A Vegetation Inventory
Of The
Proposed Eastex Reservoir

Resource Protection Division
Texas Parks and Wildlife Department

Texas Water Development Board
Interagency Contract No. 93-483-358

October 1993

INTRODUCTION

The purpose of this study was to classify, delineate, and map major vegetational communities for the proposed Eastex Reservoir in Cherokee County, Texas. The study was conducted through a Water Research and Planning Grant Operating Agreement (TWDB contract No. 93-483-358, TWPD contract No. 333-0214) between the Texas Water Development Board (TWDB) and Texas Parks and Wildlife Department (TPWD). The vegetation mapping and inventory included a multi-temporal data analysis for different years to assess land-use changes. These studies were accomplished through a subcontract (TPWD Interagency Contract No. IAC [92-93] 2174, SWT # 754-C-0033) with the Department of Geography and Planning, Southwest Texas State University. The work was conducted under the supervision of Dr. Ryan Rudnicki. Vegetation inventory data submitted to the TWDB will be used by the Board to evaluate and compare environmental factors associated with proposed reservoir sites in East Texas.

STUDY AREA

The Eastex Reservoir site lies within a portion of the floodplain of Mud Creek in Cherokee County. Mud Creek is within the Neches River Basin. The site is approximately 6 miles east of Jacksonville, Texas (Figure 1). The reservoir will lie within the Pineywoods ecological region (Gould et.al. 1960). Climate can be generalized as subtropical, humid, with warm summers and mild winters. The average annual precipitation ranges between 40 and 44 inches, average annual high temperature ranges between 76 and 77 degrees F., while average annual low temperature ranges between 53 and 55 degrees F. The average annual gross lake surface evaporation rate for this region is about 50 inches (Texas Department of Water Resources 1983).

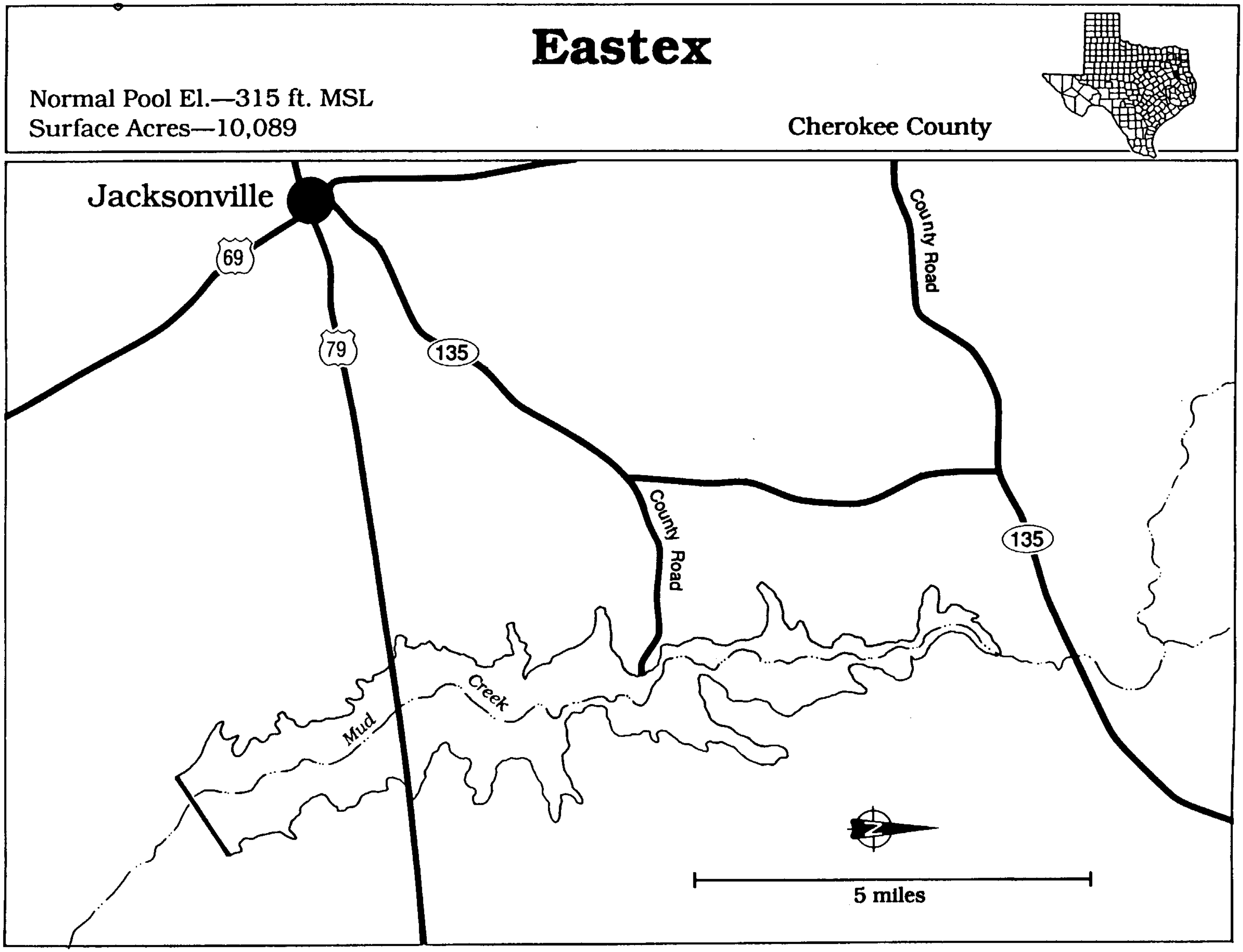

Figure 1. Site Location for Eastex Reservoir

Major vegetation cover types typical of this region have been previously mapped (McMahan et. al. 1984). These include a mixed pine-hardwood forest interspersed by non-native grasslands and bottomland hardwood communities along creek and river drainages. Commonly occurring plants within the mixed pine-hardwood association include loblolly pine, shortleaf pine, sweetgum, water oak, willow oak, southern red oak, winged elm, American beautyberry, hornbeam, dogwood, and yaupon. Bottomland hardwood areas include water oak, elm, hackberry, southern red oak, white oak, willow, cottonwood, pecan, and dogwood. The study area appears to have been subjected to numerous land-use changes between the early 1980's and 1993. Confirmation of such changes was one of the tasks of this study. Additional descriptions of the study area have been previously documented in a publication entitled "Lake Eastex Regional Water Supply Planning Study" (Lockwood, Andrews & Newnam, Inc. et.al. 1991).

Results are provided as attached individual summaries by Dr. Rudnicki and his students.

Literature Cited

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Larkin, T.J., and G.W. Bomar. 1983. Climatic atlas of Texas. Tex. Dep. Water Re3s. LP-192, 149p.

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McMahan, C.A., R.G. Frye and K.L. Brown. 1984. The vegetation types of Texas including cropland. Tex. Parks and Wildl. Dep. Bull. 7000-120. 40p.

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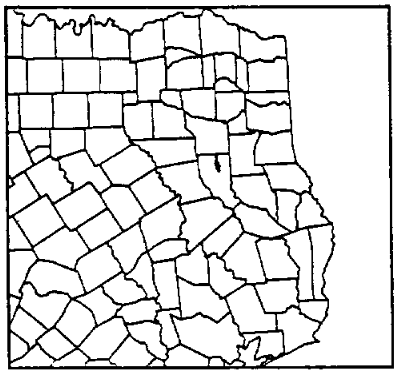
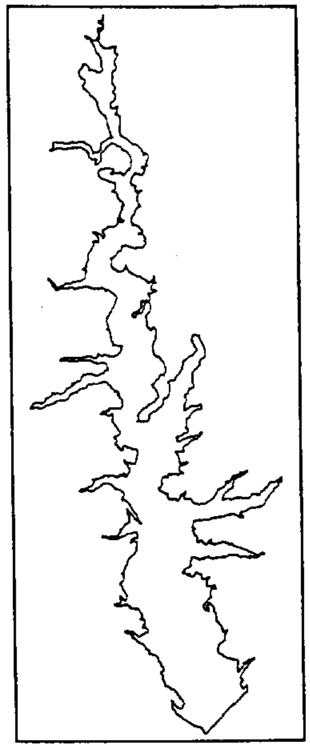
SUMMARY
Eastex Reservoir Site
Vegetation Cover Mapping and Vegetation Cover Change Analysis
August 31, 1993
Ryan Rudnicki

This summary identifies the major steps in mapping the vegetation cover of the proposed Eastex Reservoir in Cherokee county, Texas, about five miles east of Jacksonville (Map 1). This summary also reviews the results of the vegetation cover change analysis between 1981 and 1993. The proposed reservoir will extend northward fifteen miles behind a dam to be built on Mud Creek, and will have a surface area of approximately 10,234 acres (Map 2).


Map 1.


Map 2.

This project had three phases. The first involved mapping the current (1993) vegetation cover in the area of the proposed Eastex reservoir. The second phase consisted of a study to determine the nature of vegetation cover change between 1981 and 1993. The first step in this phase was to complete a vegetation cover map for 1981. Then, the 1981 and 1993 maps were overlaid and the vegetation cover changes assessed. The third phase of this project consisted of the production of a general vegetation cover map of the area along Mud Creek south of the proposed dam to the creek's confluence with the Angelina River, a distance of approximately eighteen miles.

Aerial photography, data digitized from USGS quadrangles, DLG data files, field surveys, and pcARC/INFO were the tools used to complete this project. The staff consisted of five students and myself, working over a five month period. Students had specific tasks but often worked where they were needed. These students worked as biologists, aerial photo interpreters, digitizers and digital data processors, GIS analysts, graphic artists, field workers, and computer system analysts.

The planned pool surface of the Eastex reservoir is to be 315' above mean sea level. Color infra-red aerial photography was taken of the area on March 24, 1993. Interpretation was straightforward for the most part (See Report by David Deibel). A total of 274 areas of homogeneous vegetation were identified and assigned to seven different vegetation categories (See Report by Melisa Minto). The largest category was Mixed Hardwood Bottomland Forest with 4534 acres or 44% of the total area to be under water. The Water category covered the smallest area, 48 acres, less than 1% of the total (Table 1). The Vegetation Map made from the March, 1993 photography is provided as Figure 2.

TABLE 1.
1993 Eastex Reservoir Site Vegetation Cover Types

	Number of Areas	Cover Type #*	Acres	% Cover
	16	1	4534	44
	44	3	731	7
	38	4	1083	11
	40	5	1786	17
	82	6	1458	14
	12	7	48	< 1
	42	8	594	6
Totals:	274		10,234	100

***Cover Type #**	**Cover Type Name**
1	Mixed Hardwood Bottomland Forest
2	Mixed Hardwood/Pine Bottomland Forest
3	Mixed Hardwood/Pine Upland Forest
4	Young Forest
5	Wet Grassland
6	Grassland
7	Water
8	Mixed Hardwood Upland Forest

The purpose of the 1981 vegetation category map was to enable a vegetation cover type

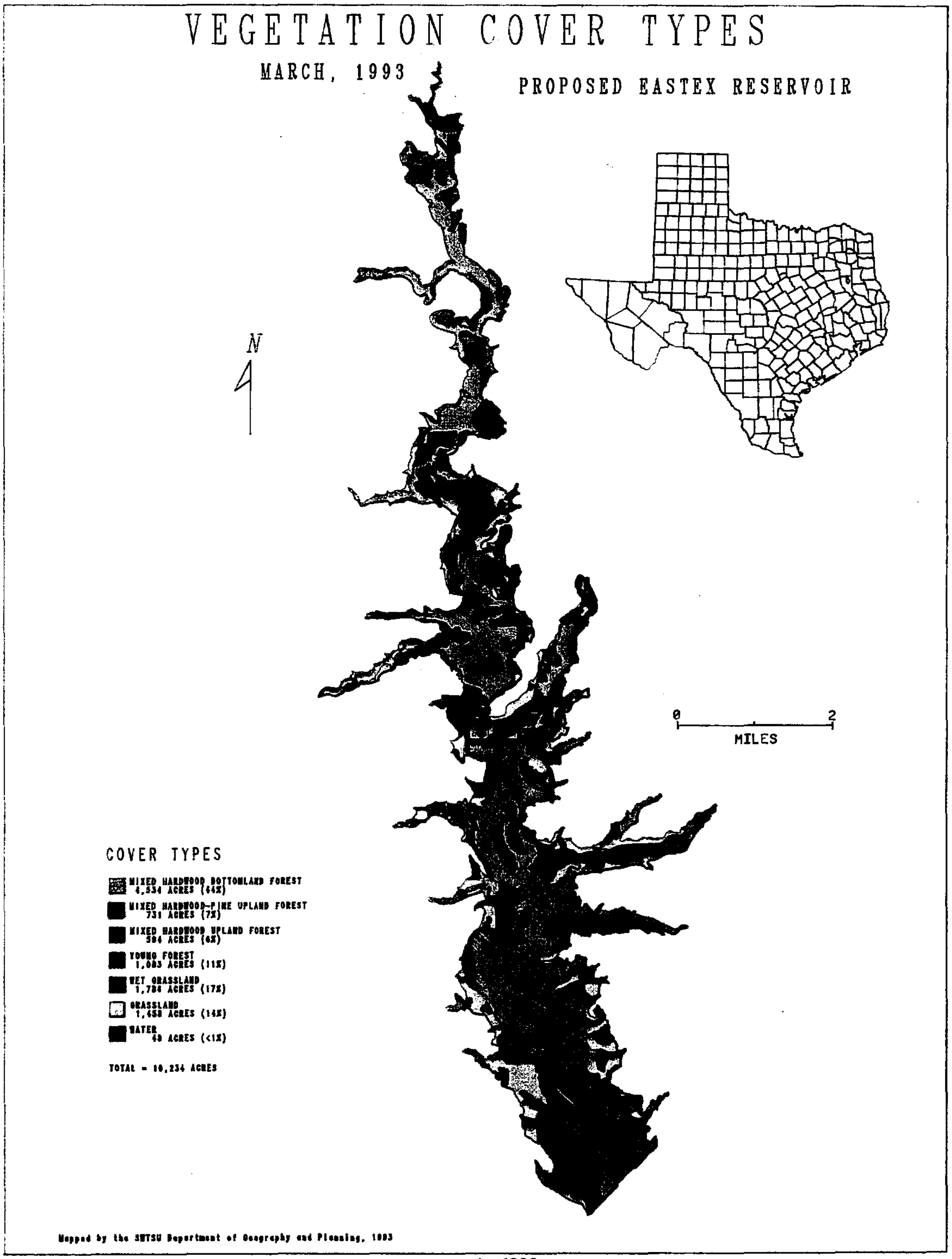


Figure 2. Vegetation Cover Types for Eastex Reservoir, 1993.

change analysis. The rationale behind the analysis was that the vegetation cover had been adversely affected by the possibility of a dam being built on Mud Creek. The Angelina-Nueces River Authority has been pursuing the building of a reservoir at that site since the late 1970s. The state of Texas has already granted a permit to the river authority for the dam. Currently (1993), the river authority is seeking a federal permit for the dam to complete necessary legal requirements before construction can begin.

As local landowners above the proposed dam site learned of the possibility that a reservoir was being planned, it was hypothesized that they would be stirred into action, such as clearing their land of marketable timber, that they would not have undertaken had the reservoir not been proposed in the area.

To test that hypothesis, vegetation in the reservoir site was mapped once again around the time that the permitting process began at the state level. Thus, aerial photography for 1981 was acquired and the vegetation mapped (See report by David Deibel). For 1981, 294 vegetation polygons were identified. While these were also assigned to seven categories, one category, Mixed Hardwood/Pine Bottomland Forest, did not exist in 1993 (Table 2) (Figure 3).

The vegetation polygon maps for the two years were compared and the changes noted. Overall, the maps contained the same categories with two significant differences. In 1981, the largest category was Mixed Hardwood/Pine Bottomland Forest which covered about 22% (2290 acres) of the total area. In 1993, that category did not exist according to aerial photo analysis. The hardwoods were still in the bottomlands, but the pines had been removed. The second change was the emergence of a new category in 1993 that did not exist in 1981: Young Forest.

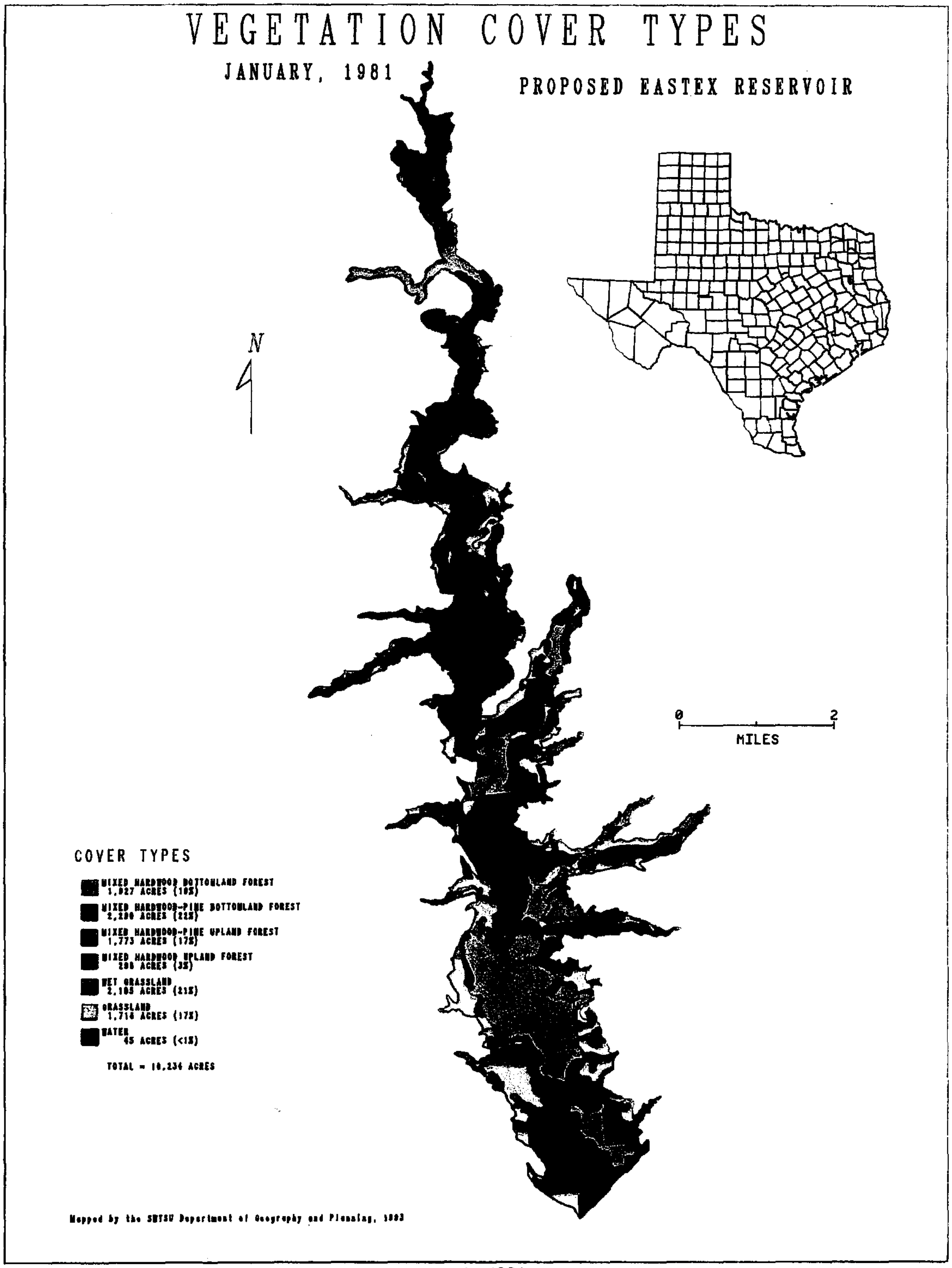


Figure 3. Vegetation Cover Types for Eastex Reservoir, 1981.

TABLE 2.
1981 Eastex Reservoir Site Vegetation Cover Types

	Number of Areas	Cover Type #*	Acres	% Cover
	13	1	1927	19
	26	2	2290	22
	81	3	1773	17
	57	5	2185	21
	87	6	1716	17
	11	7	45	< 1
	19	8	298	3
Totals:	294		10,234	100

*Cover Type #	Cover Type Name
1	Mixed Hardwood Bottomland Forest
2	Mixed Hardwood/Pine Bottomland Forest
3	Mixed Hardwood/Pine Upland Forest
4	Young Forest
5	Wet Grassland
6	Grassland
7	Water
8	Mixed Hardwood Upland Forest

While the type of bottomland forest environment changed (i.e. selective cutting of pine over the 12 year period) the total acreage in forested bottomland did not change between 1981 and 1993. Some 41% (4217 acres) of the area to be under water consisted of either Mixed Hardwood Bottomland Forest or Mixed Hardwood/Pine Bottomland Forest in 1981. Twelve years later, 44% (4534 acres) was classified as Mixed Hardwood Bottomland Forest.

On the other hand, the 1993 map had a Young Forest vegetation category that did not exist or at least was not recognizable in the 1981 aerials. These areas showed up on the 1993 aerial photographs as clear-cut areas where new growth was occurring. Some of the new growth was planned, i.e. Christmas tree farms and pine plantations. In other Young Forest areas, the aerials did not indicate any organized regrowth activities. About 10% (1083 acres) of the land within the proposed reservoir was young forest in 1993. A small amount of this new category came from bottomland forest areas (47 acres); most (890 acres) came from what had been classified as upland forest areas in 1981.

The results of the digital overlay operation produced 538 polygons whose classification is summarized in Table 3. Slightly more than half of the land (5,513 acres, 54% of the total acreage) had the same vegetation cover in both years. Nearly half, 46% of the land to be under the surface of the proposed reservoir, had experienced change in cover type. The largest changes involved the expansion of an existing category (Mixed Hardwood Bottomland Forest) and the emergence of a new category, Young Forest. Both categories are related in that their increase over the past dozen years was due to timber harvesting. In the case of the expansion of Mixed Hardwood Bottomland Forest, pine trees had been selectively removed. In the case of the Young Forest category, all trees were removed. The Mixed Hardwood Bottomland Forest category grew by 2,607 acres (from 1927 acres to 4534 acres) in twelve years. The Young Forest category grew from zero acres to 1083 acres (11% of the area) in the same period. It is not clear whether timber cutting in the area over the past twelve years was due to the reservoir or simply reflected increasing cutting rates that may be occurring across all of East Texas. Timber cutting rates for Cherokee and surrounding counties (Smith, Henderson, Anderson, Houston, Angelina, Nacogdoches, and Rusk) would help answer that question.

Another approach to an answer would be to compare timber cutting at the reservoir site with a similar area somewhere else along Mud Creek. Aerial photography of the Mud Creek area south of the dam was taken at the same time as that taken of the dam site (March 24, 1993). A map of the bottomlands area was prepared and it showed that the majority of the forested land is currently Mixed Hardwood/Pine Bottomland Forest. It would appear, therefore, that the

TABLE 3.
Eastex Reservoir Site
Vegetation Cover Type Changes: 1981-1993

Number of Polygons	1981 Cover Type #*	1993 Cover Type #*	Acres
12	1	1	1868
3	1	4	38
13	1	5	21
24	2	1	2139
2	2	4	9
29	2	5	139
1	2	7	2
41	3	3	521
37	3	4	809
48	3	6	112
31	3	8	330
44	5	1	529
4	5	4	32
46	5	5	1625
35	6	3	133
14	6	4	115
82	6	6	1329
29	6	8	139
11	7	7	45
7	8	3	76
4	8	4	81
12	8	6	17
9	8	8	125
Totals: 538			10234

*Cover Type #	Cover Type Name
1	Mixed Hardwood Bottomland Forest
2	Mixed Hardwood/Pine Bottomland Forest
3	Mixed Hardwood/Pine Upland Forest
4	Young Forest
5	Wet Grassland
6	Grassland
7	Water
8	Mixed Hardwood Upland Forest

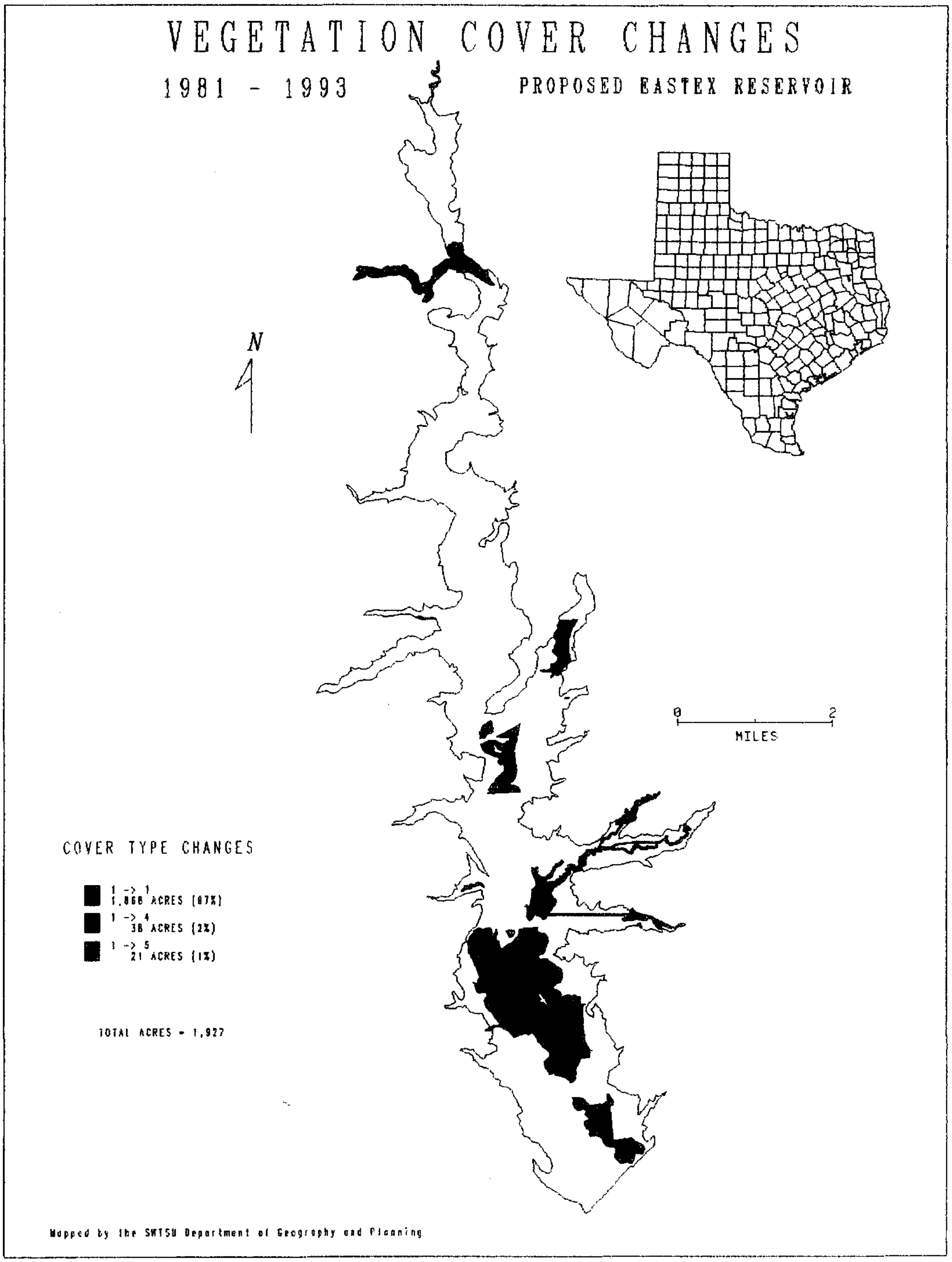
disturbed bottomland forest north of the dam was due to knowledge of a possible dam. It should be noted, however, that other factors may have been at work which precluded timber harvesting below the dam. Perhaps the area below the dam is simply too inaccessible because of frequent flooding. No inquiry was undertaken into the possible reasons for the existence (as indicated by the aerial photographs) of pristine bottomland forest.

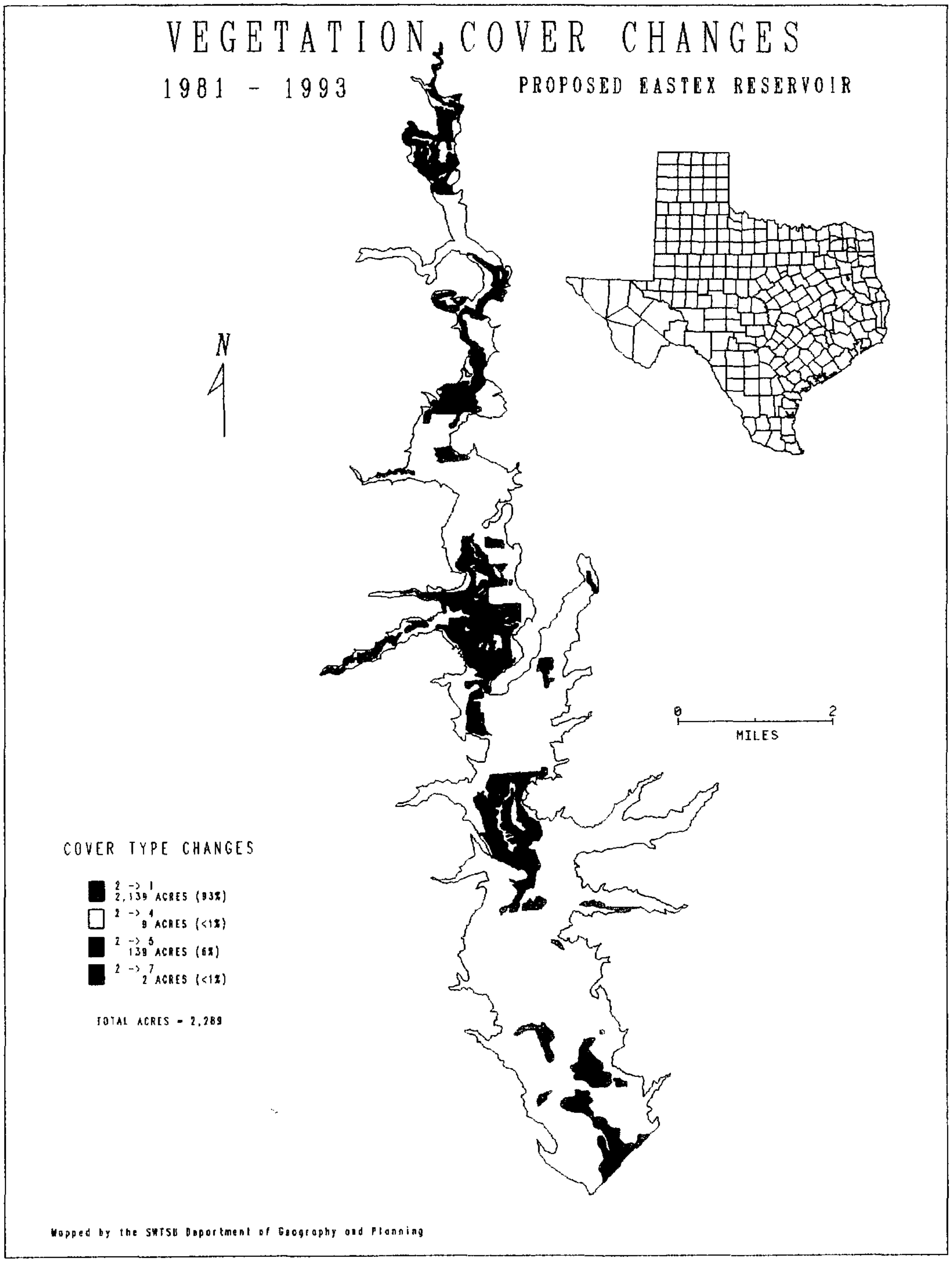
The results of the vegetation cover analysis have also been summarized as a series of six maps (attached).

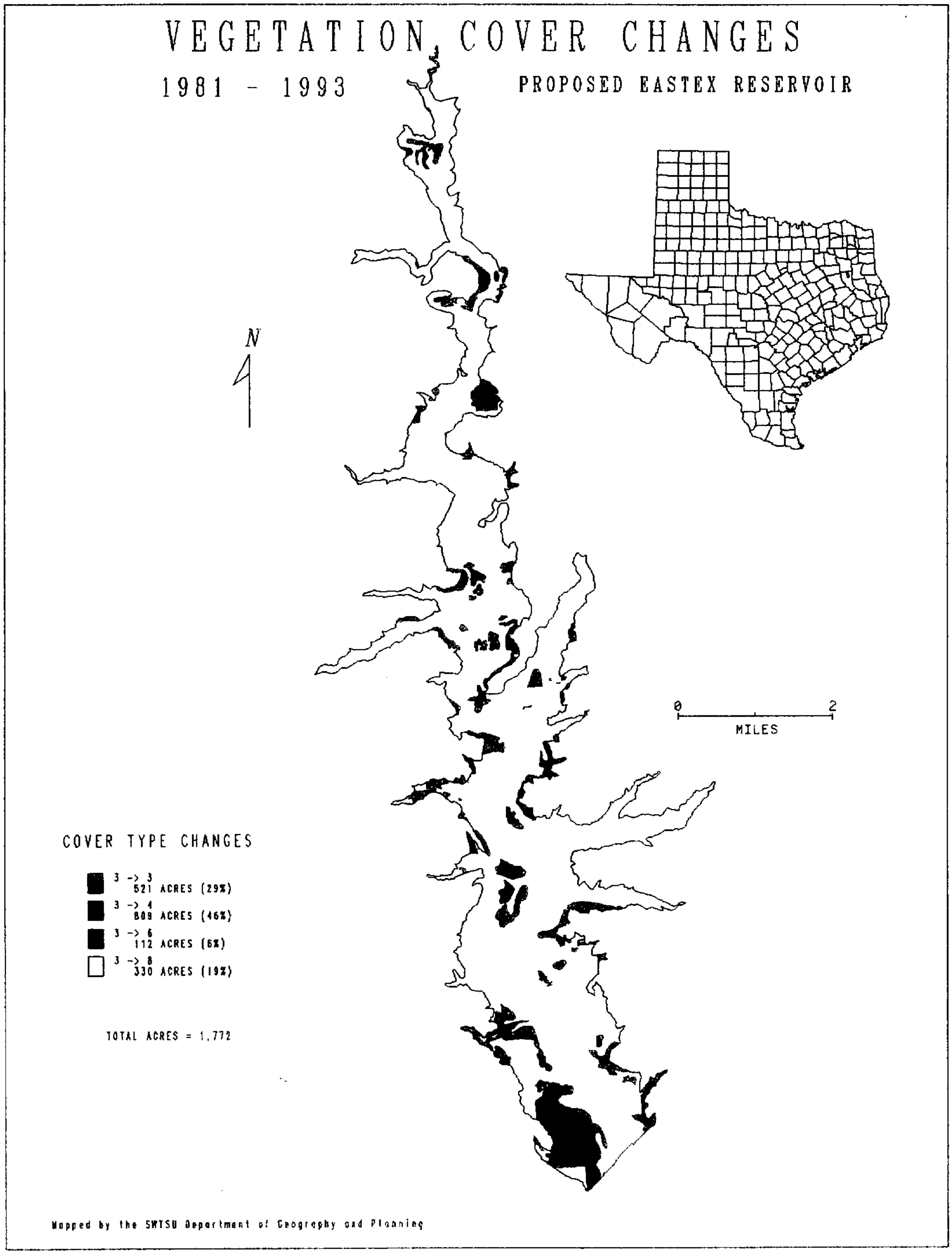
More details on the geo-processing procedures are contained in Scott Paschall's report.

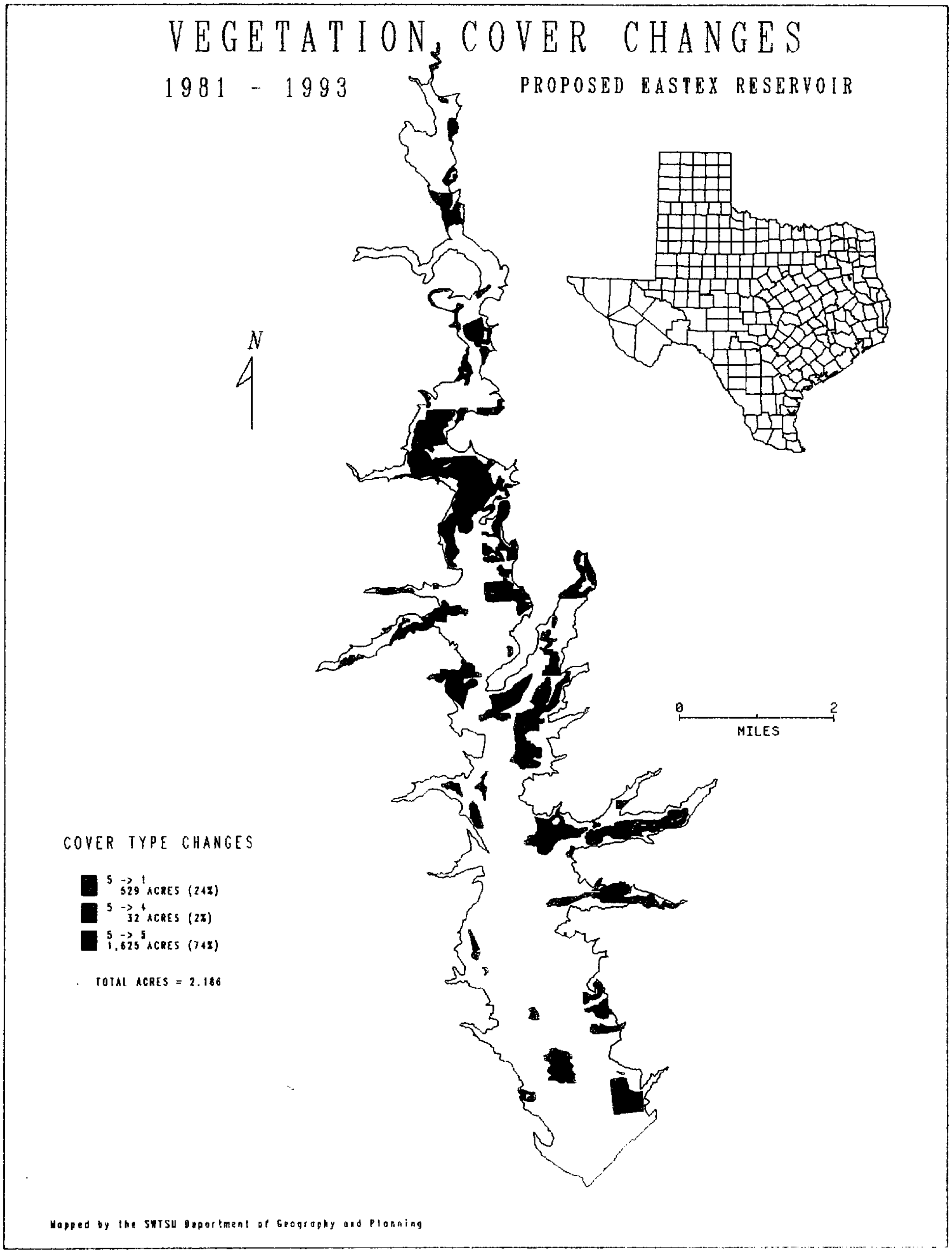
This page contains the key to the names of the cover types shown in the legends of the following six maps. The legends of those maps show the cover type number only.

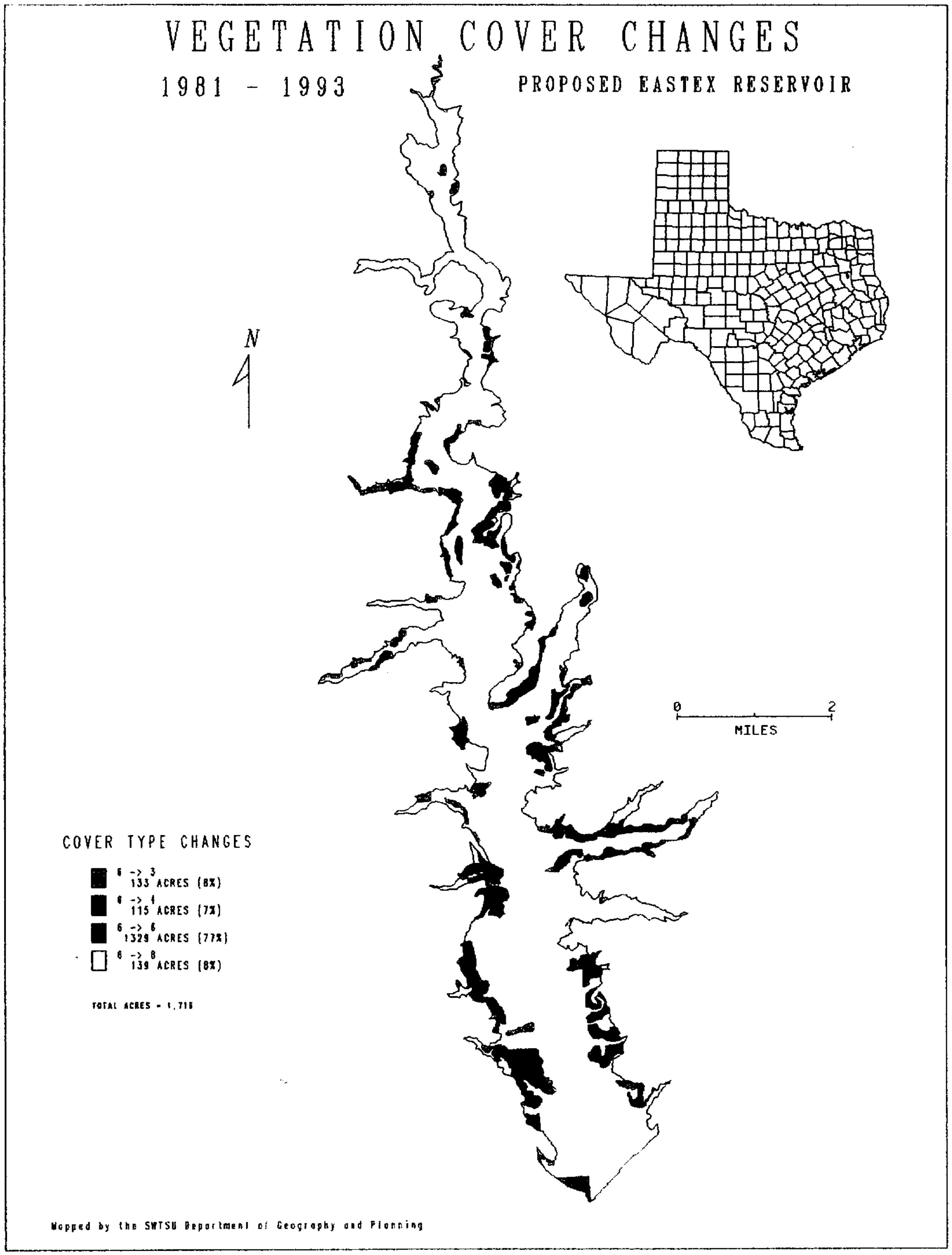
Cover Type #	Cover Type Name
1	Mixed Hardwood Bottomland Forest
2	Mixed Hardwood/Pine Bottomland Forest
3	Mixed Hardwood/Pine Upland Forest
4	Young Forest
5	Wet Grassland
6	Grassland
7	Water
8	Mixed Hardwood Upland Forest

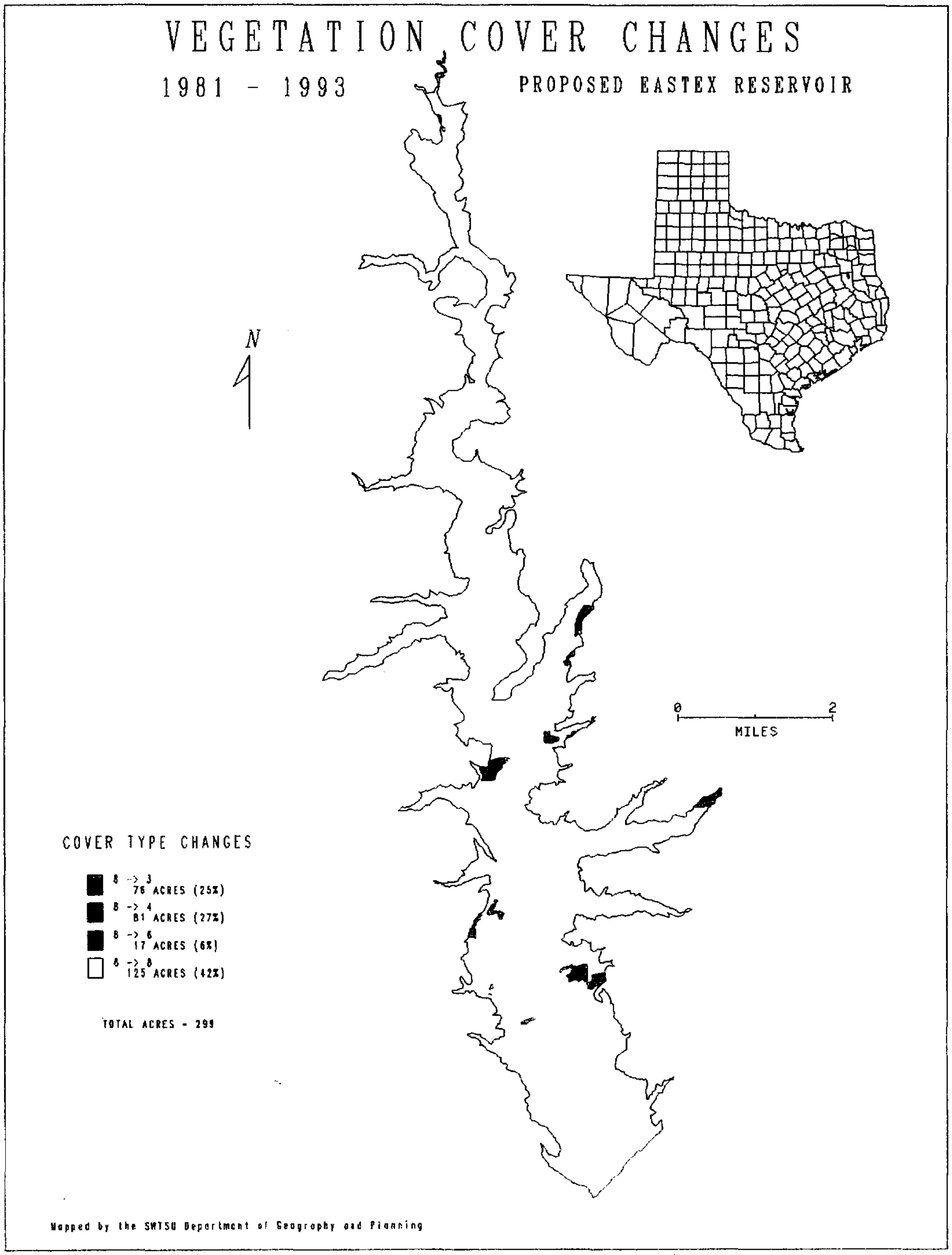

VEGETATION COVER CHANGES
1981 - 1993
PROPOSED EASTEX RESERVOIR
N
0
2
MILES
COVER TYPE CHANGES
1 -> 1
1,868 ACRES (97%)
1 -> 4
38 ACRES (2%)
1 -> 5
21 ACRES (1%)
TOTAL ACRES = 1,927
Mapped by the SWTSU Department of Geography and Planning


VEGETATION COVER CHANGES
1981 - 1993
PROPOSED EASTEX RESERVOIR
N
0 2
MILES
COVER TYPE CHANGES
2 -> 1
2,139 ACRES (93%)
2 -> 4
9 ACRES (<1%)
2 -> 5
139 ACRES (6%)
2 -> 7
2 ACRES (<1%)
TOTAL ACRES = 2,289
Mapped by the SWTSU Department of Geography and Planning


VEGETATION COVER CHANGES
1981 - 1993
PROPOSED EASTEX RESERVOIR
N
0
2
MILES
COVER TYPE CHANGES
3 -> 3
521 ACRES (29%)
3 -> 4
809 ACRES (46%)
3 -> 6
112 ACRES (6%)
3 -> 8
330 ACRES (19%)
TOTAL ACRES = 1,772
Mapped by the SWTSU Department of Geography and Planning


VEGETATION COVER CHANGES
1981 - 1993
PROPOSED EASTEX RESERVOIR
N
0
2
MILES
COVER TYPE CHANGES
5 -> 1
529 ACRES (24%)
5 -> 4
32 ACRES (2%)
5 -> 5
1,625 ACRES (74%)
TOTAL ACRES = 2.186
Mapped by the SWTSU Department of Geography and Planning


VEGETATION COVER CHANGES
1981 - 1993
PROPOSED EASTEX RESERVOIR
N
0
2
MILES
COVER TYPE CHANGES
6 -> 3
133 ACRES (8%)
6 -> 4
115 ACRES (7%)
6 -> 6
1329 ACRES (77%)
6 -> 8
139 ACRES (8%)
TOTAL ACRES = 1,716
Mapped by the SWTSU Department of Geography and Planning


VEGETATION COVER CHANGES
1981 - 1993
PROPOSED EASTEX RESERVOIR
N
0
2
MILES
COVER TYPE CHANGES
8 -> 3
76 ACRES (25%)
8 -> 4
81 ACRES (27%)
8 -> 6
17 ACRES (6%)
8 -> 8
125 ACRES (42%)
TOTAL ACRES - 299
Mapped by the SWTSU Department of Geography and Planning

Report of Activities: Eastex Reservoir Mapping Project
David Deibel
August 16, 1993

My primary duties during the project consisted of three tasks: 1) the interpretation of false color infrared (IR) aerial photographs for the purpose of delineating areas of homogeneous vegetation types; 2) the preparation of manuscript drawings of the subject site to be used for digitizing the vegetation polygons; 3) the final review of the vegetation polygons of the reservoir site; 4) the preparation of a base map of the Mud Creek bottomlands below the dam to its confluence with the Angelina River. This manuscript map was digitized as well.

The purpose of this project was two-fold. The first was to develop a current vegetation cover type map for wildlife habitat assessment. The second purpose was to show the change in vegetation cover between 1981 and 1993. The latter task posed a unique problem in interpreting the aerial photos. The two sets of photos came from different sources. For 1993 we used 9" x 9" color IRs generated from a mission flown on March 24, 1993. The nominal scale was 1 inch = 2000 feet. The 1981 photographs were National Aeronautics and Space Administration (NASA) high altitude (60 000 feet) imagery. This photography, taken in January, is not mapping quality, i.e. the effect of camera (plane) tilt is quite evident on the photos. The original photo scale was small. We received large prints (38" x 38") which approximated a scale of 1" = 2000'. The photographs for one year did not match the color tints of the photography for the other year. If one year had red and green, the photography for the other was off-red and off-green.

After studying the aerial photos, I began noticing distinct differences in the bottomland areas. I developed a set of selective keys for specific species of trees and grasses as well as keys for generalized vegetation groups. To help in that task, I picked several sites on the photos with areas that were easily accessible by vehicle, and that provided both distinctive species and generalized vegetation groups to review. We visited those sites to help validate our keys.

With the assistance of Roy Frye, Ray Telfair, and biologists from Hicks and Company, our team studied those sites on the ground and obtained the necessary information for the keys. The final selective keys, listing species and characteristic infrared signatures, are as follows:

1) Pine trees (loblolly and shortleaf) - brownish red signature; widely dispersed or in thick stands
2) Overcup oak, willow oak, water oak, and black willow - size and structure
3) Blackjack oak, post oak, and Southern red oak - size and structure
4) Bermuda grass - reddish signature and texture
5) Curly dot grass - brown signature and texture
6) Various juncos species - greenish signature (darker than other grasses) and texture
7) Regrowth areas - scattered trees (large and small), color signatures for wet and dry, and rough texture
8) Wet category - darker colors in bottomland
9) Dry category - lighter colors in upland
10) Pink signature - found only in wet category

Each of these selective keys was easily recognized and distinct from the others. The last three categories were unique. A clearly visible line, though faint at times, positively delineated the wet and dry categories. Ground truthing verified this with excellent consistency during the June 11, 1993 field trip to the Eastex site. We were unable to discern the vegetation responsible for the last category, pink signature; however, its location within the wet category proved unerringly accurate for the wet-dry delineation. From the first seven keys combined with the wet and dry categories, the following final categories of the 1993 and 1981 maps were established:

1) Mixed Hardwood-Pine Bottomland Forest
2) Mixed Hardwood Bottomland Forest
3) Mixed Hardwood-Pine Upland Forest
4) Mixed Hardwood Upland Forest
5) Young Forest
6) Wet Grassland
7) Grassland
8) Water

Representative areas of all of these categories were identified on the ground easily on the May 29 field trip.

To prepare the working manuscript drawing, I suggested that an acetate copy be made of the original mylar drawing of the reservoir site. This original drawing was a mylar photo copy of the four United States Geological Survey (USGS) quadrangle sheets mosaicked together with the reservoir outline add manually. Our acetate copy was then overlaid on the aerial photos for the delineation of the vegetation polygons.

I calculated the scale of two sets of aerial photos. The 1993 set, standard 9" x 9" false color infrared photos, had a calculated scale of 1:23 844 (1 inch = 1987 feet). The 1981 set of NASA high altitude false color infrared photos had a calculated scale of 1:28 004 (1 inch = 2334 feet). The acetate copies of the reservoir site were then made at these two scales.

Next, I overlaid the copy over the photos; first for 1993 and then for 1981. Since these photos were neither rectified nor orthophotos, distortion increased toward the edges of the photos, and scale distortion was distributed throughout the photo. The distortion, minor in the 1993 photos (approximately 3/16" per inch), was proportionally dispersed over our map by the method of locating distinguishable features, such as roads, fence lines, power lines, houses, and lone objects on the photo and our transparent acetate copy of the USGS quadrangles. Then the polygons were shaped and drawn to fit the features on the copy of the quads. The distortion in the photos was thus proportionally distributed. This method of error distribution gave a degree of accuracy on a USGS quadrangle sheet of approximately 100 feet per inch horizontally and around five feet per inch vertically. This mapping procedure was made more difficult for 1981 because the photos for that year exhibited an additional distortion, the effect of plane tilt.

After the preparation of the final 1993 Eastex map, ground truthing provided evidence of an overall degree of accuracy of approximately 97 percent. The only apparent discrepancies were minor interpretation errors between wet and dry grasslands.

During the review process, I noted that a large number of the vegetation category polygon lines I was delineating matched the contour lines on the USGS quadrangle maps. This correlation proved to be an excellent cross check as the various wet grassland species did not grow even one foot in elevation above the wet-dry line. Also, the pine trees normally grew in thick stands in the dry category down to one foot above the wet-dry line and were only scattered throughout the wet areas. Melisa Minto checked the map against the Cherokee County Soil Survey maps that cover the site and noticed that my polygon delineations matched them well. This made sense, because the same species I found matching the contours also matched with their soil types. These soil types followed the elevations of the stream, flood plain, and dispersement over the flood plain in a predictable manner.

In addition to the problem of serious photo distortion, preparation of the 1981 map posed another problem. At the time when the NASA high altitude photos were taken, the state of Texas was experiencing an extended drought (NOAA, Environmental Data Service, **Local Climatological Data, Texas**, 1980 and 1981). This condition was evident upon examination of the 1981 photos, as the wet-dry line was not easily discernible except along the channel of Mud Creek. It was decided during a team meeting with Roy Frye (June 24) that the wet-dry line from the 1993 map would be used instead. After a thorough examination of the 1981 photos, however, I was able to discern the same wet-dry line as on the 1993 photography. I then used the same procedures and selective keys for the delineation of the vegetation polygons as used for the 1993 map.

The final maps showed a distinct rearrangement in land use and vegetation habitats between 1981 and 1993. The most significant changes took place in the bottomland areas in the loss of pine and mixed hardwoods, and conversions to grasslands in both wet and dry categories.

To test the hypothesis that vegetation cover changes in the area of the proposed reservoir were a response to information about a possible dam, it was decided to sample the vegetation cover somewhere else along Mud Creek. Because 1993 photography immediately below the dam was available, I used the aerials to generate a map covering approximately the same amount of area (11,000 acres) as the area to be flooded above the dam. The mapping and interpretation of the area below the dam was straight-forward because the vegetation was fairly homogeneous. Very little, if any, pine has been removed from the forested bottomlands of Mud Creek below the dam site. This conclusion appears to support the hypothesis that knowledge of the possible flooding of land prompted landowners to harvest their timber. More data need to be collected before that hypothesis can be accepted.

To conclude, in following the procedures outlined in this document, we were able to provide, for the 1993 vegetation cover map, a degree of precision in the size and shape of the vegetation parcels equal to that of the features shown on a USGS quadrangle sheet. At the same time, we believe that we maintained the level of generalization in vegetation characteristics specified by the Texas Parks and Wildlife Department. The 1981 map, being based on less controlled photography is of slightly lower positional accuracy.

Report of Activities: Eastex Reservoir Mapping Project
Melisa Minto
August 29, 1993

My chief responsibility on this project was the identification of plant species and the delineation of vegetation areas within the reservoir region. Vegetation areas are delineated as units that would be viable wildlife habitats. Vegetation was separated into generalized polygons and categories that best characterized the dominant species representing a particular area, while maintaining plant diversity. Two field trips provided familiarity with the area, information for aerial photo interpretation, as well as covertype confirmations for the 1993 reservoir map. Delineation of 1981 vegetation polygons was also based on these observations.

The purpose of this project was to map vegetation types and to compare 1993 and 1981 locations within the area of the proposed reservoir. Standardized nomenclature provided by the Texas Parks and Wildlife Department was used to give a non-restrictive description of each covertype, so that a range of species would be included. Two field trips provided ground truthing for aerial photo interpretation, allowed for vegetation assessments, and gave an overview of the reservoir site. Several specific sites were chosen to provide information concerning what plant species were typically found in upland (dry) areas and bottomland (wet) areas. Meetings with Roy Frye and Ray Telfair from Texas Parks and Wildlife were held to monitor mapping progress and to clarify questions which arose over vegetation classification.

In addition to my tasks as one of the biologists for the project, I also assisted with digitizing, analog and digital data editing, map making, and some photo interpretation. After the first review of the 1993 map (the first map we produced), I digitized some additional polygons and corrected arcs to update the coverage. To help David Deibel interpret upland and bottomland areas on the 1981 prints, I digitized wet-dry delineations drawn from the 1993 map. As more reviews of the maps and photos warranted, I assisted Scott Paschall in cleaning up and correcting coverages (map layers) for both the 1993 and 1981 maps. Once polygons were produced for both maps, I assigned covertype numbers to the polygons that corresponded to the vegetation type for each polygon. Throughout each stage, I checked the polygons against the aerial photos to insure accuracy of the maps.

To further support 1993 photo interpretation, the polygons were checked against soil maps from the Cherokee County Soil Survey. Upland areas, especially islands, exhibited characteristic soil types including: Independence, Ochlockonee, or Iuka sandy loam soils, all of which typically support upland plant species. On the 1981 aerials, the widespread presence of pine indicated these areas clearly. Bottomland areas mainly consisted of Bibb clay loam, characteristic of a wet environment. Although both the soil maps and the vegetation maps were delineated using different data collection methods (soils by sampling, vegetation by aerial photo interpretation), they matched with excellent accuracy.

Several questions were raised while reviewing the maps and both sets of photos. One problem involved photo interpretation. On the 1993 photos, David Deibel encountered a unique signature which appeared to be scattered throughout the bottomland areas. Though these areas appeared frequently throughout the reservoir region, their coverage did not comprise more than ten percent of the total acreage, and they were not delineated as separate polygons. The significance of this signature, however, lies in the possibility that it could be used to further identify bottomland areas, as it exhibited a preference for wet areas. On the June 11, 1993 field trip, a location along county road 2064 was visited to possibly clarify the type of vegetation producing this peculiar signature. With the help of biologists from Hicks and Company, the dominant vegetation was determined to be cedar elm with a few accompanying palmetto, water oak, overcup oak, and black gum. Below the canopy was herbaceous groundcover containing primarily ground moss and smart weed. Spanish moss was also prevalent throughout the canopy, and seemed especially attracted to the cedar elms. The results of this expedition indicated that the signature indeed occurred in wet areas, but the type of vegetation responsible for producing the signature was not positively determined.

Another question raised by Wayne Collins, also a biologist on our team, concerned the presence of corridors in the reservoir site. These areas (i.e. roadways and power line cuts) were prime habitats for wildlife and differed from the surrounding areas. Since these areas did not comprise more than ten percent of the total acreage, Roy Frye suggested that they be lumped into a category based on whether the area was wet or dry.

Standard Texas Parks and Wildlife nomenclature was used as the basis for covertype categories. Our final categories are as follows:

1) Mixed Hardwood-Pine Bottomland Forest
2) Mixed Hardwood Bottomland Forest
3) Mixed Hardwood-Pine Upland Forest
4) Mixed Hardwood Upland Forest
5) Young Forest
6) Wet Grassland
7) Grassland
8) Water

The non-restrictive term "mixed hardwood" includes the oaks as the dominant species and all less dominant hardwoods accompanying the oak stands. "Mixed hardwood-pine" areas indicate regions of mixed hardwood with pine scattered throughout. The "young forest" category includes regrowth areas, clear cut areas, and a few Christmas tree farms. Many different plant species are present in these areas, but it cannot yet be determined which species will dominate each clearing. Both the upland and the "grassland" categories were delineated using the wet-dry line, and the abundance of pine in forested areas on the 1981 prints further supported upland delineation. On the June 11 field trip, upland areas we visited typically contained blackjack oak, post oak, Southern red oak, loblolly pine, and short leaf pine. Bottomland categories, which were also delineated according to the wet-dry line, contained species such as overcup oak, water oak, black gum, willow oak, and common rush. Species found in both wet and dry areas included cedar elm, sweet gum, and hickory.

Using standard Texas Parks and Wildlife nomenclature to develop vegetation categories, the vegetation in the Eastex reservoir region was delineated, and changes in land use between 1981 and 1993 were mapped based on aerial photo interpretation, field work, and all other acquired information.

*　　　*　　　*　　　*　　　*

Species list: Southern red oak, overcup oak, post oak, blackjack oak, water oak, willow oak, loblolly pine, short leaf pine, cedar elm, black willow, sweet gum, black gum, hickory, palmetto, sumac, winged elm, river birch, black berry, smart weed, sassafras, resurrection fern, Spanish moss, Bermuda grass, curly dot grass, and four varieties of juncus.

REFERENCES

Mowery, Irvin C. **Soil Survey, Cherokee County, Texas**. Washington, D.C.: U.S. Department of Agriculture. March, 1959.

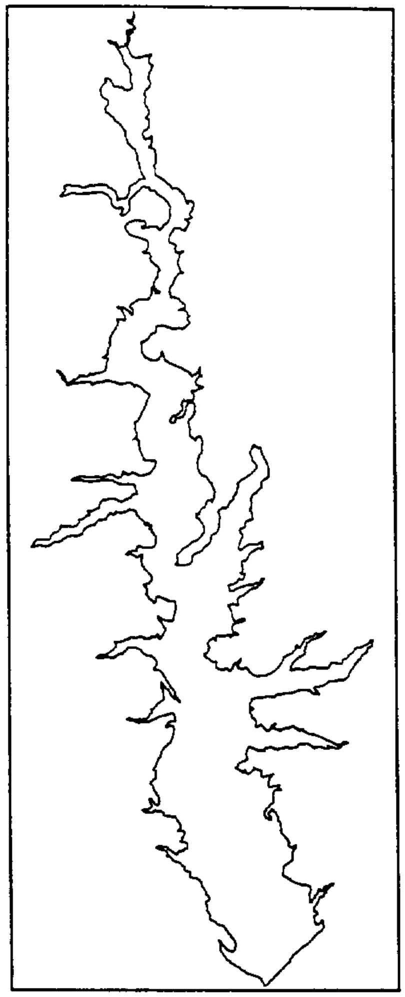
Simpson, Benny J. **A Field Guide to Texas Trees**. Austin, TX: Texas Monthly Press, 1988.

Report of Activities: Eastex Reservoir Mapping Project
Scott Paschall
August 30, 1993

I was the lead computer data processor for the project. My primary responsibilities were to: digitize the pool outlines for the proposed reservoir on Mud Creek, provide proof plots to the vegetation mappers, process DLG files for use on the project, add attributes to the digitized lines and polygons, generate final plots of the vegetation cover areas for the Eastex reservoir, utilize GIS to produce a landuse change analysis, and to digitize, compute areas, and generate by pen plotter a vegetation map for the area below the proposed dam to the confluence of Mud Creek and the Angelina River. Where applicable, plots were made for two different years, 1981 and 1993. The vegetation attribute information was derived by interpreting color infra-red aerial photos taken on those two dates. Two points in time spanning twelve years were selected so that an analysis of vegetation change over this time period could be performed.

My first task was to make a digital outline of the normal pool level of the projected Eastex reservoir. I digitized the pool outlines from two mylars provided by the Texas Water Development Board. The pool elevation used was 315 feet above mean sea level. Once I had the north and south halves digitized I edge-matched them to form a seamless outline (Map 1).

A transparent copy of the pool boundary was made available to David Deibel, the lead vegetation polygon mapper. He superimposed the outline of the pool elevation on the aerials and traced the homogenous vegetation polygons onto the pool plot manually. After David had drawn the polygons for the Eastex site, I digitized them into the reservoir file and generated proof plots for error checking. David checked each polygon by overlaying the digital test plot on the manuscript vegetation polygon map that he had produced. The proof plots were also overlaid on the mylar 1:24,000 maps to assure an accurate product.



Map 1.

The aerial photos David used, particularly for 1981, were unrectified so I digitized the main roads of the area to provide him with better ground control. Certain U.S. Geological Survey (USGS) 1:100,000-scale Digital Line Graph (DLG) files were also used for additional control and as a check of the accuracy of my work. For example, I used the DLG hydrography layer to compare the location, orientation, and shape of Mud Creek which I had digitized from the Water Development Board mylars. I also superimposed the DLG road layer on my base map and checked the position and shape of the roads I had digitized from the USGS 7.5 minute quadrangle maps. We (Melisa Minto and I) also produced a wet-dry boundary line map for control in the production of the 1981 vegetation map.

To get the DLGs into a usable format took some processing. Our workhorse software was pcARC/INFO version 3.3 which processes optional format DLGs. The Tyler and Palestine DLG files were in standard format so we used pcARC/INFO version 3.4D for the conversion process. These converted files were then imported into pcARC/INFO 3.3 for further processing, which included projecting the coordinates from UTM to Texas State Plane, North Central zone.

After digitizing all the polygons and verifying the arcs and polygons for accuracy, I began building the attribute tables. For each polygon pcARC/INFO provided, among others, the attributes of area (in square feet) and perimeter. We added three new attributes: vegetation cover code number (COVERTYPE#), vegetation cover type name (COVERTYPE), and area in acres (ACRES). Melisa Minto helped with this step.

I next wrote programs (SMLs) to plot the 1981 and 1993 maps assigning a colored pattern to each polygon (Appendix A). We generated plots at two scales: 1:24,000 for wall sized plots and 1:110,000 (publication scale) for both the 1981 and 1993 maps.

Now that we had a digital database for the two years, we could perform a landuse change analysis by comparing the cover types for 1981 and 1993. The two maps were superimposed digitally using the Overlay module of pcARC/INFO. Operations within the Overlay module were used to identify the extent and nature of vegetation cover change over the twelve year period. The areas of interest were areas where timber had been harvested. The table listing the changes in vegetation cover between the two years is attached to the summary report for this project. The changes have also been summarized in six maps also attached to the summary report.

After completing work on the area behind the dam, we turned our attention downstream. David prepared a manuscript map of the area below the dam to the confluence of Mud Creek and the Angelina River using 1:24,000 scale USGS 7.5 minute quadrangle maps. His manuscript map contained the "pool" outline which corresponded to the 270 foot contour line, the bottomland limit line, and the outlines of wet grassland areas. I digitized these and produced a working plot with computed areas for the different categories of features. The purpose of this exercise was to compare vegetation cover below the dam as well as above it.

Attached to this report are sample programs (SMLs) I wrote for this project. The programs fell into two categories: those used to help with digital map editing and those used for map production.

Appendix A.

The following program (SML) loads Arc/Info commands into 10 Function keys on the PC's keyboard. These commands are used during map(s) editing operations.

KEYS.SML

```
&SETKEY F1 "EF ARC" &CR
&SETKEY F2 "EF NODE" &CR
&SETKEY F3 "MAPE *" &CR
&SETKEY F4 "DRAW" &CR
&SETKEY F5 "V DRAW" &CR
&SETKEY F6 "V MOVE" &CR
&SETKEY F7 "V DELETE" &CR
&SETKEY F8 "SEL" &CR
&SETKEY F9 "SEL BOX" &CR
&SETKEY F10 "SEL MAN" &CR
&SETKEY A1 "SETD "
&SETKEY A2 "MAPE DEF" &CR
&SETKEY A3 "MAPE ZOOM .2" &CR
&SETKEY A4 "DRAWS" &CR
&SETKEY A5 "SPLIT" &CR
&SETKEY A6 "MOVE" &CR
&SETKEY A7 "DELETE" &CR
&SETKEY A8 "LIST" &CR
&SETKEY A9 "CALC COVERTYPE# = "
&SETKEY A10 "ADD" &CR
```

The following SML loads the appropriate legend into an Eastex map composition during the map production stage.

LC891.SML

```
TEXTFONT 3
TEXTSIZE .25
SHADESET RESERV.SHD
KEYBOX 0.50 0.65
KEYSEPARATION 0.15 0.3
KEYSHADE C891.KEY
```

The following SML produces six different vegetation covertype change maps to be used in the map compositions for those categories.

C89.SML

```
&ECHO &OFF
DISPLAY 4
MAPE C89
PAGESIZE 34 46.5
MAP C891
MAPUNITS FEET
MAPSCALE 24000
SHADESET RESERV.SHD

RESEL C89 POLYS CVRTYP#81 = 1 AND CVRTYP#93 = 1
POLYGONSHADES C89 2
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 1 AND CVRTYP#93 = 4
POLYGONSHADES C89 3
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 1 AND CVRTYP#93 = 5
POLYGONSHADES C89 4
CLEARSEL

LINESYMBOL 1
RESEL CHER_EDG ARCS CHER_EDG-ID > 0
ARCS CHER_EDG
CLEARSEL

MAP C892
RESEL C89 POLYS CVRTYP#81 = 2 AND CVRTYP#93 = 1
POLYGONSHADES C89 2
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 2 AND CVRTYP#93 = 4
POLYGONSHADES C89 3
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 2 AND CVRTYP#93 = 5
POLYGONSHADES C89 4
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 2 AND CVRTYP#93 = 7
POLYGONSHADES C89 5
CLEARSEL

LINESYMBOL 1
RESEL CHER_EDG ARCS CHER_EDG-ID > 0
ARCS CHER_EDG
CLEARSEL

MAP C893
```

```
RESEL C89 POLYS CVRTYP#81 = 3 AND CVRTYP#93 = 3
POLYGONSHADES C89 2
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 3 AND CVRTYP#93 = 4
POLYGONSHADES C89 3
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 3 AND CVRTYP#93 = 6
POLYGONSHADES C89 4
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 3 AND CVRTYP#93 = 8
POLYGONSHADES C89 5
CLEARSEL

LINESYMBOL 1
RESEL CHER_EDG ARCS CHER_EDG-ID > 0
ARCS CHER_EDG
CLEARSEL

MAP C895
RESEL C89 POLYS CVRTYP#81 = 5 AND CVRTYP#93 = 1
POLYGONSHADES C89 2
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 5 AND CVRTYP#93 = 4
POLYGONSHADES C89 3
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 5 AND CVRTYP#93 = 5
POLYGONSHADES C89 4
CLEARSEL

LINESYMBOL 1
RESEL CHER_EDG ARCS CHER_EDG-ID > 0
ARCS CHER_EDG
CLEARSEL

MAP C896
RESEL C89 POLYS CVRTYP#81 = 6 AND CVRTYP#93 = 3
POLYGONSHADES C89 2
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 6 AND CVRTYP#93 = 4
POLYGONSHADES C89 3
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 6 AND CVRTYP#93 = 6
POLYGONSHADES C89 4
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 6 AND CVRTYP#93 = 8
POLYGONSHADES C89 5
```

```
CLEARSEL

LINESYMBOL 1
RESEL CHER_EDG ARCS CHER_EDG-ID > 0
ARCS CHER_EDG
CLEARSEL

MAP C898

RESEL C89 POLYS CVRTYP#81 = 8 AND CVRTYP#93 = 3
POLYGONSHADES C89 2
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 8 AND CVRTYP#93 = 4
POLYGONSHADES C89 3
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 8 AND CVRTYP#93 = 6
POLYGONSHADES C89 4
CLEARSEL

RESEL C89 POLYS CVRTYP#81 = 8 AND CVRTYP#93 = 8
POLYGONSHADES C89 5
CLEARSEL

LINESYMBOL 1
RESEL CHER_EDG ARCS CHER_EDG-ID > 0
ARCS CHER_EDG
CLEARSEL
```