

# U.S.-Mexico Border Environmental Health Initiative

## (1) PROJECT ACCOMPLISHMENTS/CONTRIBUTIONS 2008

### Summary:

The Border Environmental Health Initiative (BEHI) website experienced an increase in visitation and use again this year, nearly doubling most statistics. The ftp site for downloading data is very popular. Seven new digital orthophotos have been added to the website for downloading. There was an effort this year to increase the formats that the data are available in, making it easier and more convenient for on-line users. The public health study in the Lower Rio Grande Valley made good progress and was greatly advanced by the contracting of an environmental epidemiologist with funding provided by EPA to assist the BEHI team in accessing, incorporating, and analyzing human health data. Among the important data layers for this study is water quality. These data are being provided through the Binational Water Quality Database (BWQD). The BWQD has many partners including the International Boundary and Water Commission (IBWC). The IBWC is a cooperator with BEHI and is cost-sharing the construction of this database. Two presentations were made at professional meetings and 17 presentations about BEHI were made at agency meetings to familiarize potential users of BEHI with its capabilities and products. A significant change for FY'09 will be the addition of co-leads from each discipline from the Western Region. The FY'09 Work Plan incorporates new efforts to be conducted over the next 4 years in the Santa Cruz basin of Arizona with the participation provided by Western Region scientists.

### Detail:

#### Task 1: Development of Data Applications

##### Application 1 – Use of Border Health GIS to Investigate Linkages between Environmental Conditions and Public Health.

The watersheds within the Lower Rio Grande basin in the counties of Hidalgo and Cameron Texas were chosen as the study area for this 2-year project begun in 2007. The analyses apply a GIS-based quantitative weight-of-evidence and weighted logistic regression (WOE/WLR) model in an attempt to associate identified areas of poor environmental quality with areas where human health may also be impaired. This method is a multi-dimensional application of an epidemiological-based approach and is being applied in three phases. The WOE/WLR model will first be used to characterize water bodies of good and poor environmental quality using extant environmental data (e.g., contaminants in biota, potential sources of contaminants, water quality, soil geochemistry, land use and land cover trends) based on the known biological condition (i.e., impairment of fish health) for a subset of the water bodies (training sites) in the study area. Once the appropriate environmental stressors associated with the biological condition are identified, then spatial interpolation predicts distribution of the biological condition throughout the study area. Finally, geostatistical methods will be used to determine if there is an association between the distribution of fish health and that of human health using a general human health indicator. Using this approach, linkages between potential environmental stressors and human health may be identified for further investigation.

In FY2008, we contracted with an epidemiologist through PAHO using a grant of \$50K from EPA. The epidemiologist was not hired until quite late in the fiscal year due to the continuing resolution. Nevertheless, Dr. Marie Socha was able to assist us in identifying a general human health indicator (school absentee rates) and potentially more specific indicators of exposure to environmental pollutants (from birth and death statistics). These large data sets, have been obtained and formatted for the two counties, and will allow us to test the hypothesis that at the

landscape-level a positive spatial association exists between the occurrence of poor fish health and poor human health. In addition, team researchers spent much of their time preparing the environmental data sets, developing the spatial layers needed for the model, and optimizing model parameters. In doing so, team members also met with one of the original USGS modelers/statisticians in Reston that worked on developing the WOE/WLR model we will be using. Water bodies that will be used as the training sites for the model have been identified and a protocol to evaluate fish health at these sites has been established. Fish health data were to be collected at these sites in September but due to hurricane IKE the field work had to be postponed until December. A presentation on the approach for this project was made at the annual US-Mexico Border Health Association meeting and an abstract has been submitted for a presentation at the upcoming TNRIS (Texas Natural Resources Information System) meeting.

#### Binational Water Quality Database Design and Content:

The focus of the 2008 effort was to design the schema (organization and framework) for the geodatabase, develop a Master Site File to integrate sites sampled by multiple agencies, and begin preprocessing and loading data that had been collected in the prior fiscal year. As part of the Border 2012 effort, the Environmental Protection Agency (EPA) commissioned the Southwest Consortium for Environmental Research and Policy (SCERP) to develop a Binational Database. The USGS decided to adopt the schema developed from that effort and expand on the work done by the EPA. Per the Border 2012 program, constituents were limited to the following (Dissolved oxygen, nutrients, chlorophyll/biomass, conductivity, chloride, sulfates, Acidity/pH, Biochemical Oxygen Demand (BOD), total suspended solids (TSS), Fecal Coliform, Fecal Streptococci, Temperature, and Total Dissolved Solids (TDS). Because the Binational Water Quality Database will include all constituents, the strategy for populating the database was to retrieve the data from the source agencies in its native format to load into the database instead of extracting the data from the populated EPA database. Once complete the EPA database will be queried and all data contained in there that have not been loaded from the source data will be loaded into the Binational Water Quality Database. Most of the data in the EPA database was directly downloaded from the EPA Storet database which is a repository for many sources of data.

In order to maintain cooperation with all the contributors on both sides of the border there are ongoing discussions and meetings with the Comision Nacional del Agua (Conagua), the International Boundary and Water Commission (IBWC), and the Comision Internacional de Limites Y Aguas (CILA), on the best approach to compile and warehouse the Binational water quality data collected in this effort.

The following are data that have been approved, verified, received, preprocessed, and loaded into the Binational Water Quality Data Warehouse. Figure 1 is a map of the locations where we currently have ground water data. As additional information comes in, this map will be updated.

Texas Commission on Environmental Quality (TCEQ): The TCEQ is a repository for most surface water quality data in Texas particularly the Clean Rivers Program water quality data. Water quality data from xx agencies including IBWC was obtained from TCEQ. Constituents include major ions, conductance, Dissolved oxygen, pH, nutrients, fecal coli form, Chlorophyll-A, and TDS.

Texas Water Development Board (TWDB): major ion, trace elements, TDS, pH

Texas NWIS database: major ions, trace elements, nutrients, pesticides, VOC's

New Mexico NWIS database: major ions, trace elements, nutrients, pesticides, VOC's

Arizona NWIS database: major ions, trace elements, nutrients, pesticides, VOC's

California NWIS database: major ions, trace elements, nutrients, pesticides, VOC's

City of Brownsville: Selected major ions, trace elements, VOC's, pH

Comision Nacional del Aqua (Conagua): major Ions, pH, solids.

#### Web Interface:

Starting in July 2008, the Texas Water Science Center began working with the IBWC (with whom they are cost-sharing this effort) to create a Web Site to allow the public to access the Binational Water Quality Data Warehouse. This Web Site will allow the public to view water quality sites along the border and download subsets of data or the entire database. The database will be available for download after the review and metadata requirements are met. The Web Site provides static thematic maps to assist with querying the data, as well as individual site pages, which include Google Maps to view site locations.

#### Data Collection:

We continue to request and receive water quality data from other agencies. We will process and load these data in fiscal year 2009. The following are data that have already been received and (or) have been requested. This list is not exhaustive, and only includes those agencies that have already been contacted and (or) have expressed an interest participating and have provided their data.

City of Reynosa: Received data for 2 sites along the Rio Grande. We will need approval from Conagua to include in database.

City of Nuevo Laredo: Received data for 2 sites along the Rio Grande. We will need approval from Conagua to include in database.

IBWC: data from sites in California and Arizona received. Preprocessing is underway.

Research Triangle Institute (RTI): There are 1,933 sites with water quality data (both surface water and groundwater). These data are from the California, New Mexico, Arizona, and Texas Legacy Storet (EPA) databases but collected by 19 different agencies.

Arizona Department of Environmental Quality (ADEQ): Request for data submitted to agency.

Comision Nacional del Aqua (Conagua): Request for surface water data adjacent to New Mexico, Arizona, and California submitted to agency. Request for ground water data submitted. We have already received site information for ground water sites, water quality data to follow.

New Mexico Water Resources Research Institute (WRRI): Request for data submitted to agency. Agency warehouses data by project. Some data have already been received.

Application 2 – GIS Applications for Land Use Planning: Collaborations with PEMEX (Petroleos Mexicanos) in the Burgos Basin of Northern Coahuila, Nuevo Leon, Tamaulipas, Mexico.

During FY2008, team member Jean Parcher spent four months in Mexico on an Embassy Science Fellowship. While in Mexico City she worked with US Embassy staff to establish communication with the appropriate researchers at the Instituto Mexicano de Petróleo (IMP) after it was learned that research projects with PEMEX should be conducted in collaboration with IMP scientists. The BEHI team had a conference call with the IMP team and discussed possible areas of mutual interest. The IMP scientists were receptive to our ideas and to going forward to

develop a joint project with PEMEX. Subsequently, US Embassy staff worked with Ms. Jean Weaver, Regional Specialist for Central America/ South America/Caribbean, International Programs to develop an agreement that will facilitate exchange of data, scientific materials, and mechanisms for funding joint projects. The agreement is awaiting finalization and signing.

### Application 3 – Investigation of Linkages between Geologic Conditions and Human Health Risks.

The major emphasis for FY 2008 was to begin a trace element geochemistry and mineralogical characterization of surface soil and stream sediments in the BEHI Subarea 7. Soils collected in Basin 8 were tested for anthrax bacteria in 2008 and the results are currently being compiled and will be released in 2009. Geochemical thematic layers were created for the WOE and WLR analysis for the PAHO study in the Lower Rio Grande Valley. Progress was made toward the final compilation. The data are being compiled in ESRI GIS and Geodatabase formats) and interpretation of geochemical data for the entire U.S. border region in the form of static maps. These maps include such layers as: geologic map describing lithologic characteristics and structure, ore deposit and mine wastes map, and thematic layers of interpolated geochemical data for selected elements. Integration of the Mexican geochemical datasets will begin in 2009.

Mosquito vectors carrying diseases such as dengue, malaria and west-nile virus all require standing water continuously available during the time it takes for them to complete their life cycle of breeding, ovipositing and larval development. These typically range from a week to ten days for most species under suitable environmental temperature and humidity conditions. Because stagnant water in flood-prone areas imply higher values of soil moisture, an index was developed for use with multispectral re-mote sensing datasets covering parts of the visible, near-infrared, and thermal infrared (TIR) regions of the spectrum.

### Application 4 – Synthesis of Changes in Landscape and Contemporary Demographic Patterns along the US-Mexico Border

With the completion of the binational integration of the 2001 Land Use and Land Cover (LULC) dataset, research was begun to document a synthesis of land use and land cover change from 1992 to 2001. The source datasets include the harmonized USGS National Land Cover Data and INEGI's Uso de Suelo to produce Anderson Level 1 LULC dataset for the 1992 and 2001 temporal time periods. The synthesis of landscape change and trends analysis was computed as a percentage of total number of pixels of change for each land use and land cover class in the eight watershed areas. The preliminary results reflect both actual change in the landscape and reflect different methods of land use and land cover classification between the production of the 1992 and 2001 datasets. These classification differences reflect both the NLCD changes in documenting impervious cover and INEGI's Uso de Suelo changes in reporting wetlands. Landscape change maps, graphs, and tables were created for each watershed subarea. In Fy 2009, the changes will be documented through a descriptive summary taking into account the demographic growth pattern of the watershed area, changes in land use, especially agriculture, and the changes in classification methods to provide the users a blueprint for use of these datasets in models and analysis. Final integration of the binational census and population density data is still in progress.

### Task 3: Data Access and Internet Mapping Tools

In 2008, the BEHI team focused on increasing user access to the available datasets. This included publishing many of the layers in the Google Keyhole markup language (KMLs). These can be downloaded from the data layers website and loaded up into the Google Earth application for ease of display of the data. The published KMLs include:

- Major cities
- Local cities

Urban area extents  
Colonias  
Hospitals  
Schools  
Study area  
International Boundary  
Major roads  
Streams and Rivers

In collaboration with the GIO and EROS Data Center, the BEHI Internet Map Service now has available seven more Digital Orthophoto layers for viewing. These include:

Mexico Digital Orthophotos from INEGI  
San Diego and Imperial County  
Arizona  
Tucson  
Pima County  
El Paso

New LIDAR data: A LIDAR contract for collection of LIDAR on either side of the border, up to 6 miles into Mexico along Southern California and Baja California was flown during the 2nd and 3rd week of December. The data will be available to all as soon as it has been accepted by the USGS NGTOC contract folks. Funding from National Geospatial Intelligence Agency.

#### | Task 4: Publications, Outreach, and Training.

##### Publications

Two four page fact sheets were published in FY 2008:

Parcher, J.W., U.S.-Mexico Border Geographic Information System (English and Spanish) FS 2008-3069

Parcher, J.W., CHIPS: Monitoring Colonias Along the United States-Mexico Border in Texas (English) 2008-3079

##### Outreach

Presentations about BEHI were made to:

Texas State Department of Health Services - December, 2007  
Mexican Technology of Water – March, 2008  
Mexican Institute of Public Health – March, 2008  
Mexico's Geographic and Census Bureau – April, 2008  
U.S. Embassy – Environment, Science, Technology and Health Section and Agency for International Development – February, 2008  
National Meteorological Survey of Mexico – February, 2008  
CONAGUA (Mexican water agency) – February, 2008  
Universidad Nacional Autónoma de México, Geography Institute – February, 2008  
Villahermosa, Tabasco Post Flood and Watershed Characteristics Workshop – February, 2008  
SEMARNAT – February, 2008  
INEGI – March, 2008  
USGS Bureau Program Council – May, 2008  
USGS U.S.-Mexico Border Strategy Team – July, 2008  
Transboundary Aquifer Committee – April, 2008  
Rio Grande Watershed Coordinating Committee in Albuquerque, NM – March, 2008  
Binational Meeting on the Restoration and Protection of Water Quality in the Lower Rio Grande below Falcon Reservoir – September, 2008

Fifth Meeting of the National Coordinators Working Session: Reduce Water Contamination – September, 2008  
Border Water Quality Coordination Meeting – July, 2008

(2) PROJECT WORKPLAN AND BUDGET FOR FY2008 – See attached separate document.

### (3) NOTEWORTHY COLLABORATIONS, MEETINGS, AND TECHNICAL TRANSFER ACTIVITIES

a) Information to Robert Fisher, BRD, San Diego, regarding science response to the 2007 firestorms in southern California. One of the fires (Harris Fire) burned along the Mexican Border in San Diego and Baja California.

b) B. E. Hubbard<sup>1</sup>, W. R. Page<sup>2</sup>, H. W. Folger<sup>1</sup>, J. W. Parcher<sup>3</sup>, and M. D. Merrill<sup>1</sup> <sup>1</sup>U. S. G. S., Reston, VA; <sup>2</sup>U. S. G. S., Denver, CO; <sup>3</sup>U. S. G. S., Austin, TX. 2008. Remote sensing and GIS analysis of soil moisture and other geologic factors influencing mosquito-borne disease potential in the Rio Grande delta, U.S.-Mexico border area. 1<sup>st</sup> Annual Geohazards conference, Getzville, NY. March 29-30, 2008.

c) Papoulias, D.M., Parcher, J.W., Page, W.R., Lurry, D., Folger, H., Stefanov, J. 2008. Relationships between Environmental Changes, Contaminant Trends, and Human and Wildlife Health along the Rio Grande, Texas. 66<sup>th</sup> Annual Meeting of the U.S.-Mexico Border Health Association. Hermosillo, Mexico. May 7-9, 2008.

### (4) REPORT PRODUCTS AND BIBLIOGRAPHIC UPDATE

Page, William R., Snyders, Scott R., Berry, Margaret, and VanSistine, D. Paco, *in review*, Preliminary geologic map of the Ciudad Acuna, Piedras Negras, Nuevo Rosita, and Nuevo Laredo 1:250,000-scale quadrangles, Mexico, and the Laredo, Crystal city-Eagle Pass, San Antonio, and Del Rio 1:250,000 quadrangle, Texas: U.S. Geological Survey Open-File Report-XXX, scale 1:250,000-scale.

Page, W.R., Hubbard, Bernard, Berry, M.E., and VanSistine, Paco, *in progress*, Geologic map of the Brownsville-McAllen 1x2o quadrangle, Texas, and the Reynosa, Matamoros, Rio Bravo, and Monclova 1x2o quadrangles, Mexico: U.S. Geological Survey Scientific Investigations Map 2008-XXX, 1:250,000-scale. Supersedes USGS Open-File Report 2006-1409

Folger, Helen, Merrill, Matthew, Hubbard, Bernard, and Page, W.R., *in review*, Geochemical characterization of surficial sediments and soils in the Lower Rio Grande Valley, Texas: U.S. Geological Survey Open-File Report 2008-XXX.

### (5) ACKNOWLEDGEMENTS/ENDORSEMENTS and TESTIMONIALS (Quotes)

a) Ladies, I wanted to pass on some information to you and also to congratulate you on the fine work done as relates to the project that USGS has taken on providing for geospatial, satellite imagery and also including the many different demographic and other datasets that are included on that website. Lorenzo Arriaga, the Chair for the FCC and myself were at a meeting back in July of this year providing presentations to the NM Chapter of the Wildlife Society and we spoke about border related efforts undertaken by agencies within DOI and this particular project was one of them. The interest expressed was great, there were many questions and we were happy to provide the website where this

- information could be accessed. I am not aware of any other Government or private entity that has attempted to provide all of this information at one location. Congratulations for the excellent product and hopefully this work will be dynamic continually changing through the years and hopefully this effort will receive the accolades that it deserves.
- Ed Guerrero, Co Chairman, US-Mexico Border Field Coordinating Committee, New Mexico International Border Advisor, Office (505) 525-4309, Cell (505) 635-8689
- b) Jean, Thanks so much for this dataset (Mexican Elevation Data). I was able to download the Mexican DEM that I needed and use it in a model to represent my binational watershed by a cascade of planes and channels, thereby allowing result parameters to vary spatially at a high-resolution (never available before!). The Kinematic Runoff and Erosion Model (KINEROS2) is an event oriented, physically-based model developed at the USDA-ARS to describe the processes of interception, infiltration, surface runoff and erosion from small (less than about 100 km<sup>2</sup>) watersheds. This is great data and I am thrilled to finally get it! Kindest regards, Laura Norman, Ph.D., Research Physical Scientist, U.S. Geological Survey-Western Geographic Science Center, 520 N. Park Ave., Ste. #355, Tucson, AZ 85719, Phone: (520) 670-5510; Fax: (520) 670-5571, [lnorman@usgs.gov](mailto:lnorman@usgs.gov)
- c) BEHI project featured in GeoReport, Feb. 2008
- d) We would like to use the map in the subject line above in a publication based on public health surveillance data collected in Cameron County and Matamoros. The map is helpful because it shows how the two populations are likely to be interdependent in a way that other maps cannot; some of the place names and streets, however, are not necessary and we would like to delete them. Is the map available in a different format other than adobe that would allow us to edit the map? Thank you for your assistance - - and for the great map! Jill McDonald, Ph.D., MCH Epi Coordinator-Assignee US-Mexico Border Region, Division of Reproductive Health, NCCDPHP/CCHP/CDC, Tel: 770 488 6373, Fax: 770 488 6291, Email: [ezm5@cdc.gov](mailto:ezm5@cdc.gov)

(6) PROJECT TEAM DIRECTORY –

Ric Page, co-lead for Geology, 303-236-1141, [rpage@usgs.gov](mailto:rpage@usgs.gov)

Floyd Gray, co-lead for Geology, 520- 670-5582, [fgray@usgs.gov](mailto:fgray@usgs.gov)

Diana Papoulias, co-lead for Biology, 573-876-1902, [dpapoulias@usgs.gov](mailto:dpapoulias@usgs.gov)

Charles Van Riper, co-lead for Biology, 520-626-7027, [charles\\_van\\_riper@usgs.gov](mailto:charles_van_riper@usgs.gov)

Jean Parcher, co-lead for Geography, 512-927-3523, [jwparcher@usgs.gov](mailto:jwparcher@usgs.gov)

Laura Norman, co-lead for Geography, 520-670-5510, [lnorman@usgs.gov](mailto:lnorman@usgs.gov)

Dee Lurry, co-lead for Water, 512-927-3571, [dllurry@usgs.gov](mailto:dllurry@usgs.gov)

James Callegary, co-lead for Water, 520-670-6671, [jcallegary@usgs.gov](mailto:jcallegary@usgs.gov)

Wyatt Anderson, 605-594-2516, [wyanders@usgs.gov](mailto:wyanders@usgs.gov)

Christy-Ann Archuleta, 512-927-3563, [carchule@usgs.gov](mailto:carchule@usgs.gov)

Mike Buswell, 605-594-2827, [buswell@usgs.gov](mailto:buswell@usgs.gov)

Helen Folger, 703-648-6346, [hfolger@usgs.gov](mailto:hfolger@usgs.gov)

Jo Ellen Hinck, 573-876-1808, [jhinck@usgs.gov](mailto:jhinck@usgs.gov)

Natalie Houston, 512-927-3565, [nhouston@usgs.gov](mailto:nhouston@usgs.gov)

Bernard Hubbard, 703-648-6155, [bhubbard@usgs.gov](mailto:bhubbard@usgs.gov)

Florence Thompsen, 512-927-3504, [fethomps@usgs.gov](mailto:fethomps@usgs.gov)

Syliva Wilson, 512-927-3500, [snwilson@usgs.gov](mailto:snwilson@usgs.gov)

(7) PHOTOS AND RESULTS GRAPHICS –

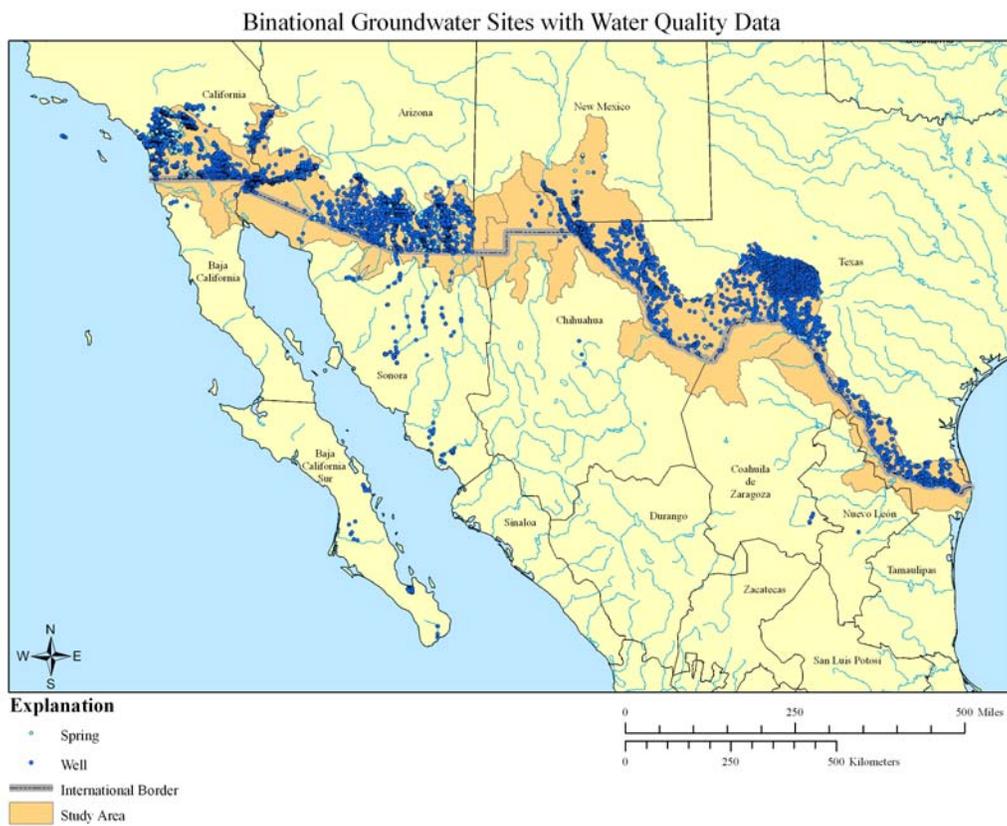
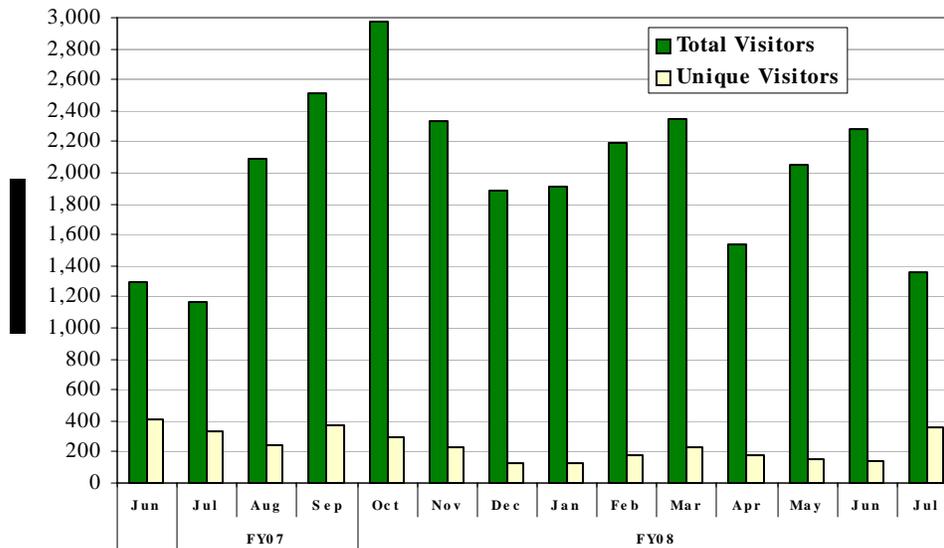


Figure 1. Location of ground water sites along the US-Mexico border as of 9/15/08. Not all Mexican data have been plotted at this time.

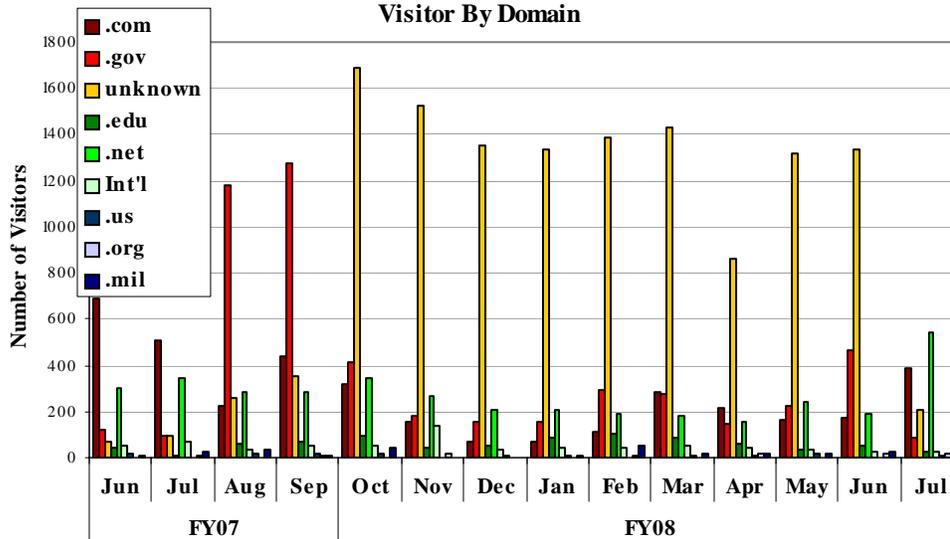


U.S. – Mexico Border Environmental Health Initiative Viewer -- Visitors

Total Visitors VS Unique Visitors

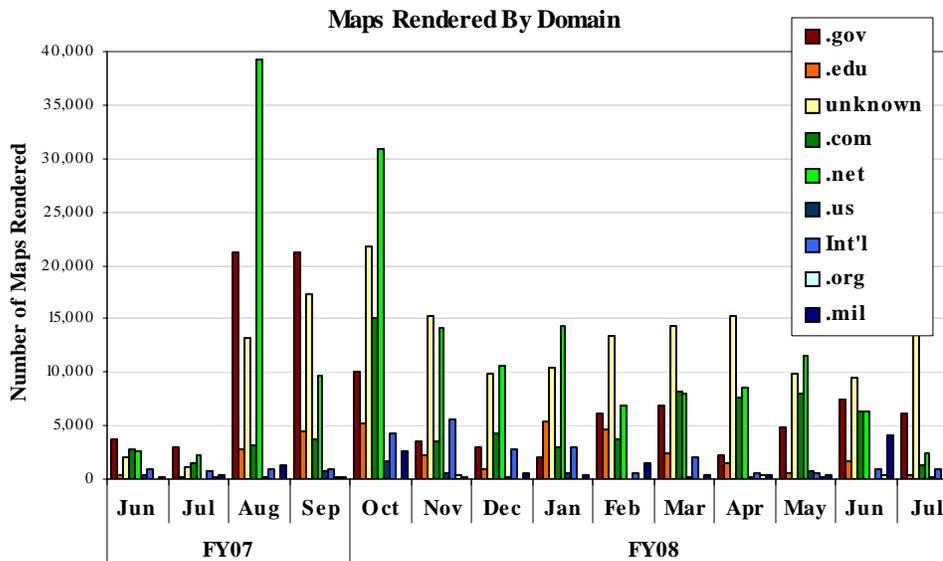
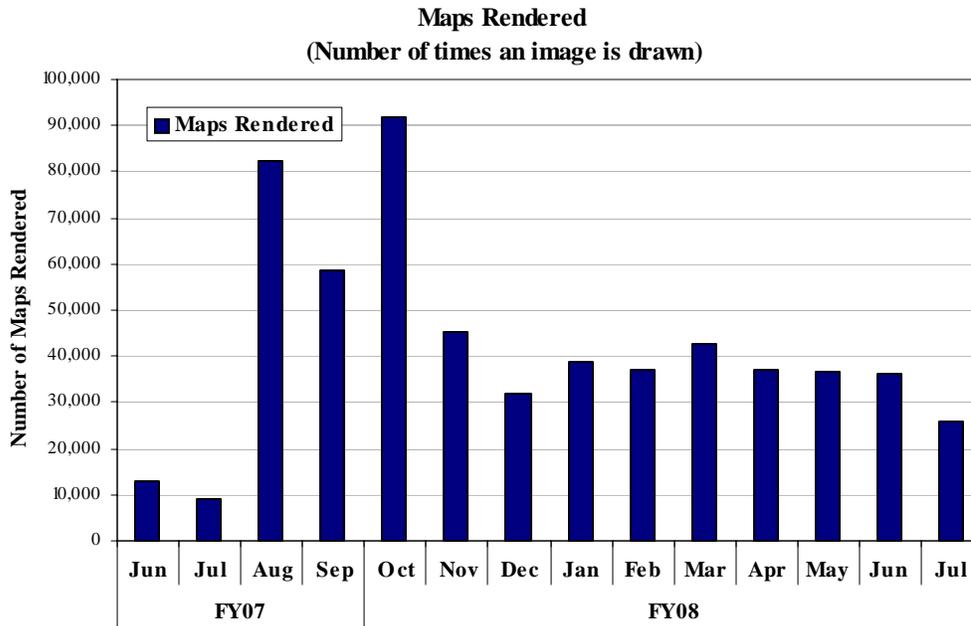


Visitor By Domain

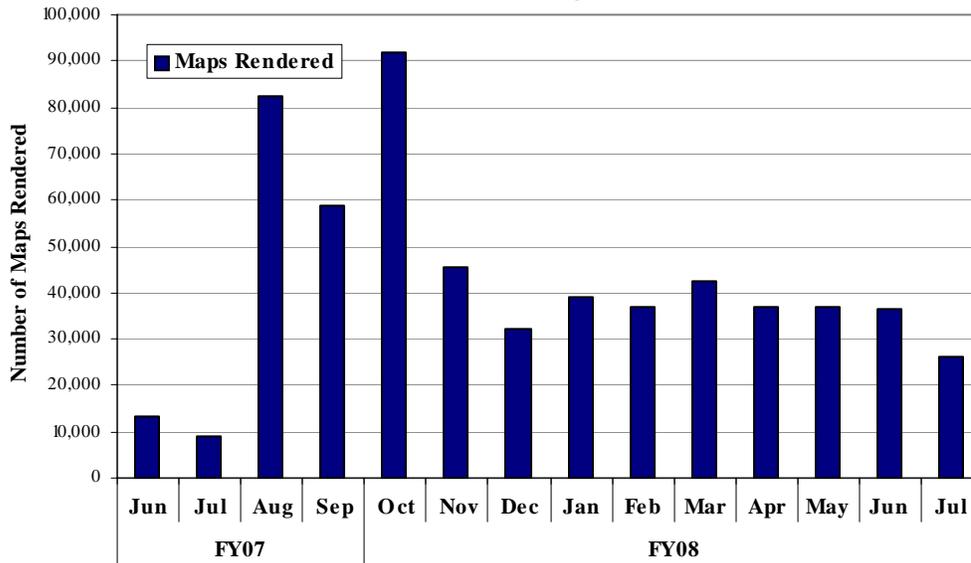




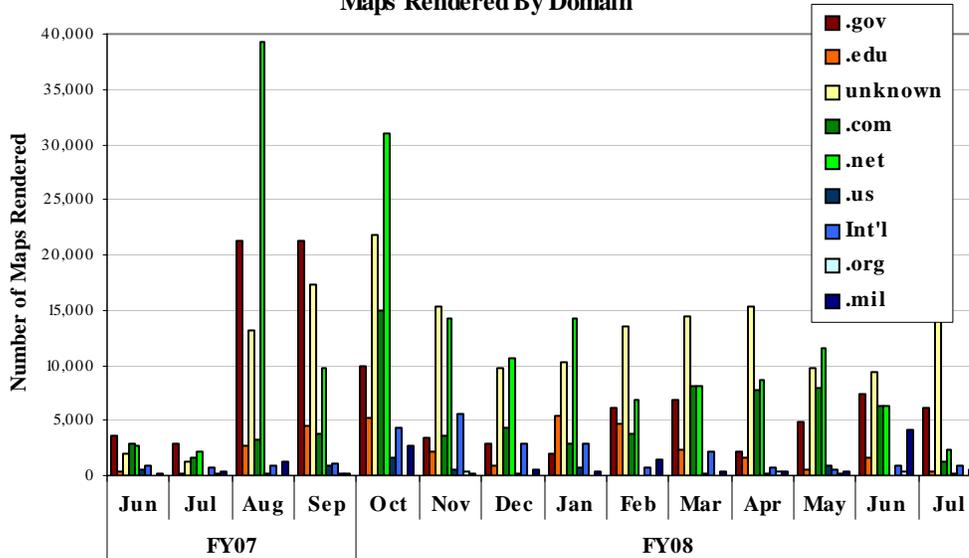
U.S. – Mexico Border Environmental Health Initiative Viewer – Maps Rendered



**Maps Rendered**  
(Number of times an image is drawn)



**Maps Rendered By Domain**





U.S. – Mexico Border Environmental Health Initiative – Data Layer Requests

