



# United States Department of the Interior

OFFICE OF THE SECRETARY  
Washington, D.C. 20240

[JAN 11 1996

Dr. John H. Zirschky  
Acting Assistant Secretary (Civil Works)  
Department of the Army  
Washington, D.C. 20310

Dear Dr. Zirschky:

In accordance with the provisions of the December 21, 1992, Clean Water Act Section 404(q) Memorandum of Agreement between the Department of the Interior (Department) and the Department of the Army, I am requesting your review of the Galveston District Engineer's decision to issue a Section 404 permit for the project described in the Public Notice of Permit Application (No. 20271) dated March 27, 1995.

The proposed permit would authorize the applicant, the City of Lake Jackson, to fill wetlands within a 200-acre tract of mature bottomland hardwood forest adjacent to the Brazos River in Brazoria County, Texas, for the purpose of constructing an 18-hole public golf course and attendant facilities.

After a thorough review of background information on the proposed project, I have concluded that its authorization will have substantial and unacceptable impacts on aquatic resources of national importance. Due to its locality, maturity, size, contiguity, and complex wetland characteristics, the native bottomland hardwood forest within which the permit site is located provides habitat for seasonally large populations of numerous high-priority wildlife species the Department is mandated to protect. I believe the net effect of permit issuance will be incremental and significant population losses to several of these native amphibian, reptile, bird, and mammal species, including neotropical migrant bird species already experiencing significant population declines.

The Fish and Wildlife Service has estimated that issuance of this permit would cause the direct loss through filling of 28 acres of wetlands consisting of small ephemeral ponded depressions, and shallow creeks and sloughs within a mature bottomland hardwood forest matrix (in contrast to the District's estimate of 2 acres of small ponded depressions); direct loss through clearing of 115 acres of mature bottomland hardwood forest; degradation and loss of wildlife habitat in an adjacent 1,600-acre contiguous bottomland hardwood forest through habitat fragmentation and induced development; degradation of the adjacent forest ecosystem through siltation and contamination caused by runoff of disturbed soils, building materials, and associated pollutants during and following construction; and degradation of the adjacent forest ecosystem by interruption and diversion of sheetflow that maintains the present hydrologic regime.

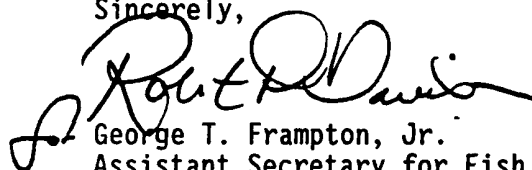
It is my opinion that the District has not fully considered severe impacts to the aquatic ecosystem and wetland wildlife resources of national significance that would result from the proposed project. There appear to be less damaging practicable alternatives to the proposed work and, if impacts were unavoidable, they would be substantially undercompensated. It also appears that the District's delineation of project site wetlands has significantly underestimated the extent of Federal jurisdiction, thereby limiting the scope of their analysis and findings.

Based on the above considerations, it is my recommendation that the Galveston District be directed to deny a permit for the project as proposed. The Department would have no objection to a golf course being constructed for the citizens of Lake Jackson in almost any other nearby location, including those containing wetlands of lesser importance which could more readily be replaced. However, even if there were no other practicable site for this project, the compensatory mitigation proposed does not offset the acres or values lost. Compensation for a project of this scope should be at least the equivalent of the restoration of 230 acres of wetland/floodplain forest, substantially more than the offsite stream stabilization being proposed.

Regardless of the final decision on permit issuance, I also recommend that the Corps utilize its experts at the Waterways Experiment Station to work with the Fish and Wildlife Service and other agency personnel to evaluate the wetland characteristics of bottomland hardwood forests in this region. I believe such an analysis would have been instrumental in reducing the amount of time it has taken to resolve this issue, and it will provide valuable information on these wetlands to future permit applicants and the public.

Enclosed is additional information addressing these and other issues relating to the proposed permit decision. Please do not hesitate to contact me if you have any questions regarding this request.

Sincerely,

  
George T. Frampton, Jr.  
Assistant Secretary for Fish  
and Wildlife and Parks

Enclosure

**ASSISTANT SECRETARY FOR FISH AND WILDLIFE AND PARKS  
EVALUATION AND REQUEST FOR REVIEW**

**LAKE JACKSON GOLF COURSE PROJECT**

**Project Description**

The Corps of Engineers is proposing to issue a permit to the City of Lake Jackson for the purpose of constructing a 18-hole public golf course and attendant features (driving range, clubhouse, roads and cart paths) on a 200-acre site in Lake Jackson, Brazoria County, Texas. Approximately 1,600 cubic yards of fill material will be placed in wetland areas, and drainage swales and catchbasins excavated along proposed fairways.

A Corps-verified wetland delineation identified approximately 24.5 acres of jurisdictional wetlands on the site. Of these, approximately 3.5 acres are small depressional areas scattered throughout the site. Based on the Corps determination, approximately two acres of the depressional wetlands will be affected by the fill.

**Aquatic Resources of National Importance**

Located adjacent to the Brazos River, the forested 200-acre permit site lies within a larger 1,600-acre forest tract which is one of the largest mature bottomland hardwood forests in Texas (Figure 1). This site is unusual in its size, maturity, and contiguity. It contains several trees reaching 90 feet in height and 7 feet in diameter, which is exceptional for Brazos River forest lands. Dominant tree species include live oak, water oak, Shumard oak, swamp white oak, green ash, bitter pecan, tupelo gum, honey locust, cedar elm, and sugar hackberry. Live oaks, many of them very large and thickly adorned with epiphytes such as Spanish moss, resurrection fern, and wild grape, are the dominant tree species. This species usually occupies slightly raised hummocks, and provides excellent forage and cover for resident birds and mammals.

Common understory and herbaceous plants in this forest are yaupon holly, arrow-wood viburnum, American beautyberry, deciduous holly, green hawthorn, blackberry, and Virginia creeper, among others. A few small stands of native bamboo, or canebrake, still persist within this forest. The numerous sloughs and ponded depressions on the site are dominated by such wetland plants as lizard-tail, smartweed, rushes, and others. The dwarf palmetto and Cherokee sedge are found throughout the site, often in dense stands along the edges of seasonal wetlands. A series of natural drainages run generally northwest - southeast across the central portion of the entire tract, with their tributaries extending well up into the proposed project location. Sheet-flow drainage from the 200-acre site and adjacent forest proceeds generally in a north to south manner, with the sloughs and depressions in the upper, or northern, portions feeding the larger sloughs and creeks nearer the Brazos River and Buffalo Camp Bayou. This entire 1,600-acre forested wetland

ecosystem, including the permit site, provides excellent forage and cover for one of the richest wildlife communities in the State of Texas.

Due to its location 10 miles north of the Gulf of Mexico and at the extreme western edge of North America's eastern deciduous forest biome, the forest tract within which the permit site is located forms part of the only large forest habitat adjacent to the Gulf of Mexico in Texas (Figure 2). At least 102 neotropical migrant bird species are known to occur in similar forests in the lower Brazos and San Bernard River drainages (Table 1). Several of these birds species also remain to nest in this forest. Some, like the prothonotary warbler, which is common at the permit site, are wetland-dependent. A comparison of breeding bird censuses in different habitats in Louisiana and east Texas (Dickson 1978)<sup>1</sup> showed bird densities in three bottomland forest stands ranged from 752 to 1,480 territorial male birds per square kilometer, about 2 to 4 times that of the best upland stands.

Dr. Sidney Gauthreaux, Jr. (personal communication), using radar studies of trans-Gulf migrating birds, found huge numbers of songbirds (at least in the hundreds of thousands) utilizing the forests of the lower Brazos River near the Gulf of Mexico, as spring migration stopover points (Figure 3). The remaining bottomland forest tracts in the area provide corridors for these migrating woodland birds each spring. Population declines for some species have been documented in recent years, as measured by the North American Breeding Bird Survey. Among these are the Kentucky warbler, American redstart, hooded warbler, red-eyed vireo, wood thrush, golden-winged warbler, rose-breasted grosbeak, northern oriole, and cerulean warbler. Dr. Gauthreaux's comparison of radar images from National Weather Service stations in Louisiana and Texas suggest that, since the 1960's, there has been a 50 percent reduction in the waves of spring migrants in this region<sup>2</sup>.

Bottomland hardwood forests of east Texas are also known to contain important wintering habitat for various waterfowl species, and are recognized as playing a key role in sustaining continental waterfowl populations<sup>3</sup>. Several pairs of nesting wood ducks, and wintering flocks of more than 100 wood ducks and black-bellied whistling-ducks have been seen in wetlands at the permit site. The wood duck is a common nester on the permit site, frequently using as brood habitat sloughs that were not delineated as jurisdictional wetlands (see discussion of site delineation below).

Temporarily flooded bottomland forests provide habitat supporting some of the

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<sup>1</sup>Dickson, J.G. 1978. Forest bird communities of the bottomland hardwoods. Proc. of the Workshop, Management of Southern Forests for Nongame Birds. U.S. Dept. Agri. For. Serv. Gen. Tech. Rep. SE-14: 66-73.

<sup>2</sup>Line, L. 1993. Silence of the songbirds. National Geographic, June 1993: 68-91.

<sup>3</sup>U.S. Fish and Wildlife Service. 1984. Texas bottomland hardwood preservation program, final concept plan. USFWS Region 2, Albuquerque: 378p.

most diverse mammal communities of any North American habitat type<sup>4</sup> and also have been shown to support significantly higher deer populations than other east Texas habitats because they have more mast-bearing trees and fruiting shrubs<sup>5</sup>. Local residents consider this particular forest tract to be excellent white-tailed deer habitat, and it provides habitat for the principal furbearers and small game species of east Texas, including raccoon, opossum, gray fox, bobcat, mink, beaver, gray squirrel, and fox squirrel.

Thirty-six species of amphibians and fifty-nine species of reptiles are known to inhabit bottomland hardwood forests in east Texas<sup>6</sup>, more than any other habitat type in the State. At least twenty of these species have been verified as occurring at the permit site or in nearby lower Brazos River wetland forests, and undoubtedly many more would be found here if extensive surveys were conducted. Moreover, numerous tadpoles and amphibian egg masses were found in ponded depressions and sloughs on the permit site, some of which were determined to be "non-wetland" by the Corps delineation.

Of the original bottomland hardwood forests found in Texas, only 37 percent were estimated to have remained as of 1980<sup>7</sup>. Available data on trends indicates a 10 percent decrease occurred between 1975 and 1985<sup>8</sup>. Of the original estimated 700,000 acres of bottomland hardwood forests in the lower Brazos River and San Bernard River basins, approximately 170,000 acres remain, much of this in a somewhat degraded state. The average historical rate of loss of this forest type has been about 9,000 acres per year<sup>9</sup>.

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<sup>4</sup>Wharton, C.H., V.W. Lambou, J. Newsom, P.V. Winger, L.L. Gaddy, and R. Manke. 1981. The fauna of bottomland hardwoods in southeastern U.S. pp. 87-160 in J.R. Clark and J. Benforado, eds., *Wetlands of Bottomland Hardwood Forests*, Proc. of Conference on Bottomland Hardwood Forest Wetlands. Elsevier Sci. Publ. Co., Amsterdam.

<sup>5</sup>Lay, D.W. 1965. Fruit utilized by deer in southern forests. *J. Wildl. Man.* 29: 370-375.

<sup>6</sup>Wilkinson, D.L., K. Schneller-McDonald, R.W. Olson, and G.T. Auble. 1987. Synopsis of wetlands functions and values: bottomland hardwoods with special emphasis on eastern Texas and Oklahoma. U.S. Fish and Wildlife Service Biological Report 87(12): 132p.

<sup>7</sup>Texas Parks and Wildlife Department. 1988. The Texas wetlands plan: addendum to the 1985 Texas outdoor recreational plan. Texas Parks and Wildlife Department, Austin: 35p.

<sup>8</sup>U.S. Fish and Wildlife Service. 1984. Ibid.

<sup>9</sup>Draft proposed Columbia bottomlands NWR land protection compliance document. 1995. U.S. Fish and Wildlife Service Southwest Region, Albuquerque, New Mexico: 30p.

### Substantial and Unacceptable Project Impacts

The proposed project would require the clearing of some 115 acres of a forested wetland complex, and lead to habitat fragmentation, hydrologic modification, induced development, and other perturbations, not only to the permit site but to the larger 1,600-acre contiguous forested wetland ecosystem. In its Statement of Findings for the proposed project, the Corps concludes that unmitigated impacts to numerous native amphibians, reptiles, over 100 species of neotropical migrant birds (many showing documented population declines on a national level), migratory waterfowl, and mammals are not significant. We do not concur with this finding, and can find no clear evidence in the document that the Corps has considered the individual and cumulative losses that this forest type has sustained at the local and regional level, or the overall impacts that this project will have on site wetland and other habitat values.

Compensatory mitigation proposed to offset the impacts described above consists mainly of stabilizing 2,000 linear feet of actively eroding streambank and lateral gullies in a stream approximately one-quarter mile below the permit site in order to prevent further habitat loss and protect the hydrology of adjacent bottomlands. While this may be advisable, it does not adequately compensate for these losses. This view is also held by the Texas Parks and Wildlife Department, which in its November 22, 1995, letter to the Corps stated that "the proposed work will not fully compensate the losses to wetland values and functions to be incurred by the proposed golf course".

In 1986, Congress and President Reagan recognized the significance of bottomland hardwood forests in the Water Resources Development Act. This Act directed the Corps to compensate for the loss of this habitat at a 2:1 ratio in its Civil Works activities. While this standard does not apply to the permit program, it should be noted that for a Federally-funded project, the minimum compensatory mitigation would be the restoration of 230 acres of forest for the 115 acres cleared. This provides an important frame of reference for judging the limited compensatory mitigation proposed by the Corps.

Many forest birds and other wildlife require interior forest habitat to successfully nest and breed. Destruction of mature forest habitat within large, contiguous tracts allows invasive, often exotic, plants and animals to enter the newly created forest "edges" and often puts greater parasite and predator pressure on the more sensitive native fauna. Extensive studies of various-sized woodlands in Maryland showed that the smaller the woodlot, the fewer numbers of nesting forest bird species. Probability of occurrences for various species showed significant decreases in woodlot sizes varying from 2,500 down to 30 acres. Observed differences were believed to be related to the size and isolation of each woodland, and to distance from the nearest

edge, rather than to any differences in habitat<sup>10</sup>.

Many wetland sloughs, depressions, and "ash flats" within the forest within and adjacent to the project site differ in elevation from surrounding oak hummocks and "ridges" by only a few inches. Construction-generated runoff is likely to silt over sensitive wetland herbaceous plant communities, altering their makeup and filling in smaller depressions presently valuable as amphibian and reptile habitat.

The intrusion of a 200-acre, raised site within the interior of this wetland forest complex will alter sheetflow which runs in a generally north-south direction into the wetter parts of the forest. Impacts from this sheetflow diversion are not adequately addressed in the Corps Statement of Findings. Opening of the forest canopy over so large an area and diversion of sheetflow away from the rest of the forest will almost certainly have a desiccating effect on the remainder of the forest, thus further degrading the presently rich native wetland wildlife community.

It is also likely that project construction will lead to additional indirect impacts due to growth-induced impacts to the surrounding 1,600-acre wetland forest ecosystem in the form of residential and commercial development surrounding the golf course. In at least one case, an adjacent landowner has retained a consultant to pursue additional development of several hundred acres of forest within the 1,600-acre tract. However, this impact has not been fully acknowledged or discussed in the Corps Statement of Findings.

Finally, we are concerned that this permit decision may set standards for evaluating future permit applications in the area. We note that, in a December 21, 1993, newspaper article, the applicant's consultant was quoted as stating "that place is so complex that if you can determine there's only a very minimal impact within a stone's throw of the (Brazos) River, that's very important...then any area of Lake Jackson could be developed in the future".

### Alternatives Analysis

The Corps decision to limit alternative sites to the extra-territorial jurisdiction (ETJ) of the City, a pivotal point in their analysis, is inappropriate and not supported by their own report. The Environmental Assessment states, "The overall project purpose is to provide an 18-hole public golf course for the citizens of Lake Jackson". The factors considered for practicability were, "cost, existing technology, and logistics". However, this purpose and these factors do not dictate that the facility be located within the ETJ. We are aware of sites outside the ETJ that could, in our opinion, be practicable alternatives to the proposed action.

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<sup>10</sup>Whitcomb, R.F., C.S. Robbins, J.F. Lynch, B.L. Whitcomb, M.K. Klimkiewicz, and D. Bystrak. 1981. Effects of forest fragmentation on avifauna of the eastern deciduous forest. Chap. 8 in Ecological Studies Vol. 41, Forest Island Dynamics in Man-Dominated Landscapes. Springer-Verlag, New York.

In its discussion of the "No Action" alternative, the Corps assumes that if the City sold the tract, it might subsequently be developed. There is no evidence that this would be the case, and this logic would lead one to always conclude that there is little conservation value in a no action alternative. In fact, the City might be able to minimize or eliminate financial hardship associated with relocating the project. It is common knowledge through press reports that a buyer is interested in acquiring the site and preserving its natural values.

There is ample evidence that a less damaging alternative was available at the time of site acquisition, and such an alternative is probably available today. After a review of aerial photography, the Fish and Wildlife Service identified eight potential alternative locations for the proposed project to Corps staff. Although several of these sites were addressed in the Statement of Findings, the Corps assessment was not complete, and the most logical alternative site was omitted from their analysis. Furthermore, the Service's review was not exhaustive, and we are aware of several other locations currently for sale that were not evaluated. The Service and the Department would have no objection to this project being constructed on almost any other site, including sites containing wetlands whose values could be more readily replaced.

#### Wetland Delineation

The project site and surrounding forest lie entirely within the floodplain of the Brazos River. There was extensive flooding in this basin in the winter of 1990-91, and less extensive overbank flooding again in October 1994. Delineation of project site wetlands has been the subject of considerable disagreement since January 1993. The Statement of Findings fails to mention that the first delineation conducted by the applicant's representative was rejected based in part on Service comments. Because of our knowledge of the flooding and because of the deficiencies in the first effort, the Service closely scrutinized the subsequent delineation procedures and determinations.

In its verification of the current delineation, the Service surveyed 4 of the 16 transects and sample locations used by the Corps in its delineation, and randomly sampled numerous other locations throughout the site. It was the Service's conclusion that, even in the second effort, the Corps and the consultant overlooked obvious boundaries of wetland plant communities and readily identifiable margins of topographic relief. The Service also evaluated the extent of inundation (which the Corps had not been able to do), since it appeared to be the primary basis for the Corps determination.

Service data presented in a April 17, 1995, letter to the Environmental Protection Agency and cited in comments on the Corps Public Notice demonstrated that jurisdictional wetland impacts would actually be more than 10 times greater than impacts based on the Corps delineation. Field surveys showed that, during the early growing season of 1995 (typical in terms of rainfall), an estimated 3,800 ponded depressions greater than 8 feet in diameter were present on the 200-acre permit site. These depressions were shown to hold standing water for at least 40 consecutive days during this period. This information, together with soils and vegetative data, led the



Service to conclude that the total jurisdictional wetland acreage should have been delineated as approximately 52 acres, bringing the total acreage affected by the proposed project to approximately 28 acres, rather than 2 acres.

The Corps used this limited jurisdictional determination as the crux of its aquatic ecosystem impact analysis. Although the Corps concluded that onsite wetlands are valuable, and that there will be problems associated with fill, jurisdiction would extend to only 2 acres - a minor impact. Moreover, an inaccurate delineation probably had an impact on the response to the Public Notice. Public comments might have been more extensive if comments were solicited on a project affecting 28, rather than 2, acres of wetlands.

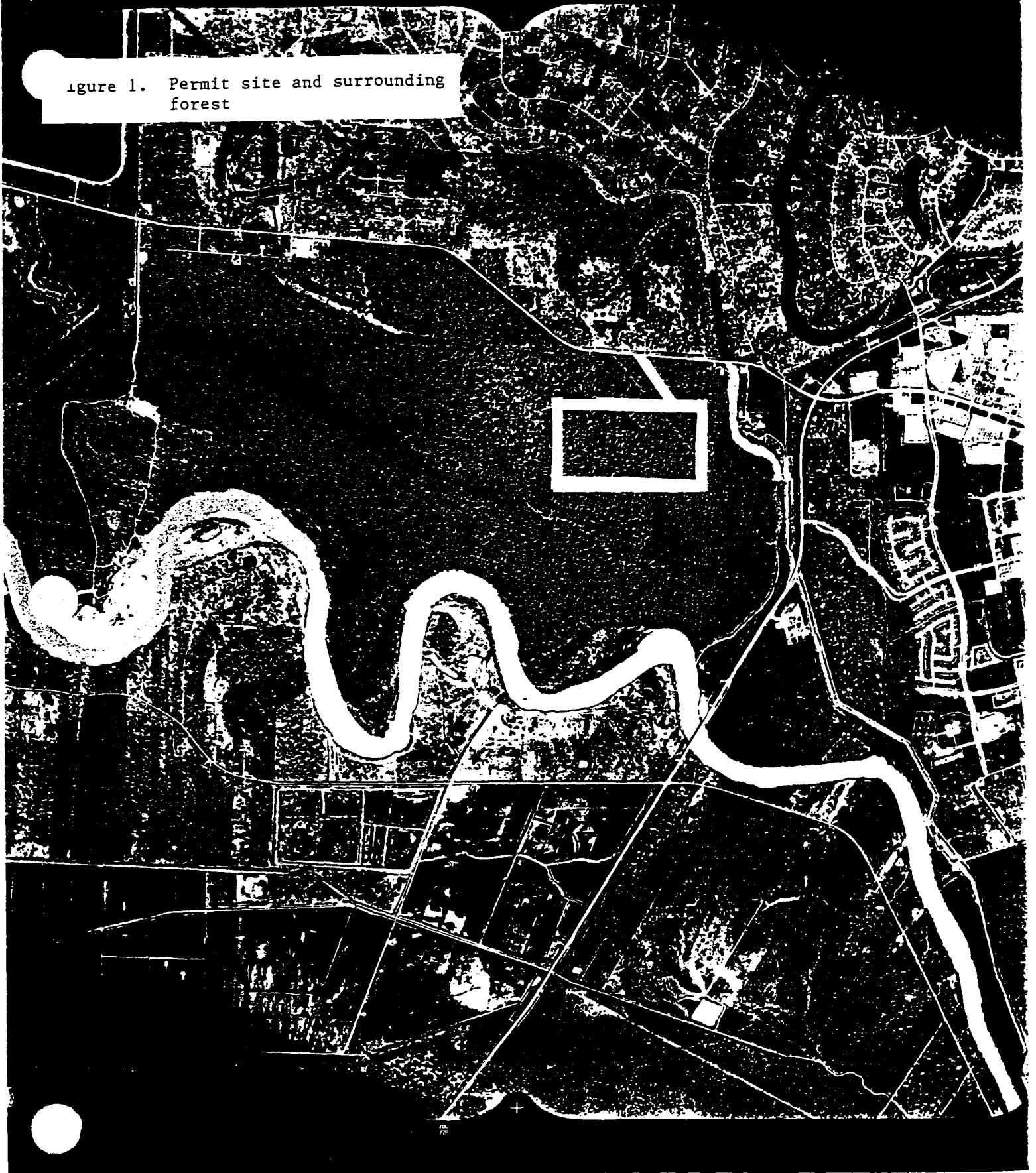
### Conclusions

After reviewing available information regarding the Corps of Engineers - Galveston District decision to issue a section 404 permit to the City of Lake Jackson for a public golf course within a 200-acre bottomland hardwood forest, the Fish and Wildlife Service and Department of the Interior have reached the following conclusions.

1. The proposed project site is a floodplain forest/wetland complex consisting of functionally interrelated jurisdictional wetland, non-jurisdictional wetland, and non-wetland forest components. This forest complex, due to its maturity, undisturbed nature, and location, serves as important habitat for seasonally large numbers of neotropical migrant birds.
2. On a regional and national basis, bottomland hardwood forests and the neotropical migrants they support have experienced significant declines.
3. The Corps Galveston District has greatly underestimated proposed project impacts by failing to delineate all onsite jurisdictional wetlands, and limiting its analysis to the loss of 2 wetland acres. Regardless of the wetland acreage affected, the Corps analysis virtually ignores the complex functional relationships of wetlands and "uplands" on this floodplain site.
4. The Corps analysis of alternatives has not considered all practicable alternatives to the proposed project, and has inappropriately limited the scope of this analysis by concluding that, to meet the overall project purpose, the golf course must be located within the City of Lake Jackson.
6. In-kind compensatory mitigation is not proposed to offset the substantial habitat losses that will occur if the project is authorized.

Based on the above considerations, we conclude that the project site's aquatic and other natural resources are of national importance, and the impacts to those resources substantial and unacceptable. Therefore, a permit should not be issued for the project as proposed.

Figure 1. Permit site and surrounding forest



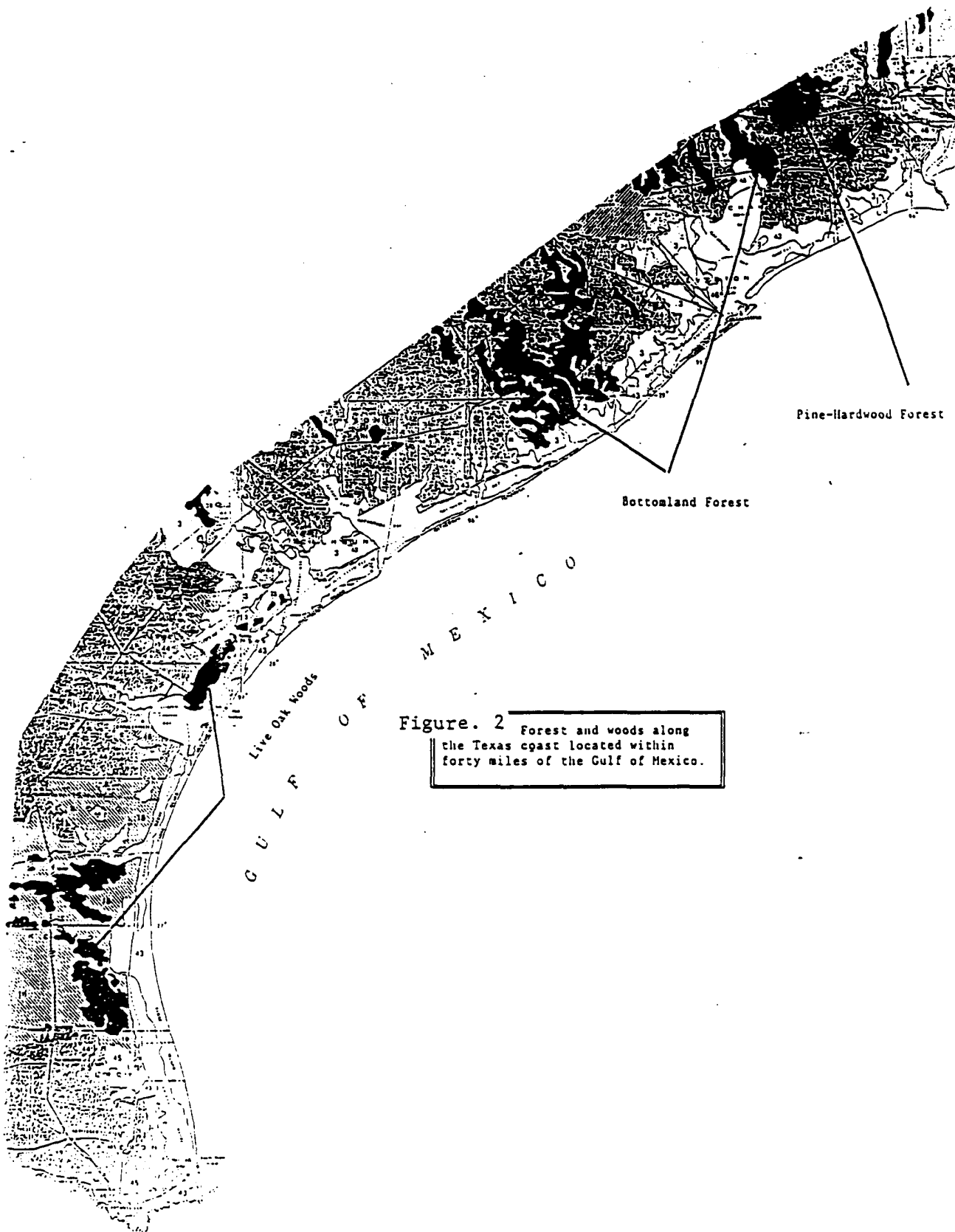


Figure. 2 Forest and woods along the Texas coast located within forty miles of the Gulf of Mexico.

Table 1

Neotropical Migrant Species Using the Coastal Bottomland  
Hardwood Forests of the Brazos/San Bernard River Floodplain

\* Breeding

Likely occurrence

A = Abundant; C = Common; U = Uncommon; O = Occasional; R = Rare

Species	Common name	Season			
		S	S	F	W
<i>Cathartes aura</i>	Turkey vulture	C	C	C	C
<i>Ictinia mississippiensis</i> *	Mississippi kite	R	R		
<i>Accipiter striatus</i>	Sharp-shinned hawk	U	U	U	
<i>Accipiter cooperii</i>	Cooper's hawk	U	U	U	
<i>Buteo lineatus</i> *	Red-shouldered hawk	C	C	C	C
<i>Buteo platypterus</i>	Broad-winged hawk	R	R		
<i>Buteo swainsoni</i>	Swainson's hawk	U	U		
<i>Buteo jamaicensis</i>	Red-tailed hawk	C	U	C	C
<i>Falco sparverius</i>	American kestrel	C	C	C	
<i>Falco columbarius</i>	Merlin	U	U	U	
<i>Coccyzus erythrophthalmus</i>	Black-billed cuckoo	R			
<i>Coccyzus americanus</i> *	Yellow-billed cuckoo	U	C	U	
<i>Chordeiles minor</i> *	Common nighthawk	C	C	U	
<i>Caprimulgus carolinensis</i>	Chuck-will's-widow	U	R		
<i>Caprimulgus vociferus</i>	Whip-poor-will	R	R		
<i>Chaetura pelagica</i>	Chimney swift	C	C	U	
<i>Archilochus colugris</i> *	Ruby-throated hummingbird	C	U	U	
<i>Sphyrapicus varius</i>	Yellow-bellied sapsucker	U	U	U	
<i>Contopus borealis</i>	Olive-sided flycatcher	U	U		
<i>Contopus virens</i> *	Eastern wood-pewee	C	C	C	
<i>Empidonax virescens</i> *	Acadian Flycatcher	U	U		
<i>Empidonax sp</i>	Empidonax	U	U	U	
<i>Sayornis phoebe</i>	Eastern phoebe	U	U	C	
<i>Pyrocephalus rubinus</i>	Vermilion flycatcher	U	U	U	
<i>Myiarchus crinitus</i> *	Great crested flycatcher	U	U	U	U
<i>Tyrannus verticalis</i>	Western kingbird	O			
<i>Tyrannus tyrannus</i> *	Eastern kingbird	C	C	C	
<i>Tyrannus forficatus</i> *	Scissor-tailed flycatcher	C	C	C	
<i>Tachycineta thalassina</i>	Tree swallow	C	C	U	
<i>Stelgidopteryx serripennis</i>	Northern rough-winged swallow	C	C		
<i>Riparia riparia</i>	Bank-swallow	U	U		
<i>Hirundo pyrrhonota</i>	Cliff swallow	O	R		
<i>Hirundo rustica</i>	Barn swallow	C	C	C	
<i>Troglodytes aedon</i>	House wren	R	U	U	
<i>Regulus satrapa</i>	Golden-crowned kinglet			R	R
<i>Regulus calendula</i>	Ruby-crowned kinglet	U	U	C	
<i>Polioptila caerulea</i>	Blue-gray gnatcatcher	U	U	U	
<i>Sialia sialis</i> *	Eastern bluebird	U	U	U	U
<i>Catharus fuscescens</i>	Veery	U			
<i>Catharus minimus</i>	Gray-cheeked thrush	U			
<i>Catharus ustulatus</i>	Swainson's thrush	U			
<i>Catharus guttatus</i>	Hermit thrush	U	U	U	
<i>Hylocichla mustelina</i> *	Wood thrush	U	U	R	
<i>Turdus migratorius</i>	American robin	C	C	C	
<i>Dumetella carolinensis</i>	Gray catbird	U	U	R	
<i>Bombocilla cedrorum</i>	Cedar waxwing	C	C		
<i>Lanius ludovicianus</i> *	Loggerhead shrike	C	C	C	C
<i>Vireo solitarius</i>	Solitary vireo	U	U	U	
<i>Vireo flavifrons</i>	Yellow-throated vireo	R	R		
<i>Vireo gilvus</i>	Warbling vireo	U	C		
<i>Vireo philadelphicus</i>	Philadelphia vireo	U	U		
<i>Vireo olivaceus</i> *	Red-eyed vireo	C	C	U	
<i>Vermivora pinus</i>	Blue-winged warbler	U	U		

<u>Species</u>	<u>Common name</u>	<u>Season</u>			
		<u>S</u>	<u>S</u>	<u>E</u>	<u>W</u>
<i>Vermivora chrysoptera</i>	Golden-winged warbler	U			
<i>Vermivora peregrina</i>	Tennessee warbler	C	C		
<i>Vermivora celata</i>	Orange-crowned warbler	U		U	U
<i>Vermivora ruficapilla</i>	Nashville warbler	U		U	
<i>Parula americana*</i>	Northern parula	C	C	U	
<i>Dendroica petechia</i>	Yellow warbler	C	U	U	
<i>Dendroica pensylvanica</i>	Chestnut-sided warbler	U		U	
<i>Dendroica magnolia</i>	Magnolia warbler	C		U	
<i>Dendroica tigrina</i>	Cape May warbler	R			
<i>Dendroica coronata</i>	Yellow-rumped warbler	C		U	U
<i>Dendroica nigrescens</i>	Black-throated gray warbler	U		U	
<i>Dendroica fusca</i>	Blackburnian warbler	U			
<i>Dendroica dominica</i>	Yellow-throated warbler	U			
<i>Dendroica pinus</i>	Pine warbler	R			
<i>Dendroica discolor</i>	Prairie warbler	R			
<i>Dendroica palmarum</i>	Palm warbler	R			
<i>Dendroica castanea</i>	Bay-breasted warbler	C		U	
<i>Dendroica striata</i>	Blackpoll warbler	U			
<i>Dendroica cerulea</i>	Cerulean warbler	U			
<i>Mniotilta varia</i>	Black-and-white warbler	U	R	R	
<i>Setophaga ruticilla</i>	American redstart	C		U	
<i>Protonotaria citrea*</i>	Prothonotary warbler	-			
<i>Helminthos vermivorus</i>	Worm-eating warbler	U			
<i>Limnithlypis swainsonii*</i>	Swainson's warbler	R	R		
<i>Seiurus aurocapillus</i>	Ovenbird	U			
<i>Seiurus noveboracensis</i>	Northern waterthrush	U		U	
<i>Seiurus motacilla</i>	Louisiana waterthrush	U			
<i>Oporornis formosus</i>	Kentucky warbler	U			
<i>Geothlypis trichas*</i>	Common yellowthroat	C	C	C	C
<i>Wilsonia citrina</i>	Hooded warbler	U		U	
<i>Wilsonia pusilla</i>	Wilson's warbler	U	U	U	C
<i>Wilsonia canadensis</i>	Canada warbler	U		U	
<i>Icteria virens</i>	Yellow-breasted chat	U			
<i>Piranga rubra*</i>	Summer tanager	R	R		
<i>Piranga olivacea</i>	Scarlet tanager	R			
<i>Pheucticus ludovicianus</i>	Rose-breasted grosbeak	R		R	R
<i>Guiraca caerulea</i>	Blue grosbeak	U		U	
<i>Passerina cyanea</i>	Indigo bunting	C	U	U	R
<i>Passerina ciris*</i>	Painted bunting	U	U	U	
<i>Spizella pusilla</i>	Field sparrow	U		U	U
<i>Poocetes gramineus</i>	Vesper sparrow	U		U	
<i>Chondestes grammacus</i>	Lark sparrow	O	R	O	R
<i>Passerculus sandwichensis</i>	Savannah sparrow	C		U	C
<i>Agelaius phoeniceus*</i>	Red-winged blackbird	A	A	C	C
<i>Xanthocephalus xanthocephalus</i>	Yellow-headed blackbird	U			
<i>Euphagus cyanocephalus</i>	Brewer's blackbird	U		U	U
<i>Molothrus ater*</i>	Brown-headed cowbird	C	C	C	C
<i>Icterus spurius*</i>	Orchard oriole	U	U	U	
<i>Icterus galbula</i>	Northern oriole	U		R	U
<i>Carduelis tristis</i>	American goldfinch	U		R	U

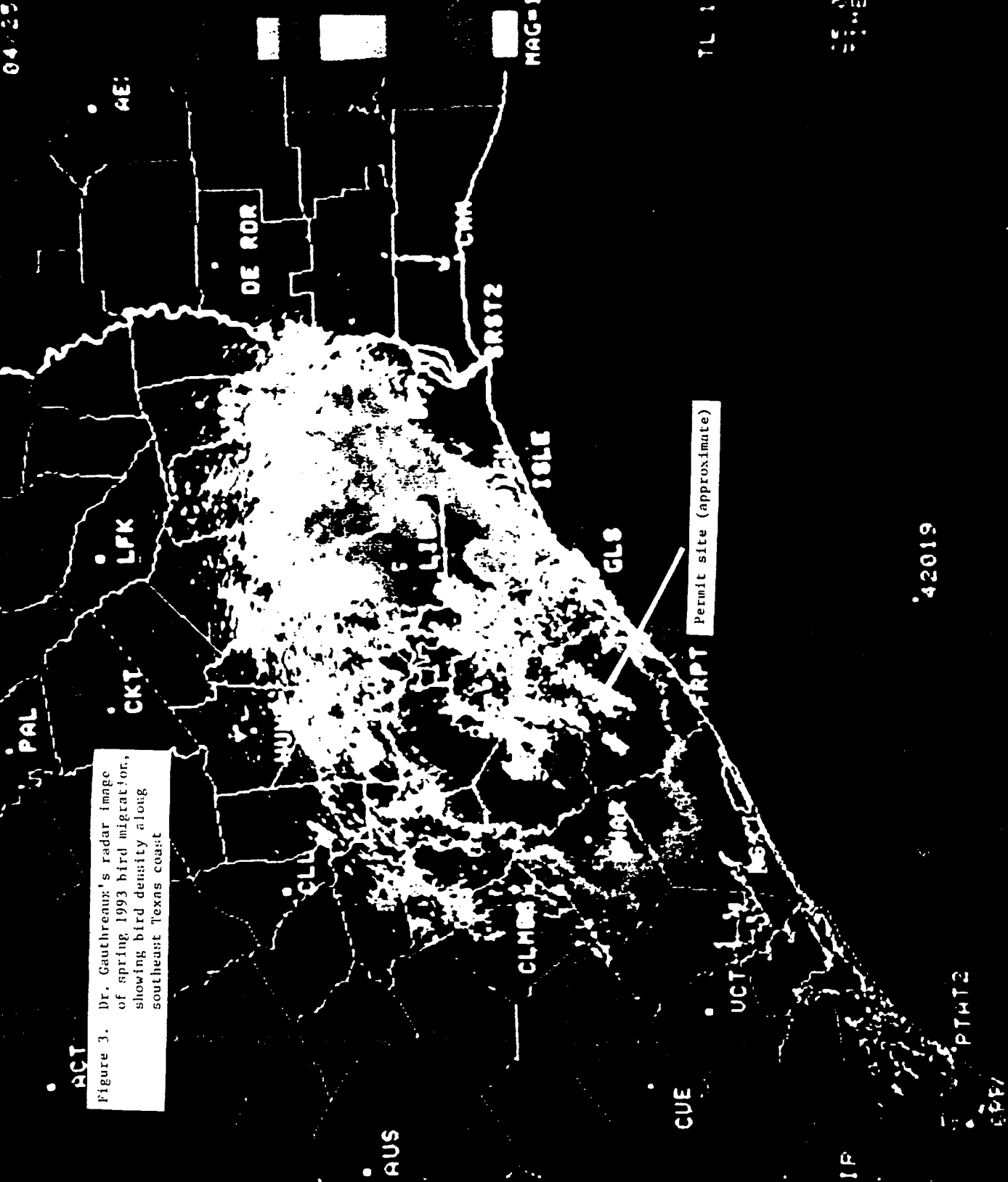
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MAG=1X FL=1 COM=1

TL 1 ENTER +

Figure 3. Dr. Gauthreaux's radar image of spring 1993 bird migration, showing bird density along southeast Texas coast



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