

Using GIS to Develop and Improve Local Governance in Iraq

Bill Wheaton, RTI International

Abstract

RTI International¹ (RTI) is under contract to the U.S. Agency for International Development (USAID) to help establish local governance, civic society, and municipal administration systems in Iraq. Geographic information systems (GIS) technology is being used as a primary tool by RTI staff in Iraqi cities as that nation begins to enhance and develop the institutions and systems required to govern municipalities. Many of the major cities in Iraq, including Baghdad, Mosul, Najaf, and Diwaniya, have begun the process of developing nascent GIS to help guide city services, land records, utilities, and other vital municipal functions. This paper will describe the goals, challenges, activities, and status of RTI's efforts to bring GIS to bear in solving Iraq's municipal governance problems. Our experiences on this project may help other humanitarian agencies as they plan for the development of GIS in other parts of the world.

Introduction

RTI was awarded USAID's Local Governance Project (LGP) contract in April, 2003. The purpose of the LGP contract is to strengthen the management skills and capacity of civic institutions and local administration, as well as to improve the delivery of essential municipal services to the country, such as water, health care, public sanitation, and economic governance.

Throughout the first year of the project, RTI's in-country team of 200 international development specialists and roughly 2,000 Iraqis worked in 18 Iraqi governorates on a wide array of locally selected priorities, ranging from increasing access to basic utilities and healthcare to establishing and training local governing councils. Funding for the first year of the LGP contract was greater than \$140 million. Figure 1 illustrates the deployment of staff as of early August, 2003. Eventually, staff were deployed in all eighteen governorates.

¹ RTI International is an independent, nonprofit organization dedicated to conducting research that improves the human condition. With a worldwide staff of more than 2,500 people, RTI offers innovative research and development and a full spectrum of multidisciplinary services in health and pharmaceuticals, advanced technology, survey and statistics, education and training, economic and social development, and the environment. Universities in North Carolina founded RTI in 1958 as the first scientific organization in and centerpiece of the Research Triangle Park. Today, RTI serves clients in government, industry, academia, and public service throughout the United States and abroad.

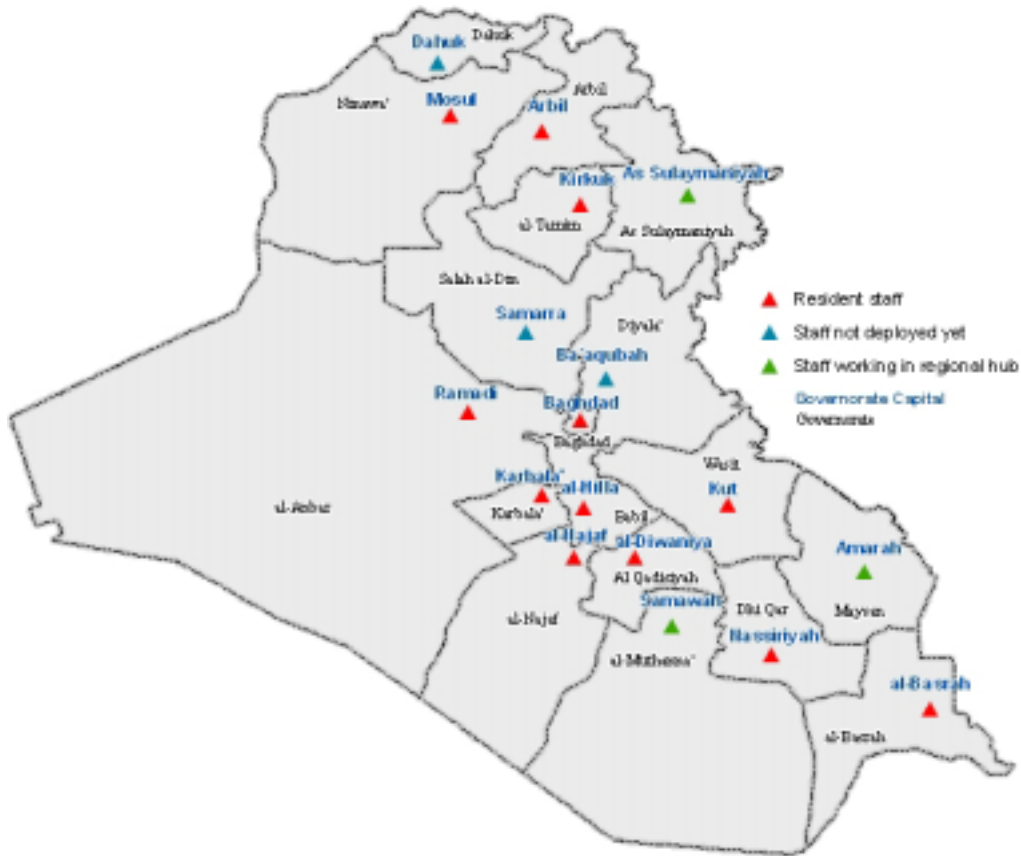


Figure 1. RTI deployments as of early August, 2003. Eventually over 200 RTI staff were deployed in all eighteen governorates.

The LGP is not a GIS project. Indeed, GIS is not mentioned in the scope of work; however, RTI’s GIS staff, management, and the RTI staff in Iraq recognized the potential for GIS to support the needs of the contract.

Early Project Activities

RTI began deploying staff to Iraq in May, 2003, shortly after the fall of the Sadaam Hussein regime. As this time, hiring, logistics, travel, visas, and security were in a high state of flux. In many cases, staff did not know where they would be stationed when they first traveled to Iraq; therefore, some of initial materials needed by staff included basic maps of the country. The former Hussein regime was highly centralized and secretive—a trait that precluded the development and availability of high quality maps. In order to provide staff with maps of the country, RTI located published tourist maps of Iraq and purchased several hundred for use. These were provided to all staff traveling to Iraq.

GIS staff embarked on an intense search for existing hard-copy maps and digital spatial data for the country. Although there were topographical maps of Iraq of various scales generated by the Soviet military in the 1970s, it soon became clear that a modern, national set of topographical maps of Iraq did not exist. RTI purchased DRGs of the Soviet military maps for major Iraq cities and provided hard copies of these maps to staff traveling in country. Throughout the summer of 2003, RTI GIS staff concentrated on developing improved and more detailed maps for staff than

what was already available. These efforts resulted in several series of map products, including *City Map Books*. These are 8.5x11” map books (insert sample) that used either satellite imagery (taken from the Humanitarian Information Center Web site, www.agoodplacetostart.org) or vector street data. These city map books were created for all 18 governorate capitals. A complete set consisted of over 300 maps. Figure 2 illustrates the basic contents of the city map books.



Figure 2. City Map Books were produced for the 18 governorate capitals. Map books contained vector maps, satellite imagery, or both, depending on data availability.

1:100,000 Scale Base Maps. RTI acquired a detailed vector base map database for Iraq from USAID that was based on 1:100,000 scale source maps. The provenance of these data was never fully explained, but it is clear that the data were originally a military source that was scrubbed of the most sensitive information. RTI designed and produced a national map series from the 1:100,000 vector data that contained 108 map sheets. RTI plotted many sets of these maps and shipped them to various places in-country for use by staff. Figure 3 illustrates an entire map sheet, and Figure 4 shows a smaller detail view.

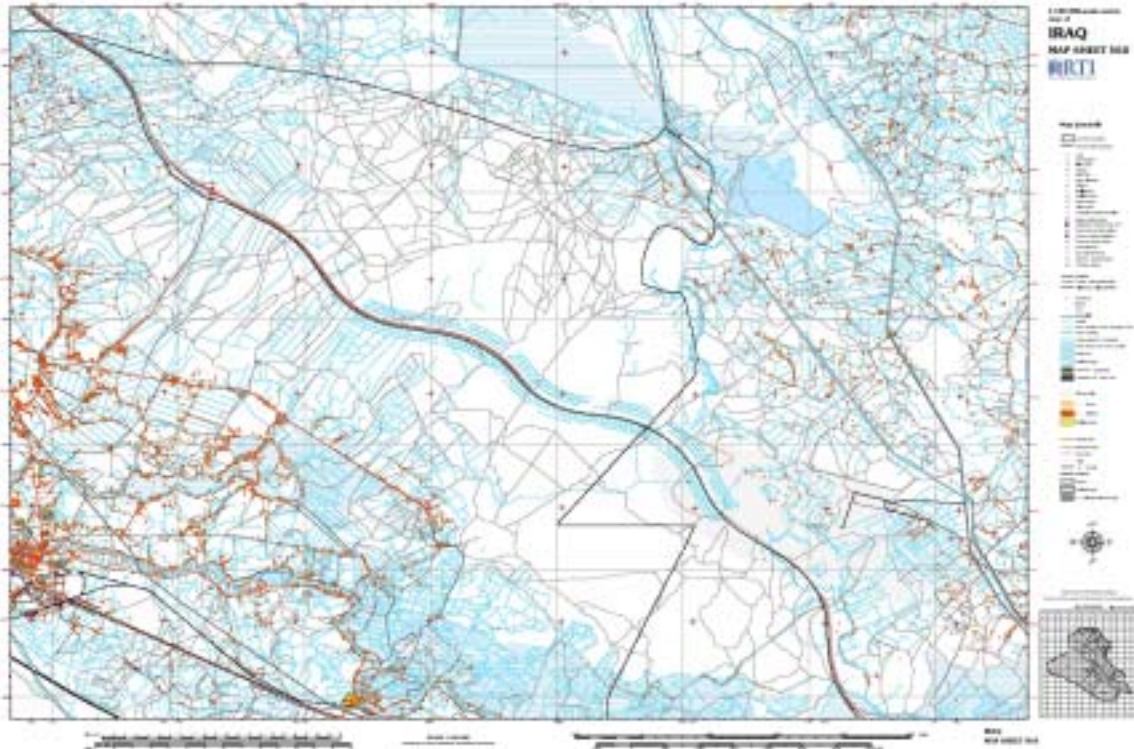


Figure 3. The 1:100,000 map sheets created by RTI were the first complete set of detailed base maps generated for Iraq for use by the public.



Figure 4. A detail from one of the 1:100,000 scale map sheets.

1:100,000 Scale Base Maps with Imagery. The National Geospatial Agency's (NGA) GeoEngine Web site provided free access to 10-meter black and white imagery for Iraq. RTI download all of these data and used them as a backdrop to a second set of 1:100,000 scale base maps. Figure 5 illustrates a detail from one of the 1:100,000 scale maps with the imagery background.

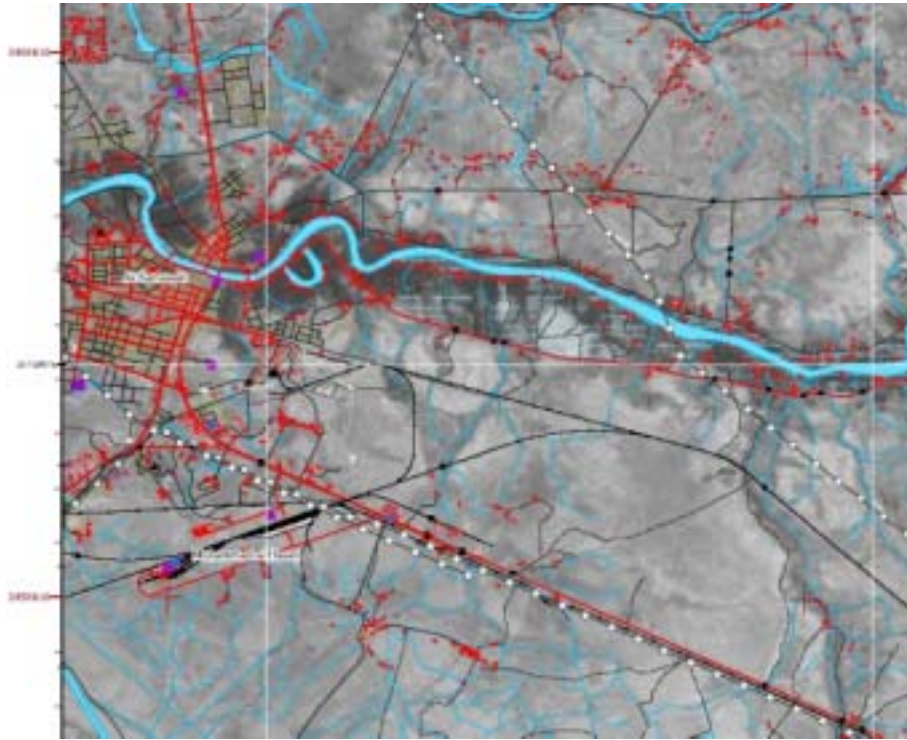


Figure 5. A detail image of a 1:100,000 map sheet that includes the 10-meter black and white background imagery.

1:100,000 Scale Base Maps with Military Grid: Because military operations were so critical in the early stages of the contract and staff deployments, RTI produced a set of 1:100,000 scale base maps with the Military Grid Reference System (MGRS) to aid in coordinating activities with military personnel (Figure 6).

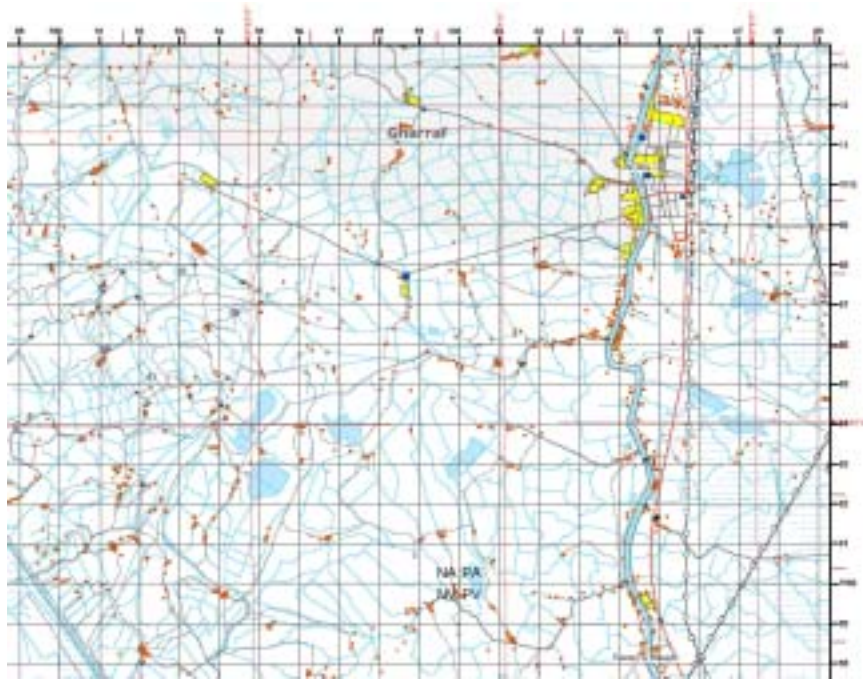


Figure 6. The Military Grid Reference System consists of grid marks at 1,000 meter intervals that are lettered and numbered in such a way as to provide an easy scheme to express locations quickly and concisely.

Governorate Base Map. Using the same 1:100,000 vector data, RTI produced a set of 18 governorate base maps, where each map included an entire governorate. Figure 7 illustrates one of the Governorate Base Maps.

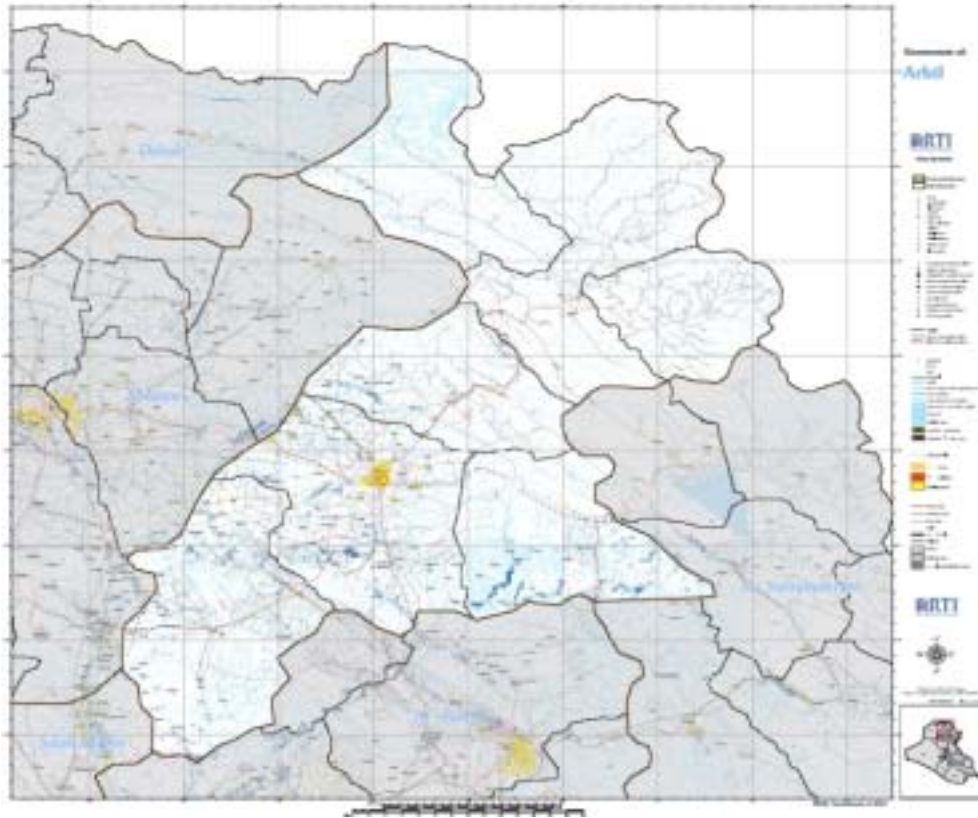


Figure 7. A governorate base map built from the 1:100,000 source data.

Municipal GIS Start Ups

The logistics of setting up GIS (indeed, setting up any modern working systems) in Iraq are enormous. The problems encountered initially included

- Lack of stable power (due to years of neglect and mismanagement)
- Lack of telecommunications (due to years of insufficient infrastructure investment)
- Lack of office furniture (due to looting following the fall of the Hussein regime)
- Lack of source materials (most maps and documents had been looted)
- Lack of equipment (again, due to looting).

Despite these issues, an enormous amount of work had been accomplished by November 2003, and staff began making requests for GIS data, software, and advice.

The lack of source maps for GIS is especially problematic in certain areas. Without paper maps of infrastructure, facilities, and land records, initiating a modern GIS-supported municipal government is extremely difficult. Additionally, because almost all national and local government planning and investment decisions had previously been made in the capital city of Baghdad, there was almost no local decision making or control (not even local government, per se) in individual Iraqi cities. Therefore, establishing the governmental systems (including the establishment of local councils, determining the type of local government systems to establish, and educating local populations about the purpose and responsibilities of local governments) was a priority before sophisticated GIS could be deployed.

As RTI staff established themselves in-country and started to organize their work, they began to focus on the tools they would need to do their jobs. In Mosul, Najaf, Diwaniyah, and Baghdad there was early interest in developing GIS systems to support municipal government. The

interest came from LGP staff who either knew some GIS or knew that they needed GIS to do their jobs. These staff included former city managers from the United States, water resources specialists, and urban planners.

Base Data: When LGP staff in Iraq requested data, we acquired and delivered good quality basemap databases and basic GIS software for them. The basic data package included governorate boundaries, 1:100,000 vector data, high-quality and recent satellite imagery (.6-1.2 meter resolution in either color or black and white), and street vector data matching the satellite data. Satellite imagery and vector data were purchased from commercial vendors.

Since setting up full-fledged GIS operations in Iraq was not part of the LGP project scope, RTI was limited in how much support we could provide in purchasing hardware and software. RTI purchased a few copies of ArcView for individual LGP staff; however, we did not purchase any hardware. It was left to the local LGP staff to develop grant applications to find funding for multi-user workstation GIS systems.

Mosul

In November, 2003 the Mosul LGP team began planning for and setting up a GIS. The GIS initiative was led by Peter Ray with assistance from Tom Chapman, Zuhair Ismail Ali and Safwan Alhiali. Initially, a basic data package was sent along with a copy of ArcView.

Water System: One of the first initiatives to be explored with the basic GIS implementation was the Mosul municipal water system. Staff in Mosul located blue-line maps of the water system as it existed in the mid-1990s. These blue-lines were then sent back to RTI headquarters in North Carolina to be digitized. The resulting water system layer was registered and rubbersheeted to the satellite imagery for Mosul. (As it turns out the blue-line maps were created by Kanal Ablul Lateif Yass, an Iraqi graduate student in Mosul, as part of his civil engineering degree. Dr. Yass now has his own engineering firm, Al-Ghadak, and was contracted by the LGP team in Mosul to provide GIS training, services, and consulting.) The water system layer was sent back to Mosul to be used with the municipal water agency staff, who began the process of learning GIS. Figure 8 illustrates the water system layer.

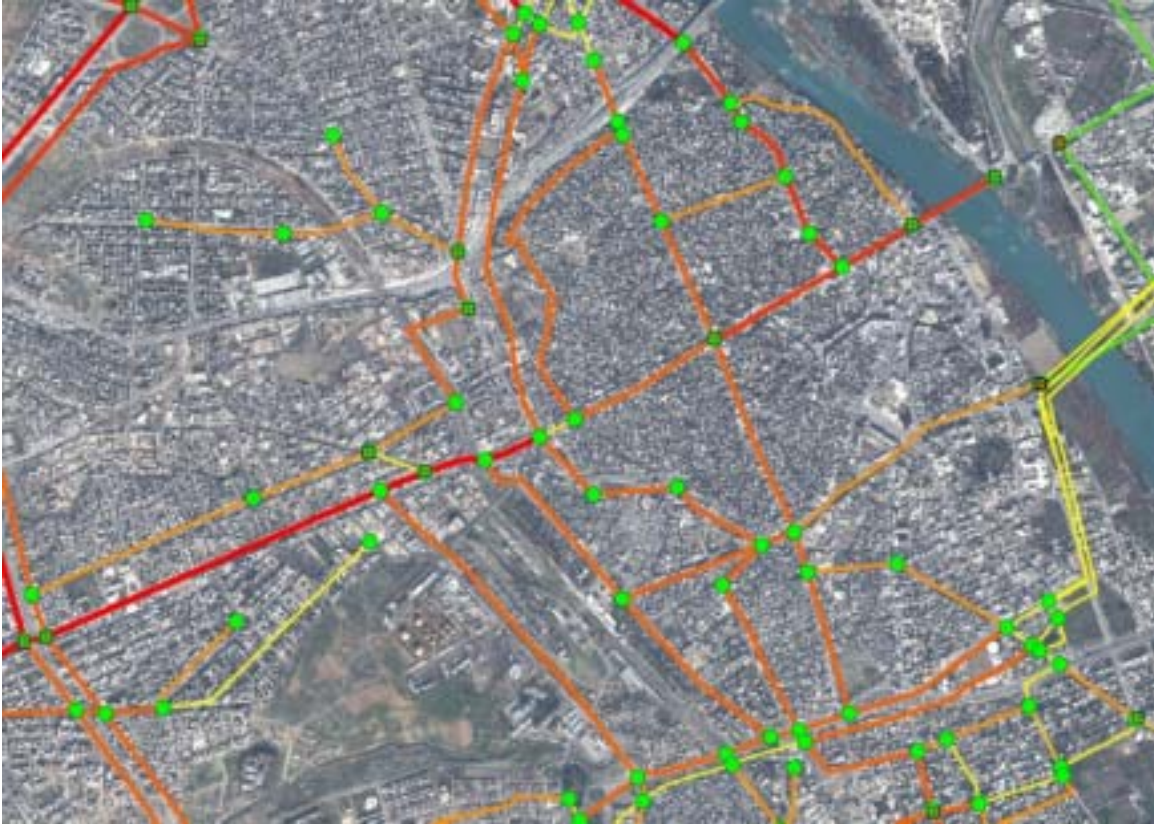


Figure 8. A portion of the Mosul water system layer.

By late January 2005, municipal departments were already using the satellite imagery and street vector files to do street analyses and traffic projects.

Grant for Full GIS Implementation: The GIS team in Mosul then went about the process of writing a grant application to acquire a full GIS system consisting of computers, software, peripherals, and training. The grant was approved, and several PC workstations, software, and peripherals were installed for use in the GIS center. By late February 2004, Al-Ghadak was conducting an extensive training course for engineers and planners from a variety of municipal service agencies. They used satellite imagery and associated street vectors for base mapping purposes in the city of Mosul. Staff from the water, sewer, roads, and urban planning departments attended training and were described as “very enthusiastic about the new technology, often staying after the training sessions to continue working and learning”. Training and pilot projects continued in March and April.

Current Status. The GIS system continues to function in Mosul despite security issues. The local Iraqi staff are building their expertise and confidence with the system; however, additional training and support are needed to develop more sophisticated applications and to take advantage of more sophisticated database designs and data integration strategies.

Diwaniyah

The situation in Diwaniyah was very similar to that in Mosul. One of the local LGP staff, Steve Blanchard, was involved in urban services, water delivery, and other urban planning activities identified the need for a GIS system to support his work. Mr. Blanchard spearheaded GIS

implementation in Diwaniyah. He was able to purchase PCs locally and ordered ArcView. His original intent for the system was to “collect all relevant local utility information and to use it to coordinate traffic studies, solid waste collection networks, and to help the different branches of government here coordinate basic utilities.” As with other cities, the RTI GIS group provided a base map package that included satellite imagery and street vector layers. By November 2003, the Diwaniyah staff had A3 scanners, A3 printers, ArcView, PCs, and basic data for Diwaniyah and the entire Qadisiyah governorate.

By March 2003, the Diwaniyah staff had scanned several hundred individual A2 sized blue print drawings that detail the existing water system. The resulting water systems layer was then used as an input to water system modeling software called KYPipe2000. These analyses helped to determine where new infrastructure was needed and of what capacity. In addition to the water maps, existing property/parcel maps were also available and scanned.

Soil Salinity Index Mapping: Iraq has an enormously important and productive agricultural system; however, one of the biggest threats to agriculture is soil salinity. Local agricultural experts in Diwaniyah (Juan Sevilla) requested help in creating soil salinity maps to assist with irrigation and agricultural planning. RTI staff researched methods for using satellite imagery to create soil salinity indexes and found a recent methodology used in Syria². This methodology used the ASTER satellite imagery and a fairly simple calculation to create an index of soils salinity. The ASTER data was available for much of Iraq; therefore, RTI began the process of creating soil salinity maps, primarily at first in the southern region. RTI will develop and publish subsequent articles on this methodology and its success in the near future. RTI has not performed any ground truthing on this methodology, and so the results are considered preliminary. However, the method shows promise. An example of the results is shown in Figure 9.

² “Soil Salinity Detection Using Satellite Remote Sensing”, March 2003, Fouad Al-Khaier.
http://www.itc.nl/library/Papers_2003/msc/wrem/khaier.pdf

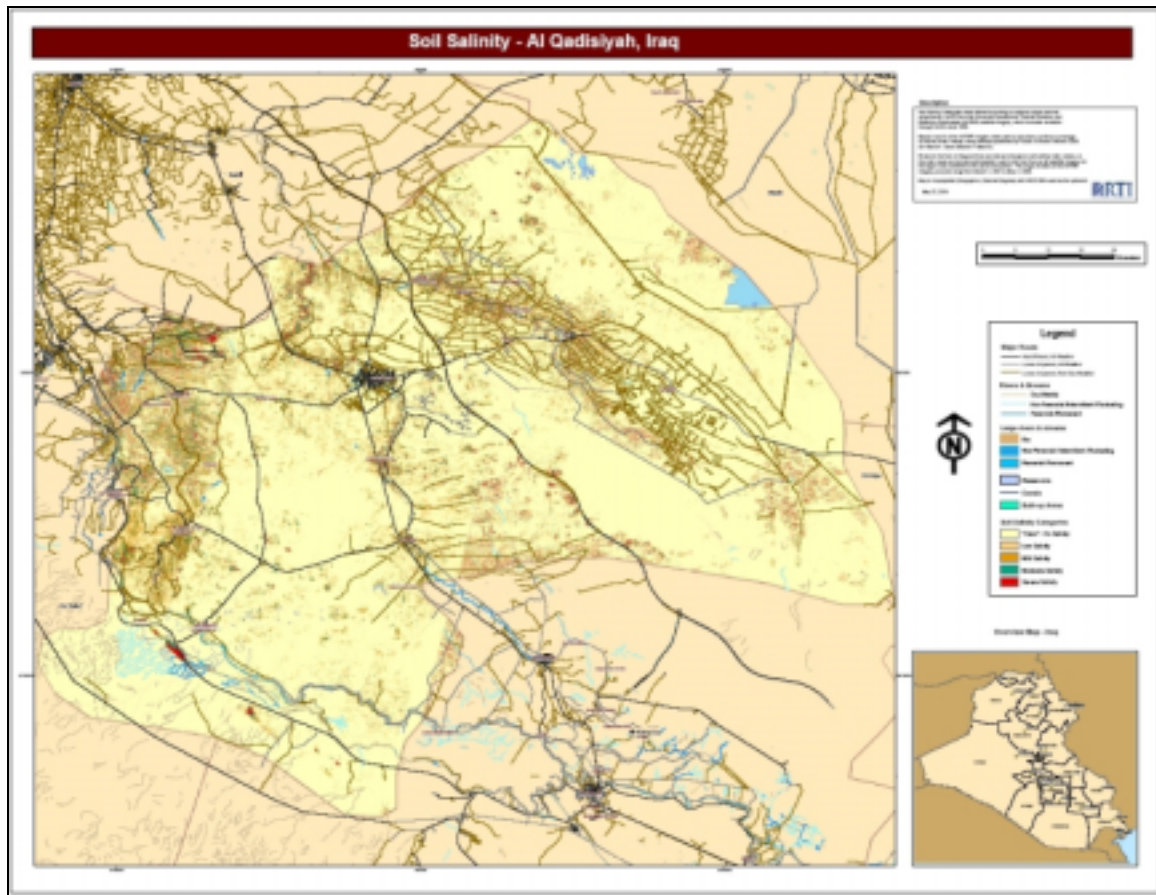


Figure 9. Soils salinity maps will help agricultural specialists plan for irrigation projects.

Najaf

Although a GIS system per se has not yet been developed in Najaf, one of RTI's LGP staff, Gabriel Abraham, has been using ArcView, along with standard satellite imagery and vector street data, to begin some preliminary uses of GIS in Najaf. One of the first needs identified was for additional data on local landmarks, facilities, and government offices, as well as other points of interest in Najaf. With Mr. Abraham's help, new layers were created that included these points of interest. A sample of the point locations added is included in Figure 10. Note some of the interesting land use characteristics, such as the location of the produce market, which is almost completely surrounded by the Najaf Cemetery. As of this writing, future work in Najaf is somewhat in jeopardy because of a security situation that arose in April. Nevertheless, when possible, work is continuing to develop additional layers in Najaf.



Figure 10. Najaf imagery and street layer, along with custom landmark layer derived from LGP staff member stationed in Najaf.

Baghdad

There was early interest in re-establishing a GIS in Baghdad. In the mid-1980s, a significant design study had been performed in Baghdad, but after the first Gulf War, no further steps were taken. RTI contracted with GPCI, Inc., to conduct a preliminary assessment and to develop a technology strengthening strategy. GPCI's Mark Sorenson traveled to Baghdad in early April 2004 to conduct interviews with Baghdad GIS staff who still remained in the city and with municipal department heads and engineers. (Mr. Sorenson, coincidentally, had been the lead consultant who had performed the study done in the 1980's.) Although the security situation deteriorated shortly after Mr. Sorenson's arrival, he was able to carry out most of his tasks. Since Baghdad is a city with a population of over 6,000,000 establishing a GIS there will be an enormous undertaking. Although some first steps have been taken, the development of GIS in Baghdad will require significant investment and a great deal of time.

Future Directions

Other cities in Iraq are in various stages of development of GIS, the author of this paper is not familiar with the details in those areas. As the security situation improves and local sovereignty is returned to Iraq, GIS will naturally develop at the national and local levels. What will be needed is sustained investment in training and consulting until the Iraqis have developed enough expertise to sustain their own operations. Based on the experience of RTI's LGP staff, the Iraqi

professionals who run municipal service departments are highly professional and highly motivated to learn GIS and use it to the benefit of their missions.

One critical aspect of GIS development in Iraq that is yet to be addressed is the relationship between national level GIS infrastructure development and local level development. Without a dialogue between these two levels of government, opportunities for standards development and data sharing may be lost. In the near future, RTI GIS staff will attempt to initiate this dialogue between local GIS users and national and international GIS development organizations.

Author Information

Bill Wheaton
Senior Research Geographer
RTI International
3040 Cornwallis Rd
RTP, NC 27709
919-541-6158
wdw@rti.org