PESTICIDE OCCURRENCE IN THE UPPER FLORIDAN AQUIFER IN THE DOUGHERTY PLAIN AND MARIANNA LOWLANDS DISTRICTS, SOUTHWESTERN GEORGIA AND ADJACENT AREAS OF ALABAMA AND FLORIDA

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Abstract. In 1991, the U.S. Geological Survey (USGS) began full-scale implementation of the National Water-Quality Assessment (NAWQA) program. The three major objectives of the program are to provide a consistent description of current water-quality conditions for a large part of the Nation's water resources; define long-term trends (or lack thereof); and identify, describe, and explain the major factors that affect observed water-quality conditions and trends. The NAWQA program includes investigations of hydrologic systems in 60 study units that include parts of most major river basins and aquifer systems in the United States. Study units range in size from 1,200 to about 65,000 square miles, and incorporate 60 to 70 percent of the Nation's water use and population served by public water-supply systems. The Apalachicola-Chattahoochee-Flint (ACF) River basin (Figure 1) was among the first 20 NAWQA study units selected for study under the full-scale implementation plan.

The NAWQA design for ground-water studies focuses on assessing the water-quality conditions of major aquifers with emphasis on the quality of recently recharged ground water that is associated with present and recent human activities (Gilliom *et al.*, 1995). The NAWQA study of the ACF River basin chose the recharge areas of Upper Floridan aquifer for the first of these ground-water studies.

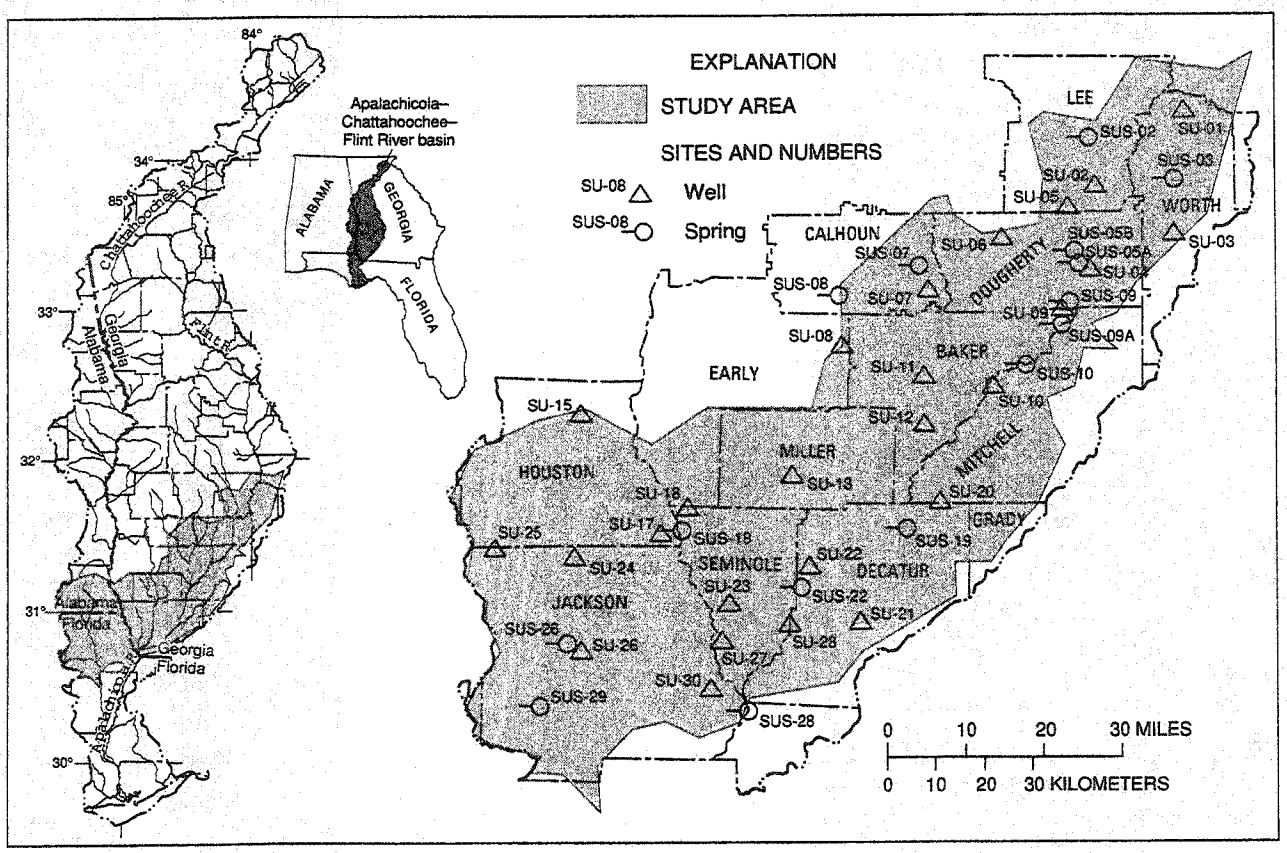

Figure 1. Location of study area and sampling sites.

The Dougherty Plain and Marianna Lowlands Districts of the Coastal Plain Province, in southwestern Georgia and adjacent areas of Alabama and Florida, are major crop producing areas that also generally coincide with recharge areas of the Upper Floridan aquifer. In the early 1980's, traces of the soil fumigant ethylenedibromide were discovered in the Upper Floridan aquifer in parts of the Dougherty Plain and Marianna Lowlands. Since the initial investigations of these occurrences, there have been few additional regional studies to evaluate pesticide occurrence and distribution in these areas.

During August and September 1995, ground-water samples were collected from the Upper Floridan aquifer at 26 wells and 15 springs as part of the USGS NAWQA study of the ACF River basins. Samples were analyzed for 86 pesticide residues using analytical methods with detection limits that generally are orders of magnitude less than existing water-quality standards and guidelines. The pesticide-concentration data were compared with published estimates of pesticide use on cropland and pecan orchards in the study area, and empirical ratings of pesticide ground-water leaching potentials to better understand the occurrence and distribution of pesticides in the Upper Floridan aquifer.

Preliminary results of this study indicate that trace concentrations (less than one microgram per liter) of 13 pesticides were detected in ground-water samples from the Upper Floridan aquifer (Table 1). The measured concentrations are below existing standards and guidelines for drinking water. The pesticides detected include: (1) selective preemergent herbicides used on cropland (alachlor, atrazine, butylate, fluometuron, metolachlor, and simazine); (2) the pesticide soil metabolite deethylatrazine; (3) nonselective herbicides used for vegetation control along fences, roads, and rights-of-way (bromacil, diuron, prometon, and tebuthiuron); (4) the soil fumigant 1,2-dichloropropane that has been banned from agricultural use by the U.S. Environmental Protection Agency (USEPA); and (5) the insecticide dieldrin, that also has been banned from all uses by the USEPA. Alachlor, atrazine (and its soil metabolite deethylatrazine), and butylate were among the pesticides detected with greatest frequency; however, they were in greatest use about 15 years prior to the sampling period, when corn and soybeans comprised a much greater percentage of the planted acreage in the study area.

Most detected pesticides have large ground- water leaching potential ratings on the basis of their soil half-life and soil organic-carbon partitioning coefficients. Of the pesticides used in the Dougherty Plain and Marianna Lowlands, these compounds are the most likely to be detected in ground water based on ground-water leaching potential ratings.

Table 1. Pesticides detected in ground-water samples from springs and wells in the Upper Floridan aquifer in the Dougherty Plain and Marianna Lowlands, August through September 1995
[all concentrations in micrograms per liter; <, less than; —, not applicable]

Compound detected	Spring sites (15)		Well sites (26)		Drinking water standard or guideline[1/]		Ground-water leaching potential[2/]
	Percent of sites with detects	Maximum concentration	Percent of sites with detects	Maximum concentration	Maximum contaminant level	Lifetime health advisory level	
Compounds (and their soil metabolites) primarily used for selective preemergent weed control							
Alachlor	20	0.019	35	0.14	2	—	medium
Atrazine	60	.024	54	.009	3	3	large
Butylate	0	<.002	8	.004	—	700	small
Deethylatrazine	60	.011	35	.009	—	—	—
Fluometuron	0	<.035	4	.040	—	90	large
Metolachlor	47	.036	38	.041	—	100	large
Simazine	7	.007	4	.020	4	4	large
Compounds primarily used for nonselective vegetation control							
Bromacil	0	<.035	4	.13	—	90	large
Diuron	0	<.020	4	.070	—	10	medium
Prometon	7	.045	8	.003	—	100	large
Tebuthiuron	13	.062	19	.79	—	500	large
Compound primarily used for soil fumigation							
1,2-dichloropropane	0	<.20	4	.40	5	—	—
Compounds primarily used for insecticide control							
Dieldrin	7	.015	4	.006	—	—	—

[1/] Nowell and Resek (1994).
[2/] Goss and Wauchope (1990).

LITERATURE CITED

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