

## Geographic Information System Subgroup

The Environmental Information Resources (EIR) Workgroup was established in 1996 to establish a comprehensive inventory of border environmental data. Within the EIR Workgroup, a Geographic Information System (GIS) Subgroup is addressing and resolving binational geospatial data and GIS issues relevant to the U.S.-Mexico environmental border programs. This fact sheet provides information on the GIS Subgroup's background, current activities, and future plans.

### Background

A GIS uses computer hardware and software to layer different types of information from multiple maps on to a single image. This enables users to evaluate geographic relationships between different types of information. Border XXI will utilize GIS as a tool to assist in identifying and addressing environmental issues in the U.S.-Mexico Border Region. For example, air emissions from the maquiladora industry and occurrences of respiratory illness could be compared geographically to see if a correlation exists. Spill response teams could also use GIS to locate any endangered species that may live near where a spill has occurred.

Current and consistent geospatial data is being developed by the GIS Subgroup. The current geospatial databases that are available for the border region vary in detail for every geographic region, and compatibility across the border is not consistent. The GIS Subgroup is taking steps to resolve this issue by using aerial photography and advanced computer technology to create consistent binational geospatial data.

The "geospatial" data created from the aerial photography project (see page 3) will build the foundation for subsequent binational digital mapping efforts. The GIS spatial database combines aerial photography and digital mapping with environmental data to produce a comprehensive picture of the border region. The United States Geological Survey (USGS) and Instituto Nacional de Estadística Geografía e Informática (INEGI) are leading the effort in compiling these geospatial data sets.



### The Border XXI Program

The Border XXI Program (Border XXI) is an innovative binational effort between the United States and Mexico to protect the natural resources and environment of the border region. The mission of Border XXI is to achieve a clean environment, protect public health and natural resources, and encourage sustainable development along the U.S.-Mexico border.

Border XXI is implemented through nine binational workgroups. The nine workgroups under the Border XXI Program are *1 water, 2 air, 3 hazardous and solid waste, 4 pollution prevention, 5 contingency planning and emergency response, 6 cooperative enforcement and compliance, 7 environmental information resources, 8 natural*

# GIS Subgroup Activities



## Digital Elevation Models and Digital Raster Graphics

Digital elevation models provide a computerized (digital) map similar to a topographic map. In 1996, while new aerial photographs were being acquired, the USGS began computerized mapping efforts for areas where the new photographs would not be used. The USGS, in partnership with private industry, began and completed the production of all border region 1:24,000-scale digital elevation models (DEM), digital raster graphics (DRG), public land survey system (PLSS), and boundary digital data files. These digital geospatial data are now available by order through USGS Earth Science Information Centers and at the following Internet address: <http://mapping.usgs.gov/www/products/1product.html>.

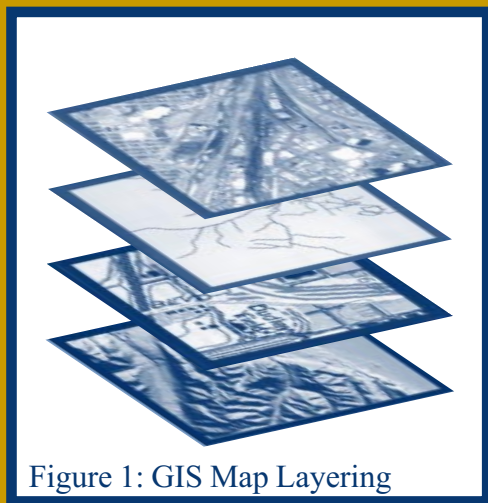


Figure 1: GIS Map Layering

## Color Infrared Digital Orthophotography and Digital Revision Mapping

In 1997, USGS used newly acquired imagery to begin the production of 1:12,000-scale Color Infrared (CIR) digital orthophoto quadrangles (DOQ) for the U.S. portion of the border region. The USGS separates maps into square sections called quadrangles. These quadrangles vary in size depending on the scale of the map. A digital orthophoto is a digital image of an aerial photograph in which displacements caused by the camera and the terrain have been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Unlike a

standard aerial photograph, relief displacement in orthophotos has been removed so that ground features are displayed in their true ground position. This allows for the direct measurement of distance, areas, angles, and positions. Also, an orthophoto displays features that may be omitted or generalized on maps. To date, DOQ's are being produced for approximately one-half of the U.S. border area. These initial quadrangles became available to the public in June 1998. The remaining border region DOQ's are being completed on a priority basis, with the lowest priority quadrangles to be completed by the year 2001. Information pertaining to DOQ availability and ordering information can be obtained through USGS Earth Science Information Centers and by using the following Internet address:

<http://edcwww.cr.usgs.gov/glis/glis.html>.

DOQ's are used to compile information for GIS because they combine the image characteristics of an aerial photograph with the geometric qualities of a map. DOQ's serve as the primary source for geographic data and as the foundation for 1:24,000-scale USGS digital mapping and revision efforts. They can also be used in GIS as the georeferenced photographic image base layer, or foundation, from which other thematic data layers and information can be referenced. Thematic data layers refers to the different views of a geographic region that GIS offers users. For example, a user could view the hydrology or topography of a selected area separate from all other information available for that particular region. As DOQ's become available, USGS will use them to start updating and revising the transportation and hydrography data themes.



Figure 2: Digital Orthophoto



Figure 3: Digital Line Graphs



Figure 4: Digital Raster Graphics



Figure 5: Digital Elevation Models



## Pilot Project and USGS and INEGI Cooperation

For the first time in history, mapping efforts in the United States and Mexico are being coordinated and designed to be compatible so that important geographic data can be understood in a common framework on both sides of the border. The USGS and Instituto Nacional de Estadística, Geografía e Informática (INEGI) cooperated on the El Paso/Ciudad Juarez pilot project to develop processes to assist in the integration of digital data between the two countries. The result of this pilot project is that USGS and INEGI successfully collaborated to develop software that translates and converts INEGI's digital data features and data themes into theme-separated digital line graphs (DLG). Because this pilot project was a success, USGS and INEGI now have the technical ability to integrate and use each other's digital geospatial data for GIS applications. Although differences remain with regard to the standards for data content, accuracy, and scale, technical experts from the USGS and INEGI are working together to understand and resolve these differences.

A major goal of the mapping initiative is to ensure that both countries have consistent and seamless mapping information for use in numerous GIS applications. To accomplish this, USGS and INEGI are now involved in program planning and technical standards meetings. The USGS and INEGI partnership continues to grow in conjunction with a binational agreement for data sharing now in progress. Information sharing is essential for USGS and INEGI to complete border region mapping projects so that the maps will merge to form a cohesive binational map.

## Future Plans

Funding availability will largely determine the timeframes for collecting and revising the transportation and hydrography data and producing the subsequent updated graphic maps. However, for planning purposes, a goal of 2005 has been established for completion of all USGS-supported digital data themes for more than 2,500 7.5-minute quadrangles in the U.S. border region. These efforts will provide the basis for developing the border GIS.

## Aerial Photography Project

On May 6, 1996, during the 13th annual meeting of the U.S.-Mexico Binational Commission (BNC) in Mexico City, both countries agreed to begin an ambitious aerial photographic survey along the entire 3,250-kilometer-long and 200-kilometer-wide border region. This agreement was the result of nearly 2 years of negotiations between the United States and Mexico.

As a result of this binational agreement, and through funding partnerships with Federal and State agencies, the USGS has completed the acquisition of 1:40,000-scale color-infrared (CIR) photographic images for the entire U.S. part of the border region. The CIR aerial photographs are now available for purchase through USGS Earth Science Information Centers and at the following Internet address: <http://edcwww.cr.usgs.gov/webglis>.

Similarly, Mexico's mapping agency, INEGI, is acquiring aerial photographs for the Mexican side of the border. INEGI's photographic survey includes the acquisition of 1:40,000-scale CIR images for natural resource and environmental studies in protected areas that are defined as environmentally sensitive and 1:75,000-scale black-and-white images in nonpriority areas.

## Envirofacts

EPA's Envirofacts is a national information system that provides a single point of access to data extracted from seven major EPA databases. The Envirofacts Warehouse allows environmental information to be retrieved from EPA databases on Superfund sites, drinking water, toxic and air releases, hazardous waste, water discharge permits, and grant information. Online queries can retrieve data or generate maps of environmental information by choosing from several mapping applications available through EPA's Maps On Demand.

The EnviroMapper application allows users to view spatial data at the national, state, and county levels, as well as use GIS functions, such as displaying multiple spatial layers, zooming, panning, identifying features, and querying single Envirofacts points. Envirofacts can be accessed at the following sites:

[http://www.epa.gov/enviro/index\\_java.html](http://www.epa.gov/enviro/index_java.html)

<http://maps.epa.gov/enviro/html/mod/enviromapper>





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