

# **IMPROVING COMMUNITY ACCESS TO TRANSBORDER ENVIRONMENTAL INFORMATION IN THE SAN DIEGO-TIJUANA REGION**

**PROJECT NUMBER: EIR97-2**

**RICHARD WRIGHT, SAN DIEGO STATE UNIVERSITY**

**ERNST GRIFFIN, SAN DIEGO STATE UNIVERSITY**

**ALAIN WINCKELL, EL COLEGIO DE LA FRONTERA NORTE**

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## **NARRATIVE SUMMARY**

### **INTRODUCTION**

The Tijuana River Watershed (TRW) is a highly significant transborder drainage basin that covers an area of approximately 1,750 square miles in California and Baja California. It supports some of the most diverse ecosystems in North America, as well as the largest urban population along the United States-Mexican border. Because of the enormous development pressures in the San Diego-Tijuana region, natural and human environments are unable to co-exist in a sustainable way. The huge demand for fresh water in this semi-arid region has had devastating effects on the Tijuana Estuary, one of the last remaining functioning wetlands in Southern California. Industrial, agricultural, and domestic sewage releases into the river have produced dangerous consequences for the human population in the form of outbreaks of gastrointestinal diseases and other illnesses.

Differences between cultural systems, availability of technology, and access to information have hampered efforts by both countries to jointly address the inter-related issues of environmental quality and human occupancy of the watershed. However, an initial geographic information system (GIS) for the watershed has been developed binationally by San Diego State University (SDSU) and the Colegio de la Frontera Norte (COLEF). This GIS, which represents a potentially powerful community access tool, contains data on physical and human characteristics of the basin. The data layers were developed in consultation with numerous individuals from government agencies in the United States and Mexico, as well as GIS experts, academics, ecologists, and community activists. Strong community input insured that the topical content and spatial resolution of the database were relevant to watershed-level applications on both sides of the border. The TRW database has been employed successfully in several projects addressing environmental problems in the watershed. These include efforts to estimate industrial pollution, model surface water runoff, and examine housing quality and population growth for Tijuana. Despite its value for scientific research, the database was not easily accessible to groups outside of the participating universities. Thus, this project sought to address the access issue by developing more user-friendly products from the database. The process by which this was accomplished is described in this report.

## **RESEARCH OBJECTIVES**

This project sought to improve community access to environmental data for the Tijuana River Watershed, thereby contributing to greater awareness of the characteristics of the basin and the nature and causes of its environmental problems. This objective was achieved through the development of a CD-ROM that allows the user to explore the watershed and an ArcView version of database.

## **RESEARCH METHODOLOGY/APPROACHES**

The methodology for this project encompassed a wide range of activities culminating in the generation of a CD and other products for conveying environmental information about the watershed in a user-friendly fashion. The principal activities were: a pre-workshop, student training at ESRI Inc., database development, procurement of aerial photographs, development of a search program, and preparation of the TRW CD.

### **USER NEEDS WORKSHOP**

Prior to official project startup, a workshop on the integration of GIS and communications technology was held at SDSU on February 20–21, 1997. This workshop was co-sponsored by SDSU, the University of Utah, Arizona State University, New Mexico State University, and the University of Texas at El Paso. The objectives of this workshop were (1) to explore alternative technologies for providing GIS-based environmental information to a variety of audiences and (2) to obtain input from those in attendance regarding the most appropriate mix of products required to meet the needs of their constituents. Those invited included representatives from academia, government, the private sector, and NGOs who need to have more effective methods of accessing and conveying environmental information. This project was built on the results of the workshop.

### **STUDENT TRAINING**

A key element of this project involved the use of ESRI's AVENUE, an object-oriented scripting language, for customizing ArcView applications. However, at the time of project startup there was a temporary shortage of graduate research assistants with a knowledge of AVENUE software. To remedy this situation arrangements were made for one of the graduate student project members to intern at ESRI Redlands during the summer of 1998. This was a win-win situation for the student, ESRI, and SDSU because the student made a contribution to ESRI's labor force and upgraded his computer skills, which he brought back to this project. In addition, while at the University of Redlands, he was able to obtain information about CD design from ESRI staff who were consultants on the project.

### **DATABASE DEVELOPMENT**

The TRW database developed prior to the beginning of this project was in fairly good condition, but it had a number of shortcomings and gaps that needed to be corrected. At least one-third of the project effort was directed to making improvements in the database. These

improvements included: modifying the existing geology, geomorphology, boundary, land use, soils, and vegetation coverages; compiling and automating a new roads layer; generating a revised sub-basin layer; and matching all data sets at the border to create an integrated transborder GIS. In addition, new data on precipitation, temperature, housing quality, and water quality were introduced into the database. Finally, it was necessary to re-project all layers in the database to correspond to the terrain-corrected, geo-referenced SPOT image that serves as the project base.

#### AERIAL PHOTOGRAPH INTERPRETATION AND DEVELOPMENT OF SEARCH PROGRAM

An important part of this project was the documentation of historical land use/land cover change in the watershed. This was accomplished through the compilation of information from the aerial photographs dating back to the late 1930s. The compiled information was digitized and added to the TRW GIS database.

Several hundred aerial photographs were purchased for this project. Initially, the number of photographs on hand was manageable, but as the collection grew it became apparent that some type of information system was needed to manage it. The result is a search program that is designed to allow a user to quickly and easily search through a digital database of current and historical aerial photographs to identify specific images. Metadata are also generated for each photo session (flight) that conform to National Spatial Data Infrastructure standards. The metadata files include relevant flight information such as flight height, camera specifications, photo quality, atmospheric conditions, and problems encountered.

#### TIJUANA RIVER WATERSHED EXPLORER CD-ROM

The principal product of this project is a CD-ROM titled, "The Tijuana River Watershed Explorer." The principal purpose of the CD, which was prepared through a partnership with COLEF and ESRI, is to allow users with little or no GIS expertise to visualize the geographic characteristics of the watershed. The "Explorer" was developed in the Center of Earth Systems Analysis Research (CESAR) in San Diego State University's Department of Geography. Utilizing a customized version of ESRI's ArcView version 3.1 and ESRI's Data Publisher, the CD has combined months of intensive geographic data collection and development with a friendly, easy-to-use interface. After the design and customization process at SDSU, the TRW Explorer was sent to ESRI for inspection. Currently, the TRW Explorer is being evaluated at ESRI. The research team is waiting for final approval of the TRW Explorer from ESRI before release of the product.

The CD is organized into an introductory section and four modules. The introduction contains background information about the CD project, an explanation of menus and buttons for navigating through the CD, and an overview of the modules. The content of the CD proceeds from simple watershed description in Module 1 to more complex modeling in Module 4. Module 1, What is a watershed?, introduces the user to the concept of a watershed. It includes sections on the components of a watershed and explanations of the functioning of a watershed approach in understanding the geography of an area. Module 2, Exploring the Tijuana River Watershed, enables the user to examine the major sub-basins that comprise the TRW and the

physical and human dimensions of the watershed. Module 3, Examining Relationships in the Tijuana River Watershed, allows the user to improve his/her understanding of the watershed. This is accomplished by examining a selection of human and physical associations in the watershed. Module 4, Modeling in the Tijuana River Watershed, is intended to further elevate the user's comprehension of watershed relationships through the development of predictive models. The examples employed are those concerned with land use change, temperature and precipitation estimation, and fire risk analysis.

## **CONCLUSIONS**

This research project resulted in significant improvements in the Tijuana River Watershed database and in the development of user-friendly products from that database. These products, which include an ArcView version of the database and a CD-ROM titled "The Tijuana River Watershed Explorer," will allow greater access to information about the TRW.

## **RESEARCH BENEFITS**

The main benefit of this project is the greater accessibility to information about the TRW. In this regard, the principal beneficiaries are watershed educators, planners, and resource managers. Another benefit is improved graduate research education. At least six graduate research assistants received training in techniques of GIS database development, visualization techniques, and data management and analysis. Additionally, another 10 students in the seminar on New Directions in Watershed Analysis, taught during fall 1999, had access to the project database. One of the project research assistants received on-the-job training through an internship at ESRI. The knowledge this student gained during the internship was then imparted to other students on the project team upon his return.

## **ACKNOWLEDGEMENTS**

The principal investigators wish to acknowledge the contributions of the following individuals: Alain Winckell, COLEF, who was the principal Mexican partner; Dan Sherrill, ESRI, who provided guidance in the conceptual design of the CD-ROM product; Carmen Masó, United States Environmental Protection Agency (U.S. EPA) Region 9, who was the contact for this project; and Paul Ganster, Institute for Regional Studies of the Californias, who contributed funds to cover portion of the cost of aerial photographs. Lastly, we wish to express our gratitude to the SCERP Management Committee for funding this project.