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GIS MAPPING FOR IRRIGATION DISTRICT RAPID APPRAISALS

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ABSTRACT

Geographic information system (GIS) mapping is slowly becoming commonplace in irrigation districts as the need for more accurate and organized data becomes increasingly important. The Irrigation Training and Research Center (ITRC) at California Polytechnic State University, San Luis Obispo commonly uses GIS as a tool in technical assistance packages for irrigation districts. One of the challenges in developing a strategic irrigation district modernization plan is to organize spatial data in such a way that various options can be easily understood. ITRC uses a combination of commercially available software with web-downloadable maps and photographs to organize and present the spatial information. An example of information organization for a Rapid Appraisal Process (RAP) of Tulare Irrigation (TID) district is given, showing how the district boundary, major portions of TID's open channel distribution system, field boundaries, biannual groundwater elevation contours, major water bodies, streams, rivers, and wetland areas are overlaid on two basemaps, one with aerial photographs and the other with USGS topographic maps (1:24,000 and 1:100,000), using ArcView® GIS and the 3D Analyst extension.

INTRODUCTION

Mapping is an important component in irrigation district management and operations. Most irrigation districts have large maps covering the walls of lobbies and boardrooms. Generally, these maps show the district boundaries and the surrounding areas. In many cases, highlighters have been used to indicate the distribution system and the maps are littered with handwritten notes made over the years.

A number of events in the last 10-15 years have changed the way mapping is used throughout the irrigation district community. Some of these events include:

- Pressure from external organizations to show improved water use efficiency, increasing the necessity to record, organize, and present large amounts of data that were not originally needed for day-to-day operations.
- Increase in data made available through the World Wide Web by local, state, and federal government agencies.

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Providing the spatial layout of Tulare Irrigation District's complex distribution system to the RAP project staff was an important aspect of this GIS project. It not only helped facilitate the modernization recommendations, but it was also instrumental in presenting these recommendations to the District. The open channel shapefile was modified to show only TID distribution components. The key components were labeled and the line weights and colors were modified so that the map could be easily interpreted. In this case, the district personnel had very good estimates of the time it takes for flow rate changes to travel from the sources to key points in the system. However, if a need exists, channel lengths and slopes can be estimated using ArcView® and used to help estimate travel times.

Cropping information can also provide useful information for making irrigation district modernization recommendations. For example, over the last two decades California has seen a dramatic shift from conventional irrigation to drip and microspray on orchard and vineyard crops. Drip and microspray irrigation methods require more flexible irrigation water deliveries than conventional flood irrigation. If the district cannot meet this demand, farmers shift to using groundwater instead of the surface water provided by the district. If a portion of the district is primarily orchards and vineyards, this region may become the focus of an initial modernization effort to provide increased flexibility in district water supplies. The field boundaries shapefile containing crop information was used to show the spatial crop distribution.

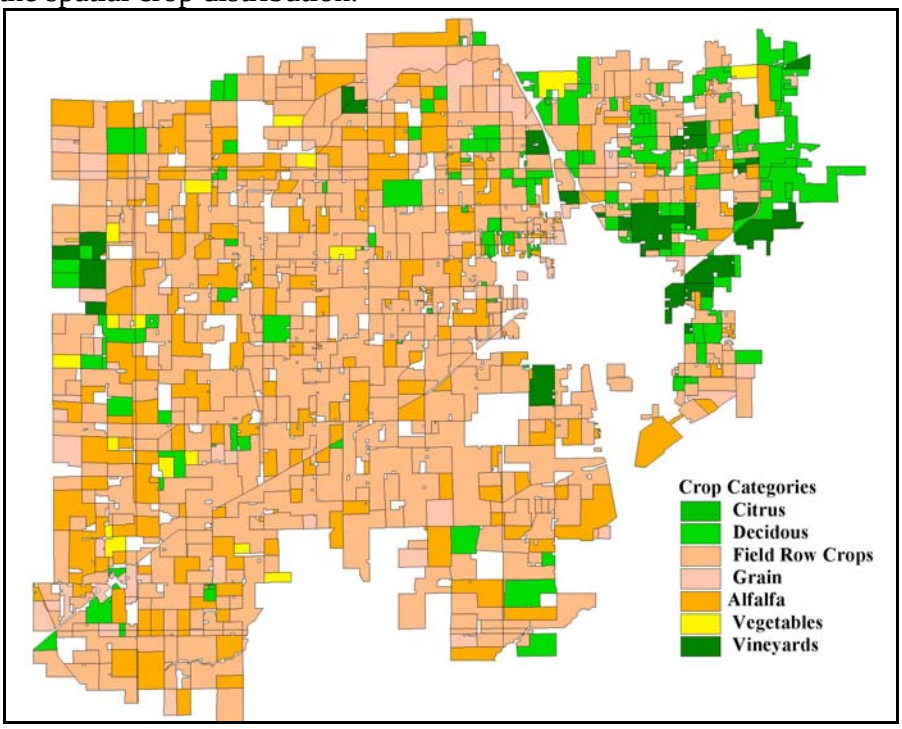

Figure 2. Crop distribution in Tulare Irrigation District

Groundwater elevations and movement have become increasingly important in California because of overdraft and water quality concerns. Subsurface groundwater movement into and out of the district boundaries is an important component of the water management plans that the districts are required to submit to the California Department of Water Resources or the U.S. Bureau of Reclamation and, in some cases, both agencies. Groundwater lines of equal elevations (contours) can assist the district in estimating subsurface lateral groundwater movement as well as areas of significant overdraft. The DWR generally takes well elevation readings in the spring and fall of each year. The ITRC generated TID groundwater contour maps for Spring and Fall of 2002. ArcView® 3D Analyst extension was used to generate these contours in ArcView® GIS.

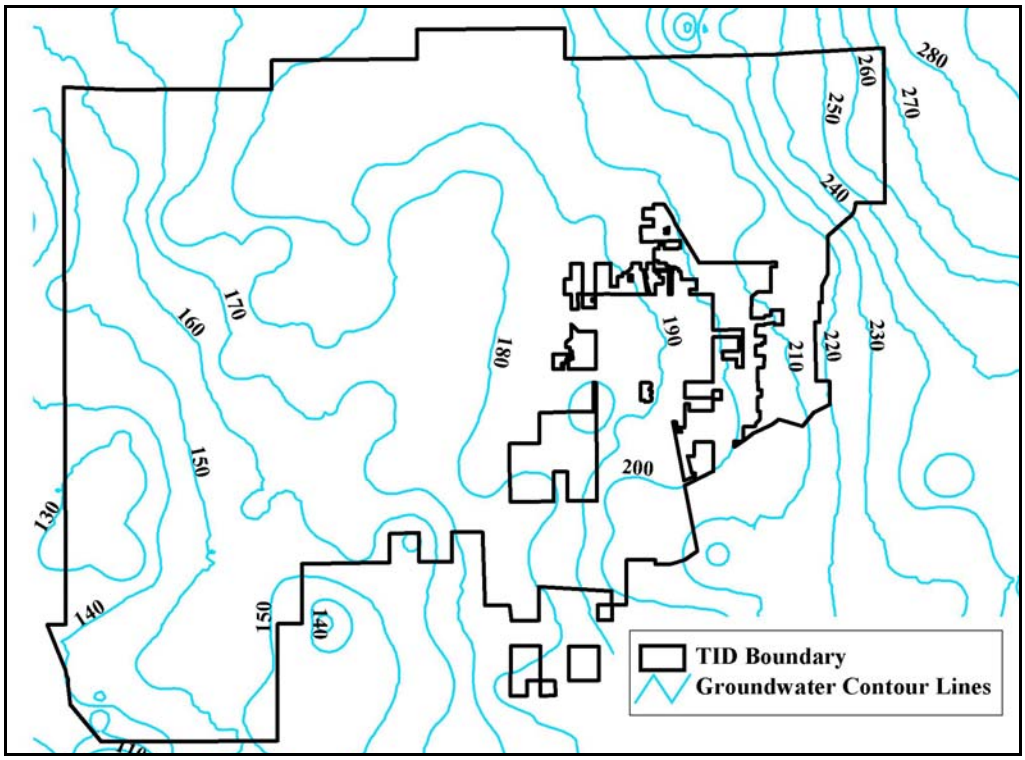

Figure 3. Groundwater lines of equal elevation from mean sea level for Tulare Irrigation District using data for Spring 2002

ArcView® GIS can also be used to generate approximately lengths and areas from scaled aerial photos, which is helpful in the preliminary design of improvement structures. The areas of potential reservoir sites, as well as lengths and elevations of potential pipelines and open channels, are common examples of the data obtained for preliminary designs.

Step 4. Presentation

Once the Tulare Irrigation District modernization plan was complete, GIS mapping was used to present the recommendations to the district in report and PowerPoint format. A simple well-labeled map without a basemap was used at the front end of the document and presentation so the reader and audience had a reference to refer back to when specific sites were mentioned.

Aerial photos were used extensively to layout conceptual designs of each recommendation. The export function in ArcView® GIS allowed ITRC personnel to extract recommended improvement areas as images so they could be imported into the main report and Microsoft™ PowerPoint presentation without making modifications to the overall GIS project. A final version of the GIS project with summarized recommendations was printed out on a large format printer and given to the district with the final RAP report.

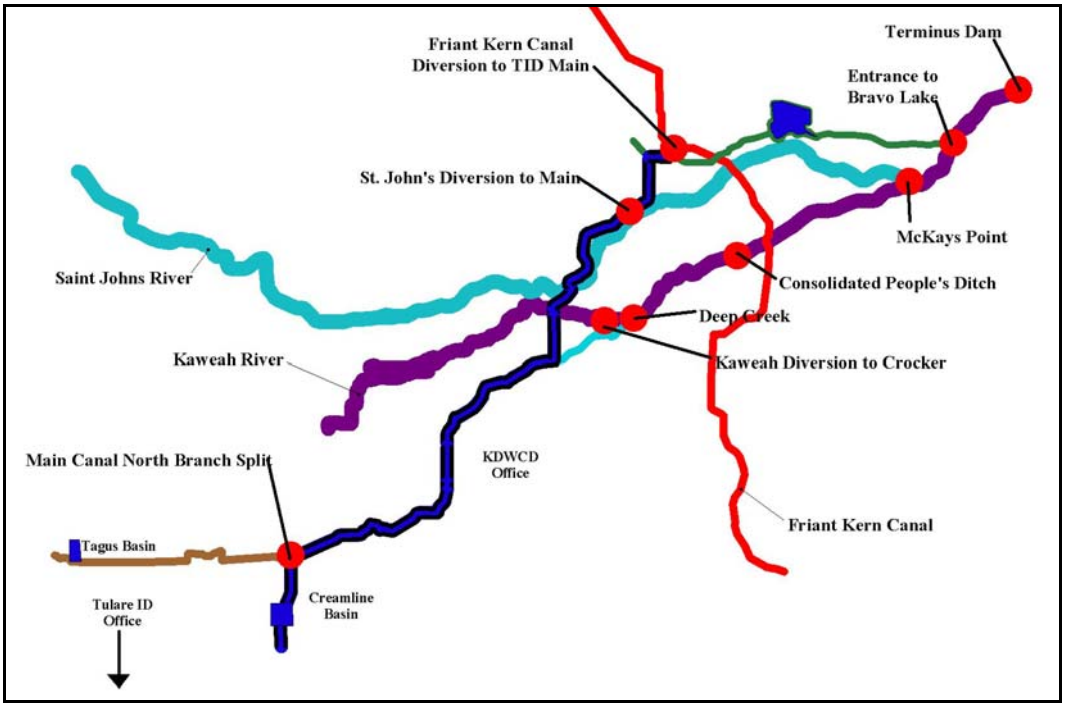

Figure 4. Simple layout of distribution system northeast of Tulare Irrigation District. The labeled points indicate key modernization sites discussed in the report.

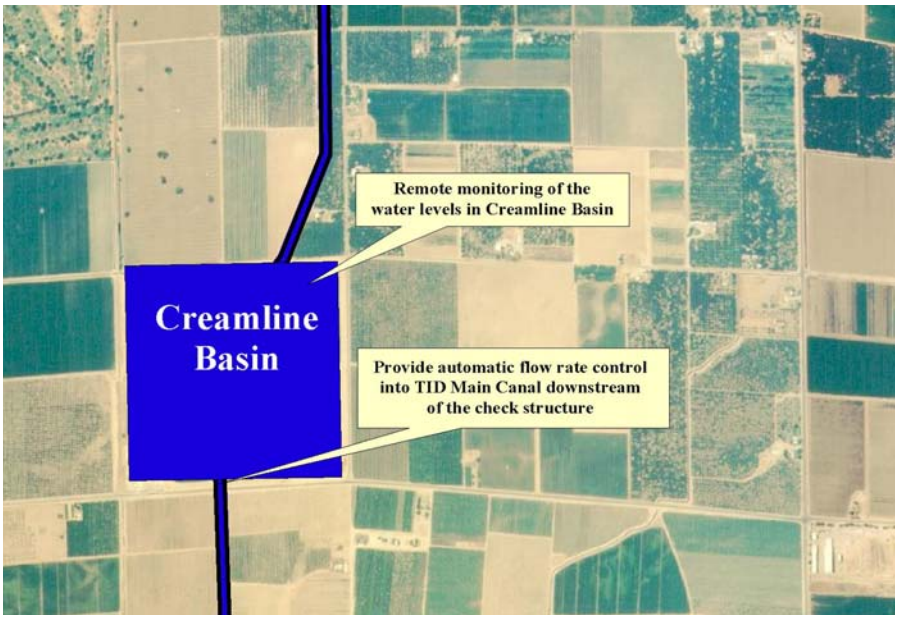

Figure 5. Example of using the export function in ArcView® 3.2a to export images for reports and presentations.

SUMMARY

In summary, GIS mapping can be an effective tool to organize, retrieve, and present spatial data for irrigation districts. The Irrigation Training and Research Center (ITRC) at California Polytechnic State University, San Luis Obispo uses a combination of commercially available software with web-downloadable maps, photographs, and datasets to organize and present the spatial information.

ITRC has provided similar project datasets to some irrigation districts and has trained district staff in the use of ArcView® GIS. The spatial information offers districts an excellent starting point from which to expand their GIS mapping capabilities.

REFERENCES

Environmental Systems Research Institute. 1999. Getting to Know ArcView® GIS. ESRI Redlands, CA.