

# **The Evolution of GIS, Hydrographic Surveys, and Adjudications**

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## **Abstract**

This paper examines how GIS and digital data management technologies have supported the hydrographic survey and adjudication of water rights in New Mexico and emphasizes how changes in the use of GIS and data management can change the process of water rights surveys and adjudications in the future.

The Office of the State Engineer (OSE) has been performing hydrographic surveys and adjudications of water rights since the turn of the last century. In the last 10 years the Litigation and Adjudication Program of the OSE has pushed to implement GIS and database technologies to perform surveys and support the adjudications. At first the new technologies replaced corresponding tasks in the existing process. Now new technologies are supporting changes in how the technical and legal processes interact to survey and adjudicate water rights.

## **Introduction**

The Office of the State Engineer (OSE) has a long history of performing hydrographic surveys pertaining to water use and the right to use water. The Litigation and Adjudication Program (LAP) uses those surveys in the Adjudication of those water uses. The Office has always made use of current technology, beginning with plane table surveys and moving through various stereoplotters to perform the surveys and create maps and reports. Other types of tabular data used in the surveys were kept in extensive paper files. Initially, the shift to digital technology was used to update existing processes. We used a database to augment the paper files for storing the data and to create the reports and other documents. Digital ortho-photography and GIS software were used to create the maps and analyze the spatial information.

The implementation of digital spatial and tabular technology has been slowly influencing the business process to the point where we have recently undertaken several new surveys in which the technology is supporting a fundamental change in the business process of surveying and adjudication. The historical methods relied on field crews collecting data from individual water users. The current method utilizes digitized historical data, contemporary digital data and ortho-photography to minimize field work and generate a more accurate product. The survey and adjudication of the La Plata River section of the San Juan River adjudication is a good example.

## **Historical Methods**

Traditionally surveys were the responsibility of a survey crew. They made the initial contact with people in the field and collected information on irrigation as well as ownership and history of the water rights. This meant talking directly to land owners or

water users and irrigation officials about land ownership and researching ownership through paper records at the County. They also researched paper records at our office for water rights applications that might affect the water uses being surveyed and meeting with landowners to physically inspect irrigated lands. The surveyors would compile all this data into files and then send it onto the mapping group and the database manager to create the maps and build the water rights database. Essentially we were using the new technology to improve the old process.

The La Plata River was surveyed in 1938 and adjudicated in 1948 along with the entire San Juan Basin under the Echo Ditch Decree. For various legal reasons, the basin is involved in another water rights adjudication. The 1938 Hydrographic Survey consisted of 6 Key map sheets and 103 individual map sheets. Twelve map sheets covered the La Plata River. The Hydrographic Survey also included a 2-volume report. The most extensive was volume 2, the ditch records. This 441-page report gives a detailed listing of the individual uses as shown on the map for each owner on each ditch. The decree itself was published in a 379-page volume broken up into two sections. The first section is 88 pages long and gives the general findings of the decree. The remainder of the decree is devoted to describing the elements of the individual rights by ditch and owner. The main problem with the decree is that the rights described in the decree do not always relate to the uses described in the Hydrographic Survey maps or report. The Hydrographic Survey maps were not updated to reflect changes to the uses given as rights in the decree. In most cases, an unidentified person entered handwritten notes in the ditch records to try and reconcile the report to the decree, but in many cases supplemental information is left out or is incomplete. This makes it difficult to definitively map all the decreed rights. There are also cases in which land that was mapped as irrigated was not decreed a right and new owners were added to the decree that do not appear on the maps.

The La Plata was resurveyed in 1982. That survey consists of 4 key maps, 21 individual maps sheets and a report approximately 700 pages long. This survey never had any public input and never went through any type of field office based corrective process. It was therefore used as an intermediate field inspection or snap shot in time between the 1948 decree and the present survey. The twenty plus year time period between the 1982 survey and the present gives a good indication of which uses may have been abandoned since 1948.

### **Modern Methods**

The basic plan of the current Hydrographic Survey is to compile and covert all the historic data discussed above into a digital format. The digitized historical data is then integrated with the available contemporary digital data. The available contemporary data consists of San Juan County ownership data, current irrigation as interpreted from ortho-photography and any water rights filing with our office that had occurred since the 1948 survey. We wanted to put together as much information as possible in the office before any field inspections or consultations were made with water users. We wanted to see how much background information we could provide to the survey crew before they began working on the ground.

We began the current survey by acquiring 1 ft. pixel ortho-imagery of the basin to use as a base-mapping layer. We then scanned and georeferenced the 1938 Hydrographic Survey maps to get as best a fit as possible with the ortho-imagery. We then generated a polygon feature class of the decreed lands from the Echo Ditch Decree, the ditch records, and the georeferenced maps.

We then incorporated any water right transfers or changes of ownership that had been filed with the Office of the State Engineer since 1948. The Water Rights Administrative Program (WRAP) of the OSE created abstracts of the water rights files and recorded the abstract in the Water Administration Technical Engineering Resource System (WATERS) database. The abstracts begin with or include the decreed rights and any applications to change those water rights. Since those abstracts include the decreed rights we could match the abstracts to the polygons we created of decreed lands and determine where and how water rights filings had changed the decreed rights. We then scanned and georeferenced the maps submitted with the filings and created a polygon feature class from those maps to see how they had affected the decreed lands. Any water use that existed now would have to be derived from either the decreed lands or the water rights filings to qualify as a “water right”.

We then used the 2003 1 ft. pixel imagery to photo interpret areas that looked irrigated, using the decreed/water rights areas as a guide to the interpretation and analysis of those lands. We then overlaid San Juan County assessor maps, which were created as AutoCAD files, onto the aerial photography and polygon feature class and divided the irrigated parcels based on ownership. All of this data could then be compared together to create uniquely defined water rights with current ownership. This allowed for the creation of subfiles to begin the actual adjudication phase of the process. We now have a whole body of information about the water rights in the basin that can assist the survey and adjudication team in a number of ways.

1. We can create a list of potential owners of water rights that can be used by the survey crew as a contact list and by the attorney to create mailing lists for legal proceedings or documents. It can also help identify areas that may have problems with ownership.
2. Provide the survey and adjudication team with files of important historic information, such as decrees and water rights abstracts, so they don't have to start from scratch looking for that information.
3. Help to identify areas where historic information or interpretation of current aerial imagery indicate field inspections are required to precede with the adjudication.
4. Allow the attorneys to provide information to water users that will inform them of how we think their water right may look and get water users involved in the legal part of the process in a concrete manner earlier than we had done previously. The goal is to focus discussions about the water right claim for both field inspections and legal issues.
5. In the case of the La Plata, an early and thorough review of the data brought to light several important legal and technical issues that allowed the team to examine those issues from an early stage in the process.

## **Lessons Learned**

You have to have support of management. Even though we work with non-technical attorneys, they bought into our efforts and offered support on a management level, which resulted in funding to buy imagery and software and gave us the time to do the work needed to prove the concept.

You have to have the cooperation and support of other parts of your agency upon which you rely for data, in this case the WATERS bureau of the Water Rights program. When we began the San Juan project, they were also beginning work on the San Juan and we were able to collaborate with them to learn their system and access their data.

It's a sign of the maturing of GIS technology that San Juan County created a GIS of their ownership data. These data and the cooperation of San Juan County was instrumental in the success of the project.

## **Future Planning**

We applied the methodology developed for the San Juan Hydrographic Survey to the Hydrographic Survey of the Animas Underground Water Basin, located in extreme southwest New Mexico. The small size of the basin and relatively few water users allowed the opportunity to create a "Proto-Survey", which maximizes both available and created digital information prior to field visits. A wealth of information was obtained from state, county, and government sources, some already in GIS form and the rest requiring scanning and georeferencing. Using this information, we have been able to ascertain a large percentage of the land ownership and water right attributes using strictly GIS techniques.

The legal issues surrounding water rights continue to become more complex, amplified by regional drought that has stressed nearly all water supplies. As a result, the GIS techniques and processes needed to interpret this information will have to become more accurate and efficient to deal with the growing need for water right adjudications.

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