

## Texas Digital Aerial Photo Archive Project (TXDAPA)

TNRIS Preservation and Digital Conversion of  
Historical Aerial Photography for the State of Texas

Authors: Thomas W. Brown, Jr. and Anwar Slitine

Abstract: *Texas Natural Resources Information System (TNRIS) maintains over one million frames of aerial photography for the State of Texas. Deterioration has been a major problem for the collection. In order to reduce the amount of deterioration the TXDAPA Project was initiated two years ago. TXDAPA takes hard-copy photographs and scans them, then using the ArcView 8.x geo-referencing tool to geo-reference each image. By using the geo-referencing tool it allowed us to be flexible in our approach to the TXDAPA project. For example third party plug-ins were used to display the aerial imagery and using a batch .aml file saved us time and money on rectifying each image. In the two years of the project more than 20 years of county coverage has been completed.*

In the State of Texas the division Texas Natural Resources Information System (TNRIS) of the Texas Water Development Board maintains over a million frames of historical aerial photography for the entire state. The collection consists of mostly black and white photography, there are however some color infrared photos. TNRIS' aerial holdings are the largest publicly held aerial photography collection in the State of Texas. Access to the collections can be obtained by signing a contract with the Board that holds researchers responsible for damage to the documents. Dates of the photography in the collection are back to the 1930's for some parts of the state. Photography formats are primarily nine inch frames, there are about 20% that are larger (12 to 14 inch) frames.

Beginning in the summer of 2002 TNRIS began the TXDAPA project through funding by the Texas General Land Office (GLO) for the counties along the Texas Gulf Coast. In 2003 additional funding was provided by the Environmental Protection Agency (EPA) through their Gulf of Mexico Program to include additional coastal coverage in Texas. Also in 2003 the Texas GLO's Coastal Impact Assistance Program funded additional coastal counties. By the end of summer 2004 these combined grant funds will have paid for the completion of twenty-two historical county coverage's along the Texas Gulf Coast. Each of these grants required not only the scanning of the historical aerial photographs, they included the geo-referencing of the imagery too.

Steps in the TXDAPA project were extensive and required some labor intensive work to make the project a success. These steps included selection of photography, line index creation, scanning, geo-referencing, metadata creation, mosaicing and distribution. Our selection process involved three criteria: age of photography, amount of usage (high, med, and low), and completeness of coverage. We were able to identify the major urban counties and their surrounding counties as the highest priorities with the gulf coast coming in second. Beyond the top two the Texas/ Mexico border, East Texas and the pan handle/ West Texas rounded out number three through five on the priority list. When we applied and were awarded grant funding for a portion of our number two priority area, the

Texas gulf coast, we began the TXDAPA project. Our next couple of grants through the EPA and the Texas General Land Office also allowed us to continue fulfilling our goal of converting coverage along the coast.

Once our selection process was complete we moved to the scanning portion of the project. We use an Agfa T2000 scanner to scan in our aerial photography. All photography used up to the writing of this paper has been 9 inch format prints. Although TNRIIS has larger format prints we limited the selection in the collection to only the 9 inch format, mainly due to the fact that our scanner did not have the capacity to scan larger prints. During scanning we wanted to achieve a similar resolution to the 1995-96 DOQQ's for the state of Texas which was 1 meter resolution. In order to accomplish this we scanned our photography at 500ppi (pixels per inch). Photography contrast varied from set to set and in some cases from frame to frame. To capture as much information as possible and to obtain the highest quality image we utilized the histogram settings on the coverage's. Our file naming convention consisted of the county FIPS code, roll number, frame number and the last two digit year number (i.e. 453\_4aa\_248\_56).

Line indices were created for each year that we processed. These indices served as a reference tool for locating the placement of the photography. Texas Department of Transportation county road maps were scanned and the aerial photography frame numbers were placed in their general location on the maps. In addition to locating the placement of photography these indices also served as a tracking tool. With multiple staffers working on a set of photography the indices were a quick reference tool by indicating the frames that had been geo-referenced or re-scans.

Step three in the process is scanning of the photography. Initial scanning began with the settings of 12bit, grey scale, 500ppi with adjustment to the histogram for contrast. Two problems arose from these settings: first was the 12bit grey scale depth, this setting did not allow for the files to be compressed which was the intent at the end of the project for distribution. Problem two was the file size created using these setting, with limited network storage space we had to be aware of how much scanning could be done and processed before we hit the storage limit.

In order to correct our issue we adjusted our setting to 8bit grey scale, 500 ppi with checks on our histogram for contrast. Our change to 8 bit made it possible to utilize Mr. SID Compression at the end of our process and it provided smaller file sizes which allowed for more work to be completed without having to remove files from the network. We chose the pixel setting of 500 ppi due mostly because we wanted these images to have a close resolution as the 1995-96 DOQQ's that were developed for the state of Texas. One meter resolution was the pixel resolution for the '95-96 imagery. With our historical aerial photography having a majority of coverage at a scale of 1"= 24,000" the pixel sizes for the two sets of coverage would be a close match.

Adjustment of the histogram for the different sets of coverage took some time to work out. Some frames required that they needed more adjustment than others in the coverage. For those frames we did prints to further insure we were capturing as much information

from each image as possible. Final scan size of each of the images was approximately 17mb.

Geo-referencing of the historical imagery was the most labor intensive and timing effort for the entire project. We utilized the 'Geo-referencing' tool that comes in the standard ArcMap product. Control points were established by locating features on the 1995-1996 DOQQ's for Texas, which we used as our base layer, and connecting them to the same features on the historical aerial imagery. An example would be matching up an intersection of roads or the corner of a building. Areas that had few man made features were more difficult to geo-reference however we turn to using property fence lines or natural features such as trees or streams.

Accuracy in the imagery does vary do to the methods given in the previous paragraph. Imagery that had several clear control points saw the best accuracy and those that were along undeveloped shoreline or agricultural land had a dimensioned accuracy. Those with the best accuracy saw miss alignments of zero or up to 20 meters off; as for the other end of the scale only a few images came in over 100 meters off.

Our process for geo-referencing the historical imagery went as follows: first we created image catalogs to pull only the 1995-96 base imagery we needed for our working area. Second we created ArcMap projects for the counties to be referenced. Third the historical image was added to the project and using the 'geo-referencing' tool this image was 'fit to display' in the view window of our project; pyramids were built for each image brought in. Fourth the historical image is adjusted using the 'rotate' and 'pan' tools on the geo-referencing tool bar. Next, the placement of control points is done. Control points are placed as evenly as possible throughout the image. Shoreline imagery of course did not allow for this to always be the case, for those instances control points were placed on land features that sometimes were concentrated in small portions of the frame. Finally when all control points were in place the 'update geo-referencing' command was selected and then 'rectify' command from the tool bar.

During the placement of control points problems did occur that needed correcting in order to create the geo-referenced image. The most common problem was misplacement of a control point. Misplaced points sometimes caused the historical image to warp and created extremely high RMS (root mean squared) errors. In order to correct this problem the last placed point needed to be removed and redone. Some frames needed a couple of points removed and redone to correct this problem. Another problem was the pixel size of the scanned historical image. A small portion of the project used higher altitude aerial photography, as a result the standard scanner setting needed adjustment to obtain the one meter pixel size we wanted to achieve. For these photographs we scanned at 800ppi and this remedied the problem.

Metadata for each of the frames in the project was created using ArcCatalog by setting up a template file that updated only the individual frame information. Setting up a template allowed for quicker file creation by maintaining static information such as how the data was developed, who was the creator of the data, and contact information for the data.

Distribution of the final historical imagery will be in a compressed format, although if requested the original .tiff files will be available. Plans are to make these images available over the internet and applications are being worked on to access this imagery in a user friendly manner. Future distribution could include mosaic county files for the historical imagery. This format would ease viewing of large areas by having to access only one file per county as opposed to hundreds per county with the individual imagery files.

Within the TNRIS historical aerial photography holdings the majority of the Texas Gulf Coast has been completed. Plans are to focus on the urban centers of Texas, then moving to the U.S./ Mexico border and East Texas forests. In addition to this historical project TNRIS has also started work on scanning and geo-referencing their historical map collection; which consists primarily of USGS topographic maps.