



US Army Corps  
of Engineers

Waterways Experiment  
Station

# RECNOTES

NATURAL  
RESOURCES  
RESEARCH  
PROGRAM

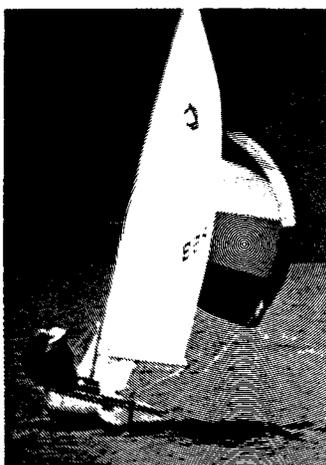
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The recreation potential of a section of the Chattahoochee River was measured through in-stream flow methodologies



## MEASURING THE EFFECT OF STREAM FLOW ON RECREATION POTENTIAL

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Stream flows on the Chattahoochee River are regulated for hydropower generation by the Corps of Engineers at Buford Dam at Lake Sidney Lanier, Georgia. Increasing demands on the Chattahoochee River as a water supply for Atlanta and its environs has caused Savannah District to examine a number of alternatives for increasing the minimum flow. In 1984, at the request of Savannah District, the Waterways Experiment Station studied the effect of stream flow on river recreation. This study was a joint effort of the Water Quality Modeling Group and the Resource Analysis Group at WES and the US Fish and Wildlife Service

(F&WS). The following article describes the use of an in-stream flow model to predict the recreation potential of part of the Chattahoochee.

### STUDY AREA

The area of concern was a 48-mile stretch of the Chattahoochee River from Lake Sidney Lanier south to Atlanta (Figure 1). In this section of the river, there are both shoal areas where the river is wide and shallow and pools where the river is narrow and deep. The substrate varies from predominantly bedrock in the shoals to silt in the pools with sand in between.



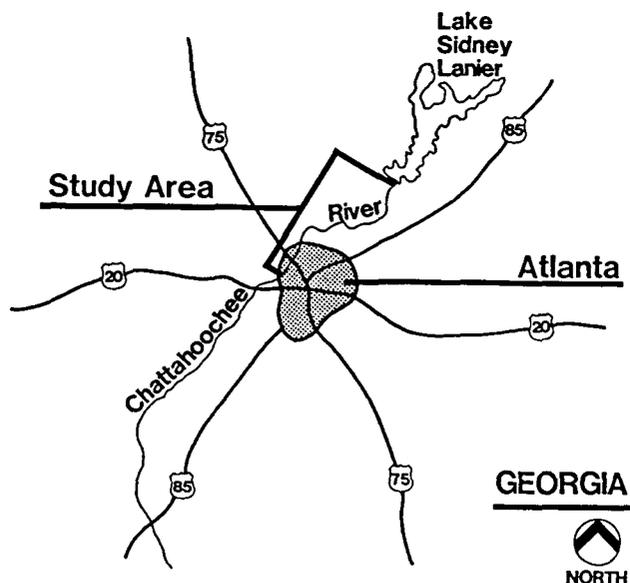


Figure 1. Location of study area

Due to its proximity to Atlanta, this section of the Chattahoochee receives a tremendous amount of a variety of recreational uses. Typical recreation activities include rafting, canoeing, fishing, wading, swimming, sunbathing, and just relaxing. Much of the activity is accommodated in or originates from public recreation areas operated by the National Park Service, the Corps of Engineers, and the surrounding counties. However, there is also a substantial amount of river access from bridges, road ends, and roads that parallel the river. In addition, much use originates from several major apartment complexes that border the river as it nears Atlanta.

### PHYSICAL HABITAT SIMULATION SYSTEM

Instream-flow models used for the study comprised the Physical Habitat Simulation System (PHABSIM) developed by the F&WS. Although not designed specifically for recreation, PHABSIM can be used to predict the effect of changes in stream flow on the recreation potential of a resource. This is done by applying depth and velocity criteria for various water-based recreation activities to stream profiles and hydraulic information.

Measurement of the physical characteristics of the study area was accomplished by dividing that section of the river into representative reaches. Sites within each reach were selected as representative cross sections, and transects were run. Four recreation activities were selected for analysis: rafting, canoeing, fishing, and wading. All

activities except wading were further broken down based on type or skill level.

### SYSTEM APPLICATION

With PHABSIM, the data can be analyzed in a number of different ways. The results of three of these analyses are presented. First, in the study area of the Chattahoochee, it was found that there was relatively little change in river stage and width as velocities increased. This was particularly true for the lower third of the river, which tends to be wider and shallower.

The area available for each recreation activity at different flows was also examined (Figure 2). As might be expected, the most area available for wading, wade fishing, and raft landing was found at flows at or below 750 cubic feet per second (cfs). The greatest available area for midlevel rafting and canoeing occurred at the highest flows (12,000 cfs was the maximum discharge modeled). The maximum available area for the remaining activities fell

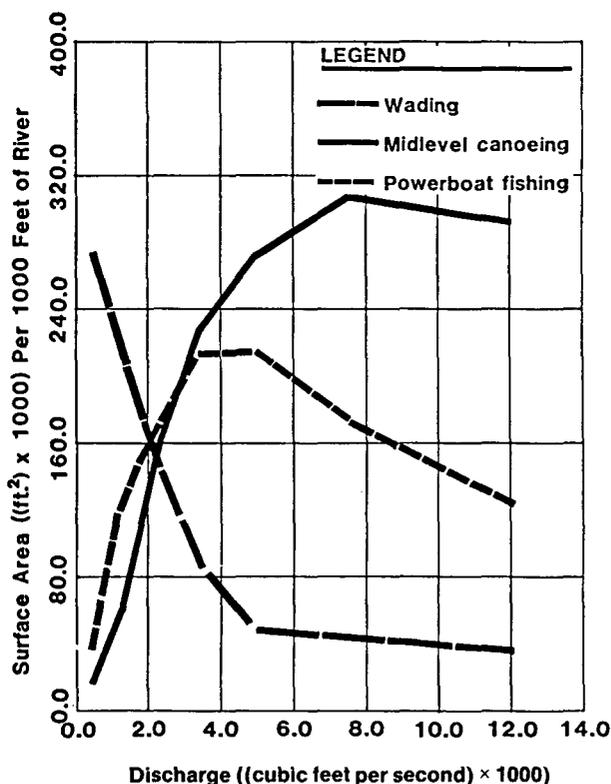


Figure 2. Prediction of the area available for selected recreation activities at different discharges (the graph represents the lower 14 miles of the river study site)

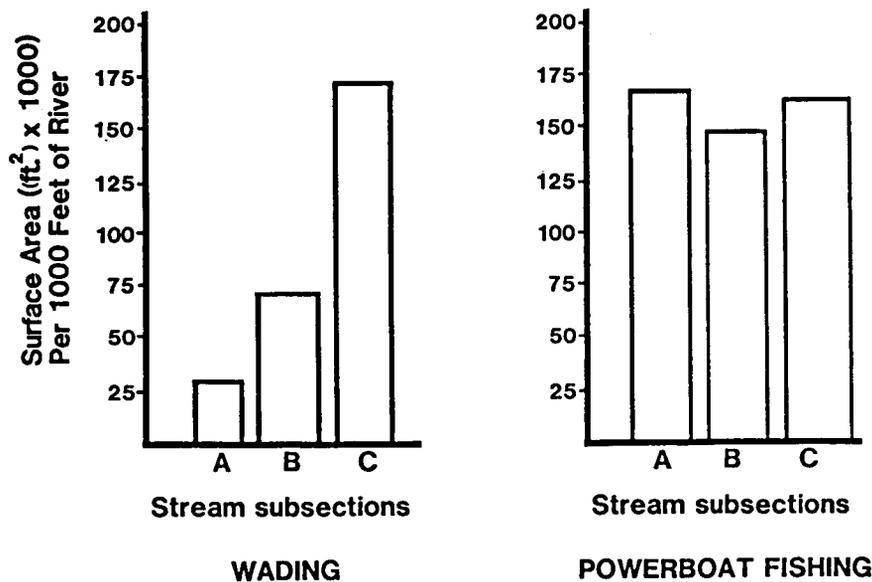


Figure 3. Comparisons of available area between subsections of the study site (discharge = 2000 cfs)

in between these two extremes.

Finally, different subsections of the study area were compared in regard to the amount of area available for each activity. Three subsections were selected: upstream, middle, and downstream sections (called sections A, B, and C, respectively). Figure 3 illustrates the results for two activities at a discharge of 2000 cfs. For all activities (except powerboat fishing and fishing from an inner tube), the greatest area at all flows occurred in the lower third of the river. Location also had an effect on the area available for wading and wade fishing. In the shoal areas, where these activities occur most often, area actually increased at flows of up to approximately 2500 cfs.

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### SUMMARY

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Increasing pressures on environmental resources have created a need for accurate quantitative descriptions of all possible resource uses. This information has generally been lacking for recreational use of river resources. PHABSIM offers one method of obtaining some of these data. Through PHABSIM, it is possible to measure not only the amount of surface available for different recreational activities at selected stream flows, but the changes in stream depth and width at these flows. These data can be used with other resource and sociological data to provide the information necessary to make informed decisions.

## A MULTIPLE-SURVEY EVALUATION OF BOATING CONDITIONS AT BERLIN LAKE

By

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Boating has always been popular at Berlin Lake, Ohio, which has 3,590 surface acres at summer conservation pool. Since its completion in 1943, people from neighboring cities such as Youngstown and Alliance have enjoyed boating activities on the lake.

A marina was constructed in the late 1950s to

provide boat slips and fuel. Until 1966 the only places to launch boats were the ends of several roads leading into the lake. Since that time two multilane ramps have been constructed to accommodate increasing use.

Private boat docks began to appear shortly after impoundment began. The number of private boat

slips grew slowly at first, but increased residential development in the 1960s and 70s produced over 1000 such slips on the lake.

The construction of these facilities increased the public's ability to use and enjoy boating opportunities on Berlin Lake. However, as use increased, managers became concerned that higher use levels were affecting the quality of boating opportunities. Increased congestion, complaints, and some boating accidents during peak-use periods indicated that the management of Berlin Lake for boating use needed to be evaluated.

In order to evaluate management options, information was needed on the distribution of boating use, boaters perceptions of use levels, and the effects of boating densities on use patterns. In 1982 the Pittsburgh District requested the Waterways Experiment Station (WES) to conduct a study of boating use on Berlin Lake (a similar study was performed by WES on Youghiogheny Lake, Pa. and Md.).

The primary study objectives were to:

- Measure boat densities on the lake during peak-use periods on summer weekend afternoons.
- Identify boating use patterns, user characteristics, and perceptions of boating conditions.
- Evaluate relationships between boat densities, use patterns, and user perceptions.

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### APPROACH

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To achieve the study objectives, a simultaneous multiple-survey approach was used. First, aerial photographs (1:7200 scale) were taken of the entire lake between 1300 and 1500 hours (peak-use period) on each survey date. These aerial surveys provided a basis for determining the amount, composition, and distribution of use on the pool. Densities were established in acres per boat based on the actual number of boats *in use on the water* (not in slips) and the acreage at the pool elevation of 1021.66 ft (summer conservation pool).

Second, during each survey personal interviews (performed by project management staff) were conducted with boaters between 1400 and 2100 hours at all major boat ramps, campgrounds, and the marina. Also during each survey, owners of one-quarter of all private boat slips on the lake were surveyed utilizing a mail-back questionnaire. This approach allowed an examination of the relationships between actual boat densities (determined through the aerial photographs) and boater perceptions and behavior (determined through boater surveys).

Weather conditions were monitored immediately prior to each survey to determine if they would affect aerial photography or boating levels. Several surveys were postponed due to adverse weather conditions.

Four survey periods were selected during the 1982 recreation season. Two periods were originally scheduled for holiday weekends and two for nonholiday weekends. Inclement weather eventually forced the substitution of one nonholiday period for a holiday.

While the study was primarily intended to evaluate boating conditions during average peak-use periods (summer weekend afternoons), observations of holiday use provided an opportunity to evaluate future conditions if average use levels continue to increase.

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### FINDINGS

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Study findings were arranged into four categories: boat densities, crowding perceptions, effects of crowding, and relationships between densities and behavior.

**Boat densities.** Using the aerial photographs, both total densities and densities by section of the lake were calculated in acres per boat. The larger the number of acres/boat, the more room each boat had on the average. Total densities for Berlin Lake were:

Survey	Total Boating Density acres/boat
1	7.08
2	5.36
3	10.68
4*	10.32

\* Labor Day weekend

The boating densities reflected the total visitation to the lake during the survey periods. Survey 2 was the most crowded while survey 3 was the least crowded. Survey 1 approximated the normal visitation for 1982 according to staff personnel at Berlin Lake. Survey 4 (Labor Day weekend) was the only holiday survey period. Historically, the lake receives the least visitation of the three major holidays (Memorial Day, Fourth of July, and Labor Day) on Labor Day. However, according to project staff, visitation was even lower than normal on Labor Day 1982.

Densities were also determined for each of the five lake areas delineated in the Berlin Lake Master Plan. Figure 1 shows the densities for each area by survey date. It can be seen that area 2 was the most heavily used for all survey dates, followed by areas 4, 3, 1, and 5. High boating densities in area 2 can be explained in part by the existence of a five-lane launching ramp and a major marina on that part of the lake.

**Crowding perceptions.** In order to evaluate the relationship between perceptions and behavior, respondents were asked, "How would you describe boating conditions on the lake today?" To answer the question, a choice was made among five alternatives ranging from "very crowded" to "very uncrowded." Responses to the question in all four surveys are summarized in Table 1. Dock permit holders perceived the greatest crowding followed by campers, day users, and marina users.

**Effects of crowding.** The importance of crowding comes from its effect on user behavior and levels of satisfaction with the boating experience. Crowding would not be a problem if it did not change how boaters feel and behave.

All boaters surveyed on peak-use days (weekends) were asked to respond to a series of statements by marking a five-point scale from "strongly disagree" to "strongly agree." The results are summarized in Table 2.

Boaters were asked to respond to the statement, "I stayed off the lake during part of the day because there were too many boats on the lake." Dock permit holders were most likely to agree with this statement. More than one half of this group (54%) reported avoiding the lake sometime during the day because of crowded conditions.

Campers were the next most likely to report avoiding the lake during part of the day because of crowding. Crowding caused about one-fifth (19%) of the campers to stay off the lake part of the day. Day users stayed off in somewhat fewer numbers (15%), and very few marina users (8%) were displaced by crowding.

If the various classes of boaters surveyed are ordered by their perception of crowding and by their response to this item, the rankings are identical. Dock permit holders perceived the greatest crowding and stayed off the lake in the greatest proportion, followed by campers, day users, and finally marina users.

**Relating boat density to perceptions and behavior.** Using boat density data, survey days were first ranked from the least to the most acres per boat. Then survey days were ranked according to scores on each of 12 perception and behavioral variables. Relationships were evaluated between the density rankings and each of the perception and

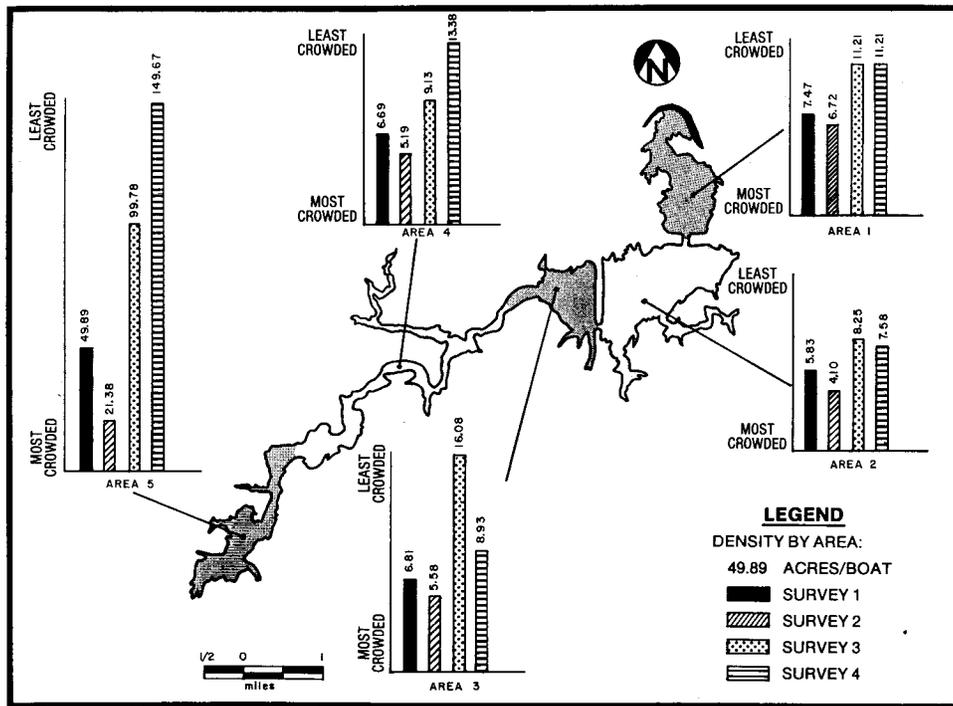


Figure 1. Boating capacity analysis of Berlin Lake, Ohio - 1982

**Table 1. Perceptions of Crowding**

Boater Type	Perception - Percent of Respondents				
	Very Crowded	Crowded	Neutral	Uncrowded	Very Uncrowded
Dock permit holder (N= 115)*	30.4	42.6	20.0	7.0	0
Marina user (N = 86)	17.4	10.4	61.6	10.4	0
Camper (N = 149)	24.1	48.9	21.4	4.6	0.6
Day User (N = 701)	25.1	44.5	22.6	7.1	0.5

\* N = sample size for all surveys

**Table 2. Effects of Perceived Crowding on Boating Behavior at Berlin Lake  
Percent of Respondents Who Agreed With Statement**

Behavior	Dock Permit Holder	Marina User	Camper	Day User
Avoided favorite parts of lake	48.21	55.81	30.87	29.10
Number of boats reduced enjoyment	58.41	53.49	20.81	24.39
Stayed off the lake part of the day	53.51	8.14	19.46	14.86
Near accident	11.21	6.98	7.38	11.27
Noise reduced enjoyment	41.59	10.47	21.92	15.29
Did not participate in some activity as much as desired	58.41	48.84	31.58	20.92

behavioral rankings. General interpretations of the results were:

- Undesirable perceptions and displacements were associated with increases in density.
- Increased density was not importantly associated with reduced satisfaction except among campers.
- Increased density was associated with:
  - Reduced enjoyment because of crowding.
  - Greater perceived crowding except among marina users.
  - Avoiding favorite parts of the lake and staying off the lake part of the day.
  - Perceived encroachment by all but dock permit holders.

permit holders apparently are *not* contributing much to peak use. Therefore, placing limits on the number of private boat docks might be only a partial solution to controlling peak-use conditions.

The uneven distribution of boating use on Berlin Lake appears to be more of a problem than total number of boats. Average boating density during the four surveys was 11 times greater on the most crowded section of the lake (area 2) than on the least crowded section (area 5). Large numbers of day users launching at the Mill Creek ramp add to the already crowded conditions in area 2. When these boaters were asked why they used this ramp, 28% responded that they did not know of any other ramp on the lake. It might be possible to alleviate crowded conditions on area 2 by simply providing information on alternative launching ramps.

In summary, the survey procedures employed at Berlin Lake revealed significant differences in perceptions and behavior between boating groups (i.e., campers, day users, marina users, and dock permit holders). These differences point toward the need to develop separate management strategies for each group to effectively manage boating conditions during peak use periods.

## CONCLUSIONS

The study findings provide some insight into the effectiveness of potential management options. For instance, with over 50% of all dock permit holders staying off the lake part of the day and 8% staying off all day because of crowded conditions, dock

# USE OF TRAFFIC TEETH IN DESIGNING ENTRANCE STATIONS

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Benbrook Lake, Ft. Worth District*

Increased pressure on Corps of Engineers recreation areas in recent years, especially at projects near large metropolitan areas has had a drastic effect. Impacted resources, increased vandalism, congested roadways, and safety problems in campgrounds are forcing some resource managers to take what some consider drastic measures.

Of primary concern has been the control of vehicular traffic, especially after dark. The belief is that if access to areas (both day use and camping) is denied, both vandalism and safety problems would be reduced. However, simply locking the gates is not the answer. Major thoroughfares may cross through day-use areas. Large day-use areas may also contain several boat ramps. It would be difficult to have all boaters return to ramps and clear an area by closing time. The problem is equally complex in campgrounds. Campground visitors are notorious for their attempts to "beat the clock" and stretch their stay past closing time. Contract gate attendants have a long day that does not need to be extended by inconsiderate visitors. There are also legitimate reasons, such as severe weather or medical emergency, for persons to leave the campground at any hour.

Installation of one-way traffic teeth at entrance stations has provided a workable solution. The teeth are placed in the exit lane of a traffic island. A gate then can be closed across the entrance lane, denying access but allowing vehicles to leave at any time.

There are several points that must be considered when designing a traffic control station which incorporates traffic teeth.

- The island must be substantial enough to discourage vehicles from attempting to cross it. Ten-inch railroad ties stacked three high have proved more than adequate.
- At campgrounds, the teeth must be placed far enough from the fee booth so there would be no chance of a camper rolling back onto the teeth

when pulling up to the booth.

- The exit lane should be wide and provide adequate maneuvering room so the largest of recreation vehicles can straighten out before crossing the teeth. Any protrusions from the fee booth must be corrected.
- The station should be well lit and signed. Amber and red reflectors can be placed on appropriate sides of the roadway and structures. A lighted sign can be purchased from teeth manufacturers and a spotlight fixed to shine directly on the teeth.

While this solution has not been perfect (there have been reports of vehicles crossing the teeth by laying boards over them), it has served as a deterrent to unruly nighttime traffic. Most importantly it has allowed gate attendants to get a good night's sleep!



## PARK RESOURCE MANAGEMENT WORKSHOP

The first multi-regional Park Resource Management Workshop will be held on March 5, 6, and 7, 1986, in Cincinnati, Ohio. The workshop, held in cooperation with the National Society for Park

Resources—NSPR (a branch of the National Recreation and Parks Association) is jointly sponsored by Federal, state, and local park agencies; professional societies; universities; and the

private sector and promises to be an in-depth look at park resources in the eastern and midwestern areas of the country.

The objective of the workshop is to provide low cost/high quality professional training while increasing field managers' interest and participation in NSPR. Continuing education credits (CEUs) will be provided, and an NRPA-NSPR membership incentive is expected to be included in the modest registration fee.

The program agenda calls for sessions on topics such as efficiency and economy, forest and wildlife management in park settings, creative management techniques, computer use, motivation, and recreation liability. These are just a few of the topics being considered for the workshop. General sessions of interest to the entire group will be presented, but most will be small concurrent sessions providing hands-on training and management techniques that managers can use to improve their day-to-day job performance. Some sessions will be repeated. Overall, there will be something of interest for all participants.

To provide effective training, the workshop will be limited to the first 200 registrants. Contact lists are being compiled from eastern/midwestern area Federal, state, and local park resource agencies; professional societies; universities; and businesses. Registration/information packages will be sent to these addresses later this year. If you are not on such a mailing list and would like to receive a package, or if you have any questions on the workshop, call Sherman Gee or Nancy Tessaro, US Army Corps of Engineers, Ohio River Division, at (513) 684-3191 (FTS or commercial).



## NATURAL RESOURCES RESEARCH PROGRAM

This bulletin is published in accordance with AR 310-2. It has been prepared and distributed as one of the information dissemination functions of the Environmental Laboratory of the Waterways Experiment Station. It is primarily intended to be a forum whereby information pertaining to and resulting from the Corps of Engineers' nationwide Natural Resources Research Program can be rapidly and widely disseminated to OCE and Division, District, and project offices as well as to other Federal agencies concerned with outdoor recreation. Local reproduction is authorized to satisfy additional requirements. Contributions of notes, news, reviews, or any other types of information are solicited from all sources and will be considered for publication as long as they are relevant to the theme of the Natural Resources Research Program, i.e., to improve the effectiveness and efficiency of the Corps in managing the natural resources while providing recreation opportunities at its water resources development projects. This bulletin will be issued on an irregular basis as dictated by the quantity and importance of information to be disseminated. Communications are welcomed and should be addressed to the Environmental Laboratory, ATTN: A. J. Anderson, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, MS 39180-0631, or call AC 601, 634-3657 (FTS 542-3657).

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# OCE NATURAL RESOURCES MANAGEMENT TOPICS

Hello and welcome to a new feature column for RECNOTES — Natural Resources Management Topics. Since this is the inaugural column, I'd like to take a moment to discuss my objectives. Time and again I have heard suggestions for a Natural Resources Management newsletter. Each time I've been receptive to the idea, but I have never been able to come up with an approach that didn't overtax our capabilities to produce a quality product over the long haul. A while back, Larry Lawrence called from WES and suggested that a column on natural resource management would be a good addition to RECNOTES. It seemed like a great idea, so here we are!

The column will be a place to discuss the issues facing the Natural Resources Management (NRM) Program today. In each column I'll try to give a concise overview of one or two key happenings or issues that are significant to the program. We'll keep it informal and try to bring everyone up to speed on the background, facts, and implications of issues that concern us all.

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As an opener, I'd like to discuss a recent initiative that I think will help shape the course of our program for the next couple of years. An ad hoc committee was selected from all levels of the Corps to meet in OCE to discuss efficiency in the recreation program. The committee was formed as follow-up action to the Army Audit Agency's (AAA) report on recreation facilities published in June 1984. However, given the need to continue to work on efficiency, we'd probably have had a session like this regardless of the AAA report.

Eight representatives from division, district, and project levels participated in a weeklong forum that covered a variety of topics. The representatives (committee members) were Wayne Lanier (ORN), Mike Mason (NPD), Mike Miller (SAD), Bill McCoy (SPD), Mike O'Keefe (NCD), Phil Parsley (OCE/SWD), Dwight Quarles (SWD), and Frank Walker (LMVD).

The committee worked hard to deal with a number of subjects. Over the course of the 4-1/2 day meeting, the following major topics were discussed:

- NRM Program goals and objectives.
- Measuring the products we provide.
- Training plans/career development.
- Improved communications in all directions from the top down and from the bottom up.
- OCE role in program management.
- Measuring and monitoring efficiency.
- A functional award system.

When you look at this list out of context, the subjects don't seem to apply directly to recreation efficiency. But when you pull the topics together and consider their applicability towards improving overall program efficiency, you can see the committee has done a thorough job of reviewing the overall program.

A summary of the results of the meeting is being sent to NRM managers for further input. When we get that input, we will use the results to formulate Corps goals for the NRM Program for the next two or three years. It is our full intent to use the AAA audit and the committee findings to be pro-active from this point on rather than to be reactive as we have done so often in the past.

Two things that I anticipate in the near term will be (1) an appendix to ER 1130-2-400 that discusses management considerations for efficient operation of our recreation areas (this answers the mail as far as the AAA audit report is concerned) and (2) a training plan establishing an NRM curriculum geared to professional development of Corps resource management staff at all levels (entry level through positions in the Chief's Office).

In summary, we are trying to give direction to a program that has taken some pretty hard licks in the past few years. I am enthused about the prospects. You will be hearing more about this as we circulate some of the material already prepared and as we start tapping Corps people from all levels to work on various tasks. If you are interested in serving on committees or reviewing drafts, don't hesitate to drop me a line. There's work enough for everyone!

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One other event that will probably take place before this goes to press is the naming of the President's Commission on Outdoor Recreation as set forth in Executive Order 12503. This promises to be a significant effort and we expect to be tasked with numerous data requests over the 12- to 18-month life of the commission. This is tailored after the Outdoor Recreation Resource Review Commission that significantly affected the way outdoor recreation was dealt with by the Nation for many years. It is too soon to predict how effective the commission will be, but we are in touch with a number of people working on this, and we will keep you posted.

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In closing, I'd like to ask you to take the time to suggest topics you'd like to see discussed. Just drop me a note or give me a call. I am committing myself to making this a meaningful column and would appreciate any ideas on how to make this the first place you turn to when you pick up the latest issue of RECNOTES!



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