OGC Web Map Services Requests

The current upgrade program for the RGIS includes the development of both standards-based (WMS, WFS) visualization services and custom mapping clients that provide both interactive previews of available data and domain specific custom mapping and analysis applications. The domain specific mapping and analysis applications will be developed in consultation with specific user communities (e.g., water policy decision-makers) as resources and demands become available.

Data Delivery

- Data delivery remains a key capability of the RGIS system as it evolves further capabilities
- RGIS currently provides data via the HTTP protocol
- Planned RGIS improvements will continue to support the HTTP protocol while providing enhanced services including:
 - Subsetting and compression (Clip & Zip)
 - Format Selection

The current version of RGIS provides discovery and delivery of raster and vector datasets in a variety of predefined formats, projections, and spatial domains. Planned enhancements to the RGIS data delivery include the development of services that allow for subsetting of both raster and vector datasets and the use of lossless compression algorithms for the delivery of requested data. Additional services include the selection of format and projection parameters for the reprocessing of data prior to delivery to facilitate the delivery of products that better meet user needs.

Analysis

- In support of project-specific analytic requirements, RGIS (and services based upon the RGIS data repository) may create specific analysis services.
- These may include:
 - Domain specific decision support systems
 - Research data sharing, integration, and visualization systems
- Previously developed applications include:
 - Basic road hazard mapping system for McKinley County based upon NEXRAD precipitation data
 - Water allocation decision-making feedback application for UNM Economics Department
 - Data-sharing application for Sandia National Laboratory's ongoing US-Mexico water modeling projects

Over the past 18 months, EDAC has developed several domain-specific data registration/delivery, visualization, and analysis applications that exemplify the types of data and analysis services that may be built upon RGIS in support of water management decision-making. These include an application that downloads daily NEXRAD precipitation data and combines those data with a basic hydrologic flow-accumulation model to aid in the identification of road segments that may have been impacted by high-water-flow events. Another application consists of the development of a web interface to a PowerSim hydrologic model for use in a water allocation experiment for the UNM Economics Department. A third application is a basic data upload and sharing application in support of an ongoing US-Mexico water modeling project including participants from Sandia National Laboratories, Instituto Mexicano de Tecnologia Del Agua, and the University of Arizona.

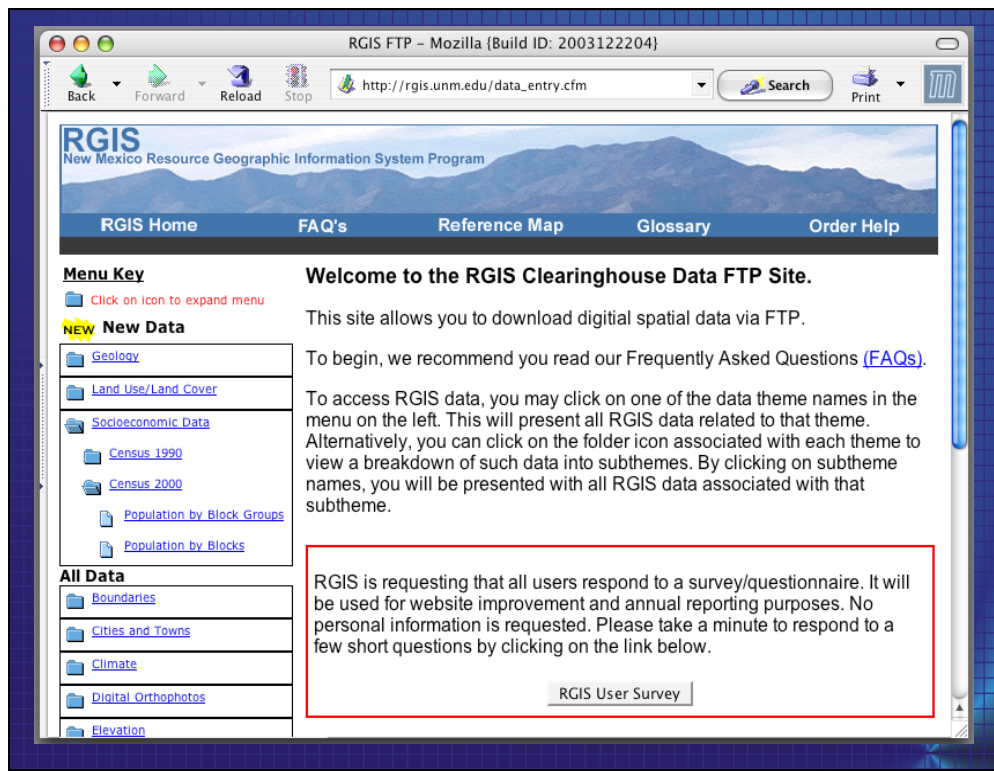
Registration

- RGIS participates in cross-organizational data registration services hosted by:
 - Federal Geographic Data Committee
 - National Biological Information Infrastructure
 - Earth Science Information Partnership Federation
- With support from the FGDC, EDAC is developing a data registration service for partner organizations.
 - Data and services hosted by partners may be added to RGIS by submitting an FGDC compliant metadata record
 - These records will also be available through registration services that support direct access to FGDC metadata

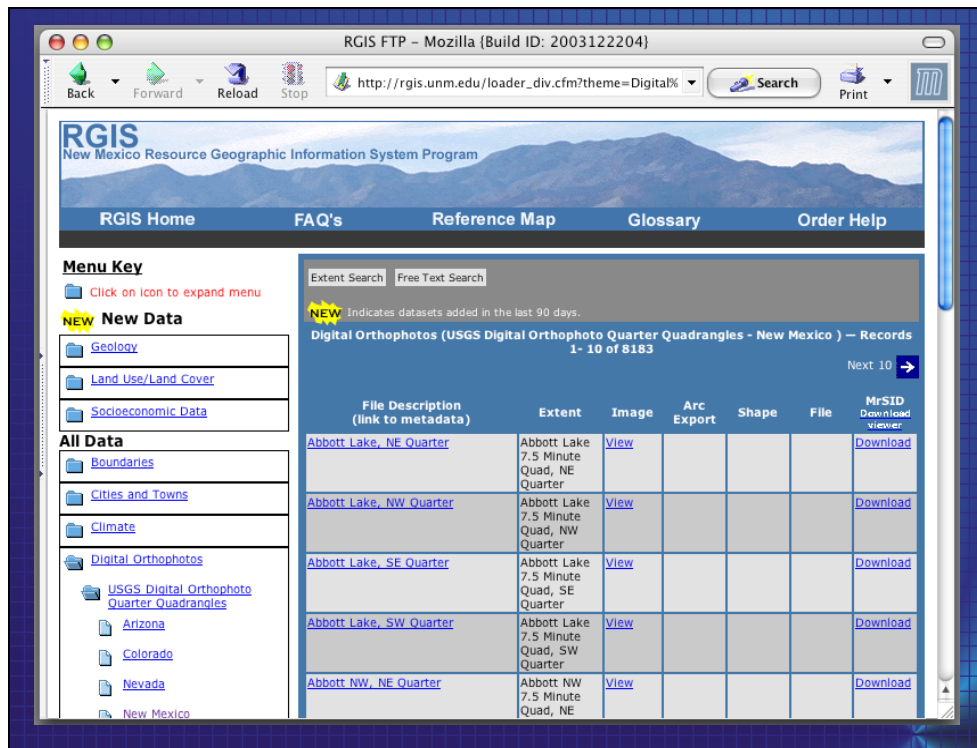
The data and services available through RGIS are not limited to those that are physically stored on EDAC's servers, but may also be located at facilities hosted by other data and service providers of interest to RGIS's users. This distributed data discovery and access system will be provided through a data and service registration application being developed at EDAC in support of data and service clearinghouse operations hosted by the FGDC, NBII, and ESIP Federation. At their core, these data registration services are based upon the FGDC XML metadata standard for geospatial data and provide a framework for facilitating powerful data discovery and delivery functions.



Entry page for the current RGIS web site.

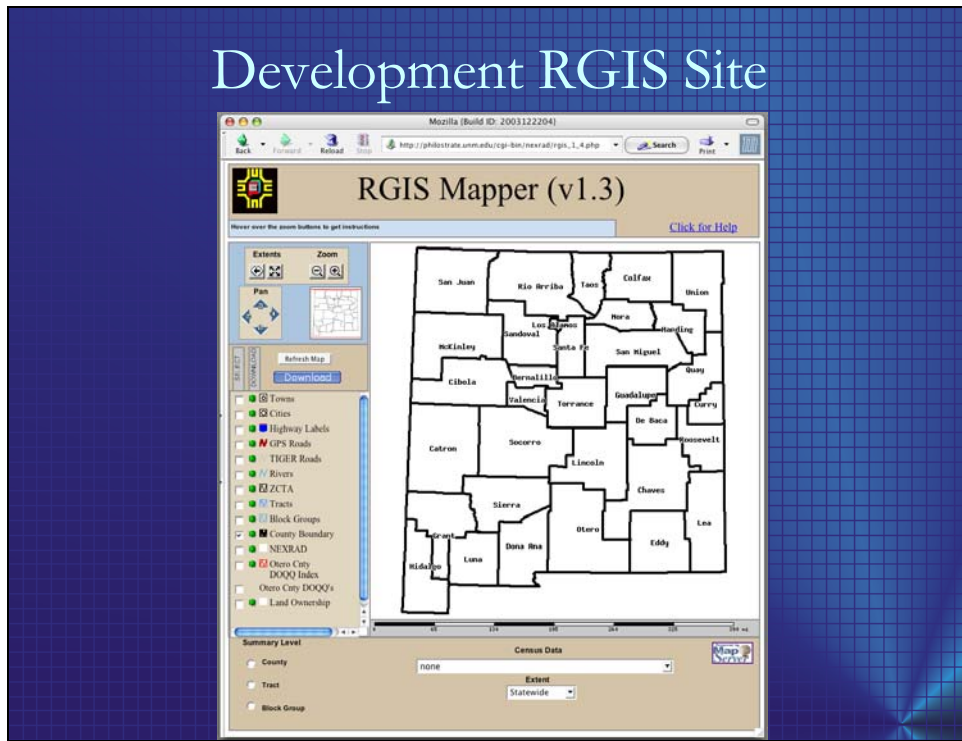


Hierarchical data access menu in the current RGIS web site.

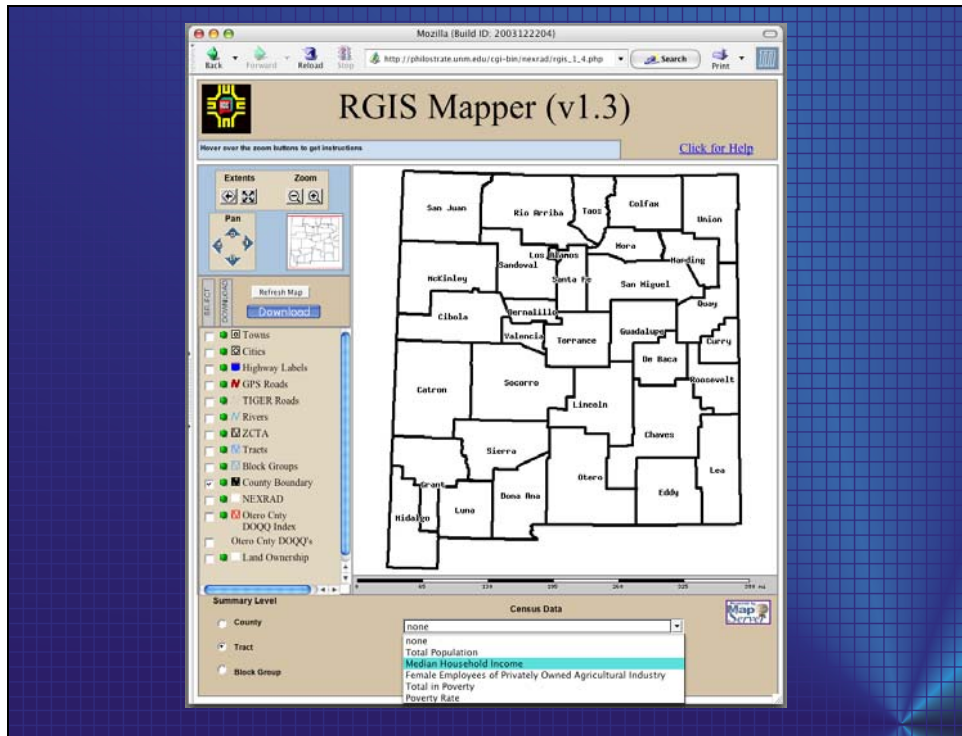


Listing of data records available as a result of selecting one of the data categories in the data listing on the left side of the page.

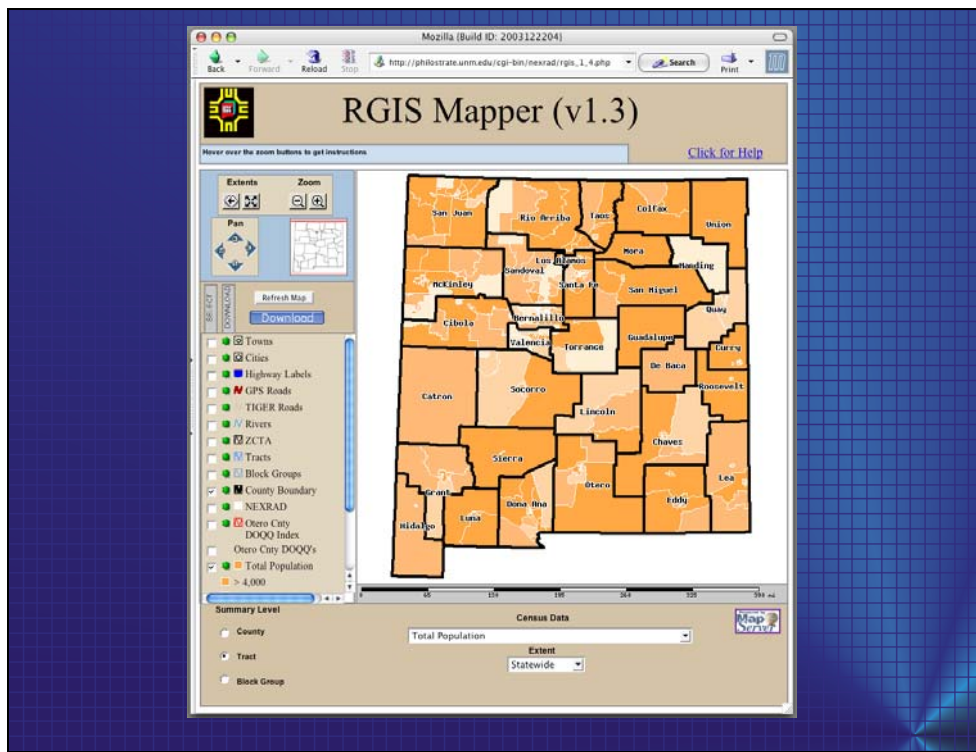
Development RGIS Site



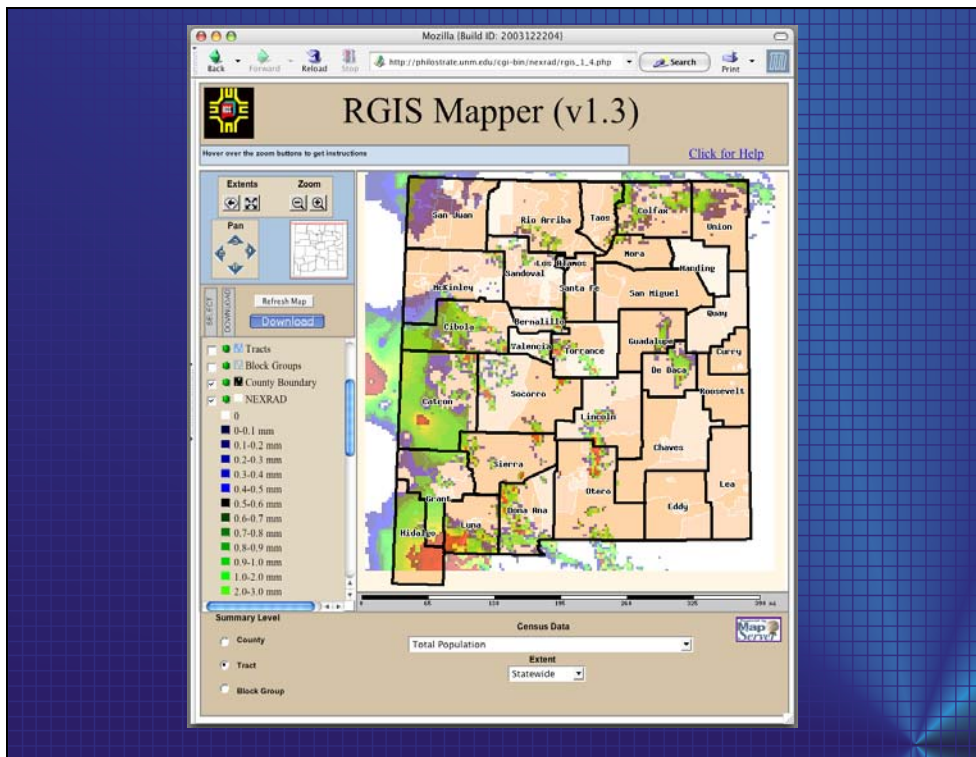
The new version of the RGIS application currently has a new mapping interface that supports both data visualization and download functionality.



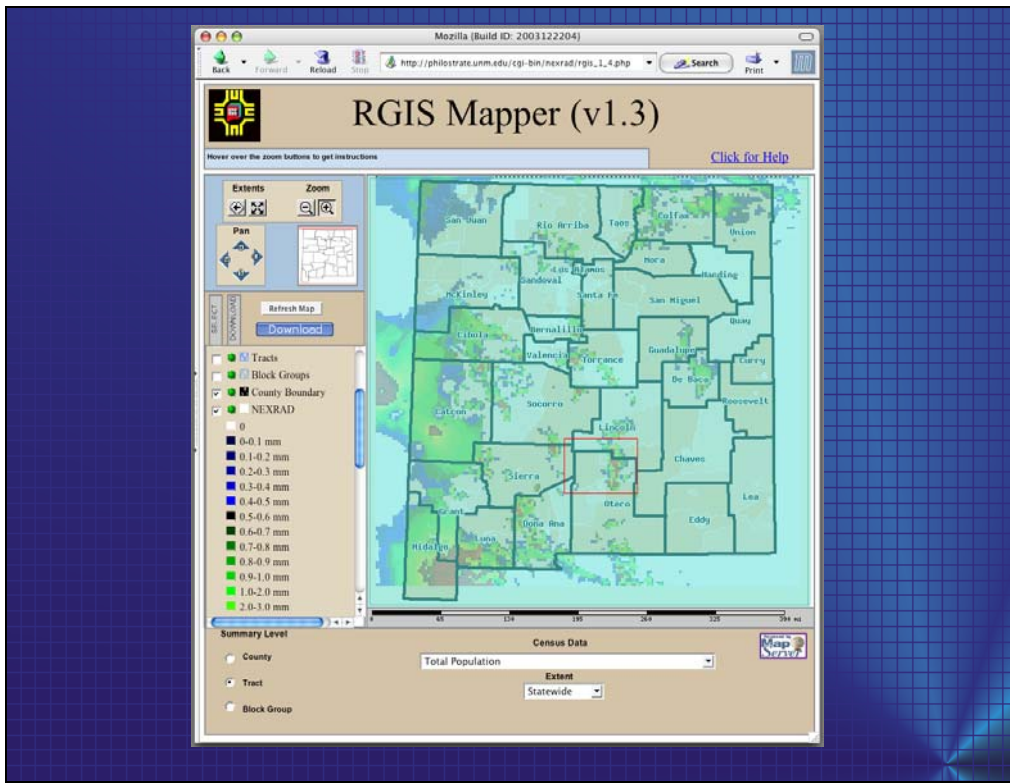
Census data may be selected from the menu at the bottom of the window. The spatial resolution (County, Tract, Block Group) of the census data may also be selected in this area.



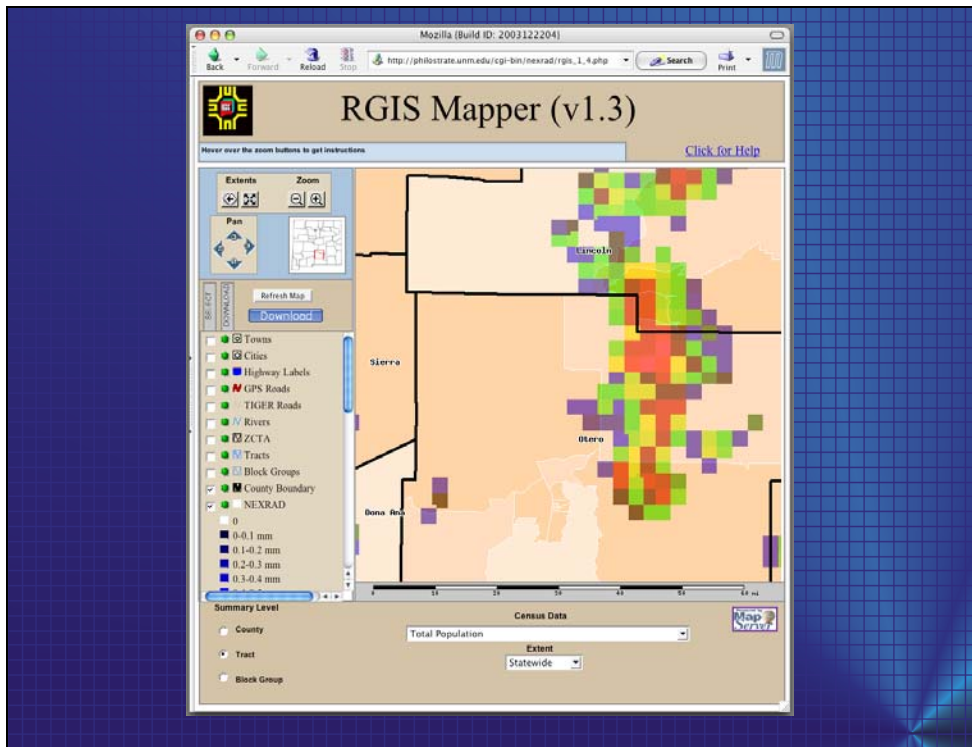
The selected data are then available for display in the map area.



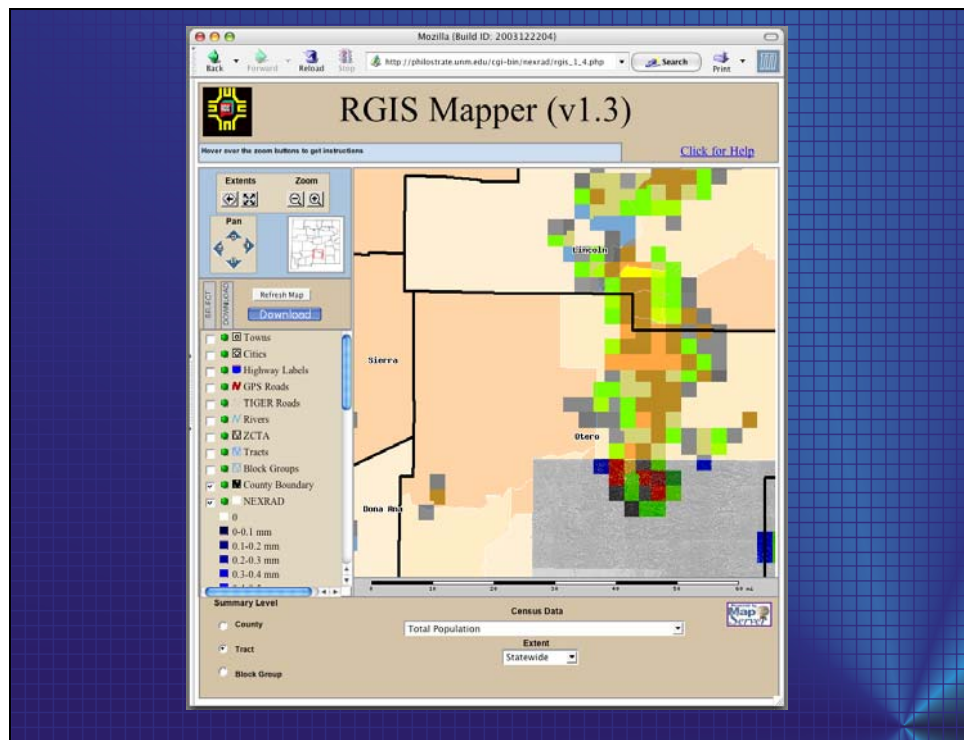
Environmental data, such as the NEXRAD data displayed here may added to the data display for comparison with the mapped census data.



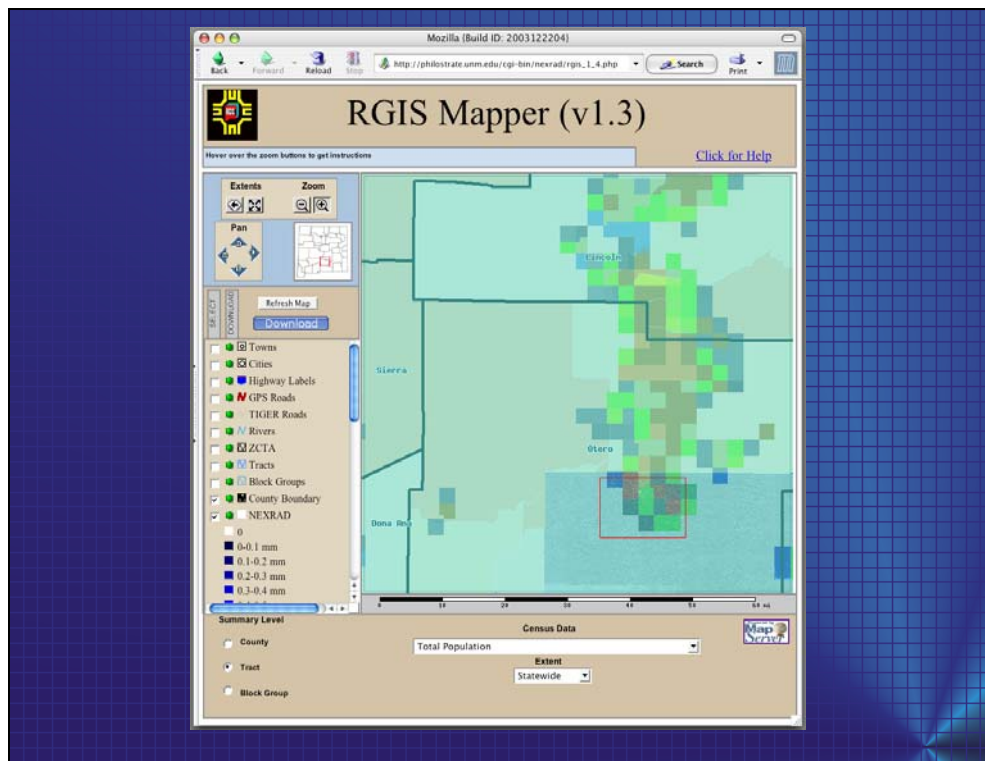
By placing the map in 'zoom' mode and dragging a rectangle over the map, an area to zoom to may be selected.



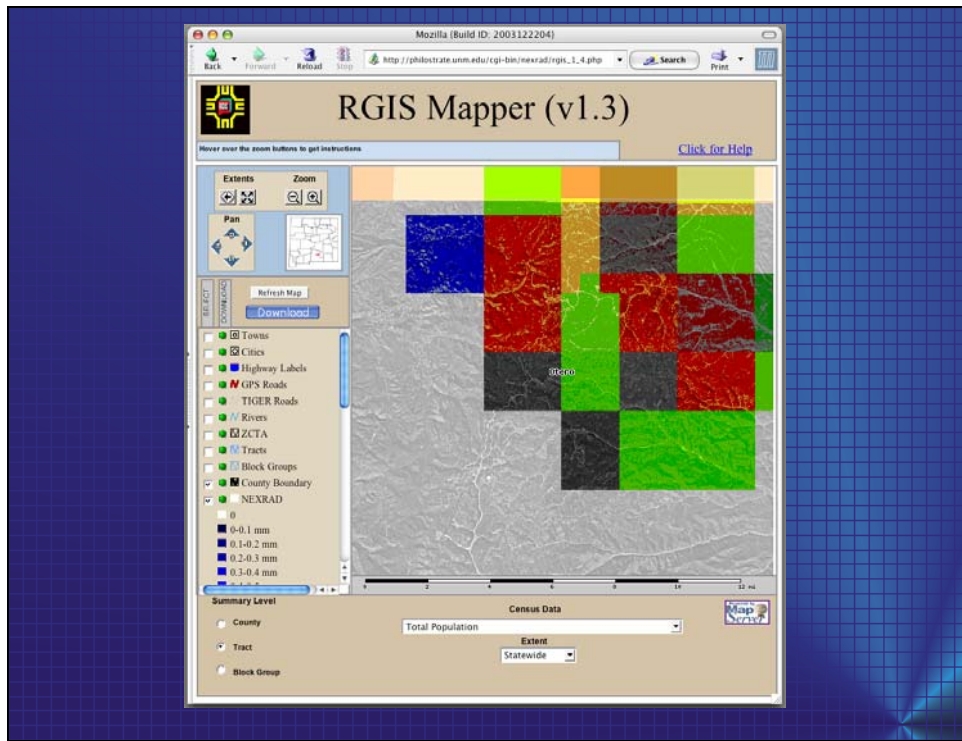
After defining the zoom area on the map, the map display refreshes, displaying the newly selected area.



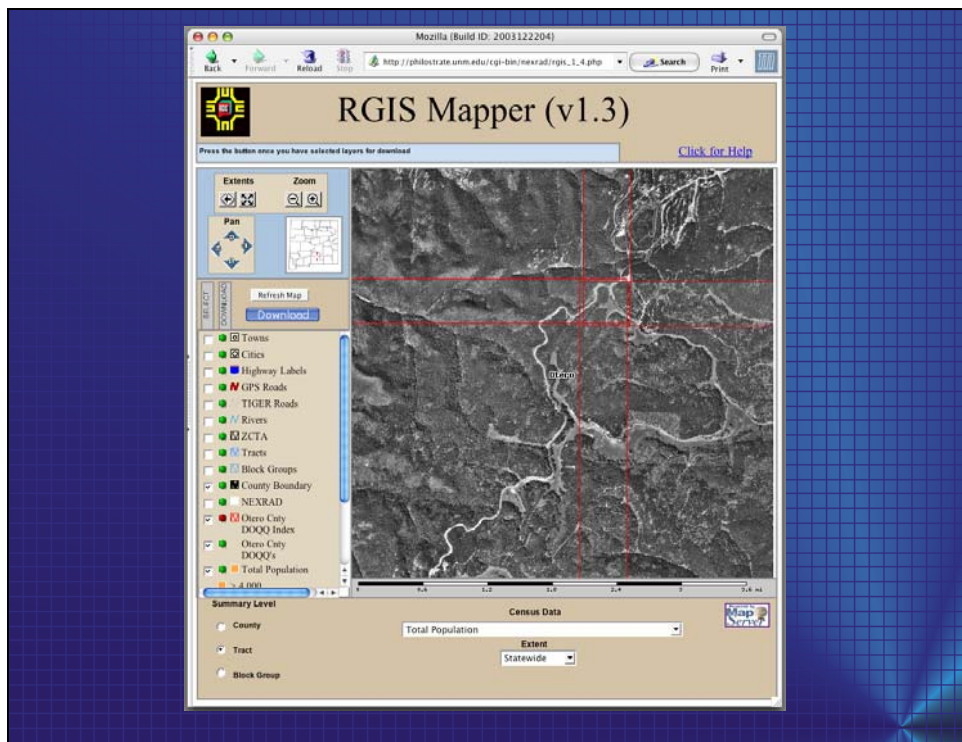
Raster data, such as USGS Digital Orthophoto Quads (DOQQ) may also be displayed in the client



Additional detail may be obtained by zooming in.



Additional details in the DOQQ are visible when zoomed in.



Data may be selected for download by selecting the download button in the legend (the red/green buttons), and clicking the “Download” button above the legend. This results in a subset of the selected data layers being zipped into a compressed archive that may be downloaded to the user’s system for further use.

Concluding Remarks

- RGIS provides a foundation resource for geospatial data for the state of New Mexico
- Currently over 12,000 geospatial datasets are available for download from RGIS
- Planned upgrades to RGIS include:
 - Live previews of data
 - More comprehensive data discovery tools
 - Clip & Zip data delivery options
 - Standards-based data visualization services
 - Analysis applications, as needed by specific user populations

The New Mexico Resource Geographic Information System represents a valuable resource for geospatial data and services for New Mexico. The planned upgrades to RGIS will build upon the vast repository of data within RGIS's holdings by developing enhanced data discovery, delivery, and visualization services that are available both through web interfaces and through other client applications (i.e., desktop GIS).

Contact Information and Links

- Author e-mail: kbene@edac.unm.edu
- Related Links
 - RGIS: <http://rgis.unm.edu>
 - FGDC: <http://www.fgdc.gov/>
 - OGC: <http://www.opengis.org/>
 - W3C: <http://www.w3c.org/>
 - NBII: <http://www.nbio.gov/datainfo/metadata>
 - ESIP Federation: <http://esipfed.org/>

For additional information contact Karl Benedict (kbene@edac.unm.edu) and visit the websites listed above.