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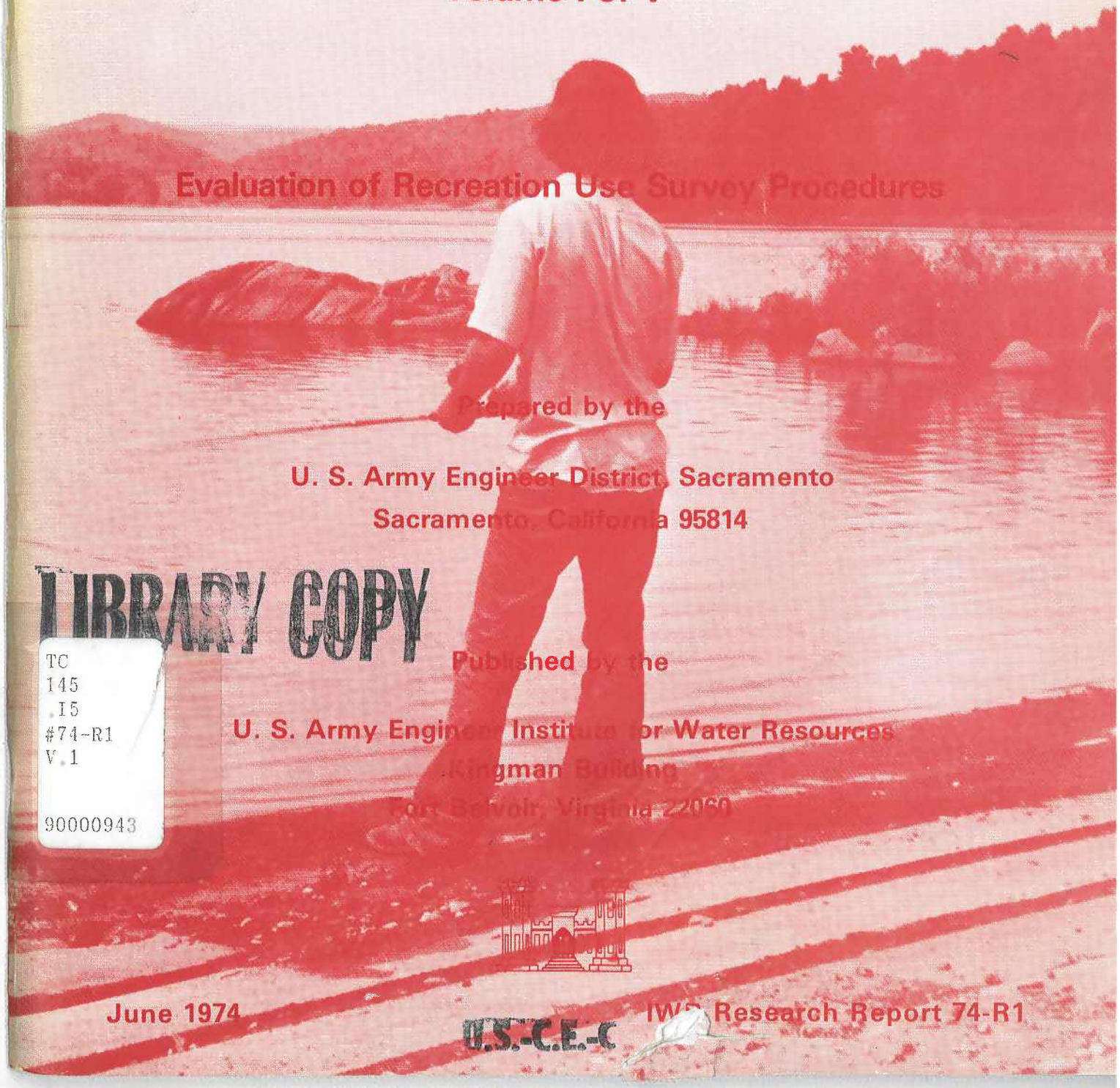
PLAN FORMULATION AND EVALUATION STUDIES — RECREATION

Volume I of V



Evaluation of Recreation Use Survey Procedures

Prepared by the

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Published by the

U. S. Army Engineer Institute for Water Resources
Kingman Building
Fort Belvoir, Virginia 22060

June 1974

U.S.-C.E.-C

IWR Research Report 74-R1

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Volume I of V

Evaluation of Recreation Use Survey Procedures

A Report Submitted to the
Department of the Army
Office of the Chief of Engineers

Published by the
U. S. Army Engineer Institute for Water Resources
Kingman Building
Fort Belvoir, Virginia 22060

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Approved for public release; distribution unlimited.

Copies may be purchased from:

National Technical Information Service
U. S. Department of Commerce
Springfield, Virginia 22151

June 1974

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PREFACE

In 1962, the Chief of Engineers initiated a Corps-wide method of sampling the existing recreation use on Corps of Engineers civil works reservoir projects. The data collected were incorporated into existing planning processes and provided the basis for improved administration of operating projects. The availability of data with which to describe recreation use provided the foundation for specialized studies such as those presented in this report. An evaluation of the data collected indicated that improvements could be made to make the data more useful. Consequently, in 1965 the Director of Civil Works authorized studies to be undertaken to:

a. Evaluate the recreation-use data collection procedure and recommend methods for improving the statistical accuracy of such data and applying standardized data collection on a Corps-wide basis.

b. Develop methodology for recreation-use prediction. Preliminary methodology to be developed as soon as possible and a long-range research program initiated to improve and refine the methodology.

c. Develop methodology for determination of the number and type of recreation facilities needed to serve a given number of recreation days of use (facility load criteria).

d. Develop methodology for determination of recreation benefits.

Studies to date have been performed under the general functional direction of Mr. Harold L. Blakey, Office, Chief of Engineers, with the actual work being assigned and performed in the Sacramento District under the direct supervision of Mr. Dale A. Crane. This report is the second of a series to be published indicating significant results obtained from these studies. The first was Contract Report No. 1, entitled "Analysis of Recreational Use of Selected Reservoirs in California." A third, Technical Report No. 2, entitled "Estimating Initial Reservoir Recreation Use" is currently being published.

This report presents results of the studies authorized by the Director of Civil Works and evaluates the current recreation-use survey and provides alternative suggestions for improvement of survey techniques, that would be applicable on a Corps-wide basis. Staff research efforts were performed by Mr. Richard E. Brown and Mr. Arthur M. Kinsky, under the research project leader, Mr. Dale A. Crane, Dr. Jack L. Knetsch, Director of the Center for Natural Resources Policy Studies, George Washington University, provided expert consultant services and invaluable assistance throughout the entire study. Special appreciation is extended to the office and field personnel in the Savannah, Nashville, Little Rock, Fort Worth, Tulsa, Portland, and Sacramento Districts who collected the data which provides the basis for this report.

SUMMARY

An experimental recreation-use survey was put into effect in seven U. S. Army Engineer Districts at 52 reservoir projects in 1966 to test a survey procedure designed to provide a low cost system for obtaining reliable, consistent recreation-use estimates for research and planning activities. One objective of the experimental survey was to provide the basis for designing a Corps-wide survey procedure. Testing in the seven selected districts was made so that weaknesses in the survey system could be identified and evaluated. This report presents the evaluation of the existing survey procedures and provides alternative suggestions for the improvement of the survey.

The alternative survey designs presented build upon the accomplishments of the existing survey procedure. A modified recreation-use survey designed for administration by district offices is presented. Alternatives to the district survey design, which could be administered from a single central Corps element, are given with explanation of the effect of the alternatives on the survey results.

EVALUATION OF RECREATION USE SURVEY PROCEDURES

TABLE OF CONTENTS

	Page
PREFACE	i
SUMMARY	ii
PART I: INTRODUCTION	
General	1
Purpose and Scope	2
PART II: THE EXISTING SURVEY	
Survey Design Criteria	3
Sampling Procedures	3
Limitations	4
PART III: REDESIGN OF THE DISTRICT SURVEY	
Survey Design Criteria	5
Stratification	6
The Sample Selection	9
The Measurements	12
The Estimates	13
Effectiveness of the Modified District Design	16
PART IV: ALTERNATIVES TO THE DISTRICT SURVEY DESIGN	
The Survey Control	18
Possible Alternatives	18
The Effects of Alternatives	19
Discussion of Alternatives	21
PART V: FINDINGS	23
TABLE 1	23
TABLE 2	23

APPENDICES

Appendix A - The Existing Survey
Appendix B - The Modified District Survey
Appendix C - Example of the First Stage Sample Required by Alternatives to the District Survey Design

EVALUATION OF RECREATION USE SURVEY PROCEDURES

PART I: INTRODUCTION

General

1. The Corps of Engineers officially became involved in recreation with enactment of the 1944 Flood Control Act which states in part "...The Chief of Engineers... is authorized to construct, maintain, and operate public park and recreational facilities in reservoir areas ...." At that time, recreation development at Corps projects generally consisted of providing public access to the water and minimum basic facilities for public health and safety. With the provision of recreation facilities, public recreation attendance has grown at a phenomenal rate--from 16 million visits in 1950, to 190 million in 1960, to over 240 million in 1969. In 1958, recreation was given equal status with other project purposes in the planning and formulation of multiple purpose projects. Including recreation as a purpose required that standard methods and procedures for estimating recreation benefits on a level of accuracy equal to those used for flood control, power, irrigation and other benefits be developed. Available recreation-use estimates and data was used in this planning, but it was recognized that improvements were necessary in recreation-use data collection and estimates in order to accomplish a more effective job of planning.

2. In 1963, improvements to existing use estimates were initiated by a new survey procedure for reporting recreation attendance at all Corps administered reservoir projects. This survey was continued until March of 1966. At that time, the Sacramento District developed an experimental survey design incorporating improved statistical procedures and organizational controls and with an expanded format to provide additional information for planning purposes and incorporating automatic data processing procedures for analysis and data retrieval. Office, Chief of Engineers, designated seven districts to participate in a test program using the experimental design to develop standardized data collection procedures. From the seven districts, with a total of 68 reservoir projects available, 52 projects were selected for participation in the data collection program. The program covered essentially three full years of data collection; 1966, 1967 and 1968. During this period, more than 200,000 vehicles representing about 615,000 people were sampled.

3. The Sacremento District was assigned as the repository for this data and was further assigned to: (1) evaluate the data collection procedures and recommend methods for improving the statistical accuracy of such data and applying a standardized data collection program on a Corps-wide basis, (2) develop methodology for recreation-use prediction with preliminary methodology to be developed as soon as possible and a long range research program to be initiated for improvement of such methodology, (3) develop methodology for determination of the number and type of recreation facilities needed to serve a given number of recreation days of use (facility load criteria), and (4) develop methodology for determination of recreation benefits.

4. Within the framework of the experimental survey design, the results of the data collection program have been excellent. Preliminary methods for estimating recreation-use have been developed from the data it produced and those methods are currently under consideration for adoption on a Corps-wide basis. However, three years of data collection under this design have emphasized a limitation inherent in the design--specifically, no precise quantitative estimate regarding the reliability of sample results can be made. It is toward achieving this goal that improvement is sought. This report considers the limitations of the experimental survey design and evaluates the possible methods for improvement. Potential data requirements for planning and development and organizational statistical and monetary limitations were considered in developing the alternative survey design modifications proposed herein.

Purpose and Scope

5. This paper presents an evaluation of the data collection program and suggests improved alternative survey procedures that would be applicable for nationwide surveys at reservoir projects. The process of selecting and measuring the sample and of estimating recreation statistics from the sample defines the survey design. The proposals for improving the survey design discussed herein are directed toward obtaining more reliable recreation-use data and analysis of such data to provide for improved procedures for economic analysis of recreation and recreation planning and development. Accordingly, alternative survey designs are proposed and relative merits of each are discussed.

PART II: THE EXISTING SURVEY

Survey Design Criteria

6. The existing survey was designed to provide a recreation-use data collection system that would provide standardized objective information from reservoir projects suitable for analysis by automatic data processing procedures and at the same time conforming to two of the basic criteria of sample surveys--uniformity and least cost. Uniformity was achieved by the use of a standardized survey questionnaire and instructions using essentially the same project personnel and standardized procedures following the same routine from project to project and year to year. Pretesting of data collection procedures in the Sacramento District indicated that the least cost criteria could best be achieved by (a) utilizing existing project personnel for the interviews with the sample to be surveyed thereby eliminating the need for and the costs associated with hiring, training and providing transportation for special survey teams; and (b) incorporating automatic data processing procedures as an integral part of the entire survey and analysis system.

Sampling Procedures

7. Survey of project recreation use was conducted in such a manner that the data obtained were representative of all recreationists visiting the projects being surveyed. Appendix A contains details of the existing survey. The data were collected on selected weekend days and weekdays at recreation areas that were representative of the various types of recreation opportunity available at the projects being surveyed. The survey year was divided into three four-month periods--February through May, June through September, and October through January. The survey was conducted for a minimum of 12 hours per day on a weekday and weekend day in the same week. All traffic entering the project was metered continuously at both surveyed and non-surveyed entrances. Sample measurements were obtained through questionnaire interviews with recreationists entering the projects in automobiles. Aggregate estimates were functions of sample measurements and mechanical traffic counts. Survey data were used with traffic measurements to estimate total annual attendance expressed in recreation days.[1/] Other statistics estimated from this sample included activity percentages; length of stay; periods of greatest use by hour, week, and season; origin of users by activity groups; number of persons per party and various measures of user needs and satisfaction.

1/ Supplement No. 1 to Senate Document 97 defines a recreation day as "a standard unit of use consisting of a visit by one individual to a recreation development or area for recreation purposes during any reasonable portion or all of a 24-hour period."

Limitations

8. Selection of the sample was an intuitively controlled selection; that is, personnel conducting the survey at each project selected the representative areas to be surveyed and the weekday and weekend days to be surveyed in accordance with general instructions but without regard to the probabilities of selection. Therefore, the accuracy of estimates made from a sample selected in this manner can only be measured by assuming that the intuitive selection of the sample areas and survey days was random. This could be true and the estimates could compare favorably or even exactly with the actual conditions; however, there is no way of determining the exact measure of reliability of these estimates under the existing design. Therefore, even though the existing survey may be providing accurate information, exact measurement of reliability can only be approximated. Accordingly, the proposals for the survey redesign contained in this report are aimed primarily at achieving a probability sample as a basis for measuring the precision of the estimates. The redesign of the survey is discussed in detail in the following text.

PART III: REDESIGN OF THE DISTRICT SURVEY

Survey Design Criteria

9. Statistical evaluation procedures and resultant survey design alternatives were constrained by the limitations inherent in the geographical and numerical size and diversity of Corps of Engineers reservoir projects, and those imposed by existing organizational constraints. However, the goal of the district survey would be unchanged; the basic objective of the modified design is to provide a well defined, low cost process of obtaining reliable, consistent estimates of recreation use at reservoir projects. In addition to the criteria of least cost and uniformity, the modified design would impose the following criteria.

a. Reliability. Considerable improvement in the reliability of the survey estimates is possible through emphasis on sampling with known probabilities. The reliability goal of the survey has been to achieve estimates of 80 percent accuracy. The variance estimator (paragraph 31, equation (5)) is a measure of this reliability. In terms of the variance estimator, for a given level of estimates, the sampling variance, $V(\hat{x})$, would be such that:

$$3\sqrt{V(\hat{x})/\hat{x}} = 0.20.$$

Therefore, the coefficient of variation sought, defined by $\sqrt{V(\hat{x}) / \hat{x}}$, is .0667. The suggested 80 percent accuracy thus implies a 99 percent confidence interval for $\hat{x}$ of from $.80\hat{x}$ to $1.20\hat{x}$. However, if the survey achieves annual project attendance estimates with coefficients of variation on the order of .0667, this does not mean that the coefficients of variation for other survey statistics necessarily will be of this magnitude. However, since control of the sampling variances can be exercised at a single level of estimate only, annual project attendance estimates were designated as the control. Estimates smaller than annual project attendance will tend to have smaller absolute error but higher relative error. For estimates larger than annual attendance, just the opposite would be expected. Accordingly, the 80% accuracy of annual project attendance estimates implies less than 80% accuracy for annual project activity estimates and greater than 80% accuracy for annual district estimates.

b. Efficiency. One sample design is said to be more efficient than another if for a given cost the precision of the results is greater, or if a specified level of precision can be obtained for a lesser cost. Under this criterion, any redesign of the district survey can build upon the least cost accomplishments of the existing design. Given the least cost structure, maximum efficiency implies optimum allocation of costs with minimum sampling variance. Consequently, the relative efficiency of any design considered would be approximately proportional to the relative reliability of that design.

c. Fit. The proposed survey design should fit as well as practicable the existing design, enabling compatibility between past and future estimates.

Stratification

10. Redesign of the district survey envisions participation by all Corps of Engineers districts regardless of whether each district conducts the survey individually or one district or division conducts the survey for a group of districts. District boundaries may be redrawn for survey purposes; however, the end result should be contiguous coverage over the nation. The district survey design presented in this section assumes a continuing survey so that aggregate and incremental annual estimates can be made. Stratification for the survey is discussed in the following paragraphs and consists of strata defined by: (a) project, (b) season and (c) type of recreation area.

11. The population from which the sample would be drawn contains all people visiting all civil works reservoir projects within a district during a year for the purpose of recreation. When that population is divided into groups such that the elements of the entire population (universe), the partitioning process is called stratification. The resulting strata are the groups whose elements possess relatively similar recreation characteristics. Therefore, the stratified sample contains elements selected from each group, which increases the precision of the sample results.

12. Measurement of the small differences in the recreation characteristics associated with the variables that may be influencing use requires small unit rather than average estimates. Consequently, all recreationists at civil works projects within a district during a calendar year are stratified according to individual project visited.[2/] The sample selected from an individual project should be representative of all visitors associated with the project. To insure this, the sample is further stratified in two ways, by recreation season and by area.

13. The normal procedure for stratification by season is to use supplemental information, usually in the form of recent attendance estimates, to partition the year into seasons of approximately equal visitation. Based upon the experimental survey results it appears that the most adequate partition is three seasons; an early recreation season, a late recreation season and an off season. [3/] Based on average attendance records from the 52 projects surveyed during 1966-68 those seasons would be: (a) early recreation season, April through June, (b) late recreation season, July through August and (c) off season, September through March. Within each season a sample representative of all individuals visiting the project is sought. To achieve this, further stratification by area is required.

2/ Although desired precision and completeness indicate that every district should sample all projects within the district, other considerations may indicate alternative approaches, several of which are given in Part IV.

3/ A three season stratification was used in the experimental recreation-use survey; the year was partitioned into seasons of equal length rather than equal visitation.

14. Regardless of the number of recreation areas at a given project it is believed a meaningful partitioning of the various areas can be accomplished by defining seven area types.[4/] These seven area types are:

Type of Area	Stratum
a. Camping only.	1
b. Multipurpose camping.	
Small	2
Large	
vicinity 1a	3
vicinity 2a	4
c. Day use only	
Small	5
Large	
vicinity 1b	6
vicinity 2b	7

15. To accomplish the above stratification, the recreation areas would be grouped first by activity categories as follows:

a. Camping only. These are camping areas situated such that recreationists must leave the area to participate in other project activities; i.e., water-oriented activities.

b. Multipurpose camping. These are areas where water-oriented activities are available within the area and both camping and day use recreation occurs.

c. Day use only. All areas in this category would have immediate access to water-oriented activities and exclude camping except as incidental or as overflow areas used during peak periods.

The first grouping will completely define one stratum; specifically, those areas set aside exclusively for camping. Groups b and c may require further partitioning.

16. Group b, multipurpose camping areas, would be separated into two groups based on relative size. There is no rigid measure of size available; none would be applicable in all cases. However, the partitioning is to be by number of recreationists, not by physical size of the area. Therefore, the size of an individual area is the size of that group of recreationists using the area. If there is no obvious difference in size, the median use

4/ On many projects an eighth type of area may be encountered; e.g., golf courses and/or resorts. However, these areas are excluded from the survey because it is more efficient to estimate attendance from guest registration records for such areas than to include them in the survey. If no records exist, attendance estimates can be made from a simple "head count."

level is used as the dividing line. This grouping completely defines one additional stratum, i.e., small multipurpose camping areas. The next step is to stratify the large multipurpose camping areas geographically. Again, no rigid measures exist--the partitioning might be in terms of east or west, north shore or south shore, or access from highway x or access from highway y. With these groupings, two more strata are defined; i.e., two groups of large multipurpose camping areas.

17. The final three strata are determined from the "day use only" areas in the same manner as described in paragraph 16. It should be noted, however, that the division between large and small for day use need not correspond with that for camping. Also, the geographic partitioning need not coincide.

18. Using the partitioning process previously discussed, an example of stratification of "like" areas for Isabella Reservoir (Sacramento District) is given below.

AREA STRATA - ISABELLA RESERVOIR

Stratum	Areas	Description
1	Main Dam - camp 2 Pioneer - camp 3 Hungry Gulch - camp 5 Live Oak - camp 7	Camping only. Recreationists must leave campground to participate in reservoir-oriented recreation.
2	Paradise Cove Boulder Gulch - camp 4 East Side - camp 9	Small camping multipurpose areas.
3	Tillie Creek - camp 6	Large camping multipurpose, considerably larger than above type areas.
4	(None)	Geographic location for large camping multipurpose areas.
5	Rich Gulch Siphon K. V. Cemetery Robinson #1 Old High School Big Blue #1 Big Blue #2 Edison Intake Wagy Flat Road D. G. Pit	Small day use areas.
6	Pioneer Point French Gulch West End aux. dam East End aux. dam	Large day use areas, western side of project.
7	Old Isabella Road South Fork marina Kissack Bay Patterson Lane & Hwy. 178 North End Patterson Lane	Large day use areas, eastern side of project.

19. In the above example, note that the partitioning yielded only six strata because the measure of size used (the metered automobile count during a year) indicated only one large multipurpose camping area.5/ The size division for day use areas was less obvious than for camping. If the distinction between large day use areas and small day use areas had not been clear, the median of the size measurements would have been the criterion used as the basis for division. The geographic partitioning of large day use areas was done in such a way as to approximate equality (according to the size measurements) between eastern and western areas.

20. The procedure used is not the only one possible for stratification of areas. However, it is one that yields stata composed of recreation areas that are relatively homogeneous with respect to the statistics sought. The above procedure completes stratification of the population into "primary" strata. Once the primary strata are identified at each project they should not be changed unless recreation development is such that the definition of the area is changed. New areas that are developed should be identified and added to the strata list. Each of the primary strata contains those members of the population whose recreation visits occur at a specific type of area, at a given project during a particular season.

The Sample Selection

21. Surveying all recreationists within the primary strata would not be feasible. Therefore, a sampling process for these strata must be devised. The sample of recreationists is selected from the primary strata by a two stage process that provides maximum accuracy and efficiency and allows the reliability of the sample results to be estimated. The selection of the sample from the primary strata is accomplished in accordance with sampling units defined as follows: (a) an "elementary sampling unit" consisting of an automobile entering a recreation area at a civil works project for the purpose of recreation. (Each automobile is an elementary sampling unit only if it is the first such visit of the day.) (b) A "primary sampling unit" consisting of all consecutive elementary sampling units over a period of either a weekend or a midweek. The first stage of the sampling is a selection of a pair of primary sampling units from each primary stratum. The second stage is a selection of a cluster of elementary sampling units from each primary sampling unit. Primary sampling units are sets of arriving automobiles associated with an area and a period of time. The time periods are weekends (Friday night through Monday morning) and weekdays (Monday morning through Friday night). Each of the primary units contains a variable number of automobiles or elementary sampling units. It is on these elementary units that measurements are made and analyses from survey results will be done.

5/ It is anticipated that any given project may yield from one to seven strata depending upon the individual project characteristics.

22. The sample selection involves a sequence of random selections. The selection procedure is based on the availability and use of random numbers. In the initial selection, one area is selected at random from each of the primary strata with each strata selection performed independently. For example, consider the six strata given in paragraph 17 for Isabella Reservoir --suppose a random entry into a table of random numbers yields:

4 1 1 2 9 6 7 3 1 2

For the first stratum selection, number the areas consecutively within each stratum. Next, from the entry into the random numbers table, choose the first number from 1 to 4. In this example, number 4 is selected and the fourth area listed, Live Oak - Camp 7, is selected from the first stratum. From the third stratum, Tillie Creek is selected by virtue of being the only area in the stratum. Repeating the random procedure for successive strata results in the following area selections:

Strata	Area Selected	List Number Random Number
1	Live Oak	4
2	Paradise Cove	1
3	Tillie Creek	
5	Rich Gulch Siphon	1
6	French Gulch	2
7	Kissack Bay	3

Using random numbers in this manner accomplishes the equivalent of thoroughly mixing before selecting, thereby insuring selection of areas with a known probability.

23. Upon completion of the selection of areas for survey, time periods of survey must be selected. First the time periods (weekend days and weekdays) associated with the survey season are listed. Some of these periods such as holiday weekends and days of occurrence of special events are excluded from the sample due to the extreme difficulty in conducting the interviews during such periods. The remaining time periods are grouped into pairs of contiguous intervals (weekend days and weekdays). Each pair of time intervals may be considered as a potential sample week. These potential sample weeks (which may begin or end with a weekend) are then numbered. From the numbered list of potential sample weeks, one is selected at random, by survey season, without replacement for each area to be sampled. For the example given, Isabella Reservoir, one week is selected for each stratum (six strata--six weeks) for each survey season. This selection is accomplished utilizing random numbers in the same manner as that used for selecting an area from a stratum.

24. With first stage selection completed, a selection is made of the particular entering automobiles to be measured. The elementary sampling units (automobiles) to be surveyed are those automobiles entering the sample area during the sample week. Each sample area should be surveyed for 20 hours (10 hours on weekdays and 10 hours on weekend days) during each

sample week. The hours selected for survey are based on a partition of the sample week into two hour time intervals. The selection of the hours would begin with the following partition of the sample week.

Time Hours:	Interval No.	Days Mon.	Tues.	Wed.	Thurs.	Fri.
0600-0800	1					
0800-1000	2				4th	
1000-1200	3		2nd			
1200-1400	4					
1400-1600	5					5th
1600-1800	6			3rd		
1800-2000	7	1st				

Each weekday is divided into seven two-hour intervals, which yields 35 weekday intervals available for selection; one interval is selected from each day and each time. To achieve this, begin with Monday and select one interval at random from the seven. For Tuesday, select one time at random from the remaining six. Continue the process until five intervals have been selected, one from each of the five days. As will be noted in the example, once a time interval has been selected, all other like time intervals are excluded for the remainder of the week.

The weekend selection would be from the predetermined schedule as follows:

Time Hours:	Interval No.	Days Saturday	Sunday
0600-0820	1	A	B
0820-1040	2	B	C
1040-1300	3	C	A
1300-1520	4	A	B
1520-1740	5	B	C
1740-2000	6	C	A

One of the three schedules, A, B, or C, would be selected at random. If schedule A were selected, then recreationists entering the area from 0600-0820 hours and 1300-1520 hours on Saturday would be interviewed, and recreationists entering the area from 1040-1300 hours and 1740-2000 hours on Sunday would be interviewed.

During the off recreation season, length of daylight generally would be less than 12 hours. Accordingly, the time intervals available during the sample week would be less. Therefore, the survey day should be shortened from 0600-2000 hours used during the early and late recreation season to 0800-1800 hours. The weekday partition would exclude intervals 1 and 7, and selection would be made from the five remaining intervals. The weekend intervals for these shorter days would require rescheduling as follows:

Time		Days	
Hours:	Interval No.	Saturday	Sunday
0800-1030	1	A	B
1030-1300	2	B	A
1300-1530	3	A	B
1530-1800	4	B	A

The sampling process is completed--the sample now contains all individuals who come to any of the sample areas during the sample hours.

The Measurements

25. The measurements outlined in this proposal for district surveys are virtually identical to those of the existing design. The measurement process is given in some detail here to define the modified design completely. Throughout the process of obtaining the required measurements, potential clerical error exists. The recording and transcribing of the data is subject to error. However, this type of error can be made negligible through continuous process of deliberate, critical inspection.

26. The initial measurement required is size of the surveyed population. The closest approximation to an exact measure of the population size is a mechanical traffic count at recreation area entrances. There are measurement errors associated with such a traffic count. Also, it is realized that a traffic count includes multiple counts of the same recreation automobile and includes counts of non-recreation vehicles. However, corrective procedures are used to accommodate such errors.

27. The next measurement required is the size of each selected primary sampling unit. This measurement is accomplished by taking meter readings at the beginning and end of the time period (weekend or weekday) from the same meter or meters used to measure the population (the number of automobiles) entering the selected area during the selected time interval.6/

6/ If an automobile is not sampled due to heavy traffic or non-response, it is considered as an unselected element within the primary unit. In terms of the estimates given in paragraph 31, a passed automobile is contained in the set of $(N_{hij} - n_{hij})$ automobiles.

28. The last and most significant measurement required is a measurement of the recreation characteristics associated with an entering automobile of recreationists. The estimates desired dictate the measurements to be made upon the automobiles in the sample. The form of these measurements are questions asked of the automobiles' occupants. Answers to these questions are recorded on the standardized questionnaire which can then be analyzed by standard ADP procedures to provide information needed for recreation development planning.

29. In addition to estimates of activity participation, estimates of other visitor characteristics are sought. Such estimates are duration of stay, percent of visitation contributed by repeat visitor, visitation by origin, visitation by length of vacation, and visitation by income. The questions on visitation by length of vacation and by income are considered "add in" questions. There are indications that the data from these questions may be extremely pertinent to any attempts to project recreation use changes over time.

30. Two kinds of error are associated with the measurement process, a response error and a measurement error. Measurement and response error can be minimized by proper questionnaire design and use and by location and time of the survey. Error may result from failure to ask all questions properly, improper entry, or omitting answers given or by requiring subjective responses which can be defined within the respondent's definition of the question. Efforts to minimize response and measurement error have been made in design of the questionnaire and by the standard instructions for its use. This detail is contained in Appendix B.

The Estimates

31. A number of measurements are made on every elementary sampling unit (recreation vehicles) in the clusters. An individual measurement is a recorded response from an occupant of a sample automobile to the interviewer's question. The estimators are the formulas directing the process of getting recreation use statistics estimates from the sample measurements. The estimator used is the product of measured traffic and a ratio of estimated totals. The notation required is defined as follows. Let X_{hijk} be the value of the measurement of characteristic X, where:

h = 1,2 or 3 identify the season

i = 1,2,3,4,5,6 or 7 identify the type of area

j = 1,2 identify the primary sampling units from the hi primary stratum

k = 1,2,..., n identify the elementary sampling unit in the hij primary sampling unit.

Example: When measuring the recreation attendance contributed by the first automobile sampled on a weekday during the off-recreation season from area type stratum number 4, $X_{3,4,2,1}$ will denote the number of people in that automobile; where X is the value of the measurement of attendance.

h = 3 off season

i = 4 area type stratum designation

j = 2 midweek designation

k = 1 the automobile number

An estimate of a project total will be of the form:

$$\hat{x} = \sum_{h=1}^{3} \frac{x''_h}{y''_h} C_h \qquad (1)$$

Where C_h is a metered count of traffic entering all areas of the project during season h.

$$x''_h = \sum_i \frac{M_{hi}}{2} \sum_j \frac{N_{hij}}{n_{hij}} \sum_k X_{hijk} \qquad (2)$$

Where: M_{hi} denotes the number of primary units in the hi primary stratum.

N_{hij} denotes the number of elementary units in the hij primary unit.

n_{hij} denotes the number of elementary units sampled from the hij unit.

y''_h is similarly computed with Y_{hijk} defined by:

$$Y_{hijk} = \frac{\sum_m Y_{hij \cdot m}}{n_{hij}} + 1 \qquad (3)$$

Where: m denotes any automobile contributing to the traffic count.

$Y_{hij.m}$ = 0 if hij.m auto is without trailer and sampled

= 1/2 if hij.m auto is with trailer and sampled (4)

= 1 if hij.m auto is without trailer and not sampled

= 1-1/2 if hij.m auto is with trailer and not sampled

Thus, Y_{hijk} is the average meter count increase per entering recreation automobile and is the value assigned to each of the measurements of the hijk automobile's contribution to the total meter count.

The variance of the estimator $\hat{x}$, formula (1) is given by:

$$V(\hat{x}) = \sum_h C_h^2 R_h^2 V_{R_h}^2 \tag{5}$$

where $R_h^2 = (x_h''/y_h'')^2$ (6)

and $V_{R_h}^2$ is the rel-variance of the ratio R_h given by:

$$V_{R_h}^2 = V_B^2 + V_w^2 \tag{7}$$

$$V_w^2 = \frac{1}{\bar{x}_h''^2} \sum_i \frac{M_{hi}^2}{2} S_{h2}^2 \tag{8}$$

$$S_{h2}^2 = \frac{1}{2} \sum_j \frac{N_{hij}^2}{n_{hij}} \frac{N_{hij}-n_{hij}}{N_{hij}} \left[\frac{1}{n_{hij}-1} \sum_k X_{hijk}^2 - \frac{1}{n_{hij}(n_{hij}-1)} \left(\sum_k X_{hijk} \right)^2 \right] \tag{9}$$

$$V_B^2 = \frac{1}{\bar{x}_h''^2} \sum_i \frac{M_{hi}^2}{2} \frac{M_{hi}-2}{M_{hi}} \left(S_{h1x}^2 + R_h^2 S_{h1y}^2 - 2R_h S_{h1xy} - S_{h2}^2 \right) \tag{10}$$

$$S_{h1xy} = \sum_j \left(\frac{N_{hij}}{n_{hij}} \sum_k X_{hijk} - \frac{1}{2} \sum_j \frac{N_{hij}}{n_{hij}} \sum_k X_{hijk} \right) \left(\frac{N_{hij}}{n_{hij}} \sum_k Y_{hijk} - \frac{1}{2} \sum_j \frac{N_{hij}}{n_{hij}} \sum_k Y_{hijk} \right) \tag{11}$$

$S_{h1x}^2 = S_{h1xx}$ $\qquad$ $S_{h1y}^2 = S_{h1yy}$

Effectiveness of the Modified District Design

32. Sample data from the projects in the Sacramento District for the years 1964-66 were used to estimate the statistics necessary for analysis of the recreation-use survey design. Modifications of the existing design and the proposed district design were compared. Principal differences considered were variations in estimators. Coinciding with these variations were alternate sets of definitions and assumptions regarding selections. The modified design is the variation which most uniformly indicated the lowest sampling variances for aggregate estimates.

a. Reliability. Select estimates are given in Tables 1 and 2 for two recreation characteristics, attendance and fishing. Computations of these estimates were as if the data had been collected according to the proposed district survey design, except for the definition of primary strata. The stratification of an individual project, although by area and season, differs. The seasons are defined by: spring, February through May; summer, June through September; and winter, October through January. Each area selected defines a stratum. The size of each stratum is inflated by a fraction (equal to the inverse of the number of selected areas) of the non-sampled area's meter counts. The estimates presented, however, illustrate the sampling distribution that can be expected from the proposed design as shown in the following tabulation.

Anticipated Standard Error

Size of Estimate (Thousands)	Standard Error (Thousands)
50	10
250	19
500	30
700	41
1000	52
1250	63
1500	74
1750	85

b. Efficiency. The survey design variations compared have essentially the same unit costs. This was the least cost structure evolved through experimentation at Corps projects with the existing design. Consequently, the efficiency of each variation was closely related to its reliability. Allocation of the sample over first and second stage sampling units was examined for the most efficient distribution. The statistics examined were the within- and between-variance components of attendance estimates for the Sacramento District by season over the nine four-month seasons from 1964 through 1966. Unit cost estimates were rough and the assumption underlying the statistics computations was as given above. Assuming the reliability desired is as indicated in paragraph 9a and the sample size per project is to remain approximately the same, the result is the proposed season stratification as discussed in paragraph 13. It is also apparent that the size of the present sample, when the sample is allocated over the redefined primary strata, is sufficient.

c. Fit. The benefits of a continuing procedure are intact. The proposal for a district survey design would eliminate only the disadvantages of the existing design.

PART IV: ALTERNATIVES TO THE DISTRICT SURVEY DESIGN

The Survey Control

33. There are obvious organizational advantages in having the districts administer the surveys which were considered in formulating the proposed district sample design. However, the proper conduct of such a survey puts demands upon the districts which in some cases may be extremely difficult to meet. The survey design is defined by the process of selecting the sample, the process of obtaining the sample, and the process of estimating from the sample. The process of obtaining the sample, if at all possible, should remain with the district. However, the districts should have available to them whatever assistance they need in the process of selecting the district sample. Much of the process of estimating from the sample measurements will become routine data handling, but the simultaneous error analysis is a continually demanding process. Here again, assistance should be made available. The kind of assistance that can be provided and should be available could be accomplished by a single staff operating as a central survey control. Such assistance, provided in the interest of facilitating the conduct of the survey, can be expected to have the very important additional effects of increasing and maintaining standardization and accuracy and decreasing cost. Consideration of the need to develop survey design options to the district survey design that would minimize the above problems and still be functional within Corps of Engineers organization restricted the types of survey design options that could be considered. Accordingly, the options presented in the following paragraphs were considered suitable to meet these requirements and are evaluated on the basis of relative accuracy and cost.

34. The district survey design requires sampling of all projects within all districts. The anticipated magnitudes of the sampling variances presupposes that each project is selected with certainty. If this condition holds, while the survey is administered by the districts, the population surveyed may be considered as delimited by a single project. If this condition does not hold, an additional stage of sampling is introduced and the proposed design is incomplete.

Possible Alternatives

35. Sampling of each project provides the most reliable data and experience indicates such sampling is practicable. However, numerous optional design alternatives could be utilized to provide some degree of recreation use data. Alternatives considered were limited by the criteria of reliability, efficiency, fit and Corps organizational framework. Accordingly, it was found that any practical survey design alternative must utilize a central survey control. The following paragraphs present discussion of three possible alternative sample conditions (paragraph 35a, b and c); and four possible alternative sample designs (36a, b, c and d) to the district survey design developed in accordance with the above limitations.

a. Alternative case 1. Assume some, say half, of the districts will not participate in the survey. If the districts that participate are selected with known probabilities, all projects would be represented and a Corps-wide survey can still be the result. However, the increase in variance of the Corps-wide estimates would be substantial, and the number of functional estimates would be limited.

b. Alternative case 2. Assume some, say half, of the projects in each district will not be included in the sample but that every district will survey the remaining projects. If the projects are selected independently within each district with known probabilities, then a Corps-wide survey does exist. The sampling variance for district and national estimates will increase and specific project estimates will be fewer. However, in general, the increase in variance and loss of functional estimates should be less than in Case 1, assuming the same number of projects are sampled in each case.

c. Alternative case 3. Assume some, say half, of the projects in the Corps will not be included in the sample. Assume, however, that for survey purposes the projects are not partitioned by district but by Corps of Engineers Divisions. It appears likely that if the projects in each division were partitioned by other than district boundaries prior to selection of projects, the design in Case 2 would be improved. Also, if the partitioning were accomplished according to some measure of project recreationist homogeneity, the anticipated increase in sampling variance would be less. At this time, however, there is difficulty ascertaining an appropriate uniform measure of homogeneity.

The Effects of Alternatives

36. As to the extent of the increase in sampling variance due to the selection of projects from a district, consider the estimates of attendance and the ratio estimates of attendance to meter count for the 1966 summer season shown in the following tabulation. In this example, consider these estimates as if they were the expected values of the sampling distribution. This implies that any sampling variance may be disregarded except for that variance introduced by a sampling of projects from the district.

Sacramento District attendance; summer season, 1966

	Projects							Population	
								Total	Mean
	1	2	3	4	5	6	7		
Attendance (Thousands)	104	75	189	259	184	227	895	1933	276
Ratio of Attendance to Meter Counts	2.5068	2.8681	2.6830	2.3011	2.1879	2.2973	2.0186	. . .	2.2011

Assume in the above example that an estimate of the population mean is desired and the situation is that as described by Alternative case 2 in paragraph 35b. The variance of the estimate will be a function of the attendance distribution over projects, the proportion of projects sampled, and the sample design. The distribution of attendance over projects is illustrated above. As to the proportion of projects sampled, the results of sampling from one to six of the seven in the population are considered.

a. Alternative sample design 1. Suppose that the sample will be selected at random from the population, and that non-sampled projects will contribute no measurement whatsoever. The estimate of the population mean will be the sample mean.

b. Alternative sample design 2. Suppose experience with the population indicates that the value forthcoming from project 7 will be considerably different from the remaining projects. Thus, the population will be partitioned into two groups. This stratification will result in Stratum 1, defined by project 7, and Stratum 2, defined by the remaining projects. Under this design, project 7 will be sampled with certainty, and from one to five of the remaining six projects will be sampled at random from Stratum 2. Again, non-sampled projects will contribute no measurement. The estimates of the population means by strata will be the strata sample means.

c. Alternative sample design 3. Suppose that the sample will be selected at random from the population, but that the traffic at all projects will be metered. Sample values will be for the ratio of attendance to traffic count. Estimates of the population mean attendance will then be the products of a weighted mean ratio and a real number, the mean traffic count.

d. Alternative sample design 4. This design incorporates the stratified selection of design 2 with the measurements and estimates of design 3.

37. The following tabulation is a summary of measures indicating the variance introduced by sampling N projects from the Sacramento District and estimating the mean attendance for the 1966 summer period. Two measures are given for each of four designs and all possible sample sizes. The standard error is the square root of the sampling variance expected for the given design and sample size.

An example of variance introduced by a sampling of projects from a district.

Design 1			Design 2		
Sample size N	Standard* error	Coefficient of variation x 100	Sample size N	Standard* error	Coefficient of variation x 100
1	240	87			
2	155	56	2	58	21
3	113	41	3	37	13
4	85	31	4	26	9
5	62	22	5	19	7
6	40	14	6	12	4
	Design 3			**Design 4**	
1	39.8	14			
2	25.7	9	2	16.8	6
3	18.8	7	3	10.6	4
4	14.0	5	4	7.5	3
5	10.3	4	5	5.3	2
6	6.6	2	6	3.4	1

*Thousands

Although the estimates of variation and the stratification are strictly for attendance for this particular population, similar relationships would be expected for most other characteristics of recreationists. The costs of designs 1 and 2 would be approximately equal for equal sample size, as would the costs of designs 3 and 4. Accordingly, from an efficiency standpoint, neither design 1 nor design 3 would be desirable. Therefore, the choice would be between the comparative variance per cost of designs 2 and 4 with careful attention to the reliability desired.

Discussion of Alternatives

38. Survey design alternatives one, two, three and four appear to meet the requirements imposed by the Corps of Engineers organizational structure. Designs one or two would be the least costly; however, the accuracy level is considerably below that considered necessary for meaningful planning estimates. Design three and design four would cost about the same but design four provides much more accurate data.

39. In view of the relative costs and accuracy the alternative most feasible appears to be alternative sample design four. Under this option, broad regional boundaries, not necessarily corresponding with administrative boundaries, would define a geographic stratification of the Corps' civil works

projects. Within a regional stratum, the projects could be partitioned by size of recent attendance estimates (excluding non-reservoir projects and projects with no permanent pool) with approximate equality between strata attendance. From each of the region-size strata, a plurality of projects could be selected with known probability. At each project selected, seasonal traffic measurements would be required and sampling could be accomplished by the district. For each project not selected, a measure of seasonal traffic would be required. (It is assumed that this would require traffic meters at all entry points on these projects.) At projects selected for sampling and stratification of project recreation areas the selection of those areas to be sampled must be under uniform procedures and should be accomplished by the survey control center. Additionally, project estimates for all projects, sampled and non-sampled, would have to be computed by a survey control center to which all data would be submitted. Appendix C contains an example of a stratification procedure that would be required by design four. Elements of this stratification would also be required by designs two and three.

PART V: FINDINGS

40. Findings are as follows:

a. The existing survey generally meets the organizational requirements of the Corps of Engineers and provides an acceptable format to provide standardized data. Information collected generally provides adequate information for attendance reporting and for use in recreational planning. However, the survey should be modified to provide known probabilities so that precision of the survey information can be estimated with greater accuracy.

b. The modified district survey design meets requirements to provide for precision in estimating the accuracy of the survey information without reducing the advantages of the existing survey.

c. Incorporation of the ADP procedures required by the modified district survey design will substantially reduce the costs required for data retrieval and analysis and, in general, will provide for a more efficient operation.

d. A reliable Corps-wide survey can be accomplished without the necessity for surveying all projects. Such an alternative survey design would result in relatively greater cost savings but would provide less accurate data and would require the establishment of a central survey control office with adequate authority to oversee all survey activities.

TABLE 1

Attendance Estimates, by Reservoir, 1964-1966

Reservoir	Year 1964	1965	1966
	Attendance (thousands)		
Black Butte	110	158	216
Englebright	106	134	126
New Hogan	110	245	347
Pine Flat	679	496	533
Terminus	385	454	402
Success	640	557	554
Isabella	1,313	1,540	1,673
	Coefficient of Variation x 100		
Black Butte	8	7	8
Englebright	9	4	8
New Hogan	10	11	7
Pine Flat	12	5	7
Terminus	7	8	8
Success	5	7	9
Isabella	6	3	4

TABLE 2

Fishing Estimates, by Reservoir, 1964-1966

Reservoir	Year 1964	1965	1966
	Fishing (thousands)		
Black Butte	6	24	53
Englebright	14	29	14
New Hogan	5	47	117
Pine Flat	218	178	161
Terminus	153	175	164
Success	242	230	244
Isabella	992	1,167	1,407
	Coefficient of Variation x 100		
Black Butte	28	23	6
Englebright	24	33	25
New Hogan	43	10	10
Pine Flat	7	7	5
Terminus	6	7	12
Success	5	9	5
Isabella	6	3	4

TECHNICAL REPORT No. 1
OCTOBER 1969

PLAN FORMULATION AND EVALUATION STUDIES-RECREATION

evaluation of recreation use survey procedures

APPENDIX A

THE EXISTING SURVEY

PLAN FORMULATION AND EVALUATION STUDIES – RECREATION
TECHNICAL REPORT NO. 1
EVALUATION OF RECREATION USE SURVEY PROCEDURES

APPENDIX A

THE EXISTING SURVEY

1. **General.** – This appendix describes the selection of survey location, survey days, procedures for traffic metering and the interview procedures used in the existing recreation use survey.

2. **Selection of Survey Areas.** – Areas to be surveyed should be selected so as to provide a representative sampling of the types of recreation activities available on the project. It is necessary to survey only the entrances to such areas. Survey points should be located close enough to the traffic counter to permit observation of traffic crossing the counter and yet afford safe traffic control.

3. **Selection of Survey Days.** – Surveys are conducted at least three times a year to sample recreation activity types during the major recreation seasons. Normally, the survey is held on a midweek day and a weekend day in the same week. The particular dates selected should have normal conditions prevailing for the season being sampled; i.e., weather, water level, available activities, etc. No holidays or special events should be taking place at the project or in the vicinity, such as boat races, fishing season openings, rodeos, etc., which might tend to draw abnormally large crowds or bias the normal activity type at the project.

4. **Traffic Metering.** – Traffic is recorded at each area by means of mechanical traffic counters. Traffic counters are checked for mechanical accuracy at least once a month. Additionally, it is recommended that checks be made during the week preceding and the week following the survey and such checks recorded on the weekly traffic distribution form (see figure 1). During the week of the survey, counter readings are taken to determine the weekday-weekend distribution of traffic for the survey week. These counter readings will be made as follows:

On the Monday morning preceding the survey – before 9 a.m.

On the Friday afternoon during the week of the survey – between 5 and 6 p.m.

On the Monday morning following the survey – before 9 a.m.

5. **The Survey Questionnaire.** – The survey form (figure 2) is designed for easy and rapid use by field personnel during the visitor interview, and for direct utilization by data processing personnel in the office. The numbers 1-28 in the three top rows and 29-80 at the bottom of the form are keyed to columns of the data card that is used in computer analysis. To be correctly interpreted by the data processors, numbers must be placed in the proper space. Where more than one column is provided for an entry such as fishing, a single digit entry should be preceded by a zero. For example, an entry for two fishermen would appear as "02". All entries should be made neatly with a hard pencil. Colored pencils or pen should not be used.

6. **Field Entries.** – Instructions for information to be completed in the field (columns 1-22) are as follows:

a. **Date.** – Show numbers for day-month-year, in that order.

b. **District.** – Name of district in which project is located and the number of the district assigned by OCE.

c. **Project.** – Official name of project and the number of the project assigned by OCE.

d. **Area.** – Official name of area and number of the area assigned by the district.

e. **Weather.** – Fair, rain, cloudy, etc.

f. **Start of Period.** – The survey day is divided into two-hour time periods starting with the opening of the survey station. The time the two-hour survey period started is to be shown in 24-hour time.

RECREATIONAL-USE SURVEY – WEEKLY TRAFFIC DISTRIBUTION AND COUNTER CHECKS

DISTRICT	PROJECT	AREA

WEEKLY TRAFFIC DISTRIBUTION

DAY	DATE	TIME	COUNTER READING	DIFFERENCE	% OF TRAFFIC	
MONDAY						
						WEEKDAY %
FRIDAY						
						WEEKEND %
MONDAY						

TRAFFIC COUNTER CHECKS

DATE	TIME		COUNTER READINGS		METER COUNT OF AXLES	ACTUAL COUNT OF AXLES	CORRECTION FACTOR (+ OR –)
	FROM	TO	ENDING	BEGINNING			

SAMPLE

ENG FORM 3912b 1 APR 66 *(EC 1120-2-16)*

FIGURE 1

CORPS OF ENGINEERS

RECREATIONAL—USE SURVEY

DATE (DAY 1 2 | MO. 3 4 | YR. 5 6) | DISTRICT (7 8) | PROJECT (9 10 11 12)

AREA (13 14) | WEATHER | START OF PERIOD (15 16) | END OF PERIOD (17 18) | MADE BY | WEEK-END 1 (19) | WEEK-DAY 0 (19) | SHEET NUMBER (20 21 22)

SURVEY NUMBER (23) | WEEKLY DISTRIBUTION OF VEHICLES | WEEKDAY % (MON–FRI) (24 25 26) | (27 28)

LINE NUMBER	NUMBER OF PERSONS IN VEHICLE	TRAILER: BOAT 1/	TRAILER: CAMP 2/	FEES: ANNUAL STICKER	FEES: ENTRANCE AND USER FEES PAID ($)	ACTIVITIES—NUMBER OF PERSONS: OVER-NIGHT USE: CAMPING ON PROJECT	OVER-NIGHT USE: TYPE 3/	DAY—USE: FISHING	HUNTING	PICNICKING	USING PICNIC FACILITIES	SWIMMING	WATER SKIING	PLEASURE BOATING	SIGHTSEEING ONLY	OTHER	TYPE 4/	DURATION OF VISIT: OVER-NIGHT (No. of days): CAMPING ON PROJECT	STAYING IN AREA	DAY-USE (Hrs.)	VISITS PER YEAR	DISTANCE TO RESIDENCE (Miles)	STATE—COUNTY CODE	FLAG—LC=3	RESIDENCE (city and county)
01																								
02																								
03																								
04																								
05																								
06																								
07																								
08																								
09																								
10																								
11																								
12																								
13																								
14																								
15																								
16																								
17																								
	29,30,31,32,33,34			35,36,37,38,39		40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61												62,63,64,65,66,67			68,69,70	71,72,73,74	75,76,77,78,79,80		

SAMPLE

CODES: 1/ TRAILER & BOAT (T): CARTOP BOAT (C): MOORED ON PROJECT (M): RENTAL BOAT (R)
2/ HOUSE TRAILER (H): CAMPER PICKUP (P)
3/ WEEKEND (W): VACATION DESTINATION (D): VACATION ENROUTE (R)
4/ SAILING (S): HORSEBACK RIDING & HIKING (H): OTHER (Ø)

ENG FORM 1 APR 66 3912 (EC 1120-2-16)

U.S. GOVERNMENT PRINTING OFFICE : 1966 OF—214-94

FIGURE 2
A-3

g. **End of Period.** – The time the two-hour survey period ended in 24-hour time.

h. **Made By.** – Name of interviewer.

i. **Weekend or Weekday.** – Circle appropriate category.

j. **Sheet Number.** – Sheets should be numbered consecutively through the entire survey day – no sheet number should be repeated.

7. **The Interview.** – All vehicles entering an area are surveyed unless traffic becomes congested. When necessary, every second, third, fourth or fifth vehicle is surveyed. This is a discretionary decision made by the interviewer; however, once decided, the sequence should not be varied until the congestion eases off. The number of vehicles missed during each two-hour time period should be noted. Do not survey or record vehicles **leaving** the area. Once the survey has started, an interviewer should be at the survey point at all times until the survey day is completed. Surveys should be established so as to sample at least 90 percent of the public entering the area on the survey day. The interviewer should be courteous, extending a polite greeting to each driver as he starts his interview. All items on the survey form should be completed without unnecessarily delaying the vehicle. Each vehicle surveyed should be represented by one line of information as identified by the "Line Number" (columns 29 and 30). The following is a description and explanation of each item and suggested methods for interviewing.

a. **Number of Persons in Vehicle.** – The number of persons per vehicle can usually be counted by the interviewer as the vehicle approaches. All persons in the vehicle are counted. If the vehicle has been surveyed before on this day, at this or another area on the project, it should be entered as an "RV" (reentry recreation vehicle). Vehicles which enter the project for service functions should be entered as "NV" (non-recreation vehicle). If a trailer is attached to any "RV" or "NV", it should be so indicated in the trailer column. Except for the entry of "RV" or "NV" in the "number of persons in vehicle" columns and the entry of "T" or "H" in trailer columns when applicable, **no other entries should be made for "RV" or "NV" vehicles.**

b. **Trailer.** – Indicate by letter the type of boat or trailer the party is using.

(1) **Boat.** – The code (1/) for entry into this column is shown on the bottom of the survey form.

(2) **Camp.** – The code (2/) for entry into this column is shown on the bottom of the survey form.

c. **Annual Sticker.** – At all areas where entrance fees are charged, indicate with a "1" if the vehicle has an annual Recreation/Conservation sticker. Leave blank if it does not have one.

d. **Entrance and User Fees Paid.** – At all fee areas, indicate total costs paid by all persons in the vehicle for the use of the area being surveyed. For example: four persons paid 50 cents each – enter "$2". Do not include the cost of the Recreation/ Conservation sticker.

e. **Activities – Overnight Use.**

(1) **Camping on Project.** – Enter the number of persons planning to camp on the project. Ask, "Are any of you camping on the project?" If yes ask, "How many?"

(2) **Type.** – If the party is camping on the project, enter the appropriate code shown in 3/ at the bottom of the survey form. Ask, "Are you camping here just for the weekend or are you on your vacation?". If they are here for the weekend, enter "W" (weekend campers). If on their vacation ask, "Are you spending your vacation here or are you just passing through the area?". If they are spending their vacation on the project, enter "D" (destination vacation campers). If they are passing through and only spending the night, enter "R" (enroute vacation campers).

f. **Activities – Day Use.** – Enter the number of persons planning to take part in the activity indicated. Ask, "How many of you will be . . . (activity) . . ." It is best to state the activity exactly as shown on the form. Further clarification of the activity terminology is given as follows:

(1) **Fishing.** – Indicate the number of people fishing in the project area.

(2) **Hunting.** – Indicate the number of people hunting in the project area.

(3) **Picnicking.** – Indicate the number of people eating a prepared meal on the project,

whether on shore or in a boat. Persons camping should not be shown as picnicking or using picnic facilities unless they are using a designated picnic area outside of their campground.

(4) **Using Picnic Facilities.** – If picnicking is indicated as an activity, ask if they will use project facilities provided for this purpose. If none are available ask, "Would you like to have picnic facilities?". Indicate the number of people if the answer is affirmative.

(5) **Swimming.** – Indicate the number of people swimming, wading or sunbathing on the beach.

(6) **Waterskiing.** – Indicate the number of people taking part in any water sports where one is towed behind a boat; i.e., on a disk, sled, surfboard, skis, etc.

(7) **Pleasure Boating.** – Indicate the number of people **boating for pleasure only** and not in conjunction with another boating activity such as fishing or waterskiing.

(8) **Sightseeing.** – Indicate only those persons in vehicle who are taking part in **no other activity** on the project except sightseeing.

(9) **Other.** – Indicate number of persons taking part in an activity other than those shown and indicate "type" by code designated in 4/ at the bottom of the survey form.

g. **Duration of Visit – Overnight Use.** – If the party has indicated that they will camp on the project, then ask them, "How many **days** will you be camping here?". Enter number of days camping (**not** number of nights) under "Camping on Project". If the party is not camping on the project, ask them if they are staying in the area for more than one day and how long. Enter number of days (**not** number of nights) under "Staying in Area". Note that a one-night visit is equivalent to two days; as such, there should never be an entry of "1" under either of these column headings. Notice also that the survey does not count fractions of camping days. Any portion of a camping day should be shown as a full day.

h. **Duration of Visit – Day Use.** – Show number of hours the party expects to spend on the project **on the day of the survey**, in one-hour increments. There should be no less than one hour or more than 12 hours shown. Day use duration information should be obtained from all **except those who are camping on the project.**

i. **Visits Per Year.** – Show the estimated number of times in a year that the party visits the project. If it is the first visit to the project for the party, write "1st".

j. **Distance to Residence.** – Fill out later, when time permits, from a standard table of distances to be provided. These must be one-way distances, to the nearest mile, from the residence to the initial point of intersect with project boundaries.

k. **State-County Code.** – This should be filled out after "distance to residence" from the standard table of state-county codes. If the "distance to residence" exceeds 250 miles, show only the applicable state code.

l. **Residence – City and County.** – Ask where the party lives – get name of city and county. If from out of state, note state also.

8. **Unusual Circumstances.** – If there are any unusual or special circumstances encountered during the survey, make note of them on the back of the page for the time period during which they occur.

9. **Post Survey.** – At the end of the survey day, the interviewer will staple together sheets for each time period (staple in the upper left-hand corner). Assemble these time periods chronologically and fasten with a paper clip. To these sheets, attach the form titled "Weekly Traffic Distribution and Counter Checks" (see figure 1). Return this package, representing the survey for one area, to the project office for transmittal to the district office for processing. At the end of the month, complete the form titled "Monthly Traffic Counter Readings" (see figure 3) and submit to the district within five days after the end of the month.

10. **Office Entries.** – Instructions for entries to be completed in the office (columns 23 through 26) are as follows:

a. **Survey Number.** – All surveys will be coded for the pertinent season, as follows: Winter – 1, Spring – 2, Summer – 3, Fall – 4.

b. **Weekly Distribution of Vehicles.** – Compute the percentage, to the nearest whole number, of weekday and weekend traffic from traffic counter reading. Enter **weekday** percentage only.

MONTHLY TRAFFIC COUNTER READINGS *(Feeder Report for SPK 171)*

PROJECT _____ MONTH _____

AREA & COUNTER NUMBER	START	END	NUMBER OF VEHICLES	COUNT		COUNTER CHECK				REMARKS
				TWO WAY	ONE WAY	ACTUAL AXLES COUNTED	METER COUNT OF AXLES	PERCENT OF ERROR	DATE OF CHECK	

SAMPLE

SPK FORM 298
18 DEC 63

FIGURE 3

TECHNICAL REPORT No. 1
OCTOBER 1969

PLAN FORMULATION AND EVALUATION STUDIES-RECREATION

evaluation of recreation use survey procedures

APPENDIX B

THE MODIFIED DISTRICT SURVEY

18 DEC 63

PLAN FORMULATION AND EVALUATION STUDIES – RECREATION
TECHNICAL REPORT NO. 1
EVALUATION OF RECREATION USE SURVEY PROCEDURES

APPENDIX B

THE MODIFIED DISTRICT SURVEY

1. **General.** – This appendix describes selection of survey location, survey dates, procedures for traffic metering and the procedures which must be followed during the interview portion of the recreation use survey considered most appropriate for administration at the district level.

2. **Selection of the Survey Areas.** – All areas at projects to be surveyed are stratified. Strata are defined by the type of recreation available at the area, the size of the area in terms of visitation and the location of the area. One area from each stratum is randomly selected to be surveyed each season.

3. **Traffic Metering.** – Mechanical traffic counters are used to meter entrance lanes of all roads providing access to the project. All meters are to be placed so as to count one-way traffic only; i.e., entering vehicles. The meters at the areas to be surveyed will be checked for accuracy at the end of each month and the meter readings submitted on the form, entitled "Recreation Use Survey – Monthly Traffic Counter Readings," (see figure 1). Additionally, the meters shall be read during the week of the survey to determine the weekday-weekend distribution of traffic and submitted on the form, entitled "Recreation Use Survey – Survey Week Traffic Counter Readings," (see figure 2). The following survey week readings are necessary:

a. On the Monday morning preceding the weekday of the survey – before 0900 hours.

b. On the Friday evening following the weekday of the survey – after 1800 hours.

c. On the Friday evening preceding the weekend day of the survey – after 1800 hours.

d. On the Monday morning following the weekend day of the survey – before 0900 hours.

4. **Selection of the Survey Dates.** – The year is partitioned into three "seasons." Each "season" is defined in terms of recreation visitation, each "season" having approximately equal visitation. The seasons are: early recreation season – April, May and June; late recreation season – July and August; and off recreation season (in two sections) – September through December and January through March. There must be a survey for each stratum for every season. Within each season, all weekend and weekday periods are made available for selection. By random selection, representative time periods (a weekend and a weekday) are selected for survey. Next, one day (excluding holidays) from each period is randomly selected for survey.

5. **The Survey Questionnaire.** – A sample of the survey questionnaire to be used is shown in figure 3. The project manager shall ensure that the personnel conducting the survey become familiar with the following instructions prior to the survey week. Before the first day selected for survey, project personnel shall, from experience, determine what activity types shall be entered on the survey form under "other," columns 56-57, 58-59 and 60-61. In these columns, enter activities which are popular at the project. For example, one project may enter hiking in columns 56-57, horseback riding in columns 58-59, and scuba diving in columns 60-61; while another may enter sailing in columns 56-57, golfing in columns 58-59 and leave columns 60-61 blank. On the day of the survey, the following entries shall be accomplished in the field.

a. **Date.** Numerical entry for day-month-year, in that order.

b. **District.** Name of district in which project is located.

c. **Project.** Official name of project.

d. **Area.** Official name of area.

e. **Start of Period.** The survey day is divided into two-hour time periods starting with the opening of the survey station. The time each two-hour survey period started is to be shown in 24-hour time.

f. **End of Period.** The time the two-hour survey period ended in 24-hour time.

RECREATION-USE SURVEY - MONTHLY TRAFFIC COUNTER READINGS

DISTRICT PROJECT MONTH

AREA & COUNTER NUMBER	BEGINNING OF MONTH METER READING	END OF MONTH METER READING	TOTAL MONTHLY VEHICLE COUNT	METER CHECK				REMARKS
				AXLE COUNT (OBSERVED)	AXLE COUNT (METERED)	% ERROR (+ or -)	DATE OF CHECK	

SAMPLE

FIGURE 1

RECREATION-USE SURVEY - SURVEY WEEK TRAFFIC COUNTER READINGS

DISTRICT	PROJECT	AREA

WEEKEND TRAFFIC COUNT

METER CHECK	AXLE COUNT (OBSERVED)	AXLE COUNT (METERED)	% ERROR (+ or -)	DATE OF CHECK

METER PERIOD		DATE READ	TIME READ	READING
BEGIN	FRIDAY EVENING BEFORE WEEKEND SURVEY			
END	MONDAY MORNING AFTER WEEKEND SURVEY			
		TOTAL WEEKEND TRAFFIC COUNT		

WEEKDAY TRAFFIC COUNT

METER CHECK	AXLE COUNT (OBSERVED)	AXLE COUNT (METERED)	% ERROR (+ or -)	DATE OF CHECK

METER PERIOD		DATE READ	TIME READ	READING
BEGIN	MONDAY MORNING BEFORE WEEKDAY SURVEY			
END	FRIDAY EVENING AFTER WEEKDAY SURVEY			
		TOTAL WEEKDAY TRAFFIC COUNT		

REMARKS:

SAMPLE

FIGURE 2

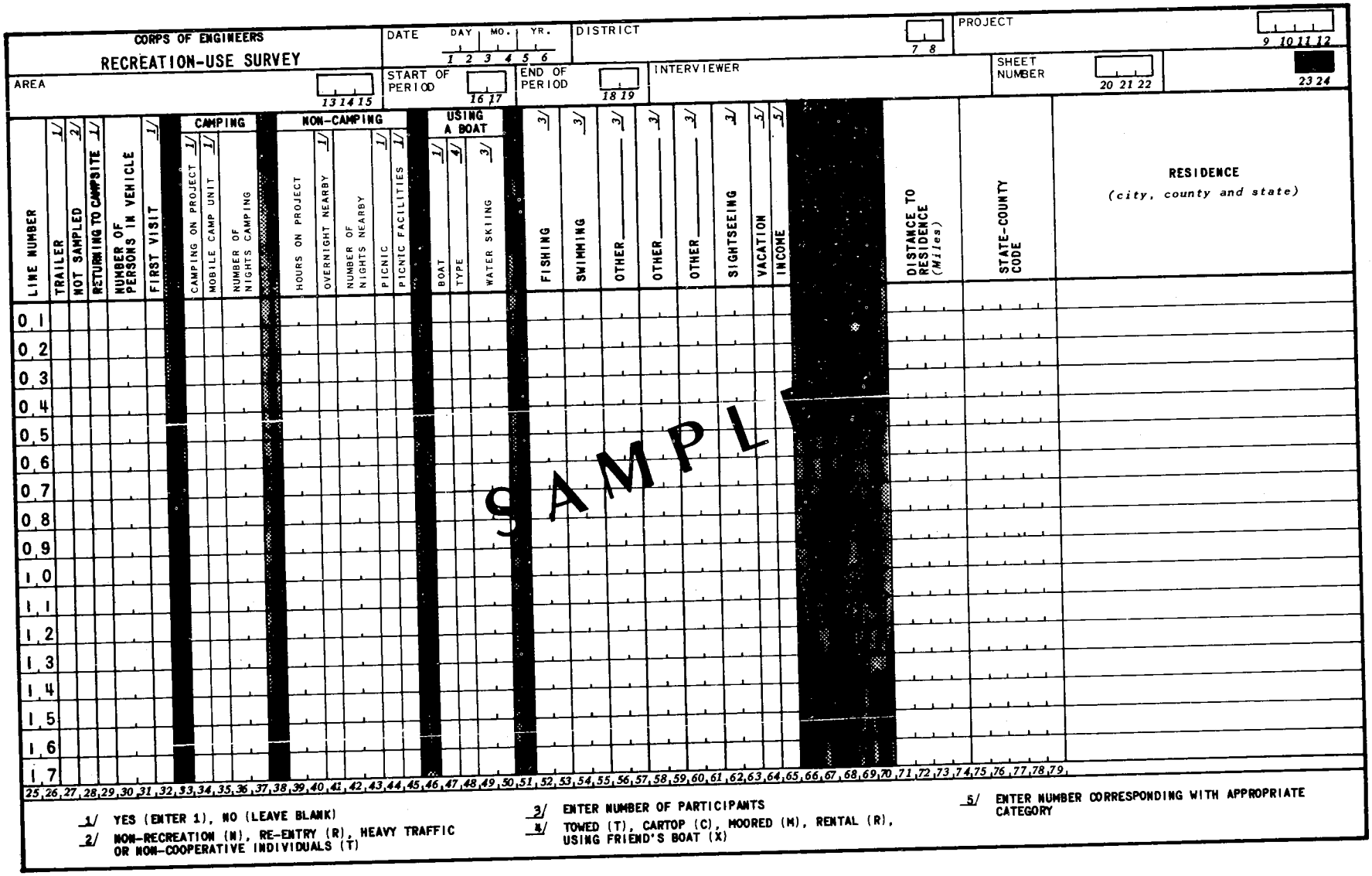
CORPS OF ENGINEERS
RECREATION-USE SURVEY
DATE DAY MO. YR. 1 2 3 4 5 6
DISTRICT 7 8
PROJECT 9 10 11 12
AREA 13 14 15
START OF PERIOD 16 17
END OF PERIOD 18 19
INTERVIEWER
SHEET NUMBER 20 21 22
23 24
CAMPING
NON-CAMPING
USING A BOAT
LINE NUMBER
TRAILER 1/
NOT SAMPLED 2/
RETURNING TO CAMPSITE 1/
NUMBER OF PERSONS IN VEHICLE
FIRST VISIT 1/
CAMPING ON PROJECT 1/
MOBILE CAMP UNIT 1/
NUMBER OF NIGHTS CAMPING
HOURS ON PROJECT
OVERNIGHT NEARBY 1/
NUMBER OF NIGHTS NEARBY
PICNIC 1/
PICNIC FACILITIES 1/
BOAT 1/
TYPE 4/
WATER SKIING 3/
FISHING 3/
SWIMMING 3/
OTHER ____ 3/
OTHER ____ 3/
OTHER ____ 3/
SIGHTSEEING 3/
VACATION 5/
INCOME 5/
DISTANCE TO RESIDENCE (Miles)
STATE-COUNTY CODE
RESIDENCE (city, county and state)
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
SAMPLE
25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,
1/ YES (ENTER 1), NO (LEAVE BLANK)
2/ NON-RECREATION (N), RE-ENTRY (R), HEAVY TRAFFIC OR NON-COOPERATIVE INDIVIDUALS (T)
3/ ENTER NUMBER OF PARTICIPANTS
4/ TOWED (T), CARTOP (C), MOORED (M), RENTAL (R), USING FRIEND'S BOAT (X)
5/ ENTER NUMBER CORRESPONDING WITH APPROPRIATE CATEGORY

FIGURE 3

g. Interviewer. Name of interviewer.

h. Sheet Number. Sheets will be numbered consecutively through the entire survey day--no sheet number should be repeated.

6. Every auto passing the survey station will be recorded as a line entry on the survey form. Recreationists entering in autos for the first time are completely surveyed. However, when autos would be forced to wait an excessive length of time some can be passed without being surveyed (in order of arrival) but each auto so passed must be recorded. It should also be noted if autos not sampled have a trailer (see instructions for column labeled "not sampled"). All items on the survey form should be completed without unnecessarily delaying the vehicle. Questions are asked of the driver of the vehicle only. When making column entries, it is particularly important that where two spaces are allowed for an entry on the survey form, both spaces must have a digit; e.g., if there are two persons in the vehicle, enter 02. The following is a description and explanation of each item on the survey form and suggested methods for conducting the interview.

LINE NUMBER

All entries for each vehicle are to be made on a single horizontal line. There will be an entry made for each vehicle passing the survey point including passed vehicles.

TRAILER

If an auto is pulling a trailer of any kind, enter "1"; if not, leave blank (col. 27).

NOT SAMPLED

(Explanation)

If the auto is not sampled, an entry is still required. If it was not sampled because it was (1) a re-entry vehicle, enter "R"; (2) a non-recreation vehicle, enter "N"; or (3) passed because of heavy traffic or non-cooperation enter "T" (col. 28).

(Definition)

(1) Non-Recreation vehicle - a vehicle entering for purposes other than recreation.

(2) Re-entry vehicle - (a) a vehicle that has been previously surveyed or (b) a vehicle that has visited the project earlier that day but is not camping at this area.

(Procedure)

After greeting the occupants of the auto, the first question asked is "Is this your first visit to this area today?" If answer is yes, leave blank and continue to next question. If answer is no, ask "Have we interviewed you before?" If answer is yes, thank them, pass them and enter "R". If answer is no, leave "not sampled" column blank and enter "1" in "returning to camp site" (col. 29) and continue to next question.

NUMBER OF PERSONS IN VEHICLE	Ask, "How many people are in the vehicle?" and enter number in columns 30 and 31. If the number of persons is obvious, do not ask this question but make the entry.
FIRST VISIT	Ask, "Is this the first time you have ever been to this project?". (First ever, not today, this week, or this year.) If yes, enter "1"; if no, leave blank (col. 32).
	CAMPING
CAMPING ON PROJECT	Ask, "Are you going to be camping on the project?". If yes, enter "1"; if no, leave blank (col. 34).
(Note)	(If persons are camping, continue this section; if not, go to first entry under non-camping, "hours on project.")
MOBILE CAMP UNIT	If a camping unit is in evidence, enter "1"; if not, leave blank (col. 35).
NUMBER OF NIGHTS CAMPING	Ask, "How many nights will you be camping on the project?". Enter the number of nights camping (cols. 36 and 37). Go to first entry under using a boat, "Boat."
	NON-CAMPING
HOURS ON PROJECT	Ask, "How many hours will you spend at the project today?". Enter the number in columns 39 and 40.
OVERNIGHT NEARBY	Ask, "Are you going to be staying overnight nearby?".
(Explanation)	Will they be staying in a campground off the project, a cabin or a motel (on or off the project land) or a friend's home. If yes, enter "1"; if no, leave blank (col. 41). If persons are staying overnight nearby, continue. If not, skip next question and ask picnicking question.
NIGHTS NEARBY	Ask, "How many nights will you be staying overnight nearby?" Enter the number in columns 42 and 43.
PICNICKING	Ask, "Are you going to be picnicking?". If yes, enter "1"; if no, leave blank (col. 44).
(Definition)	Picnicking--eating a prepared meal on the project (may be prepared either at home or at the project). One need not be in a picnic area nor utilize picnic facilities to be picnicking. If persons will be picnicking, continue; if not, go to first entry under using a boat, "Boat".

USING PICNIC FACILITIES — Ask, "Are you planning to use picnic facilities?". If yes, enter "1"; if no, leave blank (col. 45).

USING A BOAT

BOAT — Ask, "Will you be using a boat while you are at the project?". If yes, enter "1"; if no, leave blank (col. 47). If persons will be boating, continue; if not, skip next two questions and ask next fishing question.

TYPE
(Explanation) — If the boat is being brought in with the vehicle, no question need be asked but an entry is necessary. If the boat is being towed, enter "T"; if carried on top of the vehicle, enter "C". If a boat is not visible, the following questions should be asked: (a) "Is your boat moored here?" if yes, enter "M"; or (b) "Will you rent a boat?" if yes, enter "R"; or (c) "Will you use or ride in a friend's boat?" if yes, enter "X" (col. 48).

WATERSKIING — Ask, "How many persons in this auto will waterski?". Enter the number who will participate. If none, leave blank (cols. 49 and 50).

The following questions apply to all occupants of the vehicle. Every question is to be asked by the interviewer in the sequence shown on the sheet. Ask:

"How many persons from this auto will be fishing?" - (Enter cols. 52 & 53)
"How many persons from this auto will be swimming?" - (Enter cols. 54 & 55)
"How many persons from this auto will be other?1/)
"How many persons from this auto will be other?1/)
"How many persons from this auto will be other?1/) - (Enter cols. 56-61)
"How many persons from this auto will be sightseeing?"2/ - Enter cols. 62 & 63)

Enter the number who will participate; if none, leave blank.

(Definition) — Sightseeing is defined as participating in no other activity while visiting the project; do not ask this question if any other activities have been listed and leave columns 62 and 63 blank.

VACATION — At this point, the driver is handed the Vacation/Income card (see figure 4) with side one (Vacation) up and asked "Would you please tell me the appropriate vacation group number?" Enter 1,2,3,4 or 5 in column 64.

1/ Activities determined by individual projects.
2/ See definition.

INCOME	Request the driver to turn the card over and ask, "Would you please tell me the appropriate income group number?" Enter 1,2,3,4 or 5 in column 65. Request that the card be returned.
DISTANCE TO RESIDENCE	To be filled in by the project office.
STATE-COUNTY CODE	To be filled in by the project office.
RESIDENCE	When driver returns card say, "I have one more question, in what city, county and state do you live?". Enter city, county and state on the sheet under "residence". Conclude the interview with "Thank you, I hope you enjoy your stay". (or a similar remark).

SIDE 1 *Survey Item: VACATION*

TOTAL WEEKS VACATION TIME THIS YEAR

Group-1	Group-2	Group-3	Group-4	Group-5
0-2 WEEKS	3-4 WEEKS	5 WEEKS OR MORE	RETIRED	PREFER NOT TO ANSWER

Thank you for your cooperation

CORPS OF ENGINEERS RECREATION USE SURVEY

SAMPLE

SIDE 2 *Survey Item: INCOME*

APPROXIMATE FAMILY INCOME LAST YEAR

Group-1	Group-2	Group-3	Group-4	Group-5
0-$3,999	$4,000-$7,999	$8,000-$11,999	$12,000 +	PREFER NOT TO ANSWER

Thank you for your cooperation

CORPS OF ENGINEERS RECREATION USE SURVEY

NOTE: It is recommended that the above survey form item be printed back-to-back on heavy, durable card stock.

FIGURE 4

7. Office Completion of the Survey. - After completion of the field portion of the survey, the appropriate district and project numbers assigned by OCE and the number assigned by the project to the area surveyed must be filled in on all survey forms used during the day of survey. The state and county code for the county of residence indicated for each line entry must be located in the state and county code list and filled in along with the appropriate distance of that residence from the project. To ensure that the same distance is always entered for the same town, a list of standard road-mile distances from the project to the major surrounding towns will be compiled by each project. Also, a copy of that list must be supplied to the district before completion of the first survey.

TECHNICAL REPORT No. 1
OCTOBER 1969

PLAN FORMULATION AND EVALUATION STUDIES-RECREATION

evaluation of recreation use survey procedures

APPENDIX C

EXAMPLE OF THE FIRST STAGE SAMPLE REQUIRED BY ALTERNATIVES TO THE DISTRICT SURVEY DESIGN

PLAN FORMULATION AND EVALUATION STUDIES – RECREATION
TECHNICAL REPORT NO. 1
EVALUATION OF RECREATION USE SURVEY PROCEDURES

APPENDIX C

EXAMPLE OF THE FIRST STAGE SAMPLE REQUIRED BY ALTERNATIVES TO THE DISTRICT SURVEY DESIGN

1. **General.** – This appendix presents an example of a first stage sample under a three stage survey design, incorporating the district survey and administered at district level with assistance from a central survey control. The criteria used in stratification of projects discussed herein were: (a) size of annual attendance at each reservoir, and (b) geographic location. The basic data used in selection and stratification of projects were taken from the updated Corps publication "Recreation". The data are for 1966 and therefore represent only projects existing at that time and attendance estimates for that year. Inspection of those data indicated 181 projects suitable for inclusion in the alternative design. Projects such as canals, waterways, multiple locks and dams, and reservoirs with no permanent pool were excluded on the basis that they either were or had the characteristics of a non-reservoir project and as such were not applicable to this particular design. Projects formed by a single lock and dam were, in general, considered most like a reservoir and as such were included in the example. The attendance estimates available from the alternative design would be based on a sample of representative projects selected from each stratum. For each project not selected, a measure of seasonal traffic would be required. The selection of projects and the attendance estimates from the sample for selected and non-selected projects would be accomplished by the survey control center.

2. **Stratification.** – Stratification of projects by geographic regions partitioned the 181 applicable projects into seven geographic regions. These regions adhere as closely as practicable to Corps division boundaries. The regions and the general location of projects are shown on Figure 1.

3. Stratification of projects by size of annual attendance partitioned the projects into three size groups. In general, these groups are: (a) the uniquely large – over 2½ million recreation days annually, (b) the large – 1-2½ million recreation days annually, and (c) the small – under 1 million recreation days annually. Exceptions are two reservoirs in the Los Angeles District, Hansen and Whittier Narrows. Although less than 2½ million recreation days of use were reported, these reservoirs are regarded as uniquely large; their uniqueness lies in their large attendance size relative to their small physical size.

4. **The Strata.** – As used in this example, stratification by geographic region and attendance size produced 17 non-zero strata – each conforming to a particular regional boundary and a particular attendance size. Within the framework of the criteria used, four additional strata were available; however, they had no projects and were therefore excluded from subsequent selection. The following tabulation shows the distribution of the 181 projects over the available strata.

Number of Projects by Region and Attendance Size

		Attendance Size Groups		
Region	**Total**	**Group 1**	**Group 2**	**Group 3**
	181	12	38	131
1	26	0	2	24
2	19	0	0	19
3	16	0	2	14
4	46	2	8	36
5	15	4	5	6
6	10	2	2	6
7	49	4	19	26

5. **The Sample.** – The first stage sample would be selected from each non-zero stratum. Because of their uniquely high attendance and importance in national estimates, all projects in Size Group 1 would be selected with certainty. The sampling fraction from the remaining strata would determine the size of the

first stage sample. In this example, it is assumed that a minimum of 50 projects is sought. It is also assumed that unbiased estimates of strata sampling error are desired; this latter assumption requires selection of a minimum of two projects from each stratum. Accordingly, from the remaining strata, approximately one project in five would be selected with a minimum of two from each stratum required. These projects would be selected at random without replacement. This scheme yields a sample of 54 projects. The following tabulation shows the distribution of the sample over the available strata.

Number of Sample Projects by Region and Attendance Size

		Attendance Size Groups		
Region	**Total**	**Group 1**	**Group 2**	**Group 3**
	54	12	14	28
1	7	0	2	5
2	4	0	0	4
3	5	0	2	3
4	11	2	2	7
5	8	4	2	2
6	6	2	2	2
7	13	4	4	5

6. The strata for this example are completely defined below. The projects indicated with asterisks represent a possible first stage sample, pages C-3 thru C-11. Project locations are shown on Figure 1, page C-12.

REGION I – MISSOURI RIVER

Reservoir	State	District
	Size Group #1	
	NONE	
	Size Group #2	
*Pomme De Terre	Missouri	Kansas City
*Gavins Point	South Dakota	Omaha
	Size Group #3	
Cherry Creek	Colorado	Omaha
Coralville	Iowa	Rock Island
Kanopolis	Kansas	Kansas City
Pomona	Kansas	Kansas City
Tuttle Creek	Kansas	Kansas City
Wilson	Kansas	Kansas City
Lac Qui Parle	Minnesota	St. Paul
Gull Lake	Minnesota	St. Paul
*Leech Lake	Minnesota	St. Paul
Pine River	Minnesota	St. Paul
Poke Gama	Minnesota	St. Paul
Sandy Lake	Minnesota	St. Paul
Winnibigoshish	Minnesota	St. Paul
*Orwell	Minnesota	St. Paul
*Fort Peck	Montana	Omaha
Harlan County	Nebraska	Kansas City
*Garrison	North Dakota	Omaha
Homme	North Dakota	St. Paul
Lake Astabula	North Dakota	St. Paul
Big Bend	South Dakota	Omaha
Cold Brook	South Dakota	Omaha
Fort Randall	South Dakota	Omaha
*Lake Traverse	South Dakota	St. Paul
Oahe	South Dakota	Omaha

REGION II – NORTH ATLANTIC

Reservoir	State	District
	Size Group #1	
	NONE	
	Size Group #2	
	NONE	
	Size Group #3	
*Mansfield Hollow	Connecticut	New England
West Thompson	Connecticut	New England
Buffumville	Massachusetts	New England
East Brimfield	Massachusetts	New England
*Littleville	Massachusetts	New England
Westville	Massachusetts	New England
Edward MacDowell	New Hampshire	New England
Hopkinton-Everett	New Hampshire	New England
*Otter Brook	New Hampshire	New England
Surry Mountain	New Hampshire	New England
Almond	New York	Baltimore
East Sidney	New York	Baltimore
Whitney Point	New York	Baltimore
Alvin R. Bush	Pennsylvania	Baltimore
Francis E. Walter	Pennsylvania	Philadelphia
Prompton	Pennsylvania	Philadelphia
North Hartland	Vermont	New England
*North Springfield	Vermont	New England
Townshend	Vermont	New England

REGION III – NORTH PACIFIC

Reservoir	State	District
	Size Group #1	
	NONE	
	Size Group #2	
*Bonneville	Oregon	Portland
*McNary	Washington	Walla Walla
	Size Group #3	
Albeni Falls	Idaho	Seattle
*Lucky Peak	Idaho	Walla Walla
Cottage Grove	Oregon	Portland
*Cougar	Oregon	Portland
Detroit	Oregon	Portland
Dorena	Oregon	Portland
Fall Creek	Oregon	Portland
Fern Ridge	Oregon	Portland
*Hills Creek	Oregon	Portland
Lookout Point	Oregon	Portland
The Dalles	Oregon	Portland
Chief Joseph	Washington	Seattle
Ice Harbor	Washington	Walla Walla
Mill Creek	Washington	Walla Walla

REGION IV – OHIO RIVER

Reservoir	State	District
	Size Group #1	
*Lake Cumberland	Kentucky	Nashville
*Old Hickory	Tennessee	Nashville
	Size Group #2	
Barkley	Kentucky	Nashville
Mosquito Creek	Ohio	Pittsburgh
Senecaville	Ohio	Huntington
West Fork of Mill Creek	Ohio	Louisville
*Center Hill	Tennessee	Nashville
*Cheatham	Tennessee	Nashville
Dale Hollow	Tennessee	Nashville
Summersville	West Virginia	Huntington
	Size Group #3	
Cagles Mill	Indiana	Louisville
Mansfield	Indiana	Louisville
*Monroe	Indiana	Louisville
Barren River	Kentucky	Louisville
Buckhorn	Kentucky	Louisville
Dewey	Kentucky	Huntington
Nolin River	Kentucky	Louisville
*Routh River	Kentucky	Louisville
Mount Morris	New York	Buffalo
Berlin	Ohio	Pittsburgh
*Delaware	Ohio	Huntington
Dillon	Ohio	Huntington
Atwood	Ohio	Huntington
Beach City	Ohio	Huntington
Charles Mill	Ohio	Huntington
*Clendening	Ohio	Huntington
Leesville	Ohio	Huntington
Piedmont	Ohio	Huntington
Pleasant Hill	Ohio	Huntington
Tappan	Ohio	Huntington
*Wills Creek	Ohio	Huntington
*Tom Jenkins	Ohio	Huntington
Allegheny	Pennsylvania	Pittsburgh
Conemaugh	Pennsylvania	Pittsburgh
Crooked Creek	Pennsylvania	Pittsburgh
Curwensville	Pennsylvania	Pittsburgh
East Branch Clarion River	Pennsylvania	Pittsburgh

REGION IV – OHIO RIVER (Cont'd)

Reservoir	State	District
	Size Group #3 (Cont'd)	
Loyalhanna	Pennsylvania	Pittsburgh
*Mahoning Creek	Pennsylvania	Pittsburgh
Shenango River	Pennsylvania	Pittsburgh
Tionesta	Pennsylvania	Pittsburgh
Youghiogheny River	Pennsylvania	Pittsburgh
John W. Flannagan	Virginia	Huntington
Bluestone	West Virginia	Huntington
Sutton	West Virginia	Huntington
Tygart River	West Virginia	Huntington

REGION V – SOUTH ATLANTIC

Reservoir	State	District
	Size Group #1	
*Allatoona	Georgia	Mobile
*Buford	Georgia	Mobile
*Hartwell	Georgia	Savannah
*Clark Hill	South Carolina	Savannah
	Size Group #2	
Jim Woodruff	Florida	Mobile
Walter F. George	Georgia	Mobile
*Grenada	Mississippi	Vicksburg
*Sardis	Mississippi	Vicksburg
John H. Kerr	Virginia	Wilmington
	Size Group #3	
*Columbia	Georgia	Mobile
New Savannah	Georgia	Savannah
Arkabutla	Mississippi	Vicksburg
*Enid	Mississippi	Vicksburg
W. Kerr Scott	North Carolina	Charleston
Philpott	Virginia	Wilmington

REGION VI – SOUTH PACIFIC

Reservoir	State	District
	Size Group #1	
*Hansen	California	Los Angeles
*Whittier Narrows	California	Los Angeles
	Size Group #2	
*Coyote Valley	California	San Francisco
*Isabella	California	Sacramento
	Size Group #3	
Black Butte	California	Sacramento
Harry L. Englebright	California	Sacramento
*New Hogan	California	Sacramento
*Pine Flat	California	Sacramento
Success	California	Sacramento
Terminus	California	Sacramento

REGION VII – SOUTHWEST

Reservoir	State	District
	Size Group #1	
*Table Rock	Missouri	Little Rock
*Denison	Oklahoma	Tulsa
*Ferrells Bridge	Texas	New Orleans
*Whitney	Texas	Fort Worth
	Size Group #2	
*Beaver	Arkansas	Little Rock
Blakely Mountain	Arkansas	Vicksburg
Bull Shoals	Arkansas	Little Rock
Dardanelle	Arkansas	Little Rock
Greers Ferry	Arkansas	Little Rock
Narrows	Arkansas	Vicksburg
Norfolk	Arkansas	Little Rock
*Wappapello	Missouri	Memphis
Eufaula	Oklahoma	Tulsa
Fort Gibson	Oklahoma	Tulsa
*Keystone	Oklahoma	Tulsa
Tenkiller	Oklahoma	Tulsa
Belton	Texas	Fort Worth
Benbrook	Texas	Fort Worth
Grapevine	Texas	Fort Worth
Lavon	Texas	Fort Worth
*Garza-Little Elm	Texas	Fort Worth
Texarkana	Texas	New Orleans
Waco	Texas	Fort Worth
	Size Group #3	
Blue Mountain	Arkansas	Little Rock
Millwood	Arkansas	Tulsa
*Nimrod	Arkansas	Little Rock
Council Grove	Kansas	Tulsa
Elk City	Kansas	Tulsa
*Fall River	Kansas	Tulsa
*John Redmond	Kansas	Tulsa
Toronto	Kansas	Tulsa
Wallace Lake	Louisiana	New Orleans
Clearwater	Missouri	Little Rock
*Conchas	New Mexico	Albuquerque
Canton	Oklahoma	Tulsa
Fort Supply	Oklahoma	Tulsa
*Great Salt Plains	Oklahoma	Tulsa

REGION VII – SOUTHWEST (Cont'd)

Reservoir	State	District
	Size Group #3 (Cont'd)	
Heyburn	Oklahoma	Tulsa
Hulah	Oklahoma	Tulsa
Oologah	Oklahoma	Tulsa
Wister	Oklahoma	Tulsa
Bardwell	Texas	Fort Worth
Canyon	Texas	Fort Worth
Dam B	Texas	Fort Worth
Hords Creek	Texas	Fort Worth
Navarro Mills	Texas	Fort Worth
Procter	Texas	Fort Worth
Sam Rayburn	Texas	Fort Worth
San Angelo	Texas	Fort Worth

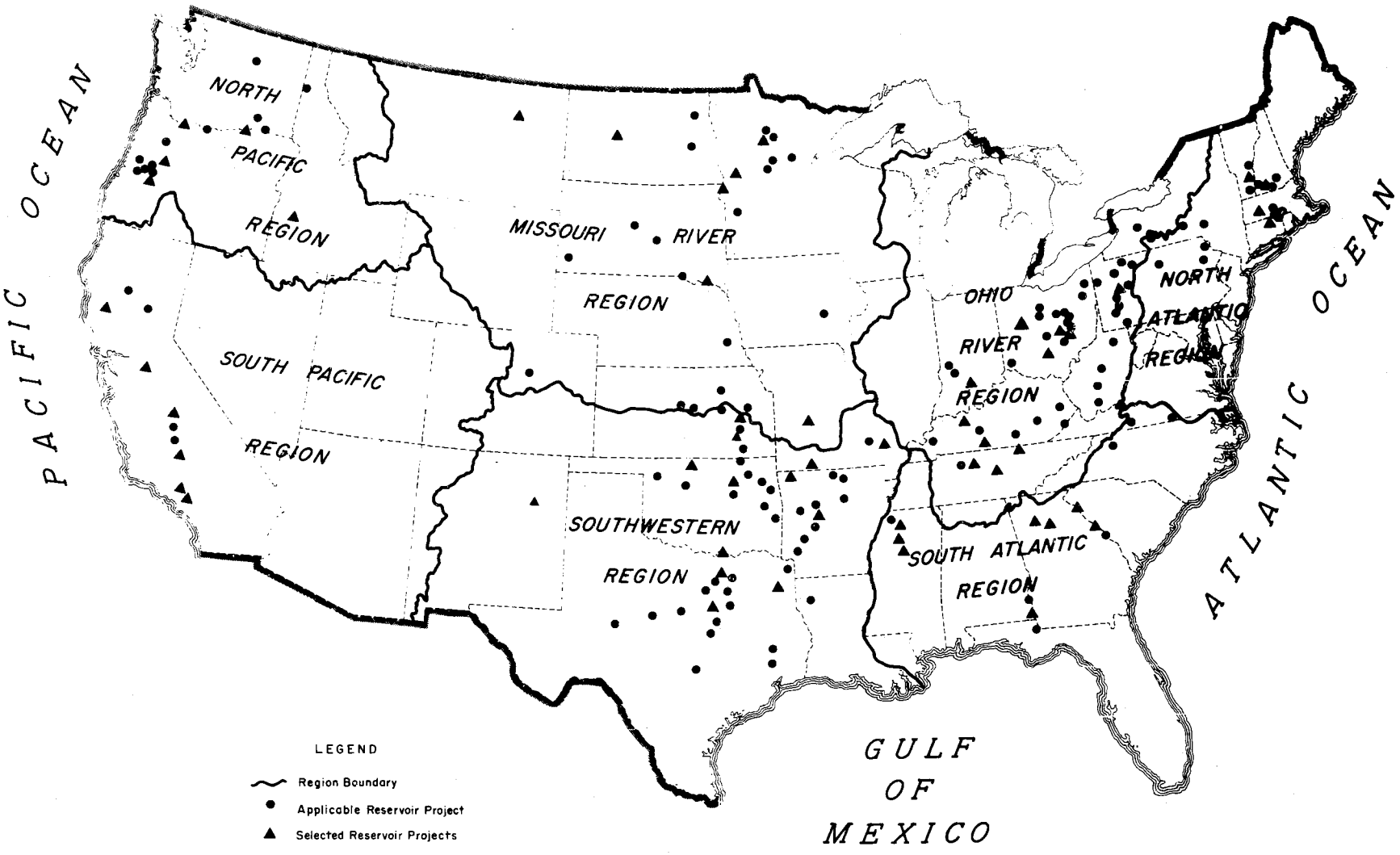
PACIFIC OCEAN
NORTH PACIFIC REGION
MISSOURI RIVER REGION
OHIO RIVER REGION
NORTH ATLANTIC REGION
SOUTH PACIFIC REGION
SOUTHWESTERN REGION
SOUTH ATLANTIC REGION
ATLANTIC OCEAN
GULF OF MEXICO
LEGEND
Region Boundary
Applicable Reservoir Project
Selected Reservoir Projects

FIGURE 1

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Office, Chief of Engineers, ENGCW-PV Washington, D.C. 20314	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

Plan Formulation and Evaluation Studies - Recreation
"EVALUATION OF RECREATION USE SURVEY PROCEDURES"

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (First name, middle initial, last name)

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6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
October 1969	46	

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S) Technical Report No. 1.
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

This document has been approved for public release; its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Office, Chief of Engineers, ENGCW-PV Washington, D.C. 20314

13. ABSTRACT

An experimental recreation use survey was put into effect in seven U.S. Army Engineer Districts at 52 reservoir projects in 1966 to test a survey procedure designed to provide a low cost system for obtaining reliable, consistent recreation use estimates for research and planning activities. One objective of the experimental survey was to provide the basis for designing a Corps-wide survey procedure. Testing in the seven selected districts was made so the weaknesses in the survey system could be identified and evaluated. This report presents the evaluation of the existing survey procedures and provides alternative suggestions for improvement of the survey.

The alternative survey designs presented build upon accomplishments of the existing survey procedure. A modified recreation use survey designed for administration by district offices is presented. Alternatives to the district survey design, which could be administered from a single central Corps element, is given with explanation of the effect of the alternatives on the survey results.

DD FORM 1 NOV 65 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

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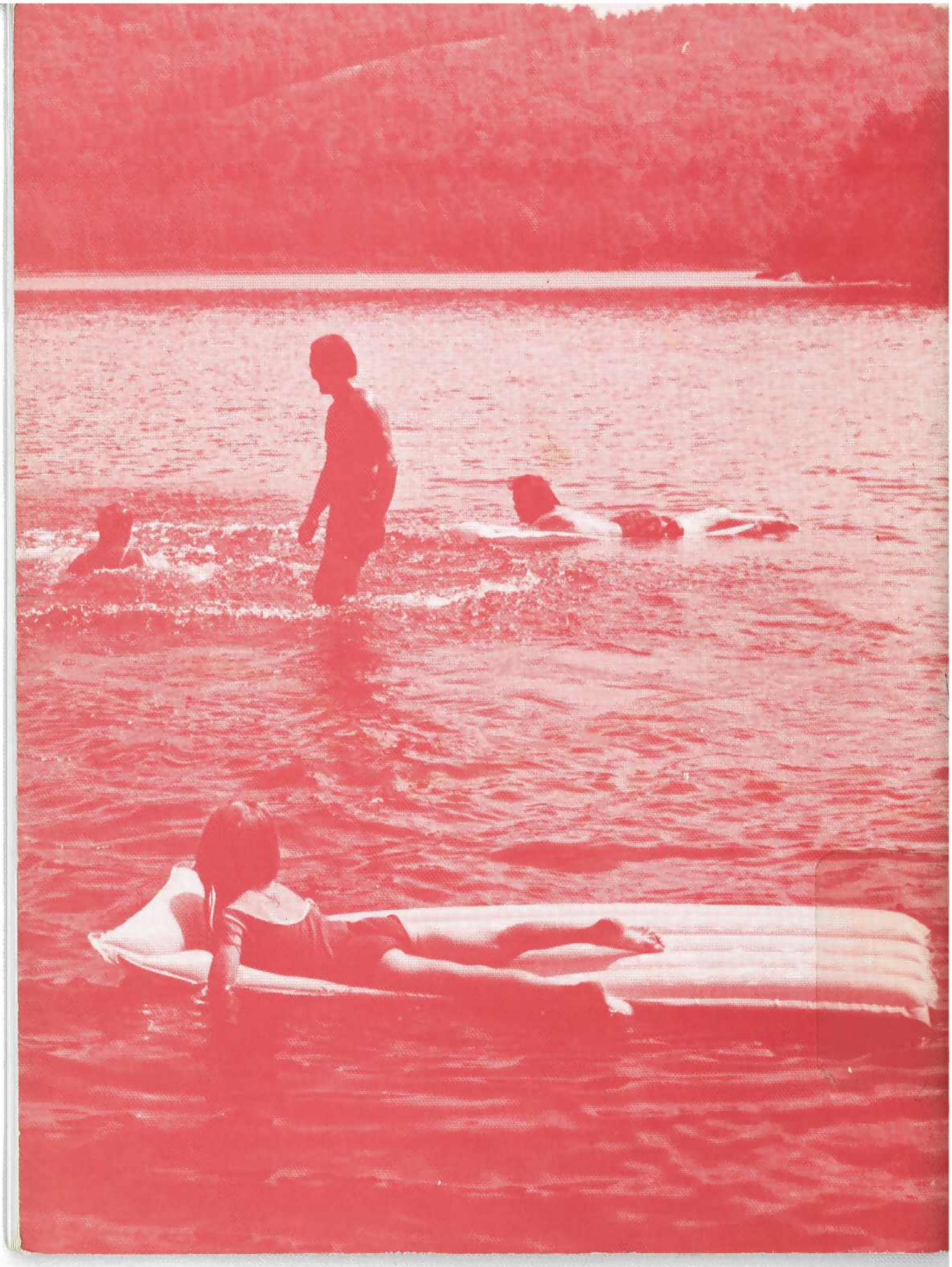
14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
recreation use survey recreation statistics survey design sampling