



Municipal Watershed Management Survey

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Based on survey data, this report provides a general summary of the nature and extent of land uses, management problems, and informational needs for municipal watersheds in the southeastern US. Emphasis is placed on small and heavily forested watersheds and related forestry activities.

Based on projections made in 1965, municipal water withdrawal is expected to more than double by the year 2000 in the South Atlantic-Gulf, Tennessee, and Lower Mississippi Regions.¹ Population increases will contribute to these increased water needs, particularly in the South Atlantic-Gulf Region. A recent report² emphasized the need for planning at a municipal level in order to meet future water demands; research needs have been discussed in several reports.^{2,3}

It is clear that the management of municipal watersheds will become increasingly important in the future. Since many of the watersheds include forested lands, the Forest Service, USDA, through the Southeastern Forest Experiment Station and the Southeastern Area Office for State and Private Forestry, conducted a municipal water-shed-management survey in the southeastern US in 1972, encompassing Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. The study also included Oklahoma and Texas, but for the purposes of this

summary. only eleven states inventoried are included. The study had the following basic objectives:

1. Inventory the land uses allowed in water-supply watersheds
2. Inventory the nature and extent of various land-management problems occurring within these watersheds
3. Determine what information, research, and types of management practices are needed to improve the management.

Survey Procedures

Questionnaires containing nineteen separate questions were sent to municipalities and water-supply companies who used streams as their water source. Therefore, a municipal watershed was defined as any watershed that supplied surface water to a community, irrespective of watershed ownership or control by a water-supply agency. Mailing lists were compiled using available records and publications of state and federal agencies. For the eleven states reported here, 628 questionnaires were mailed. Two months after the questionnaires were mailed, a follow-up mail contact was made with the nonrespondents. No phone contacts were made except in Georgia, where Shaw⁴ conducted the survey. The respondents ranged from water-supply managers to mayors and clerks who used available data and personal knowledge to complete the questionnaire. The survey had a 61 per cent response.

Size and Ownership

In the eleven states at least 381 watersheds are used as sources of water. These 381 water-supply agencies and companies tap at least 272 streams and 162 lakes and reservoirs to provide approximately 12 million people with 1 860 mgd of water. Several large rivers are tapped for municipal water; for example, the Chattahoochee, Tennessee, and Mississippi Rivers. In the area surveyed, 20 per cent of the watersheds that supply municipal water are greater than 1 000 sq mi (Table 1). However, when management of municipal water-supply watersheds is contemplated, one must limit this consideration to relatively small watersheds where land management might be influenced by a community or a water-supply agency. The practical limit to the size of such a watershed is probably 100 sq mi. The southeastern survey found 61 per cent of the watersheds used were less than 100 sq mi (Table 1).

Heavily forested watersheds were analyzed separately because these are watersheds where forest management practices more clearly have an effect on the quantity, timing, and quality of the water supply. A heavily forested watershed was defined as one where forest occupied 80 per cent or more of the land area. Twelve per cent of the respondents indicated their watersheds are heavily forested, and 81 per cent of these watersheds are less than 50 sq mi in area (Table 1).

For all replies, 67 per cent of the watershed land area is in private ownership, with 16 per cent in municipal ownership and 11 per cent in federal ownership (Table 2). However, for watersheds less than 5 sq mi, municipal ownership increases to 41 per cent and for small, heavily forested watersheds, municipal ownership increases to 59 per cent. Federal ownership accounted for 24 per cent of the land area for all heavily forested water sheds.

Land Management

In the Southeast, 53 per cent of the watershed land area is estimated to be forested, with 88 per cent of the respondents indicating that their watershed contains some forest. Brush was reported for 48 per cent of the watersheds and occupies 12 per

TABLE 1
Watershed Size Class Distribution in the Southeast—per cent

Watershed Size Class sq mi	All Watersheds	Watersheds Greater Than 80 per cent Forested
< 5	18	37
5-9	11	14
10-49	22	30
50-99	10	5
100-499	15	9
500-999	4	0
1 000+	20	5
Total	100	100
Number of replies	381	45

TABLE 3
Restriction on Use of Municipal Watersheds

Type of Restriction	Percentage Response			
	All Replies	Watersheds		
		< 5 sq mi	> 80 per cent Forest	< 5 sq mi and > 80 per cent Forest
Open	71	46	39	19
Permit	12	20	18	19
Closed	10	27	36	56
Other	3	5	5	6
Open and permit	4	2	0	0
Open and closed	trace	0	0	0
Permit and closed	trace	0	2	0
Open, permit, and closed	trace	0	0	0
Total	100	100	100	100

TABLE 5
Hyrologic Data Collected on Watersheds

Parameter	Percentage Occurrence			
	All Replies	Watersheds		
		< 5 sq mi	> 80 per cent Forest	< 5 sq mi and > 80 per cent Forest
Precipitation	52	19	37	21
Humidity	4	4	5	7
Air temperature	22	8	27	14
Water quality	77	78	81	85
Streamflow	20	10	10	7
Evapotranspiration	3	2	2	7
Water temperature	52	48	45	42
Other	69	63	70	57

TABLE 7
Sources of Pollution Identified

Pollution Source	Percentage Occurrence			
	All Replies	Watersheds		
		< 5 sq mi	> 80 per cent Forest	< 5 sq mi and > 80 per cent Forest
Industry	23	0	0	0
Municipal	29	7	12	11
Livestock and agriculture	39	26	12	11
Recreation	22	11	18	11
Logging	9	19	31	33
Woodland grazing	1	0	0	0
Wildlife	6	15	12	11
Roads	6	7	12	11
Fire	0	0	0	0
Mining	9	0	18	0
Other	30	42	37	33

TABLE 2

Ownership of Land Supplying Municipal Water in the Southeast—
per cent

Ownership	All Replies	Watersheds		
		< 5 sq mi	> 80 per cent Forest	< 5 sq mi and > 80 per cent Forest
Municipal	16	41	37	59
Industrial	4	0	5	1
State	2	0	0	0
Federal	11	11	24	7
Private	67	48	36	33
Total	100	100	100	100

TABLE 4

Types of Activities Allowed Within Municipal Watersheds

Activity	All Replies	Percentage Occurrence		
		Watersheds		
		< 5 sq mi	> 80 per cent Forest	< 5 sq mi and > 80 per cent Forest
Hunting	72	40	62	39
Fishing	88	79	75	59
Camping	51	22	34	19
Boating	50	22	21	9
Snow skiing	7	0	3	0
Swimming	45	11	18	9
Riding and hiking	41	18	40	29
Water skiing	29	4	12	9
Timber management	46	25	46	39
Mining	16	0	21	0
Grazing	52	27	15	0
Other	4	13	9	29
Agriculture	57	27	25	0

TABLE 6

General Areas of Water Problems Identified by
Municipal Watershed Managers

Problem	Problem Severity	Percentage Occurrence			
		Watersheds			
		All Replies	< 5 sq mi	> 80 per cent Forest	< 5 sq mi and > 80 per cent Forest
Water yield	serious	5	10	16	25
	moderate	17	17	16	0
Seasonal distribution	serious	6	7	16	19
	moderate	22	24	31	19
Water quality	serious	7	5	9	13
	moderate	34	29	24	38

TABLE 8

Information Respondents Thought Useful in Evaluating the
Impacts of Forest Management

Information	All Replies	Percentage Response		
		Watersheds		
		< 5 sq mi	> 80 per cent Forest	< 5 sq mi and > 80 per cent Forest
Chemical composition	29	24	25	13
Water yield	25	24	41	44
Timing of yield	14	14	18	6
Water temperature	7	7	2	0
Turbidity	33	25	39	25
Biological composition	26	22	36	19
Other	1	2	0	0
Recreation-bacteria	34	22	32	19
Recreation-chemical composition	22	15	11	0

cent of the area. Agriculture and range occupies 33 per cent of the area, with 2 per cent in other land classifications. On watersheds less than 5 sq mi, forest occupies 72 per cent of the area.

In surveying the general level of land-use restriction, only 10 per cent of the respondents reported all or any portion of the watershed as closed (Table 3). Seventy-one per cent reported that the watershed area is open to use, and 19 per cent reported partial restrictions, either by use of permits or reported combination of degrees of restriction. There tends to be more restriction in watersheds less than 5 sq mi and in heavily forested watersheds (Table 3). Small, heavily forested watersheds experience even more control of use.

A wide range of activities are allowed in municipal watersheds in the southeast (Table 4). Various forms of recreation are generally allowed in most watersheds, with hunting and fishing as the most prevalent activities. Grazing and agricultural practices were reported as occurring on more than half of the watersheds. But on small watersheds and those heavily forested, less recreation is allowed, which is probably a reflection of increased municipal ownership and tighter restriction of uses. There was little difference in the occurrence of timber-management activities with size or on heavily forested watersheds.

A question asked was: Do you have watershed-management agreements with outside landowners or other agencies? Negative answers were received from 75 per cent of the respondents. However, 4 per cent indicated they had agreements with private landowners and 4 per cent with the Forest Service, USDA. The remaining agreements were with industry and other federal and state agencies, and were probably for water or water-quality analysis.

Hydrologic and Water-Quality Data

The type and quantity of hydrologic and water-quality data collected are very similar between analyses of watersheds (Table 5). The emphasis on water-quality data is apparent, with 77 to 85 per cent of the watersheds collecting raw-water-quality data. Sixty-nine per cent reported the parameters analyzed, including temperature, pH, turbidity, color, bacteria, suspended matter, and chemical constituents. The quantity of hydrologic data such as humidity and air temperature is limited and may prevent the use of some analytical tools to evaluate streamflow modification. It is also significant that only 7–10 per cent of the small or heavily forested watersheds have records of the quantity and timing of streamflow. The category of "Other" shows a high occurrence and includes a variety of data.

Major Problem Areas

Municipal watersheds in the Southeast are experiencing a variety of water problems. For all replies, 41 per cent reported moderate or serious water-quality problems (Table 6). Quantity and seasonal distribution of streamflow was reported by 22 and 28 per cent of the respondents, respectively. Towns using small forested watersheds report a high occurrence of serious water-yield and seasonal-distribution problems. These data indicate a need for forest-management information aimed at solving water-yield problems.

Where water quality was a problem, the respondent was asked to indicate the sources of contamination. The results are summarized in Table 7. For all replies, the leading source is agriculture and livestock, followed by municipal industrial, and recreational sources. Logging is recognized as only a minor source of water-quality problems. By contrast, the major sources of pollution were entirely different for the smaller and heavily

TABLE 9
Management Information Needed for Future Decisions

Management Information	Percentage Response			
	All Replies	Watersheds		
		< 5 sq mi	> 80 per cent Forest	< 5 sq mi and > 80 per cent Forest
Methods to increase yield	24	31	31	44
Optimum land use mix				
Water yield	17	19	13	13
Water quality	31	25	29	31
Timing of yield	10	7	7	0
Technical assistance	24	27	20	25
Other	2	0	4	0

forested watersheds. Logging activities are clearly the major source of pollution on these watersheds because it is a major activity in this watershed category (Table 4). In the absence of other pollution sources, the relationship of logging to water quality is more evident. Recreation activities are also frequently allowed on small, heavily forested watersheds (Table 4), but recreation is only a relatively minor pollution source (Table 7).

Information Needs

The southeastern survey asked for data on the types of forest-related information the respondent thought would be useful in making future decisions on a specific watershed. Water-supply problems are not exclusively related to forest management, but forestry practices and forest uses do have a role in accentuating or alleviating these problems.⁵ For all replies, the impact of recreation on bacteria was ranked highest, followed closely by the effects of forest management upon turbidity (Table 8). Three water-quality items followed, with water-yield information cited as a need 23 per cent of the time. In analyzing the responses from small and heavily forested watersheds, water-yield information ranked first in importance and turbidity ranked second (Table 8). On small forested watersheds, managers are clearly interested in water-yield information.

The survey also asked what land-management information and methods managers believed would help them meet their water needs. For all replies, water quality again came to the forefront with water yield second (Table 9). Of particular interest, and also ranked second, was that 24 per cent of the respondents were interested in technical assistance to improve land management. Again, the respondents who use small and heavily forested watersheds, showed an increased interest in land management to increase water yields.

Publications Received

The survey asked the respondents to list the journals and publications they receive that aid them in managing their watersheds. The top five publications were trade journals that concentrate on water-supply management (Table 10). Few respondents received publications which concentrate on land management. Although they indicate an interest in land-management data and methods, it is apparent that the information is not reaching an important audience. As further evidence of interest, they were asked if they wanted to be put on a mailing list for publications relevant to land management on municipal watersheds. Forty-eight per cent of the respondents requested to be put on such a list.

TABLE 10
Water-Supply Agencies Receiving a Publication—per cent

Publication	All Replies	Watersheds		
		< 5 sq mi	> 80 per cent Forest	< 5 sq mi and > 80 per cent Forest
Wtr. Wastes Engrg.	70	61	67	63
Jour. AWWA	64	53	64	38
Public Wks.	52	32	44	25
Jour. WPCF	29	10	16	6
Indl. Wtr. Engrg.	20	17	13	13
Farm Jour.	7	12	2	6
Jour. Soil Wtr. Conservation	1	3	0	0
Southern Lumberman	1	0	0	0
Jour. Forestry	1	0	0	0
USFS Res. Papers	0.3	0	0	0
Other	6	2	9	0

Conclusions

In this report the authors have provided a general summary of the nature and extent of land uses, management problems, and information needs for municipal watersheds in the south-eastern US, with emphasis on small and heavily forested watersheds. The survey represents a reasonable sample of municipal watersheds using surface waters in the region, and several trends emerge which are useful to both management and research.

Water-supply managers recognize the relationship between land management and water supply. Private ownership of water-supply lands is dominant in the region, but the majority of the small, forested watersheds have significant municipal ownership and the towns could directly influence the management of land and, hence, the water resource. Currently, on more than half of the small forested watersheds, all or a portion of the watershed is closed to use. On the remaining watersheds that are open, recreational activities are predominant, with some timber-management activities. Water yield was consistently of first concern on the small, forested watersheds, followed by water quality. A vast quantity of literature and guidelines exist on the effects of forest-management activities on the quantity and timing of streamflow, but survey data indicate that this information may not be reaching the water-supply manager. It is clear that more land-management articles should be aimed at this audience through their trade magazines. Less is known about the impact of forest practices on water quality—particularly on chemical and biological characteristics of water. Research in these areas is needed for the region. Municipal watershed managers also expressed a definite interest in technical assistance in helping alleviate some of their problems.

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